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Impact of Anthropogenic Activities on Coastal Landscape Changes in Unawatuna Coastal Zone, Sri Lanka

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ABSTRACT

Coastal landscape changes are an ultimate result of natural factors, population growth and different anthropogenic factors including tourism. Changes in coastal landscape directly influence on the socio-economic, cultural and environment facets at global, regional and local scales. However, unplanned tourism industry highlighted as a main cause for coastal landscape changes. Understanding and quantifying the spatial and temporal dynamics of coastal landscape changes and its driving factors is essential to put forward the right policies and monitoring mechanisms on coastal growth for decision making. Thus, the objectives of this study were to i) analyse the impact of anthropogenic activities on changing coastal landscape in Unawatuna Coastal zone and ii) identify the temporal changes of coastal landscape and it's in turn effects. The study was conducted in two (02) Grama Nidhari Divisions viz. Unawatuna Central and Yaddehimulla selecting 60 (10%) households out of 600 total households using random sampling method. Questioner surveys, target group discussions and field observations were used as methods of primary data collection. The magnitude of affected geomorphologic features and ecosystems were identified through the analysis of satellite images while changes of coastal landscape in the area were analysed by ArcView GIS. The study found that there was an increased expansion of built up areas in the last 61 years by reducing the coastal vegetation. Some erosion processes and coastal protection methods also highlighted as a driving factors to change coastal landscape. Considering all the observed and analysed data it could be identified that the area has now become the maximum development stage as a tourist area with 52% out of all anthropogenic activities in the area. Further, the study ascertained that within a short period of time from 2002 to 2017, the natural vegetation cover of the shore has been abated and the tendency of build-up areas has been increased. Anthropogenic activities carried out by inhabitants, tourism business people and Department of Coastal Conservation within coastal areas has changed the coastal landscape and which in result to increase the process of coastal erosion. Finally the study concludes that the need of increasing the awareness of all the stakeholders act as driving forces on negative impacts of changing coastal landscape and the importance of preserving the environment.

KEYWORDS: *Coastal Landscape Change, Unawatuna, Erosion, Tourism, Anthropogenic*

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1. INTRODUCTION

The coast is where a land mass meets the sea (The American Heritage Dictionary, 2000).Coastal landscape is shaped by the natural forces of the wind and waves. These geographical forces erode or construct the natural environment, constantly changing its shape. Features of coastal landscapes include beaches, dunes, bays, cliffs, platforms, spits and lagoons. Coastal areas are transitional areas between the land and sea characterized by a very high biodiversity and they include some of the richest and most fragile ecosystems on earth, like mangroves and coral reefs. At the same time, coast are under very high population pressure due to rapid urbanization processes. More than half of the world population live in coastal area and its number is on the rise. On the other hand, coastal areas are those which are most visited by tourists and in many coastal areas tourism presents the most important economic activity. As this reasons coastal landscape have a huge impacts by different tourism related activities.

Humans are the guardians of coastal landscape and they have affected them both positively and negatively. Some of the ways that they have impacted the landscape is by dredging, pollution, constructing buildings, land reclamation, creation beaches, planting exotic vegetation and trees, erosion sea walls and by destroying natural habitats of wild life. Therefore understanding the coastal landscape change in Unawatuna and how anthropogenic activities have influence for it is the subject of this research. Coastal landscape changes is a result from natural factors, population growth and different tourism related activities. Changes in coastal landscape directly influence the socio-economic, cultural and environment facets at global, regional and local scales. However, unplanned tourism industry highlighted as a main drive to alter or change the coastal landscape. Although a number of researches have been carried out on the coastal and coastal landscape changes with a physical perspective, there are limited researches on the study of anthropogenic activities that affect the change in landscape of *Unawatuna*. Although a number of researches have been carried out on the coastal and coastal landscape changes with a physical perspective at international and local levels, there are limited researches on the study of anthropogenic activities that affect the change in landscape of *Unawatuna*. Therefore, this research is a considerable contribution to fill the knowledge gap of coastal landscape changes in Sri Lanka with special reference to anthropogenic activities. Thus, the objectives of this study were to i) analyse the impact of anthropogenic activities on changing coastal landscape in *Unawatuna* Coastal zone and ii) identify the temporal changes of coastal landscape and it's in turn effects.

