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M. de Bruin
M. Giaoutzi
P. Nijkamp
G. Pepping

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TOURISM AND DEVELOPMENT OF ISLAND ECONOMIES

Michiel de Bruijn **Peter Nijkamp**
Maria Giaoutzi **Gerard Pepping**

In this paper the economic development potential of small islands depending on tourism will be discussed. An attempt will be made to provide a systematic impact analysis taking in consideration a detailed sectoral composition of an island economy by means of input-output analysis.

The analysis will focus on the Greek island of Alonnisos as an empirical case study. Micro survey data and meso statistical information will be used to compose an operational framework for assessing the impacts of tourism.

New statistical methods in case of missing information - based amongst others on qualitative input-output analysis - will be discussed and applied as well. Various empirical results will also be presented.

1. Preamble

The importance of tourism in the emerging European network economy is increasingly recognized. Tourism is one of the most significant exponents of a leisure society and the potential offered by modern transport systems induces an international penetration of tourism, even in remote areas. Tourism has nowadays the features of a mass phenomenon, rather than the privileges of a happy 'few'. From elitarian via conformist behaviour we observe nowadays increasingly an individualistic tourist attitude, differentiated according to age, income, culture, leisure-orientation etc. Those tourist resorts which offer a wide variety of services to individually-oriented clients may be expected to become winners in this strong international competitive game. Reliability of services and sophisticated logistic systems are often seen as major critical success factors for exploiting the socio-economic tourist potential of relevant areas.

In this context, also island economies have a specific role to play. Individualistic behaviour can be combined with access to nature, beach resorts and social atmosphere. This is in conformity with the VID model (verification, integration and discovery) advocated by MacCannell (1976) amongst others.

The impacts of tourism on an island economy may have various forms: financial-economic, socio-cultural and environmental. Unfortunately such impacts are not always mutually compatible. The tourist sector is a typical example of a field where the notion of an ecologically sustainable economic development, as advocated in particular in the Brundtland report, applies.

The present paper gives an analysis of sustainability issues in the development of one of the Greek islands, Alonnisos, where the tourist sector plays a critical role. The main aim is to design - despite unreliable and 'soft' information - an operational tourism impact model as the basis for strategic development evaluation by means of scenario analysis. A set of strategic development scenarios will be developed by using a linear programming approach as the basis of a parametrisation of some relevant constraints associated with the scenarios concerned. This paper gives mainly the main conclusions from these results (see for details Pepping and De Bruijn, 1991). This study is part of a broader sustainability analysis commissioned by the Commission of the European Communities (see also Giaoutzi and Nijkamp 1990).

2. Tourist Impact Analysis

A small developing island may face some specific problems which are inherent in its size and location. A major problem

is the small size of the domestic market, caused by a small population. Producing solely for this market would, in many cases, bring about serious diseconomies of scale. Economic development therefore implies a heavy dependence on foreign trade.

The small size of islands also generally implies a less diverse resource base. Therefore many small islands are able to produce only a few different export products. In some cases tourism is even the only feasible export service. For the case of the Caribbean islands Holder notes (1979 in Theuns 1989, p.174): 'In some Caribbean states, tourism can do the job along with other sectors. In several others however, it will be virtually alone. There are no other prospects'. The small size of islands may also have important repercussions for the structure of tourism.

International tourism may broaden and deepen the supply side of an economy as a result of the additional and probably more diversified demand, generated by it. Impacts of the tourist sector on the various domestic economic sectors can be subdivided into (stimulating) effects on production, gross income and employment. In as far as more sectors benefit from activities in the tourist sector, the notion of multiplier effects initiated by incoming tourist expenditures is relevant. A multiplier value may be interpreted as a stimulus-respons ratio of effects vis-à-vis the initial (monetary) injection. The quantification of these effects by means of so-called tourist multipliers is a modification of the standard Keynesian multipliers ("snowball effects") developed in a general context, for the tourist sector.

The magnitude of these multiplier effects is determined by the way in which initial tourist receipts filter throughout the economy, stimulating linked sectors on their way. Tourism demand is met by the output of tourist sectors, which again require deliveries from linked sectors and so forth.

The first round of this seeping process is defined as all expenditures of tourists on their vacation in the country or region concerned, including expenses on transport to their destinations. These expenditures create direct revenues in the touristic sectors. These are called direct production effects ("direct" refers to the tourist sector, "indirect" to all other sectors). The tourist sector must re-stock its inventories to provide for future sales. The distribution of re-spending of the additional tourist receipts (the second round) on intermediate inputs affects the output of sectors supplying to the tourist sector. Again, their input levels must rise, affecting the output of a third group of enterprises, and so on. All such production rises caused by the growth in the tourist sector are called indirect

production effects. Direct and indirect production effects together are called the primary production effect.

Production rises also lead to rises in total income and total employment in all these sectors. Rise of total income in the tourist sectors is called the direct income effect of additional tourist expenditures. Rise of total income in sectors directly or indirectly linked to the tourist sector, caused by additional production in this sector, is called the indirect income effect of tourism. Together, these effects are called the primary income effect. Employment effects refer to the number of new jobs created. Similar definitions can be given concerning these effects. There may however be large differences in the order of magnitude of these two kinds of effects. A linear relationship between income effects and employment effects would exist only in case of homogeneous production techniques in all linked sectors (no differentiation in more capital intensive sectors) and no differences in labour productivities (equal value added per head). In developing countries these differences may be large, since the existence of hidden unemployment and many part-time jobs especially in the service sectors implies an underutilization of the number of working people.

A rise of total income leads to additional local demand. To which extent income rises lead to additional consumption expenditures depends on the marginal consumption behaviour of those receiving this additional income, and on potential demonstration effects of international tourism. Additional consumption leads again to additional production, and so on. The snowball effect of tourism can thus also find its way through household consumption. All further effects, once initiated by this additional demand of residents of the country or region, are called induced or secondary effects of tourism.

Thus an instrument of major importance in a tourist impact analysis (TIA) is a multiplier analysis. In this approach it is -in principle- possible to calculate the specific effects of tourism on regional production and income levels. Input-output modelling is based on the principle of deriving sectoral multiplier values from a regional inter-sectoral transaction table. A sectoral multiplier concerns the total cumulated effect on production or income in all sectors caused by one sector. An input-output model is the most accurate analysis in describing the various expense rounds of initial tourist money. However, detailed insight in the sectoral input structures is a necessary condition. Therefore, the possibility of constructing a regional input-output table depends heavily on data availability.

