



An Evaluation of the Land-Use Changes and the Associated Environmental Impact of Coastal Tourist Destinations: A Comparative Study of the Hikkaduwa and Bentota Sites

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Abstract

The study focuses on the analysis of land-use patterns and environmental impact in two coastal tourist destinations in the Southern coast of Sri Lanka: Hikkaduwa and Bentota. The aim was to assess how tourism has influenced land-use changes and the associated environmental problems. Primary and secondary data were collected through questionnaires, mapping techniques and remote sensing tools. The findings revealed significant transformations in both areas over time.

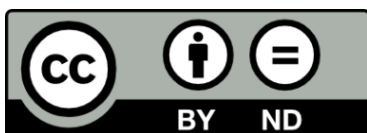
In Hikkaduwa, coconut plantation lands decreased by 22.54%, rice cultivation lands by 8.27%, and mixed vegetation lands by 2.21%. Similarly, Bentota experienced reductions in coconut, rice, and mixed vegetation lands by 15.28%, 16.5%, and 1.16%, respectively. However, built land increased by 30.41% in Hikkaduwa and 22.03% in Bentota. The study also highlighted a shift in land-use patterns. Hikkaduwa transitioned from a proportional mixed land-use to a dominant land-use type, while Bentota maintained a more balanced proportion of major land uses.

Moreover, Hikkaduwa faced severe environmental problems compared to Bentota, emphasizing the need for a formal and sustainable land-use plan in Hikkaduwa. The involvement of stakeholders responsible for land use, tourism development and environmental conservation was deemed crucial for achieving this. The findings underscore the importance of implementing sustainable land-use practices and effective environmental management to ensure the long-term sustainability of the popular tourist destinations.

Keywords: Southern coast, Hikkaduwa and Bentota, Coastal tourism, Land-use change, Environmental Impacts

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INTRODUCTION

Tourism has become one of the most important industries globally, generating revenues, employment, and infrastructure development for many countries (Gee and Sola, 1997). This industry is diverse, encompassing accommodation, transportation, food and beverage, retail, culture, sports, and recreation, catering to domestic and international visitors (Gee and Sola, 1997). The spatial distribution of tourism activities is fragmented, occurring in environments with various attractions (Marcovic et al., 2009; UNEP, 2009; Miller et al., 2011). Coastal areas, with their biodiversity and natural beauty, hold significant potential for tourism development (Journal of Coastal Zone Management, n.d.; Mukherjee, 2021). However, these areas are subject to high population pressure due to urbanization, making tourism a vital source of income (Burke et al., 2001 in Ghosh, 2011). Coastal tourism offers diverse activities, including the development of hotels, resorts, restaurants, and supporting infrastructure (Piyadasa and Ranasinghe, 2017).

In Sri Lanka, with its extensive coastline, tourism plays a crucial role in the coastal region's economy and land use (Piyadasa and Ranasinghe, 2017). The demand for land for tourism-related facilities puts pressure on the environment and existing land cover (Gössling, 2001). The southern coastline, particularly Hikkaduwa and Bentota, has experienced significant

tourism-led land-use changes (Gunawardana and Sajeewani, 2009). Hikkaduwa is an example of unplanned land-use development, with informal sector tourism being popular (Gunawardana and Sajeewani, 2009). The area has seen the conversion of residential houses into guesthouses and hotels, leading to environmental issues and limited coastal accessibility (Gunawardana and Sajeewani, 2009).

Bentota, on the other hand, has witnessed planned and formal sector tourism development, targeting top-class tourists (Gunawardana and Sajeewani, 2009). These divergent approaches in Hikkaduwa and Bentota provide an opportunity for a comparative analysis of land uses, environmental impacts, and sustainable management (Gunawardana and Sajeewani, 2009).

Understanding and addressing the environmental issues arising from tourism-led land-use changes is crucial for sustainable coastal tourism development. Such insights can inform land-use planning and management strategies at a regional or national level, ensuring the long-term viability of the tourism industry (Piyadasa and Ranasinghe, 2017). Tourism is a significant economic activity with diverse land-use requirements. Coastal areas, with their natural attractions, have emerged as popular tourist destinations. However, uncoordinated and unplanned tourism-led land-use changes have resulted in environmental issues. A comparative



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analysis of Hikkaduwa and Bentota in Sri Lanka can provide valuable insights into the spatial and temporal dynamics of land use, environmental impacts, and contribute to sustainable tourism-led land-use management. The main objective of this research is to analyze the contrariety of land-use changes in the tourist sites of Hikkaduwa and Bentota in Sri Lanka. In order to achieve this, several minor objectives have been identified. Firstly, this study aims to analyze the changes in land-use in both sites from 1984 to 2022. This will provide a comprehensive understanding of how land-use has evolved over time in these destinations. Secondly, the research will analyze the contrariety of mixed-land-use diversity in both Hikkaduwa and Bentota from 1984 to 2022. This analysis will highlight the differences in land-use patterns and diversity between the two sites. Additionally, the study will explore the environmental effects of tourism-led land-use changes in both destinations. It will assess the impact of tourism development on the natural environment and identify any associated environmental issues. Furthermore, the research aims to identify the challenges of implementing a proper land-use plan in the Hikkaduwa area. This will involve examining the barriers and obstacles faced in managing land-use effectively in this particular destination. Lastly, the study will provide suggestions to promote sustainable tourism development through a proper land-use plan in the

Hikkaduwa area. These recommendations will aim to enhance the management of land-use in order to ensure the long-term sustainability of tourism in the region.

LITERATURE REVIEW

Land-use, which refers to the human use of land, encompasses various economic and cultural activities such as agriculture, residential areas, industries, mining, and recreation (United States Environmental Protection Agency, 2021). Tourism, being a significant economic activity worldwide, is closely intertwined with land use (Wang and Liu, 2014). However, the competition for land in tourism often leads to conflicts between different land uses in a given area (Bandara and Ratnayake, 2015). Unfortunately, tourism-led land-use changes have also resulted in environmental issues (Wang and Liu, 2014).

