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Urban Heritage Decline: Conservation Challenges in the Historic Town of Chukai, Terengganu, Malaysia

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ABSTRACT

Mapping plays a pivotal role in preserving the cultural identity of heritage towns, serving as a systematic approach to documenting and safeguarding historical assets. In smaller towns like Chukai, Malaysia—a coastal port with a rich history—the loss of historical buildings signals physical deterioration and the erosion of cultural heritage and urban characters. This study investigates both the spatial and physical transformation of Chukai's historical buildings, integrating content-based document analysis, field-based structured observation, and GIS-based spatial mapping using QGIS software. The research utilises two core spatial datasets from 1995 and 2021, which are cross-referenced with field-verified building conditions and GPS-based location data. Findings reveal significant gaps in conservation strategies and inconsistencies in mapping practices, contributing to the neglect of heritage assets and diminishing the town's historical identity. Through comparative spatial analysis, the study identifies areas of concentrated heritage loss, particularly along the waterfront, suggesting patterns linked to commercial redevelopment pressures. The study highlights how spatial trends in building loss reflect broader urban policy shortcomings and limited on-ground conservation efforts. This research advocates for an inclusive and strategic approach to heritage preservation by addressing the unique challenges of smaller heritage towns. It underscores the value of integrating mapping technologies into heritage management systems and recommends embedding GIS-based monitoring within local planning frameworks. These insights inspire stakeholders to recognise the value of smaller heritage towns and prioritise their protection within broader cultural and urban sustainability frameworks.

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1. Introduction

Historical buildings in Malaysia reflect the nation's rich and diverse heritage, spanning public, residential, religious, and commercial structures (Yusoff et al., 2013). While cities such as Melaka, Georgetown, and Kuala Lumpur are internationally recognised for their well-preserved heritage, smaller towns with equally significant histories often remain underappreciated and underserved in conservation efforts. For example, Chukai, a coastal town in Kemaman, Terengganu, exemplifies this disparity. A 1992 study by the Heritage Foundation of Malaysia documented 28 historical buildings in Chukai (Idid, 1995). However, a 2022 mapping exercise revealed that only one of these buildings remains preserved, underscoring critical gaps in local conservation

practices.This neglect highlights systemic challenges in safeguarding heritage assets in smaller towns, including the lack of effective conservation strategies and an uneven focus on building selection (Cohen, 2001; Cura et al., 2019). Without immediate intervention, these gaps could result in further physical deterioration of historical structures and the gradual erosion of Chukai's cultural and historical identity. Such losses compromise local heritage and diminish opportunities for sustainable urban development rooted in cultural preservation.

In response to this urgent need, this study positions Chukai as a case study to assess the current condition of its historical buildings, focusing on dilapidated or demolished ones, and to analyse their impact on the town's urban morphology. This effort aligns with the Terengganu state government's vision, as articulated in the Terengganu 2050 Draft Structure Plan (2019), to designate Kemaman, including Chukai, as a Heritage and Cultural Conservation Corridor. By examining Chukai's heritage landscape, this study aims to provide actionable insights for policymakers and stakeholders to strengthen conservation strategies and integrate heritage preservation into the broader development framework of smaller *towns. This research is primarily concerned with mapping and using GIS tools and spatial datasets to trace the transformation and disappearance of the historical structures of Bandar Chukai's historical buildings. The evaluation of buildings' physical conditions supplements the spatial dimension, producing a dual-layered analysis of heritage decline.* By examining both spatial patterns of building loss and the current physical state of remaining structures, the study contributes to a clearer understanding of heritage vulnerability in small Malaysian towns. Ultimately, this paper advocates for integrated conservation planning that embeds geospatial intelligence into local decision-making frameworks.

2. Literature Review

Historical buildings are critical repositories of cultural heritage and historical knowledge, reflecting communities' social, cultural, and architectural development (Yusoff et al., 2013). Effective heritage conservation begins with systematic documentation and mapping, identifying and cataloguing heritage assets and providing a foundation for long-term preservation strategies. Under Malaysia's National Heritage Act 2005, a historical building is legally defined as any stand-alone or connected structure with notable historical, artistic, or scientific value and is at least 50 years old (Act 645, 2006). However, despite such legal frameworks, conservation efforts remain disproportionately focused on prominent cities, leaving smaller heritage towns, such as Chukai, underrepresented in research and policy.

This is particularly evident in Malaysia, where research on heritage conservation has predominantly centered on large cities like Kuala Lumpur, Georgetown, and Melaka, celebrated for their well-preserved historical sites (Said & Hamzah, 2020). Smaller towns like Chukai, despite their rich historical significance, receive comparatively little attention. For instance, while the Heritage Foundation of Malaysia documented 28 historical buildings in Chukai in 1992 (Idid, 1995), recent mapping efforts in 2022 revealed that only one building remains intact, a stark indication of inadequate conservation strategies.

