SCIENTIFIC CULTURE
www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 11, No. 3.1, (2025), pp. 1091-1102
Open Access. Online & Print

DOI: 10.5281/zenodo.11325103

# SACRED CURRENTS: MAPPING BUDDHIST CULTURAL LANDSCAPES IN SAMUT SONGKHRAM, THAILAND

**Pornperm Sae-ngow[1], Nayot Kulpanich[1*], Manlika Sukitpaneenit[2] and Morakot Worachairungreung[1]**

*[1]Suan Sunandha Rajabhat University, Bangkok, Thailand. nayot.ku@ssru.ac.th*
*[2]Chulalongkorn University, Bangkok, Thailand.*

*Received: 21/09/2025*
*Accepted: 15/10/2025*

*Corresponding Author: Nayot Kulpanich (nayot.ku@ssru.ac.th)*

## ABSTRACT

***Cultural tourism has surged in appeal, especially in locations shaped by religious tradition. This study analyses the spatial distribution and density of Buddhist influenced cultural tourist sites in Samut Songkhram Province utilising Geographic Information Systems (GIS) and spatial statistics. Data were acquired from spatial sources, field surveys, and OpenStreetMap, and analysed utilising Average Nearest Neighbour (ANN) and Kernel Density Estimation (KDE) on a 100 100-meter grid with a 785-meter bandwidth. The Nearest Neighbour Ratio of 0.8435 and a z-score of –3.4524 (p = 0.000556) indicate statistically significant spatial clustering as confirmed by the ANN test. KDE results indicated high-density zones (> 1.81 temples/km²) around the Mae Klong River and its tributaries—regions comprising about 8% of the province while housing nearly 40% of all temples, with a maximum density of 5.23 temples/km². These data highlight the impact of waterborne transportation systems on the distribution of temples. The study underscores the importance of integrating riverbank geospatial patterns into cultural tourist planning to enhance site management, alleviate congestion, and foster equitable economic advantages. The suggested methodological framework provides a model applicable for the monitoring and management of cultural tourism in additional river basins in the future.***

**KEYWORDS:** Buddhist Cultural, Spatial Distribution, Spatial Statistics, Average Nearest Neighbour, Kernel Density.

## 1. INTRODUCTION

Thailand continues to be a premier destination for both domestic and international travellers, attracting over 35 million arrivals in 2024 and producing around USD 60 billion in yearly tourist revenue (Ponjan & Thirawat 2016; Law 2025; Sangkaew et al. 2025; Nitivattananon & Srinonil 2019). The government enhances its attractiveness by advocating for "Soft Power 5F" (Food, Film, Fashion, Fight, Festival) and has introduced the BCG Economy Model to harmonise economic development with environmental sustainability and cultural conservation (The Government Public Relations Department 2023; Strippoli et al. 2024). However, the swift increase in visitors exacerbates strain on heritage sites and reveals deficiencies in local infrastructure, highlighting the necessity for improved capacity management and fair sharing of benefits. Presently, Geographic Information System (GIS) is a system engineered for the administration of spatial and attribute data. It streamlines data collection, input, editing, retrieval, and systematic management, resulting in thorough analysis and visualisation of geographical phenomena. Geographic Information Systems (GIS) are acknowledged as an essential element of geoinformation technology and function as a robust instrument for analysing spatial patterns and processes (Song et al. 2023; Liang et al. 2023). It is applicable across multiple disciplines and administrative tiers from national to local levels for activities like natural resource assessments, spatial analysis, and development planning. Moreover, GIS facilitates the development of geographic datasets crucial for informed decision making (Mallick et al. 2021) and strategic planning across several industries. Furthermore, mapping temple density yields significant insights into regions with elevated visitor concentrations (Liu et al., 2022), which may encounter challenges related to overpopulation and the overexploitation of local resources. Encouraging visits to lesser known yet promising temples can alleviate congestion at overwhelmed locations and foster more diverse and equitable tourism patterns. This methodology facilitates infrastructure and service planning, allowing pertinent authorities to construct roads, pathways, and parking amenities that correspond with visitor demand (Kulakov et al. 2024; Szromek et al. 2023). These techniques can alleviate congestion at prominent temples while enhancing access to other culturally important sites. Consequently, tourist development may become more sustainable, promoting the conservation of historical and religious heritage while mitigating the adverse effects of mass tourism. It also augments the economic potential of the region by reallocating tourism earnings to villages next to less frequented temples (Wong et al. 2013), thus fostering more equitable local economic development. Local enterprises, such as dining establishments, souvenir retailers, and lodging facilities, may experience enhanced revenue. Buddhist influenced cultural tourism sites are destinations where the main attraction stems from both the tangible and intangible aspects of Buddhist heritage. These include concrete elements such as temples, stupas, religious art, and architecture, alongside intangible cultural expressions including rituals, monastic traditions, and religious festivals. Visitors are mostly motivated by the desire to study, investigate, experience, and engage with this history, rather than to partake in solely devotional or pilgrimage activities (Shinde 2025). This type of tourism signifies a culturally enriched interaction with Buddhist traditions, rather than merely a religious one. Samut Songkhram Province is renowned for its cultural and religious tourism, particularly its historically and architecturally significant temples, including Wat Bang Kung, Wat Phet Samut Worawihan, and Wat Amphawan Chetiyaram. Nevertheless, the disproportionate allocation of tourists has led to certain locations being under visited, whereas others have experienced significant overcrowding (Zhang et al. 2022). Consequently, examining the spatial distribution and density of tourist attractions is crucial for sustainable tourism growth and efficient site management (Jiang et al. 2024), and can guide strategies for tourism area design (Deng et al. 2025). This study seeks to examine the density and spatial distribution of Buddhist influenced cultural tourist sites in Samut Songkhram Province through the application of GIS technologies. The objective is to improve tourism quality by establishing a sustainable equilibrium among economic, social, and environmental factors, which are essential for sustainable spatial growth. This strategy aligns with the Sustainable Development Goals (SDGs), specifically SDG 8 concerning decent work and economic growth, by generating and distributing income within the community, and SDG 11 regarding sustainable cities and communities, by promoting resilient and self-sustaining local economies throughout Samut Songkhram Province.

## 2. MATERIALS AND METHODS

### *2.1. Study Area*

This research was carried out in Samut Songkhram Province, situated in the midstream region of the Mae Klong River Basin in central Thailand. The map of the study area is presented in Figure 1. The province covers roughly 413.8 square kilometres, located at latitude 13° 26′ 45″ N and longitude 100° 01′ 55″ E. **The ecology is characterised by three aquatic systems** freshwater from the Mae Klong River, saltwater from the Gulf of Thailand, and brackish water at the river mouth, which collectively support the province's rich natural resources throughout the year (Worachairungreung et al. 2024). Samut Songkhram is a prominent destination for cultural tourism, renowned for its unique traditions and lifestyle. It functions as a principal centre of Buddhism in the Mae Klong River Basin, a significant river system in western Thailand. Before the COVID-19 epidemic, Thailand's tourism sector produced substantial national revenue (Pleerux & Nardkulpat 2023). Samut Songkhram attracts over 2.2 million people each year, yielding roughly 3 billion baht in tourism revenue, with over 98 percent derived from domestic travellers. Samut Songkhram serves as a prominent exemplar of community based tourism and equitable income sharing within the Mae Klong Basin.