2 MATERIALS AND METHODS

The study conducted in the coastal area of *Unawatuna*. This area represents the *Habaraduwa* divisional secretariat in

Galle district. There are fifty one *Grama Niladari* divisions in this divisional secretariat. Among them, *Unawatuna* Central *Grama Niladhari* Division and *Yaddehimulla Grama Niladhari* Division's coastal zones have drastic destructions on coastal landforms and ecosystems due to the anthropogenic activities. Hence, *Unawatuna* coastal zone is selected as the study area covering these specific aspects. To fulfil the fair of the study, out of the number of 304 households in *Unawatuna* Central GND and 296 of households in *Yaddehimulla* GND, 60 (10%) households were selected using random sampling method. To achieve the more realistic and correct results, consulting the officers and workers who enrolling with the government institute, and Private sector owner's doctrines more essential for the study. The sample collected by employing judgement sampling method.

Required data for this study was collected from both primary and secondary sources. For the identification of landscape changes in the study area, secondary data was collected from *Habaraduwa* divisional secretariat office, Coastal Conservation Department and Survey Department of Sri Lanka. Questioner surveys, target group discussions and field observations were carried out as relevant methods for primary data collection. The magnitude of affected geomorphologic features and ecosystems were identified through the analysis of satellite images while changes of coastal landscape in the area were analysed by using ArcView GIS. Using these data, a tentative geomorphologic map was constructed to demarcate the changes of geomorphologic units and this was verified through the field works. Aerial photograph of 1956, 1976, 1986 and 1996 were pre-processed using ArcGIS. Comparison of the changes for each year was done referring the Google maps 2002 to 2017. Buildings near the beach area were calculated by digitizing Google maps to identify the coastal landscape changes.

3 RESULTS & DISCUSSION

3.1 Existing Anthropogenic Activities in the Study Area

Generally, the results of this study indicated that there was an increased expansion of built up areas in the last 61 years by reducing the coastal vegetation. Some erosion processes and coastal protection methods also highlighted as a driving factors to change coastal landscape. Considering all the observed and analyzed data, it could be identified that the area has now become the maximum development stage as a tourist area. All the features of under urbanization such as population growth, migration pattern highly effected for that dynamism. Among them residence in the coastal zone, fishing and aquaculture, shipping, land use practices (Agriculture, Industrial development and unauthorized constructions) are main existing anthropogenic activities. Another reason for the destruction of the *Unawatuna* Beach is the breakwater that was built by the Coast Conservation Department. The breakwater, which stretches nearly a kilometre into the ocean has disturbed the natural balance of the eco-system, and is

washing away the sand from one half of the beach, and depositing it on the other half.

As coastal zone of *Unawatuna* area provide a variety of goods and services, they have long been used for many different activities such as settlement, fishing, agriculture, forestation, urban development, industrial expansion, mining and recreation. Population growth was the main factor because it causes to change the coastal landscape. Settlement area was expanded to near the coastal zone and people favour coastal zone for their living because these areas provide many benefits, including biological productivity and ecosystem services as highlighted by Turner *et al*. (1996) and Priess and Volk (2012) in other countries. The expansion of urban areas as a consequence of population growth emerges significant impacts to the environment, including coastal land cover change and habitat destruction, increasing beach erosion, coastal flooding and inundation, and pollution. According to data and information obtained from the field study, several outstanding anthropogenic activities can be identified as depicted in Figure 1.

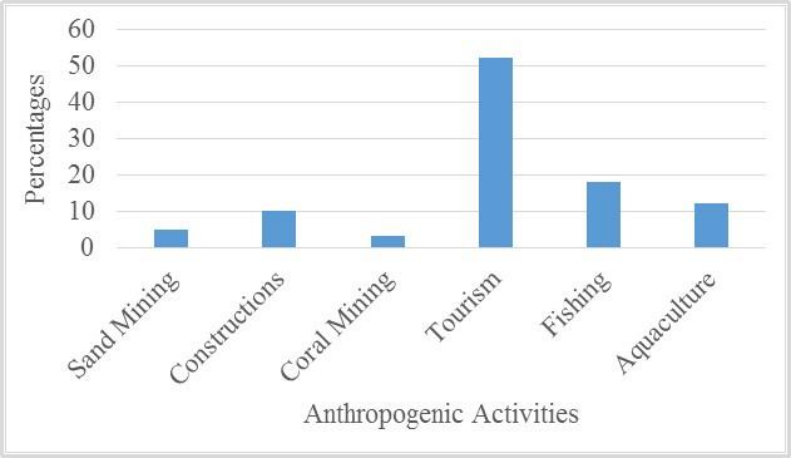

Figure 1: Existing Anthropogenic Activities in *Unawatuna* Coastal Zone

Source: Field Survey, 2017.