In the Asian/Pacific region, uncoordinated and unplanned mass tourism has caused degradation of coastal environmental resources, jeopardizing the long-term sustainability of tourism (Tantrigama, 2017). For instance, Hikkaduwa, Sri Lanka, and Goa, India, both popular tourist destinations, have suffered from haphazard and ad-hoc coastal tourism development, negatively impacting environmental resources (Tantrigama, 2017). Similarly, the Bentota river basin has experienced land use and land



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cover changes, potentially transforming the area into a large tourist development (Piyadasa and Ranasinghe, 2017). However, these studies have not thoroughly addressed existing or potential environmental issues arising from these changes.

A detailed study by Bandara and Ratnayake (2015) focused on conflicts and planning efforts in coastal land use for tourism in Sri Lanka. They discussed the importance of land zoning and conservation in coastal tourism planning but highlighted the challenges faced due to a lack of cooperation, funding, implementation, monitoring, and evaluation. The Ceylon Tourist Board (CTB) in Sri Lanka had the authority to acquire land for tourism projects, but this approach led to haphazard constructions and ecological problems in coastal areas. Only two planned beach resorts, Bentota and Passikudah, were successful, emphasizing the need for better land-use planning and allocation.

Considering the significance of land planning and resource allocation in tourism management, Pushpakumara and Peiris (2020) conducted a study in the southwest coast of Sri Lanka. Their research aimed to design a framework for evaluating land use patterns and infrastructure transformation toward eco-tourism in the Welipanna area. They proposed land zoning based on a development and locational analysis, identifying suitable areas for leisure and recreational hotels and medical

tourism clusters. However, the potential socio-economic and environmental costs of such developments were not addressed.

While there is extensive literature on temporal changes in land-use in coastal tourism sites, a few studies have focused on the negative impact of unplanned tourism-related land uses on the environment (Gunasekara, 2016; Saha and Poul, 2020). Additionally, land use planning has not received sufficient attention in sustainable tourism development discussions. Moreover, comparative analyses of formal and informal land use patterns in two tourist areas, such as Hikkaduwa and Bentota, are lacking in Sri Lankan research. Thus, a comprehensive comparative analysis of land use changes, their environmental impacts, and strategic plans for sustainable tourism development in these two popular destinations would greatly contribute to the future development of the coastal tourism industry.

METHODOLOGY

Study Area

Hikkaduwa is located on Sri Lanka's southwestern coast in the Hikkaduwa Divisional Secretariat Division (DSD) of the Galle District. It is approximately 100 km south of Colombo and 15km north of Galle, at latitude 6009'N and longitude 80008'E. The area is highly urbanized with extensive development



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along the coastal zone corridor of the Galle Road. A commercial fisheries harbour exists within this corridor. The selected study area covers 36 sq. km, including the Hikkaduwa Municipal Council area, to analyze the coastal area and land use changes. Within this area, there are 46 Grama Niladhari Divisions (GND), with 36 belonging to Hikkaduwa and 9 to Gonapinuwala. The GNDs range in size from 0.1 sq. km to 2.2 sq. km.

Bentota, a tourist paradise in Sri Lanka, stretches 9.5 km along the Galle-Colombo main road. It covers a large area with resorts and hotels parallel to the coastal boundary and the Bentota River. The selected study area covers 36 sq. km, including 30 GNDs, with 28 belonging to the Bentota DSD and 2 to the Mathugama DSD. The GNDs range in size from 0.49 sq. km to 9.32 sq. km.

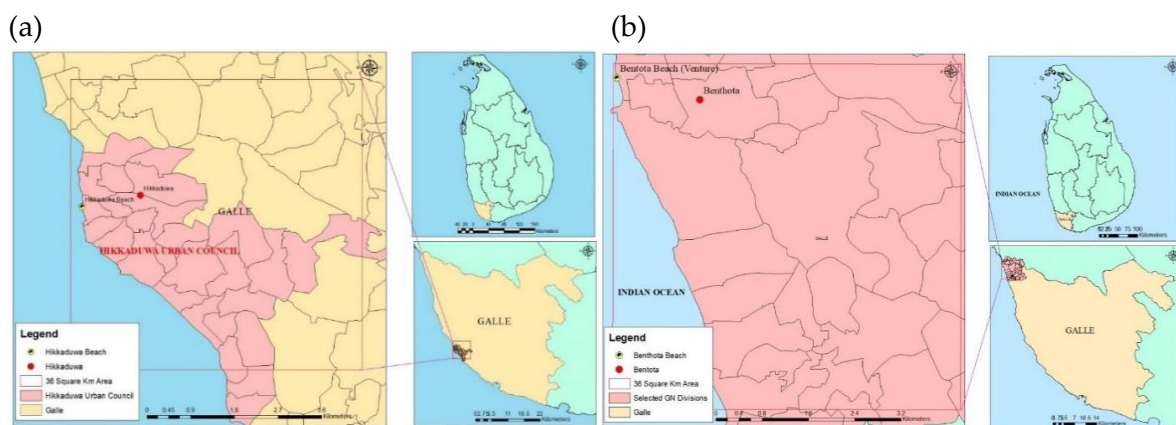


Figure 1: Selected 36 square km area in Hikkaduwa (a) and Bentota (b).

Source: 1:500000 Digital data from the Survey Department of Sri Lanka, 1999

Data collection

Three different structured questionnaire surveys were conducted with 150 respondents at each tourist site, including local and foreign tourists, local communities, and tourism stakeholders. The surveys aimed to gather information on various aspects, such as tourist satisfaction, environmental problems, and proposed solutions. 10 semi-structured interviews were carried out with officers of the institutes related to the topic, and the observation method was used to examine changes in land

caused by the tourism industry, identify difficult-to-detect land uses, and assess the severity of environmental problems.

Researchers collected secondary data from journals, organization records, annual statistical reports, and documents. Additionally, topographic maps, digital data from ArcGIS, high-resolution satellite imageries, Landsat satellite imageries, and various indexes and models were used for map analysis and creating visuals for the study. For the study, high-resolution satellite imagery from Google Earth Pro



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software was downloaded for the years 1984, 2010, 2018, and 2022. This imagery was used to analyze changes in the study area over time. To ensure accuracy and precision in the study, topographic maps were used as a guide for field navigation. They helped in selecting Ground Control Points (GCP), which are essential reference points for satellite imagery analysis and mapping.

Sample

The survey included 3 separate questionnaires for each tourist site. Respondents were divided into 3 categories: tourists (local and foreign), stakeholders representing various businesses in the tourism industry, and members of the local community such as fishermen, farmers, flaked lime workers, and residents. 50 questionnaires were randomly distributed to selected respondents from each category.

