

EREM 82/3Journal of Environmental Research,
Engineering and Management

Vol. 82 / No. 3 / 2026

pp. 37–52

10.5755/j01.erem.82.3.41711

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Received 2025/05

Accepted after revisions 2026/07

<https://doi.org/10.5755/j01.erem.82.3.41711>

A GIS-Based Spatial Categorization of Priority Areas for Environmental Quality Improvement in the Cultural Heritage Areas of Surabaya City, Indonesia

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Conventional development approaches that prioritize economic growth often overlook social and environmental dimensions, resulting in inequality and declining environmental quality, particularly within cultural heritage areas. This study proposes an integrated analytical framework combining Importance-Performance Analysis (IPA) and Geographic Information Systems (GIS) to classify heritage kampongs based on slum severity and to spatially assess environmental quality in Surabaya City, Indonesia. Spatial overlay analysis using ArcGIS was employed to identify intersections between designated cultural heritage areas and slum settlements, while primary survey data were utilized to evaluate environmental conditions based on established slum indicators. Subsequently, IPA was applied to identify and prioritize the most critical attributes influencing slum severity. The findings revealed

that several heritage kampongs exhibited pronounced slum characteristics, with key issues including inadequate drainage systems, poor road infrastructure, and limited living space per capita. By integrating IPA with GIS-based spatial analysis, this study not only reveals patterns of environmental degradation but also pinpoints priority attributes requiring intervention. The resulting classification and spatial visualization provide a robust basis for formulating targeted strategies to improve environmental quality in urban heritage contexts.

Keywords: environmental, heritage, slum, settlements.

Introduction

Development is broadly understood as a process of transformation toward improved social, economic, and environmental conditions. However, when implemented with an exclusive focus on economic growth, it has often generated adverse consequences, including widening social inequality and environmental degradation (Rosana, 2018; Salim, 2010). Globally, the conventional growth-driven model has led to an uneven distribution of resources, with 20% of the population in developed countries controlling 80% of global income, while the remaining 80% of people in developing nations share only 20% (Suparmoko, 2020). This imbalance is not only economic but also ecological: rapid urban expansion and unsustainable development practices have intensified environmental problems such as pollution, inadequate waste management, and heightened disaster risks (World Bank, 2021; ESCAP, 2020; Hasan, 2023).

Heritage cities worldwide, from Cairo to Havana, and Kathmandu, similarly struggle to balance preservation with modernization, often facing deterioration of historic neighborhoods due to poor infrastructure, limited governance capacity, and socio-economic pressures (Bandarin and van Oers, 2012; Hosagrahar, 2017). Recent studies highlight the growing importance of technological tools, particularly Geographic Information Systems (GIS), in addressing these challenges through mapping, risk assessment, and integrated planning (Sardella et al., 2021; Zerrudo, 2024; Gao et al., 2024). These international experiences demonstrate how cultural heritage areas are increasingly vulnerable to climate change and environmental degradation, while also showing the potential of GIS-based approaches to guide sustainable interventions.

In the Indonesian context, awareness of the importance of preserving historic areas can be traced back to the Dutch colonial period with the identification of archaeological sites. A formal commitment was reinforced

through Indonesia's ratification of the 1972 UNESCO Convention in 1989 and the enactment of Law No. 11 of 2010 on Cultural Heritage, which provides the legal basis for conservation initiatives (Purwantiasning, 2021). Despite these frameworks, implementation challenges persist, including limited public awareness of cultural values, insufficient infrastructure, and increasing pressures from urban development and land-use change (Idajati, 2014; Paramita et al., 2017; Maulidiah and Jatiningsih, 2019). Moreover, empirical evidence suggests that economic growth, fossil fuel consumption, and inequality continue to drive environmental degradation in Indonesia (Nasution et al., 2024), reinforcing the urgency of exploring integrated strategies to safeguard environmental quality in heritage contexts.

As a rapidly developing metropolitan city, Surabaya has experienced extensive infrastructure growth, which has unfortunately marginalized several historic districts, particularly in North Surabaya. Once serving as the city's core, these areas have lost their function and identity, becoming degraded and classified as informal or slum settlements (Putra, 2016). Meanwhile, local communities in these heritage neighborhoods are often excluded from decision-making processes and play a limited role in preservation activities (Wirastari and Suprihardjo, 2012; Paramita, 2017; Wijaksono, 2013).

Literature suggests that effective heritage conservation requires a holistic approach that integrates social, cultural, and environmental dimensions while positioning local communities as central actors in the process (Farouk Hassan et al., 2022; UNESCO, 2016). Yet, most existing studies focus either on slum upgrading strategies or on heritage preservation in isolation, with limited attention to how these two agendas intersect in the lived realities of historic neighborhoods. This creates a research gap that is particularly evident in Surabaya City, where kampongs with rich cultural heritage often coincide with severe environmental challenges. A Kampong is not merely a local Indonesian term but is also used across Southeast Asia to denote

traditional settlements with culturally distinctive variants (Shirleyana et al., 2018). In the Southeast Asian context, a *kampung* represents organically developed traditional settlements that embody the socio-cultural characteristics of local communities (Samsudin et al., 2018).

Within this context, assessing the physical quality of the environment is a critical prerequisite for policy intervention. Heritage *kampungs* in Surabaya City show complex signs of urban decay, including poor drainage systems, inadequate road infrastructure, and limited personal space (Paramita et al., 2017; Putra, 2016). These conditions accelerate the deterioration of historic buildings and diminish the cultural value of the area. Therefore, a structured categorization approach is needed to assess the level of slum conditions in heritage *kampungs* and systematically map their environmental quality.

This study addresses the gap by presenting a case study of Surabaya's heritage *kampungs* and integrating spatial overlay techniques with community-based assessments of slum indicators through Importance-Performance Analysis (IPA). The aim is not only to identify priority areas for intervention but also to provide a replicable framework that links slum mapping with heritage conservation. Accordingly, this study hypothesizes that the integration of spatial overlay analysis and IPA can effectively generate a categorization model to identify heritage *kampungs* with high cultural potential but low environmental quality, thereby defining priority areas for targeted intervention.

Methods

Research methods

The research employed a mixed-methods approach that integrates quantitative and qualitative methods within a single study to overcome the limitations of relying on either method alone (Byrne and Humble, 2007). Specifically, this study adopted an explanatory sequential research design, in which quantitative analysis was conducted first to identify patterns and relationships, followed by qualitative inquiry to provide deeper insights and contextual explanations of the quantitative findings. This design allowed the integration of statistical results with community-based perspectives,

thereby ensuring that the research objectives were addressed both empirically and interpretively. The primary objective of the study was to develop an overlay concept for categorizing the spatial distribution of environmental quality in heritage *kampungs*. Quantitative data were used to identify the level of slum conditions based on established slum settlement indicators, while qualitative data were utilized to assess the cultural heritage potential of each *kampung*. The categorization of slum severity and cultural value serves as the foundation for overlay analysis, which aims to map and classify the spatial distribution of environmental quality across heritage *kampungs*.