Among the areas of *Unawatuna* Central and *Yaddihimulla*, majority of people mainly engage in the tourism industry in *Yaddehimulla*. The historic *Welle Devalaya* (shrine) located along the coastal belt has also contributed to the development of tourism in this area. Due to the construction of tourist spots irregularly violating the Coast Conservation Act, the natural beauty of the shore has been damaged. The construction work has blocked the road leading to the shrine *Devale.* The unplanned nature or the irregular construction of the buildings and the pollution of the coastline destroy the enchanting environment of tourists. A systematic program should be prepared

for the beauty of the beach and the beauty of the environment. Currently ,while visiting the Coastal area, tourist hotels (*Calamander Unawatuna* beach, Coco Bay, *Unawatuna* Beach Resort, Blue Eyes Inn Hotel Dunes, *Unawatuna* Hotel, etc), restaurant (Lucky Tuna, Happy Spice ,Black & White Restaurant, etc) ,Guest house (Black Beauty Guest House, French Lotus, Primrose, Sunny Mood ,My Place, etc), tourist shopping complex (Made In Ceylon, *Unawatuna* Pearl Drive Centre) and unauthorized constructions could widely be seen. The tourism industry is basically a host of anthropogenic activities throughout the study area. There are many tourist activities such as boat service, diving and swimming in the coastal area. Chairs, tables, beach beds, sun shade huts are abundant on the beach to spend leisure time for tourist.

Unauthorized constructions are another feature that can be seen in study area. Although these constructions removed by the Coastal Conservation Department, they have been rebuilt and are associated with tourism related activities. Small cloth shops and ornaments shops as well as small cafes are examples in this regard. Although these unauthorized constructions have been demolished in several times, those have been rearranged for different tourism related activities. For the last time, all the unauthorized constructions in the study area were demolished by the Coast Conservation Department on 2017 November 6 as depicted in Figure 2.

Figure 2: Demolishing Unauthorized Constructions at *Unawatuna* beach on 2017.11.06
Source: Field Survey, 2017.

The information on coral reefs mining that obtained through field study is very limited. However, the inhabitants in this area stated that some people are mining coral reefs secretly, although the rules and regulations in this respect restrict the

breaking up of coral reefs. There is no the past as per the interviews done. Sand mining is another existing anthropogenic activity that operates in the study area somewhat. Some of the youths are secretly doing sand mining, while the hotel and restaurant owners also take sand near their construction to open up beach platforms. However, the Coast Conservation Department has prohibited the sand extraction process and weekly comments are made by the field officers of the department.

As equally significant anthropogenic activities that must be considered over the range of spatial and time scales, activities along the coast: Building houses on land reclamation or within sand dune areas and development area has a long-term impact on shoreline change. Protective seawalls lead to erosion at the end of the structures, generate beach scouring at the toe of seawall and shorten the beach face This can occur in the short term (less than five years) or the long term (more than five years). Other structures such as groynes and jetties typically cause erosion down-drift of the structure within a short period of time (between five and ten years). Removal of dune vegetation and mangroves will expose low energy shorelines to increased energy and reduced sediment stability, causing erosion within five to ten years.

more coral reefs mining as it was done in

Cannel diversion causes reduction of sediment supply to the coast that contributes to coastal erosion. The effects of cannel diversion in terms of coastal erosion are not straightforward, but there are mid-to long-term impacts (20 to 100 years) with spatial scales approximately from one to 100 kilometres.

3.2 Temporal changes of Coastal Landscape

From 1956 to 2017, aerial photographs, satellite images and Google Maps were used to study the nature of the landscape in *Unawatuna* beach, which possible to clearly identify the coastline. Especially these maps can be used to analyse the changing patterns of landscape using the GIS tool. From 1956 to 2017 the coastal landscape of the study area has undergone a drastic change in several times. In addition to anthropogenic factors, natural factors have also been affected on these changes. Maps can be analysed to prove the extent of the landscape changed due to various anthropogenic and natural activities in each year. Figures 3 to 6 depict the temporal changes of coastal landscape from 1956 to 1996 in four time durations.

