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Assessing Landcover Changes from Coastal Tourism Development in Ghana: Evidence from the Kokrobite-Bortianor Coastline, Accra.

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Abstract

As a major driver of landcover change, tourism-based developments are growing rapidly along different part of Ghana's 560 km coastline. Kokrobite and Bortianor, with their serene environment, relatively clean, and pristine sandy beaches, have become popular coastal tourism destinations for tourists, recreationist, and holiday seekers in the Greater Accra region of Ghana. This study assesses how landcover changes emanating from coastal tourism establishments such as hotels, resorts, restaurants, and recreational facilities are affecting the socio-ecological landscape of the area. In this study, we utilize the maximum likelihood supervised classification along with post classification change detection techniques to analyze Landsat images for the years 1990, 2000 and 2010. Landcover maps of the different years were created and used to analyze changes occurring along the coastline of Kokrobite and Bortianor. Assembled results showed that built-up areas associated largely with tourism-based establishments have increased substantially from 1.02 km^2 (16%) to 2.20 km^2 (34.6%) between 1990 and 2010. Approximately 60% of the Kokrobite and Bortianor coastline's natural ecosystem has been converted into different forms of tourism-based facilities such as hotels, resorts and settlements. Conversely, all forms of vegetative cover–riverine, dense active, and shrub/herbaceous cover are declining significantly. Increased tourist and recreationist demands along with the rapid urban growth in Accra is a preeminent cause of the current trends of developments. Regrettably, majority of the tourism-based establishments are unplanned, lacking authorization from development institutions and agencies, a reflection of the lack of a coherent integrated coastal zone management plan and functional urban landuse policy in Ghana. The result is a significant encroachment and degradation of the coastal ecosystems. Considering the already vulnerable state of most coastal areas in Ghana including Kokrobite and Bortianor, such developments could aggravate social and ecological vulnerability if left unchecked. In line with this, this study recommends the urgent need for a functional integrated coastal zone management plan and resourced institutions and agencies to enable effective management and regulation of developments in coastal zones in Ghana. Ultimately, coastal tourism, with all its recognized and potential socio-economic benefits to local and national economies can only be sustained with an ecologically productive coastal zone.

Keywords: Tourism, Coastal tourism, Landcover, Kokrobite and Bortianor, Erosion

1.0 Introduction

Notwithstanding the occasional global economic shocks in recent years, international tourism arrivals has continued to experience growth, particularly over the last half century. From 25 million in 1950 to 1,035 million in 2012, global tourists arrivals is expected to reach 1.8 billion in 2030 (UNWTO, 2014). According to the United Nations World Tourism Organisation (UNWTO), international tourism receipts grew by 4% in 2012 generating over US$1,075 billion in revenue. Tourism is thus, now of major socio-economic significance, recognized in developed and developing countries. It is now considered one of the fastest growing service industry in the world (UNWTO, 2014).

Since the 1960s, many developing countries have focused on tourism to generate additional jobs and income, to raise foreign exchange earnings and to diversify their economy (Sharpley and Telfer, 2002; Baoying and Yuanqing, 2008). One of the oldest and currently fastest growing sector of the global tourism industry is coastal or marine tourism. This form of tourism is generally dependent on the physical environment with the beach

serving as its main resource (Hall, 2001). While coastal zones remain the focus of coastal tourism, it occupies less than 15% of the earth's land surface, but yet accommodates more than 44% of the world's population (UNEP, 2006). The attraction of coastal zones to human developments is largely attributable to the multiple socio-economic functions, environmental services that it provides as well as its resilience to disturbances (Mulder *et al*., 2011; Sellamuttu *et al.*, 2011).