The research population comprised three main groups: cultural heritage buildings, residents of heritage settlements, and key informants. Cultural heritage buildings were defined as structures that met the criteria established by the Government Regulation of the Republic of Indonesia (2010). These include buildings that were at least 50 years old, represent architectural styles or historical periods of at least 50 years, hold particular significance for history, science, education, religion, or culture, and possess cultural values that contribute to shaping national identity. The community population serving as the unit of analysis in this study consists of residents from the selected sample locations. The sample size was determined using a probability sampling approach, calculated using Slovin's formula and a 5% margin of error. Based on the Slovin approach, it was determined that there were 400 respondents who are residents of heritage areas in 18 cultural heritage areas in Surabaya City, Indonesia. In addition to the general public, local community leaders were actively engaged in the analysis process:

- Government stakeholders: Officials from Surabaya City agencies responsible for slum settlement management and cultural heritage protection, including the Department of Culture, Youth, Sports, and Tourism, and the Department of Housing, Settlement Areas, and Land.
- Local community stakeholders: Village leaders (*Lurah*), neighborhood heads (*RW*), and community members with knowledge of the historical development and cultural values of their *kampungs*.
- External stakeholders: Members of the Cultural Heritage Expert Team and representatives of cultural heritage communities.

Data collection

Data collection was carried out using two techniques: primary surveys and secondary surveys. The primary survey was conducted to measure variables related to slum settlement criteria, heritage value criteria, and forms of community participation, using observation, questionnaires, and interviews. The primary survey was conducted in 2024. Questionnaires were given to local residents in 18 cultural heritage areas, while in-depth interviews were conducted with key actors who played a role in environmental and cultural heritage preservation. The questionnaire and interview questions were related to indicators of slum settlements and cultural potential

and were processed using IPA. The data from the primary survey was then processed using IPA techniques and subsequently used for overlay analysis in ArcGIS to combine the values of slum settlement criteria and heritage value to obtain priority areas for environmental quality improvement in the city of Surabaya City, Indonesia.

The secondary survey was conducted to obtain data on the spatial distribution of slum settlements and heritage kampongs in the city of Surabaya. Data obtained from secondary surveys were used to support primary data and interpret the results of the analysis that had been conducted. *Table 1* presents a list of secondary data used in this study.

Table 1. *Secondary survey*

No.	Stakeholders	Data	Data usage
1	Public Works and Housing Agency of Surabaya City	Regional Spatial Plan of Surabaya Detail Spatial Plan of Surabaya Thematic Regional Spatial Plan of Map (Shapefile) Regional Spatial Plan of Surabaya Map (Shapefile) Map of distribution of slums in Surabaya (shapefile) Plan for Settlement Quality Improvement and Prevention in Surabaya	Policy analysis Cultural heritage preservation policy Overlay analysis
2	Regional Development Planning Agency of Surabaya City	Surabaya City cultural heritage conservation plan	Identification of Slum Settlements in Surabaya City
3	Department of Tourism and Culture of Surabaya City	Information on cultural heritage objects and areas of Surabaya	Potential and value of cultural heritage
4	Central Statistic Agency of Surabaya City	Surabaya In Figures Document	Interpretation of Community Participation Conditions in Surabaya City

Location

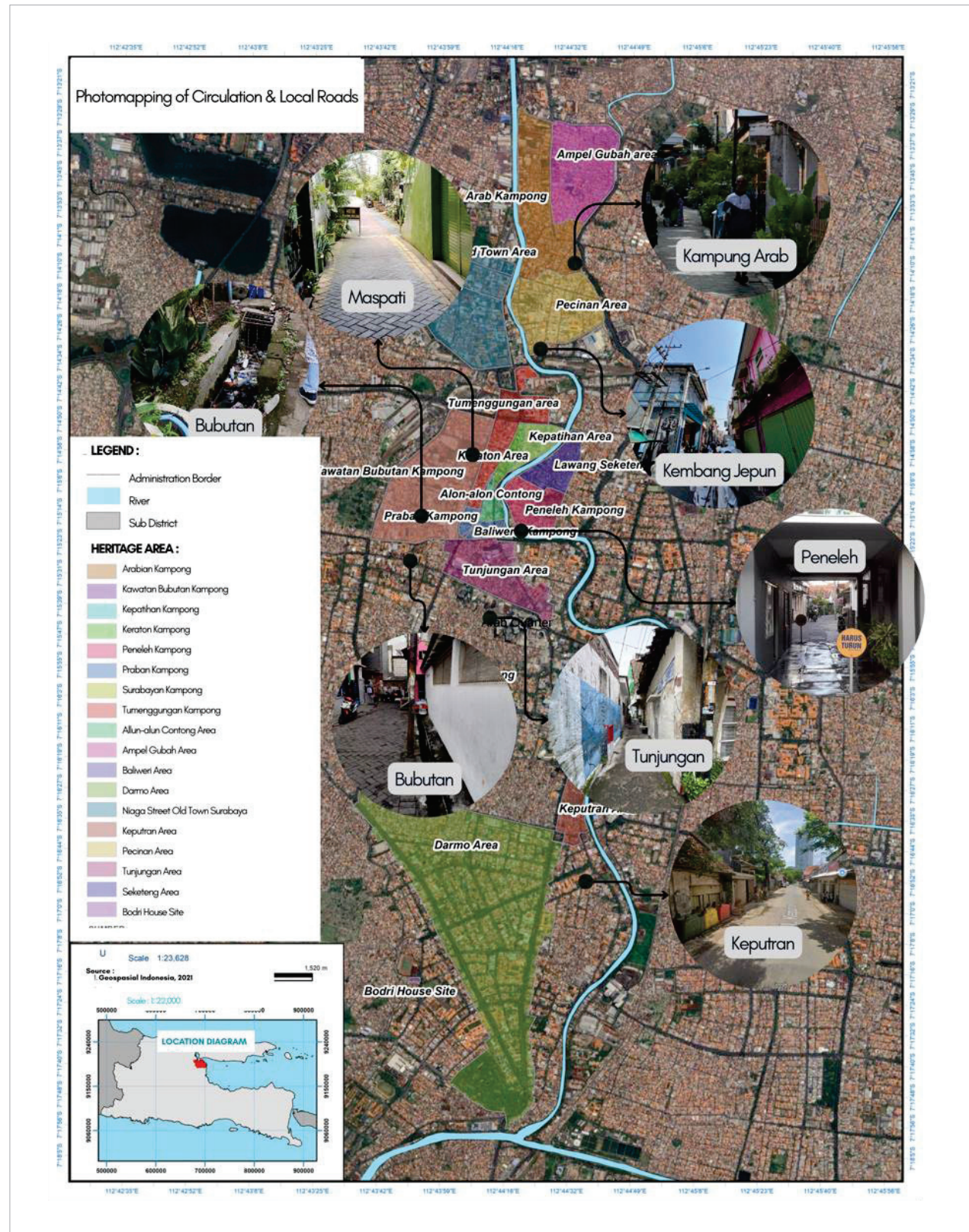
The research was carried out in Surabaya City, which has formally designated 18 cultural heritage areas under its Spatial Planning Policy (RDTR). All of these heritage areas were included as research sites, and their spatial distribution is shown in *Fig. 1*.