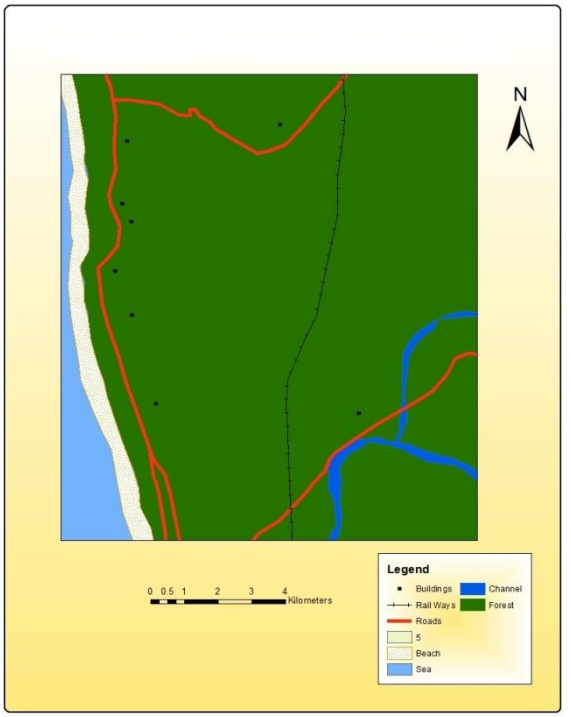

Figure: 3 *Unawatuna* Coastal Area-1956
Source: Compiled by authors based on Survey Department, Aerial Photograph, 2017

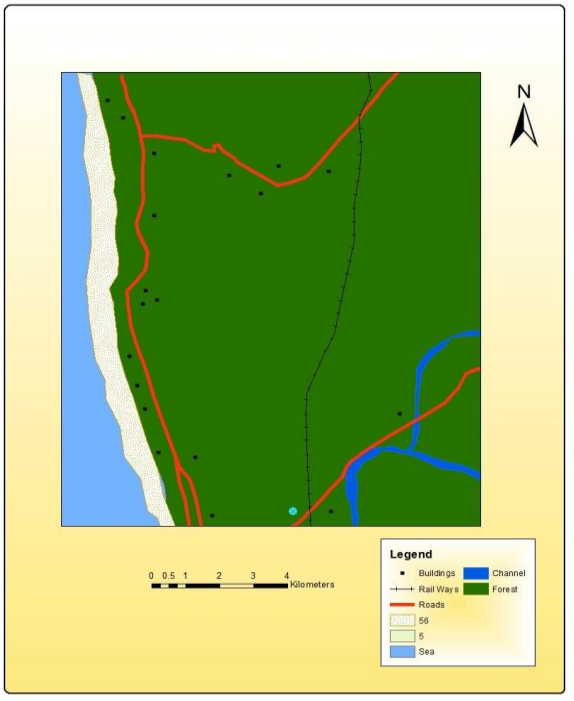

Figure 4: *Unawatuna* Coastal Area-1976
Source: Compiled by authors based on Survey Department, Aerial Photograph, 2017

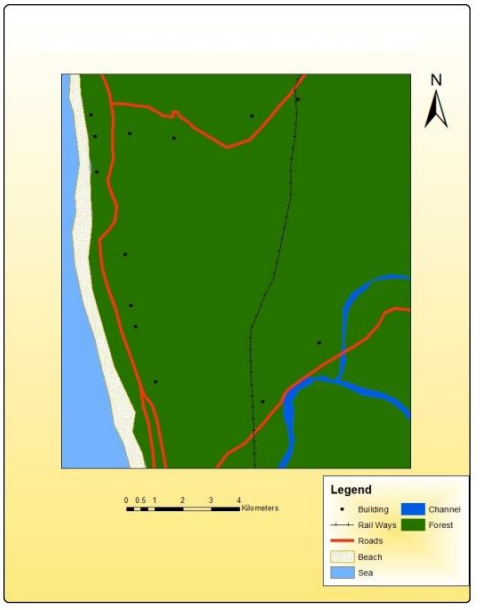

Figure 5: *Unawatuna* Coastal Area-1986
Source: Compiled by authors based on Survey Department, Aerial Photograph, 2017

Figure: 6 Unawatuna Coastal Area-1996
Source: Compiled by authors based on Survey Department, Aerial Photograph, 2017

The maps in Figures 7, 8 and 9 show how coastal areas have changed over the years 2002, 2009 and 2017. The special feature is the destruction of the coastal vegetation system in the year 2002 and the construction of buildings in those areas in 2017. Thus, the conclusion is that within a short period of time from 2002 to 2017, the natural vegetation cover of the shore has been abated and the tendency of build-up areas has been increased. This has a direct impact on the changing coastal landscape.