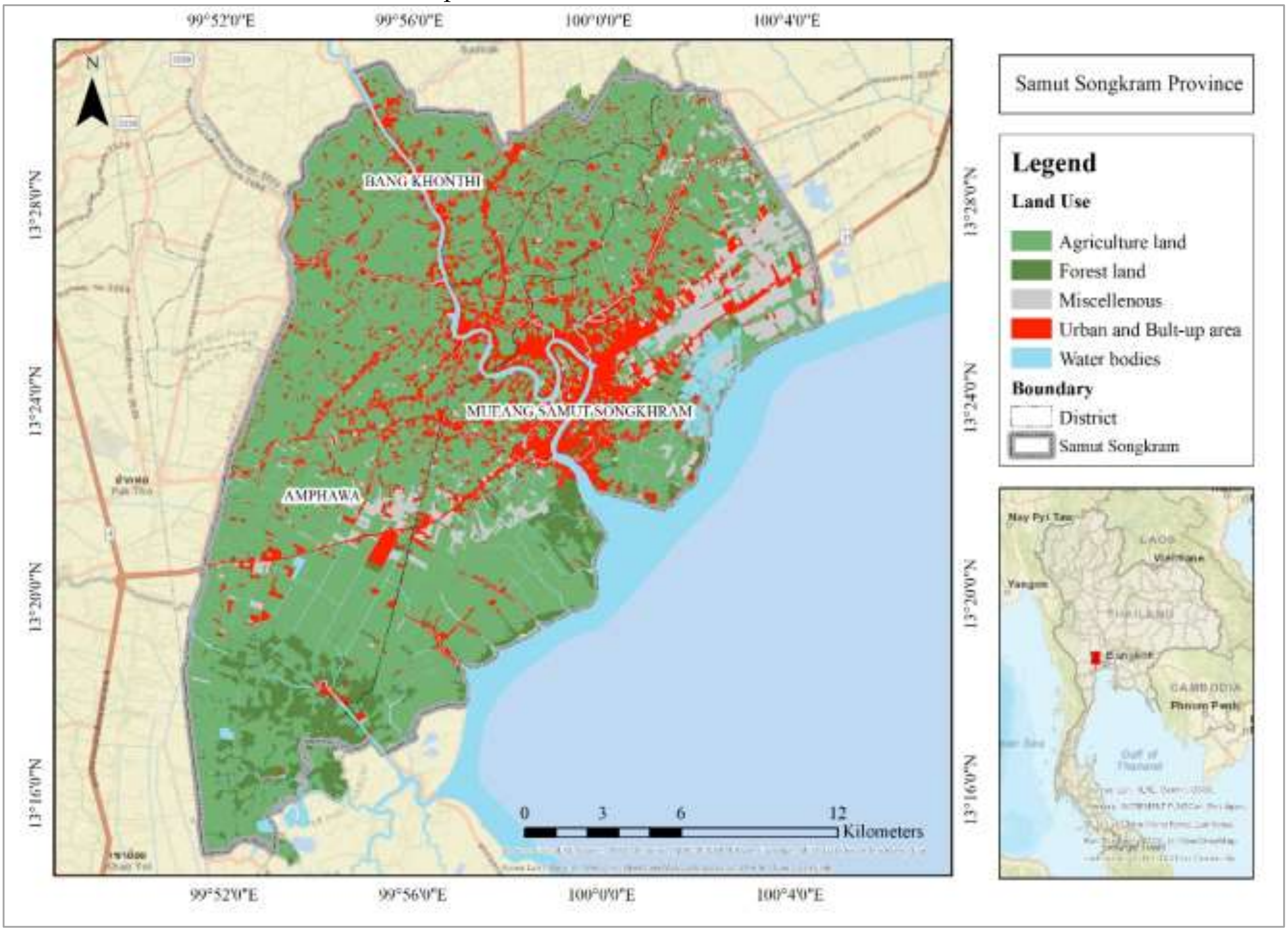


*Figure 1: Study Area: Map of Samut Songkhram Province.*

## 2.2. Data Collection

This study entailed the collecting of field data by compiling landmark information from OpenStreetMap, subsequently confirmed through ground surveys. A Global Positioning System (GPS) device was employed to document the geographic coordinates of temples and cultural tourism attractions affected by Buddhism. Attribute data were sourced from several origins, including the temple registration database managed by the National Office of Buddhism, alongside papers, scholarly books, and oral histories provided by local academics. The gathered data were then structured into a Geographic Information System (GIS) database, with the findings displayed in Table 1 and Figure 2.

*Table 1: Data Collection and Manipulation.*

| NO. | Stage/Component | Descriptions | Results |
|---|---|---|---|
| 1 | **Definition of Scope and Variables** | **1.1 Study Area** Samut Songkhram Province (3 districts, 38 subdistricts)<br>**1.2 Primary Unit of Analysis** Temples / Monastic Centers / Religious Sites Connected to Tourism Activities<br>**1.3 Indicators of "Buddhist Influence"** (more than one indicator may be selected)<br>• Historical age/status as registered historical sites<br>• Association with significant rituals (e.g., almsgiving by boat, End of Buddhist Lent festival)<br>• Architectural or mural significance<br>• Number/type of important Buddha images | **Metadata Table** (CSV/Excel) |
| 2 | **Spatial Data Collection and Preparation** | **2.1 Coordinates of Religious Sites**<br>• Based on data from DOPA, the Fine Arts Department, OpenStreetMap (OSM), and GPS surveys<br>• Quality verification/Identification of "riverside" locations<br>**2.2 Supporting Data Layers** (Subdistrict–District level)<br>• Transportation networks/Water resource layers | **Shapefile** |
| 3 | **Temple Clustering and Typological Classification** | **3.1 Qualitative Criteria** Royal vs. Common, Level of Heritage | **Attribute Data** |
| 4 | **Density and Concentration Analysis** | **4.1 Kernel Density Estimation (KDE)**<br>**4.2 Spatial Autocorrelation**<br>• Nearest Neighbor Analysis (NNA), *Getis-Ord Gi** | **Raster heatmap (.tif)** |
| 5 | **Linkage of Enabling and Counterbalancing Variables** | **Overlay KDE results** with transportation networks and water resource data | **Overlay Map** |
| 6 | **Field Verification and Ground Truthing** | **Select at least 3 random points** from each density level: high, medium, and low | • **Field Survey Report**<br>• **Geo-tagged Photos** |