Advancements in mapping technologies, such as GIS and Building Information Modelling (BIM), provide promising solutions for systematic heritage documentation. Liu (2023) underscores the role of BIM in sustainable cultural heritage tourism, noting that such technologies enable efficient cataloguing, visualisation, and analysis of heritage structures. However, access to these advanced tools is often limited in smaller towns, exacerbating the disparity in conservation efforts compared to well-funded larger cities. Integrating GIS with other technologies offers significant potential to address these challenges. GIS enables spatial analysis and visualisation of urban morphology, making it a critical tool for identifying heritage structures and assessing their relationship with the broader urban fabric (Montealegre & Sánchez, 2019). Combining these tools with community engagement and economic incentives, as Marushina et al. (2020) recommended, can lead to more inclusive and sustainable conservation approaches, especially for under-resourced heritage towns.

Mapping is pivotal in heritage conservation, offering a systematic method to identify, document, and assess heritage structures. In smaller towns, where conservation efforts often lack funding and institutional support, mapping can highlight the intrinsic value of historical buildings and their broader role in shaping urban identity (Zhang, 2012; Phui et al., 2019). Unfortunately, the lack of comprehensive mapping frequently results in the neglect and eventual loss of critical heritage assets, eroding the cultural identity of these towns (Yusuf & Halim, 2014).

Globally, heritage building evaluations often utilise a range of qualitative and quantitative parameters, including structural integrity, material condition, architectural typology, cultural significance, building usage, and potential for adaptive reuse (Prabowo et al., 2020; Puy-Alquiza et al., 2019). These indicators form the basis for assessing the vulnerability and priority level of heritage sites within both urban planning and conservation contexts. Frameworks such as UNESCO's Historic Urban Landscape (HUL) approach also emphasize a multiscale analysis, taking into account spatial interconnectivity, temporal layering, and socio-economic factors (UNESCO, 2016).

In this study, four key parameters were applied to evaluate heritage buildings in Chukai: (i) physical condition, including material decay or structural damage; (ii) spatial visibility within the current urban layout; (iii) historical designation or listing in past inventories; and (iv) observed use or adaptive reuse. These were assessed through field-based structured observation and integrated into GIS layers to support spatial pattern analysis.

In this case, UNESCO's Historic Urban Landscape (HUL) approach offers a holistic framework for understanding urban heritage by integrating cultural, social, and environmental dimensions into conservation strategies. Unlike traditional methods that treat heritage buildings as isolated assets, the HUL approach emphasises their interconnectedness within the broader urban landscape, including public spaces, infrastructure, and natural features (Gu Hayward et al., 2015). Mapping is a cornerstone of the HUL approach, facilitating the documentation

and management of heritage assets while considering their dynamic relationship with urbanisation and sustainability challenges (Sarihan, 2021). This systematic methodology bridges urban geography and planning, offering a robust tool for heritage conservation (Conzen, 2012; Rashed et al., 2022). However, as noted by Gu (2018), the effectiveness of the HUL approach relies on consistent and comprehensive mapping efforts, which are often lacking in smaller towns like Chukai.

1. Mapping efforts should be guided by the principles of the HUL approach, leveraging GIS and BIM technologies to create a comprehensive inventory of heritage assets. Furthermore, local stakeholders must be engaged to ensure that conservation strategies are inclusive and reflect community values. By prioritising the mapping and preserving heritage assets, smaller towns like Chukai can safeguard their cultural identity while contributing to broader urban sustainability goals.

