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CREATING A SUPPLY TYPOLOGY. GREECE AS A CASE STUDY

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The objective of this paper is to illustrate both the necessity and the methodology for the creation of a supply typology which will be able to contribute to decision-making process. A supply typology can contribute in policy formulation and implementation that can lead to the overall goal of sustainability in a destination area. The methodology proposed by this paper is based in the use of Geographical Information Systems (GIS) as a tool of visualizing and communicating a big amount of information stored in data bases. Are data are stored in time series and they concern the minimum available spatial scale and policy formulation and implementation for tourism. The case study area of this paper will be the Greek coastal and insular area. In order for all available data to be recorded, analyzed, synthesized and, finally, spatially visualized, the use of advanced information technologies is essential. Furthermore, the use of technologies and methodologies that can categorize data and various multi-combinations of them are also essential. In this case, the use of Geographical Information Systems (GIS) combined with the Fuzzy c-Means algorithm was used.

Keywords: *Tourism planning, Supply Typologies; GIS; Fuzzy c-Means*

JEL Classification: *L83, M1, O1*

INTRODUCTION

Tourism is without a doubt one of the most important forces shaping our world (Cohen & Kennedy, 2000). It is a complex phenomenon (Farrell & Twinning Ward, 2004;2005). Simmons and Leiper suggest that "Around each element and around whole tourism systems are many kinds of environmental features: social, cultural, economic, physical, legal, political, and technical. Interactions between tourism systems and their environments are pervasive..." (1998:90). Each destination has its own characteristics. Planning is crucial to sustainable tourism development

and is a practice and a principle widely adopted (WTO, 1994). Planning at a national level should take into consideration the specific character of each destination.

Ideally, a plan should produce policies that are possible to be implemented, and implementation should follow the principal plan. The existing literature on tourism planning refers to the failure of plans (Burns & Sancho 2003; Cooper, Fletcher, Gilbert & Wanhill, 1995; Tosun, 1996). In many cases, policies coming from tourism planning process are top-down and take account neither of the local population nor of the spatial characteristics of the area (Dredge, 1999; Pearce, 1995; Timothy, 1998; Wick & Walter, 2009).

In tourism planning, it is important to understand that the geographical dispersion of tourism exceeds the "narrow" administrative boundaries of destination areas (Jennings, 2004). Thus tourism planning and decision-making, as well as formulating and implementing policies for tourism at macro-level, cannot be based on the administrative boundaries (Farrell & Twinning-Ward, 2004) of destination areas but it should be oriented on the minimum possible administrative spatial unit (Hall & Page, 2006; Hall, 2008).

Planning as a process should incorporate all the actors of the system (Hasse & Milne, 2005). It also needs a proper framework of evaluation, not only specification of objectives but also a monitoring system that focuses on outputs rather than inputs (Northcote & Macbeth, 2006). Integrated planning on a national level should be adjusted in real time and should represent the structure and the dynamics of each destination (Stevenson, Airey & Miller, 2006; Northcote & Macbeth, 2006).

Planning needs political will and capacity (The author would like to thank the anonymous Reviewer for this insight). In planning process data availability is critical. Geographical Information Systems (GIS) are widely used to grapple with a multiplicity of planning problems (Hasse & Milne, 2005). They link spatial phenomena with associated strong data bases that contain the attributes. Thus GIS can substantially aid planning process (Elwood, 2002) in order to achieve the goal of sustainability.

Typologies have a rich tradition in social sciences disciplines (Selin, 1999) but most of the literature on typology construction is quite old (Bailey, 2005). Typologies are essentially an organizational model that systematically illustrates how a social phenomenon varies or is similar along a number of selected attributes (Waddock, 1989) Classification is a generic process for grouping entities by similarity but there is no ideal type or prototype as this cannot be found anywhere in reality (Rosch,

1975). This means that the boundaries of the types/clusters produced from a typological process are fuzzy.

This paper proposes a tool and a conceptual framework to examine the creation of supply typologies. This framework views supply typologies as essentially issue in planning and decision making processes. The supply typology proposed is a tool not a policy typology and will aid policy making by creating more targeted policies.

The basic objective of this paper is to illustrate a methodology of creating supply typologies in order to better direct policies. This typology will be able to contribute to a decision-making process as well as plan formulation and implementation. The methodology for the creation of this typology is highlighted. In order for this typology to be effective, it should be concerned with the smallest possible spatial unit of analysis. The case study area of this paper will be the entire Greek coastal and insular region. In order for all available data to be recorded, analyzed, synthesized and finally spatially visualized, the use of advanced information technologies, which can operate routines in real time, is essential.

LITERATURE REVIEW

The inadequacies of tourism planning and policies

Tourism planning has followed a significant evolution in development and planning paradigms that moved from myopic and rigid concerns to more comprehensive, flexible, responsive, systematic and participatory approaches (Inskeep, 1994; Tosun, 2006). Tourism can be considered from both short-term and strategic long-term perspectives. The merits of planning can only be possible, given that a plan can be implemented in the first place (Lai Kun, Xuegang, 2006).