Data Analysis

The study utilized high-resolution Google Earth images and topographic maps from multiple years to classify land use in two study areas. The 36 sq km area was divided into four equal parts and separate Google Earth images were downloaded for each part. Geometric correction was done by establishing at least 10 well-distributed GCPs using topographic maps as references. Various land-use categories were defined, including built-up lands (urban areas and buildings), water bodies (oceans, streams, rivers, and

lakes), roads (major and minor roads, railways), paddy and coconut lands (for agriculture), mangroves (coastal trees and shrubs), swamps and lagoons, and bare lands (unused or difficult to use). All identified land-use features were digitized using ArcGIS software and their extents were calculated in hectares using the Geometric Calculator tool.

To verify the accuracy of the digitized land-use maps in the Hikkaduwa and Bentota tourist areas, a Systematic Point Sampling (SPS) method using gridded classified images was planned. The area where point samples were to be chosen was determined, and the number of samples was determined accordingly. A grid of 200m x 200m squares was created over each selected 6km x 6km area. Within this grid of 900 squares, 300 sample points were systematically arranged on a square, except for every two squares. The locations of these sample points were tracked using GPS devices, recording their X and Y coordinates. This allowed the study to identify the actual current land use in those specific locations.

The development of tourism leads to changes in land-use demands and patterns, which are complex and dynamic in tourist cities (Gao et al, 2021). Therefore, “mixed land-use” patterns are commonly observed in many tourist cities in developing countries (Bordoloi et al, 2013). To identify the change of mixed land-use diversity of Hikkaduwa and Bentota during the last four decades, the



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“Entropy Value” for land-use patterns of the two sites in 1984, 2010, 2018, and 2022 was calculated considering the types of land-use as construction lands, water bodies, roads, paddy lands, coconut lands, mangroves, and unused lands. The entropy value (Equation 1) was calculated by applying the following formula developed by Cervero & Kockelman (1997) to assess the similarity and diversity of land use types of the areas.

$$H = -1 \left[\frac{\sum (P_j) * \ln(P_j)}{\ln(K)} \right]$$

Equation 1: Entropy Value (H) formulae
Source: Cervero & Kockelman, 1997

Where H is the entropy value, and K is the number of different types of land use in the area. P_j indicates the proportion of the total land area in the j^{th} land use type and $\ln$ is a natural logarithm using e (approximately 2.718) as its basis. Entropy values range between 0 and 1, with 1 representing the equal proportion of each land use type and 0 representing the presence of a single dominant land use.

RESULTS AND DISCUSSIONS

The growth and present status of the Hikkaduwa tourism industry

Hikkaduwa is well-known for its coral reef and marine environment, which have been major attractions for tourists. The tourism industry in Hikkaduwa began to flourish after the discovery of

the coral reef by Sir Arthur C. Clarke and Rodney Jonas. Initially, the only accommodation available was the Hikkaduwa Rest House, which was later renovated into the Coral Garden Hotel, the first hotel in the area. Following the 1970s, more hotels such as Blue Coral and Coral Sands were established.

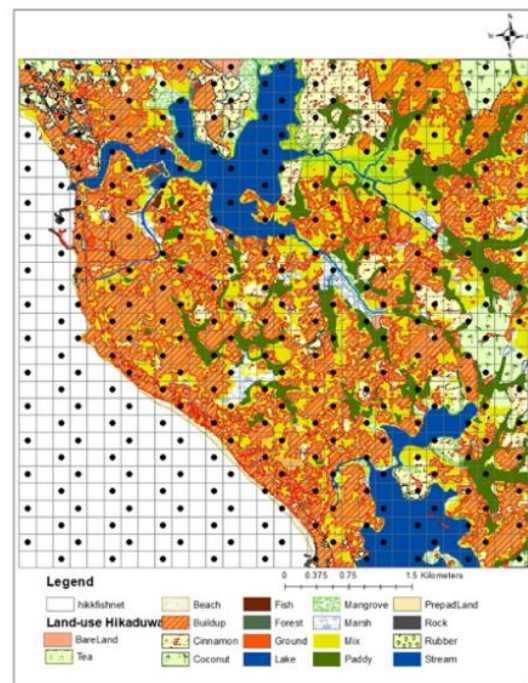


Figure 2: Systematic point samples within 36km² of the area in Hikkaduwa
Source: Google Earth Images, 2022

Before the rise of tourism, the local economy relied on cinnamon cultivation, coral mining, lime production, toddy tapping, and the coir industry based on coconut cultivation. However, fishing, tourism and coral mining have now become the main sources of income for the local population. The growth of the tourism industry in Hikkaduwa occurred without proper planning, leading to haphazard development along the



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coastline (Tantrigama, 1994; Nakatani, 1994; Gunawardana and Sajeewani, 2009; USAID SCOTIA-SL., 2007; Bandara and Rathnayaka, 2015).

During the 2004 tsunami disaster, many tourism-related buildings were damaged but were subsequently restored. Hikkaduwa currently offers a range of hotels, from five-star to one-star establishments. According to statistics from the Sri Lanka Tourism Development Authority (SLTD) and the Urban Development Authority (UDA), there were approximately 46 hotels and guest houses operating along the beachfront in 2007. By 2020, there were 65 tourist hotels and resorts, as well as 113 guest houses in the Hikkaduwa division. Overall, Hikkaduwa's natural beauty and coral reef have attracted both local and foreign tourists, contributing to the growth of the tourism industry in the area.

The growth and present status of the Bentota tourism industry

Bentota is an important tourist town in Sri Lanka, known for its pristine beaches, mangrove walks, and tranquil environment. It has two tourism zones: the Bentota National Holiday Resort (NHR) established by the CTB in 1969 to preserve the area and the zone with businesses run by local people outside the resort. The resort occupies about 100 acres of land on the beach frontage and comprises 1-star to 5-star hotels, restaurants, banks, shops, and

transport services. The tourism industry in the area took off around the 1970s, and the resort area was planned from the beginning. The Bentota NHR mainly attracts affluent foreign tourists, while budget tourists stay in guest houses and homestays outside the resort.