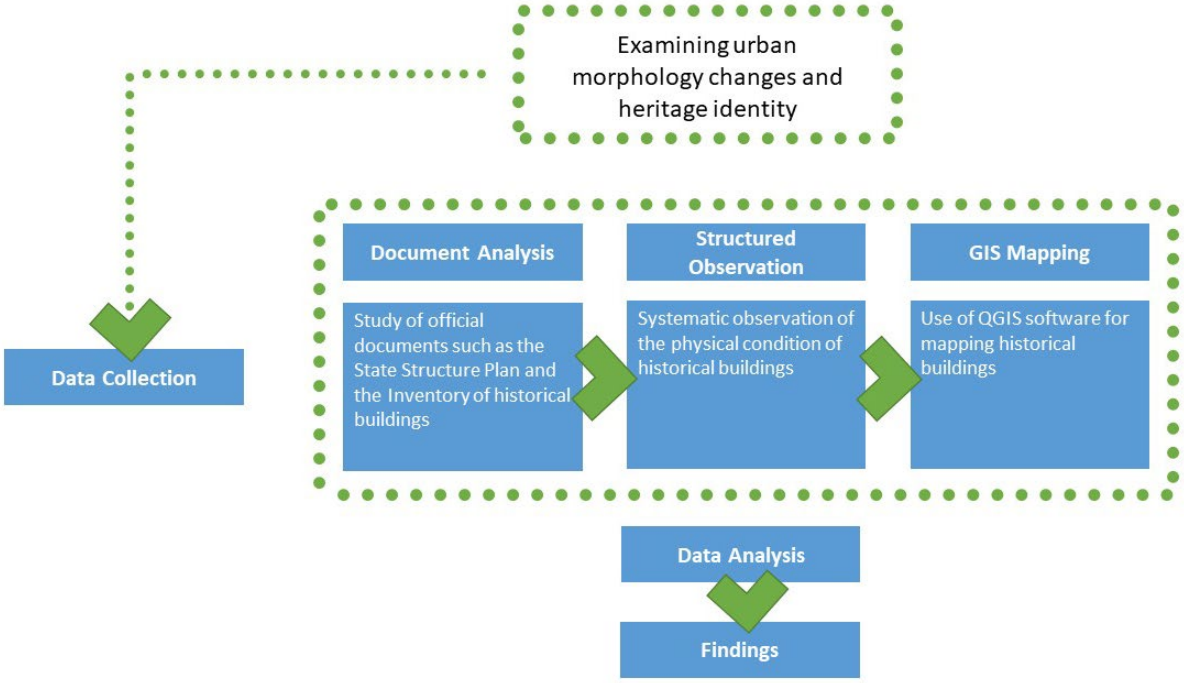

Figure 1 The methodological study design

Preliminary research indicates that conservation policies in Malaysia disproportionately favour large urban centres, leaving small towns without adequate strategies or resources (Wang et al., 2023). Chukai, for instance, faces significant challenges due to the absence of a strategic plan for heritage conservation. The Terengganu State Structure Plan 2050 identifies only one heritage site—the Kampung Tuan Mosque—as a priority for preservation, neglecting other historically significant structures. Local administrations also lack detailed mapping data, hindering effective conservation initiatives (Zuraidi et al., 2011; Masrom & Kadir, 2020).

The absence of comprehensive mapping and strategic planning has led to the neglect and demolition of several key historical structures in Chukai, including former customs offices and residential buildings. Without immediate intervention, the town risks losing its unique urban morphology and cultural identity, as evidenced by the decline in heritage assets between 1995 and 2022. To address this gap, spatial evaluation methods such as GIS-based change detection, field-level condition auditing, and policy document content analysis are combined in this study to offer a multiscale understanding of heritage decline. There is an urgent need to integrate systematic mapping into local and regional planning frameworks to address these gaps, as suggested in Figure

3. Methodology

This study used a qualitative technique to thoroughly examine the state of historical buildings in Bandar Chukai, Kemaman, and the impact of alterations to these structures on the city's morphology and heritage identity. This methodology was used as it facilitates a more unrestricted examination of intricate and conceptual dimensions grounded in the research framework, particularly those pertaining to heritage value that cannot be quantitatively assessed (Nebbia et al., 2021). This approach emphasises the processes and underlying meanings associated with the physical alterations and conservation of historical structures, which is essential for comprehending the dynamics of urban transformation and its effects on heritage assets.

To support this, a mixed-method qualitative design was adopted, combining document content analysis, field-based observation, and GIS-based spatial mapping. The methodological framework was structured to reveal both temporal and spatial dimensions of building loss.

3.1 Research Methodology Framework

To comprehensively understand the condition and significance of Chukai's historical buildings, this study employed three primary methods: document analysis, structured observation, and GIS-based cartography. Each method was selected to address specific aspects of the research questions, providing complementary insights into the heritage value, physical condition, and spatial relationships of historic structures within the urban morphology of Chukai. Integrating these methods ensures a holistic assessment of heritage conservation challenges and opportunities.

3.1.2 Analysis of Documents Analysis of Document

Document analysis serves as the foundational method for this study, offering a detailed exploration of the historical, cultural, and policy context surrounding the conservation of Chukai's heritage buildings. This method focuses on the systematic review of official documents, archival records, and historical inventories, enabling a comprehensive understanding of the town's heritage landscape and the policies that have shaped its preservation. By analysing these documents, the study aims to uncover the socio-cultural narratives and administrative strategies associated with Chukai's historic buildings, providing a baseline for evaluating

Figure 2 : (a) Map of Bandar Chukai (b) The site of the case study along the waterfront

3.1.1 Study Area

This study was conducted in an old town located in the southern part of Terengganu, namely Bandar Chukai. Serving as the administrative center of Kemaman District — the southernmost district of the state — Bandar Chukai is situated adjacent to both the South China Sea and the Kemaman River (Figure 2). Geographically, it is positioned at latitude 4° 14' 9.4" north and longitude 103° 25' 15.6" east. The town holds considerable significance for Terengganu's tangible heritage and historical narrative, given the presence of numerous historic buildings within its vicinity.

Today, Chukai plays a critical role in the economic development of Malaysia's East Coast region. The Kemaman District, particularly Chukai, has emerged as one of the most vital economic hubs in both Terengganu and Malaysia. Chukai's substantial contribution is largely attributed to its involvement in the country's oil and gas processing and petrochemical industries This strategic focus was initiated in the 1980s, as evidenced by the development of infrastructure such as specialised ports designed to facilitate the extraction and export of mineral resources, including oil and gas, from the coastal waters of Kemaman.

architectural styles, construction dates, original functions, and current conditions.

The document analysis process involved three key steps: data extraction, cross-verification, and policy gap analysis. First, relevant data were systematically extracted from each document, focusing on information about the identification, historical significance, and conservation status of Chukai's historical buildings. This step also included gathering insights into existing heritage conservation guidelines and strategies at the state and local levels. Next, the extracted data were cross-referenced with findings from other methods, such as structured observations and GIS mapping, to validate their accuracy and relevance. This triangulation process was crucial in ensuring the reliability of the study's findings, especially given the discrepancies observed between documented policies and on-ground realities. Finally, a policy gap analysis was conducted to identify inconsistencies in conservation strategies' application and evaluate their effectiveness in safeguarding Chukai's heritage.