The type of information, basic to all input-output studies, is of much greater value to policy-makers and

planners than the bare multiplier values produced by other techniques. Some researchers have even segmented their tourist categories to show the multiplier effects of several 'groups of buyers with common characteristics and attitudes' within the structure of the regional tourist demand (Archer 1973).

The inclusion of induced effects in the input-output model can take place by treating households as a producing sector, as if consumption were intermediate inputs which are purchased in order to produce 'household services'. If an input-output model is being constructed to forecast the long-term growth of a regional economy, it is indeed appropriate to use a long-term consumption-income relationship, which is a proportional one. Thus, provided the household sector is allowed to change in size (through population growth and migration), such a relationship would seem to be appropriate. Allowing household expenditure to be responsive to income changes is therefore particularly appropriate for small area studies, since the household sector can easily change its size substantially through net migration (Armstrong and Taylor 1985, p.38). In this context, the use of average propensity-to-consume coefficients -rather than (in the short term more realistic) marginal propensity figures- may be preferable. Some of the strongest arguments are that average propensity figures are far more accurate; that these coefficients remain stable in the short and medium run; and that in most cases it is impossible to determine meaningful marginal figures where data are available for only a single time period and no cross-check data are available (Archer and Owen 1971, p.292). When household feedback effects are incorporated in the model, the production and income multipliers will be larger than when these effects are ignored. The total multiplier impact can than be divided between direct, indirect and induced effects.

Some serious limitations of the method should also be mentioned in addition to the already mentioned large data requirements.

The nature of such an analysis is semi-dynamic, that is, it can technically be used to predict changes in output levels but the model coefficients are fixed in a base year. That an input-output table only shows the regional economy structured in the base year, does not reduce its value for the case study. Also the fact that a multiplier value does not contain information about the time period that passes before the cumulative effect has been reached is here no limitation, because the evaluation finds place in a long term perspective.

The unrealistic assumption of linear input-output relationships between supplying sectors is a serious drawback because the possible existence of economies of scale is ignored and multiplier values are largely determined by these

relationships. However, potential economies of scale are positively correlated with factors such as capital intensity and firm size. In the case of Alonnisos there are practically no capital intensive activities. The only secondary activity is the construction sector, while the primary sector is dominated by small family units. It is therefore plausible that on the island no significant economies of scale occur, implying that a linear input-output model in this respect may be a realistic approach.

Furthermore, the practical use of the multiplier theory is restricted to those areas with underutilization of production factors. An inflexible regional supply side could induce rising price levels, which in turn would reduce the initial multiplier impacts, depending on the price elasticity of local demand and the level of inter-regional economic interaction of the area. This side-effect may especially occur in the case of relatively isolated small island economies with an undiversified primary production capacity (Theuns 1989, p.141).

3. Case Study for Alonnisos

In the preceding centuries, the island economies of the larger Aegean islands such as Rhodes and Lesvos could flourish because of their commerce activities combined with the famous Greek marine transport system. Smaller islands, such as Alonnisos, could indirectly benefit from these circumstances. Therefore, Alonnisos, which has never been a cultural and commercial centre, has not been an economic autarky, totally dependent on her natural terrestrial and marine resources (UNESCO 1981, p.47). Exports and imports took place without serious transport problems.

Like on many islands in the Aegean Sea, the exporting agricultural sector was the main source of income for the local population. Before the fifties, Alonnisos used to have large vineyards, responsible for a large share of the island's exports. The contamination by a fungus led to a rapid collapse of the harvest and a complete abandonment of the vineyards. Although now the infection has disappeared, no grape production of any economic importance takes place anymore. Today the production of olives is the main agricultural export activity, while various other agricultural products are of minor economic importance. Other crops, fruits like peaches, figs, pears and grapes, and vegetables like cucumber and egg-plant are grown for personal use, and not exported.

Exploitation of forestry land takes place by resin collectors. Resin collection, which is taking place from the pine trees (seasonal work), is only of small economic importance, supported by the EC with large price subsidies.

Only about 12 people on the island exploit the maximum number of tappable trees on the island; this is just a part-time job. All resin is exported. This activity is not expanding at the moment while the unpopularity of this (hard) work with the younger generation makes its future uncertain.

Another traditional island activity is cattle breeding, by which scrub and rock soils are exploited. Goat herding is the main activity, while sheep and poultry account for only about 5% of the gross income of this sector. The herding of goats is also subsidized by the EC. The most important products sold are meat, milk and cheese.

After 1965, in which year an earthquake ruined parts of the main village on the inland, people were forced by the government to migrate to the coast (Patitiri). With the growth of this small harbour village, the fishery sector also expanded rapidly. The main activity is tuna fishing (exports to France). However, this sector is now under pressure. Since the establishment of the marine park in the Aegean (1986), fishermen are restricted to rules concerning zones, time periods and types of nets. Also the marine environment suffers from overfishing, caused by the operation in the waters surrounding Alonnisos of large-scale fishing boats (so-called anemotratas and gri-gri's) from the mainland.

The primary sector is responsible for only one third of the gross product of the island. The small population of Alonnisos could thus not be characterized anymore as a society, orientated on the primary sector. Although the island's landscape is dominated by olive, pine, fig and almond trees and other fruit bearing trees, the "big money" is circulating in the southern and eastern valleys where the tourist sector is concentrated (Patitiri and coastal hotel resorts). The tourist sector which has already expanded there very rapidly in the past decade, is nowadays the sector with the largest growth potential. In fact about half of the private gross income of the island in 1989 was made up out of tourist receipts. See table 1.

Table 1. Sectoral shares in the regional gross domestic product (RGDP)[1] of the private sector of Alonnisos (1989).[2]

Total RGDP 750 million drs.

Primary sector	32%	Agriculture	5%
		Cattle breeding	8%
		Fishery	19%
Secondary sector	4%	Construction	4%
Tertiary sector	64%	Non-tourist food retail	17%
		Tourism	47%

Without any industrial activity (except for the construction sector which includes a small factory), the primary activities and tourism form the basic (exporting) sector of the economy of Alonnisos. The rest of the tertiary activities can be characterized as service sectors, whose size is directly correlated with the demand of the local population. Furthermore, there is the role of both the construction sector and the public sector on the island. The magnitude of the construction sector mainly depends on the growth of the tourist sector, the growth of the local population (traditionally a dowry of a bride consists of a house or apartment) and the local government policy towards urban planning. The role of the public sector is limited in the sense that the island is provided with only elementary public goods. It is assumed that there is a large informal sector on the island.