All businesses within the resort are owned by outside investors and until recently, people from outside areas were hired as workers for those businesses. This has caused job opportunities for locals to be lost. However, the situation has changed slightly, allowing locals to reap some economic benefits from the businesses within the resort.

The environmental impact due to tourism related land-uses changes in Hikkaduwa

The informality of land use for tourism in Hikkaduwa has created some serious environmental problems.

Unclean beaches and land areas

Hikkaduwa faces significant issues with unclean beaches, littered roads and land areas, which are commonly observed in the area. The community attributes this problem to multiple parties. Firstly, local tourists are identified as a primary contributor to the pollution of the beaches and land. Secondly, businesses associated with the tourism industry, including hotels, restaurants, and temporary shops, are



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also held accountable. Lastly, individuals from outside Hikkaduwa

town are seen as another responsible party.



Exhibit 1: Irregularly dumped waste on the beach
Source: Field observations, 2022

Obstructive beach access

In certain areas, the access roads to the beach are narrow, causing difficulties in reaching the beach freely, especially during the peak tourist season. Temporary booths constructed along the road further obstruct access. Additionally, due to the high density of buildings, tourists are forced to navigate through very narrow paths between two structures in order to reach the beach. Furthermore, the natural beach views are significantly hindered by large walled buildings that have been erected between the beach and the main road.

Coastal erosion

Coastal erosion is a significant problem in Hikkaduwa, resulting in the damage or loss of coastal structures, the loss of valuable land and the disruption of human activities like fishing and recreation. Some people believe that erosion has reached its maximum level and there is no more beach left to erode. As a result, it is difficult to find a clear, uneroded coastline from Hikkaduwa to Narigama for promoting coastal tourism. The community has noted that compared to the past, Hikkaduwa has smaller, scattered, and narrow beaches with no wide, continuous coastline.



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Exhibit 2: Coastal erosion in the north section of the Hikkaduwa beach
Source: Field observations, 2022

The Coast Conservation Act No 57 of 1981 states that anyone planning "development activities" within the coastal zone, which extends 300m inland from the mean high-water mark, must comply with permit requirements regulated by the Coastal Conservation Department (CCD). Due to the significant economic contribution of the Hikkaduwa tourist town, the institutions responsible for coastal conservation have relaxed the rules and

regulations surrounding tourism development activities on the Hikkaduwa beach to some extent. However, this leniency in institutional regulations has resulted in informal land use practices and severe coastal erosion along the Hikkaduwa coast today. The beachfront length (in meters) of tourist establishments, shops and private houses located in the coastal strip of Hikkaduwa is depicted in Fig. 3.

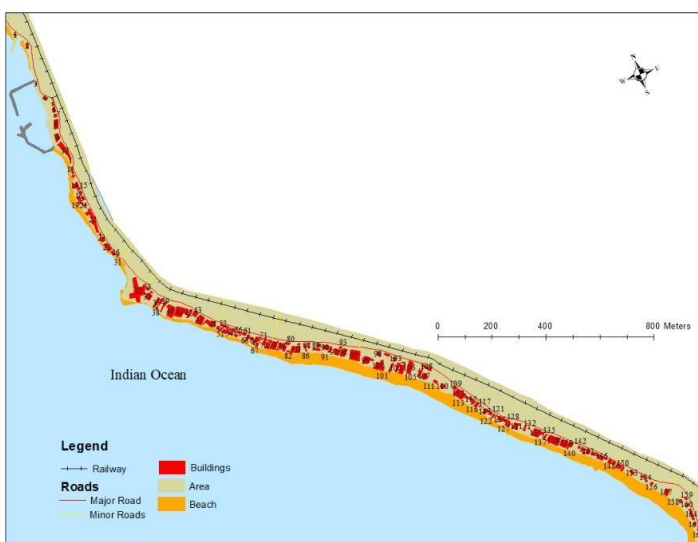


Figure 3: Beach access and land use by tourist establishments, shops, and private houses in the coastal strip between the main road and sea
Source: Prepared by the author based on Google Earth Images, 2022



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In the Hikkaduwa beach area, out of the 166 establishments identified, around 73.4% (122 establishments) have a beachfront area of fewer than 50 meters. Unfortunately, there is severe erosion along the beach, stretching from the Coral Sands Hotel in the north to the Citrus Hotel in the south. To combat the erosion, hoteliers have been constructing retaining walls and filling the areas between the buildings and the walls with sand. This has led to a reduction in the available beach area for visitors and recreational activities. In some cases, such as at the Coral Reef Hotel, Mama's Beach Restaurant, and Coral Rock by Bansei, there is no beach remaining due to encroachment and construction efforts.

There is a growing opinion among stakeholders, particularly tour guides, that the long, uninterrupted beaches extending from Kahawe Junction to Akurala in the north of Hikkaduwa, as well as the Narigama beaches in the south, are becoming increasingly popular among tourists. As a result, there seems to be a tendency for future tourism to shift towards these areas.

Pedestrian traffic

The lack of a sidewalk on the A2 road has posed significant challenges, particularly in a tourist hotspot where thousands of tourists frequent the area. The absence of a sidewalk has resulted in a large volume of pedestrian traffic on the road, which is quite unsafe considering the presence of buses,

trucks, and lorries. Unfortunately, accidents involving tourists have occurred multiple times on this stretch of road. Compounding the issue is the limited space available due to buildings constructed close to the main road, making it impossible to widen the road and construct a sidewalk.



Exhibit 3: The absence of a sidewalk near the Hikkaduwa beach on the Galle-Hikkaduwa main road

Source: Field observations, 2022

Pollution of inland waterways

One of the major environmental concerns in Hikkaduwa is the pollution of inland waterways that eventually connect to the sea. Within the study area of 36 km², there are two canals, namely the Tuduwegoda Canal and the Mawakada Canal (Exhibit 4), which serve as outlets for excess rainwater to flow into the sea through the Hikkaduwa municipality. The Thuduwegoda Canal joins the Thelwatta ganga (Molapu oya) and empties into the sea from the Wavulugoda west GND, while the Mawakada Canal flows into the sea near the Hikkaduwa beach, where most tourist activities take place at the Pannamgoda GND (Exhibit 6). These canal outlets are periodically



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obstructed by sandbar formations throughout most of the year, exacerbating the issue.