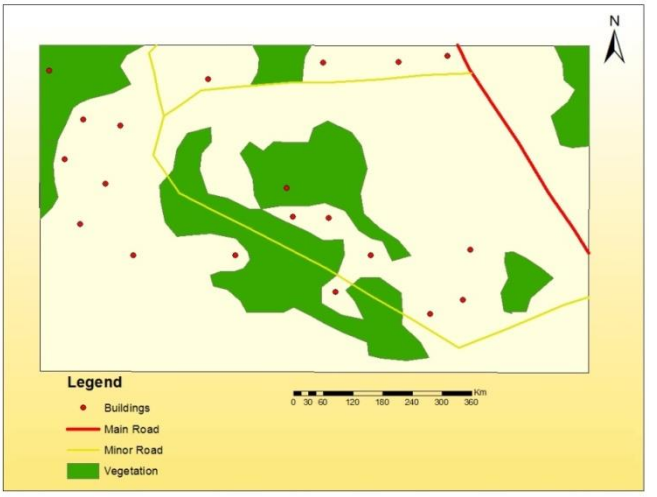

Figure 7: Landscape Changing Pattern, 2002
Source: Compiled by authors based on Survey Department, Aerial Photograph, 2017

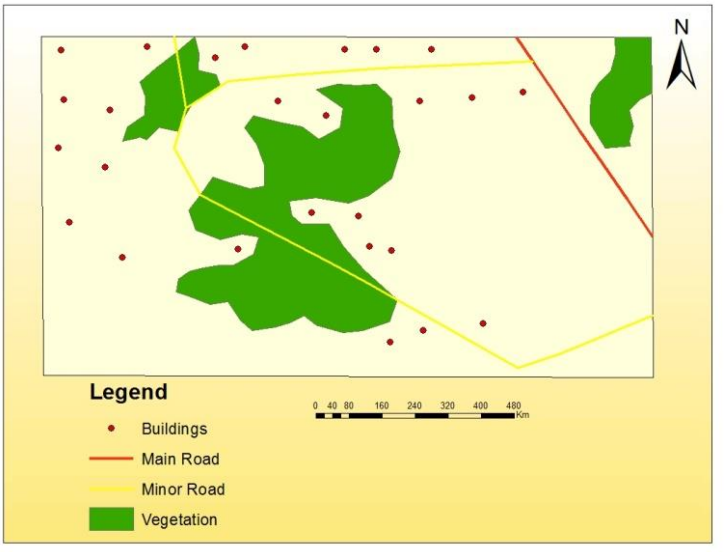

Figure 8: Landscape Changing Pattern, 2009
Source: Compiled by authors based on Survey Department, Aerial Photograph, 2017

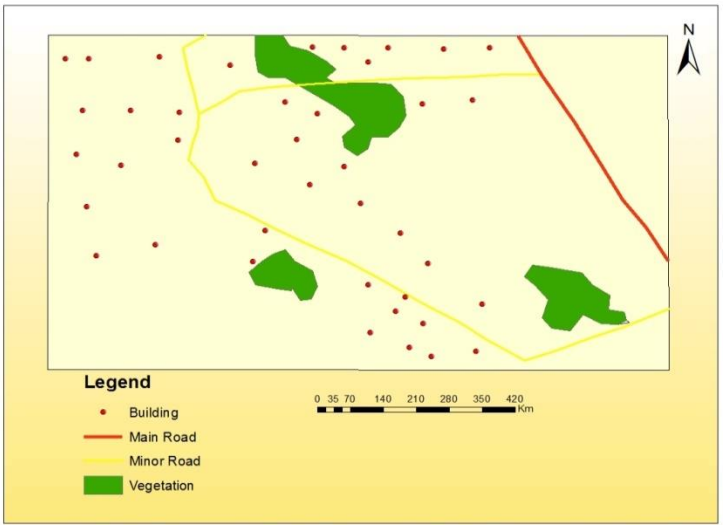

Figure 9: Landscape Changing Pattern, 2017
Source: Compiled by authors based on Survey Department, Aerial Photograph, 2017

The calculation of beach huts in 2002 and 2017 on the *Unawatuna* Beach has revealed how tourism has grown over the population and therefore, the pattern of coastal landscape has changed.

