

Carrying capacity assessment and environmentally-friendly based plans for tourism development in Rhodes Island, Greece

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Abstract

During the last decades, Greece has emerged as a popular tourist destination providing high quality tourist services. Diverse landscape, extended sandy beaches, numerous archaeological sites, people's hospitality, filling of safety, and adequate infrastructure are some factors that have increased the touristic value of Greece. In particular, Rhodes Island, located in the southeastern Aegean Archipelagos, attracts more than 1,800,000 non-residents visitors per year that is 10% of the Greek tourist product. The carrying capacity assessment of Rhodes Island aims in finding different, high standards touristic activities, in order to continue the growth of this sector but with the reduction of the impact on the environment. All the required data (socio-economic, environmental, and geographical) were analyzed according to the PAP/RAC methodology. The results were showing that the northern part of the island is a very saturated area, with crowded beaches, leading to the environmental degradation. In order to reduce these negative effects of tourism, different activities must be provided such as, hiking, biking, "marathon"-like races, archaeological tourism, walks in the remarkable natural environment of the island. Furthermore, the construction of a wastewater plant and the redefining the urban planning will help the environmental decompression, and it will contribute to the sustainable development.

Keywords: Carrying Capacity Assessment, Carrying Capacity indicators, Island of Rhodes, sustainable development, environmentally-friendly based growth.

1. Introduction

Greek tourism is one of the main pillars of entrepreneurship and growth of the Greek economy. Through rational practices and studies of the dynamics of tourism, the Greek economy can be helped to overcome successfully the financial difficulties. Also, the latest GNP surveys highlight the need for tourism entrepreneurship to contribute to sustainable economic, social and cultural development. The promotion and distribution of the tourism services offered, attracts new employees and investors, thus making it a rapidly evolving sector.

Over the last 20 years, tourism standards have been trying to match the social requirements for better environmental quality, using good environmental practices, taking advantage of the cultural specificities for the benefit of the tourist development of the region. In order to determine the beneficial tourist load of an area, the World Tourism Organization defines the Carrying Capacity (Figure 1) as **"the maximum number of tourists who may visit a destination at the same time without affecting the economic, physical and social environment and not to limit the satisfaction of tourists"** (Butler, 1997; UNEP, 1997; Fokiali et al., 2005; Tselentis et al., 2006; Klaric et al., 2007). This satisfaction depends on resources, which they need protection. The total participation of Tourism in GDP was close to 9.3% in 2015 (IOBE, KEPE, Ikkos, 2015-SETE) and 18.6% (SETE) in 2016 with small differences but always with a positive impact on the Greek economy (Maroulis & Ikkos, 2016-SETE).

In particular, tourism contributes positively to the growth or containment of the fall in GDP, as in the case of 2013 to -3.2% (SETE).

Greek tourism constitutes a noticeable difference, is the coastal areas, adding important criteria to the final decision of the tourists to visit our country. Moreover, high biodiversity emphasizes the uniqueness of the carrying capacity of each region, since Greece consists of various environments (coastal, mountainous, semi-mountainous, etc.). In the case of our country, there are 9,835 islands and more than 15,000Km length of coastlines. If tourism in these areas develops without viable frameworks then the natural environment is in danger of being destroyed and the impact will also be negative in the industry itself. The burdened environment is a negative factor for the tourist development of a region. Each region therefore has different tolerance to the impact of tourism.