(a)



(b)



Exhibit 4: Outlets of Tuduwegoda canal (a) Mawakada canal (b) are filled with sand



Exhibit 5: The Mawakada canal is connected to the sea by cutting the sandbank



Exhibit 6: Dirty water from the canal has accumulated in the sea near the Hikkaduwa beach
Source: Field observations, 2022

The environmental impact due to tourism-led land-use changes in Bentota

In comparison to Hikkaduwa, a small number of problems related to land-use were identified in Bentota.

The problem of waste disposal

Waste from the Bentota resort and town area is collected once a day by the Bentota Pradeshiya Sabhawa. In particular, the waste in the tourist



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resort area is collected by the garbage collectors of the SLTDA and collected in one place to be given to the tractor of the Bentota Pradeshiya Sabhawa. Although the waste collection is regular in the area, it has been difficult to find a permanent place to dispose of the accumulated waste. Apart from this, non-segregated garbage from hotels and houses in the Varahena and Atawalawatta GNDs, where there are more hotels and tourist accommodations in the area, has also become a big problem.

Pollution of inland water sources

Among the inland water sources in the study area, the Bentota River has been the most environmentally affected. One of the sources of river water pollution is the discharge of sewage pipes from houses and hotels located on the banks of the river (Especially the hotels in the Pitaramba and Yatramulla GNDs). Dumping and burning unseparated garbage from urban areas like Alutgama to land very close to the river is another reason that can cause a big environmental problem in the Bentota river. According to the residents of the area, water pollution is also happening due to the waste getting stuck in the nets drawn for shrimps in small streams of Bentota.

Coastal erosion

The community and stakeholders believe that the main reason for the erosion of the Bentota coast is the effect

of natural sea waves rather than human factors. As shown in Fig. 4, most of the tourism-related establishments are concentrated in the north-end and south-end of the coastal strip. The north end comprises tourism establishments inside the resort while the south -end is with establishments near the Induruwa beach. All hotels within the resort are constructed following the building regulations of the CCD, the Central Environmental Authority (CEA) and other relevant authorities. Therefore, the size of the beach frontage of the hotels built within the resort area along the coast from the Pahurumulla GND to the north section of the Varahena GND is at least 50 meters or more.

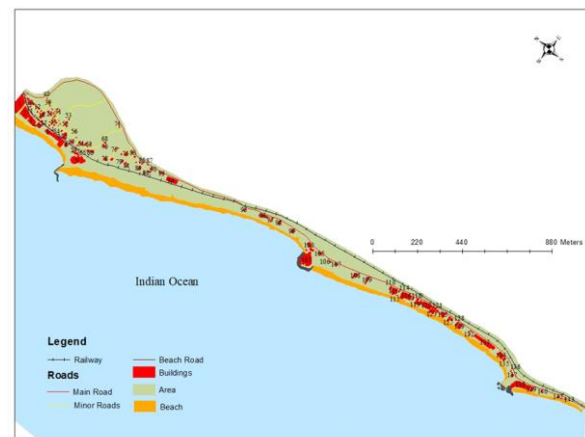


Figure 4: Beach access and land use by tourist establishments, shops, and private houses in the coastal strip between the main road and the sea

Source: Google Earth Images, 2022

Changes of land-use in Hikkaduwa

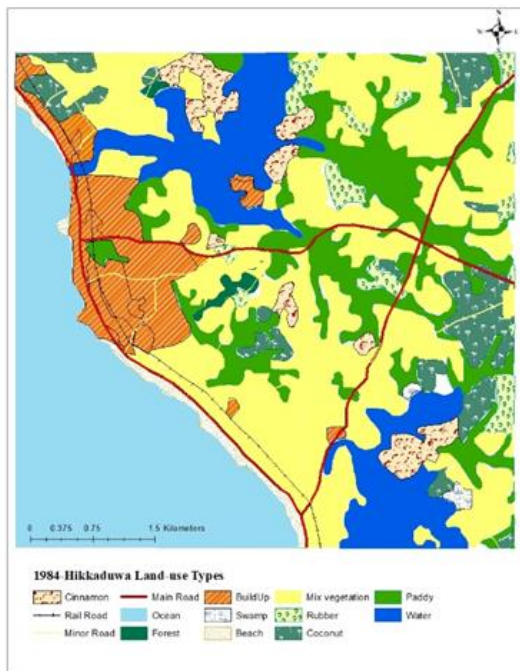
The discussion from here on will focus on the percentage representation of land use activities found within the land area, excluding the ocean, as



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shown in Fig. 5 depicting the land use changes in the selected area of Hikkaduwa from 1984 to 2022.

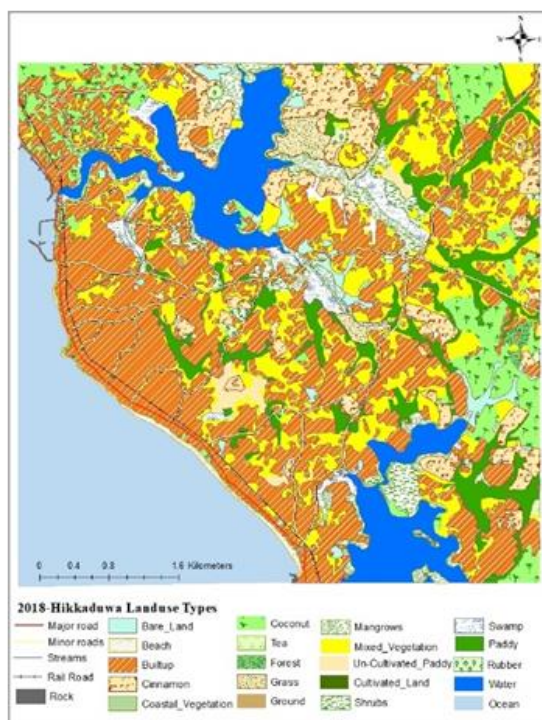
(a)



(b)



(c)



(d)