According to Hall (2009), there is a gap between planning and implementation due to planners' needs to balance between what should be done ideally and what can be done in reality. The existing literature in tourism planning offers little in the field of inadequacies between planning, policy and implementation (Pearce, 2000). Some cases in the literature report the failure of tourism planning caused by the lack of analytical data (Shepherd, 1998), the lack of community involvement (Tosun & Jenkins, 1998) and the mismatch between central planning and local possibilities (Burns et al., 2003).

In many cases, policies are top-down and they take into account neither the local possibilities nor the opinion of the local community

about tourism development (Simpson, 2001). In cases where tourism policy is top-down and refers to regions of a country, this policy is probable to fail due to the fact that in the same region the dynamics of tourism development are not the same. For instance, the region of Cyclades in Greece consists of over 32 islands, where Myconos, Ios, Paros have a strong tourism development but Anafi, Donousa, Koufonisia have a basic level of tourism development. So, policies for this area should be more specific. Furthermore, in these small and isolated areas, where there is scarcity in resources, community involvement in tourism planning is of crucial importance.

In other cases, policies for tourism do not take into account the spatial particularities of an individual locality (Hunter & Shaw, 2007). Tourism is essentially place-based activity and involves the production of destination identity at different scales and time periods (Lu & Nepal, 2009). This leads to the logical conclusion that policies which do not take into account the spatial characteristics of destinations are (in most of the cases) condemned to fail in their implementation. In order for the planning as a process and for policies as its result to be reliable and realistic, they should fit in the spatial, environmental and socio-economic characteristics of each destination. Typologies in this case can be a very effective tool.

Demand & Supply Typologies

Tourism is a spatially specific phenomenon (Wiliams et al, 2001), which has impacts that manifest themselves in several different ways at various destinations. Specifically, the extent and intensity of development differ per destination area. The image of a place as a pleasure travel destination is derived, to a greater or lesser extent, from attributes towards the destination's perceived tourism attributes (Lacitingola et al, 2007). In turn, these tourists' socio-economic characteristics, travel motives, and behavior, while traveling, also vary and generate different image for each destination. Tourist's perception and consequent behavior depend mostly on the tourism typology (Becken & Gnoth, 2004).

This differentiation inevitably shows the necessity of finding different ways to manage tourism both at macro- and micro-level. For example, Rodos and Lesvos are two islands in Greece that each one has developed tourism in its own way. On the one hand, Rodos has a profile of mass tourism destination with big complexes and advanced services. On the other hand, Lesvos is a rising destination with an ecotourism profile. These two islands, as tourism destinations, should be treated in

different ways, and policies should also be differentiated in order to be effective.

The ascertainment of this necessity has led to the creation of typologies of tourists (demand side) and destination areas (supply side), aiming at the most effective tourism planning and management. The creation of a typology helps substantially in organizing the information provided every time, and consists one of the most basic operations of human brain and reception. Lakoff (1987, p.6) claims that "… without the ability to categorize we could not function at all".

Classification can help in terms of organizing and recognizing common advantages and disadvantages that, in turn, can lead to the creation of patterns of tourism development (henceforth TD) such as mature destinations, destinations of low or high development etc. Those patterns can help decision-makers (at macro-level) to have a more clear, reliable and comprehensible picture of the tourism system, and thus to establish more effective policies for tourism. In this case, the development of a typology is essential, since it is possible that policies and actions may be specialized according to the type of the destination area. Policies coming from the implementation of the basic principles of tourism planning are more rational, systematic and effective, since they are concerned with areas with common problems and growth characteristics.

Typologies of supply (destinations) or demand (tourists), respectively, encountered in the literature, were created in order to accomplish different aims and objectives. For example, according to Williams (2009) demand typologies have been created not only to deal with planning issues, show the effects created from tourism, recognize different types of tourism, tourists, and motives of traveling, but also to demonstrate the differences to the structural characteristics and dynamics of tourism (provided services, types of accommodation, means of transport etc).

The basic assumption and recognition that tourism can be developed in various ways and has a different character in coastal or mountainous areas, has led to the creation of supply typologies for coastal areas (Barbaza, 1970; Gormsen, 1981, 1997; Peck & Lepie, 1977; Wong, 1986), and mountainous areas (Pearce, 1978; Preau, 1968). Moreover, other typologies have also been created, such as the one by Miossec (1976, 1977), which describes a general model of TD in destination areas. Coccosis and Tsartas (2001) have presented the most important models of TD, including the one by Turner and Ash (1975), who studied the dispersion of tourism at worldwide level through a typology, and Lundgren's (1982) classification who studied the center-periphery

conflict and the degree of mutual attraction of tourists between those two poles.

The following Table 1 is a simplification that provides an illustration of this overview and a critical analysis of the supply typologies encountered in literature. It should be underlined that this distinction is a simplification and it is made primarily because of the analysis, thinking orientation and understanding of general criteria, which have been used so that a typology may be created.