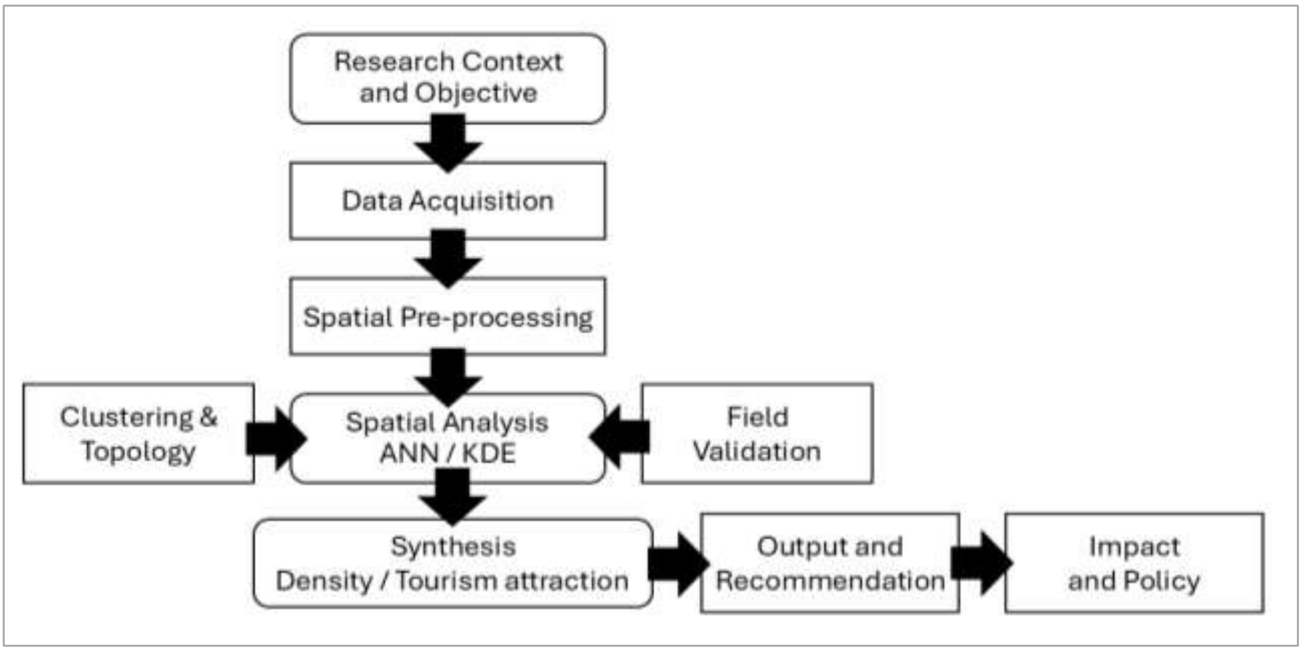


*Figure 2: Research Flowchart.*

## 2.3. Methods

Figure 2 depicts a spatial study framework for the analysis of cultural tourist locations impacted by Buddhism. The procedure commences with the delineation of the research context and objectives, succeeded by data collecting and spatial pre-processing. Fundamental analytical techniques, including Average Nearest Neighbour (ANN) and Kernel Density Estimation (KDE), are utilised, complemented by clustering analysis, topological evaluation, and field validation. The findings are consolidated to assess spatial density and tourism appeal, resulting in outputs and policy suggestions designed to foster sustainable tourism development. This research utilised the Nearest Neighbour Index (NNI), a spatial statistical method for examining the distribution patterns of point characteristics (Wang et al. 2025). NNI evaluates the distribution of points in the studied region as clustered, random, or scattered by contrasting the observed mean distance to the closest neighbour with the anticipated mean distance under a situation of total spatial randomisation. **The Nearest Neighbour Ratio (NNR) is interpreted as follows** a value near 1 signifies a random distribution; a value below 1 shows clustering; and a value over 1 denotes dispersion (Kun et al. 2025).NNI serves as a potent instrument for examining the geographical distribution of temples, religious sites, and other cultural attributes, especially within the realms of spatial planning and cultural asset management. It provides a quantitative analysis of settlement patterns and spatial density, elucidating their relationship with the socio-cultural framework and physical geography of the study area. This analysis is depicted in Equation 1.

$$R = \frac{Observed\ Mean\ Distance}{Expected\ Mean\ Distance} \quad (1)$$

Where:

- R = Nearest Neighbor Ratio
- Observed Mean Distance = The actual average distance from each point to its nearest neighbor
- Expected Mean Distance = The average distance expected if the points were randomly distributed
- The Getis-Ord Gi* statistic is computed using Equation 2, which incorporates the mean (X ̅,Equation 3) and standard deviation (S, Equation 4) of the attribute values to evaluate spatial dustering. The analysis yields Z-scores and p-values (Zikirya et al. 2024), which are used to distinguish between hot spots (areas with a high concentration of tourism activities or resources) and cold spots (areas that are underutilized or have untapped potential).

$$Gi*\ or\ G_i^* = \frac{\sum_{j=1}^{n} w_{i,j} - \bar{X}\sum_{j=1}^{n} w_{i,j}}{S\sqrt{\frac{\left[n\sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i.j}\right)^2\right]}{n-1}}} \quad (2)$$

$$\bar{X} = \frac{\sum_{j=1}^{n} x_j}{n} \quad (3)$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - \overline{(X)}^2} \quad (4)$$

**Where**

- $x_j$ = Attribute value at location $j$ (e.g., number of temples or density value)
- $w_{i,j}$ = Spatial weight between locations $i$ and $j$ (e.g., proximity)
- $\bar{X}$ = Mean of all attribute values
- $S$ = Standard deviation of attribute values
- $n$ = Total number of points

The data were further analysed to estimate the density of cultural tourist sites impacted by Buddhism utilising Kernel Density Estimation (KDE). KDE is a non-parametric statistical method employed to evaluate the spatial density of point patterns (Qi et al. 2025). The fundamental objective is to provide a continuous density surface that offers a more lucid understanding of the frequency or concentration of events spatially, in contrast to traditional point-count grids (Iqbal et al. 2024). The KDE method computes the distance from each data point to its vicinity within a certain radius (termed the bandwidth, or h) and employs the Gaussian kernel function to assign weights to those distances, so generating a density value at each site. A broader bandwidth yields a more uniform surface that emphasises overarching patterns, whereas a narrower bandwidth reveals finer details but may elevate the likelihood of overfitting. A key advantage of KDE is its capacity to produce visual heatmaps that distinctly delineate hot spots (regions of high density) and cold spots (regions of low density). This procedure is depicted in Equation 5.

$$f(s) = \frac{1}{nh^2}\sum_{i=1}^{n} K\left(\frac{d(s,s_i)}{h}\right) \quad (5)$$

**Where**

- $f(s)$ = Estimated density at cell $s$
- $n$ = Total number of points
- $h$ = Bandwidth (the radius of kernel influence)
- $d(s, s_i)$ = Euclidean distance between point $s_i$ and cell $s$
- $K(\cdot)$ = Kernel function (e.g., Gaussian, Quartic, Epanechnikov)

## 3. RESULTS

This section delineates the spatial analysis of Buddhist influenced cultural tourist sites within Samut Songkhram Province. **The results are divided into two primary sections** the first investigates the general spatial distribution pattern utilising the Average Nearest Neighbour (ANN) method, whereas the second evaluates the density of temple clusters through Kernel Density Estimation (KDE) to delineate high and low density areas within the study region.