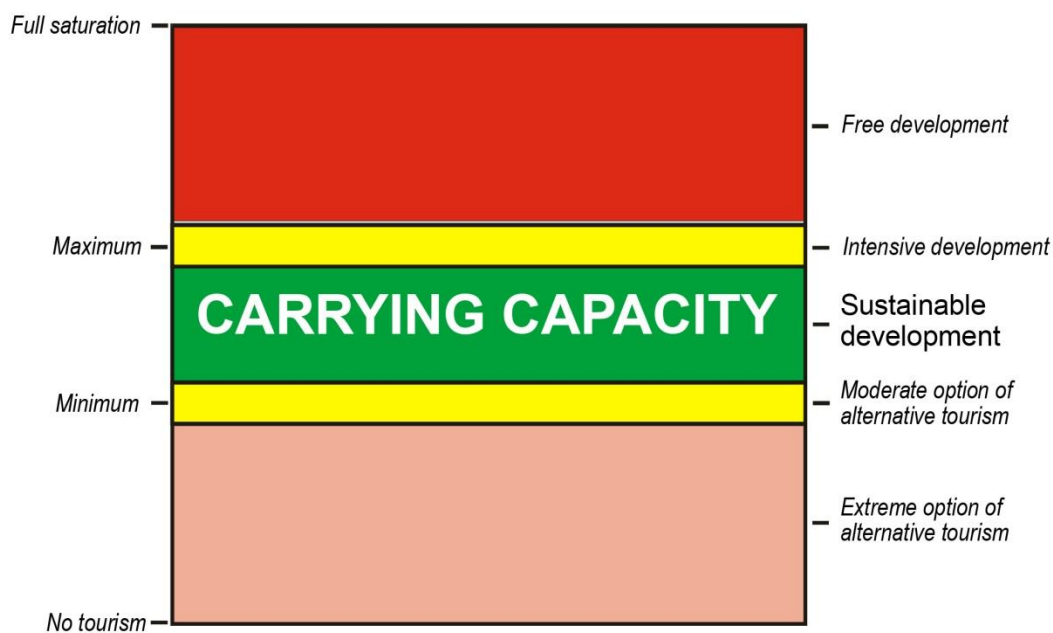


Figure 1: illustration of the definition of the Carrying Capacity of Tourism. (Source: Klaric et al., 2007).

In this study the tourism sector of Rhodes will be calculated and analyzed in relation to the population, the length and quality of coasts, social services, etc., in order to determine the Carrying Capacity of the coastal areas of Rhodes Island and the possibilities to develop alternative tourism sectors.

2. Recent facts of greek tourism and the coastal environment

Since 2013 there has been an increase in arrivals of non-native tourists in Greece (Maroulis & Ikkos, 2016). 2013 was the year in which a significant increase was seen in several factors, with an increase of 15.5% in non-resident arrivals and a 13.5% increase in non-residents' accommodation in all types (Maroulis & Ikkos, 2016). The next year, in 2014, tourism continued its growth as it was the main driver of the recovery of the Greek economy, GDP growth of 0.7% and employment by 0.55%. This was due to the increase in arrivals from abroad by 23%. As well as, the income from tourism increased by 10.2% since 2013. In 2015, there was a further increase in arrivals, of non-residents, by 7.6%, while the income growth by 5.5%. was recorded in the turnover of accommodation and catering by 3.1% and by 9.7% in the turnover in air transport. As a result, the fall in GDP was just -0.2% (Maroulis & Ikkos, 2016). Then, in 2015, there was a significant increase in average overnight stays of 6%, with a significant increase in arrivals from traditional countries of origin such as Germany (14.3%), United Kingdom (14.7%), France (4%), Italy (21.3%), and the USA (26.8%) (Maroulis & Ikkos,

2016). Lastly, in 2016, Greek tourism followed the same course as it was favorably influenced by the same factors. Also, the growth of the economies of the main countries of origin (USA, Russia, UK etc.) will positively influence the development of Greek tourism. Another point to be taken into consideration is the country's view as a safe destination after the terrorist attacks in competing countries in the Eastern Mediterranean, such as Turkey (Maroulis & Ikkos, 2016-SETE).

The main advantage of Greek tourism is based on the coastal areas. Excellent environmental conditions are an important prerequisite for the development of tourist activities such as bathing, water sports, sunbathing on beaches, visits to archaeological sites and museums as well as entertainment in nightclubs. Therefore, the degradation of the environment directly affects the quality of the tourist product. This component determines how satisfied or dissatisfied are the tourists, with the services offered, which returning to his home country advertises the visited country to third parties.

For this reason, tourism development must follow a viable basis with respect to various parameters such as, 1. Ecological, 2. Financial, 3. Social, 4. Cultural, 5. Institutional.

In this context, sustainable development of tourism consists of:

1. The environmental challenge in the form of resistance against the destruction of the natural basis of human life.
2. The economic challenge in the form of increasing current income while ensuring the future of this.
3. The social challenge in the form of promoting social justice, security and equality.
4. The cultural challenge in the form of preservation and promotion of culture and aesthetic values.
5. The institutional challenge in the form of promoting the involvement of local communities in strategic decision making.

In these circumstances, policies towards the sustainable development of tourism require both the integration of environmental, social, economic, institutional and cultural objectives into a coherent strategy and the safeguarding of the essential interests of each dimension (Fokiali et al. 2005).

