Landscape change trends and their impacts on coastal tourism resources in the future: a case study from Pak Phanang, Thailand

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Received: 16 November 2021 / Revised: 26 May 2022 / Accepted: 20 November 2022 / Published online: 26 November 2022
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Abstract
This study aims to investigate the impacts of landscape change on natural tourism resources in coastal areas of Pak Phanang and to estimate future landscape changes. Data on tourism resources, land covers and coastline modification were collected on a random basis and combined with in-depth interviews of key informants. Data analysis seeking to demonstrate future coastline modification and projections interpreted satellite imagery using the hybrid approach to generate periodic coastal maps and the Dinamica EGO program to analyze future change rates of the coastline and landscape change. The results found that during 2021–2036, the areas of rice/vegetable farms, mudflats, beaches, and beach forests are likely to increase. The impacts on tourism resources can be negative or positive. The negative impacts arising from such changes include the decrease in the number of beaches in the southeast area and the increase in mudflats in Pak Phanang. The positive impacts include the beaches and beach forests in the northeast area increasing. These results can equip governments, communities and tourists with knowledge on the changes in landscape and tourism areas to prepare and adjust for such changes in the future.

Keywords Impact · Landscape change · Tourism resource · Natural resources · Coastal area

Introduction
Landscapes significantly affect the experiences gained during visits to tourist destination (Skowronek et al., 2018). The characteristics and qualities of the environment are important for tourism in terms of retention, returns, and decreasing the number of tourists (Caletrío, 2011). Furthermore, the environmental landscape including natural tourism resources also attracts tourists to an area (Liu et al., 2007) as tourism and landscapes have reciprocal relationships (Heslinga et al., 2017; Terkenli et al., 2021). The study conducted by Terkenli et al. (2021) indicated that the landscapes attracting visitors have considerable natural tourism resources and can be utilized as tools to promote tourism. Landscapes can help enhance natural protection and cultural heritage, both of which play a pivotal role in driving tourism (Li et al., 2021). Hence, the study of landscape change trends and their impacts on tourism resources is key to the planning and management of tourists and tourist attractions.

Landscape changes have continually occurred on an enormous scale in Pak Phanang. Kittikhun et al. (2020) illustrated changes in the utilization of land in the Pak Phanang River Basin caused by floods. As climate change has raised global sea levels, increased floods pose a growing threat to the lives of people living in coastal areas (Kim & Aoki, 2021). This particular area and the entire district usually experience the impacts of monsoons, especially from August to January. The district’s land features are characterizedly floodplains (Waewsak et al., 2014) with the unique topography of a cape called Talumphuk Cape protruding into the sea and the inner bay situated in the Pak Phanang estuary. In 1962, Talumphuk Cape was hit by the destructive typhoon Harriet, causing over 1,000 casualties (Prabnarong & Thongkao, 2006). Besides, Pak Phanang Bay and
Talumphuk Cape in Nakorn Sri Thammarat were announced as Ramsar areas in 2000 by virtue of their change and significance. Presently, Pak Phanang has celebrated its abundance of both terrestrial and marine resources and its well-recognized value as a tourist destination.

Pak Phanang’s tourism resources include natural tourism resources such as beaches, coasts, canals and seas, which are direct impacted by landscape changes in terms of size, location and shape of each type of tourism resources, such as floods (Kittikhun et al., 2020), land use change and coastal land erosion (Thepsiriamnuay & Pumijumnong, 2019). Because of the district’s distinct geographical features, great local biodiversity exists, and its importance and value contribute to local tourism. Nevertheless, Pak Phanang continuously suffers from coastal change as a result of natural and human activities such as the construction of wave protection walls, wave impacts and rising sea levels. Research conducted by Thepsiriamnuay and Pumijumnong (2019) revealed that the effects of coastal erosion (6–12 m yr-1) and deposition resulting from severe waves and rising sea levels on Nakhon Si Thammarat were 0.74–0.85 cm yr-1. Additionally, a loss of 1.36 km2 in the width of coastal areas is estimated to occur by 2100, subsequently leading to eroded tourist destination beaches to the degree of the area being covered by sea water. Moreover, the Department of Marine and Coastal Resource (2021) reported that Nakhon Si Thammarat experiences impacts from waves continuously growing in strength and that Pak Phanang is affected by the impacts of severe coastal erosion reaching 5 m annually. As indicated by the data, it is not appropriate to assert that Pak Phanang is an area facing a landscape change crisis.