As one of the largest segments of the tourism industry, coastal tourism dates back to the Roman era when holiday villas were available on the northern sides of the Bay of Naples (Wong, 1993). From the 18th century emerged the 'grand tours'to natural and cultural features of the continents with the Swiss Alps and coasts of France, Italy and Spain being famous attractions. In the late 19th century, wealthy Americans enjoyed visits to coastal areas particularly along the Florida and California coastlines (Ceballos-Lascuráin, 1997). The current rapid growth in global tourism and specifically coastal tourism has its own benefits and cost implications. While much of the emphasis has often been on the economic benefits associated with its development in both developed and developing economies, comparatively little attention has been given to the pronounced environmental and social impacts (Hall, 2001). Nonetheless, there is no escaping the fact that a booming coastal tourism sector usually associated with the construction of hotels, resorts and the operation of related facilities will fundamentally alter the coastline ecosystem and traditional landuse patterns in host communities (Wong, 1993; 2001; 2009). Meryem *et al*. (2010) draws attention to the impacts of coastal tourism on environment by elaborating on it as a major driving force behind landuse and landcover changes in many coastal tourism destinations in Turkey. Holden (2000) explains how demand for tourism has increased the pressure on coastal areas of high natural and visual value using the Mediterranean coastal regions as case study destinations. In the view of Seto *et al*. (2002), growing population and increasing socio-economic necessities put pressure on landuse often resulting in unplanned and uncontrolled urbanization in many coastal communities.

Historical data on landuse and landcover changes can provide critical input for decision-making on environmental management and planning for future landuse (Prenzel, 2004; Fan *et al*., 2008). In assessing the effects of tourism-based establishments on coastal landscapes, satellite remote sensing and Geographical Information Systems (GIS) tools have become useful for generating and analysing data required for planning coastal management on a sustainable basis. It is well established that, the analysis of satellite imagery helps in defining land cover types and also facilitates the documentation of major natural and human-induced changes in landcover in successive years. Remote sensing and GIS have been used in various coastal zone studies including mapping of coastal ecosystems (Chauvaud *et al*., 1998; Dahdouh-Guebas, 2002; Tzatzanis, 2003; Serraa *et al*., 2008), change detection (Ciavola *et al.,1999;* Yagoub and Kolan, 2006; Sesli *et al*., 2009;) biotope mapping (Downie *et al*., 1999; Malthus and Mumby, 2003), and monitoring (Pasqualini *et al.,* 1998; Rao *et al*., 1999; Donoghue *et al*., 2002; Chen *et al*., 2009; Frost, 2009). In this paper, we examine the current state of landcover as a result of increasing tourism-based establishments in two popular coastal tourism destinations of Kokrobite and Bortianor located in Accra, the capital city of Ghana. Specifically, the study assesses how the recent patterns of landcover and landuse change driven by tourism infrastructure development is impacting on the sustainability of the socio-ecological environment of the host communities.

2.0 Study Location, Materials and Method

2.1 Location

In Ghana, tourism has served as a means of diversifying the economic base beyond agriculture and industry which have dominated the economy since independence (Teye, 1998; GSS, 2006; GTB, 2010). Ghana's tropical climate and diverse 540 kilometer coastline covering four administrative regions (Volta, Greater Accra, Central and Western) have made it an important area for coastal tourism development. Bortianor and Kokrobite, the two study communities in the Greater Accra region are well known coastal tourism destinations for both foreign and domestic tourists. The beaches serve as ideal locations for sunbathing, swimming and other forms of water sports. Although the Bortianor and Kokrobite coastline were amongst the eight areas proposed for beach resort development under the Ghana Tourism Development Guide (1975-1990) and the National Tourism Development Plan (1996-2010), implementation of these plans by the Ghana government have been fraught with economic and political limitations (Teye, 1998). As such, the set-out development standards and design values for resort developments enshrined in these development plans have not been implemented.

Kokrobite (5°30′ N and 0°22′ W) and Bortianor (5°31' N and 0°20' W) are adjoining communities located on a stretch of beach along the Atlantic Ocean. Generally, both communities lie in the coastal plain surrounded by a series of isolated hills to the north and the Gulf of Guinea to the south. Figure 1 is a topographical map showing Kokrobite and Bortianor. A considerable part of Kokrobite and Bortianor is covered by the protected wetland;

the Densu Delta Ramsar site. The Densu Delta wetland declared a Ramsar site on 14th August, 1992 covers an area of 5,892 hectares. Ecologically, the wetland comprises of lagoons, sand dunes, salt pans, marshy and scrub vegetation. Mangroves in this area which are known to provide physical protection for the shorelines against erosion is under serious threat (Armah and Amlalo, 1998). Bortianor and Kokrobite are noted amongst the coastal towns experiencing severe erosion at a rate of 1.30 meters per year (Appeaning-Addo *et al.,* 2008).

