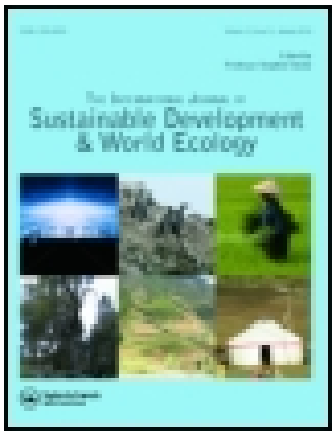

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Geographical analysis of tourism sites in Andaman Archipelago (India) and ecotourism development for Smith Island of North Andaman

Sridhar Rengarajan[a], Sachithanandam Veeraragavan[a], Mageswaran Thangaraj[a] & Ramesh Ramachandran[a]

[a] Integrated Island Management Unit, National Centre for Sustainable Coastal Management, Ministry of Environment and Forests, Government of India, Anna University Campus, Chennai - 600 025, India

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Geographical analysis of tourism sites in Andaman Archipelago (India) and ecotourism development for Smith Island of North Andaman

Sridhar Rengarajan*, Sachithanandam Veeraragavan, Mageswaran Thangaraj and Ramesh Ramachandran

Integrated Island Management Unit, National Centre for Sustainable Coastal Management, Ministry of Environment and Forests, Government of India, Anna University Campus, Chennai – 600 025, India

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This paper applies the nearest-neighbour analysis to analyse the clustering of tourist attractions in Andaman region and suggests ecotourism development for Smith Island of North Andaman using remote sensing techniques. The results indicated that present tourism sites are distributed in clusters in three regions (Port Blair, Mayabunder and Diglipur). To avoid concentration of tourism sites and population pressure in one particular area, there is a need to promote tourism to other locations as well. The study provided suggestions for ecotourism development in Smith Island after analysing its various ecological features to support the Andaman Administration's vision to promote ecotourism.

Keywords: nearest-neighbour analysis; Andaman; Smith Island; ecotourism; environmental protection

Background

The Andaman & Nicobar (A&N) are a group of picturesque islands, big and small, inhabited and uninhabited, a total of 572 islands, islets and rocks lying in the south-eastern part of the Bay of Bengal. They lie along an arc in long and narrow broken chain, approximately north-south over a distance nearly 800 km. It is logical to presume a former land connection from Cape Negris at south part of Burma to Achin Head (Cape Pedro) in Andalas (Sumatra). These islands have been recognised as an eco-friendly tourist's destination with its great deal of natural beauty. Their flora and fauna are of a special type, having very high degree of biodiversity and endemism. The coral reefs of these islands are among the richest in the Indian subcontinent, which not only protects the coastline against the sea erosion but also harbours host of animal communities. These islands have the required infrastructure facilities but not at par with other states and union territories (UTs) of India due to its geographical distribution of Islands. As the Islands are one of the largest tourist spots in India, there is a tremendous need for the development of infrastructure facilities in transport like airways, seaways and roadways in order to improve the connectivity and promote this destination among tourists. The A&N Administration has the vision to develop A&N Islands as an up market island destination for ecotourists through environmentally sustainable development of infrastructure without disturbing the natural ecosystem with the objective of generating revenue, creating more employment opportunities and synergise socio-economic development of the islands (Andaman and Nicobar Islands Development Report 2008). According to 'India Tourism Statistics 2012', there has been a continuous increase in India's domestic tourist visit to its all states/UTs from 1991 to 2012, with the compound annual growth rate (CAGR) being 13.96%. Tourist visit (both domestic and foreign visitors) to A&N Islands was 86,066 in the year 2000 which has gone up to 1,46,990 in 2007, 2,18,035 in 2011 and 2,56,237 in 2012. With the continuous increase in tourist flow to Andaman and subsequent population pressure, this study made an attempt to understand the spatial distribution pattern of various tourism sites in the Andaman Archipelago through an analytical approach. The reason is that maps as the basic geographic tool can reveal the spatial distribution of attractions as well as potential tourists (Cheng & Masser 2003), and visualisation of the spatial distribution pattern can provide an intuitive inspection of the market accessibility of the attractions. The geographic locality is one of the most powerful tourist segmentation variables utilised by scholars and practitioners (Smith 1995; Kotler 1999; Hsu & Lee 2002; McKercher et al. 2005). Literature review showed that so far in A&N Islands, there has not been any study on spatial distribution of tourism sites.