Therefore, the researchers were interested in studying the impacts of landscape change on tourism resources and activities in the coastal-land boundary, as well as the map projections of potential landscape changes in Pak Phanang for the business-as-usual scenario in order to study the existing and potential impacts on tourism resources and activities. It was expected that this research would lead to guideline and suggestion for all stakeholders’ planning and proper tourism resource management.

Conceptual framework

Land cover changes resulting from both human activities and natural processes (Antrop, 1998; Baker, 1989) impact coastal natural resources and landscapes, which are substantially significant tourism resources. As the landscape has a relationship with tourism (Heslinga et al., 2017), the impacts of emerging changes have had effects from the past up to the present, and there is a likelihood of the continuance of these impacts in the future. Therefore, creating future landscape change scenarios plays an important role in estimating the impacts on tourism resources and activities (Abuharris & Ruddock, 2005; Heslinga et al., 2017) and properly attuning those changes to prospective effects (Fig. 1).

Methodology

This study used qualitative data analysis of the interviews of 12 key local informants. To facilitate the expression of the nonrestricted opinions of the informants, nonstructured interviews were employed. Nonprobability sampling, especially snowball sampling (Etikan et al., 2016), was used to suit the characteristics of the sample group including locals, community leaders and tourism communities. In the study, the community leaders and tourism communities were selected as key informants for interview because they are person in the coastal which have experience with a change in coastal areas and the change in tourism resources, consistent with these objectives. Furthermore, field observations were included to investigate the characteristics and uniqueness of natural tourism resources, changes in the area and the impacts of these changes. The geographical locations of marked areas include tourism areas and the emerging impacts. The data also featured the locations of impacted communities and photographs detailing the impacts and situations in the areas. Spatial analysis was conducted to shed light on the effects of landscape change on tourism resources and activities using the following instruments:

Surveys were designed to acquire data on the area’s topography and locate the geographical coordinates of the area’s physical features. Land cover from the past to the present (1996 to 2016) was differentiated using a hybrid approach by unsupervised classification and history data verification methods utilizing digital data from the LANDSAT satellite collected from 1996 to 2016; L7018 digital geographical maps at a 1:50,000 ratio from the Royal Thai Survey Department; the Global Positioning System (GPS) and computer programs that include ERDAS IMAGINE (a program for satellite data analysis), ArcGIS (a data analysis program for geographical information systems), DNR Garmin (a program for geographical data analysis), the Digital Shoreline Analysis System (DSAS) and Dinamica EGO (Environment for Geoprocessing Objects).

Data analysis

Qualitative analysis

Secondary data and qualitative data collected through the in-depth interviews and the data from the field observations were analyzed, synthesized and summarized in descriptive
form to demonstrate the landscape changes and their impacts on both the resources and local communities.

**Analysis of the data on coastal change and future scenarios**

1) **Preliminary Preparation of Satellite Imagery Data**

Satellite data specifically on cloudless days over each season were collected, and geometric correction was performed using tie points from the L7018 geographical map at a 1:50,000 ratio. This was followed by the false color composite process that converts the brightness of the data in each band of the LANDSET satellite into images through red, green and blue light (RGB).

2) **The making of the coastal map for each period**

The infrared wavelength and band ratio between band 2 and band 5 are utilized. Any areas with a value higher than 1 were specified as water and areas with a value lower than 1 were specified as other land covers. In the event that some of the land covers were plants falling into the band ratio between band 2 and band 5, causing an inability to clearly distinguish water, the researcher used a band ratio between 2 and 4 to determine the coastline.
To produce a map projecting future coastline changes, the ArcGIS 9.3 information system tool was employed to manage the data before proceeding to the analysis using the landscape simulation model in Dinamica EGO (Environment for Geo-processing Objects) version 2. This program is a landscape dynamic analysis program that has been broadly applied to different other aspects of area dynamic analysis (Britaldo et al., 2013; Cheng et al., 2020; Soares-Filho et al., 2009). Data collected through surveys and interviews, other parts of the data and the analyzed data were input to the model to project the scenario of perspective landscape change forms, as shown in Fig. 2.