Table1. *General simplified model of supply typologies for coastal areas*

Criteria	**Types**	**Life cycle stage (**after Butler's model of the Tourist Area Life Cycle (Butler,1980)	**Impacts intention**	**Participation of the local community in tourisms growth**
a) the power of the local society b) the rate of development	1)extensive development	Stagnation	High	Low
	2)local development with extensive trends	Development	Medium	Medium
	3)slow localized development	Exploration	Low	High

According to the simplification shown in Table 1, it seems that there are two basic criteria in order to create a supply typology; these criteria are the growth rate and the degree of participation of the local society in it (growth). When these criteria are used, three types of areas come out as a result.

First, there are the areas that indicate intensive growth as a result of external investors. In this case, the area's tourism product has already been saturated, and the effects of this growth for the natural, social and economic environment are maximized.

Second, there are the areas showing a rapid growth rate which occurs mainly due to local investors from the destination area itself. In this case, the product is in its development stage and the effects of this growth for the natural environment increase.

Third, there are the newly explored destinations, discovered by a small number of pioneer tourists. This destinations' natural environment

remains uninfluenced and whatever growth occurs happens mainly because of the local population. It should be underlined that this distinction is a simplification and is made primarily because of the analysis, thinking orientation and understanding of general criteria that have been used, so that a typology may be created.

From the study of the existing literature, there are two main points worth mentioning. First, there is no optimal way to create typologies. Instead, every effort is distinct and is called for to fulfill specific needs. At the same time, it is carried out having specific limitations, aims and objectives. Up to now, efforts have been primarily descriptive, they have used neither information technologies nor advanced statistical methods, while being spatially limited to spatially small destination areas (local level) (Constantoglou, 2006). Due to the limited area, the research was carried out with the use of questionnaires and descriptive statistical methods so that results to be drawn.

Descriptive statistics are unable to deal with the large volume of data needed (Hall & Page, 2009) for the creation of a typology at national or regional level. Typology in this case will assist in the tourism planning process and decision making by helping in the production of targeted policies that will take into account spatial contingencies. In this case, GIS can be a very effective tool for creating typologies which can act as a Decision Support System.

Apart from demand and supply typologies in the literature for tourism there are a lot of efforts for creating typologies. Many of them are made for land uses classification (Williams & Shaw, 2009). Hall (2011) in his influential work creates a typology of conceptual frameworks of governance. He finally notes:

«Typologies contribute to conceptualizing and describing empirical developments. They therefore serve as an appropriate analytical framework to structure analysis and comparison and can potentially be used for the development of quantitative as well as qualitative analysis... However, like all maps, a typology of governance applies a simplifying lens to a complex reality. As Stoker (1998, p. 26) commented, "The issue is not that it has simplified matters but whether that simplification has illuminated our understanding and enabled us to find an appropriate path or direction".»

The purpose of this paper is to introduce a methodology of creating supply typologies that can assist tourism planning by the production of more targeted policies. Those policies will be based from quantitative analysis. But policies need political will and planning should incorporate all the actors of the system in order to be effective. Tourism is part of a

complex system and should be integrated into the wider political system in order its results to be effective.

GIS

Effective tourism planning requires monitoring, evaluation mechanisms and feedback information about the effect of planning decisions and policies on tourism resources and destination areas. Much of this information is inherently spatial, indicating where and how extensive the tourism resources are or how intensively they are used; that is, GIS can be a useful tool for planners and decision makers (Hall & Page, 2009).

GIS is described as hardware, software and procedures that collectively support the collection, input, storage, retrieval, manipulation, transformation, analysis and presentation of geo-referenced object and field data (Malczewski, 1999). Since GIS technology couples common database operations, such as query and statistical analysis, with geographically represented data, it is considered a decision support system involving spatially-referenced data in a problem-solving environment (Beedasy & Whyatt, 1999; Malczewski, 1999). In practice, managers can test many scenarios with GIS as a tool to help to determine who or what might be affected by certain decisions (Landres, Spildie, & Queen, 2001). Finally, GIS are systems which deal with geographical information but, unless they have an actual application, they remain just another technology (Bahaire & Elliott-White, 1999).

Counter to the lack of tourism system models, the application of GIS for tourism has been diverse (Table 2), including: the systematic inventory and audit of tourism resources and conditions (Bruehler & Sondergaard, 2004); identification of potential development locations (Boyd & Butler 1996; Gunn, 1994; Starr, Gratzer, & Lewis, 1999); simulating and modeling spatial outcomes of proposed developments through visibility analysis (Selman, Davidson, Watson, & Winterbotomm, 1991) and simulation modeling to facilitate monitoring and management of tourist flows (Itami, Raulings, Maclaren, Hirst, Gimblett, Zanon, & Chladek, 2002; Wing & Shelby, 1999;). As GIS technology advances, its application will expand (Bahaire & Elliott-White, 1999).

The usefulness and usability of GIS in decision-making is critical and has been proven very crucial, since GIS can depict all relevant parameters (qualitative and quantitative, spatial and non-spatial). Thus, it strengthens the ability to clarify any spatial kinds of problems/questions

(Constantoglou, 2006). In addition, GIS can provide users capabilities like linkage, intersection, union, search (queries) for information in voluminous databases and can process the required information in real time. Thus, GIS is able to provide important support in tourism planning (Bahaire et al., 1999; Batty & Densham, 1996; Nedovic-Budic, Knaap & Scheidecker, 1999).