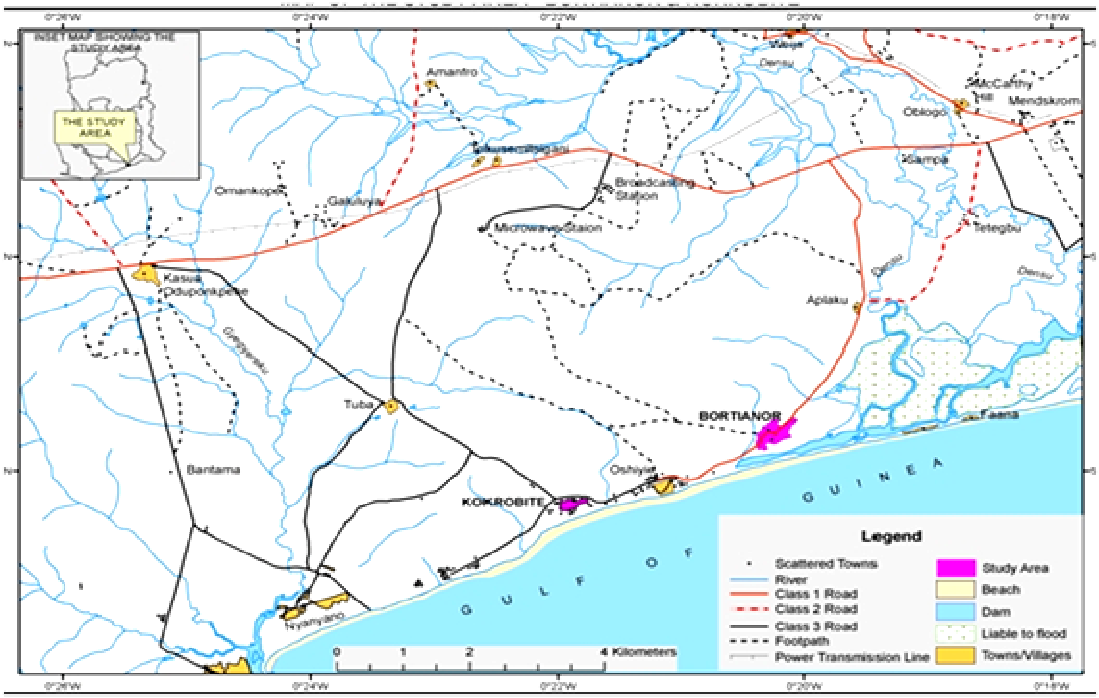


Figure 1: Map showing the locations of Kokrobite and Bortianor

In terms of climate, Kokrobite and Bortianor fall within the Dry Coastal Equatorial Climate (Finlayson *et al.,* 2000) which covers the entire coastal belt of Ghana. The rainfall pattern in the area is bi-modal with an annual mean of 790 millimeters. The average annual temperatures range between 25.1°C in August and 28.4°C in February with March being the hottest month. The coastal savannah vegetation with a mixture of grassland corresponds with the areas climatic conditions. The Coconut palm (*Cocos nucifera*) dots the coastline of Kokrobite whereas Bortianor's coastline is made up of predominantly mangrove species (*Rhizophora racemosa*).

Kokrobite and Bortianor are considered among the fastest urbanising communities in the Greater Accra region with populations of 4,183 and 7,608 respectively, according to the 2010 National Population and Housing Census (GSS, 2011). Settlements in Bortianor and Kokrobite are a mixture of nucleated and dispersed. In Kokrobite, the area close to the coastline is built-up and occupied by indigenes. Bortianor also has a similar pattern of settlement but, the main difference being that indigenes here have abandoned the coastline to be settled by migrant fishermen because of the vulnerable state of the coastline to coastal erosion (Oteng-Ababio *et al.* 2011). Fishing is the most dominant economic activity in Bortianor and Kokrobite engaged in by over 80% of the population. Farming is undertaken on small scale subsistence level. The growth in coastal tourism in recent years in the study locations has seen an increasing number of local indigenes and migrants working in bars, restaurants, hotels and resorts mainly as cooks/caterers, waitresses, tour guides, handicraft manufacturers, labourers and other forms of unskilled jobs.

