

# Carrying capacity as a tool to design tourism policy: case study for the islands of Dodecanese

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## Abstract

The tourist industry is one of the most important economic activities in Greece. The country receives over 20 million visitors per year. In an era where tourism is one of the fastest growing sectors of developing countries the competition with existing tourism destinations, such as Greece, will intensify. Greece has enjoyed increasing numbers and revenues from tourism due to its unique environment – both natural and man-made – making it a high profile tourist destination. However, it is already clear that the uncontrolled growth of the industry can bring serious environmental and social problems, leading to a decline in the quality of the tourist product and services provided. Tourism development is related to environment and natural resources management. Carrying capacity indices are tools for evaluation of the impacts caused from tourism policies. In previous studies we produced a model of carrying capacity evaluation. In this study we go one step further using the results of our analysis for Greek Islands archipelago Dodecanese to design a sustainable tourism policy scenario.

*Keywords: tourism policy, tourism carrying capacity, tourism development at Rhodes Greek Island.*

## 1 Basic principles of the EU tourism policy

After the Agreement of Lisbon, for the first time the European Union, recognized tourism as a major economic activity with a broadly positive impact on economic growth and employment in Europe and tried for an EU tourism policy.

Tourism is an increasingly important aspect in the life of European citizens who are traveling more and more, for private or professional reasons. Tourism, is

an activity that is related to the cultural and natural heritage and contemporary cultures and traditions of the European Union as it supports economic growth with sustainable development and the ethical dimension. Tourism also has an important meaning to enhance Europe's image worldwide, as it allows you to view the values and promote the attractiveness of the European model, which is the result of centuries of cultural exchanges, linguistic diversity and creativity.

The quantitative objective of European policy is that Europe is the first tourist destination in the world and tourism is able to capitalize the wealth and economic diversity of the regions. Moreover, as mentioned in the treaty, tourism is an economic activity that can generate growth and employment in the EU, while contributing to economic development and social integration. In particular, tourism supports economy in rural and mountain areas, coastal regions and islands, as remotes the structure of the local economies. Key challenges to achieving this goal are:

- i The opening of new tourist markets;
- ii Adapting to demographic developments;
- iii Addressing the effects of climate change on tourism product.

According to the Lisbon Agreement, strengthening the competitiveness of the tourism sector should take into account the long term. Competitiveness is closely linked to the sustainability of the development.

This last point leads to the need for environmentally sustainable practices in the tourism industry; that policy has been raised by scientists from the 60s. The concept of sustainable tourism requires the identification of adverse effects and the need to manage to achieve the objectives of sustainable development and implementation of these policies.

In previous years the concept of sustainable tourism was implemented; tourism development policies of a region as opposed to the conventional tourism prevalent in recent decades. Sustainable tourism based on new forms of tourism, alternative or special, with tourist demand arising from small groups of tourists. Economic growth will result from the greater economic value of each tourist and not on massive development of small economic value tourists.

A key gauge of sustainability of a region is the carrying capacity of the area. Carrying capacity is designated generally "the maximum number of people that can use a site without any unacceptable modification to the natural environment and without an unacceptable reduction in the quality of the experience acquired by tourists" (Mathieson and Wall [1]). This definition is generalized to use and socio-cultural and economic environment and according to the World Tourism Organization, carrying capacity is "the maximum number of people that can simultaneously visit a tourist destination, without causing damage to the natural, economic and socio-cultural environment, as well as an inadmissible negation of quality and guest satisfaction". The above definition refers only to the satisfaction of tourists and researchers have already expressed the view that the carrying capacity should be measured and be for the residents.

Eventually Getz [2] has identified the concept of carrying capacity in six subcategories (physical, economic, perceptual, social, ecological and political), each with different implications. The carrying capacity is one of the central

frameworks within which such issues can be addressed locally (Lindberg *et al.* [3]).