The results from the aforementioned data analysis were processed to analyze the spatial effects together with

![Diagram of landscape analysis process]

**Fig. 2** Creating Landscape Change Scenarios and Analyzing the Impacts on Tourism Resources

- **Analysis of the Coastline Change Rate**
  Periodic data on the coastline were processed to analyze the change rates of the coastline occurring over different periods of time compared with the baseline. Two methods for rate change calculations were included, namely, the end-point rate and the linear regression. The Digital Shoreline Analysis System (DSAS), which is an extension of the ArcGIS program developed by the United States Geological Survey (USGS), was employed. This extension consists of three major components including baselines, perpendicular lines and different calculated values. For the calculation part, end-point rates were calculated based on a ratio of the coastline change rate at the beginning and ending times, followed by a linear regression as it is a statistical approach for describing coastline changes and evaluating change rates. The change rate from DSAS was then used in the future coastal line projection.

3) **Analysis of Future Landscape Changes**

![Diagram of landscape analysis process]
Results and discussion

Types and characteristics of tourism resources

Parts of Pak Phanang are connected to the sea and have a long history (Panapitukkul et al., 1998). Communities’ ways of life are intertwined with the surrounding resources, and residents earn livings through a variety of occupations. The area’s tourism resources comply with natural resources and local traditions. Overall, the district’s tourism resources can be categorized into three types including the following: 1) natural tourist destinations, namely, seas, beaches, mangrove forests and the Pak Phanang River; 2) cultural tourist destinations comprising ways of life and traditions representing how the locals live and agritourism; and 3) historical tourist destinations including temples and rice mills/rice mills’ chimneys.

Most tourist attractions, especially seas and coasts, are landscapes that are natural tourist attractions (Liu et al., 2007). Interviews revealed that Talumphuk Cape receives overwhelming interest to visit. In terms of the historical attraction quarter, Pak Phanang Royal Palace receives considerable interest. Pak Phanang has the Pak Phanang River flowing into the Pak Phanang Bay, resulting in fertility (Jutagate et al., 2009); therefore, agricultural practices such as rice farming and gardens also appeal to tourists’ interests. This particular type of tourism has increasingly become a trend for those attracted to learning and exploring locals’ community lives.

Landscape change as demonstrated by satellite imagery analysis

Analysis of satellite imagery for landscape change over the five years (2016–2021) suggested that a majority of Pak Phanang’s land was utilized as rice/vegetable farms, followed by mangrove forest areas and orchards, respectively (Table 1). Although many countries around the world have experienced a decline in mangrove forests (Alongi, 2002), Pak Phanang showed the opposite trend. This significantly indicates the district’s major land utilization for agricultural practices, particularly orchards. Regarding orchards, the results evidently demonstrated significant growth in the total area of orchards compared to that in the past. Analysis of the satellite imagery showed that the total area of orchards in 2016 was up 23,200.50 ha. and this number increased to 23,388.60 ha in 2021. This proves that over the past five years, Pak Phanang witnessed an increase of 188.10 ha in
and ecological systems interact, particularly due to the increased populations, economic development, and interest in tourism along coastal areas (Vanclay, 2012).

Landscape changes directly impact natural tourism resources in Pak Phanang both positively and negatively (Fig. 3). The changes included beach areas, beach forests, mangrove forests, and mudflats, which impacted natural tourism resources in different ways according to the areas. The nature of this type of impact was an interaction between natural tourism resources and landscape that influenced changes. Thus, when natural tourism resources change, the landscape is affected and vice versa (Chen et al., 2021; Heslinga et al., 2017).