Based on *Fig. 1*, it can be observed that Surabaya's cultural heritage areas are distributed from the northern to southern parts of the city, with varying spatial extents, reflecting diverse cultural potentials and environmental qualities. To systematically

evaluate the spatial variation in cultural potential and environmental quality depicted in the spatial distribution map, an ArcGIS-based overlay analysis was employed to determine priority cultural heritage areas as shown in *Fig. 2*.

Priority cultural heritage areas were identified through GIS-based overlay analysis, by selecting zones with high cultural potential and high levels of slum severity, indicating significant cultural value coexisting with poor settlement environmental quality that needs to be improved. The values input into the overlay process

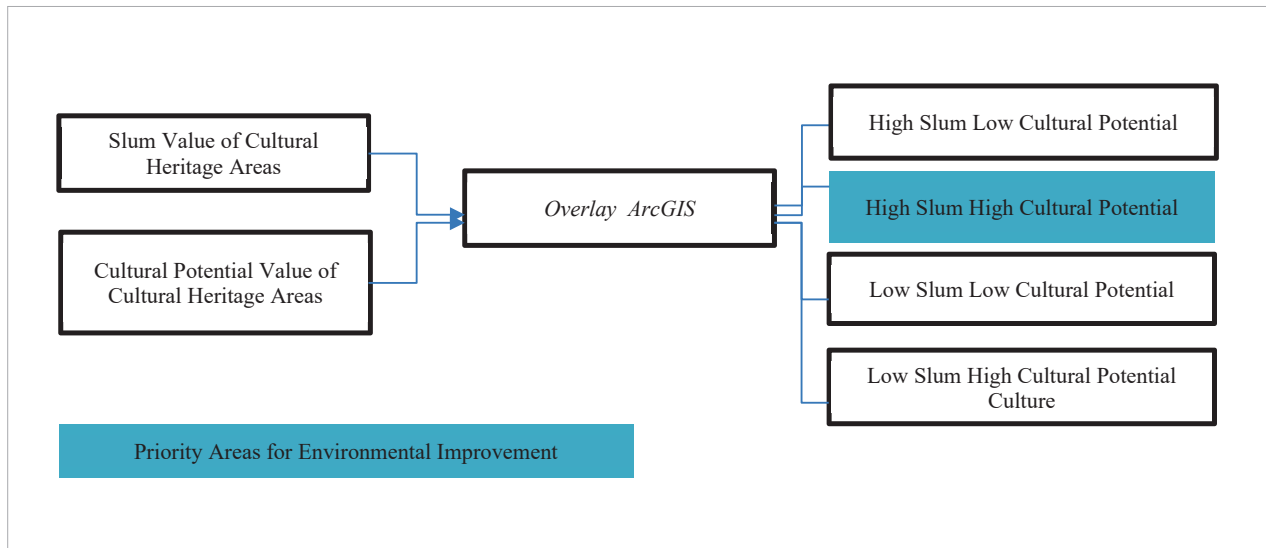
Fig. 1. Spatial distribution of heritage area of Surabaya City



were derived from local residents' perceptions in cultural heritage areas. These perceptions were analyzed using IPA to compare the importance and performance of attributes related to cultural heritage potential and environmental quality. Based on the questionnaire results, the demographic characteristics of residents

of 18 cultural heritage areas in Surabaya City can be identified in *Table 2*. A total of 75.93% of respondents are native residents, and 25.9% are private-sector employees, many of whom live in commercial areas in Surabaya City, such as Kampung Arab, Kembang Jepun, Peneleh, and Tunjungan (*Fig. 2*).

Fig. 2. Spatial categorization process of cultural heritage areas



Demographic profile of respondents

A total of 69.5% of residents have a monthly income below the Surabaya City minimum wage, making it difficult for many residents to maintain their homes while preserving their authenticity and aesthetic appeal. More details on the demographic profile of residents in the 18 cultural heritage areas of Surabaya City can be found in *Table 2*.

Based on Baswarani and Novianto (2025) also on Tan and Tan (2020), residents' origin and long-term attachment significantly influenced community participation and environmental sustainability in cultural heritage areas. Therefore, this study incorporated residents' data as a supporting variable to strengthen the overlay analysis result. Thus, it is important to identify the proportion of the population based on place of origin as shown in *Table 2*. In Surabaya's heritage kampungs, native residents constitute the majority, accounting for 75.93% of the population. The highest concentrations of native residents are found in Alun-Alun Contong, Ampel, and the Arab Quarter, while other areas are

Table 2. Respondent characteristics

Respondent characteristics based on origin			
1	Native residents	287	75.93%
2	Migrant residents	91	24.07%
Respondent characteristics based on occupation			
1	Private-sector employee	103	25.9%
2	Self-employed	151	38.0%
3	Small entrepreneur	33	8.3%
4	Civil servant	9	2.3%
5	Homemaker	66	16.6%
6	Unemployed	4	1.0%
7	Retired	5	1.3%
8	Laborer	24	6.0%
9	Farmer	2	0.5%
Respondent characteristics based on income level / month			
1	Rp 4.961.753,00	41	10.3%
2	Rp < 4.961.753,00	276	69.5%
3	Rp > 4.961.753,00	80	20.2%

Source: Author's elaboration based on field survey, 2024.

increasingly inhabited by migrant populations. This diversity of origins within cultural heritage areas presents opportunities for innovative and inclusive community activities, highlighting the need for community-based approaches to heritage preservation that embrace social diversity.

The occupational profile of local residents reflects their level of welfare, household economic stability, and the time and resources available for participation in social activities, including environmental improvement efforts in heritage kampongs. The majority of residents work as self-employed entrepreneurs (38.0%) and private-sector employees (25.9%), followed by housewives (16.6%), small-scale traders (8.3%), and laborers (6.0%). This composition indicates that the local economy is dominated by informal and semi-formal sectors, characterized by flexible but often precarious employment. Only a small proportion of respondents are employed in the formal sector, such as civil servants (2.3%) or retirees (1.3%).