Figure 10: Google Image for 2005-2006
Source: Google Earth Pro

In 2005 and 2006, the number of buildings built around the coastline as depicted in Figure 10. In 2006, the coastline was complicated. Tourism and fishing have been growing around the Coastal area is confirmed by the surrounding boats and tourist buildings. The Coast that was destroyed by the tsunami has recovered in 2006, and since 2004 to 2006, there have been many discernible changes in the coastal landscape. By the end of 2012, at the request of people, the Coast Conservation Department set up a breakwater and further tourism increased. By 2012, again, the shore has changed. The coastline has

been largely created by the breakwater near *Welle Dewalaya*, At the same time, people have increased tourist activities on the coast. As the map shows, the coastal line near *Welle Devalaya* is full of tourism related activities. But the other part of this beach has been rapidly deteriorating from .2014. Due to the violent waves of the area, this coastal area has become deeper than 8-7meters.

The reason for the destruction of the *Unawatuna* Beach is the breakwater that was built by the Coast Conservation Department. The breakwater, which stretches nearly a kilometre into the ocean has disturbed the natural balance of the eco-system, and is washing away the sand from one half of the beach, and depositing it on the other half. To prevent the erosion that is currently taking place, large rocks have been placed along the shore, and this has become a hindrance for tourists. The opinion of the locals of *Unawatuna* is that the Breakwater be destroyed. Even though the authorities acquiesced to their plea, it is only the top layer of the Breakwater that has been removed thus far. The livelihoods of the locals too have been gravely affected because a wide network of hotels, restaurants and other businesses depend on the tourists arriving to the beach for their survival.

Figure 11: Google Image for 2012, 2014
Source: Google Earth Pro

It is clearly shows from Figure 11 that coastal debris in the *Welle Dewalaya* temple in *Yaddehimulla* area in 2014 image. At the same time, the other side of this coastal strip, such as *Unawatuna* central, is found to be eroded by shore towards the land.

From the Google Maps in two periods of 2015, it was highlighted that coastal erosion process has taken place by February 7, 2015, due to the fact that of the coral reef has severely been damaged. However, this situation has changed by December 2015 due to the building of 47 meters wide new coastline with sand nourishment by Coast Conservation Department (Figure 12 and 13).

Figure: 12 Google Image for *Unawatuna* Coastline on 2015.02.07
Source: Google Earth Pro

Figure 13: Google Image for *Unawatuna* Coastline on 2015.12.22
Source: Google Earth Pro

There is a wide coastal area beside the coastal line near the *Wella Dewale* due to that the Coast Conservation Department feeds artificial sand as depicted in Figure 14.

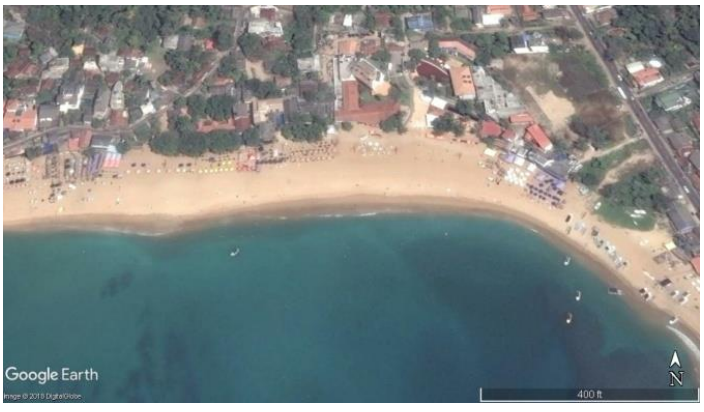

Figure 14: Google Image for *Unawatuna* Coastline 2017
Source: Google Earth Pro

When compared to Google Photos in 2002 (Figure 15), large numbers of tourism related buildings, temporary structures and various tourist activities are located in the coastal belt fed by artificial sand in 2015 (Figure 16).