The life cycle of a tourist product development has been described by Butler [4]. The carrying capacity of the model referred as the element that limits growth, and appears in the stage of economic stagnation of the tourist destination and is shown as a relatively static zone which controls the amount of growth in a particular environment (Lagos and Diakomanolakis [5]). The interface between the life cycle representing the tourism development and the carrying capacity is a dynamic process (Butler [6], Martin and Uysal [7]). Despite the fact that unlimited growth to any destination is impossible, the shape of growth can have a cyclical form (Baum [8], Butler [9]). As suggested in the final stage of economic stagnation or even earlier, if significant new products or marketing systems are imported, the life cycle of a tourist destination can begin again to show growth. Otherwise, there may be a drop (Tooman [10]).

Accordingly, the limit of development in model development of Butler is not based on the capacity of the destination and the “original” resources for tourism absorption, but the industry (activity) and ability. A key common theme is the idea of limits to tourist use and changes in the physical and social environment to be accepted (Butler [11, 12]).

## 2 Dodecanese

Rhodes is the largest of the Dodecanese Archipelagos islands in terms of both land area and population. According to the 2011 Census, the population was 115,490 and it is the fourth largest island of Greece. It covers an area of 1,390 sq. km and has 70 km of beaches.

Kos has more than 1,000,000 tourist arrivals from charter flights; Karpathos has 100,000 arrivals (Table 1). Rhodes has almost 2,000,000 arrivals; Rhodes concentrates 400,000 cruise arrivals as Patmos 114,000 and Kos 65,000 (Table 2).

Table 1: Arrivals in Dodecanese International Airports.

Island	International		Domestic	
	Arrivals	Departures	Arrivals	Departures
Rhodes	1,926,675	1,934,341	339,902	351,138
Kos	1,011,367	1,013,347	91,265	97,485
Karpathos	71,986	72,036	29,318	30,072

Table 2: Cruise arrivals.

Island	Year	Arrivals (ships)	Arrival (passengers)
Rhodes	2010	536	565,786
	2011	526	588,171
	2012	448	472,308
	2013	373	409,991
Patmos	2013	177	113,399
Kos	2013	86	64,756



The Dodecanese environment, both natural and man-made is the cultural and historical heritage can sustain a polymorphic tourism product.

It is noteworthy that the population of Dodecanese increased considerably during the period of 1950–2011 representing a rise of more than 70%. The increase of the population is considerably higher than the national average and has been associated with the increase in tourism especially after the 1970s especially for Kos and the north part of the Island. In contrast, the other islands of the archipelago have a different weight regarding tourism industry pressures.

Rhodes is the administrative center for all the Dodecanese islands. Employment in the primary and secondary production level has dropped whereas there is an increase in the tertiary level, confirming both the national trend as well as the increase in the tourist trade for the area during the 1980s.

Focusing on the resources and infrastructure of the islands, factors measured at the carrying capacity assessment model show

- i. Water, with increased demand during the summer months, has been a serious problem for the island. The need to provide satisfactory water quality remains a pressing issue both to local citizens as well as visitors during the summer.
- ii. Urban waste management (solid and liquid) is characterized by the lack of efficiency and environmental protection. Only the large urban centers fulfil the basic requirements of modern waste management installations.
- iii. Electrical consumption has increased over recent years. The surge in consumption during the summer months is also highlighted. Taking into account that the power generation plant at Soroni is powered by heavy duty oil, it is not surprising that both costs and environmental impacts are high for the island.
- iv. Rhodes as Kos are a bad practice example of tourist planning. The first areas have been developed on basis at plan were Ixia and Faliraki in Rhodes and Karamena in Kos. The building method in tourist areas and villages has brought alteration in the traditional architectural model. The illegal building construction in tourist areas in the island can be distributed to the following categories:
  - a. Illegally constructed hotels;
  - b. Illegally used buildings as hotels; and
  - c. Other illegal buildings on the seashore.

The following activities can be identified as important pressures on coastal ecosystems:

1. Permanent exploitation of the tourist industry;
2. Garbage is dumped at sea;
4. The cleaning and flattering of coasts carried out with the use of machines;
5. Traffic;
6. The coastal cereal and vegetable cultivations;
7. Exploitation of sand;
8. Soil erosion;



9. The model of tourism used in practice imposes the existence of night clubs, the operation of which takes place after formation provided in certain areas. The policy of specific working hours aims at the particularization of every single region without, however, always protecting the citizens from noise.