In the present study, the nearest-neighbour analysis was used to understand the spatial distribution of tourism sites that are declared by A&N Administration for tourism development (Directorate of Economics and Statistics Andaman and Nicobar Administration 2013). The nearest-neighbour analysis was conceived and proposed by the ecologists Clark and Evans (1954) and was considered appropriate for a large number of points that were randomly distributed in a given space. Later Pinder and Witherick (1973, 1975) and Ebdon (1976) improved the mathematical modelling to enable an analysis that would be applicable for every form of distribution of the point-patterns in the space, even in these cases where the number of points is low. This model is stated as

*Corresponding author. Email: sridharaug@gmail.com

$$dr = [\sqrt{(a/n)}], \quad (1)$$

where dr is the theoretical average distance. The coefficient C is calculated by the relationship

$$C = 0.497 + 0.127\left[\sqrt{(a/n)}\right],$$

where a is the area of framed space of exploration and n the number of points of exploration, and

$$do = \sum (\text{of the closest distances})/n \quad (2)$$

with do being the observed average distance. From the relations (1) and (2), the nearest-neighbour ratio is estimated.

$$R_n = do/dr, \quad (3)$$

where R_n is the statistical test of the nearest-neighbour analysis.

The method gives estimations for the form of the points in space (e.g. it clarifies whether the question is about clustered, uniform or random distribution). The values of nearest-neighbour ratio indicate an average distance. It is theoretically an indicator of evaluation based on the statistic exploration of the null hypothesis of a random distribution. A uniform form of point distributions in a pattern has an R_n-value: $R_n > 1.00$. The theoretical maximum of R_n is about 2.15 (for a uniform hexagonal pattern). A clustered form has ratio values $1.00 > R_n \geq 0.00$. In this case, the value of R_n indicates a complete occupation of all the points in the pattern which means that all the points in the pattern are closer together than expected (Smith 1995). The above-mathematical model was used, and the distribution of tourism sites as points in the whole region of Andaman was shown in Figure 1. The calculations of the short distances between points have been made in the kilometre scale. The measurements per pair of points with their names are presented in Table 1. R_n has been calculated based on form (3) (Pinder 1978). Finally, the application of form (3) based on Table 1 provides the results shown at the end of the Table 1. Thus, $R_n = 0.333$ and following Smith (1993), this indicates a clustered arrangement of locations as R_n approaches zero.

