

Beaches Carrying Capacity Assessment in Kuwait Based on Photointerpretation and Ground Survey

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Key Words: Carrying Capacity, Beach, Photointerpretation, Visitors density, Kuwait

SUMMARY

The concept of Carrying Capacity (CC) as a tool for beach management in the State of Kuwait was investigated focusing on two most widely used public beaches; Al-Shuwaikh and Green Island beaches. This has been done, in order to establish a balance between the nature of the beaches and the current and future uses of available resources and services and taking into account the social and environmental requirements of the present and future generations. A CC approach was adapted to the culture and traditions of Kuwaiti society and built on the established approaches adopted in the previous studies.

The CC maps produced for both beaches revealed that visitor's distribution was not uniform across the beaches. High density zones were concentrated at the intertidal areas; the sports and children playgrounds and the greenery areas on the beaches represented the highest pressure of use in comparison with the total area of the studied beaches. Moreover, results of visitor's perception revealed the importance given by the beach users to both the occupancy area and the distance between each group of people when visiting the beaches. Such factors are important when applying the CC of the beach and should be considered in order to come up with a realistic determination of CC and better management of these beaches. Differences between the two studied beaches were also noted as related to their CC. It has been shown that the percentage of visitors to Al-Shuwaikh public beach was greater than the Green Island public beach and the visitor's distribution was different too.

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1. INTRODUCTION

1.1. Previous Studies

Carrying Capacity (CC) is the amount of activity or use that can be handled by a system before it begins to deteriorate. The determination of CC depends on the following factors (Transit, 2009):

- Natural resources (Physical and biological characteristics);
- Social factors that consider the needs of local community;
- Managerial factors including legal directives and agency (stakeholders) missions, in order to determine appropriate resource, management and social conditions.

Carrying Capacity in coastal zones is often determined by physical CC where limits on use (threshold) are, for example, set by available space, natural constraints, the dimensions of infrastructure, recreation experience, beach accessibility, parking, leisure facilities and play grounds (Da Silva, 2002). Furthermore, Aerial photography has been used to determine physical CC of Portugal beaches, in addition to visitor interviews to determine the social CC (Mira and Gomes, 2002). Another similar study has been conducted in Malta (Julian's, 2001).

United Nations Environment Program (UNEP) has set up a program for the Mediterranean region for CC assessment for tourism development (UNEP, 2003). The Regional Organisation for the Protection of the Marine Environment (ROPME) was established for the monitoring and protection of the gulf region and uses to produce regularly a report on the state of marine environment (ROPME, 2003).

The coastal zones of Kuwait were classified according to their geology, biology and vulnerability to degradation and pollution (Al-Saraawi et al., 1988). Furthermore, the oceanographic Atlas of Kuwait waters was produced (Al-Yamani et al., 2004). The status of coastal areas of Kuwait bay in terms of geology and waters environment has been investigated in order to identify hot-spot areas (El-Sammak et al., 2005).

1.2. Research Objectives

The aim of this research is to investigate the concept of Carrying Capacity as a tool for beach management in Kuwait through focusing on two public beaches (e.g. Green Island public and Al-Shuwaikh beaches). This has been done in order to establish a balance between the nature of the beaches and the current and future uses of the existing resources. This main goal will

be achieved through the following sub-goals:

- Describe the current status of the beaches chosen for this study in terms of land use categories;
- Identification of services and activities available in beaches;
- Assessment of Carrying Capacity of the two beaches.

2. PRESENTATION OF THE STATE OF KUWAIT

2.1. Geographic Location and Population

The state of Kuwait is situated between the Arabian Gulf from the East, Iraq from the North and Saudi Arabia from the South, and thus lying between the Latitudes 28° 45' and 30° 06' North of the Equator and between the Longitudes 46° 30' and 48° 30' East of the meridian of Greenwich (Figure 1).