2.2 Methods

Datasets

The datasets used for this study were: (a) a Landsat Thematic Mapper (TM) image taken in January 1990 (b) a Landsat Enhanced Thematic Mapper (ETM+) image taken in February 2000, (c) a Landsat Enhanced Thematic Mapper (ETM+) image taken in January 2010 and (d) 1:50,000 topographic map. These images were obtained from the United States Geological Survey (USGS), and delivered through the Centre for Remote Sensing and Geographic Information System (CERSGIS), at the University of Ghana, Legon. The topographic map was obtained from the Ghana Survey Department. The Landsat images were multi-spectral with spatial resolutions of 30m each, the 6 visible and near infrared bands at 30m resolution were processed and used for the analysis.

Data Processing Approach

The raw satellite images were converted from Tag Image File Format (TIFF) to IMG file format in ERDAS Imagine 9.2 in order to ensure compatibility of the images with other ERDAS Imagine files. Georeferencing (rectification) of the images was done using 1:50,000 topographic map from Ghana Survey Department in ArcGIS 9.3. Unsupervised classification was first utilized to classify all the images. Interactive Self-Organising Data Analysis Technique Approach (ISODATA) was used to perform the unsupervised classification with the maximum iteration set at 99, while the convergence threshold was set at 0.9 and the number of classes was set at 40. Groundtruthing was done using thematic maps from initial unsupervised classified images and Global Positioning Systems (*Trimble Juno Handheld).* This was later compared to features on the images for the study area to derive positional accuracy of landuse and land cover map. Accuracy of the GPS was 3-5metres. Supervised classification of the images was done using the ERDAS IMAGINE 9.2 based on previous knowledge from the unsupervised classification and field validation. The goal was to obtain landuse classes of interest. Six classes namely; water body, built-up area/bare surface, dense active vegetation, grass/herb cover, riverine vegetation dense and shrub/herbaceous cover were classified. Table 1 provides a description of the six main landuse/cover classes utilized for this study. The classified images were then exported to ArcGIS 9.3 to compose landuse maps for the three time-periods. Post classification analysis was carried out on the classified images for change detection.

Table 1: Description of landcover classes of the study areas

	Landcover class	Description
1	Water body	Includes sea, rivers, streams, lagoons and lakes
2	Built-up area/bare surface	Areas with intense infrastructural developments such as hotels, restaurants, resorts, and parks. Also exposed surfaces due to human activities and natural factors.
3	Dense active vegetation	Thick mat of vegetation, closed fresh greenish bushes
4	Grass/herb cover	A mixture of all forms of grasses and sparsely disperse herbs
5	Riverine vegetation dense	Very active shrub vegetation with scattered trees along water bodies, which looks greenish even in dry season due to the moisture contents
6	Shrub/herbaceous cover	A mixture of shrubs (smaller plants) and herbs