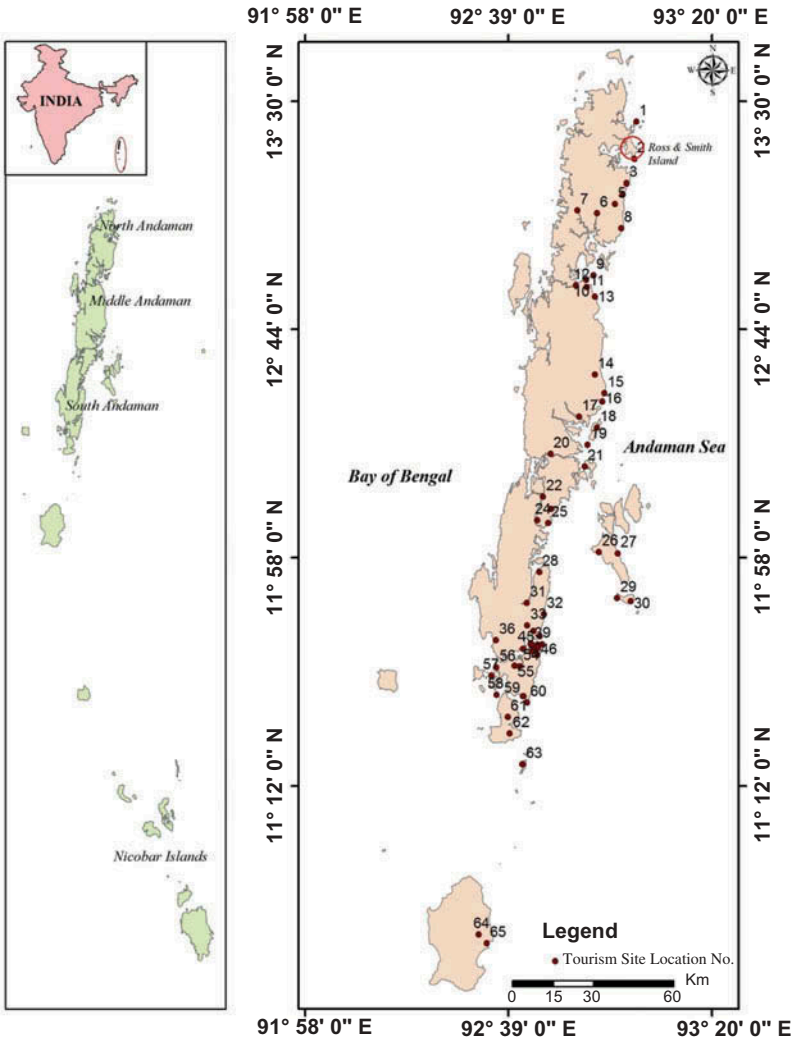

Figure 1. Points in the space location of Andaman Archipelago.

Table 1. Nearest-neighbour analysis for pattern in Figure 1.

		Nearest-neighbour distances (km)		
S. no.	Site location	Point no.	Nearest point no.	Distance (km)
1	Viper Island	37	41	3.26
2	Corbyn's Cove	53	52	2.28
3	Marina Park	47	48	0.25
4	Anthropological Museum	42	43	0.66
5	Andaman Water Sports Complex	49	48	0.15
6	Jolly Buoy Island	58	57	7.47
7	Red Skin	57	56	3.48
8	Mount Harriet	34	35	3.01
9	Chidiya Tapu	59	60	2.73
10	Cinque Island	63	62	12.38
11	Sitapur (Neil Island)	30	29	5.12
12	Radha Nagar (Havelock Island)	26	27	6.88
13	Baratang Creek	22	23	5.35
14	Ross & Smith Island	2	3	9.44
15	Kalipur Beach	3	4	4.19
16	Lamia Bay Beach	4	3	4.19
17	Saddle Peak	5	4	4.52
18	Ram Nagar Beach	8	5	9.28
19	Kalighat Creek	6	7	7.25
20	Karmatang Beach	13	11	4.63
21	Pokhadara Beach	10	11	2.7
22	Austin Creek	12	11	3.97
23	Aves Island	9	10	3.18
24	Cutbert Bay Beach	16	15	3.23
25	Amkunj Bay Beach	15	16	3.23
26	Panchavati Hills	14	15	7.81
27	Lalaji Bay	18	19	7.32
28	Mark Bay	21	19	8.10
29	Uttera Creek	20	21	13.29
30	Yarata Creek	17	18	7.71
31	White Surf Waterfalls	64	65	4.30
32	Butler Bay Beach	65	64	4.30
33	Agriculture Farm (Sippighat)	55	56	1.90
34	Parangara Creek	7	6	7.25
35	Munda Pahar	60	59	2.73
36	North Bay	35	34	3.01
37	Wright Myo	31	32	7.46
38	Wandoor	56	57	3.48
39	Rutland	62	61	6.25
40	Collinpur	36	37	10.42
41	Kalapathar (Havelock)	27	26	6.88
42	Guitar Island	19	18	7.32
43	Rampur	11	10	2.7
44	Table Island	1	2	13.97
45	Shoal Bay	28	31	12.30
46	Madhuban	32	31	7.46
47	Wimberlygunj	33	34	3.11
48	Forest Museum (Haddo)	38	39	0.33
49	Samundrika Marine Museum (Delanipur)	41	40	0.13
50	Smrithika Museum (Ross Island)	51	49	1.64
51	Cellular Jail	50	49	0.25
52	Cottage Industries Emporium	44	43	0.03
53	Khadi Gramodyog	43	44	0.03
54	Fisheries Museum (Atlanta point)	48	49	0.15
55	Zoological Garden (Haddo)	40	41	0.13
56	Gandhi Park	45	46	0.50
57	Children's Park, Dairy Farm	52	44	1.60
58	Radha Krishnan Park	46	45	0.50
59	Botanical Garden	39	38	0.33
60	Water Sports SAI Complex	54	55	1.90
61	Natural Bridge (Neil)	29	30	5.12

(*Continued*)

Table 1. (Continued).