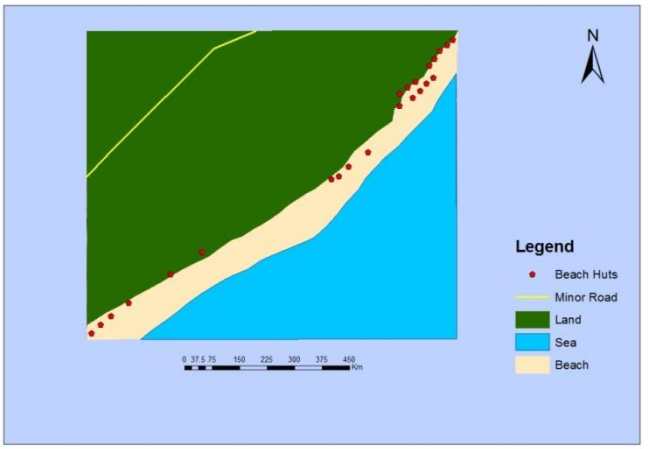

Figure 15: Landscape Changing Map, 2002
Source: Compiled by author based on Survey Department, Aerial Photograph, 2017

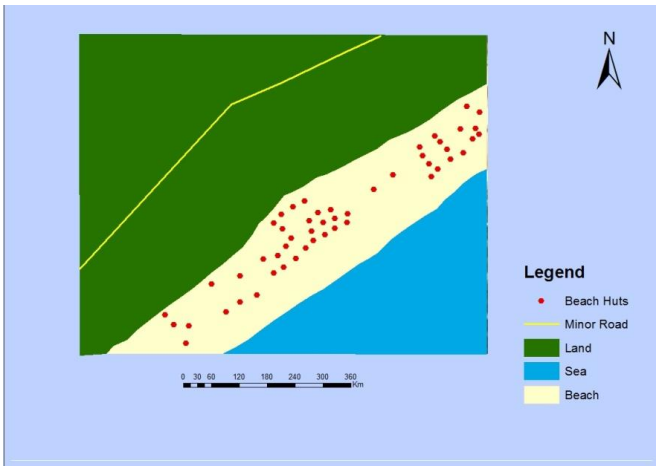

Figure 16: Landscape Changing Map, 2017
Source: Compiled by author based on Survey Department, Aerial Photograph, 2017

Figure17: Changing of Coastal Landscape due to Erosion in *Unawatuna* Beach in 2002 and 2017
Source: Field Survey 2017

This study mainly found that many anthropogenic factors influenced for changing coastal landscape changes which concurs with other studies. Complying with the findings of this study several authors contended that human related driving factors influence in changing the coastal landscape and coastal degradation (Priyanto, 2010; Pellizzaro *et al*., 2014; Mimura, 2008; Priess and Volk, 2012; Dahuri *et al*., 2004)

4. CONCLUSIONS

Coastal Landscape changes have wide range of consequences at all spatial and temporal scales. Because of these effects and influences, it has become one of the major problems for environmental change as well as natural resource management. Identifying the complex interaction between changes and its drivers over space and time is important to predict future developments, set decision making mechanisms and construct alternative scenarios. Anthropogenic activities carried out by the community of the area, business community of the tourism sector and the Department of Coast Conservation within coastal areas caused to change the coastal landscape and which in result to increase the process of coastal erosion. When the total areas in *Yaddehimulla* and *Unawatuna* Central is considered, the residential activities have been gained more land in *Unawatuna* Central while *Yaddehimulla* has gained more areas for tourism related activities.

The trend and extent of changes in built up areas are likely to continue with the rapid development of infrastructure, economy and increasing of population. It has led to major efforts to manage coastal erosion problems and to restore coastal capacity to accommodate short-and long-term changes induced by anthropogenic activities, extreme events and (not relevant the sea level rising. The erosion becomes worse whenever the countermeasures applied are inappropriate, improperly designed, built, or maintained and if the effects on adjacent shores are not carefully evaluated. The Coast Conservation Department suggests building Green Boarders (Haritha Theera) to improve the quality of the *Unawatuna* Coastal area as a future plan. But still it has not come into action. Government should pay attention and sponsored to precede such schemes to conserve the coastal area. Finally the study concludes that the need of increasing the awareness of all the stakeholders who act as driving forces to increase coastal erosion on negative impacts of changing coastal landscape and the importance of preserving the environment.

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