Table2. *General model of supply typologies*

Functional capabilities of a GIS	GIS Basic Questions		Tourism Applications
Data entry, storage and manipulation	Location	What is at?	Tourism Resource Inventories
Map production	Condition	Where is it?	Identify most suitable locations for development
Database integration and management	Trend	What has changed?	Measure tourism impacts
Data queries and searches	Routing	Which is the best route?	Visitor management / flows
Spatial analysis	Pattern	What is the pattern	Analyze relationships associated with resource use
Spatial modelling Decision Support Systems	Modelling	What if?	Assess potential impacts of TD *Crate a typology*

After Bahaire, & Elliot-White, 1999

Since the '90's GIS have been moved from the related field of environmental research where it was born and already had been well established by that time (Bahaire & Elliott-White, 1999) to tourism. Nowdays there are GIS applications for dynamic web-maps with query functions, for hotel search, best routing, (Dickmann, 2005; Joun & Ryu, 2004), tourist information systems (TIS) (Worboys & Duckham; 2004), or even application for 3D Web GIS, or even augmented reality (AR)

offering tourist information and guiding (O'Looney, 2004; Schilling, Coors, & Laakso, 2005; Dye & Shaw, 2007).

This ability is crucial for the creation of a typology. Nevertheless, GIS is only a tool, and its basic problem is that the user should decide upon the number of classes a priori. The tool that has been created to develop a typology for the Greek coastal area should have the ability to execute itself the optimum classification. It should be able to determine the number of classes and place each community into the appropriate class. Thus, what is needed is an analytical hierarchical process to classify the communities according to multiple criteria given by the user within a GIS environment.

Fuzzy c-Means

One of the most basic abilities of living creatures involves the grouping of similar objects to produce a classification. This is a primal process since classification is required for the development of language. Being a basic human activity, classification is also fundamental to most branches of science. For example, Aristotle built up an elaborate system for classifying species in the animal kingdom. In the broadest sense, a classification may represent a convenient method for organizing a large volume of data so that the retrieval of information can be more efficient. Describing patterns of similarity and difference among the objects under research by classifying them may provide a convenient summary of the data.

One of the fundamental problems of developed classification methods is that they require an a priori definition of the number of clusters that would be created (Dzung, 2001). This is due to the fact that most methods consider that a certain amount of minimum information is available in the real system, usually given by the expert. Nevertheless, whenever the real system is completely unknown ("black box"), the rate of success of these methods decreases quite substantially (Tsekouras & Sarimveis, 2004). In this case, it is the theory of Fuzzy Clustering that can deal successfully with these problems (Bezdek & Pal, 1992; Dunn, 1973).

The classification of a set of unlabeled data into classes of similar individuals has been stated as a major problem in pattern analysis. So far, fuzzy logic has proven to be a very effective tool to handle this problem (Burrough, MacMillan, & van Deursen, 1992; Tsekouras et al., 2004). There are two general approaches to fuzzy classification namely, supervized and unsupervized classification. On the one hand, supervized classification algorithms are based on a set of training data, and usually

assume ordinary fuzzy partitions (kbir, Benkirame, Maalmi, & Bensilame, 2000). The main characteristic of these methods is that their results strongly depend on the training data set, meaning that different training data sets may lead to different fuzzy partitions.

A very common unsupervized classification approach is the fuzzy clustering analysis. Fuzzy clustering algorithms do not require training data. However, different algorithms may lead to different fuzzy partitions or different parameters and/or different initial conditions may also give different results for a specific algorithm (Al Sultan & Selim, 1993; Windham, 1982). Therefore, there is a need to validate the fuzzy partition produced by the implementation of a fuzzy clustering algorithm. More specifically, cluster validity answers the question of whether the resulted fuzzy partition is able to describe the real data structure or not. The most representative fuzzy clustering technique is the fuzzy c-means algorithm (Bezdek, 1973). This algorithm has been applied to huge range of applications and has been proven to be a very good tool of classification, provided that the number of clusters is known a priori, which is the main disadvantage of this algorithm.

In order for this undesirable behavior of FcM to be eliminated, some control criteria of cluster validity of this algorithm have been developed. The control of cluster validity of FcM answers the question whether the clusters coming out of this procedure describe the real structure of the initial data or not. In order for this to be achieved, a function (indicator) is defined, whose minimum value corresponds to the optimal number of clusters. Initialization is an important factor of the system, since it should represent the data-system to give reliable results, too. Moreover, different initializations can lead to different classifications.

As far as the degree of fuzzification is concerned, it is of crucial importance since it determines substantially the system's "fuzzyness" (Hathaway, Bezdek, & Devenport, 1996; Kanade & Hall, 2003; Karmakar & Dooley, 2002). When the degree of fuzzification is defined as equal to one, then the classification is "hard". Wherever it is bigger than one, the classification is fuzzier, meaning that the boundaries of clusters are more "flexible" (Flores-Sintas, Cadenas, & Martin, 1999).