Household income not only influences the ability to meet basic needs but also affects the level of community participation in cultural and environmental preservation. Survey results showed that 69.5% of respondents earn below IDR 4,961,753 per month, placing them in the lower-middle-income category. Meanwhile, 10.3% fall near this threshold, and only 20.2% earn above it. This socio-economic profile illustrates the reality of Surabaya's heritage kampung residents: most are engaged in informal livelihoods, live in dense urban environments, and face daily economic constraints. Low income often limits active participation in preservation initiatives, as residents prioritize meeting essential household needs.

Nevertheless, this condition also opens opportunities to promote preservation through local economic empowerment. Initiatives such as cultural tourism, traditional culinary enterprises, and community-based creative industries could serve as pathways to strengthen both livelihoods and heritage conservation simultaneously.

Slum settlements and state of the art

The expansion of residential settlements without corresponding improvements in the quality and quantity of supporting infrastructure often results in the emergence of slum conditions. According to the Ministry of

Public Works and Public Housing Regulation No. 2 of 2016, slum settlements are defined as uninhabitable areas due to irregular building layouts, high building density, substandard construction quality, and inadequate infrastructure and facilities. Slum settlements are typically characterized by overcrowding, low-quality construction, minimal infrastructure and services, and are closely associated with poverty. One of the main indicators of slum conditions is the lack of access to basic settlement services, including clean water, sanitation, housing provision and rehabilitation, and improvements to the residential environment.

In this study, the distribution of heritage kampongs with high cultural potential but categorized as slum areas with poor environmental quality was identified through overlay analysis in ArcGIS. Previous studies, such as Crysta and Budisusanto (2018), have analyzed the level of slum severity and proposed intervention patterns in general settlement areas, for example, in Keputih, Surabaya. However, such studies did not specifically address heritage kampongs, which possess not only environmental challenges but also cultural values at risk of degradation. The state-of-the-art contribution of this research lies in developing an overlay concept, referring to a GIS-based analytical method that integrates several spatial data layers (e.g., land use, infrastructure, and environmental indicators) to identify patterns and interactions. This concept enables the categorization of environmental quality across heritage kampongs, bridging the gap between slum analysis and cultural heritage conservation.

Cultural heritage areas of Surabaya City

Surabaya is a city with a long historical trajectory, reflected in its rich collection of heritage buildings and districts that embody both colonial and local traditions. Iconic sites such as the Old Town, Jalan Tunjungan, Jalan Rajawali, Bubutan, and Ampel illustrate the city's transformation from a trading port into a modern metropolis. Buildings like Hotel Majapahit and Gedung Internatio serve not only as architectural landmarks but also as symbols of Indonesia's struggle for independence. Similarly, the Old Town corridor and Ampel area preserve a blend of European, Chinese, and Islamic architectural styles, though many structures face deterioration due to age, neglect, or incompatible redevelopment. While revitalization efforts such as repainting heritage façades and improving pedestrian

networks have been initiated, challenges remain in balancing conservation with commercial pressures, traffic congestion, and inconsistent accessibility.

Beyond their physical form, Surabaya's cultural heritage areas also retain profound social and cultural values. Ampel continues to embody Arab-Indonesian religious traditions, Pecinan sustains Chinese cultural practices and commerce, and the European quarter is being reactivated through creative districts, cafés, and art spaces. These non-physical values reinforce identity, social cohesion, and local economic vitality, aligning with the Historic Urban Landscape (HUL) approach that integrates tangible and intangible heritage. However, many historic neighborhoods still face threats of neglect, functional shifts to warehouses or modern shops, and the pressures of urban development. Local community initiatives, festivals, and programs such as the Surabaya Heritage Track demonstrate grassroots commitment, yet stronger, more integrated management is needed to restore the historic atmosphere and position Surabaya's heritage districts as inclusive cultural tourism destinations that also enhance local livelihoods.

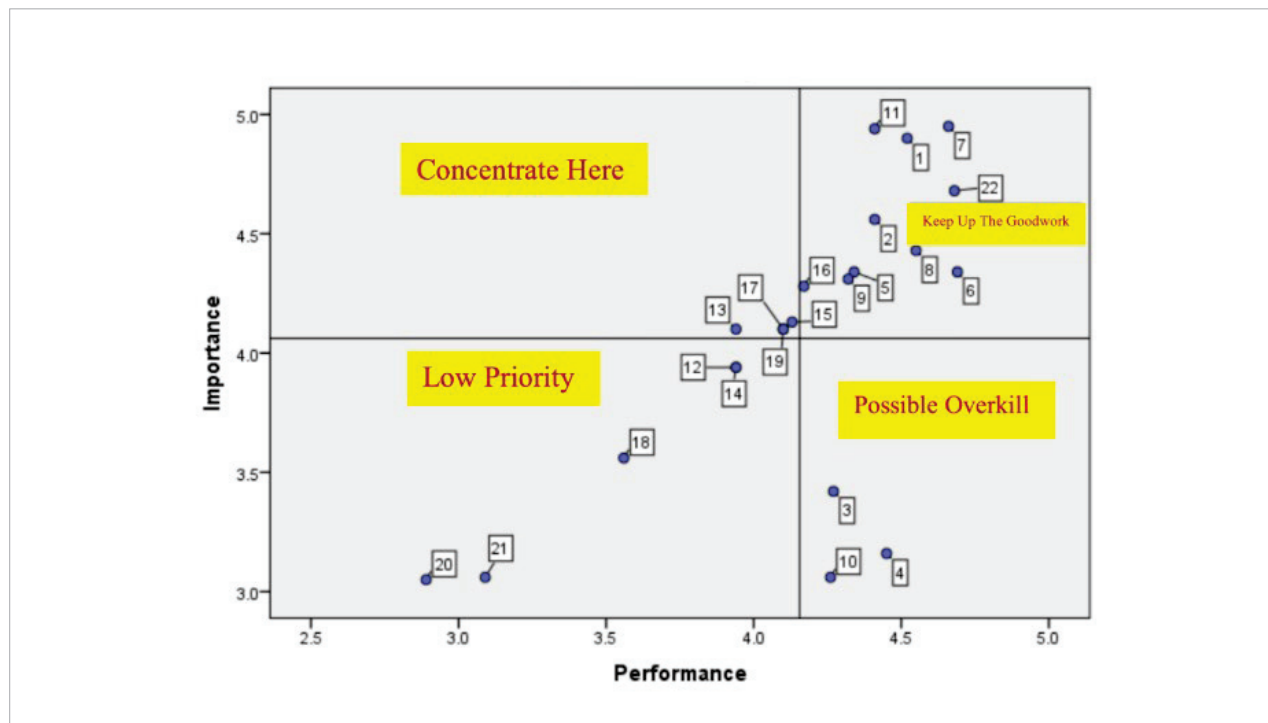
Results and Discussion

Importance performance analysis of slum attributes

Based on the IPA of 22 environmental quality attributes in the cultural heritage areas of Surabaya City, it was found that the overall performance level, as perceived by the community, is relatively high. The performance scores (X) ranged from 3.89 to 4.68 on a five-point scale, with an average score of 4.15. Meanwhile, the importance scores (Y), reflecting respondents' expectations, ranged from 3.95 to 4.68, with an average of 4.06. The mean values of X and Y served as the axes for the Cartesian diagram, where each attribute's position was determined based on its individual X and Y scores. These positions illustrate the priority level of each environmental quality attribute, helping to identify which aspects require immediate attention and which should be maintained or deprioritized.