Landscape changes in the area of Pak Phanang have been proven to generate both positive and negative impacts on tourism resources. Beach losses can have many causes including storms (de Santiago et al., 2017; Schambach et al., 2018). The coastal erosion problem found in different Pak Phanang subdistricts including Khanap Nak, Tha Phaya, Ban Phoeng, and Bang Phra was caused by increasingly more severe wave impacts eroding beaches once serving as a place for recreation for locals and tourists. Beach displacement had repercussions on restaurant and hotel entrepreneurs whose businesses were located in eroded areas.

Interviews and in-depth discussions with the locals in Tha Phaya subdistrict revealed data concerning the displaced areas as a result of coastal erosion before 2013. The coastal erosion problem included the erosion of fine sand beaches, coarse sand beaches, coconut orchards, residential areas, shrimp farms and Highway No. 4013, which altogether made the average distance from the sea to residential areas 60–80 meters. Currently, these particular coastal areas have been completely transformed into water.

Fig. 3 Relationship of the Impacts between Landscape Change and Natural Tourism Resources

Impacts of landscape changes on natural tourism resources in coastal areas

Tourism management should explore the relationships between preserving nature and creating economic and social benefits (Heslinga et al., 2017). Landscape changes may arise from 2 major activities (Host et al., 2005). The first factor is natural processes including continuous erosion and sedimentation along coastal areas resulting from the wind and currents from the Gulf of Thailand (Prabnarong & Thongkao, 2005). The second factor is human activities such as the construction of breakwaters and other types of construction protruding into the sea. These factors contributed to the changes in the areas and their vicinities.
Simulation of future landscape change in 2036 and its likely impact on tourism resources

Studies concerning landscape change in terms of both time and area have continuously increased (Krajewski et al., 2018). The study’s analysis of future landscape changes revealed that Pak Phanang’s total orchard area is expected to decrease by 4,462.80 ha from 2021 to 2036. A similar trend is predicted for the community area, which is expected to decrease by 502.50 ha. However, growth is expected in the areas of rice farms/vegetable farms, beaches, beach forests, mudflats and others.

As the results show, in 2036, Pak Phanang’s orchard and community areas will decrease, both of which will have demonstrated a decreasing trend since 2021. However, in 2036, the areas of rice/vegetable farms and mudflats are expected to increase by 4,563 ha and 461.70 ha, resulting from the water and sea areas providing sedimentary deposits to aid of mudflat formation. Prabnarong and Thongkao (2005) reported that during 1995–1999, before the Uthokawaiphatprasit Watergate was constructed, the coastal area increased to 1.89 km². However, after the watergate was built, during 1999–2003, the coastal area increased by 0.19 km². Therefore, the results show that Pak Phanang’s landscape has continuously undergone changes and has more coastal area. This pattern of change can be clearly observed at the tip of Talumphuk Cape facing shoal problems as a result of sedimentary deposits and growing mudflats. There is a possibility that the cape’s tip may transform into mudflats and mangrove forests, potentially posing a path blockage problem for both fishing boats and passenger boats.

The data apparently suggest that the emerging beach forests would be situated along the coast, particularly on the east side of the cape. However, the expanding beach forest area will positively contribute to tourist resources. The crucial coastal tourism resources of Pak Phanang are beaches, beach forests and mangrove forests. It can be concluded that substantive changes in mudflats, beaches and mangrove forests have been clearly observed over the past 15 years, as displayed in Table 2 and Fig. 4.

Increase in Mudflats

In terms of tourism resources, seas possess undeniable value and potential to be a marine tourist attraction compared to mudflats, contributing relatively less to this aspect. Nonetheless, prospective landscape change has been estimated to lean toward the growth of mudflats (Fig. 5), especially at the tip of Talumphuk Cape, and a decrease in sea waters. However, Marley et al. (2020) found that mudflats were suitable for fish nurseries. Talumphuk Cape is known as an important tourist attraction appealing to tourists interested in nature and historic quarter sightseeing. In the future, Talumphuk Cape may experience landscape change in a