Document analysis revealed several critical insights. Firstly, it highlighted significant policy gaps, including a lack of comprehensive mapping and inconsistent prioritisation of heritage sites. For instance, while the Terengganu State Structure Plan designates Chukai as a key conservation area, implementation has been minimal, with only one site—the Kampung Tuan Mosque—receiving active preservation efforts. Secondly, the analysis underscored the absence of a systematic and updated inventory of

historical buildings, contributing to the neglect and loss of many heritage assets. Finally, the findings emphasised the disconnect between policy frameworks and local-level execution, suggesting the need for stronger integration of heritage conservation into urban planning processes. It has provided a detailed understanding of the historical and policy context, framing its exploration of Chukai's heritage conservation challenges. It establishes the historical significance of the town's buildings and identifies the systemic shortcomings that must be addressed to ensure their preservation. This method sets the stage for subsequent analyses, such as structured observations and GIS mapping, enabling a holistic assessment of Chukai's heritage landscape.

3.1.3 Structured Observation

Structured observation was a critical method for evaluating the current physical condition and conservation status of historical buildings in Chukai. This approach involves systematic data collection based on predefined benchmarks, ensuring consistency and reliability across all sites. By directly observing the physical state of the town's heritage assets, this method provides tangible evidence of preservation levels, highlighting areas of neglect or success in conservation efforts. It also complements the findings from document analysis by validating whether the listed buildings are still intact, have been altered, or have been demolished. The structured observation process was meticulously designed to capture detailed and actionable information about the state of Chukai's historical buildings.

The observation phase was conducted between October and December 2021 and involved on-site visits to the study area. Each accessible building from the 1995 inventory was physically inspected and evaluated. GPS coordinates were captured using handheld GPS units to verify building locations and enable spatial georeferencing in the GIS system.A standardised checklist was developed, guided by established frameworks and guidelines in heritage conservation literature. The checklist encompassed four key criteria: structural integrity, construction materials, visible signs of damage, and alterations or modifications (Albert & Hazen, 2010).

i Structural Integrity:
This benchmark assessed the stability of the building's structural components, including walls, roofs, foundations, and load-bearing elements. Observers recorded signs of structural instability, such as cracks, sagging roofs, leaning walls, or collapsing sections. Buildings exhibiting severe structural issues were identified as requiring immediate intervention to prevent further deterioration or complete loss.

ii Construction Materials:
Observers documented the materials used in the original construction, such as timber, brick, or stone, and evaluated their current condition. Any replacements or repairs using non-original materials were noted, as these could impact the authenticity and historical value of the buildings. This criterion was particularly important in assessing whether conservation practices adhered to heritage guidelines emphasising material authenticity.

iii Visible Signs of Damage:
Observers systematically documented damage caused by environmental factors, such as weathering, erosion, water intrusion, or biological growth. Additional attention was given to vandalism or neglect, such as graffiti or debris accumulation. Each building's level of degradation was classified, enabling a comparative analysis of which buildings were most at risk.

iv Alterations and Modifications:
This criterion identified changes to the buildings' original designs. Observers noted additions, such as new structures attached to the buildings and demolitions or repurposing for modern uses. These modifications were evaluated regarding their impact on the buildings' historical authenticity and integrity.

The observation process was carried out in three phases: preparation, fieldwork, and post-observation analysis. During the preparation phase, the checklist was finalised, and historical maps and inventories were reviewed to identify the buildings targeted for observation. This preliminary step also involved coordinating with local authorities and stakeholders to ensure site access.

The fieldwork phase involved systematic site visits to all accessible historical buildings in Chukai. Observers used the checklist to document each building's condition in detail, supported by high-resolution photographs for visual evidence. Where possible, informal conversations with local residents or stakeholders were conducted to gather additional contextual information about these buildings' history, usage, and challenges. This qualitative input provided valuable insights that complemented the quantitative data collected during the observations.

In the post-observation analysis phase, the data collected were categorised and synthesised to identify patterns and trends. Buildings were categorised based on their conservation status: intact and well-preserved, partially damaged, and severely deteriorated or demolished. *These findings were mapped into GIS layers* and then cross-referenced with document analysis and GIS mapping results to provide a holistic understanding of Chukai's heritage conservation landscape.

The structured observations yielded several significant insights. Many of the buildings that were well-documented in historical inventories had either been extensively altered or completely demolished, highlighting a lack of enforcement of conservation policies. Among the surviving buildings, structural degradation was common, particularly in those constructed with timber, which is more susceptible to weathering and termite infestation. A smaller number of buildings were found to be well-preserved, often due to active usage or community-led maintenance initiatives. The data collected also underscored the uneven distribution of conservation efforts, with some areas of Chukai receiving little to no attention.

By systematically documenting the physical state of Chukai's historical buildings, structured observation validated the findings from document analysis and filled critical knowledge gaps. This

method provided real-time evidence of the urgent need for conservation interventions and highlighted the most at-risk buildings. The results of structured observations serve as an essential input for the GIS mapping analysis, enabling the spatial visualisation of conservation priorities within the town. Ultimately, structured observation is vital in crafting actionable recommendations for preserving Chukai's cultural and architectural heritage.