3.0 Results and Discussion

3.1 Landcover Trends and Tourism-based Landuse Situation

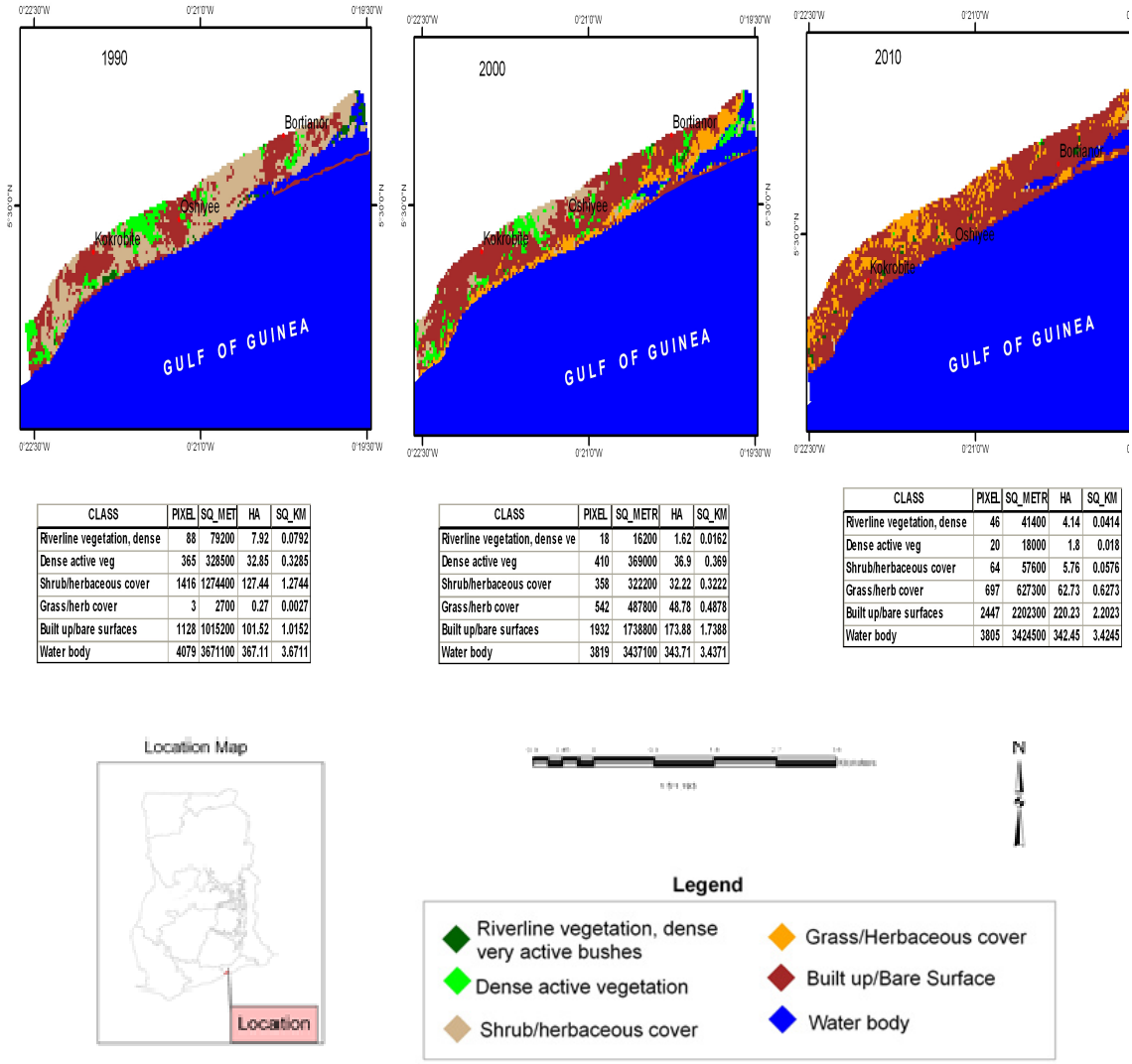
Accuracy assessment for 1990 and 2000 landcover was not carried out as groundtruth data was not available. Table 2 indicate the landcover distribution patterns between 1990, 2000 and 2010 for Kokrobite and Bortianor coastlines. Generally, the coastline of the study communities have witnessed significant changes in landuse and landcover during the past 20 years.

Table 2. Landcover patterns distribution between 1990, 2000 and 2010

	1990		2000		2010	
Landcover class	**Area (km^2)**	**Area (%)**	**Area (km^2)**	**Area (%)**	**Area (km^2)**	**Area (%)**
Built-up/bare surfaces	1.02	16.00	1.74	27.20	2.20	34.60
Riverine vegetation	0.08	1.20	0.02	0.25	0.04	0.65
Dense active vegetation	0.33	5.10	0.37	5.80	0.02	0.28
Shrub/herbaceous cover	1.27	20.0	0.32	5.10	0.06	0.90
Grass/herb cover	0.01	0.04	0.49	7.60	0.63	9.84
Water body	3.67	57.60	3.44	54.0	3.42	53.70
Total	**6.37**	**100.0**	**6.37**	**100.0**	**6.37**	**100.0**

All the landcover classes decreased in utility area except built-up/bare surfaces and grass/herb cover (Table 2). In 1990, built-up/bare surface category accounted for 1.02 km^2 (16%) out of the 6.37 km^2 area of interest for the study. Riverine vegetation on the other hand accounted for 0.08 km^2 (1.2%) of the area whilst dense active vegetation was 0.33 km^2 (5.1%). Shrub/herbaceous landcover constituted about one fifth (1.27 km^2) and 20% of the study area. Water body occupied the largest area of 3.67 km^2 or 57.6% of the area. Figure 2 provides a visual illustration of the landcover classes using maps generated from Landsat satellite images of the study period and the changes occurring.