### 3.1. *Spatial Distribution Measurement of Buddhist Influenced Cultural Tourism Sites in Samut Songkhram Province*

This study utilised the Average Nearest Neighbour (ANN) statistical method to evaluate the geographical distribution pattern of temples classified as cultural tourism sites. The investigation employed Euclidean distance within a study region of approximately 460.46 square kilometres in Samut Songkhram Province. The calculated mean distance was determined to be 784.756 meters, suggesting that, on average, cultural tourism locations within the province are quite proximate to one other. This indicates a propensity for these locations to be concentrated, perhaps attributable to the riverbank topography, which historically enabled aquatic transit, functioning as a principal conduit for community habitation and the founding of religious establishments. In contrast, under a simulated random distribution in the same study area, the anticipated mean distance was 930.336 meters. The Nearest Neighbour Ratio (NNR) calculated was 0.843 (i.e., < 1), signifying that real temple locations are roughly 15% closer than anticipated under a wholly random distribution. This indicates a spatial clustering pattern at the province level.

To confirm the result, additional statistical analysis yielded a z-score of −3.452 and a p-value of 0.000556, suggesting that the probability of this clustering pattern arising by chance is below 0.06% ($\alpha < 0.01$). Consequently, the null hypothesis of random distribution can be rejected with substantial statistical significance. The distribution of temples is not arbitrary; it mirrors the historical, social, and geographical dynamics of the area. The clustering was most pronounced in the northern and central regions of the province, according to the curvature of the Mae Klong River. This pattern aligns with the historical establishment of riverbank towns and the river's function as a primary transportation and economic conduit, rendering the area a central hub for both religious activities and cultural tourism. These findings are depicted in Figures 3, 4, and Table 2.