| Land Cover Changes in Pak Phanang from 2021–2036 | Area in 2021 | Area in 2036 | Area Change from 2021–2036 |
|-------------------------------------------------|-------------|-------------|-----------------------------|
| Farm/Vegetable Farm                             | 50,125.20   | 49,224.60   | 4,563.00                    |
| Orchards                                        | 23,211.60   | 17,689.80   | -324.00                     |
| Aquafarming                                     | 21,025.50   | 20,079.00   | -950.50                     |
| Communities                                     | 19,380.60   | 17,654.70   | -1,725.90                   |
| Beaches                                         | 395.70      | 124.20      | -271.50                     |
| Mudflats                                        | 19,791.00   | 19,772.70   | -1.30                       |
| Mangrove Forests                                | 35,029.80   | 34,612.80   | -417.00                     |
| Beach Forests                                   | 327.90      | 300.60      | -27.30                      |
| Water                                           | 100,128.90  | 98,907.00   | -1,221.90                   |
| Others                                          | 25,586.10   | 24,681.90   | -904.20                     |
| Total Area in 2036                             | 54,688.20   | 53,881.90   | -806.30                     |
| Area Change from 2021–2036                      | -1,617.70   | -1,179.00   | 451.70                      |

Table 2: Land Cover Changes in Pak Phanang from 2021–2036
which shall subsequently modify the information provided way that turns it into a mudflat and mangrove forest area,
for the tourists by tourism management. Such a phenomenon explicitly represents a change in the landscape, and past images and future change will become a story to tell. Ecosystem changes impact landscape changes, which, in turn, affect the relationships between humans and nature (Chan et al., 2016; Foley et al., 2011).

**Increase in Natural Tourist Attraction Beaches and Beach Forests Located in the North**

Beaches are important tourist attractions that can generate tourism income (King, 1999). For the beach areas of the Talumphuk subdistrict and the tip of Talumphuk Cape, the study revealed rich deposits of sand sediment and expanded and wider beaches, which then became well-visited tourist distractions (Baltranaitė et al., 2017). The survey suggested that at the restaurant area located at the intersection leading to the cape’s tip, the beach increased in size as a result of sedimentary deposits. Restaurant businesses appeared to serve more visitors as a result. Beach areas can generate incomes for communities and the country (King, 1999). Physical factors and perceived positive changes in beach quality are important in beach management (Baltranaitė et al., 2021).

It is evident that the features of beaches constantly change depending on natural factors and breakwaters. An example is the beaches in Talumphuk subdistrict. Interviews with a community leader provided information concerning continuous coastal erosion over the period between 2013 and 2014. After breakwater construction to the south between 2015 and 2016, the northern side gradually hosted more layers sedimentary deposits translating into greater beach areas. Such transformation subsequently enhanced local tourism. Moreover, the areas are also the location of the Talumphuk Cape nonhunting area, providing more tourism facilities to accommodate more tourists’ visits. Accordingly, the northeastern area will be a new suitable place for recreation in the future. In particular, nature-based landscapes for sandy beaches will be traveled by tourists during and after the COVID-19 pandemic (Moreno-Casasola et al., 2021).

**Increase in Natural Tourist Attraction Related to Communities’ Way of Life and Agriculture**

Because of Pak Phanang’s geographical features and local occupations, the district possesses abundant agricultural areas. Pak Phanang is the district in which more than half of the total area is rural conservation area and agricultural area. A wide diversity of agricultural practices are present; and some interesting types include rice farming, pomelo gardens and Nipa palms. These products can boost tourism, which is aligned with the current tourism trend leaning toward the Thai community and local life experiences. Consequently, the likelihood of tourism growth featuring ways of life, local communities and agriculture is clear.

**Tourism resource management and adaptation for tourism in the future**

In future tourism in coastal areas, especially post COVID-19, tourists will be aware of the distances from each other (Sohn et al., 2021). Moreover, Samuelsson et al. (2020) state that natural areas are convenient for distancing people. Therefore, both the landscape and tourists’ behavior in Pak Phanang will change. Tourism resource management should be managed and planned as follows.