According to Bezdek (1980), the degree of fuzzification should be between one (1) and thirty (30) with a range from one and half (1.5) to three (3) giving good results, while the case of two is the most valid. On the contrary, it is considered that there is no theoretical basis for the choice of good value for the degree of fuzzification (Cannon, Dave, & Bezdek, 1986), and the proposed range of values from one up to five - being deducted from the literature review – seems to give better results. A

series of tests were conducted with different degrees of fuzzyfication, whereas the optimum result came out with four degrees. It is assessed that the optimum degree of fuzzyfication cannot be determined, since in every case it depends on the structure of the data-system that is going to be classified.

According to international literature, the main advantage of FcM is that it converges much more easily (Flores-Sintas et al., 1999; Hathaway et al., 1996; Kanade et al., 2003; Karmakar et al., 2002). Furthermore, it can give results in real time (Al Sultan et al., 1993; Barshan & Ayrulu 2004; Bezdek, 1993; Dae-Won, Kwang, & Doheon, 2003; 2004), while data normalization is not necessary (Dzung, 2001; Hanesch, 2001; Hoppner, 2002; Karmakar et al 2002). Data normalization/standardization that has a wide range of values in the scale zero to one would decrease the precision of system. For this reason, real data were used without being processed to the normal distribution. According to Edelbrock (1979), standardization process allows variables to contribute equally to the definition of clusters, but may also eliminate meaningful differences among clusters.

CASE STUDY AREA

The case study area encompasses the entire Greek coastline, including all insular areas. Greece is a country with the most extended coastline among all other Mediterranean countries. The Greek total area is about 131,957sq.km, and the total length of its coastline amounts to approximately 15,000km. This coastline is almost equally divided between the mainland and the islands. Indeed, 7,700km of coastal zone corresponds to the country's 3,053 islands, though it should be taken into account that only 227 islands are inhabited (NSS, 2001). The Greek coastal area is of crucial importance because it covers 26.2% of the total area of the country, 38% of the total population (NSS, 2001) and 90% of the entire tourism activity (Constantoglou, 2006).

The definition and orientation of the coastal area is a particularly complex process. According to the definition given by the group of experts, who studied the "National Program for Sustainable Development of Greek Island and Coastal Areas" (Ministry for the Environment, Physical Planning and Public Works, 1997), "The Coastal area is this geographic space that includes sea and land … the land should be defined to include the area that is between the coastal line and the administrative boundaries of coastal OTA/communities" [OTA in Greek stands for "Organization of Local Government"].

In the present research, a typology of tourism areas was determined based on the minimal possible administrative unit which henceforth will be called community. The main reason for defining the coastal zone in this way was the basic ability to collect and manage essential statistical data such as, number of beds in primary and secondary accommodations, number of overnight stays etc.

OBJECTIVES OF THE TYPOLOGY

The typology for the Greek coastal and insular area should contribute to the strategic management and planning for tourism, to the identification of strengths and weaknesses of the system, to policy making, and to the implementation of actions taken. It should also be useful for evaluation and audit purposes. Such a process would encourage a rational and integrated approach (Wiek & Walter, 2009) to tourism planning and management that could help the overall goal of sustainable TD to be achieved. This, in return, requires firstly the formulation, creation and implementation of an administrative/managerial system whose administrative center should be the coastline; and secondly the parallel creation of an administrative/managerial system, which would aim at implementing suitable administrative policies adjusted to the particular characteristics that different clusters of tourism destinations of the coastal area have.

In order for these aims to be achieved, the following three are required: first the differentiation of the policies for tourism planning and management, while the individual characteristics of each cluster or type of tourism coastal community are recognized; second, the use of GIS, because it provides complete solutions of databases (import, process and visualization of spatial quantitative and qualitative data), whereas the advantage of this technique rests in its ability to depict/visualize spatial and non-spatial information of a database. Moreover, GIS can be a very important tool for planning and decision-making (Dye & Shaw, 2005; Feick & Hall, 2000; McAdam, 1999); third, the use of advanced classification methods, since the complexity, range and differentiation of these characteristics go beyond and over the possibilities of simple classification methods.

In order for the above requirements to be fulfilled, the specifications, as described below, should be observed. The system that will be created should be able to:

- support decision-makers who do not always have the required know-how for the use of complex systems and/or do not have enough time to attain this objective.
- detect trends, which potentially may lead to problematic situations in the coastal area;
- support decision making process so that multidimensional problems would be dealt with;.
- represent and depict spatially complex structures and relations;
- process and analyze qualitative and quantitative information;
- process spatial and non-spatial information;
- create, use and process sustainability indicators;
- be linked dynamically and in real time with other types of databases;
- have open and extensionable architecture;
- portray different levels and scales of information at the same time; and finally
- distinguish, according to the observed situation, the spatial entity which, at a given time, has the necessity to be coped with.