3.1.4 Cartography Using GIS Software

Cartography using GIS (Geographic Information Systems) software was a core method employed in this study to map and analyse the spatial distribution, historical changes, and urban transformation of Chukai's historical buildings. GIS mapping provides a dynamic and highly visual approach to documenting heritage assets, allowing for spatial patterns and trends to be identified over time. This study selected QGIS, an open-source GIS platform, due to its accessibility, cost-effectiveness, and ability to handle complex spatial datasets. Using GIS technology ensured the research could integrate historical records, structured observation data, and current mapping efforts into a cohesive geospatial database.

The cartography process was designed to achieve three primary objectives: (1) to document the current locations and conditions of Chukai's historical buildings, (2) to analyse changes in the urban morphology over time by comparing data from different periods, and (3) to identify areas of significant heritage loss or transformation. These objectives were addressed through a structured workflow that included data compilation, georeferencing, layer creation, and spatial analysis.

i Data Compilation:
The first step involved collecting and compiling relevant spatial data from historical and contemporary sources. Historical data from a 1995 mapping exercise were digitised to establish a baseline inventory of 28 historical buildings documented during that period. Current data were obtained from a 2021 mapping initiative, which reflected the present state of the town's heritage assets and urban morphology. Additional spatial data, such as road networks, waterways, and land use patterns, were incorporated to provide contextual information. Descriptive attributes, such as building type, architectural style, construction materials, and conservation status, were also collected to enhance the richness of the dataset.

ii Georeferencing and Digitisation:
Historical maps from 1995 were georeferenced within the QGIS software to align them with contemporary geographic coordinates. This process ensured that the spatial data from different periods could be accurately compared. Each historical building from the 1995 inventory was digitised as a point feature, with associated attributes recorded in the GIS database. Similarly, data from the 2021 mapping exercise were digitised and overlaid onto the historical data, creating a temporal dataset that allowed for the analysis of changes over 26 years.

iii Layer Creation and Classification:
Separate layers were created within QGIS to classify historic buildings based on their conservation status. Buildings were categorised as intact, altered, or demolished, allowing for a clear visualisation of which structures had been preserved, modified, or lost. Additional layers were added to represent other urban features, such as roads, public spaces, and natural landmarks, to provide a holistic view of Chukai's urban morphology. These layers enabled a better understanding of the spatial relationships between heritage buildings and their surrounding environments.

iv. Spatial and Temporal Analysis:
The primary analytical process involved comparing the spatial data from 1995 and 2021 to identify changes in the urban landscape and heritage conservation outcomes. Temporal comparisons highlighted missing or altered buildings' locations and revealed heritage loss patterns. Spatial analysis techniques, such as proximity analysis and clustering, were applied to evaluate the concentration of historical buildings in specific areas and their relationships to urban features such as major roads or waterways. These analyses provided insights into how urbanisation and development pressures had impacted Chukai's heritage assets.

The GIS mapping revealed several critical trends in the conservation and transformation of Chukai's historical buildings. Many of the 1995 inventory buildings were no longer present in the 2021 mapping, indicating a pattern of demolition and neglect. These losses were most pronounced in areas experiencing rapid urban development, where new infrastructure and commercial projects had replaced historical structures. Buildings that remained intact were often located in areas with less development pressure or where active community-led conservation efforts were in place. The spatial analysis also highlighted gaps in the distribution of conservation efforts, with some heritage-rich zones receiving little to no attention from local authorities.

The use of QGIS in this study allowed for a highly visual and evidence-based approach to heritage mapping and analysis. By integrating spatial data with descriptive attributes, GIS mapping provided a deeper understanding of how Chukai's urban morphology had evolved over time and how heritage conservation efforts (or the lack thereof) had shaped this transformation. The maps generated through this process serve as a valuable tool for stakeholders, offering clear visualisations of conservation priorities and areas requiring immediate intervention.GIS mapping complements the findings from document analysis and structured observation by offering a spatial dimension to the research. While document analysis provided historical and policy context and structured observation captured real-time data on physical conditions, GIS mapping tied these elements together within a geospatial framework. This integration enabled the study to draw broader conclusions about the relationships between urbanisation, heritage conservation, and cultural identity. The GIS analysis's outputs inform the study's findings and provide practical tools for policymakers and planners to develop more targeted and effective conservation strategies

4. Result

4.1 Bandar Chukai's Heritage Potential and Current Challenges

Bandar Chukai, situated in Kemaman, is uniquely positioned to become a central hub for cultural and economic development due to its rich history and abundant heritage assets. These historical buildings, many of which date back to the colonial era, represent invaluable cultural, architectural, and historical resources. Their presence contributes to Chukai's identity, making the town a potential magnet for heritage-based tourism and community pride. The Terengganu State Structure Plan Draft 2050 (2019) acknowledges this potential by designating Kemaman as part of a Heritage and Cultural Preservation Corridor within the Southern Terengganu Region (Wilayah Selatan).