3. Methodology

Carrying Capacity Assessment is one of the main techniques of tourism calculation and management. Its aim is to set the maximum desirable growth limits, which reflects the optimal use of tourism resources. Incorporating Carrying Capacity Assessment (CCA) into the planning process of tourism and management is a necessity and should be taken as a set of guidelines for shaping tourism plans at all levels.

Understanding the concept of Carrying Capacity Assessment in the field of tourism has evolved over recent years with the aim of directing research into measurable physical and ecological-environmental parameters through socio-demographic and socio-cultural factors that are not so easy to quantify (Klaric et al., 2003-UNEP; PAP, RAC, 1997; Fokiali et al., 2005; Tselentis et al., 2006; Tselentis et al., 2012; Lagos & Diakomichalis, 2014). In the context of efforts to strengthen the role of the state-administration in planning of the development of tourism, mostly by increasing or restricting the economic measures (tax policy, construction of large-scale public infrastructure systems, etc.) and the handling and utilization of the CCA, especially in less-developed countries of the Mediterranean, mainly to which these guidelines are addressed. Therefore, three sets of parameters have to be determined for the Carrying Capacity of the Mediterranean Tourism: (a) physical-ecological parameters; (b) socio-demographic parameters; and (c) political-economic

parameters. Regarding the abovementioned parameters, the consideration of natural and ecological parameters as less important, does not lead to safe conclusions.

The relation between the parameters that matter most in terms of the overall framework of the carrying capacity through an Integrated Coastal Area Management (ICAM) program obviously loses importance in assessing the strict criteria of the carrying capacity of tourism. Also, when assessing the Carrying Capacity for Tourism, great importance is given to the socio-demographic, political and economic parameters as they have been neglected in the past, mainly due to the significant difficulties encountered in their precise definition, as opposed to ecological parameters which are easily measurable. The research approach was based on the quantification, analysis and evaluation of PAP / RAC data (1991) (UNEP-PAP / RAC, 1997; Lagos & Diakomichalis, 2011; Panousis & Soklis, 2015; Kyriakou et al. 2017), in order to come up with safer conclusions about the Carrying Capacity of Tourism on the island of Rhodes. The types of data collected were mainly based on population data (permanent residents, non-residents, seasonal population working in tourism enterprises, physical characteristics of the island, environmental data (total length of coastal area, environmental quality, infrastructures etc.), economic data (GDP per capita, number of tourist businesses, available beds and number of arrived tourists in Rhodes).

The data will be quantified and calculated through equation proposed by Tselentis et al., 2012, Lagos & Diakomichalis, (2014) and Panousi & Soklis (2015). After statistical processing, the results will be presented and analyzed, as well as possible scenarios of sustainable development will be proposed for short and long term for the island of Rhodes.

4. Results

4.1. Number of beds overall on the island of Rhodes and their distribution per Km².

Table 1: Total beds and their distribution over the total area on the island of Rhodes (sources, ELSTAT, SETE, Tselentis et al., 2012).

Island of Rhodes	Permanent Residents (2011)	Hotel beds (2016)	Beds in different accommodation type (2016)	Total beds	Beds per inhabitant	Total area of Rhodes in km ²	Beds per km ²
	115490	87020	14588	101608	0,88	1398	72,9

Table 1 shows the total number of beds (per hotel and tourist accommodation) on the island of Rhodes, along with information on the total population and area of the island. 115490 permanent residents (census 2011, ELSTAT) were recorded on the island. The total of Hotel beds (2016) and beds in different tourist accommodation type (2016) was about 101,608 in total. This means that there are 0.88 beds per person. So, if the number of beds is divided by the total surface of the island, it is estimated that one (1) square kilometer (Km²) corresponds to 72.9 beds. At this point it should be noted that this indicator is generalized for the entire island, since in some areas with a higher concentration of hotel units or units of different tourist accommodation type (Rhodes, Afandou, Ialysos, Kallithea, Kamiros etc.) (Tselentis et al., 2012) this number may vary. In some cases, hotel and tourist beds are far outnumbering the permanent residents of a region. In general, as shown in table 1, the number of beds per km² is high, indicating the great interest for the island of Rhodes during the last decades, making it one of its most valuable tourist destinations in Greece.