S. no.	Site location	Nearest-neighbour distances (km)		
		Point no.	Nearest point no.	Distance (km)
62	Mud Volcano (Baratang)	23	22	5.35
63	Limestone Cave (Baratang)	24	25	4.07
64	Baludera Beach (Baratang)	25	24	4.07
65	Mount Ford	61	62	6.25

$$\sum = 294.25\,\text{km}$$

$$do = 294.25/65 = 4.527$$

$$[dr = [0.497 + 0.127\left[\sqrt{(5692.75/65)}\right]\left[\sqrt{(5692.75/65)}\right] = 1.6855 \times 8.0622 = 13.588\,\text{km}]$$

$$R_n = do/dr = 4.527/13.588 = 0.3331$$

While the whole of the Andaman is known for its natural beauty, tourism is concentrated in certain specific parts. The points are distributed in clusters in three regions namely the South Andaman (Port Blair area), the Middle Andaman (Mayabunder area) and the North Andaman (Diglipur area). It is noted that among the three clusters, tourism attraction is concentrated more in and around Port Blair area, and in Mayabunder and Diglipur areas, they appear medium and low, respectively. Port Blair plays a critical role in tourism development, not only as tourist origins or destinations, but also as hubs that provide transportation, hospitality, infrastructure and facilities to support tourism in peripheral areas. This finding was well supported by earlier work (Ferguson 2003; India Tourism Statistics at a Glance 2012), wherein tourist arrival to Port Blair has been projected to be 1,14,114 for the year 2007, 1,28,419 for 2012 and 1,62,631 for 2022 based on a model which factored in various aspects including historic and current tourist arrivals, carrying capacity and international experience. It also said that the Port Blair would reportedly have low carrying capacity in terms of tourist flow. The coastal areas of Port Blair are required to be regulated as per the Island Coastal Regulation Zone of the Island Protection Zone Notification, 2011 issued under the Environment (Protection) Act, 1986. Based on the evaluation of the current tourist attractions in Andaman and the potential tourist destinations, Port Blair has high potential for tourism development. But the city of Port Blair itself is crowded, and therefore, tourists need to be distributed across the region. In order to widen the tourist attraction portfolio of the islands by opening up more areas and creating attractions on some others, the North Andaman region was selected and Smith Island was taken for the study for ecotourism development as this island is already having few attractions. For this purpose, satellite data of Landsat-8 of the year 2014 were utilised to analyse various land use and land cover (LU&LC) features. The landsat image was geo-referenced (Universal Transverse Mercator-UTM, WGS84) to the survey of India topographic maps with the scale of 1:50,000. Remote sensing data were performed using ERDAS IMAGE software. Coastal wetland and land-use features were delineated using the basic elements of visual interpretation like tone, texture, shape, size, pattern and association (Nayak et al. 1992). Visual interpretation is one of the most widely used methods for detecting or identifying the spatial features on an image (Lillisand & Kiefer 1994). From the satellite data analysis coupled with extensive ground verification and based on secondary data collection from various government departments, a general profile on Smith Island's ecology has been developed.

The Smith Island (Figure 2) is situated on the eastern side of the North Andaman Island and connected to the adjoining Ross Island, a wild life sanctuary. The island is mostly covered by forest with a small settlement area. According to the Forest Statistics (2009), the total geographical area of the Smith Island is about 2470 ha. Out of the total geographical area, the total forest area is 1579 ha (61.90%) and the non-forest area is 891 ha (36.07%). The non-forest area may be considered for any development after conducting carrying capacity study for this island, bearing in mind the fragile ecology and limited freshwater resources available in the island. It has extensive coverage of mangrove vegetation on the north-western side and narrow fringing reefs on eastern and south-western sides of the island. There are several coastal stretches on the eastern side of the island with sand beaches. It was estimated that the total shore length covered under sandy beach is around 3.5 km. The beaches are the nursing ground for some of the endangered species such as birds, crabs, turtles, etc. The green turtles and the Olive Ridley species are reported in the north-eastern and south-eastern side of Smith Island (Harry 2000). Developments are required to be planned properly to avoid ecological and economic losses. The major agricultural crops grown in the island are paddy, coconut, arecanut and fruits, and in addition to which, vegetables namely brinjal, ginger, ladies finger, tomato, gourd and pumpkin are grown. The existing development includes a jetty and internal road for commuting in the village for some areas.