METHODOLOGY OF IMPLEMENTATION

In order for a tourism typology of the Greek coastal areas to be deduced, an extensive spatial database was created for each coastal community, which is also the minimal spatial administrative unit of the study area, as mentioned above. The database was created with the aid of GIS. The developed GIS took advantage both of the commercial software (ArcGIS version 9.1) and the routines that have been developed in programming languages. They consist of a set of tools interacting with each other complementarily, so that not only the desired typology of tourism areas in the coastline of Greece would be deduced but also tourism planning and decision-making for tourism would be supported.

All effort follows the logic of extensionable, fluctuating, scalable and open architecture. In any case, the system is able to change not only the data volume of the database but also the factors/indicators which participate in the deduction of the desired supply typology.

For the typology of tourism areas in the Greek coastline to be created, the following were used: Spatial data at a 1:50,000 scale including the borders of the country and boundaries of prefectures, communities, areas of the Natura 2000 network, road network, railway network, great hotel units, lakes, port premises, fish-farming, contour lines of 100 meters, a

digital terrain model of the area, map of ground slops, map of exposure/orientation of polygons, CORINE landuse, areas of special regulations (institutionalized areas of industrial, tourism, real estate development etc.), industries, archaeological areas of national and international importance, the coastline, airports – helidecks, installed power plants. The scale used here is small for national level planning but it is only indicative in order to create a supply typology. The methodology proposed can work in any scale.

Furthermore, geographic databases were used, connected with the above created GIS. In the specific database, at the community level, firstly all census data available in time series from 1971 up to 2001 (NSS, 2001) were registered; as well as data for the number of beds and overnight stays in primary and secondary accommodations for the decade 1990-2000 (NSS, 2001).

The National Statistical Organization has census data for 1961, 1971, 1981, 1991, 2001. As far as the statistical data for hotels is concerned, the Greek National Tourism Organization has collected data each year, starting in 1990. Data for secondary accommodations are only available for the time period 1990-1997. Also there are no records for second homes. Because of these constraints, the time period for the study was determined to be 1990-2000. The main aim was to create a typology and a system which could be able to give a safe and realistic result, so the time period is only indicative.

Using the primary available data, a series of indicators was generated concerning tourism and demographic characteristics of every coastal community; these characteristics usually show the structure, the dynamics and the pressure these areas experience. Next, the spatial database was developed. The communities which showed no (null) tourism activity (estimated in number of beds or overnight stays) during the decade were removed from the study. This cluster of communities can be distinguished as a cluster of null tourism activity in the cartographic material. As far as the coastal communities are concerned, a series of cartographic material was created depicting the existing situation with regard to tourism in the area of interest. From the analysis of the cartographic material, answers were given to questions concerning: which communities were the most rapidly developing; which communities show signs of saturation; and which ones are those experiencing the greatest pressure from tourism?

The depiction of multiple levels of information in layers of the same thematic map is called the “overlay” technique and has been widely used in planning and decision-making for spatial kinds of problems (eg. suitability analysis). In the case of the creation of a typology for the Greek

tourism coastal communities, the overlay method for multiple information in the same thematic map, cannot give a distinct result due to the large volume of necessary data (both in spatial and descriptive form). For this reason, another more advanced method of data classification was utilized.

Firstly the simple rule "If… then". The rule was implemented with the aid of Microsoft Excel software. For the classification of communities two parameters were used: a) the rate of population change showing the growth dynamics that each coastal community has, and b) the rate of tourism change being estimated in the number of beds of primary and secondary accommodations; this rate shows the dynamics of tourism growth in each coastal community (Table 3). The result that came out was satisfactory and made a distinction between nine clusters/categories of communities. The main disadvantage of this method was the fact that the classification with the use of more than two parameters was exceptionally time-consuming, while the result was not very reliable.

Table 3. Typology based on the rule "If..Then".

population (p) ***tourism (t)***	***DEVELOPING***	***STABLE***	***DECREASE***
DEVELOPING	CATEGORY 1 ($t>81, p>12$)	CATEGORY 2 ($t>81, 12<p<0$)	CATEGORY 3 ($t>81, p<0$)
STABLE	CATEGORY 4 ($81<t<0, p>12$)	CATEGORY 5 ($81<t<0$, $12<p<0$)	CATEGORY 6 ($81<t<0$, $p<0$)
DECREASE/NON EXISTING	CATEGORY 7 ($t<0, p>12$)	CATEGORY 8 ($t<0$, $12<p<0$)	CATEGORY 9 ($t<0$, $p<0$)

In the second phase, classifications were made while simple statistical methods of hierarchical classification with the aid of statistical packages such as SPSS and SPlus were being used. Hierarchical and non-hierarchical clustering algorithms, which are very good described in Everitt (1993), were tested. In those cases, the following were observed:

Firstly, these methods require the establishment of stopping rules; meaning that there should be very good knowledge of the data system which would eventually allow an a priori definition of a number of clusters.

If the system itself seeks for the optimum number of clusters, the process would be particularly time-consuming and require robust calculations.

The system could not examine more than one variable at the same time and simultaneously perform the optimum number of clusters in real time.