4.2. *Beach impact factor of the island of Rhodes, inhabitants per km of beach.*

Table 2: Ratio of the number of inhabitants and tourists in terms of the length of the island's beaches (sources, ELSTAT, SETE, Tselentis et al., 2012).

Island of Rhodes	Beach length in Km (Total)	Permanent Residents (2011)	Hotel Beds (2016)	Beds in different accommodation type (2016)	Total Beds	Seasonal population	Total area of Rhodes (in km ²)	Beds per km ²	Beds per km of beach	Indicator of environmental impact of beach (people-users per m of beach)	Tourists per kilometer of beach
	151	115490	87020	14588	101608	217098	1398	72,9	1092	1,44	673

Table 2 demonstrates the number of the permanent population, the total number of beds, the total length of the coastline, the total beds per km² as well as an indicator of the environmental impact of the beach, which is calculated by dividing the total number of people at the peak of the tourist season with the total length of the coastline.

The seasonal population at the peak of the tourist season is defined by the sum of the permanent residents and the possible maximum number of tourists which can be accommodated on the island, i.e. the total number of beds in hotel or non-hotel units. Thus, 115490 (permanent residents) + 101608 (beds-potential population that can be hosted) = 217098 people (seasonal population of the island). The current beach load index is defined by the fraction of the total seasonal population at the peak of the tourist season, to the total length of the coastline of the island. Thus, 217098 (total seasonal population of the island) / 151000 m (total coastline) = 1.44 people per meter of beach.

At this point, it should be noted that this indicator is indicative and broadly describes the load on the total coastline of Rhodes. However, as it is known, the coastline is not accessible in its totality, as it is divided in inaccessible or accessible beaches (depends on different geomorphology). These variations significantly affect the load ratio, as the number of people who are concentrated in each beach changes accordingly. This indicator also varies according to the tourist traffic and eligibility of each of them (areas with intense tourism or not). Thus, in a prime tourist area, the beach impact factor will be much higher than in another with limited tourist traffic.

Nevertheless, this indicator is already quite high, for the study area, if it is been considered that people is concentrated at certain sites, whose extent is quite limited due to the boundaries imposed by the natural relief (geomorphology), i.e. the coastal areas.

4.3. *Tourist Operational Indicator (T.O.I.)*

Tourist Indicator is defined, as the indicator determined by dividing the total number of available beds on the island of Rhodes with the total population, multiplied by one hundred (100) (Lagos & Diakomichalis, 2014; Panoussi & Soklis, 2015). This is calculated by the equation:

$$TOI = \frac{\text{Total Beds}}{\text{Population}} \times 100.$$

If the data is replaced the fraction is presented as follows:

$$TOI = \frac{101608}{115490} \times 100 = \mathbf{88\%}.$$

4.4. Tourist Tension Indicator (T.T.I.)

The Tourist Tension Index (T.T.I.) is defined by dividing the number of beds with the population (Lagos & Diakomichalis, 2014; Panoussi & Soklis, 2015). So the TTI is calculated by the fraction:

$$TTI = \frac{\text{Beds}}{\text{Population}}$$

By doing the calculations, the result is:

$$TTI = \frac{101608}{115490} = \mathbf{0,88}$$

4.5. Indicator of Tourist Tolerant Population (I.T.T.P.)

The Indicator of Tourist Tolerant Population is defined by the division of the number of tourists per peak day, with the total population of Rhodes (Lagos & Diakomichalis, 2014; Panoussi & Soklis, 2015).

The Indicator of Tourist Tolerant Population is calculated from the equation of:

$$ITTP = \frac{\text{Number of tourists per peak day}}{\text{Population}}$$

The number of tourists per peak day is defined as the maximum number of beds on the island, since it corresponds to the number of tourists which can be accepted. Visitors owning holiday homes have not been calculated.

Thus, replacing the data in the fraction is calculated:

$$ITTP = \frac{101608}{115490} = \mathbf{0,88}$$

5. Conclusions-Discussion

Since the main occupation of the island's inhabitants is linked to the tourism industry, the calculation of the Rhodes Tourism Capacity is crucial. It is based on international and local reference standards and methods as described by the World Tourism Organization (WTO) and by corresponding work in various parts of the country (UNEP- PAP / RAC, 1997; Klaric et al., 2003; Lagos & Diakomichalis, 2014). The determination of the Carrying Capacity Indicators contribute to the delimitation and programming of suitable techniques and policies for the optimal and sustainable development of tourism. The designation of Carrying Capacity through indicators is based to a typology (Kyriakou et al., 2017), but is adapted according to the social-economic-geomorphological characteristics. The results of the data processing, which are presented as indicators, reflect the tourist reality of the island of Rhodes. According to the latter, Rhodes and, in particular, its northern part, accounted for the largest number of tourists, in terms of total tourist accommodation and foodservice (Tselentis et al., 2006; Tselentis et al., 2012; ELSTAT; Kyriakou et al., 2017).