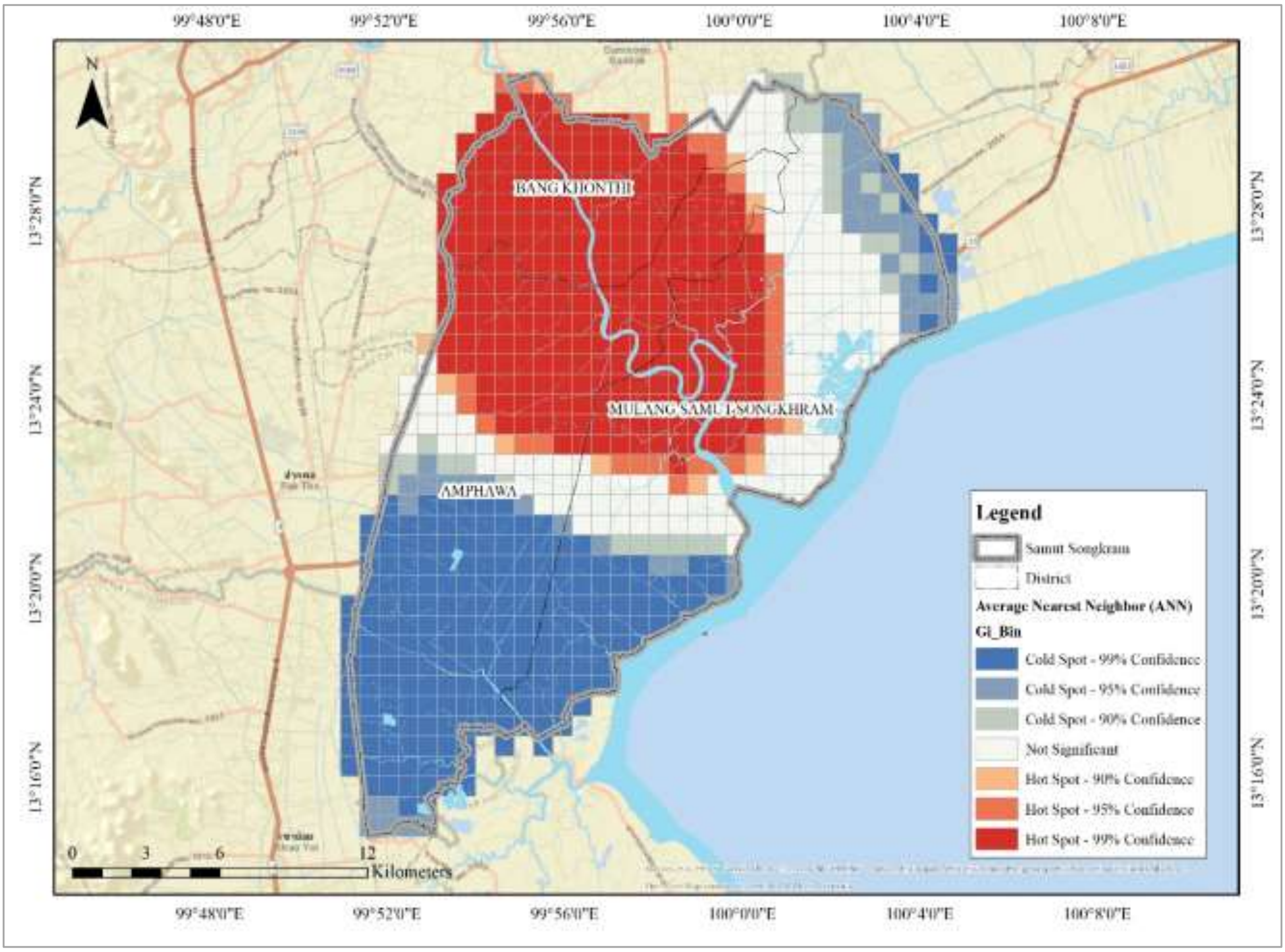


***Figure 3: Results of the Spatial Distribution Analysis.***

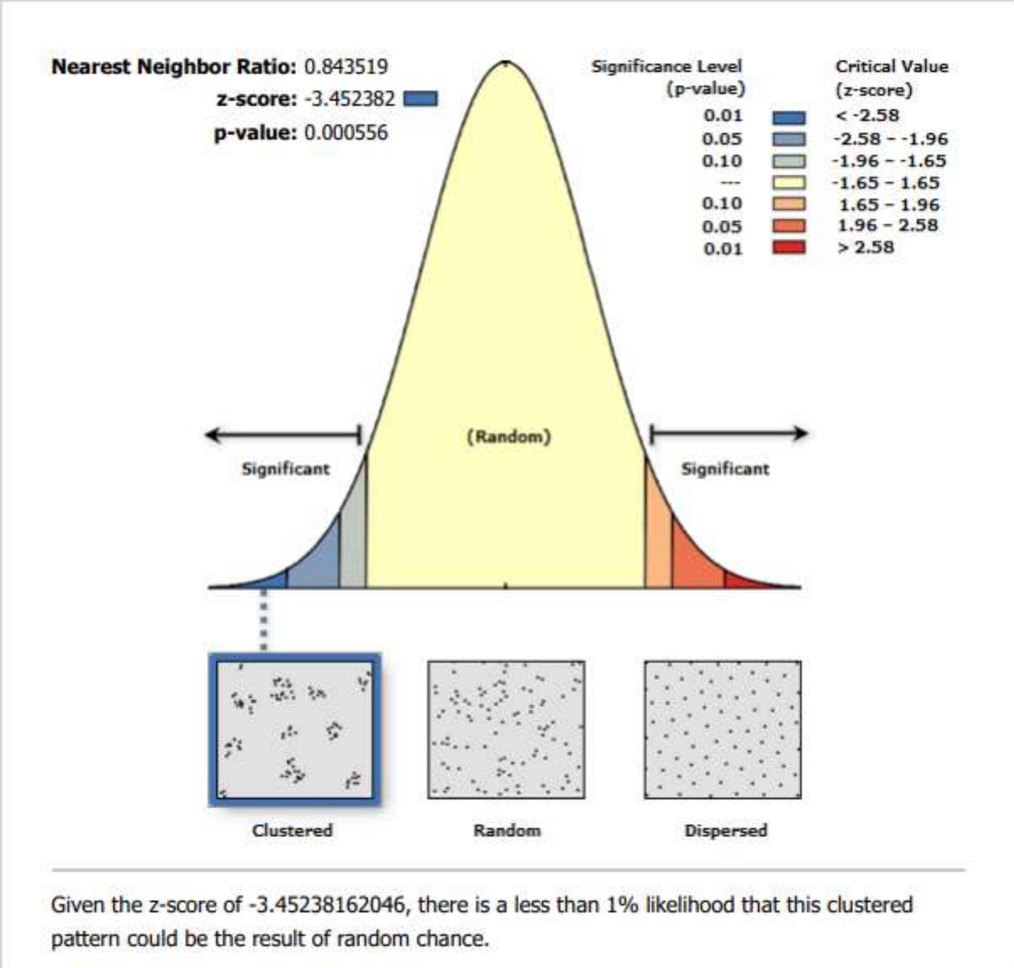


*Figure 4: Chart of the Spatial Distribution Analysis.*

*Table 2: Nearest Neighbour Index Statistics.*

| | Nearest Neighbor Ratio | Observed Mean Distance | z-score | *p*-value |
|---|---|---|---|---|
| **Nearest Neighbor Index Statistics** | 0.843519 | 784.7563 Meters | 3.452382 | 0.000556 |

Consequently, it may be inferred that the aggregation of temples aligned with the hydrological configuration of the Mae Klong River Basin, comprising the principal river and its system of subsidiary canals. This pattern was additionally influenced by ritual acts that necessitated water as a fundamental component, including water-based merit-making ceremonies. These circumstances resulted in the creation of many temples situated in close vicinity, readily accessible by both terrestrial and aquatic routes. Consequently, numerous riverfront temple clusters emerged along the canal channels, augmenting the cultural tourism significance of the region. These clusters facilitated the establishment of boating and cycling routes, which have gained popularity as tourist attractions in recent years.

### *3.2. Density Analysis of Buddhist Influenced Cultural Tourism Sites*

The Kernel Density Estimation (KDE) method was utilised on point coordinate data of Buddhist influenced cultural tourism attractions located in Samut Songkhram Province. The analysis employed a cell resolution of 100 × 100 meters and an empirically established bandwidth of 785 meters, reflecting the observed mean distance, with cross-validation utilised for precision. The outcomes were categorised into seven density intervals (spanning from 0 to 5.23 temples per square kilometre) and depicted with a graduated colour scale from white (minimum) to dark blue (maximum). KDE converts discrete point data into a continuous surface, facilitating statistically and geographically significant analysis of spatial distribution patterns. Figure 5 illustrates the distribution density of cultural tourism attractions influenced by Buddhism. The research identified a distinctly high-density zone (> 1.81 temples/km²) concentrated along the central region of the Mae Klong River and its tributaries, notably in Bang Khonthi District and the urban area of Samut Songkhram. Despite encompassing about 8% of the province's territory, these clusters housed approximately 40% of all temples, with KDE values reaching a maximum of around 5.23 temples/km². This spatial pattern underscores the significance of riverbank community hubs as enduring centres of religion, trade, and cultural tourism. Numerous temples within this cluster originate from the Ayutthaya and early Rattanakosin periods, hence enhancing their historical relevance and attractiveness as prominent cultural tourism sites. In contrast, low-density regions (< 0.48 temples/km²) were identified in the southern and lower coastal areas next to the Gulf of Thailand. These regions were predominantly utilised for agricultural activities, including coconut plantations, salt production, and mangrove ecosystems. The limited occurrence of religious sites in these areas was associated with less population density and an economy focused on production rather than services. These spatial voids signify potential zones for the establishment of supplementary tourist attractions, which could alleviate environmental and infrastructural strain from densely populated clusters.