Based on the distribution of attribute positions within the IPA quadrants, each attribute was assigned a priority level for improving environmental quality.

Fig. 3. Cartesian diagram of slum attributes in the cultural heritage areas of Surabaya City



Source: Author's elaboration based on field survey, 2024.

The highest priority for intervention falls under the “Concentrate Here” quadrant, which includes Attribute 13 (Inadequate drainage capacity), Attribute 15 (Poor drainage maintenance), Attribute 17 (Quality of neighborhood roads), and Attribute 19 (Personal space per capita). Among these, the quality of drainage systems essential for controlling runoff and flooding is identified as a top priority, especially considering that most cultural heritage areas in Surabaya City are located in zones with moderate to high flood risk.

Cultural heritage areas in Surabaya City are distributed across eight districts: Semampir, Krembangan, Pabean Cantian, Bubutan, Genteng, Tegalsari, Gubeng, and Wonokromo. According to flood risk data from the Indonesian National Disaster Management Agency (BNPB) in 2025, all eight districts are classified as high-risk flood zones. The next environmental quality attribute prioritized for intervention is the quality of neighborhood roads. The Surabaya City Government has undertaken the construction of neighborhood roads as part of its slum upgrading program, some of which are located within cultural heritage areas for example, in Alun-Alun Contong Sub-district (88.3 meters) and Krembangan Selatan Sub-district (73.30 meters).

Another slum attribute classified under the “Concentrate Here” quadrant is Attribute 19 (Personal space per capita). The mapping of these slum settlement attributes was used to assign attribute weights, which serve as the basis for determining priority areas for environmental quality improvement. The position of items in the Cartesian Quadrant affects the level of priority of the cultural heritage areas. The weight of each item based on the Cartesian Diagram is detailed in *Table 3*.

Based on *Table 3*, it can be seen that the highest weighting of determining the cultural heritage areas is on Attribute 13 (Lack of drainage pipeline), Attribute 15 (Lack of drainage maintenance), Attribute 17 (Quality of Settlement Roads), and Attribute 19 (Space for Movement per person). The weight value reflects the priority level of handling slum settlement indicators in the cultural heritage areas.

Level of performance and importance of cultural potential attributes

In an effort to understand public perception of cultural heritage values in Surabaya City, IPA was used as a tool to measure the level of importance (expectation) and performance (satisfaction) of various attributes

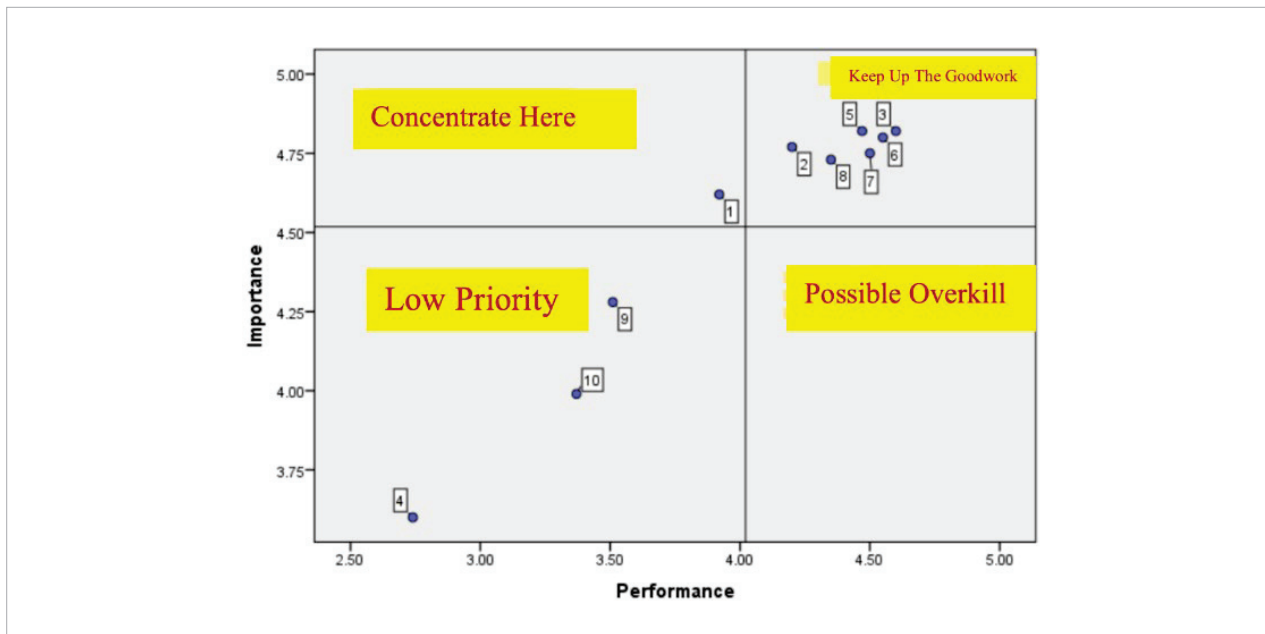
Table 3. Weight of slum attributes based on the IPA Cartesian Quadrant

No	Attribute slum settlements	Weight
1	Building suitability conditions	3
2	Building irregularities	3
3	Building density level	2
4	Non-compliance with technical building requirements	2
5	Availability of access to drinking water facilities	3
6	Fulfillment of drinking water needs	3
7	SPAL standards do not comply with technical standards	3
8	SPAL facilities and infrastructure do not meet technical standards	3
9	Waste infrastructure and facilities do not meet technical standards	3
10	The waste management system does not comply with technical standards	2
11	Lack of maintenance of waste infrastructure	3
12	Drainage pipeline inability	1
13	Lack of drainage pipeline	4
14	Poor drainage connectivity	1
15	Lack of drainage maintenance	4
16	Road Service Coverage	3
17	Quality of Settlement Road	4
18	Population density	1
19	Space for Movement per person	4
20	Unavailability of fire protection facilities	1
21	Unavailability of fire protection infrastructure	1
22	Land and building ownership status	3
	Average	3

Source: Author's elaboration based on field survey, 2024.

that form the meaning and value of cultural heritage areas. This assessment not only reflects the extent of public understanding of cultural heritage elements but also describes the extent of public expectations of the preservation and utilization of cultural heritage as an important part of the daily lives of the Surabaya City community. Through the IPA approach, this discussion aims to identify cultural heritage attributes that are a priority for intervention in enhancing the potential of Surabaya City's cultural heritage.