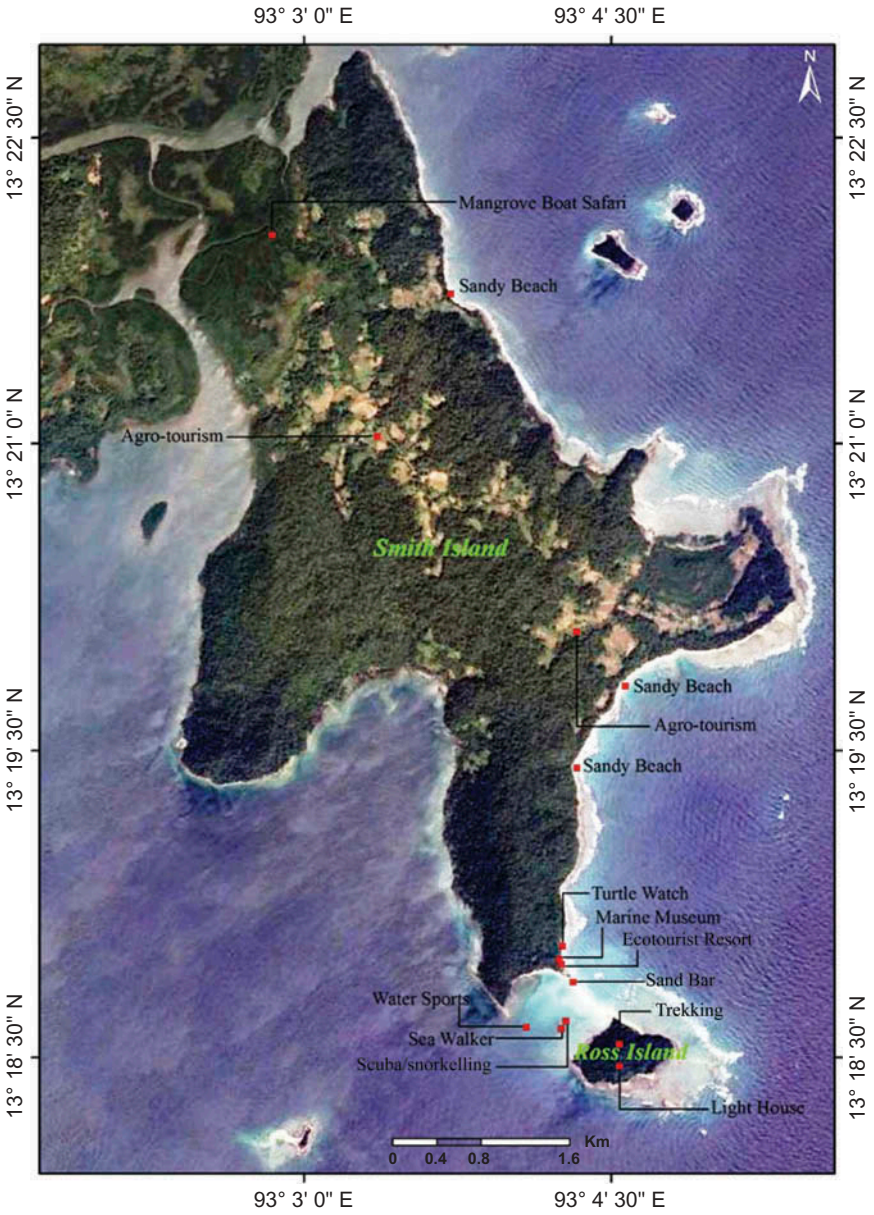

Figure 2. Suggestions for ecotourism for Smith Island of North Andaman.

Based on the above profile, the following proposed suggestions (Figures 2 and 3a–h) would be helpful for ecotourism development on Smith Island provided that (1) there should not be any disturbance to ESAs such as coral reef, seagrass/seaweeds, mangrove vegetation and turtle nesting sites; (2) there should not be any construction of hard structures on the seaward side of the corals; and (3) no disposal of untreated sewage or effluent including the non-biodegradable waste into the sea water by the tourist and related activity.

Suggestions for ecotourism development on Smith Island

(i) **Scuba diving/snorkelling, sea walker**: For adventure and knowledge generation on marine life.