The total area of the Kuwait is about 17818 km² and the total population is estimated at 2991189 peoples in 2005 (with annual growth rate of 3.8%). The climate is arid and semi-arid (desert), but delimited at the east by coastal zones and beaches. The topography is relatively flat and the geomorphology is uniform (MOP, 2005; Missak et al., 2000).

2.2. Main Beach Categories

Kuwait has about 300 km length of coastlines from North to South, overlooking the Arabian Gulf (Al-Yamani et al., 2004).

The main beaches were subdivided into three categories (Al-Ghadban and El-Sammak, 2005):

- Muddy beaches in the North of Kuwait Bay, formed as a result of deposition of fine clay particles carried by water from the Shatt Al-Arab;
- Rocky beaches stretching south from the Kuwait Bay;
- Sandy beaches spread in the most exposed areas and especially in the inter-tidal areas.

3. CHARACTERISTICS OF THE STUDY AREA

The study area consists of two beaches (e.g. Green Island and Al-Shuwaikh beaches) open for public uses. These beaches were chosen according to the following considerations:

- The type and nature of the beaches.
- Geographical location of the beaches.
- Beaches near the sea water quality monitoring stations.
- Easy access to beach facilities and services.

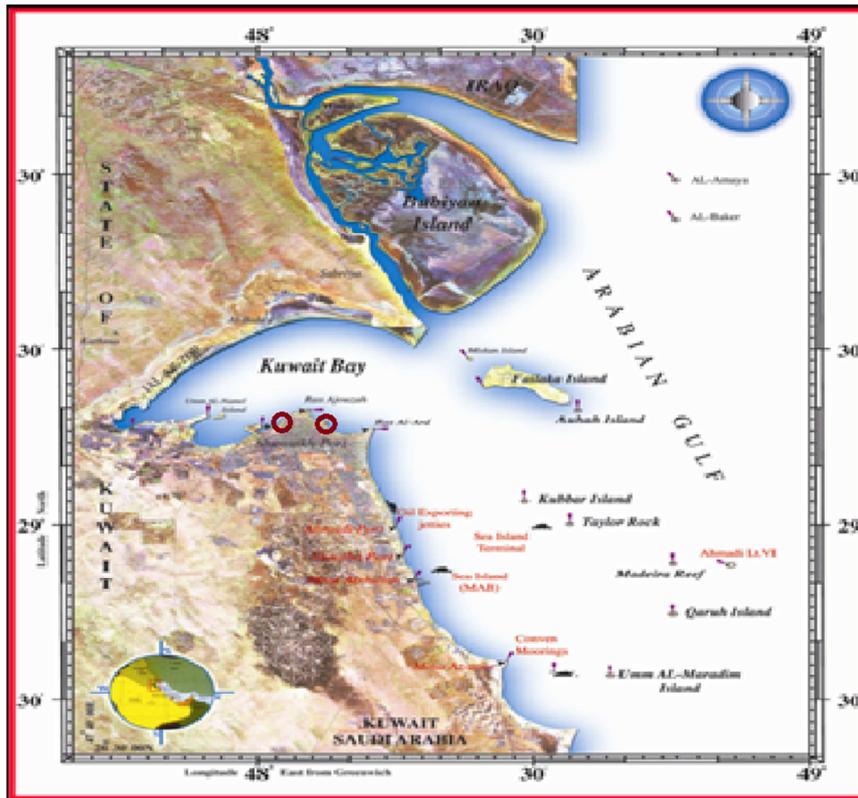


Figure 1: Geographical location of the State of Kuwait along with the two study sites of Green Island and Al-Shuwikh beaches (Red Circles)

3.1. Green Island Beach

Located in the Eastern of Kuwait city and characterized by the presence of some of the major tourist landmarks (e.g. Green Al-Jazeera, Kuwait Towers). The management of the beach is supervised by the Touristic Enterprises Company, while the hygiene is the responsibility of the Kuwait Municipality. The area of the beach is about 123422 m² and the services and recreational activities available to visitors varied from surfing, swimming, running, walking and playing balls (Figure 2).