The landcover change distribution pattern for the year 2000 shows that the built-up/bare surface class increased by almost two folds from 1.02 km^2 (16%) to 1.74 km^2 (27.2%) (Figure 3). Though by 2000, water bodies still occupied the largest proportion of the area, which is more than half of the total area of 6.37 km^2 (54%), there was a marginal decrease of about 4% over the study time period. The shrub/herbaceous cover which in 1990 occupied the second largest proportion had decreased remarkably to 0.32 km^2 (5.1%) from previous area of 1.27 km^2 (20%). By 2010, the landcover distributions of Kokrobite and Bortianor shows that the built-up/bare surface class had increased in prominence with a coverage of 2.20km^2 (34.6%). Although water bodies continue to have the largest coverage with 3.42km^2 (53.7%) by 2010, this had reduced by 3.9% relative to the 1990 size. From Figure 2, one can observe that inland water bodies have reduced considerably and in some cases lost with the area of the Densu Ramsar site being more prominent. Shrub and herbaceous further diminished to 0.06 km^2 making up a mere 0.90% of the area under consideration. Its previous coverage was 0.33 km^2 (5.1%).



CLASS	PIXEL	SQ_MET	HA	SQ_KM
Riverline vegetation, dense	88	79200	7.92	0.0792
Dense active veg	365	328500	32.85	0.3285
Shrub/herbaceous cover	1416	1274400	127.44	1.2744
Grass/herb cover	3	2700	0.27	0.0027
Built up/bare surfaces	1128	1015200	101.52	1.0152
Water body	4079	3671100	367.11	3.6711

CLASS	PIXEL	SQ_METR	HA	SQ_KM
Riverline vegetation, dense ve	18	16200	1.62	0.0162
Dense active veg	410	369000	36.9	0.369
Shrub/herbaceous cover	358	322200	32.22	0.3222
Grass/herb cover	542	487800	48.78	0.4878
Built up/bare surfaces	1932	1738800	173.88	1.7388
Water body	3819	3437100	343.71	3.4371

CLASS	PIXEL	SQ_METR	HA	SQ_KM
Riverline vegetation, dense	46	41400	4.14	0.0414
Dense active veg	20	18000	1.8	0.018
Shrub/herbaceous cover	64	57600	5.76	0.0576
Grass/herb cover	697	627300	62.73	0.6273
Built up/bare surfaces	2447	2202300	220.23	2.2023
Water body	3805	3424500	342.45	3.4245

Figure 2. Landcover maps generated from Landsat Images for the period 1990, 2000 and 2010.

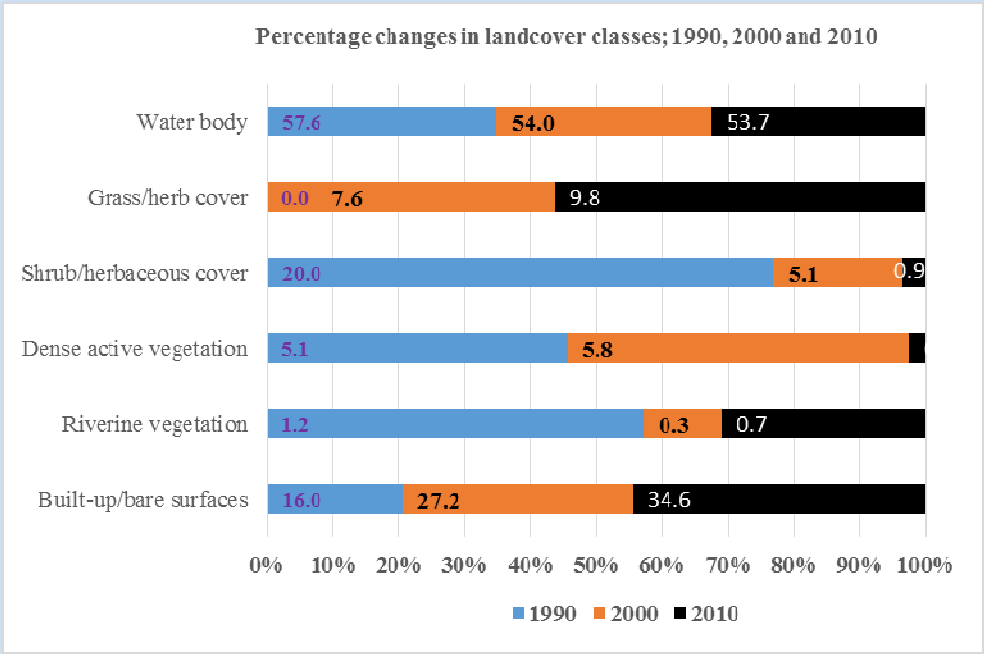


Figure 3: Percentage change in landcover in Kokrobite-Bortianor: 1990, 2000, and 2010