- **Mangrove Forest Resource Management: Ecotourism.**

Local mangrove forests require natural resource conservation tourism such as ecotourism (Treephan et al., 2019), tourism centered on the ways of life and the local communities residing in the Pak Phanang River area, seas and bay, which extends to local fishery and tourism promotion groups run by the communities, to be taken.

- **Agritourism Management.**

Since agritourism requires collaboration between communities and tourism (Flanigan et al., 2014), the communities in Pak Phanang should improve their agritourism as there will be a future increase in the area for rice /vegetable farms. From the tourism perspective, agritourism can be promoted in the area, especially that involving planting rice and Tumbo Siam Pomelo, which is considerably famous among tourists. Therefore, agritourism can be an effective approach to add value to the area.

- **Tourism Management in the Talumphuk Cape Area.**

The Talumphuk Cape has long been a well-recognized tourist attraction where tourists visit for natural sightseeing and learning about the area’s geographical features and mangrove forests. At present, there are some viewpoint towers for tourists to see the view and tip of the Talumphuk Cape. Thus, if conversion into beach forests and mudflats on a greater scale is expected in the future, resulting in altered authentic beauty of the cape’s tip and the areas being connected to form one entire piece of land, local tourism management needs to be adjusted accordingly perhaps by providing natural sightseeing and mangrove forest sightseeing and initiating local nature trails.

- **Adjustment of the Local Communities: Local Tourism, Culture and Ways of Life.**

As a result of the area’s landscape change in which Pak Phanang’s estuary will be narrower and full of mudflats and
the increase in beach forest areas, the locals’ way of life may also need to be adjusted accordingly. For instance, fishing boats must be made smaller, and their entries must be adjusted in compliance with landscape changes. Moreover, for fisheries, there may be changes in the number of types of marine animals caught compared to the previous situations.

Conclusion

Landscape change in Pak Phanang has been an ongoing phenomenon. Analysis of the data collected from 2016–2021 showed that the main change was an enormous decrease in rice/vegetable farms and aquafarming areas due to the occupation change of rice/vegetable farms, beach areas and beach forest areas, which are tourism resources, have continued to increase. In 2021, the estimated scenarios in 2036 demonstrate an enormous scale of landscape change, which entails the growth of rice/vegetable farms, mudflat areas, beach forest areas and the beaches located to the north. Therefore, future plans for natural tourism resource management are required to properly consider the tourism resource management, sustainable utilization and the adjustment of the local communities in terms of ways of life. Additionally, tourism highlighting ecotourism and tourism based on communities and local ways of life should be promoted, and the practices of local fishery also need to be rethought in response to the narrower estuary in mangrove forests, beach forest areas and mudflats.

Acknowledgements I would like to thank those responsible for giving me the opportunity to develop academic research in the field, and I would also like to thank the communities in Pak Phanang for participating in the meeting and sharing their information until this research was successfully completed.

Funding This study is sponsored by The Thailand Research Fund (TRF) under contract no. TRF_ABC5904.

Declarations

Conflict of interest The authors declare no conflicts of interest.