However, despite this recognition, significant gaps in conservation practices threaten the preservation of Chukai's heritage assets. These include insufficient focus on smaller, less prominent buildings, inadequate enforcement of conservation policies, and a lack of comprehensive planning frameworks. Heritage conservation in Malaysia often favours iconic structures, such as mosques and government buildings, while sidelining other historically significant but less prominent assets (as shown in Figure 3 below).

Figure 3 :This map highlights the positions of the buildings that have been successfully identified within the town of Chukai, with the exception of the Kampung Cina and Siew Distillery sites, as the existence of these structures could not be verified.

In Chukai, this narrow focus is evident: the Kampung Tuan Mosque is the only structure prioritised for preservation under the Structure Plan, leaving other culturally important buildings, such as shophouses, colonial-era customs offices, and early 20th-century industrial facilities like the Siew Distillery, largely neglected. Without urgent intervention, these structures risk further deterioration, erasure, and loss of cultural identity.

4.2 Location of Historical Buildings in Chukai Town

A comparative analysis of mapping efforts conducted in 1995 and 2021 revealed critical insights into Chukai's urban and heritage evolution. Mapping is a cornerstone of heritage conservation, providing a foundation for identifying, documenting, and protecting valuable assets. However, the findings indicate that mapping initiatives in Chukai have been inconsistent, resulting in significant gaps in preserving the town's historical buildings.

4.2.1 The 1995 Mapping Initiative:

The 1995 mapping exercise aimed to inventory Chukai's historical buildings, identifying 28 structures of significant cultural and architectural value. This initiative meticulously documented the buildings' names, architectural styles, structural types, locations, and heritage significance. The mapping emphasised preserving these assets, highlighting their role in Chukai's historical narrative as a trading and administrative hub. The inventory also provided a basis for future conservation planning, underscoring the need for systematic efforts to maintain and protect these structures.

4.2.2 The 2021 Mapping Initiative:

The 2021 mapping effort shifted its focus to urban planning rather than heritage conservation. It provided a broader perspective on Chukai's spatial organization, documenting building lot sites, roads, blocks, and public spaces. While this approach offered valuable insights into Chukai's urban development, it lacked the depth and specificity required for heritage preservation. The omission of detailed documentation on historical buildings represents a missed opportunity to build upon the 1995 inventory and track the status of these assets over time.

4.2.2 Key Findings from Comparative Analysis:

By overlaying the 1995 and 2021 maps using GIS technology, the study identified which historic buildings remain intact, altered, or demolished. A GIS map (Map 4.1) was created to visualise these changes, highlighting the locations of surviving buildings and those lost. Notably, sites such as the Kampung Cina residential houses and the Siew Distillery could not be verified, reflecting the limitations of current mapping efforts. These findings underscore the urgent need for consistent and comprehensive heritage mapping to guide future conservation initiatives

4.3 Condition of Historic Buildings in the Study Area: Demolished Category

Several historical buildings in Chukai have been classified as demolished based on site mapping and observation. These include the former Customs Office, residential structures in Kampung Cina, and the Siew Distillery. Two key factors contributed to their inclusion in this category: (1) physical removal of the structures, and (2) inability to trace their original locations due to insufficient documentation. (as shown in Table 1)

4.3.1 The Customs Office:

The former Customs Office was a cornerstone of Chukai's administrative and economic activities during the early 20th century. Situated along Jalan Sulaiman near the Kemaman River, it played a pivotal role in regulating trade and taxation. The river was a critical trade route for transporting iron ore from nearby mines, and the Customs Office served as a key administrative hub for managing these activities. However, the building was demolished in the early 1990s to make way for urban redevelopment, resulting in the loss of a historically significant structure. The site was repurposed into a green space featuring a playground and the Chukai City Amusement Park. While remnants such as mooring ropes near the riverbank provide a faint link to the area's historical function, the absence of the Customs Office underscores the challenges of balancing development with heritage conservation.

Table 1: Analysis of Actions Taken by Informants Based on HUL Implementation Steps (UNESCO, 2016)

Process/Steps Based on HUL Implementation	Planning Department, Kemaman Branch	Plan Malaysia@Terengganu	Kemaman Museum
Step 1 - Inventory Sources	Yes	Yes	Yes
Step 2 - Determine Values	No	No	No
Step 3 - Identify Weaknesses	No	No	No
Step 4 - Develop Strategies	No	No	No
Step 5 - Integrate Strategies	No	No	No
Step 6 - Prioritize	No	No	No
Step 7 - Built Partnerships	Yes	Yes	Yes
Step 8 - Monitor Resources	No	No	No

4.4 Disruptions in the Town's Heritage Morphology

The research identified significant disruptions in the heritage morphology of Bandar Chukai, which have adversely affected the progress of conservation efforts. Over the years, these disruptions have contributed to the loss of historical assets and altered the town's cultural and spatial identity. Three main issues were highlighted: neglect of comprehensive heritage mapping, urban morphology alterations, and stakeholders' inadequate conservation efforts. One of the primary challenges is the neglect of comprehensive heritage mapping. The 1995 mapping initiative provided a detailed inventory of historical buildings in Chukai, documenting their architectural significance, locations, and conditions. This inventory underscored the importance of these assets in preserving the town's heritage. However, subsequent mapping efforts have not continued at this level of detail. The recent 2021 mapping, focused primarily on general urban planning, failed to prioritise heritage buildings, leading to an incomplete and fragmented record of Chukai's historical assets. The lack of continuity in mapping has undermined the ability to monitor the status of the 28 buildings listed in 1995, many of which have since been demolished or significantly altered. This neglect hampers efforts to understand and address Chukai's urban landscape changes.