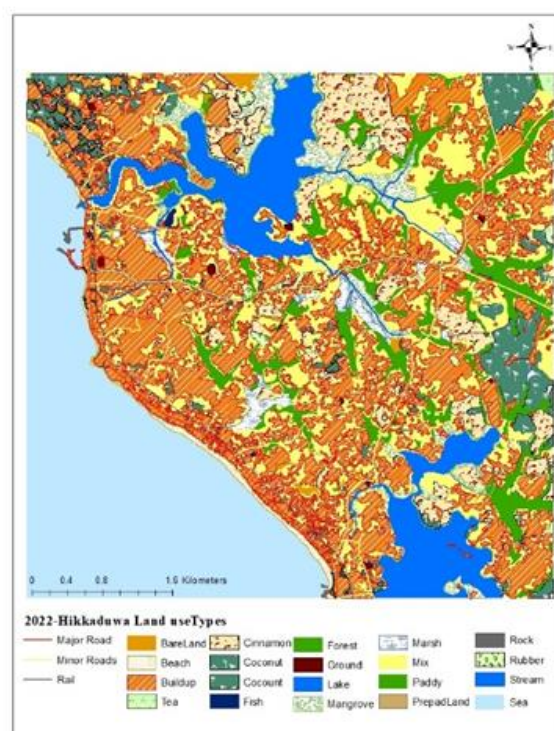


Figure 5: Land use maps of the Hikkaduwa area in 1984 (a), 2010(b), 2018(c), and 2022(d)
Source: Created by the author based on Google Earth images



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The growth of tourism in Hikkaduwa occurs in three different phases. Between 1966-1976, was a period of slow growth of the industry. This was the time when the tourism industry was introduced to the locals. Tourism growth was accelerated after 1976 (CEA, 1984) as tourism facilities and infrastructure like hotels, restaurants, and guesthouses were largely established. Hikkaduwa's tourism industry developed rapidly after the 2004 tsunami disaster. In the 1984 land use map, the rapid physical growth of the area during the second phase of tourism growth is well represented.

The Hikkaduwa anchorage consisted of a main breakwater (southward) that was developed into a fishery harbour during 1996-1998, adding up a secondary breakwater, inner and outer breakwaters attached to the main breakwater and a groin in the basin. After the Tsunami disaster, during 2005-2007, the inner breakwater extension was done to minimize the sand entering the harbour basin. The breakwaters built around the fishing harbour from land to sea have increased the land area by 6 hectares in 2010. Therefore, in the maps created in 2010 and thereafter, the land area is shown as 2833 hectares. After 16 years since 1984, by 2010 many changes in land use can be detected in this area again. The built-up area has increased to 21.11%, which is an increase of 11.51% compared to 1984. Also, the area under cinnamon has increased to 6.88%. Compared to the growth of

buildings and cinnamon-cultivated land areas, mixed vegetation, paddy fields, coconut, and rubber-cultivated land areas have decreased gradually and percentagewise they can be identified as 27.07%, 12.88%, 9.06%, and 0.87% respectively. The beach land has further decreased by 0.35% as compared to 1984. Thus, it appears that by 2010, land use of mixed vegetation, paddy fields, and coconuts has gradually turned into built-up areas.

Eight years later, in 2018, the areas with buildings and cinnamon cultivation have further increased to 34.95% and 7.56% respectively. Meanwhile, the land area cultivated with mixed vegetation, rice paddy, coconut, and rubber has further decreased to 17.94%, 8.59%, 7.72%, and 0.55% respectively. Beach land decreased by 0.24% in 2018 compared to 2010.

By the year 2022, the area with buildings represents 37.17% of the total land area, and the area under cinnamon cultivation represents 8.79%. In addition to this, the amount of tea cultivation area that has been identified as a new crop since 2018 has grown to 0.53% by 2022. In contrast to this, it can be recognized that the amount of mixed vegetation, rice fields, coconut, and rubber lands is continuously decreasing. By 2022, buildings are the dominant land use type in the area.

Changes of land-use in Bentota

In contrast to Hikkaduwa, in Bentota, the year 2010 shows an immediate



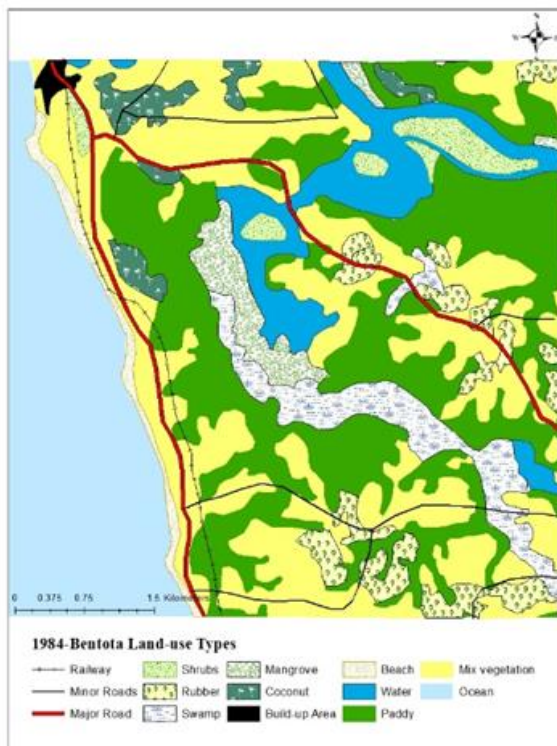
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increase in the built-up area, which is a 16.6% increase compared to the previous year. The land area under mixed vegetation decreased to 19.23% in 2010, which was 31.79% in 1984. Also, paddy has decreased by 15.12%, coconut by 1.04%, and rubber by 4.12%. This shows that most of the mixed vegetation, coconut, rubber and paddy lands have been used for the construction of buildings. The coastal area is 0.76% and coastal vegetation is 0.6% this year. In 2018, the built-up area has further increased by 2.49%. Also, shrublands have increased by 2.69% and cinnamon lands by 0.67%. Mixed vegetation, rubber, paddy, and coconut have decreased by 0.19%, 0.56%, 3.7%, and 0.55% respectively. The beach area

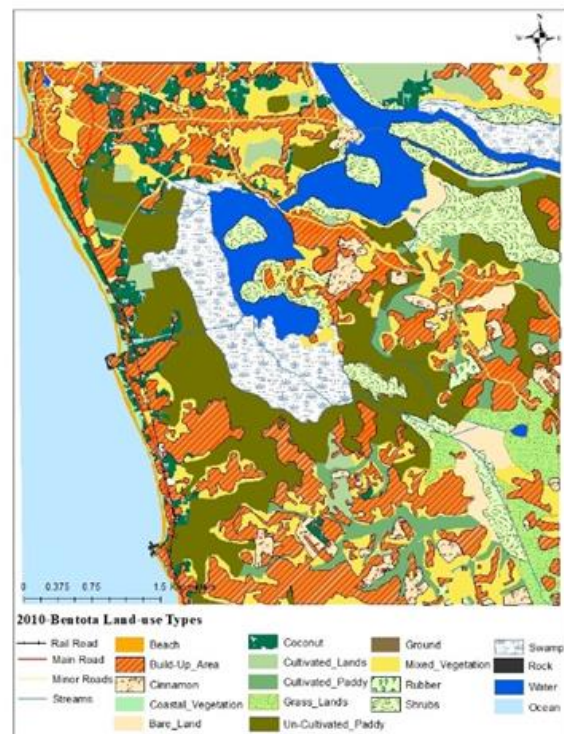
has increased by 0.16% and the coastal vegetation area by 0.27%.