(ii) **Beaches at south and eastern side of the Smith Island**: The beach areas have been identified with remote sensing data. These areas may be identified for the development of beach tourism, with the main purpose for relaxation. Public conveniences and changing rooms are also required for convenience of public visiting these beaches.

(iii) **Forests/mangrove**: It can be used for 'activity-based tourism' – natural trails, bird watching and other research work without harmful impact to forests. The sensitive areas of the forests can be earmarked as 'ESA zone' – open only for serious research. The buffer zone can allow activities with only mobile infrastructure – eco-restlets, tents, tree top 'machan', etc. All tourism infrastructures can be developed in the

Figure 3. Ecotourism areas at Smith Island: (a) Sand bar connecting Ross Island wildlife sanctuary. (b) Mangrove trees. (c) Existing ecotourism huts. (d) Coral reef. (e) Forest trekking area. (f) Seagrass. (g) Coconut plantation. (h) Paddy cultivation.

peripheral area outside the forest cover. Careful planning and monitoring of tourism will allow it to coexist with the forest environment.

(iv) **Visit to Ross Island Wild Life Sanctuary**: The Smith Island is connected to the adjoining Ross Island, a wild life sanctuary, by sand bar which is visible during the low tide. During the high tide, the Ross and Smith Islands get separated by sea water. Visit to Ross Island from Smith Island would be exploratory.

(v) **Mountaineering and trekking**: The Ministry of Tourism's guidelines on Safety and Quality Norms on Adventure Tourism 'Basic Minimum Standard for Adventure Tourism Activities, 2009' should be strictly followed by all concerned.

(vi) **Eco-friendly tourist resort**: Since the island has a good potential for beach tourism, if need be, construction of eco-friendly island tourism resort may be considered for the long-term tourism development in the island. For this purpose, the existing tourism area at the southern tip of the island may be considered for further development, as access to this place from the Aerial Bay jetty is more suitable and being practised.

(vii) **Agro-tourism/visit to cultivation areas**: Agriculture sector plays an important role and represents dominant and leading sector of economics. There is also a possibility of development of agro-tourism in the Smith Island in the long term. Tourist can visit the cultivation areas in the Smith Island village and do activities related to agriculture such as harvest, planting, fishing, etc. To improve agriculture, interested parties such as government especially Department of Agriculture may revise polices related to agriculture and intensify speech on agriculture to farmers; researchers need to discover new method of land cultivation and superior seed to harvest faster; and farmers need to improve the quality of the agricultural productions. These may help in the creation of new opportunities to develop agro-tourism in the Smith Island.

(viii) **Wildlife/maritime museum**: Education and knowledge generation on marine life.

(ix) **Need for Tourists Information Services and trained guides**: There is a need for Tourist Information Services getting guidance on places of interest, facilities available, entry formalities (if any), etc. The trained guides would make visiting tourists appreciate the true magnitude of significance of various attractions.

(x) **Entry point at Diglipur**: Currently, Port Blair is the only entry point. Hence, there is concentration of tourists in Port Blair. There should be a new entry point in North Andaman at Diglipur to promote tourism in North Andaman Island.

The study on nearest-neighbour analysis revealed that tourism sites in Andaman exhibit a cluster distribution pattern. The sites are concentrated more in Port Blair area than in Mayabunder and Diglipur areas. This finding would assist the A&N Administration in planning and development of touristic activities in Andaman based on the improvement of touristic substructure and projection of adjacent touristic resources. Recently, the Andaman Island witnessed a boat tragedy near Port Blair area. The incident occurred in January 2014, when a tourist boat was carrying more number of tourists than the actual capacity the boat can take, and the boat capsized in the sea and many people lost their lives (Press Information Bureau, Government of India 2014). Though the actual reason reported for the accident was that the boat was overcrowded and lack of life jackets, there is also a need to view the problem in the angle that because the concentration of tourism sites in and around Port Blair is high, the tourist flow and subsequent population pressure to these sites also become high which indirectly creates pressure in the tourism business. It is very important for A&N Administration to promote and expand tourism activities in other potential areas of Andaman through the establishment of necessary infrastructure and awareness creation. The suggestions proposed in this study, based on the remote sensing and ground truth information, would hopefully help for ecotourism development on Smith Island while protecting the ecological resources of the island. It is suggested that the development of ecotourism should involve the local community for the overall economic development of the area.

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