Another critical issue is the alteration of Chukai's urban morphology over the past 27 years. Rapid urbanisation and development have led to significant changes in the town's layout, often at the expense of historical structures. The spatial continuity of heritage zones has been disrupted as new developments replace or encroach upon historical sites. For example, the former Customs Office, which once played a central role in Chukai's economy, has been replaced by a green space and amusement park, erasing a vital link to the town's trading history. Similarly, the demolition of Kampung Cina residential houses and the Siew Distillery has resulted in the loss of key components of Chukai's urban heritage. These alterations diminish the town's historical character and disrupt its cultural narrative.

The third issue lies in the inadequate and fragmented conservation efforts by stakeholders. Local planning authorities, cultural organisations, and other stakeholders have not collaborated effectively to implement cohesive conservation strategies. While some steps, such as inventory creation, have been undertaken, other critical processes outlined in UNESCO's Historic Urban Landscape (HUL) framework—such as determining values, identifying weaknesses, and integrating strategies—have been neglected. The lack of coordination and shared responsibility among stakeholders has resulted in inconsistent prioritisation and insufficient protection of Chukai's historical assets. This fragmentation has further weakened the town's capacity to preserve its heritage and integrate it into broader urban development plans.

In summary, these disruptions have collectively weakened Chukai's heritage preservation efforts and accelerated the loss of its historical morphology. Addressing these issues requires a renewed focus on comprehensive mapping, greater stakeholder collaboration, and integrating heritage conservation into urban planning frameworks. Without these measures, the town risks losing its cultural and historical identity, undermining its potential as a centre for heritage-based development.

5. Discussion

The comparison of Chukai City's urban morphology between 1995 and 2021 reveals significant shifts, particularly in preserving and managing its historic buildings. Over the past 27 years, a marked erosion of the city's historical fabric is evident, with several key structures listed in the 1995 inventory no longer present in the current landscape. Notable examples include the Siew Distillery and the residential houses at 47 Jalan Bakar and K52 Jalan Kampung Cina, both of which have disappeared from the map. This loss can be attributed to physical demolition, inadequate record-keeping, and the absence of ongoing documentation. Scholars such as Zhao et al. (2023) and Unlu (2019) emphasise that insufficient mapping efforts are a critical factor in neglecting heritage sites, as they hinder the ability to trace the historical value of these structures, leading to their irreversible loss. The failure to update and maintain accurate mapping data diminishes the city's heritage value, as these sites are effectively erased from the collective memory of the built environment.

One of the most pronounced examples of urban transformation is the demolition of the former Customs Office, a building of substantial historical and economic significance. Once located along the Kemaman River, this structure played a pivotal role in the region's trading and taxation activities during the early 20th century. Its removal to make way for a green zone and the Taman Persiaran Bandar Chukai recreational park reflects the complex tension between urban development and heritage preservation. While this redevelopment was justified as serving modern urban needs, it raises critical questions about the long-term value of historic structures and their role in shaping local identity. Alqahtany and Aravindakshan (2021) highlight that such decisions often prioritise economic or aesthetic development over cultural heritage preservation, viewing heritage assets as obstacles to modernisation. In Chukai, demolishing the Customs Office signifies the physical loss of a building and the erasure of a historical narrative central to the city's identity and economic history.

This case underscores broader challenges in Chukai's urban heritage management practices, particularly neglecting systematic and ongoing mapping efforts. As Zhao et al. (2023) and Unlu (2019) argue, comprehensive mapping is essential for identifying, documenting, and managing heritage assets. In cities like Georgetown, Taiping, and Melaka, consistent mapping and integration of heritage data into urban planning frameworks have resulted in more substantial conservation outcomes (Lou et al., 2022; Hashim et al., 2022; Kunasekaran et al., 2020; Musa et al., 2020; Rasyed, 2013). These cities demonstrate that sustainable heritage conservation relies on reliable mapping processes that allow for continuous monitoring and protection of historic sites over time. In contrast, Chukai's lack of a cohesive mapping

strategy represents a missed opportunity to mitigate the negative impacts of urban development on its cultural and architectural assets.

The importance of consistent mapping and documentation is further underscored by the Historic Urban Landscape (HUL) approach, which positions mapping as a cornerstone of heritage conservation. The HUL approach, as advocated by UNESCO (2016), emphasises the integration of cultural heritage into urban development by using mapping as a proactive tool to safeguard heritage against the pressures of urbanisation (Dong & Shen, 2023; Jiang et al., 2023). Comprehensive and regularly updated mapping data allow for informed decision-making and long-term planning, ensuring that heritage assets are preserved while accommodating urban growth. Lai et al. (2017) similarly argue that the availability of such data is critical for effective heritage management, as it enables stakeholders to assess the historical, cultural, and spatial significance of sites and prioritise their conservation. Without this foundation, heritage sites risk being undervalued and ultimately lost due to development pressures.