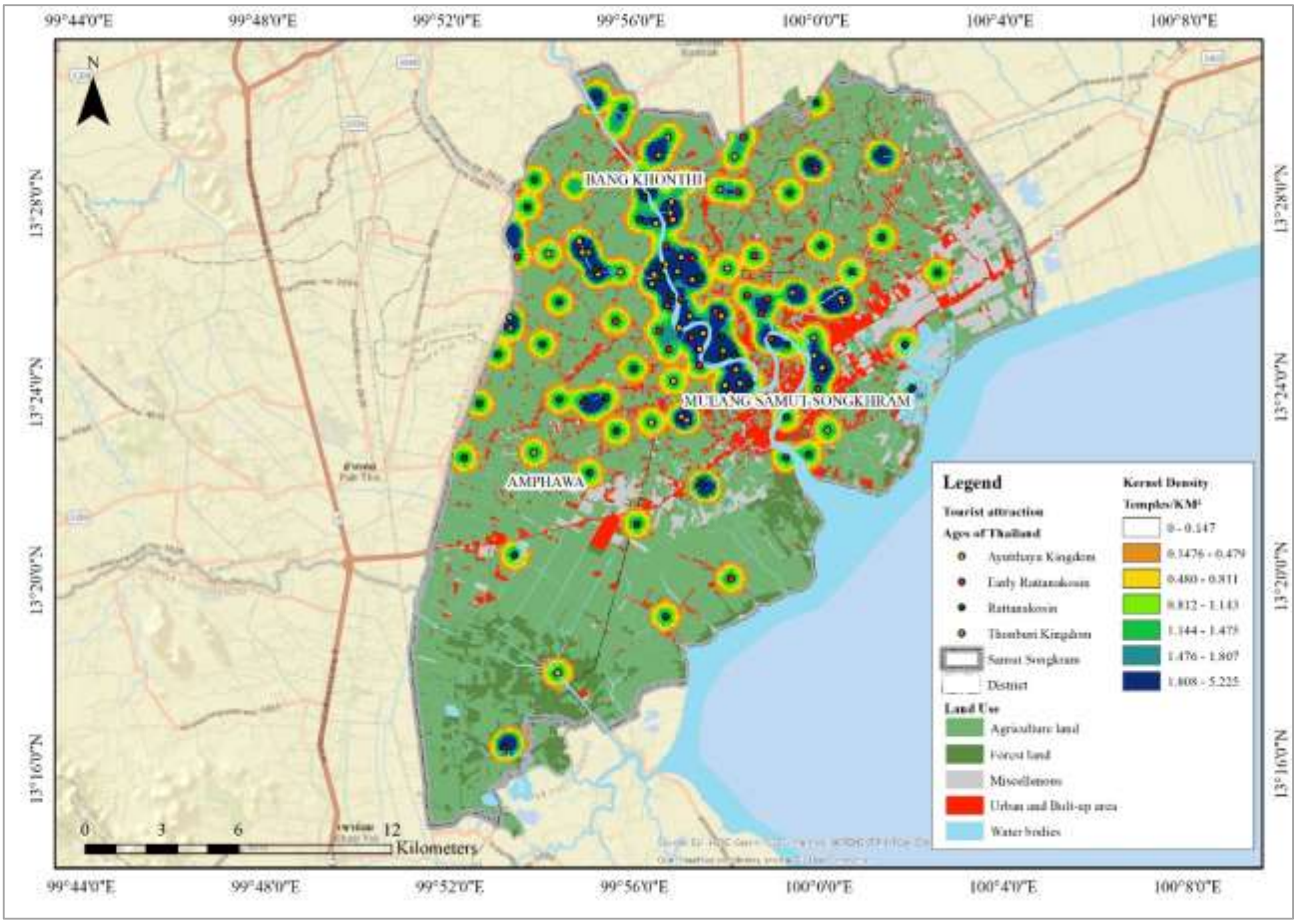


***Figure 5: Results of the Density Analysis.***

The identified clustering pattern can be elucidated by the interaction of cultural geography, hydrological systems, and conventional transportation methods. Settlement theory posits that religious institutions and residential areas are typically situated in proximity to transportation routes. The historical relationship in Samut Songkhram was influenced by the province's dependence on rivers for transportation. Temples frequently employed proximate water sources to enhance religious ceremonies, improve accessibility, and promote economic endeavours. Samut

Songkhram's riverside regions along the Mae Klong River, with a historical lineage of temple establishment from the Ayutthaya period to the early Rattanakosin era, have progressively transformed into a Buddhist cultural landscape, marked by lasting features of religious art, architecture, traditions, and lifestyles that endure to this day.

## 4. DISCUSSION

This research identified a clustering pattern of Buddhist-influenced cultural tourism sites in Samut Songkhram Province along the Mae Klong River and its tributaries, which have historically functioned as vital transportation routes and have long facilitated community life and Buddhist practices (Ploymong et al. 2023). The concentration of tourism attractions was significantly elevated in the Mae Klong River corridor, which, despite comprising merely 8% of the provincial area, housed almost 40% of all temples. This discovery aligns with the historical function of waterways as vital conduits for economic endeavours and Buddhist ceremonial activities. The existence of temples adjacent to canals enabled water-based merit-making practices, such as boat almsgiving, Loy Krathong celebrations, and Buddha bathing procedures, leading to a cluster of religious structures along the riverfront. This geographical grouping exacerbates the phenomenon of 'overtourism' in some riverfront temple clusters, notably near Wat Bang Kung, Wat Phet Samut Worawihan, and the Amphawa Floating Market. To enhance equitable economic distribution in Samut Songkhram, a spatial redistribution approach may be implemented (Du et al. 2024), which includes the establishment of tourism corridors or the formulation of comprehensive tourism routes throughout the province. An illustration is the establishment of "thematic routes," such as the Agro-Buddhist Route, which linked low density regions in coconut cultivation and salt production areas, thereby directing revenue into less frequented communities (Srisomyong & Meyer 2015). These initiatives correspond with the Sustainable Development Goals, specifically SDG 8 (Decent Work & Economic Growth) and SDG 11 (Sustainable Cities & Communities) (Damnet et al. 2024). Moreover, the integration of GIS and spatial statistics can generate evidence-based data to aid local authorities in pinpointing "priority areas for infrastructure investment," relying on actual spatial density rather than solely on aggregated tourist counts (Šoltésová et al. 2025). This methodology may also guide the formulation of diverse tourism models, such as low-carbon tourism within the BCG Economy Model (Sakcharoen et al. 2023; Zhang & Ali 2024), community-based and regenerative tourism anchored in riverside lifestyles (Rojas et al. 2023; Chan et al. 2024), and gastro-cultural routes that integrate "local cuisine" with "cultural storytelling" (Cheng 2023; Park et al. 2023). These methods could augment the attractiveness of novel tourism routes in Samut Songkhram and facilitate the province's sustainable tourism advancement. Zhou Y. et al. (2024) disclosed that more than 300 stupas are situated along the network of earthen embankments, moats, and canals linked to the Kaladan River (Zhou et al. 2024). This spatial arrangement exemplifies the design of a "sacred riverside city" in the Arakan Kingdom, which acted as a model for riverside temple complexes in Myanmar. Moonkham et al. (2023) analysed the spatial distribution of over 70 ancient temples along the Mekong River, revealing a pattern characterised as "overall dispersion with linear agglomerations," corresponding to river sandbars and moated areas. Their research emphasises how linear spatial distribution bolstered historical water-based pilgrimage networks throughout the Lanna period (Moonkham et al. 2023). The two studies highlight the extensive network of riverfront temples throughout mainland Southeast Asia. Nonetheless, riverfront tourism is significantly affected by the lunar calendar, especially with tidal events. Chang et al. (2023) assert that festival related "hotspot" maps fluctuate in relation to lunar occurrences, including temple fairs and winter ice festivities. Consequently, tourism data is often temporally concentrated during brief intervals of 8–12 weeks (Chang et al. 2023). To alleviate temporal bias, it is advisable to utilise multi-year, time-series data for enhanced spatial-temporal analysis.