By 2022, the built-up area has increased by 2.62%, cinnamon by 0.48%, and shrubland by 1.25%. In addition, mixed vegetation has decreased by 0.75%, rubber by 0.04%, rice by 2.68% and coconut by 0.36%. The coastal area has decreased by 0.01% and the coastal vegetated area has increased by 0.09%. Thus, it is clear that as in Hikkaduwa, in Bentota, the built-up area increases while other types of land use gradually decrease. When comparing the current situation of the built-up area in the two areas, it is clear that Hikkaduwa has more built-up area out of the total area.

(a)



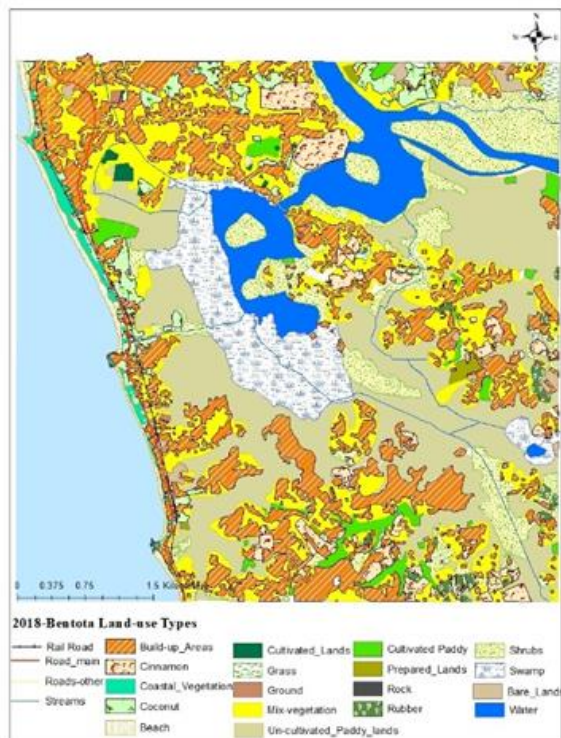
(b)





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(c)



(d)

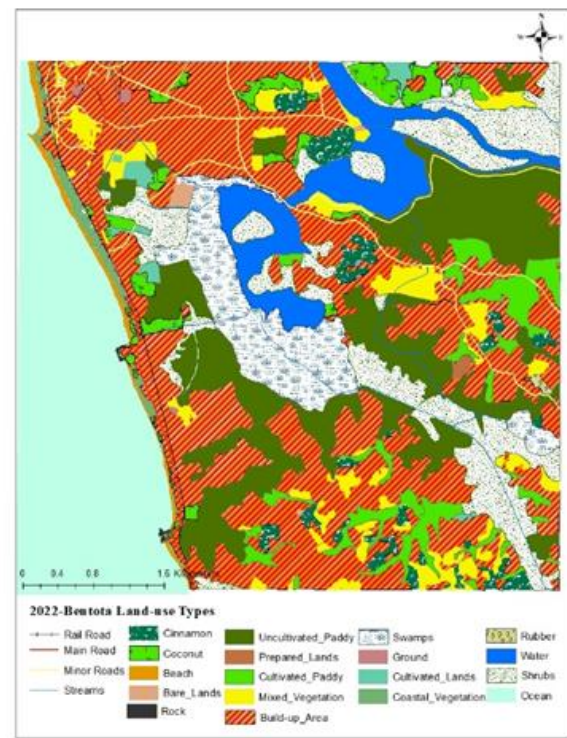


Figure 6: Land-use maps of the Bentota area in 1984 (a), 2010(b), 2018(c), and 2022(d)

Source: Created by the author based on Google Earth images

Mixed land-use diversity in Hikkaduwa and Bentota areas

The entropy values calculated for the years 1984, 2010, 2018 and 2022 in the selected area of Hikkaduwa were 0.767, 0.744, 0.704, and 0.694 respectively

(Table 1). An entropy value of 1 represents an equal proportion of each land use type while 0 represents the presence of a single dominant land-use of the area (Piyadasa and Ranasinghe, 2017).

Table 1: Land use change from 1984-2022 in the Hikkaduwa area and entropy value calculation for land use types in 1984

Type of Landuse	1984					2010		2018		2022	
	Extent (hec)	%	$l(P_i)$	$\ln(P_i)$	$(P_i) * \ln(P_i)$	Extent (hec)	%	Extent (hec)	%	Extent (hec)	%
Mix vegetation	1070	37.85	0.378	-	-	767	27.07	508	17.94	496	17.51
Swamp	10	0.35	0.004	-	-	65	2.31	58	2.04	42	1.49
				5.521	0.019						