The tourist sector on Alonnisos is subject to various kinds of regional tourist taxes, but also to the specific regional monetary incentives within the overall stimulating policy of the central government (the laws 1262 (1982), 1360 (1983) and 1682 (1987)). The Sporades islands belong to a so-called zone C, classified as a relatively under-developed tourist area. Examples of the incentives in this zone are investment grants (max. 40%), income and corporate tax allowances (max. 75% of fiscal profits) and extra depreciations.

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[1] The RGDP is defined as the total final demand for the region's output minus payments to other regions and the government.

[2] In these estimates the income of 34 business units that can be classified as non-touristic non-food retail (video clubs, fashion shops etc.) and services (technical offices, car repair services etc.) are ignored due to lack of data. Also the public sector is ignored.

4. Environment and Tourism on Alonnisos

Alonnisos as one of the three inhabited islands of the Northern Sporades archipelago is of great environmental importance. In the archipel, vegetation is exceptionally rich. There is a wide variety of plant life (including pine forests and mediterranean scrub land), even between neighbouring islands. This is because of the peculiar climatological conditions and the geographical lay-out of the islands themselves. It offers excellent habitats for a wide range of floristic species. In the undisturbed areas birds find ideal rest and breeding places. In fact, this area is an important transit place in the southward migration of birds. Bird life on the islands appears to be naturally balanced, and human intrusion has only had few adverse effects. Various rare species of birds of pray (especially falcons) and seagulls are also present. Also the surrounding sea area is exceptionally rich. Many different species of fish, dolphins and whales can be found, while the occurrence of the rare Mediterranean monk seals in the surroundings of the small uninhabited islands east and north of Alonnisos is of particular importance. In recent years their number has been declining. At the moment about 40 seals live there on a total of about 450 in the whole Mediterranean (Nijkamp and Giaoutzi 1990, p.3-4). These animals are very dependent on the ecological quality of their living places.

It is evident that tourism may affect the whole existing fragile ecosystem of this area. This influence may take several forms. At the moment, one can not say there is a visible environmental restructuring due to excessive building of tourist supporting facilities. Only two resorts are existing outside the urban areas of the island. However, in the built environment itself, in the high season traffic congestion occurs, worsened by the many parked cars near the port because of the poor roads on the island and lack of parking places. Resulting pollution and noise (especially of motorbikes and cars) are therefore concentrated around the port of the island.

Tourism demand for natural resources of the island may also lead to impacts on the marine and terrestrial environment. The rise in fish demand in the summer may be a cause of overfishing in the area (threatening the existence of the monk seals). Furthermore, excessive depletion of the ground water stock may lead to salt intrusion, having consequences for the island vegetation. In fact, there are already signs of a significant depletion of the stock (Scholte 1989, p.48).

Of minor importance is the direct destruction of flora and fauna due to open air recreation by tourists. The poor

road infrastructure makes the island area relatively inaccessible for tourists.

More serious impacts on the environment are caused by the generation of human waste residuals by the local and tourist population. The number of tourists on the island in the summer may exceed ten times the local population. Local (governmental) waste management fails to cope with this seasonal pattern in human waste generation. Household waste on Alonnisos is usually dumped directly from a rock into the sea, while remaining parts staying behind are burnt. Both ashes and solid waste like organic material, plastic, metals, glass and chemicals thus end up in the sea.

The most serious form is pollution by sewage effluents into the sea. There is no public sewage system on the island; septic tanks are used for the storage of the sewage from houses. Part of the generated sewage ends up in the sea due to lack of public sewage works. Only the hotel complexes include (private) sewage works. Septic tanks are no proper solution since the contents will eventually end up in the sea. This leads to pollution of seawater with nutrients. These pollutants are concentrated near the ports of Patitiri and Votsi. The limited flushing with the open ocean of the water in these bays aggravates the problem.

Impacts on the marine environment (especially on the monk seals that are extremely sensitive to the quality of the sea water for their food) are dependent on the amounts of these wastes and thus on the numbers of tourists visiting the island.

Using such parameters as bay depth, bay-flushing times and the level of nutrient inputs from various sources (houses, hotels), it is for Alonnisos to a certain extent possible to predict the effects on the pollution of sea water (see Van den Bergh, 1991). Using the water quality submodule of the Stella program (an ecological simulation model built for the island of Alonnisos)[3], specific parameters about average amounts of sewage effluents for different tourist types can be calculated (see table 2), since this kind of pollution caused by one tourist depends on the kind of accommodation he uses. For the case study the following five tourist classifications (characteristics) were selected: per type of accommodation used, per age category, per group type, per way of travelling (self/agency) and per nationality. The units of measurement of the parameters are percentage points of the applied water quality norm per tourist per day (see also Pepping and De Bruijn 1991). The used criterion with respect to the water

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[3] See also the forthcoming report by Van den Bergh and Gilbert (1991).

quality is the amount of biological oxygen demand of the water in the harbour area, where at the moment the tourist sector is concentrated.

Table 2. Tourist related pollution coefficients

CATEGORY	COUNTRY	GROUP	AGE	ACCOMMODATION	TRAVEL
1	greek 0.000427	alone 0.000376	15-25 0.000406	hotel 0	self 0.000435
2	far 0.000424	friends 0.000386	25-40 0.000366	room 0.000495	agency 0.000223
3	german 0.000354	family 0.000327	40-55 0.000297	camping 0.000495	
4	british 0.000322		> 55 0.000307	second house 0.000495	
5	dutch 0.000144			friends/rel. 0.000495	
6	scandinavian 0.000495			sailboat 0.000495	

5. Social Impacts of Tourism on Alonnisos

The effects of tourism on the local population may result from the behaviour of tourists, or from their sheer numbers. According to Loukissas "tourism is basically shipping the world's richest citizens into some of the world's poorest societies" (1977, p.43). These socio-economic gaps between visitors and residents (especially employees in the tourist sector) are even aggravated by the usually high spending rates of people on vacation. These gaps could lead directly to invidious comparison and hostility.

An often heard complaint of local inhabitants concerning tourists is that some tourists "do things here that they wouldn't do at home". Examples of this kind of behaviour are vandalism, nudism, noise annoyance, pollution of the environment and theft. Tourists are far from the critical eyes of those whom they respect. They need never return to the area, and they will not be held accountable for the property they use while they are on vacation.