## 5. CONCLUSION

Geographic Information Systems (GIS) and spatial statistics have demonstrated efficacy in evaluating the distribution and density of Buddhist influenced cultural tourism sites in Samut Songkhram Province. This research employed geographical data from 140 temples and religious locations throughout an expanse of 413.8 square kilometres. The Average Nearest Neighbour analysis (NNR = 0.8435; $z = -3.4524$; $p < 0.01$) validated a statistically significant clustered distribution pattern of sites. Furthermore, Kernel Density Estimation (KDE), employing a bandwidth of 785 meters, identified high-density clusters localised along the Mae Klong River and its tributaries. Despite constituting about 8% of the entire provincial area, these clusters had nearly 40% of all temples, with maximum densities attaining 5.23 temples per square kilometre. These findings underscore the historical importance of waterways in influencing settlement patterns and their lasting association with Buddhist ritual practices. Nonetheless, the study is constrained by specific restrictions. While the location data were aggregated from many sources and validated by field surveys, information on tourist activities was gathered solely during the peak tourism season. This restricted timeframe may not accurately represent annual dynamics. Seasonal Buddhist rites, such as Songkran or the End of Buddhist Lent, may affect spatial patterns and result in variations in visitor distribution. Future research ought to adopt a spatio-temporal methodology to observe monthly variations in tourist numbers and trends. A data collection duration of 3 to 5 years is advised to capture long term trends and provide statistically significant comparisons, therefore yielding profound insights into the changing dynamics of cultural tourism in the region. Furthermore, it is advisable to incorporate participatory workshops utilising Geographic Information Systems (Participatory GIS) in collaboration with local tourism authorities. This methodology would augment quantitative data with contextual and locational insights, hence increasing the relevance and utility of the study outcomes for evidence based destination management.

**Acknowledgements:** We thank the anonymous reviewers for their constructive comments. This work was partially supported by the Fundamental Fund 2025 "Analysis of cultural tourism density under the influence of Buddhism in Samut Songkhram Province using geoinformatics technology" funded by the Thailand Science Research and Innovation (TSRI) within. Finally, we extend our gratitude to the Geography and GeoInformatics Program, Faculty of Humanities and Social Sciences, The Institute of Research and Development, and Suan Sunandha Rajabhat University for their unwavering support and the facilities that greatly facilitated the execution of this research.

## REFERENCES

Chan, J. K., Tay, K. X., & Phang, I. G. (2024). Exploring local community perspectives on the development of river tourism along the Petagas-Putatan River in Sabah, Malaysia. Heliyon, 10(14), e34313. https://doi.org/10.1016/j.heliyon.2024.e34313

Chang, B., Ding, X., Xi, J., Zhang, R., & Lv, X. (2023). Spatial-Temporal Distribution Pattern and Tourism Utilization Potential of Intangible Cultural Heritage Resources in the Yellow River Basin. Sustainability, 15(3), 2611. https://doi.org/10.3390/su15032611

Cheng, D. (2023). Exploring the cultural anthropology of gastronomic tourism: Supply-side stakeholders' perspectives and experiences of Suzhou-style cakes. International Journal of Gastronomy and Food Science, 34, 100819. https://doi.org/10.1016/j.ijgfs.2023.100819

Damnet, A., Sangnak, D., & Poo-Udom, A. (2024). Thailand's innovative agritourism in the post COVID-19 new normal: A new paradigm to achieve sustainable development goals. Research in Globalization, 8, 100171. https://doi.org/10.1016/j.resglo.2023.100171

Deng, Y., Hou, M., Zhao, B., Yang, S., Fan, H., & Xie, Y. (2025). New tourism route planning for the Anyue grottoes in Sichuan, China: Fusion of personalization and data analysis. International Journal of Applied Earth Observation and Geoinformation, 140, 104603. https://doi.org/10.1016/j.jag.2025.104603

Du, J., Zhao, B., & Feng, Y. (2024). Spatial distribution and influencing factors of rural tourism: A case study of Henan Province. Heliyon, 10(7), e29039. https://doi.org/10.1016/j.heliyon.2024.e29039

Iqbal, M., Li, R., & Xu, J. (2024). Behavior Analysis of Photo-Taking Tourists at Attraction-Level Using Deep Learning and Latent Dirichlet Allocation in Conjunction With Kernel Density Estimation. IEEE Access, 12, 92945 - 92959. https://doi.org/10.1109/ACCESS.2024.3395469

Jiang, Y., Huang, W., Xiong, X., Shu, B., Yang, J., Li, M., & Cui, X. (2024). Investigating spatial patterns and determinants of tourist attractions utilizing POI data: A case study of Hubei Province, China. Heliyon, 10(11), e32370. https://doi.org/0.1016/j.heliyon.2024.e32370

Kulakov, K. Y., Uvarova, S. S., Orlov, A. K., Kankhva, V. S., & Sudakova, A. A. (2024). Determining the Level of and Potential for the Development of Tourism Clusters, Taking into Account Infrastructure and Urban Planning Factors. Sustainability, 16(19), 8660. https://doi.org/10.3390/su16198660

Kun, X., Ullah, W., Dejun, L., & Ziyun, W. (2025). Exploring the spatial patterns and influencing factors of rural tourism development in Hainan Province of China. Scientific reports, 15, 1602. https://doi.org/10.1038/s41598-025-86146-0

Law, C. C. (2025). Exploring the relationship between air travel demand and tourism in Thailand: An ARDL approach. Transport Economics and Management, 3, 183-191. https://doi.org/10.1016/j.team.2025.03.003

Liang, W., Ahmad, Y., & Mohidin, H.B. (2023). Spatial pattern and influencing factors of tourism based on POI data in Chengdu, China. Environment, Development and Sustainability, 26, 10127–10143. https://doi.org/10.1007/s10668-023-03138-8

Liu, Z., Wang, A., Weber, K., Chan, E. H., & Shi, W. (2022). Categorisation of cultural tourism attractions by tourist preference using location-based social network data: The case of Central, Hong Kong. Tourism Management, 90, 104488. https://doi.org/10.1016/j.tourman.2022.104488

Mallick, A., Ibantiq, A.A., Kahla, N.B., Alqadhi, S., Singh,V.P., Hoa, P.V., Hang, H.T., Hong, N.V., & Le, H.A. (2022). GIS-Based Decision Support System for Safe and Sustainable Building Construction Site in a Mountainous Region. Sustainability, 14(2), 888. https://doi.org/10.3390/su14020888