Finally, in the third case, the operation of fuzzy logic and more precisely fuzzy clustering algorithms like Fuzzy c Means (FcM) was examined (Bezdek 1973).

Eleven different initializations were tested and gave the same maximum number of clusters. Finally, the classification that gave the maximum degree of compactness (minimum distances of cases/communities belonging to the same cluster) and separation (maximum distances between clusters) was selected.

In order for the FcM method to be examined, an algorithm was created in Fortran, which can process simultaneously more than two variables. The algorithm of FcM was initially created in Fortran and then "translated" into Visual Basic. From Visual Basic it was exported in an executable file format to be added as new tool in the ArcMap toolbox. In this way, the results of the classification made in FcM could be depicted visually in a GIS environment.

A series of tests was done during which different parameters were used; these parameters have to do with the number of indicators, the indicators themselves, the number of clusters. the fuzzyfication coefficient, and the initialization of the system. A series of tests was conducted with the use of FcM with different initializations and different degrees of fuzzification.

The application of the preceding methodology resulted in both the classification of the Greek tourism coastal communities and the proposed system for typology creation.

Four indicators were used:

First Indicator: *The growth rate of tourism, measured in number of beds of primary accommodations.* It is the indicator that shows the dynamics of tourism growth in every community. The average of the particular indicator for the coastal tourism communities is 58.80;

Second Indicator: *The density of beds of primary and secondary accommodations for the last year of the Report period*. It is the indicator that shows the spatial pressure that every community experiences from tourism growth. The average of the particular indicator for the coastal tourism communities is 81.17 beds per square kilometer;

Third Indicator: *The rate of beds of primary and secondary accommodations for the last year of the Report period*. It is the indicator that shows the structure of tourism product in the coastal

area. The average of the particular indicator for the coastal tourism communities is two point fifty four (2.54); and

Fourth Indicator: *The ratio of beds of primary and secondary accommodations and the size and extent of the local population for the last year of the Report period*. It is the indicator that shows the "predominance" of tourism in a destination area. The average of the particular indicator for the coastal tourism communities is zero point seventy two (0.72) beds per resident or one point thirty eight (1.38) residents per bed.

RESULTS

The process of those indicators gave the typology of Greek tourism coastal communities. The centers of clusters/types of areas of tourism growth, which resulted from the application of the algorithm, are presented in Table 4. However, it should be noted that the graphic/statistical representation of all four indicators was not precisely possible due to the fact that statistically it is not easy to create 4D diagrams, even with the use of advanced software like SPSS and SPLUS, given that there were 1,323 communities/observations in the "population/sample" being processed. The large number of those observations makes the statistical representation prohibitive, even for one indicator. The typology produced is:

Table 4. Centers of classes/types of TD.

CENTRES OF CLASSES					
Levels of TD in clusters of coastal communities	**Cluster Number**	**First Indicator**	**Second Indicator**	**Third Indicator**	**Fourth Indicator**
Very high	cl1	91.70	222.94	1.10	1.74
Low	cl2	8.51	23.46	1.86	0.34
Classical destinations	cl3	62.39	953.34	0.70	3.71
Low-medium	cl4	30.02	49.32	2.55	0.67
High	cl5	145.61	162.56	3.48	1.49
Medium	cl6	97.78	102.33	2.74	1.16
Very low	cl7	0.32	3.00	0.29	0.06
Highest	cl8	251.03	235.51	4.62	1.81

Very low TD (Cl7). This particular cluster includes communities which, according to their statistics, demonstrate a decrease of their tourism potential and/or their tourism potential is minimum (lower than hundred beds). For communities of this particular cluster, the average change of beds does not exceed zero, whereas the density of beds does not exceed three beds per square kilometer. Moreover, the indicator of the structure of tourism product shows that, on average, three beds of secondary accommodations correspond to one bed of primary accommodation. Finally, the ratio of tourism product and population is just 16 residents per bed.

Low TD. (Cl2). In this cluster, communities are included whose product is at the early stages of TD. The rate of the change of beds is eight point fifty one per cent (8.51%), that is, seven times smaller than the average of the coastal area. The density of beds is 23.46 beds per square kilometer; almost four times lower than the average. The ratio of beds of primary and secondary accommodations is one point eighty six (1.86) - almost two beds of primary accommodations correspond to every bed of secondary accommodation – a fact that implies that hotel accommodations prevail in this cluster. The ratio of beds and population show that three residents correspond to one bed, meaning that this indicator is double the average of coastal tourism communities.

In these communities the beginning of TD can be distinguished, where tourism is developed along with the main occupation of the local population as a means of complementing their income. The businesses are small-sized, family-owned and operated with a small income. Moreover, the stress that is placed on the resources is minimal.

Low to medium TD (Cl4). In this cluster there are classified communities that show a higher growth rate than the two previous categories. The rate of tourism growth in the particular cluster is precisely half the average of TD rate in coastal communities. The density of beds does not exceed fifty beds per square kilometer. The rate of beds of the primary and secondary accommodations is precisely as much as the average of coastal tourism communities, that is, two point fifty four (2.54) beds of primary accommodations correspond to one bed of a secondary accommodation. The ratio between the tourism product and the population is one and half (1.5) residents per bed. From the above, it is inferred that the communities that are classified in this cluster show stronger growth dynamics compared to the two previous categories, while the pressure that they experience remains low.