It is generally assumed that overcrowding of an area by tourists leads to a loss of the original identity of the area. It is obvious however, that both tourists and local inhabitants in many cases compete for the use of scarce beaches, infrastructure and facilities, e.g. public transport.

In order to be able to compare the social impacts of tourists of different categories, it may be necessary to

quantify these impacts. The overcrowding depends on the number of tourists in an area in relation to the size of the local population. In a study of the effects of tourism development Loukissas used a so-called tourist density index (Loukissas, 1977), which can be calculated in the following way:

$$TDI_i = \frac{\sum_{k=1}^{n} (V_{i,k} \times d_{i,k}) \times 1{,}000}{P_i \times 360}$$

TDI_i = tourist density index for island i
$V_{i,k}$ = visitor arrivals in all ports of island i by mode k
$d_{i,k}$ = length of visitor stay, in number of nights, for each mode of travel and island
P_j = resident population of major city

This index thus relates the total number of days spent by tourists in the area to the total number of days spent by the local population in the area.

The value of the tourist density index can be compared with the values for other islands, that were calculated by Loukissas (1977, p.335). Only 4 of the 38 islands have a tourist density higher than the one of Alonnisos. The indices were calculated for the year 1976. Therefore nothing can be said of the actual tourist density of Alonnisos in relation to the other Greek islands. However, Loukissas reports social conflicts, both between tourists and the local population and within the local community itself, for most of the islands with a high tourist density. This is an indication that tourism on Alonnisos may have adverse social effects.
The importance of the tourist density indices for planning purposes stems from the possibility to impose restrictions on the increase of the social effects of tourism.

This tourist density index can easily be adjusted in order to reflect the effects of differences in the behaviour of tourists. To that end weighting factors have to be added for each tourist category. In this way tourists of a given category with a high risk of undesirable behaviour can be given a higher weight. The way in which the risk for each tourist category has to be determined has not received much attention in the sociological literature on tourism. Questionnaires among the local population of a tourist resort or the employees in the tourist sectors may be useful instruments.

It should be mentioned that a detailed study of the social effects of tourism on Alonnisos was beyond the scope of our study. Just as an illustration a set of weighting factors has been composed by the authors. A weight of 2 has been given

to tourists between 15 and 25 years old, and to tourists travelling with friends and relatives. A weight of 4 has been given to tourists that meet both conditions. All other tourists have received weight 1. The values of the weighted coefficients of the adapted tourist density index are shown below (table 3). This table reflects quite some variety in the social implications of tourism. This table is hypothetical, composed by the authors.

Table 3. Social impact coefficients for Alonnisos

CATEGORY	COUNTRY	GROUP	AGE	ACCOMMODATION	TRAVEL
1	greek 1.94	alone 1.21	15-25 3.38	hotel 1.56	self 1.89
2	far away 2.15	friends 2.68	25-40 1.48	room 2.02	agency 1.58
3	german 2.29	family 1.10	40-55 1.11	camping 2.66	
4	british 1.52		55+ 1.00	second house 2.14	
5	dutch 2.03			friends/rel. 1.44	
6	scand. 1.81			sailboat 1.50	

6. An Input-Output and Multiplier Analysis for Alonnisos

In this section an input-output model will be presented for the economy of Alonnisos. This model will provide sectoral multipliers. These sectoral multipliers are in turn used to calculate tourist multipliers and long-term economic effects. The long-term production effect and the long-term employment effect will be used in this study as indicators of the economic effects of tourists of different categories.

In the model, Alonnisos' economy is subdivided into eleven sectors. Ten sectors from this set make up the private sector, while the eleventh sector comprises the households, which are treated as part of the processing sector. Since the case study has a long term horizon, there are assumed to be no sunk input components in the various sectors in the model: all costs, including fixed sectoral inputs, are variable in the long term.

The matrix of intermediate coefficients in which the household sector is included (which is used for the calculation of the various sectoral multipliers) and a matrix of primary cost coefficients are derived from the input-output table 4. In doing so, a new analytical tool, qualitative data

analysis, which is useful to derive as much quantitative information as possible from the existing qualitative data set, was used (see Nijkamp et al, 1991). Therefore, cardinal data of the model were column-wise generated from ordinal data. This transformation gave the authors the possibility to express their prior or ad hoc (often ordinal or qualitative) knowledge on the island economy in a quite flexible way. By means of a proper stochastic method available in a systematic software package using a minimum number of assumptions, the cardinal data could be generated from ordinal ones. The validity of the methodology has been empirically tested by applying it to an existing regional input-output table in the Netherlands. From this test study it has been concluded that the ordinal data method gives a fairly reliable replication of the underlying quantitative input-output data. For a description of the underlying methodology we refer to Nijkamp et al (1991). In our Alonnisos case study, this qualitative statistical method has technically been column-wise utilized for the model by means of a special computer program.[4]

An illustration of the usefulness of this method concerns a rejected assumption on local demand for restaurant services. Instead of neglecting this demand (see the following table based on 'soft' data), the adjusted coefficients allow for the expenditures of local people in this sector to be about 5% of their food expenses.

[4] Credits for Hans Ouwersloot who developed this so-called OTOCSUM program.

Table 4. An Input-Output Table of the Economy of Alonnisos

INTERMEDIATE DELIVERIES												EXPORTS		TOTALS
	AG	CO	CA	FI	HO	RO	CAM	HOR	TS	NTFR	HH	TOURISM DEMAND	OTHER EXPORTS	
AG	0	0	0	0	0	0	0	15	0	25	0	0	31	71
CO	0	6	0	0	3	11.5	0	2	0.5	1	76	0	0	100
CA	0	0	0	0	0	0	0	14	0	45	0	0	22	81
FI	0	0	0	0	0	0	0	9.5	0	16	0	0	154.5	180
HO	0	0	0	0	0	0	0	0	0	0	0	144	0	144
RO	0	0	0	0	0	0	0	0	0	0	0	174	0	174
CAM	0	0	0	0	0	0	0	0	0	0	0	4	0	4
HOR	0	0	0	0	0	0	0	0	0	0	0	329	0	329
TS	0	0	0	0	0	0	0	0	0	0	0	113	0	113
NTFR	0	0	0	0	0	0	0	0	0	0	275	43	0	318
HH	35.5	25	57	147	76	139.5	4	56	19	42	0	0	0	601
PRIMARY COSTS														
LAB	0	35	0	0	7	10	0	10	2.5	3	0			
OTC	33.5	0	24	3	40.5	3	0	0	0	0	22.5			
CAP	2	0	0	30	2.5	0	0	0	0	0	0			
PRF	0	0	0	0	15	10	0	8	4	1	0			
DRI	0	0	0	0	0	0	0	72	0	76	0			
CAT	0	0	0	0	0	0	0	95	0	45	0			
AGR	0	0	0	0	0	0	0	45	0	64	0			
SEA	0	0	0	0	0	0	0	2.5	0	0	0			
MCG	0	34	0	0	0	0	0	0	87	0	227.5			
TOTALS	71	100	81	180	144	174	4	329	113	318	601			