3.2. Al-Shuwaikh Beach

Located in the Western of Kuwait city close to the Arena of Science in the South side of Kuwait Bay. The Kuwait Municipality is responsible for management and hygiene of the beach. The area of the beach is approximately 381465 m² and the services available to visitors are the following: sport practicing, fishing, swimming and walking.

4. ADOPTED METHODOLOGY

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The methodology adopted is composed of three main successive steps:

- **Data Acquisition:** color Aerial Photo for the year 2004 (scale 1/2000) provided by Kuwait Municipality, along with the existing ancillary data related to the quality of water of the beaches and geographical and socio-economical datasets (EPA, 2006);
- **Analysis/Interpretation of Geographical Data:** the aerial photo has been rectified to produce the Ortho-photo, which has been in turn classified by photo-interpretation process using (ERDAS Imagine) software, in order to produce the land use map composed of various land use categories. Furthermore, the ground survey of the beach has allowed to develop what we can call the visitor's density map in three different levels of density (Low, Moderate, High);
- **Results Output and Discussion:** the two produced maps in the previous step were overlaid using (ArcGIS) software to finally develop the Carrying Capacity map for each single beach.



Figure 2: Color Ortho-photo showing the study site of Green Island public beach (year 2004, scale 1/2000), provided by Kuwait Municipality

5. ASSESSMENT OF CARRYING CAPACITY

The Carrying capacity Approach (CCA) was adapted to the culture and traditions of Kuwaiti society and built on two established approaches adopted earlier in the previous studies (Da Silva, 2002; Mira and Gomes, 2002; UNEP, 2003). GIS techniques and tools were used to

produce thematic maps for the two beaches that included the land use categories and density distribution of visitors. Data on the environmental quality of the coastal water at these beaches as well as information on the perception of visitors through interviews based on questionnaire were also collected and analyzed.

5.1. Green Island Beach

The visitor's density map was produced into three levels (Low, Moderate and High). The land use map was also produced into 13 various categories (e.g. parking, shop, toilet, greenery, games). The overlay of the two maps has allowed producing the Carrying Capacity map indicating both the locations with high/low density of visitors, thus high/low risk along with the indications about the required services on the beach if they are sufficient or not (Figure 3).

5.2. Al-Shuwaikh Beach

The visitor's density map was produced into three levels (Low, Moderate and High). The land use map was also produced into 16 various categories (e.g. walking, fishing, games, shop, toilet). The overlay of the two maps has allowed producing the Carrying Capacity map indicating both the locations with high/low density of visitors, thus high/low risk along with the indication about the required services on the beach if they are sufficient or not.

6. RESULTS OUTPUT

The study revealed the following outputs and highlights:

- The CC maps produced for both beaches revealed that visitor's distribution density was not uniform across the beaches. High density zones were concentrated at the intertidal zones; the sports and children playgrounds and the greenery areas on the beaches represented the highest pressure of use in comparison to the total area of the studied beaches. Moreover, results of visitor perception revealed the importance given by the beach users to both the occupancy area and distance between each group of people when visiting the beach.

- Comparison between the two studied beaches revealed some differences as related to their carrying capacity. It has been shown that the percentage of visitors to Al-Shuwaikh public beach was greater than the Green Island public beach and the visitor's distribution was different too. This was related to a number of reasons including the availability of more services and leisure activities on this beach and the relatively easier access to the sea through intertidal areas in addition to the proximity and convenience of Al-Shuwaikh beach to the residential area located to the north of Kuwait city.

- A geodatabase was developed for every single beach containing all available data related to (e.g. land use categories, visitor's density, water quality, visitor's interviews, facilities and services).