Moonkham, P., Srinurak, N., & Duff, A.I. (2023). The heterarchical life and spatial analyses of the historical Buddhist temples in the Chiang Saen Basin, Northern Thailand. Journal of Anthropological Archaeology, 70, 101506. https://doi.org/10.1016/j.jaa.2023.101506

Nitivattananon, V., & Srinonil, S. (2019). Enhancing coastal areas governance for sustainable tourism in the context of urbanization and climate change in eastern Thailand. Advances in Climate Change Research, 10(1), 47-58. https://doi.org/10.1016/j.accre.2019.03.003

Park, E., Muangasame, K., & Kim, S. (2023). 'We and our stories': constructing food experiences in a UNESCO gastronomy city. Tourism Geographies, 25(2), 572-593. https://doi.org/10.1080/14616688.2021.1943701

Pleerux , N., & Nardkulpat, A. (2023). Sentiment analysis of restaurant customer satisfaction during COVID-19 pandemic in Pattaya, Thailand. Heliyon, 9(11), e22193. https://doi.org/10.1016/j.heliyon.2023.e22193

Ploymong, T., Amatyaku, P., Pidokrajt, N., & Keawbucha, M. (2023). Music Icons, Allegories and Symbolic Representation: Iconological Analysis of Thai Murals Along the Mae Klong Riverside. Manusya: Journal of Humanities, 26(1), 1 - 22. https://doi.org/10.1163/26659077-26010013

Ponjan, P., & Thirawat , N. (2016). Impacts of Thailand's tourism tax cut: A CGE analysis. Annals of Tourism Research, 61, 45-62. https://doi.org/10.1016/j.annals.2016.07.015

Qi, L., Dong, J., & Yu, R. (2025).Analysis of Spatial Layout Influencing Factors in National Forest Tourism Villages: A Case Study of Liaoning Province. Land, 14(4), 857. https://doi.org/10.3390/land14040857

Rojas, C. S., Hernández, M. M., & León, C. J. (2023). Sustainability in whale-watching: A literature review and future research directions based on regenerative tourism. Tourism Management Perspectives, 47, 101120. https://doi.org/10.1016/j.tmp.2023.101120

Sakcharoen, T., Niyommaneerat, W., Faiyue, B., & Silalertruksa, T. (2023). Low-carbon municipal solid waste management using bio-based solutions and community participation: The case study of cultural tourism destination in Nan, Thailand. Heliyon, 9(11), e22025. https://doi.org/10.1016/j.heliyon.2023.e22025

Sangkaew, N., Nanthaamornphong , A., & Phucharoen, C. (2025). Wealth and tourism in Thailand: A spatial analysis using google maps. Social Sciences & Humanities Open, 11, 101388. https://doi.org/10.1016/j.ssaho.2025.101388

Shinde, K. (2025). Regional Diversity of Buddhist Heritage Tourism in South Asia and Southeast Asia. Heritage, 8(4), 121. https://doi.org/10.3390/heritage8040121

Šoltésová, M., Iannaccone, B., Štrba, Ľ., & Sidor, C. (2025). Application of GIS Technologies in Tourism Planning and Sustainable Development: A Case Study of Gelnica. ISPRS International Journal of Geo-Information, 14(3), 120. https://doi.org/10.3390/ijgi14030120

Song, S., Wang, H., & Meng, Y. (2023). Study on spatial pattern of tourism landscape resources in county cities of Yangtze River Economic Belt. Open Geosciences, 15, 20220569. https://doi.org/10.1515/geo-2022-0569

Srisomyong, N., & Meyer, D. (2015). Political economy of agritourism initiatives in Thailand. Journal of Rural Studies, 41, 95-108. https://doi.org/10.1016/j.jrurstud.2015.07.007

Strippoli, R., Gallucci, T., & Ingrao, C. (2024). Circular economy and sustainable development in the tourism sector – An overview of the truly-effective strategies and related benefits. Heliyon, 10(17), e36801. https://doi.org/10.1016/j.heliyon.2024.e36801

Szromek, A. R., Kruczek, Z., & Walas, B. (2023). Stakeholders' attitudes towards tools for sustainable tourism in historical cities. Tourism Recreation Research, 48(3), 419-431. https://doi.org/10.1080/02508281.2021.1931774

The Government Public Relations Department, Thailand. (2023, 07 12). Soft Power (5F) of Thailand attracts tourists. Retrieved from SAWASDEE THAILAND: https://thailand.go.th/issue-focus-

detail/001_02_070
Wang, W., Cai, Y., Xiong, X., & Xu, G. (2025). Evaluating Accessibility and Equity of Multi-Level Urban Public Sports Facilities at the Residential Neighborhood Scale. Buildings, 15(10), 1640. https://doi.org/10.3390/buildings15101640
Wong, C. U., McIntosh, A., & Ryan, C. (2013). Buddhism and tourism. Perceptions of the Monastic Community at PU-TUO-SHAN, China. Annals of Tourism Research, 40, 213-234. https://doi.org/10.1016/j.annals.2012.09.004
Worachairungreung, M., Kulpanich, N., Thanakunwutthirot, K., & Hemwan, P. (2024). Monitoring Agricultural Land Loss by Analyzing Changes in Land Use and Land Cover. Emerging Science Journal, 8(2), 2250. https://doi.org/10.28991/ESJ-2024-08-02-020
Zhang, Q., Lu, L., Huang, J., & Zhang, X. (2022). Uneven development and tourism gentrification in the metropolitan fringe: A case study of Wuzhen Xizha in Zhejiang Province, China. Cities, 121, 103476. https://doi.org/10.1016/j.cities.2021.103476
Zhang, Y., & Ali, Q. (2024). Socio-economic determinants of sustainable tourism and their nexus with energy, environment, and economy (3ES): A panel data analysis. Energy Strategy Reviews, 56, 101577. https://doi.org/10.1016/j.esr.2024.101577
Zhao, H., Zheng, J., Ma, S., Zhao, L., Xu, P., & Li, J. (2023). Spatial distribution and influencing factors analysis of national key rural tourism villages in the Yangtze River Delta region based on geographically weighted regression. PLoS ONE, 18(11), e0291614. https://doi.org/10.1371/journal.pone.0291614
Zhou, Y., Jiang, H., Lu, T., & Shen, X. (2024). Formation of a Sacred Urban Landscape: Study on the Spatial Distribution of Pagodas in Mrauk-U, Myanmar. Religions, 15(6), 719. https://doi.org/10.3390/rel15060719
Zikirya, B., Xing, Y., & Zhou, C. (2024). The Matching Relationship Between the Distribution Characteristics of High-Grade Tourist Attractions and Spatial Vitality in Xinjiang. Sustainability, 16(21), 9426. https://doi.org/10.3390/su16219426