Fig. 4. Cartesian diagram of cultural potential attribute priorities



Source: Author's elaboration based on field survey, 2024.

Based on the results of the IPA of cultural heritage value attributes in the cultural heritage areas of Surabaya City, a clearer picture emerges regarding community perceptions and expectations of the non-physical aspects of heritage sites. In general, the level of satisfaction with the cultural potential reflected in these areas remains below 100%, with the lowest conformity observed in Attribute 4 (Authenticity). This low score is attributed to public concern that significant alterations to buildings and the surrounding areas have diminished the original character of the cultural heritage sites.

Performance scores for cultural value attributes range from 2.74 to 4.60, while the community's expectation levels span from 3.60 to 4.82. The average perceived performance of heritage attributes is 4.02, whereas the average importance score stands at 4.52. Based on these mean values of performance (X) and importance (Y), the distribution of each cultural heritage attribute can be mapped in a Cartesian diagram, as illustrated in Fig. 4.

Based on Fig. 4, it can be identified that the priority cultural potential attribute based on the public perception is Attribute 1 (Aesthetics). Based on the public opinion, the aesthetic attribute of the cultural heritage areas is an important attribute used to assess the high or low

cultural potential of a cultural heritage areas, but in the existing condition, the performance/satisfaction of the public towards the existing condition of this attribute is very low. Based on the Surabaya Heritage Map document released by the Surabaya Government, there are 265 cultural heritage buildings and 18 cultural heritage areas with the details in Table 4.

Based on Table 4, it can be identified that the distribution of cultural heritage buildings is also found outside the cultural heritage areas and its utilization has so far been integrated with the activities of the community around the location of the cultural heritage building. The distribution of cultural potential attributes in the Cartesian diagram is used as a weight in determining the cultural heritage areas which is a priority for handling environmental quality improvement with the weights details in Table 5.

Based on Table 5, it can be seen that the highest weight for cultural potential attributes is assigned to, aesthetics, with a weight of 4. This reflects the community's strong expectation for aesthetics to be treated as a key indicator in determining priority areas for intervention. The high importance placed on aesthetics stems from the low perceived performance of this attribute, as reported by the community, while their expectation

Table 4. Distribution of cultural heritage areas and buildings in Surabaya City

No.	Areas	Cultural heritage areas	Number of cultural heritage buildings
1	North Surabaya	Kampung Arab	11
		Ampel Gubah Area	9
		Niaga Street, Old Town Surabaya	38
		Pecinan	15
	Total		96
2	Center Surabaya	Tumenggungan	10
		Kawatan Bubutan	5
		Keraton Area	0
		Baliwerti Street	0
		Peneleh Area	5
		Lawang Seketeng Area	5
		Praban Street	1
		Alun-alun Contong	1
		kepatihan	1
		Tunjungan Street	21
		Surabayan Area	1
		Darmo Area	12
		Keputran Area	1
	Total		113
3	South Surabaya	Bodri's home site	4
		Darmo Area	8
	Total		36
4	East Surabaya	-	
	Total		18
5	West Surabaya	-	
	Total		2

Source: Author's elaboration based on field survey, 2024.

for improvements in the visual and aesthetic quality of buildings and cultural heritage areas in Surabaya City remains high. The next stage in identifying priority cultural heritage areas for environmental quality improvement involves performing an overlay analysis of slum severity values and cultural potential values for each heritage kampong. Areas that exhibit both high

Table 5. Weight of cultural potential attributes based on the IPA cartesian quadrant

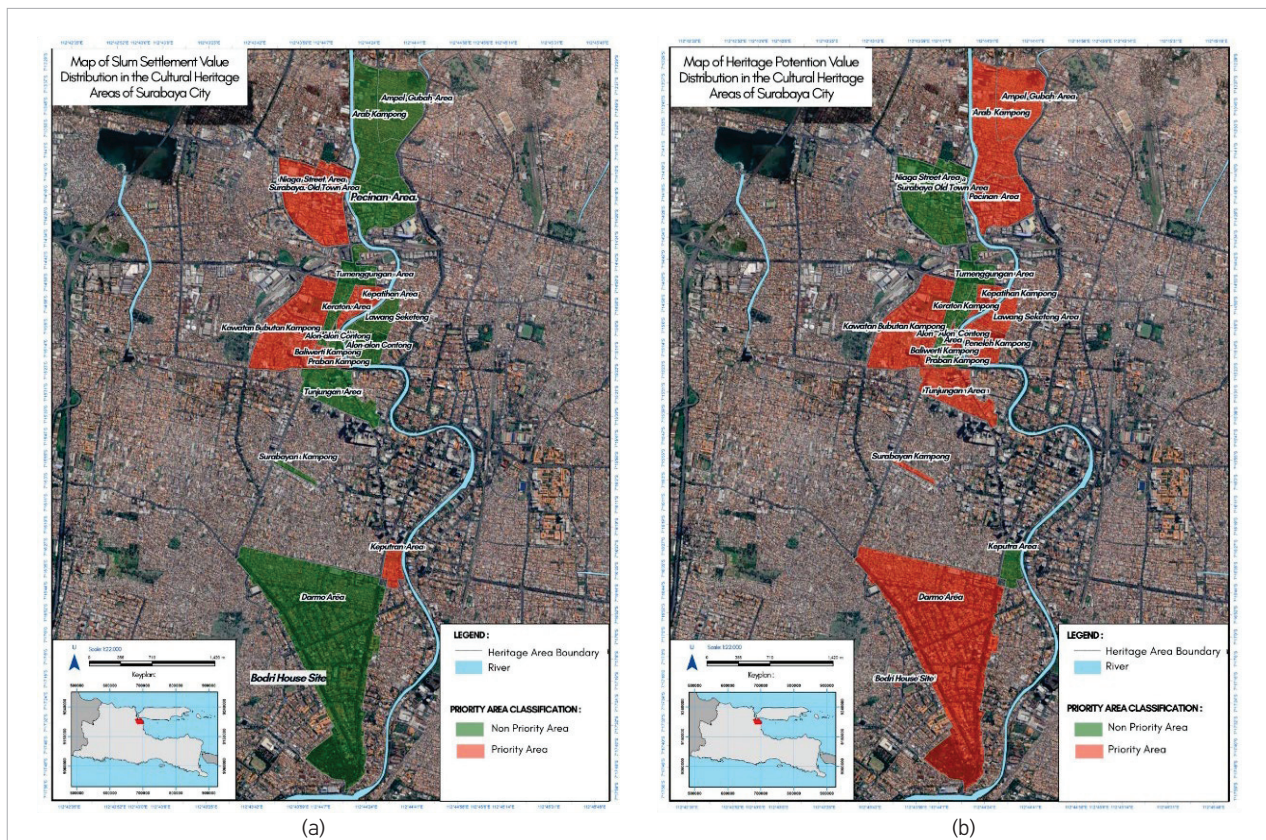
No	Attribute	Cartesian Quadrant Position	Weight
1	Aesthetics	Concentrate Here	4
2	Strengthening the area	Keep Up The Good Work	3
3	Uniqueness	Keep Up The Good Work	3
4	Authenticity	Low Priority	1
5	Rarity	Keep Up The Good Work	3
6	Landmark/ Prominent Feature	Keep Up The Good Work	3
7	Distinctiveness	Keep Up The Good Work	3
8	Age	Keep Up The Good Work	3
9	Scientific Value	Low Priority	1
10	Historical Value	Low Priority	1