- The study has provided essential information on the type of indicators and factors that need to be taken into account when evaluating the carrying capacity of beaches in Kuwait particularly the socio-environmental factors. It presented and evaluated CCA that would help in managing beaches in more realistic and deterministic way.
- The majority of visitors frequent both beaches during summer season (e.g. May to August). All the visitors prefer the farthest distance (9 m) between visitors. The visitors to Al-Shuwaikh beach prefer to have an area of (6 m²) per visitor, compared to (12 m²) in Green Island beach. The majority of visitors agreed on for both beaches that (toilet are not clean, there is no lifeguard, number of showers are insufficient).
- The study has recommended implementing and increasing the number of studies on carrying capacity of beaches for better management and planning of beaches in Kuwait.

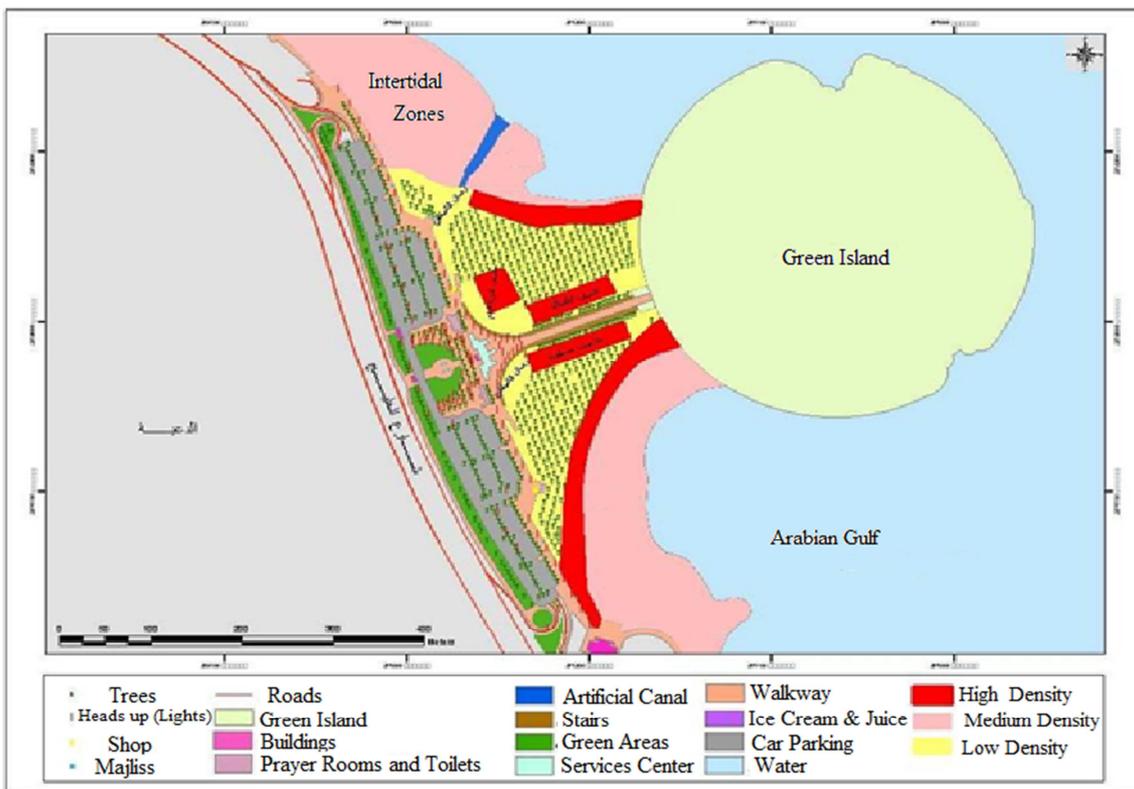


Figure 3: Carrying Capacity map of Green Island beach for the year 2004 incorporating the land use categories overlaid on the visitors's density

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BIOGRAPHICAL NOTES

Mr. Adel ALDOUKHI has got Bachelor degree in Mehcanical Engiineering from Arab Academy for Sceince and Techniology and Marine Transport (Egypt, 2002). Master in Geographci Information System and Remote Sensing from Arabian Gulf University (Bahrain, 2009). Acctually working with the Ministry of Public Works in Kuwait.

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