3.2 The Role of Beach Hotels and Resorts in Landcover Change

Over the past two decades, coastal tourism development in Ghana has received enormous boost with effective operation of internationally acclaimed beach hotels and resorts (Addo, 2011). Popular beach hotels including Labadi Beach Hotel, La Palm Royal Beach Hotel (both in Greater Accra), the Elmina Beach Hotel and Coconut Grove Hotel (both in Central region) as well as Busua Beach Hotels are amongst the most recognized chains along the west coast of Africa. The National Tourism Authority (erstwhile Ghana Tourist Board) reports of increasing development and growth in beach hotels and resorts for domestic and international tourists along the entire coastline of Ghana (GTB, 2010). In Kokrobite and Bortianor, tourism-based development projects started in 1990s with small scale hotels. One of the earliest and notable hotels established in the 1990s is Big Milly's Backyard that aimed purposely at serving the needs of the "drifter" and "explorer" type of tourists. Since the 1990s, developments ranging from private residential properties and tourism-based facilities in the form of restaurants, guesthouses, hotels and resorts have intensified. Between 2000 and 2010, the coastline of Kokrobite and Bortianor were highly developed mainly for tourists' accommodation and recreational facilities. The increase of the built-up area along the coastline especially for resorts and hotels led to a decrease in vacant land and loss of vegetative cover in Kokrobite. As shown on the landuse and landcover map, between 2005 and 2010, most of the resorts on the Kokrobite coast are relatively recent, dating from the year 2005. Field observations and interactions with locals and facility managers revealed that, Kokrobite' s coastline has more tourism-based facilities such as hotels, resorts, restaurants and thus attracts more visitors compared to Bortianor.

3. 3 Socio-Ecological Implications of Changing Landuse and Landcover (LULC) Patterns

The previous sections of this study have provided detailed evidence about the rapidly changing environmental conditions in two emerging coastal tourism destinations. Though multiple factors could account for the changing coastline of Kokrobite and Bortianor, tourism-based developments has been identified as a critical driver as shown by the analysis from satellite imageries and field observations.

The development of tourism and residential related facilities along with urbanization in Kokrobite and Bortianor has increased demand for land in these coastal communities. Results confirms that landuse change driven by tourism-based establishments is gradually replacing ecosystems and natural areas of wetlands consistent with reports in other coastal tourism destinations (Burak et al., 2004; Davenport and Davenport, 2006). Developments along the coastline to meet tourist demands along with the increasing urbanisation of Kokrobite and Bortianor are similar to coastal tourism development trends experienced in the Mediterranean Coasts in the 1970s (Rico-Amoros, 2009; Meryem *et al.,* 2010). The current strip of developments on the Kokrobite-Bortianor coastline mainly in the form of hotels and resorts for tourist accommodation, restaurants and recreational facilities is

affecting the socio-economic livelihoods options of locals. As with these kind of service industries, some locals get employed in the establishments and facilities as cooks, guides and other unskilled jobs such as cleaners and labourers. On the other hand, traditional livelihood activities like fishing is negatively affected. This happens because most often, facility owners and managers restrict the use of shoreline by locals for their fishing activities. Such concerns were raised by a number of locals who were interviewed during ground-truthing exercises. They complained about limited space for fishing activities especially during peak seasons of tourist inflow when the beach become highly congested. In the midst of the changes and worrying trend is the lack of proper national, regional, and district level strategy aimed at addressing planning deficiencies in tourism-based developments.