References

Abuharris MAT, Ruddock L (2005) Land-use planning and sustainable tourism development in Libya. June 13th to the 15th of 2008 Athens, Greece; 97, 25–55
Alongi DM (2002) Present state and future of the world’s mangrove forests. Environ Conserv 331–349. doi: https://doi.org/10.1017/S0376892902000231
Antrop M (1998) Landscape change: plan or chaos? Landsc urban Plann 41(3–4):155–161. doi: https://doi.org/10.1016/S0169-2046(98)00068-1
Baker WL (1989) A review of models of landscape change. Landscape Ecol 2(2):111–133
Baltranaitė E, Jurkus E, Povilanskas R (2017) Impact of physical geographical factors on sustainable planning of South Baltic seaside resorts. Baltica, 30(2)
Baltranaitė E, Kelpšaitė-Rimkiene L, Povilanskas R, Šakurova I, Kondrat V (2021) Measuring the impact of physical geographical factors on the Use of Coastal Zones based on bayesian networks. Sustainability 13(13):7173. doi: https://doi.org/10.3390/su13137173
Britaldo S-F, Herrmann R, Marco F (2013) A hybrid analytical-heuristic method for calibrating land-use change models. Environ Model Softw 43:80–87. doi: https://doi.org/10.1016/j.envsoft.2013.01.010
Caletiro J (2011) Tourism, landscape change and critical thresholds. Annals of Tourism Research 38(1):313–316. doi: https://doi.org/10.1016/j.anntals.2010.07.009
Chan KMA, Balvanera P, Benessiaah K, Chapman M, Díaz S, Gómez-Baggethun E, Klain S (2016) Opinion: Why protect nature? Rethinking values and the environment. Proceedings of the national academy of sciences, 113(6), 1462–1465. doi: https://doi.org/10.1073/pnas.1525002113
Chen P, Zhao Y, Zuo D, Kong X (2021) Tourism, Water Pollution, and Waterway Landscape Changes in a Traditional Village in the Huizhou Region, China. Land 10(6):795. doi: https://doi.org/10.3390/land10060795
Cheng L-l, Liu M, Zhan J-q (2020) Land use scenario simulation of mountainous districts based on Dinamica EGO model. J Mt Sci 17(2):289–303. doi: https://doi.org/10.1007/s11629-019-5491-y
de Santiago I, Morichon D, Abadie S, Reniers AJHM, Liria P (2017) A comparative study of models to predict storm impact on beaches. Nat Hazards 87(2):843–865. doi: https://doi.org/10.1007/s11069-017-2830-6
Department of Marine and Coastal Resource (2021) The situation of coastal erosion. Retrieved from https://www.dmcr.go.th/detailLib/3553
Etkinan I, Alkassim R, Abubakar S (2016) Comparison of snowball sampling and sequential sampling technique. Biometrics and Bio-statistics International Journal 3(1):55
Flanigan S, Blackstock K, Hunter C (2014) Agritourism from the perspective of providers and visitors: a typology-based study. Tour Manag 40:394–405. doi: https://doi.org/10.1016/j.tourman.2013.07.004
Foley JA, Ramankutty N, Brauman KA, Cassidy ES, Gerber JS, Johnston M, West PC (2011) Solutions for a cultivated planet. Nature 478(7369):337–342. doi: https://doi.org/10.1038/nature10452
Heslinga JH, Groote P, Vancly F (2017) Using a social-ecological systems perspective to understand tourism and landscape interactions in coastal areas. J Tourism Futures. doi: https://doi.org/10.1108/JTF-10-2015-0047
Host GE, Schultj C, Ciborowski JJH, Johnson LB, Hollenhorst T, Richards C (2005) Use of GIS and remotely sensed data for a priori identification of reference areas for great lakes coastal ecosystems. Int J Remote Sens 26(23):5325–5342. doi: https://doi.org/10.1080/01431160500219364
Jutagate T, Sawusdee A, Chaidee TT, Thongkhoo S, Chotipuntu P (2009) Fish in the pak Panang Bay and River in relation to the anti-salt dam operation, part I: assemblage patterns of the marine and brackish water fish. Agric Nat Resour 43(5):120–131
Kim HD, Aoki S-i (2021) Artificial Intelligence Application on Sediment Transport. J Mar Sci Eng 9(6):600. doi: https://doi.org/10.3390/jmsec9060600

Springer
King P (1999) The fiscal impact of beaches in California. Public Research Institute, San Francisco State University

Kittikun C, Pilailar S, Chittaladakorn S, Jhompadit E (2020) Flood Risk Index for Land-Use Changes: Case Study of Pakpanang River Basin. Eng J 24(5):25–40. doi:https://doi.org/10.4186/ej.2020.24.5.25

Krajewski P, Solec–ka I, Mrozik K (2018) Forest landscape change and preliminary study on its driving forces in Ślęża Landscape Park (Southwestern Poland) in 1883–2013. Sustainability 10(12):4526. doi:https://doi.org/10.3390/su10124526