### 3 Methodology

To measure the carrying capacity of an area made using sustainable development indicators, in a previous work (Prokopiou *et al.* [13]) proposed a measurement model of the bearing capacity of a region based on natural resources data, environmentalists and tourism infrastructure and traffic data [14].

The model was used to characterize the islands of Greece. The model was based on sixteen indicators which evolved to meet comprehensive environmental and tourist data in relation to the coastal zone.

The sixteen variables can be divided into different groups. The main objective of the first group of indicators (Table 3) is the rating of environmental characteristics and infrastructure of the area. The group includes twelve of the sixteen variables and the score for each one of these variables is obtained by using questionnaires or personal observation and qualitative indicators of each area.

The first twelve indicators grouped into three major categories: index soil; environment; water.

Table 3: Environmental indicators.

Indicator	Description	Measurement
I1	Urban waste management	0-100
I2	Legality of buildings	0-100
I3	Protection of noise nuisance	0-100
I4	Garbage management	0-100
I5	Protection of pesticide use	0-100
I6	Over pumping in sea waters	0-100
I7	Sufficient quantity of water resources	0-100
I8	Sufficient quality of drinking water	0-100
I9	Limitation of fire incidents	0-100
I10	Forest clearance	0-100
I11	Conservation of the landscape	0-100
I12	Adequacy of green areas	0-100

The second group consists of four indicators variables (Table 4). The score of each region is derived using quantitative data and quantitative indicators. It should be noted that for quantitative indicators a 13–15 high score corresponds to a large burden on the environment and therefore the variable should have a low score in the model, for reversal and mapping the value of the indicator to a 100-grade scale descriptive analysis was used, extreme values were excluded



and finally from environmental literature, minimum tolerable limits for environmental burden were defined.

Table 4: Infrastructure indicators.

Variable name	Description	Measurement
I13	Beds per kilometre of beach	0-100
I14	Beds per square kilometre	0-100
I15	Beds per inhabitants	0-100
I16	Blue flags per kilometre of beach	0-100

From these sixteen variables three individual indexes and the final score are calculated.

Total score  $Y_{score}$  is derived from the following equation:

$$Y_{score} = \frac{\sum_{i=1}^{12} b_i \cdot x_i + b_{14} \cdot x_{14} + b_{15} \cdot x_{15}}{45} \quad (1)$$

for an area without a beach, and

$$Y_{score} = \frac{\sum_{i=1}^{16} b_i \cdot x_i}{55}, \text{ otherwise.}$$

Variables  $I_i$  and correspond weights  $b_i$  are presented at Table 5.

Table 5: Indicator weights.

Variable name	Description	Weight
I1	Urban waste management	5
I2	Legality of buildings	3
I3	Protection of noise nuisance	3
I4	Garbage management	5
I5	Protection of pesticide use	1
I6	Over pumping in sea waters	2
I7	Sufficient quantity of water resources	3
I8	Sufficient quality of drinking water	4
I9	Protection of fire incidents	2
I10	Forest clearance	2
I11	Conservation of the landscape	3
I12	Adequacy of green areas	2
I13	Beds per kilometre of beach	5
I14	Beds per square kilometre	5
I15	Beds per inhabitants	5
I16	Blue flags per kilometre of beach	5

The data used for this study come from two sources:

- i. A census study that was designed to collect data for calculating carrying capacity indexes. The study population was all Greek insular municipalities, numbering 235, located in 90 inhabited islands of the country that are dispersed at 14 regions. The first wave of the study, aimed at collecting data and creating a database, was completed in 2011, and two updates of the data were made (2013 and 2015), where changes in infrastructure were recorded.
- ii. Collection from administrative sources, geographic data, tourism, hosting capabilities and environmental discrimination for the municipalities of interest.