This is the result of the occupation with the tourism, as there is great need for workforce during the summer months in particular. It is worth noting that in the South Aegean region the largest share of total GDP comes from the islands of Kalymnos, Karpathos, Kos and Rhodes (ELSTAT). This fact also testifies the great growth and development of this sector over the years.

However, the rapid development of tourism in recent years, has led to a major environmental degradation, the limited coverage of the island by sewage treatment plants and landfill sites (70%) (ELSTAT) is also taken into account. This risk is visible; especially during periods of intense tourist concentration, although the Indicator of Tourist Tolerant Population is low (Lagos & Diakomichalis, 2014; Panoussi & Soklis, 2015). Nevertheless, the tourist development and, as a result, the tourist

load is not the same throughout the island but it is concentrated mainly in specific regions (Kyriakou et al, 2017). While calculations indicate the need to improve and stimulate tourism on the island (as an island with low rates of tourism) (Lagos & Diakomichalis, 2014; Panoussi & Soklis, 2015), neighboring areas "suffer" from tourist load. Obviously, the indicators work best in the different regions individually, according to their distinctive features. Various concerns are expressed regarding the need to find and apply new models of tourism development in areas that have not been developed as in the northern part of the island (Kyriakou et al., 2017). It is necessary to design and implement a tourism development program based on environmental based tactics (Tselentis et al., 2012; Kyriakou et al., 2017). In particular, emphasis should be placed on the natural and cultural wealth of the island, as revenues-visits to archaeological sites and museums have fallen lately (ELSTAT, SETE). A noticeable difference is present in the coastal areas where the highest environmental pressure is observed, as shown in the results. However, the littoral areas are those that should be protected since they are used intensively in Rhodes at a percentage of 5.4% of the generalized coastline and 3.7% of the measured coastline (from four-five stars hotels only) (Ikkos, 2016, SETE, Kyriakou et al., 2017). At the same time, the use and exploitation of the beaches and the seaside in general, bring enormous revenues to the local community and, to the state mostly through taxation.

This pattern of tourism development has been operating for so many years and created a boom in tourism, as shown by Tourist Operational Indicator and Tourism Tension Indicator (Lagos & Diakomichalis, 2011; Panoussi & Soklis, 2015), but also due to the non-rational use negative effects are obvious on the environment (Kyriakou et al., 2017). For this reason, modern strategies for the promotion and development of tourism follow socially and financially multidimensional axes in order not only to protect the natural wealth of a region, but also to achieve different types of tourism throughout the year. Apart from the natural environment, tourism development, should follow such axes as cultural tourism, diving tourism, health tourism, luxury tourism, sea tourism, conference tourism MICE (Mazoor AK, 2015), etc. (EOT, KEPE, Kyriakou et al., 2017).

From the calculation of the environmental indicators (Beach Impact Factor), a difficulty is obvious mainly in the "environmental shift" of the tourist product of Rhodes. Which is however, necessary for the preservation of the high quality of the physical environment; this is the primary factor for the maintenance of the satisfaction of visitors-tourists, as well as to the inhabitants of the island.

Finally, in order to achieve good environmental policies in tourism activities, obstacles are present, such as the pressure in the coastal environment (Economou, 2007; Bianchi et al., 2014; Kyriakou et al., 2017). As a consequence, a reduction is present in its added value due to inadequate environmental protection (lack of waste-water management), lack of political will, limited-nonexistent spatial planning. The high quality of the services provided (in terms of human resources and infrastructures) in relation to the environmental and natural advantage of the island, according to studies and surveys in the tourist preferences, which place Greece as a desirable destination compared to its competitors (SETE). It is necessary, therefore, to have a concerted effort by the state and local factors on the island to adopt or use models of alternative tourism development (Kyriakou et al., 2011) from similar regions of Europe, or to implement a Greek model customized to the needs and the character of the island.

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