Legend:

AG	agriculture	LAB	import of labour
CO	construction	MCG	import of materials and consumption goods
CA	cattle raising	CAP	import of capital goods
FI	fishing	PRF	import of profits
HO	hotels	DRI	import of drinks
RO	private rented rooms	CAT	import of cattle products
CAM	campings	AGR	import of agricultural products
HOR	restaurants, bars etc.	SEA	import of sea products
TS	tourist shops and services	OTC	other costs
NTFR	non-tourist food retail		
HH	households		

The values of the relevant multipliers, defined before, are given in table 5. We have left out here first round leakages (implying that direct production effects are equal to 1 and direct income effects are equal to the sectoral local wage and profit proportions). The values of both kinds of sectoral multipliers, derived from the adjusted coefficients, will be used in the next section.

Table 5. Multiplier values and their components of touristic sectors and the NTFR on Alonnisos.

Sector	Production multiplier	Direct effect (%)	Indirect effect (%)	Induced effect (%)	Income multiplier	Rel. income multiplier	Direct effect (%)	Indirect effect (%)	Induced effect(%)
Hotels	1.49	67	2	31	0.64	1.22	82	1	17
Rooms	1.77	57	3	40	0.98	1.23	82	1	17
Campings	1.61	62	0	38	0.85	1.20	83	0	17
Restaurants	1.32	76	9	15	0.28	1.71	59	24	17
TS	1.15	87	1	12	0.19	1.22	82	1	17
NTFR	1.56	64	19	17	0.37	2.78	36	47	17

Accommodation multipliers are higher than those of the other tourist sectors. This accentuates the high impact of the accommodation sector compared to other tourist sectors, not only on local production but also on income levels. The high relative income multiplier of non-tourist food retail is caused by only marginal profits in this sector itself (in comparison with for example the restaurant services which have a similar input structure but are able to generate higher profits).

7. Tourist Multipliers

Using the sectoral multipliers and the tourist expenses, tourist multipliers can be composed, that reflect the economic impacts of tourism on an island. Like environmental and social impacts, different types of tourists may thus also have different economic effects on an island.

Tourist multipliers can be calculated for each of the categories used in our case study. They are weighted averages of the sectoral multipliers, the weighting factors being the tourist expenses of the various sectors. The size and the composition of these expenses have been retrieved by means of a questionnaire among tourists on the island.

The production multiplier (pmp) and the employment generation coefficient (egc) (the latter of which is strictly speaking not a multiplier), can be calculated in the following way:

$$PMP_i = \frac{\sum_{j=1}^{n} (EXP_{i,j} * PMP_j)}{\sum_{j=1}^{m} EXP_{i,j}}$$

$$EGC_i = \sum_{j=1}^{m} \left(\frac{EXP_{i,j} * IMPD_j}{WAGE_j} + \frac{EXP_{i,j} * IMPI_j}{INTWAGE} \right)$$

PMP_j is the tourist production multiplier of category i
EGC_i is the employment generation coefficient of category i
$EXP_{i,j}$ is the expenses of a tourist of category i on goods or services from sector j
PMP_j is the sectoral production multiplier of sector j
$IMPD_j$ is the direct income multiplier effect
$IMPI_j$ is the sum of the indirect and the induced income multiplier effects
$WAGE_j$ is the average wage of sector j
INTWAGE is the average wage of the delivering sectors

i = 1,2,.....,n is the tourist category.
j = 1,2,.....,m is one of the following economic sectors: hotels, rooms, camping, touristic shops, non-tourist food retail, and restaurants/bars.

A tourist multiplier can therefore be seen as an indicator of the economic performance that the tourist expenses have from the point of view of the local/regional community.

When the tourist multipliers are known the long-term production (ltpe) and employment (ltee) effects of the daily expenses of tourists can be calculated. This can be done by simply multiplying the tourist multipliers with the total expenses per tourist per day.

The long term economic effects can be regarded as indicators of the economic benefits of the stay of a tourist, of a certain tourist category, for the local/regional community.

In the remainder of this section we will present, and briefly discuss, the values of the multipliers and of the long-term economic effects for different types of accommodation.[5] For the six types of accommodation the

[5] The tourist multipliers for the other classifications can be found in appendix 1.

multipliers and long term economic effects are shown in table 6. In addition, the values of those explanatory variables are shown that differ per tourist type.

Table 6. Tourist multiplier values per accommodation type.

category	expenses per tourist per day (x 1000 drs)			ratio of stay			results			
	food	secp	total (incl. accommodation)	hotels	rooms	camp	pmp	egc	ltpe	ltee
hotel	2.45	1.32	7.96	1	0	0	1.38	0.54	11.0	4.32
rooms	2.37	1.18	4.97	0	1	0	1.44	1.23	7.17	6.14
camping	1.72	0.62	2.99	0	0	1	1.41	0.53	4.24	1.60
2d house	2.07	1.37	3.44	0	0	0	1.25	0.55	4.33	1.91
fr/rel	1.94	0.61	2.55	0	0	0	1.28	0.55	3.29	1.41
sail	2.5	0.5	3	0	0	0	1.29	0.55	3.87	1.67

Legend:

secp - souvenirs, excursions, postcards, clothes etc.
pmp - production multiplier ltpe - long-term production effect
egc - employment generation coefficient ltee - long-term employment effect

The expenses differ widely among the tourist categories. This can be explained to a large extent by the differences in the expenses on accommodation. The price of a hotel night is almost 4 times the price of a night in a rent-a-room and more than six times the price of a camping night. Since sailing boats are either privately owned or let out by a company from an other island, no money for overnight stays is received from tourists staying in this type accommodation.