## 4 Results

Table 6 presents the score for environmental indicators by island. Indicator is the arithmetic mean of the municipalities' scores. High score is presenting to the following variables: legality of buildings, protection of noise nuisance, garbage management, protection of pesticide use, over pumping in sea waters, sufficient quantity of water resources, sufficient quality of drinking water and adequacy of green areas. The mean score for these variables are between 80% and 100%.

Table 6: Environmental indicators per island.

Island	Indicators											
	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12
Rhodes	35.5	100	80	80	80	100	100	100	60	50	69	80
Karpathos	0	100	90	30	0	75	50	25	50	0	75	50
Kasos	0	100	100	0	0	80	100	100	100	100	100	0
Megisti	0	100	100	30	100	100	0	0	100	100	100	0
Simi	25	100	100	30	100	100	0	100	100	100	100	100
Tilos	0	100	100	80	100	100	100	0	100	100	100	100
Chalki	0	100	100	30	100	80	0	0	100	100	100	100
Kos	66.7	100	0	80	33.3	100	100	100	33.3	0	53.3	100
Telendos	0	0	100	30	0	100	0	0	100	100	100	100
Astypalaia	0	100	100	0	100	100	100	100	0	0	100	80
Kalymnos	60	0	0	0	0	0	0	0	50	0	50	100
Pserimos	0	0	100	0	100	0	0	0	100	100	100	80
Nisiros	0	100	100	30	100	100	0	100	80	100	100	100
Patmos	0	100	80	30	100	100	0	50	100	0	50	100
Arki	0	100	100	30	100	100	0	100	100	100	100	100
Leros	57	0	60	100	0	0	0	50	0	100	100	100
Farmakonisi	0	100	100	100	100	100	0	0	100	100	100	100
Agathonisi	0	0	100	80	100	0	0	50	100	100	100	0

The management of the urban waste with 35.50% for example indicates that urban waste management has a lack of efficiency. Due the many incidences of forest clearance the corresponding indicator takes the low score of 60.0%. The non-effective protection against fires in forests is a serious threat for the environment, so the score to the corresponding variable is only 60.0%.

According to the results for urban waste management Karpathos, Kasos, Magisti, Tilos, Chalki, Astypalia, Pserimos, Nisiros, Patmos, Arki, Farmakonisi and Agathonisi are the islands with the major pressures. There is protection for the environment against illegal buildings, and a level of protection against noise. Garbage management is cohered at all the municipalities with places of sanitary burial. Protection against pesticide use is implemented in all the municipalities except Kasos, Kalymnos and Leros. There are no incidents from over pumping in sea waters except Karpathos, Kasos, Telendos Kalymnos and Leros. The quantity of water resources is adequate as also is the quality of drinking water in Megisti, Simi, Chalki and Telendos, Kalymnos, Pserimos, Leros and Agathonisi. There are fire incidents; incidents of forest clearance have occurred in the tourist areas of Kalymnos and Patmos islands.

Table 7 presents the score for infrastructure indicators. Kos confront high pressure in its coasts I13 as Rhodes and Megisti. Rhodes and Kos economy is related with tourism industry (I14–I15). Rhodes and Kos has only certified beaches.

Table 7: Infrastructure indicators per island.

Island	Indicators			
	I13	I14	I15	I16
Rhodes	1299	253	1.1	4.36
Karpathos	180	16.7	0.73	0
Kasos	90.3	2.4	0.1	0
Megisti	993.3	24.8	0.6	0
Simi	189	16.2	0.4	0
Tilos	108.1	15.4	1.86	0
Chalki	549	8.1	0.9	0
Kos	2057	228.3	2	0.14
Telendos	95	19	1.7	0
Astypalaia	137.92	14.5	1.33	0
Kalymnos	361.69	25.93	0.18	0
Pserimos	36.92	1.62	0.18	0
Nisiros	148.24	8.41	0.44	0
Patmos	184.76	65.08	0.96	0
Arki	0	0	0	0
Leros	196.59	31.19	0.26	0
Farmakonisi	0	0	0	0
Agathonisi	23.61	2.3448	0.21519	0



Table 8: Total score per island.