Source: Author's elaboration based on field survey, 2024.

levels of slum conditions and high cultural potential are designated as top priorities for intervention. The slum severity score is derived from the community's satisfaction level with slum settlement indicators, integrated with the respective attribute weights. Likewise, the cultural potential value was calculated from the community's satisfaction with the actual performance of cultural heritage attributes, also weighted accordingly. Fig. 5 maps illustrate the spatial distribution of slum severity and cultural potential scores across cultural heritage areas in Surabaya City.

Based on Fig. 5 (a), the areas with high priority values (8.8–10.8) in terms of slum severity include Baliwerti Area, Kampung Praban, Kampung Kawatan Bubutan, Kampung Kepatihan, Kampung Keraton, Jl. Niaga in the Old Town Area, and Keputran Area. The results of integrating slum attribute scores with their respective weights indicated that residents in these seven cultural heritage areas perceive low performance across slum settlement attributes. Therefore, these areas should be prioritized for environmental quality improvement, particularly from the perspective of slum condition attributes. In addition, priority mapping of cultural heritage areas was also carried out based on the integration of cultural potential scores and their weighted attributes, with spatial distribution illustrated in the corresponding figure.

Fig. 5. (a) Distribution of slum area's priority in the cultural heritage areas of Surabaya City, (b) Distribution of cultural potential's priority in the cultural heritage areas of Surabaya City

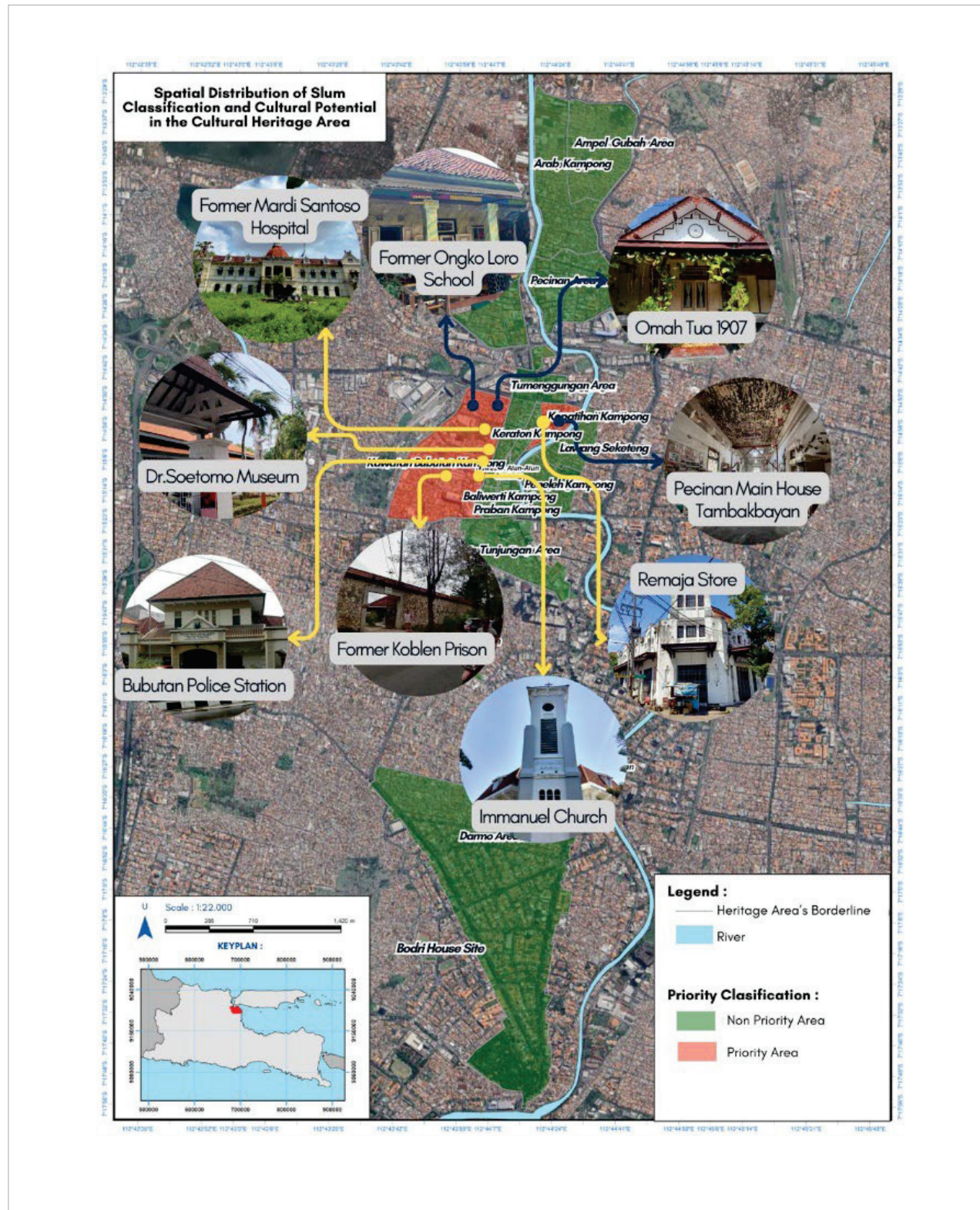


Source: Author's elaboration based on field survey, 2024

According to Fig. 5 (b), the cultural heritage areas in Surabaya City identified as having high priority for environmental quality improvement based on cultural potential indicators are Kampung Kawatan Bubutan, Alun-Alun Contong Area, Kampung Kepatihan, Lawang Seketeng Area, Kampung Peneleh, Chinatown Area, Arab Quarter, Ampel Gubah Area, Kampung Surabayan, Tunjungan Area, Darmo Area, and the Bodri Site. In these twelve areas, the community perceives the performance/satisfaction level of cultural potential attributes as high and considers these attributes important for preservation. As such, these twelve cultural heritage areas are designated as priority zones for environmental enhancement based on cultural value considerations. The integration of these aspects within the HUL regenerative model is conducted through an overlay intersection technique to identify cultural heritage areas with both high slum severity and high cultural potential, which are deemed top priorities for environmental

quality improvement. Fig. 6 presents the results of the overlay analysis combining slum severity and cultural potential values for Surabaya's cultural heritage areas. Based on Fig. 6, it can be identified that the cultural heritage areas of Surabaya City that are a priority for improving environmental quality using the HUL approach are Kampung Kawatan Bubutan and Kampung Kepatihan with the total value classification in Table 6. The former royal site of Surabaya is believed to have been located near the Tugu Pahlawan (Heroes Monument) area, particularly in Kampung Keraton, suggesting that surrounding areas such as Kampung Kawatan Bubutan and Kampung Kepatihan also have historical ties to the Surabaya Kingdom. Surabaya's role as a major port city on the island of Java was established as early as the Majapahit era. Following the fall of the Majapahit Kingdom, numerous smaller kingdoms or principalities (kadipaten) emerged as