Li W, Zhou Y, Zhang Z (2021) Strategies of Landscape Planning in Peri-Urban Rural Tourism: a comparison between two villages in China. Land 10(3):277. doi: https://doi.org/10.3390/land10030277

Liu J, Dietz T, Carpenter SR, Alberti M, Moran E, Lubchenco J (2007) Complexity of coupled human and natural systems. Science 317(5844):1513–1516. doi:https://doi.org/10.1126/science.1144004

Marley GSA, Deacon AE, Phillip DAT, Lawrence AJ (2020) Mangrove or mudflat: prioritising fish habitat for conservation in a turbid tropical estuary. Estuar Coast Shelf Sci 240:106788

Moreno-Casasola P, Martinez ML, Lithgow D (2021) New Beach Landscapes to promote Social Distancing and Coastal Conservation during and after the COVID-19 pandemic. Sustainability 13(11):6268. doi:https://doi.org/10.3390/su13116268

Panapitukkul N, Duarte CM, Thampanya U, Kheowwongsi P, Srichai N, Geertz–Hansen O, Boromthanarak S (1998) Mangrove colonization: mangrove progression over the growing pak Phanang (SE Thailand) mud flat. Estuar Coast Shelf Sci 47(1):51–61. doi:https://doi.org/10.1006/ecss.1998.0343

Prabnarong P, Thongkao S (2005) The inner area change detection in pak Panang Bay before and after the operation of the Uthokawiphatprasit Watergate using aerial photographs and Geographic Information System. Walailak J Sci Technol (WJST) 2(2):127–134

Prabnarong P, Thongkao S (2006) Land use changes in pak Panang Bay using aerial photographs and geographic information system. Walailak J Sci Technol (WJST) 3(1):93–104

Samuelsson K, Barthel S, Colding J, Macassa G, Giusti M (2020) Urban nature as a source of resilience during social distancing amidst the coronavirus pandemic. https://doi.org/10.31219/osf.io/3wx5a

Schambach L, Grilli AR, Grilli ST, Hashemi MR, King JW (2018) Assessing the impact of extreme storms on barrier beaches along the Atlantic coastline: application to the southern Rhode Island coast. Coast Eng 133:26–42. doi:https://doi.org/10.1016/j.coastaleng.2017.12.004

Skowronek E, Tucki A, Huijbens E, Jóźwik M (2018) What is the tourist landscape? Aspects and features of the concept. Acta Geogr Slov 58(2):73–85. doi: https://doi.org/10.3986/AGS.3311

Soares-Filho BS, Rodrigues HO, Costa W (2009) Modeling environmental dynamics with Dinamica EGO. Modeling environmental dynamics with Dinamica EGO. Centro de Sensoriamento Remoto

Sohn J-I, Alakshendra A, Kim H-J, Kim K-H, Kim H-D (2021) Understanding the new characteristics and development strategies of Coastal Tourism for Post-COVID-19: a Case Study in Korea. Sustainability 13(13):7408. doi: https://doi.org/10.3390/su13137408

Terkenli TS, Skowronek E, Georgoula V (2021) Landscape and Tourism: European Expert views on an intricate relationship. Land 10(3):327. doi: https://doi.org/10.3390/land10030327

Thepsiriamnuay H, Pumijumnong N (2019) Climate Change Impact on Sandy Beach Erosion in Thailand. Chiang Mai Journal of Science 46(5):960–974

Treephan P, Visuthismajarn P, Isaramalai S-A (2019) A model of participatory community-based ecotourism and mangrove forest conservation in Ban Hua Thang, Thailand. Afr J Hosp Tour Leis 8:1–8

Vanclay F (2012) The potential application of social impact assessment in integrated coastal zone management. Ocean & coastal management 68:149–156. doi: https://doi.org/10.1016/j.ocecoaman.2012.05.016

Waewsak J, Chaichana T, Chancham C, Landry M, Gagnonc Y (2014) Micro-siting wind resource assessment and near Shore wind farm analysis in Pakpanang district, Nakhon Si Thammarat province, Thailand. Energy Procedia 52:204–215. doi:https://doi.org/10.1016/j.egypro.2014.07.071

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