ISLAND	SCORE	ISLAND	SCORE	ISLAND	SCORE
KALYMNOS	26.87	KOS	45.14	SYMI	57.745
MEGISTI	34.669	ASTYPALAIA	45.292	RHODES	59.97
TELENDOS	37.273	KARPATOS	46.39	KASOS	62.804
LEROS	37.876	PSERIMOS	47.029	LIPSI	68.479
PATMOS	39.376	NISIROS	48.969	FARMAKONISI	69.091
TINOS	40.2	TILOS	53.562	ARKI	70
CHALKI	40.825	AGATHONISI	54.094		

Table 8 presents the total score per island. According to the results, Kasos, Arki Farmakonisi and Lipsi have the highest score as tourism development there is not massive. Rhodes has the highest score regarding the islands with massive tourism development.

## 5 Discussion

The existing tourism policy in Greece is mainly based on the facilitation of private investment and construction. To the key points of this policy, proposals that do not take into account the carrying capacity of each area indicators can be found, including:

1. To introduce mining activities within the areas designated “tourism priorities” that affect the natural environment;
2. To increase the building factor in off-plan areas from 200 sq. m to 800 sq. m, which allows the construction of colossal units beside the foreshore.
3. To allow the granting of rights to use the foreshore, beach, contiguous or adjacent sea space in front of complex tourist accommodation or tourist accommodation (5 or 4 stars), for the construction or retrofitting of existing platforms, to service boats and swimmers. There are reports on the environmental conditions and again while private mooring structures proliferate.
4. The elimination of step prior approval architectural design and the plot or land suitability for hotel accommodation.
5. Fast speed control of documents and within fifty days to grant E.S.L. but take care of the proper staffing of the supervisory authorities, resulting in insufficient controls.
6. To allow the construction or retrofitting of existing platforms, serving vessels and swimmers
7. To define specifications for wine tourism and medical/healing. It does not set the operating signal of medical tourism.

These policies do not exist in the case of Rhodes where there has been “classical” tourist development. According to the carrying capacity assessment model, the current development has had no limits in place which could lead to forms of sustainable development.



It is time for Rhodes Island to design a new tourism policy and introduce new tourist products, such as conference tourism, alternative tourism and cruise tourism.

The key points for this change are:

Tourist development indicators for Rhodes and Kos lead us to conclude that the tourism industry should aim at extending the tourist season to include more months and attain occupancy well over 50% for April, October, and probably more visitors with varied interests and expectations of the islands and organization for the protection and development of environmentally sensitive areas. There should be an extension of tourism services for the winter season months by developing and marketing novel tourist activities particular for the island (mountaineering, cultural events, conferences, etc.).

Due to the increased tourism demand, it is suggested that all the areas with environmental interests must be protected by a special organization that doesn't exist at the present time. Nature 2000 Network areas are a step in the right direction, but must be supported with effective management schemes.

Completion of urban waste treatment plants and network, appropriate garbage handling (urban garbage treatment – olive oil press residuals management), restriction of illegal buildings at cities and coasts and control of hotels' urban waste management systems.

The concept of linking visitors with culture, nature and the environment in a harmonious way is not a new idea, but is now viewed on a global scale.

Long-term, successful community involvement has preserved many popular rural tourist destinations such as the wine regions of Europe and the United States. Many rural communities have acted on instinct, rather than on governmental directives or support, and usually with enough individual investment to achieve results.

Alternative tourist development is conceptually related to sustainable development including approaches to deal with development and economic options, to prevent environmental damage and to involve public and stakeholders in decision-making processes. It is proposed that serious efforts have to be made in the direction of formulating viable policies and developing tools for effective implementation and control, as up to now alternative tourism has not yet been massively developed in Rhodes. The tourism industry of the island must be extended by supporting winter time charter flights.

Planning is conceptually related to sustainable development. It includes approaches to deal with development and economic options, to prevent environmental damage and to involve public and stakeholders in decision-making processes.

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