The variations in the values of the production multipliers are not very large. The high value of the multipliers of tourists staying in the first three categories is mainly due to low import leakages of the accommodation sectors, especially the rent-a-room sector.

Remarkable is the high employment generation coefficient of tourists staying in rented rooms. This is mainly due to the high labour intensity of the rent-a-room sector. However, hotel guests have the most favourable impacts on the regional production, because of the high daily expenses of tourists of this category.

8. Sustainability Constraints to Tourism

It goes without saying that uncontrolled tourism will mean a serious threat to an ecologically sustainable economic development, and therefore it seems plausible to formulate an set of constraints within which tourist development should take place. These constraints will now briefly be discussed here.

8.1 The accommodation capacity and building site on Alonnisos

At present there are 9 hotels on Alonnisos. The total number of hotel beds is 577. There are about 1150 private rooms on the island; altogether the number of beds in private rooms is about 2,300. Alonnisos has only one operating camping site. The capacity of this camping was estimated by the owner at approximately 300 persons. Free camping is prohibited on Alonnisos. The accommodation capacity of Alonnisos is thus about 3,180 beds per night. For the whole season this is about 150 x 3,180 = 477,000 bed nights.

The island of Alonnisos is fairly mountainous, and rather scarcely populated, sothat sufficient land is available for the construction of accommodation and supporting infrastructure and facilities. A large part of the island is located within the marine park. Therefore rigid restrictions have been imposed on construction activities by the municipality. Furthermore the maximum permissible height of buildings on Alonnisos is 7 meters, since the island is located in an earthquake region.

Unfortunately these restrictions have hardly been respected. The municipality is not able to alter this situation. Thus enforcement of laws and regulations is a problem here.

8.2. The beach capacity of Alonnisos

Alonnisos has numerous beaches, which all have approximately the same size. However, at present only a few of these beaches are accessible for tourists. There is no public transport on the island, and virtually none of the tourists come by their own car. The assumption is made that the maximum time tourists are willing to spend on walking to the beach is half an hour. Under this assumption about 8 beaches are accessible by foot. In the high season 6 more beaches can be reached using the regular boat service. The average size of the accessible beaches is approximately 2,500 square meters. The total accessible beach square of Alonnisos is thus about 35,000 square meters.

Using the beach density values found by Piperoglou (Piperoglou in Pearce 1981, p.37), hotel guests require about 10 square meters of beach per person. The rented rooms and the camping site are lower cost accommodation types, and it is assumed that tourists staying in these types of accommodation require about 6.6 square meters per person.

The assumption is made that about 25 % of the tourists on Alonnisos stays on the beach at the same time (Amouroux 1960 in Pearce 1981). However this percentage may be too low, since Alonnisos has not got many other attractions besides quiet

beaches.

The values of the beach use coefficients (in square meter per person per day) are presented in table 7.

Table 7. Beach use coefficients for Alonnisos

CATEGORY	COUNTRY	GROUP	AGE	ACCOMMODATION	TRAVEL
1	greek 1.77	alone 1.85	15-25 1.81	hotel 2.5	self 1.75
2	far 1.77	friends 1.84	25-40 1.87	room 1.65	agency 2.12
3	germaan 1.89	family 1.94	40-55 1.99	camping 1.65	
4	british 1.95		> 55 1.97	second house 1.65	
5	dutch 2.25			friends/rel. 1.65	
6	scandinavian 1.65			sailboat 1.65	

8.3. Economic constraints on tourism development on Alonnisos

A precondition for any policy to reduce the negative social or environmental effects of tourism may be that no jobs are lost. In this case study the following three minimum constraints to the economic effects of tourism on Alonnisos will be used: the long term production effect, the long term employment effect and the direct tourist revenues.

The current (1989) values of these effects are used as minimum constraints to policies aiming at minimizing the social or environmental effects of tourism on Alonnisos.

8.4. Environmental constraints

It is clear that the uncontrolled development of tourism on the island puts pressure on the fragile environment of this island and her satellites (see section 3).

Since the evaluation of tourist categories on the island takes place within the existing infra- and superstructure of the island (in 1989), now three feasible environmental limits to tourism of the island will be dealt with that are (partly) dependent on the existing infrastructure. These are:

1. The water supply on the island
2. The water pollution problem induced by tourism
3. Referring to the unique monk seal population, the survival of rare species in the area. This aspect is related to

the former two ones.

The total demand for water for household purposes on the island in 1989 can be estimated by multiplying the total number of inhabitant and tourist days in that year with the average domestic water usage per capita per day.[6] This results in:

- use by locals: 565,800 x 150 = 85 million litres
- use by tourists: 178,000 x 150 = 27 million litres

For drinking purposes about 10 litres per capita per day is needed (Tchobanoglous and Schroeder 1985, p.8). On a total demand of about 112 million litres, the estimate of the quantity needed for drinking purposes is 7,5 million litres.

As on many Greek islands, the availability of high quality drinking water from wells on Alonnisos is limited. The annual extraction capacity of (low quality) drinkable water from municipal wells is estimated at 35 million litres[7], which exceeds total demand for drinkable water, but in general it is not of the high quality demanded by tourists. Mainly to meet this demand, in 1989 about 2.7 million litres were imported by boat in bottles, which is only economically justified for drinking purposes. It is clear that the extent of (uncontrolled) private water collection by the island residents is huge, since the capacity of the municipal wells is too low to meet total water demand. This would especially in the summer season lead to shortages, due to little rainfall and concentration of tourists.

The (partly) unregulated water extraction can lead to increased salt water intrusion on the island, having negative consequences for the existing vegetation forms. In fact, there are already signs that with the actual tourist numbers, the island is already suffering overextraction of the aquifer (Scholte 1989, p.28). This implies conflicting water demands by tourists and agriculture.

However, no relevant ecological data are available at the moment. Though recognizing that it might be a (future) constraint to tourism development, it is not included in the

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[6] The residential water use per capita varies from 150 to 480 litres per capita per day (Tchobanoglous and Schroeder 1985, p.7). For the calculation the lower bound is taken. Also the local Institute of Geology and Mineral Exploration uses this estimate for Alonnisos.

[7] Based on an extraction capacity of drinkable water by drillings on the island of 100 m^2 per day (local Institute of Geology and Mineral Exploration).

analysis.