Fig. 6. Spatial distribution of slum classification and cultural potential in the cultural heritage areas



Source: Author's elaboration based on field survey, 2024.

independent powers. Surabaya became one of the most prominent of these, exerting significant influence from the 15th to the early 17th century, primarily due to its strategic port. As an independent kingdom, Surabaya resisted subjugation by the Mataram Sultanate, leading to a major siege by Mataram forces in 1625, which ultimately resulted in Surabaya being annexed under Mataram rule. In the 18th century, during the height of colonial expansion in the Indonesian archipelago, Surabaya came under the control of the Dutch East India Company (VOC) and was integrated into the colonial administrative structure. Several historic buildings and sites within the Kawatan Bubutan and Kepatihan areas bear witness to this layered historical legacy. These include Temba'an Cemetery (Jl. Temba'an), the Remaja Store Building (Jl. Kramat Gantung 122), the

Shopping Center (Jl. Pengela 2), and the former Mardi Santoso Hospital (Jl. Bubutan 93). Additional sites include the Nahdlatul Ulama Branch Office (Jl. Bubutan VI/2), the Building on Jl. Pahlawan 17–19, Gedung Nasional Indonesia (GNI) (Jl. Bubutan 87), the North Surabaya Police Office – Section I (Jl. Raden Saleh 2), GPIB Immanuel Church (Jl. Bubutan 69), and Koblen Prison (Jl. Koblen).

The IPA results reveal a spectrum of conditions across heritage kampongs that extend beyond the “Concentrate Here” attributes. For instance, attributes placed in the “Keep Up the Good Work” quadrant, such as access to clean water and basic waste management facilities, demonstrate areas where government intervention and community practices have already been relatively effective. From the perspective of the Historic Urban Landscape (HUL) framework (UNESCO, 2016), these strengths represent potential entry points for building trust and mobilizing communities toward broader conservation goals. In contrast, attributes in the “Low Priority” and “Possible Overkill” quadrants reflect misalignments between community expectations and actual performance. These patterns highlight the importance of aligning technical planning standards with residents' lived experiences, echoing arguments by Bandarin and van Oers (2012) that heritage conservation must be grounded in local realities rather than imposed uniformly.

More critically, the overlay of slum severity with cultural potential values exposes a paradox: kampongs with the richest cultural heritage, such as Kawatan Bubutan and Kepatihan, are also those facing the most severe environmental challenges. This finding suggests that cultural heritage areas in Surabaya are not just physical spaces of memory but also arenas of social inequality, where marginalized groups bear the burden of conserving spaces of collective identity while lacking adequate infrastructure and economic capacity. This resonates with global debates on heritage and equity (Hosagrahar, 2017), where cultural value is celebrated in policy discourse but not sufficiently supported in practice.

From a policy standpoint, these findings call for an integrated approach that moves beyond conventional slum upgrading strategies. While physical improvements in drainage, roads, and housing remain urgent, they should be coupled with heritage-sensitive interventions

Table 6. Categorization of spatial distribution of environmental quality cultural heritage areas slum classification and high cultural potential

Cultural heritage areas	Slum classification	Cultural potential
Baliwerti Area	10.4	7.5
Praban Kampong	10.1	9.6
Kawatan Bubutan Kampong	10.3	10.4
Tumenggungan Kampong	11.0	8.3
Alun-alun Contong Area	12.7	11.9
Kepatihan Kampong	10.5	11.3
Lawang Seketeng	11.3	10.7
Peneleh Kampong	11.4	10.9
Keraton Kampong	10.8	9.4
Niaga Street Old Town Area	10.5	10.0
Pecinan Area	12.6	10.8
Arab Kampong	12.7	11.9
Ampel Gubah Area	12.7	11.9
Surabayan Kampong	12.1	11.8
Tunjungan Area	12.1	11.7
Keputran Area	8.8	9.9
Darmo Area	11.7	11.4
Bodri's house site	12.1	11.6
Information:		
Priority Value Range	8.8–10.8	10.4–12.4
Non-Priority Value Range	10.9–12.9	8.3–10.3

Source: Author's elaboration based on field survey, 2024.

and community empowerment programs. The integration of IPA and GIS in this study demonstrates not only a methodological innovation but also a conceptual bridge between settlement upgrading research and urban heritage conservation frameworks. In doing so, this study contributes to rethinking how environmental quality, cultural significance, and community participation can be jointly addressed in policy interventions for heritage kampongs.

Conclusions

This study applied IPA and spatial overlay techniques to categorize slum severity and cultural potential in Surabaya's heritage kampongs. The resulting priority area map highlights zones requiring urgent intervention, particularly Kampung Kawatan Bubutan, Kampung Kepatihan, and Kampung Keraton. The findings demonstrate that preserving cultural heritage areas must be inseparable from improving residential environmental quality through physical, social, cultural, and community-based approaches. The proposed analytical model provides a reference for developing contextual and sustainable heritage preservation

policies grounded in local conditions and community aspirations.

Nonetheless, the study has limitations. Its scope is restricted to Surabaya's heritage kampongs, which may limit generalizability, and the reliance on perception-based surveys introduces potential subjectivity. Furthermore, the analysis focused mainly on physical and perceptual attributes, without fully addressing economic or governance factors. Future research should apply this model in other heritage contexts, adopt longitudinal approaches to assess long-term impacts, and incorporate broader dimensions such as economic viability, governance structures, and climate resilience. Ultimately, the study underscores that safeguarding heritage is not only about protecting the past but also about creating livable, resilient, and inclusive urban futures.

Acknowledgments

This study was funded by Universitas Brawijaya. The authors acknowledge the use of AI-assisted language tools for translation and linguistic refinement of the manuscript. The use of these tools was limited to improving clarity and grammar, and did not contribute to the conceptualization, analysis, or substantive content of the study.

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