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Beach	32	1.13	0.011	-	-	22	0.78	15	0.54	18	0.64
				4.510	0.051						
Rock	0	0.00				3	0.10	3	0.10	4	0.14
Rubber	92	3.26	0.033	-	-	25	0.87	16	0.55	12	0.41
				3.411	0.111						
Paddy (cultivated)		0.00	0.00	0.00	0.00	0.00	0.00	217	0.00	0.00	0.00
Paddy(Un-cultivated)		0.00	0.00	0.00	0.00	0.00	0.00	26	0.00	0.00	0.00
Paddy (Total)	482	17.05	0.170	-	-	365	12.8	243	8.59	238	8.40
				1.772	0.302		8				
Bare Lands	0	0.00	0.00	0.00	0.00	34	1.19	52	1.83	27	0.95
Grounds	0	0.00	0.00	0.00	0.00	5	0.19	2	0.07	7	0.25
Buildings	271	9.60	0.096	-	-	598	21.1	990	34.95	1053	37.17
				2.343	0.225		1				
Cinnamon	113	4.00	0.040	-	-	195	6.88	214	7.56	249	8.79
				3.219	0.129						
Coastal vegetation	0	0.00	0.00	0.00	0.00	8	0.28	4	0.15	0	0.00
Coconut	350	12.38	0.124	-	-	257	9.06	219	7.72	209	7.38
				2.087	0.258						
Grass Lands	0	0.00	0.00	0.00	0.00	2	0.05	41	1.44	0	0.00
Mangroves	0	0.00	0.00	0.00	0.00	125	4.40	110	3.87	151	5.32
Shrubs	0	0.00	0.00	0.00	0.00	66	2.31	56	1.99	0	0.00
Water	390	13.81	0.138	-	-	298	10.5	290	10.24	304	10.73
				1.981	0.273		1				
Tea	0	0.00	0.00	0.00	0.00	0	0.00	3	0.11	15	0.53
Forest	16	0.57	0.006	-	-	0	0.00	9	0.30	7	0.25
				5.116	0.029						
Fish	0	0.00	0.00	0.00	0.00	0	0.00	0	0.00	2	0.07
Total	2827					2833		2833		2833	
Entropy Value (H)	0.7674					0.7448		0.704		0.6914	
Ocean	774					767		767		767	

Source: Created by the author based on land extent calculations from the geometric calculator in Arc GIS 10.8.3.

According to the H values obtained for the years, the land-use is gradually shifting from a proportionally mixed land-use pattern to a single dominant land-use pattern. This may have been due to the rapid development of the tourism industry in Hikkaduwa.

On the other hand, the Entropy values for the selected land area of Bentota for the years 1984, 2010, 2018, and 2022 were 0.740, 0.728, 0.798, 0.718, and 0.729 respectively. As in Hikkaduwa, no discernible gap between the Entropy values can be discerned in Bentota. All values being close to 1 reveal that the



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major land use types in the area are mixed in equal proportion.

Challenges to implement a proper land-use plan to Hikkaduwa.

Hikkaduwa has a tourism industry that was started by local and foreign investors with the strong objective of making a profit from the tourism industry. In 1979, for the first time, the CTB, CCD and the UDA focused on controlling the growth of tourism in the coastal areas to preserve Hikkaduwa's coastal resources through joint administrative institutional measures (CEA, 1984). The relatively low level of environmental problems associated with tourism-led land-use in the Bentota NHR indicates that the existence of the environmental sector of the tourism industry is sustainable.

Even though so many plans have been prepared to improve the physical and human environment of Hikkaduwa, there are still many problems related to land use due to the deficiencies in the preparation and implementation of those plans.

Issues in Planning and Implementation

i. Institutional Issues

In the realm of institutional challenges related to the management and conservation of land and coastal resources, the presence of multiple institutes responsible for these tasks

introduces conflicts during the preparation and execution of plans. Furthermore, the considerable distance between state and provincial-level institutions contributes to strained community relations. This geographical separation adds an additional layer of complexity to the collaborative efforts required for effective resource management.

Additionally, the overall ability to make prompt decisions in response to evolving situations is hampered, further impeding the efficiency of resource management initiatives. The lack of intervention and indifference from land conservation institutes and the tourism industry after the 2004 tsunami has led to ongoing environmental challenges in Hikkaduwa. The collapse of the informal tourism industry after the disaster presented an opportunity for sustainable reconstruction, but due to short-sighted decisions and the failure of institutions to take action, an informal tourism industry emerged instead.

ii. Legal Issues

Legal challenges in the domain of resource management surface due to a lack of enforcement of existing regulations. Additionally, there is a concerning trend of deliberate relaxation of established regulations in ordinances by certain institutions from time to time. These issues contribute to a weakened regulatory framework, undermining the efficacy of legal



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measures intended for the conservation and management of resources.

iii. Funding related issues

Not only in Hikkaduwa, but in the whole of Sri Lanka, the main problem that arises in the implementation of institutional plans and projects is the difficulty of securing funds for them. Many projects proposed to manage waste in Hikkaduwa have stalled due to difficulty in securing funds. Also, large-scale development projects such as the project to create the bypass have been limited to the proposed level for decades due to problems such as the difficulty of securing funds.

iv. Social issues

Problems related to the attitudes of the people

Community involvement in land use planning is crucial, but there are instances where measures have been withdrawn due to obstacles raised by certain public parties. For example, protests against increasing the capacity of a sewage treatment plant and objections to the construction of the Hikkaduwa Bypass.

v. Strongly tied to economic activities associated with coastal resources

Implementing a coastal zoning plan in Hikkaduwa has proved challenging due to the reluctance of coastal residents to relocate from their current economic activities, such as fishing and

tourism, which heavily rely on coastal resources. Despite the benefits that coastal zoning can bring in regulating land use, providing alternative land and convincing people to leave their usual jobs has been met with resistance. This situation has hindered progress in the implementation of an effective coastal zoning plan in Hikkaduwa.

vi. Other Problems

To facilitate the preparation and implementation of a formal land use plan in Hikkaduwa, it is crucial to address the prominent issue of old informal buildings near the coastline. Many of these structures have deteriorated over time and are no longer suitable for use. Thus, a necessary step would be to remove these dilapidated buildings and replace them with new constructions that adhere to the formal land use plan. By doing so, Hikkaduwa can ensure a more organized and regulated coastal development.

CONCLUSION AND RECOMMENDATIONS

The negative impact of land use changes in tourist areas is more severe in Hikkaduwa than in Bentota. The tourism industry has failed to achieve environmental sustainability in Hikkaduwa, despite various measures taken in the past. Institutional, legal, provision-related, social and other problems make it difficult to prepare and implement organized



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development plans. Coastal zoning, which requires the removal of residents faces strong opposition from people who depend on coastal resources for their economic activities. The A2 main road limits tourism development in Hikkaduwa to a narrow area between the coast and the road and stakeholders suggest closing the road and building a bypass to develop the Hikkaduwa town as a tourist town without any hindrance. Ultimately, an appropriate, speedy physical plan is needed to address these challenges in Hikkaduwa.

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