An other feasible constraint is formed by the existence of the monk seals in the area. The main threats to this animal population are tourism and fishery. Overfishing in the area (also induced by seasonal tourist demand for fish) reduces their amount of food while their habitats can directly be destroyed by the intrusion of fishermen and tourists in the area. In order to protect these vulnerable animals against tourism and fishery, a marine park has been established around the islands of Kyra Panagia, Piperi, Gioura, Skantzoura and Psathoura. It includes a strictly preserved zone for tourists while fishing is allowed only under strict conditions. However, indirectly these animals are affected by tourism, for example by seawater pollution. The relationship between numbers of tourists and the surviving conditions for these animals is not known.

An important ecological constraint is caused by lack of waste treatment infrastructure on the island, resulting in water pollution (see section 3). This constraint will be integrated in the linear programming analysis.

8.5. Social constraints to tourism development on Alonnisos

In order to constrain the negative social effects of tourism on Alonnisos, restrictions may also be imposed on the maximum values of the tourist density indices that were mentioned before. Only for the sake of illustration, the assumption is made that the current values of both indices equal their upper limits.

9. Strategic Development Scenarios for Alonnisos

The scope of this final section is the implementation of a linear programming model for the determination of the optimal composition of the tourist flows to Alonnisos. For the case of the accommodation criterion, the following five effects are subsequently optimized:

1 the long term production effect (max)
2 the long term employment effect (max)
3 the total direct tourism revenues (max)
4 the BOD concentration in the main port (min)
5 the adapted tourist density index (min)

Each of these five goals provides an optimal mix of the tourist flow to the island by solving the respective linear programming case (scenario). The results for each scenario can

be found in Appendix 2. Here we will provide a concise interpretation of these results.

Concerning the economic impacts, it appears in this analysis that in order to stimulate production and direct tourist revenues, hotel tourism is to be stimulated. The optimal tourist mix (which occupies full hotel capacity) has a long term production effect of 20% more than the actual attracted mix. The positive effect on direct revenues is 10%. Such an optimal mix is constrained by the hotel capacity and by social factors (with an upper limit of the actual values of the tourist density indices). However, in order to stimulate employment, more emphasis has to be placed on the private accommodation sector.

A policy that deals with the quality of the seawater in the main tourist zone on the island (port of Patitiri) has to be based on stimulating hotel tourism (which is evident since only hotels are assumed to have sewage systems). Not only the hotel capacity would become restrictive, but also the long term employment effect of tourism, if it is not allowed to worsen.

Concerning social conditions, a minimization of (negative) social impacts of tourism may be reached in the situation of an equal spread of tourism over the hotel sector and private room sector. Only restrictive would then become the actual levels of employment and tourism expenditures.

The constraints of the seawater quality and beach capacity are not effective in any of the scenarios. With an upper limit of the simple tourist density index, which in fact constrains tourism volume on Alonnisos to about 180,000 tourist nights, there is assumed to be sufficient beach area and no serious seawater pollution (respective slacks of about 90% and 40%).

A similar analysis has been carried out for each of the other four tourist classifications.

In order to perform an effective policy towards the attraction of tourists, attention must be focused on the values of the target variables in the optimal situations. When comparing the potential long-term production rises in the various classifications, it appears that the scenario with a distinction into accommodation types shows the largest potential increase (of about 20%), followed by the nationality scenario, which shows an increase of about 18%. This leads to the conclusion that a policy based on influencing the demand for the different nationalities and types of accommodation can be recommended in order to stimulate production activities on the island.

9. Conclusion

In this case study an input-output model was used as the basis for the economic evaluation of the tourist categories distinguished. By deriving multiplier values for the different tourist categories from the sectoral multipliers, the long term production and employment impacts were assessed.

An effort was made in order to determine some non-economic impacts of tourism on Alonnisos. We dealt with a range of impacts on the fragile environment of the island and its surrounding sea territory, and potential social conflicts between tourists and the local population. In addition some quantification methods were presented.

We discussed also limits to tourism development on the island as a consequence of some of the non-economic impacts and the physical and environmental capacity of the island. The expected problems that could arise from a further rise in tourism development concerned the sea water pollution in the main tourist zone induced by tourists, the social impacts of mass tourism, the beach capacity of the island and its accommodation capacity. Concerning the social aspect, the actual situation, reflected in social density indices, is taken as the upper limit of the social impact of tourism development.

The impacts of and constraints to tourism development were combined in a linear programming model in order to answer the question: are there any significant improvements possible in the existing policy towards tourism on Alonnisos ?

Some conclusions have been drawn about optimal combinations of different kinds of tourists. The production activities induced by tourism on the island may show an increase of up to 20% under the limits imposed, when an optimal mix of tourists to accommodation type is realized. Hotel tourism is then to be stimulated. Also an important option is a marketing policy focusing on different nationalities of tourists. Their actual expenditure patterns make Dutch and British, as well as domestic tourism mostly favouring the local economy concerning production stimuli.

In the future, emphasis on selective tourism should become an important aspect of economic policy in developing tourist areas with a fragile environment. Such a policy has to be supported by an economic evaluation technique which is able to predict overall effects. The authors hope that the relatively simple but logical and systematic methodology presented in this paper will be of inspiration to tourism regulating bodies in relevant areas.

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Appendix 1. Tourist multipliers

Results per age category.

category	expenses per tourist per day (x 1000 drs)			ratio of stay			results			
	food	secp	total (incl. accommodation)	hotels	rooms	camp	pmp	egc	ltpe	ltee
15-25	1.89	1.34	4.86	0.18	0.59	0.07	1.40	0.96	6.80	4.68
25-40	2.38	1.21	5.37	0.26	0.48	0.03	1.39	0.85	7.47	4.57
40-55	2.30	1.01	5.60	0.40	0.42	0.02	1.40	0.80	7.84	4.49
>55	1.91	0.81	4.75	0.38	0.31	0.00	1.40	0.76	6.65	3.65

Results per generating country.

category	expenses per tourist per day (x 1000 drs)			ratio of stay			results			
	food	secp	total (incl. accommodation)	hotels	rooms	camp	pmp	egc	ltpe	ltee
greek	2.33	0.96	4.82	0.13	0.64	0.06	1.41	1.00	6.85	4.82
far away	1.1	1.5	3.80	0.14	0.42	0	1.36	0.93	5.17	3.57
german	1.80	1.07	4.78	0.28	0.5	0	1.40	0.90	6.71	4.32
british	2.45	1.25	5.64	0.34	0.33	0	1.37	0.75	7.75	4.24
dutch	2.36	1.56	7.23	0.70	0.22	0.03	1.38	0.65	9.99	4.70
scandin.	2.04	1.04	4.11	0	0.72	0	1.41	1.15	5.83	4.75