From the field observations and discussions with government officials at the national and regional level, the siting of most of the recently developed resorts and hotels have ignored the possible implications on the coastal ecological system. A number of resorts and hotels identified are virtually sited in swampy and marshy environments, which provides a bundle of ecosystem services for direct and indirect use by people (MA, 2005). Clearly, this has negative implications on the Densu Delta Ramsar site which has already experienced extensive degradation from human-based activities over the past two decades especially from urbanisation (Oduro, 2010). Field observations and interviews with facility managers and workers revealed that, most of the new infrastructural facilities lacked proper sewage and waste disposal systems. As a result, much of the waste generated in the resorts, restaurants and recreational areas are dumped untreated into the sea (Gulf of Guinea). This adds to the already poor waste disposal situation in the communities as people use the beach as waste dumping sites for all forms of domestic waste. The risk of sea pollution and its implications on the health of tourists and recreationists is a cause of concern. Boafo (2011) reports of high microbial contaminations of recreational waters along the Kokrobite and Bortianor shoreline where resorts and other tourist-based facilities dominate. This, he attributed to the location of refuse dump sites at the shoreline and the lack of proper sewage systems in the tourism-based establishments. With both Kokrobite and Bortianor well noted for their sensitivity to coastal erosion (Armah and Amlalo, 1998; Appeaning *et al.,* 2008), the situation could worsen if the current trend of development continues. Figure 4 shows pictures of physical conditions along the coastline and wetland of Kokrobite and Bortianor.

From the foregoing, it is clear that tourism-based development along the Kokrobite-Bortianor shoreline is indeed taking a heavy toll on the natural ecosystem. Visits to the sites reveals that the current nature of developments is destroying sandy spaces, vegetation and promoting coastal erosion (Armah and Amlalo, 1998). Although the current state of unplanned tourism-based developments along the Kokrobite and Bortianor shoreline has been acknowledged by officials from the National Tourism Authority and Town and Country Planning Departments, there appears to be no known practical action taken to remedy the situation. In an interview with authorities at the Town and Country Planning Department in Accra (*personal communication with Doris Tetteh, 2012*), it was revealed that, most developers have failed to adhere to development regulations. In many cases, developers do not have the necessary building permits but still go ahead to undertake their building project. Under-staffing and the fact that tourism is not considered a conventional planning sector of the planning department was cited as some of the reasons for the current state of affairs

Figure 4. Photographs showing existing conditions in the study sites: **a-** mass of waste strewn at the coastline; **b**-hotels/resorts infrastructure at Kokrobite; **c-** open space at Big Milly's backyard, a popular hotel for drifter tourist; **d-**portions of the Densu Delta Ramsar site
Source: Yaw Agyeman Boafo, 2011.

4.0 Conclusion and Recommendation

The current state of landuse and landcover change as revealed in this study, points to a worrying trend of increasing conversion of traditional and nature-based landuse patterns to tourism-based establishments to meet growing demands. The rapid loss of vegetative cover to tourism-based establishments is exposing the Kokrobite and Bortianor shoreline to a high influence of coastal erosion and wetland ecological resource degradation. Cumulatively, the percentage of vegetative landcover which accounted for 26.34 % of the total area in 1990 had reduced to an alarming rate of 11.67% by 2010. This represents more than a hundred percent (100%) loss and considering that the area forms part of Densu Delta wetland; a protected environment, various species could be endangered. Considering that future developments of tourism-based establishments could increase, coupled with increasing urbanization, the attendant problems associated with such developments is also expected to increase. To address these expected challenges, developers should be compelled to follow the necessary procedures before, during and after their facilities are established. Taking a cue from trends in Kokrobite and Bortianor, it is essential that facility developers make provision for adequate water supply, sewage and solid waste disposal systems. The results of the landcover and landuse changing pattern as revealed in this study provides a pointer to the need for all tiers of government to put in place appropriate planning regulations to guide the future direction of coastal tourism development in Kokrobite and Bortianor as well as other coastal tourism destinations of Ghana in the overall interest of the social, economic and physical environment.

As a way forward, attention needs to be paid to the emerging trends of coastal tourism developments. This should be a key focus of the Ghana Tourism Authority as it seeks to promote various aspects of the tourism industry in Ghana. Coastal tourism remains integral at Ghana's attempt to become a foremost tourism destination in Africa. However, development of infrastructure to support this sector should not be at the costs of the very environment that attracted the tourists. An ecologically sustainable coastal zone management plan, backed by appropriate policies and which also takes into consideration the interests of local inhabitants' livelihood is

necessary to ensure reduced vulnerability to existing and expected changes from natural and anthropogenic activities along coastal areas.

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