5.1 Stakeholder Perspectives on Conservation Efforts in Chukai

Interviews with key stakeholders revealed a shared recognition of the importance of preserving Chukai's historic buildings, but the findings also highlighted significant gaps in current conservation practices. Stakeholders acknowledged the need for heritage conservation but noted that efforts have been limited to two key steps of the HUL framework: Step 1 (Inventory of Resources) and Step 7 (Building Partnerships).

5.1.1 Step 1: Inventory of Resources

The inventory of historic buildings is a fundamental first step in heritage conservation, and stakeholders such as local authorities and the Kemaman Museum have identified several buildings of historical significance. These include the Kemaman Museum, rows of colonial-era shophouses along Jalan Pasar and Jalan Sulaiman, and the former Customs Office. However, despite this initial awareness, the inventory remains incomplete, lacking a comprehensive and updated database of Chukai's historic built environment. This gap undermines the ability to effectively plan and implement conservation efforts, as many heritage assets are unaccounted for or inadequately documented. Heritage buildings are at greater risk of neglect and demolition without a robust inventory, as their significance may not be fully recognised.

5.1.2 Step 7: Building Partnerships

In contrast, the Kemaman Museum has made notable progress in implementing Step 7 of the HUL framework by establishing partnerships with external organisations. These partnerships have supported the museum's conservation and adaptive reuse, transforming it from its original function as an iron ore office and later a banking facility into a cultural institution. This adaptive reuse preserves the building's historical identity and aligns with sustainable heritage management principles. The success of these partnerships highlights the potential of collaborative approaches to heritage conservation, demonstrating how external support can enhance the preservation and functionality of historical buildings.

Despite these positive efforts, the overall conservation strategy in Chukai remains fragmented and incomplete. Stakeholders' recognition of the town's heritage value is not matched by the level of action required to protect and sustain it. The limited extent of partnerships and the absence of a comprehensive inventory highlight the need for a more cohesive and proactive approach to heritage conservation. *The research relied heavily on existing inventories and field observations, but limited stakeholder engagement restricted the incorporation of local community perspectives, historical anecdotes, and lived experiences, which could have provided richer qualitative dimensions to the spatial analysis. Plus, the study faced data gaps, especially in historical records and older maps and information from historians, which made it difficult to verify the exact locations or conditions of certain demolished or altered buildings (such as the former Customs Office and Siew Distillery). These gaps may have led to the underrepresentation of some heritage losses in the spatial outputs.*

6 Conclusion and Recommendations

The discussion of Chukai City's changing urban morphology between 1995 and 2021 underscores the critical role of mapping in heritage conservation. The disappearance of significant buildings, such as the Siew Distillery and the former Customs Office, illustrates the consequences of neglecting systematic mapping and documentation. These findings highlight the need for Chukai to adopt more comprehensive and consistent mapping efforts, drawing from successful models in cities like Georgetown and Melaka.

To strengthen Chukai's conservation strategy, the following recommendations are proposed:

Develop a Comprehensive Heritage Inventory:
Create a detailed and regularly updated database of Chukai's historic buildings, incorporating both spatial and descriptive data. This inventory should align with the HUL framework and prioritise inclusivity by documenting all building types.

Strengthen Collaborative Governance:
Expand partnerships between local authorities, cultural organisations, and external stakeholders to pool resources and expertise. Collaboration with universities and research institutions could also support mapping and documentation efforts.

Integrate Heritage into Urban Planning:
Incorporate heritage conservation into broader urban development plans, ensuring that historical buildings are considered in zoning and redevelopment decisions. Adaptive reuse of heritage structures can balance preservation with modernisation.

Leverage Advanced Mapping Technologies:

Utilise GIS and other digital tools to enhance the accuracy and accessibility of heritage data. These technologies can support real-time monitoring and visualisation of Chukai's urban morphology. By addressing these gaps, Chukai can adopt a more sustainable approach to heritage conservation, protecting its cultural identity while supporting economic and urban growth. These measures would ensure that the town's rich history is preserved for future generations, enabling it to serve as a model for heritage management in smaller cities.

Furthermore, the integration of heritage conservation into urban planning is essential for sustainable development, allowing policymakers to balance modernisation with the protection of Chukai's unique historical character. A key recommendation is to enhance community engagement in heritage mapping and preservation. Involving local stakeholders, including residents, business owners, and cultural organisations, can foster a sense of collective responsibility and ensure that conservation strategies align with community values and needs. A participatory approach will not only strengthen conservation outcomes but also encourage sustainable heritage management. Ultimately, this study serves as a foundation for future research and policy development, advocating for more structured, technology-driven, and community-centred conservation strategies. By prioritising comprehensive mapping and inclusive conservation efforts, stakeholders can work toward safeguarding Chukai's historical legacy for future generations while setting a precedent for similar heritage towns facing the threat of architectural loss. *Lastly, by focusing on a lesser-studied heritage town like Chukai , this study addresses a critical knowledge gap in Malaysian conservation research, demonstrating the application of GIS-based methods to enhance heritage documentation and inform policy frameworks.*

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Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper

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