Results per group type.

category	expenses per tourist per day (x 1000 drs)			ratio of stay			results			
	food	secp	total (incl. accommodation)	hotels	rooms	camp	pmp	egc	ltpe	ltee
alone	1.72	0.87	4.19	0.24	0.41	0	1.40	0.88	5.87	3.71
friends	2.16	1.26	5.24	0.22	0.59	0.05	1.40	0.93	7.35	4.90
family	2.41	1.15	5.54	0.34	0.38	0.01	1.38	0.78	7.69	4.35

Results per travel style.

category	expenses per tourist per day (x 1000 drs)			ratio of stay			results			
	food	secp	total (incl. accommodation)	hotels	rooms	camp	pmp	egc	ltpe	ltee
self	2.20	1.09	4.76	0.12	0.65	0.05	1.41	1.01	6.73	4.84
agency	2.29	1.32	6.19	0.54	0.19	0	1.37	0.65	8.49	4.04

Legend:

secp - souvenirs, excursions, postcards, clothes etc.
pmp - production multiplier ltpe - long-term production effect
egc - employment generation coefficient ltee - long-term employment effect

Appendix 2. Linear programming results

I. Classification: ACCOMMODATION Actual value: 1,321,344
Target: MAX LTPE Proposed value: 1,583,595

Tourist nights			Constraints		
tourist category	actual number	proposed number	constrained effect	actual slack %	proposed slack %
hotel	57,342	86,500	use of hotels	34	0
room	99,790	85,768	use of rooms	71	75
camping	5,958	0	use of camping	88	100
2d house	6,702	0	use of beaches	93	72
fr/rel	6,702	6,000	seawater quality	40	55
sail	1,489	0	TDI	0	0
			adapted TDI	0	5

II. Classification: ACCOMMODATION Actual value: 894,701
Target: MAX LTEE Proposed value: 992,742

Tourist nights			Constraints		
tourist category	actual number	proposed number	constrained effect	actual slack %	proposed slack %
hotel	57,342	0	use of hotels	34	100
room	99,790	161,019	use of rooms	71	53
camping	5,958	0	use of camping	88	100
2d house	6,702	0	use of beaches	93	79
fr/rel	6,702	6,000	seawater quality	40	17
sail	1,489	0	TDI	0	6
			adapted TDI	0	0

III. Classification: ACCOMMODATION Actual value: 1,014,829
Target: MAX EXP Proposed value: 1,130,108

Tourist nights			Constraints		
tourist category	actual number	proposed number	constrained effect	actual slack %	proposed slack %
hotel	57,342	86,500	use of hotels	34	0
room	99,790	85,768	use of rooms	71	75
camping	5,958	0	use of camping	88	100
2d house	6,702	0	use of beaches	93	72
fr/rel	6,702	6,000	seawater quality	40	55
sail	1,489	0	TDI	0	0
			adapted TDI	0	6

IV. Classification: ACCOMMODATION Actual value: 60
Target: MIN SEAWATER POLLUTION Proposed value: 37

Tourist nights			Constraints		
tourist category	actual number	proposed number	constrained effect	actual slack %	proposed slack %
hotel	57,342	86,500	use of hotels	34	0
room	99,790	69,390	use of rooms	71	80
camping	5,958	0	use of camping	88	100
2d house	6,702	0	use of beaches	93	94
fr/rel	6,702	6,000	TDI	0	9
sail	1,489	0	adapted TDI	0	15
			economic effect	actual surplus	proposed surplus
			LTPE	-	12
			LTEE	-	0
			EXP	-	12

V. Classification: ACCOMMODATION Actual value: 590
Target: MIN ADAPTED TDI Proposed value: 495

Tourist nights			Constraints		
tourist category	actual number	proposed number	constrained effect	actual slack %	proposed slack %
hotel	57,342	61,579	use of hotels	34	29
room	99,790	86,913	use of rooms	71	75
camping	5,958	0	use of camping	88	100
2d house	6,702	0	use of beaches	93	94
fr/rel	6,702	6,000	seawater quality	40	54
sail	1,489	0	economic effect	actual surplus	proposed surplus
			LTPE	-	10
			LTEE	-	0
			EXP	-	0

VI. Classification: COUNTRY Actual value: 1,321,344
Target effect: MAX LTPE Proposed value: 1,553,279

Tourist nights			Constraints		
tourist category	actual number	proposed number	constrained effect	actual slack %	proposed slack %
greek	76,376	36,593	use of hotels	44	0
far away	4,774	0	use of rooms	75	83
german	9,547	0	use of camping	88	89
british	58,646	48,415	use of beaches	94	93
dutch	21,140	93,259	seawater quality	36	55
scandi- navian	7,501	0	TDI	0	0
			adapted TDI	2	0

VII. Classification: AGE Actual value: 1,308,348
Target: MAX LTPE Proposed value: 1,397,623

Tourist nights			Constraints		
tourist category	actual number	proposed number	constrained effect	actual slack %	proposed slack %
15-25	38,139	0	use of hotels	43	18
25-40	95,349	0	use of rooms	75	78
40-55	34,325	178,268	use of camping	86	92
>55	10,171	0	use of beaches	94	93
			seawater quality	36	47
			TDI	0	0
			adapted TDI	5	41

VIII. Classification: GROUP Actual value: 1,308,778
Target: MAX LTPE Proposed value: 1,362,896

Tourist nights			Constraints		
tourist category	actual number	proposed number	constrained effect	actual slack %	proposed slack %
alone	18,368	0	use of hotels	43	30
friends	77,908	0	use of rooms	75	80
family	81,708	178,268	use of camping	90	96
			use of beaches	94	93
			seawater quality	36	42
			TDI	0	0
			adapted TDI	4	41

IX. Classification: TRAVEL Actual value: 1,313,064
Target: MAX LTPE Proposed value: 1,470,647

Tourist nights			Constraints		
tourist category	actual number	proposed number	constrained effect	actual slack %	proposed slack %
self	112,511	23,250	use of hotels	44	0
agency	65,473	155,019	use of rooms	75	87
			use of camping	87	97
			use of beaches	94	93
			seawater quality	36	55
			TDI	0	0
			adapted TDI	5	13

TDI - tourist density index