Medium TD (Cl6). In this cluster there are classified communities with characteristics of medium tourism growth, if compared to the averages of the total coastal tourism communities. More analytically, the rate of growth is 97.78%, whereas the density of beds was almost 102 beds per square kilometer, that is, in both cases volumes which are higher than the average of coastal tourism communities. The ratio of beds of primary and secondary accommodations is almost three beds of primary accommodations per bed of a secondary accommodation. Finally, the ratio of beds and population is one point fifteen (1.15), that is, more than one bed corresponds to each resident. In this cluster, it is obvious that tourism activity begins to have stronger intensity and a wider extent, and thus it places more stress to the destination.

High TD (Cl5). In this cluster there are classified communities with high rates of tourism growth. More analytically, the rate of tourism growth is 145.61%, whereas the density of beds is almost 163 beds per square kilometer. Furthermore, the average of each of these two indicators is over double the average of tourism coastal tourism communities, and the ratio of primary and secondary accommodations is three point forty eight (3.48), that is, almost three and half beds of primary accommodations correspond to each bed of a secondary lodging. At the same time, the ratio of beds and population shows a correspondence of one and a half (1.5) beds to each resident. In both cases, the indicators show double averages from the respective ones of coastal tourism communities. In this cluster, stronger and more constant dynamics of tourism growth is thus observed.

Very high TD (Cl1). In this cluster a lower growth rate is observed when compared to the previous ones, but the destinations that are classified to this cluster are more mature. Tourism growth rate is 91.70%; it remains higher than the average of coastal tourism communities but lower than that of the two previous clusters. The density of beds is 222.94 beds per square kilometer, higher both than the previous clusters and the coastal zone average. The ratio of beds of primary and secondary accommodations shows a correspondence of one bed of a primary accommodation to each bed of secondary accommodation. The ratio of beds and local population shows a correspondence of one point seventy five (1.75) beds to a resident.

The preceding statistics illustrate that, while this cluster shows lower tourism growth rates, it consists of communities that have already been developed. The communities of this cluster find themselves in a more stagnant developmental situation, and the first signs of saturation are more apparent.

Fastest TD (Cl8). In this category there are classified communities that have the highest tourism growth rates. Tourism growth rate is 251.03%, and is the highest rate of all eight clusters that resulted and almost the quadruple of the average of coastal tourism communities. The density of beds is almost 236 beds per square kilometer and is the seventh bigger density among the clusters. This density shows the intense pressure that the particular communities experience from tourism growth. The ratio of primary and secondary accommodations shows roughly five beds of primary accommodations per bed of secondary accommodation. The ratio of beds and local population shows a correspondence of two beds per resident. From the above, it becomes obvious that the fastest developing new destinations of country are to be found in this cluster.

Classic destinations (Cl3). This category includes the most classic and well established to the tourism market destinations of the country. Here, tourism growth rate is higher than the average of coastal tourism communities, reaching 62.39%, but it is lower than the growth rates of previous clusters, evidencing the saturation of the tourism products in those destinations. On the contrary, the density of beds is higher and numbers 953 beds per square kilometer. At this point, it is worth being noted that in 2001 the density of population of the Prefecture of wider Thessaloniki - the second henceforth over-populated Prefecture of the country – was 652 residents per square kilometer. Consequently, the density of tourism in this category is exceptionally high.

In this cluster of classic destinations, the ratio of beds of primary and secondary accommodations is zero point seven (0.7) beds of primary accommodations per bed of secondary accommodation. This ratio shows the structure of the tourism product in these areas and the predominance of secondary accommodations over the primary ones, thus, the reduction of the quality of product. The ratio of the tourism product and permanent population shows a correspondence of almost four beds per resident and consequently, tourism is shown to prevail against the local population. Indicatively it is mentioned that this cluster includes communities such as Rhodes, Benitsa in Corfu, Kallithea in Chalkidiki, Ialysos on the island of Rhodes, Limenas of Chersonisos close to Heraklion (Creta), beach of Katerini, Pythagoreion in Samos etc. In those communities the tourism product is particularly mature, and the pressure to the environmental and socio-economic resources is the highest among all clusters.

The typology created for the tourism in the Greek coastal communities has distinguished eight categories and is more analytical, since it defines more stages of tourism developemt. The detail in the typology of tourism communities might be important to the extent that it

can help to the specialization and specification of policies required for planning and managing TD in coastal areas in a sustainable way. The classification with the use of FcM gives a representative result.

In order to achieve the optimal operation of the FcM algorithm, without "noise" coming from the data system, the communities that do not present/have tourism activity (perceived in number of beds or overnight stays), were removed from the system. Those communities represent a distinct cluster. It is noted that these communities are almost the half of the total number of coastal communities under study. The clusters that came out from the FcM algorithm consist of a different number of communities.

At this point, it is worth being mentioned the literature review that was carried out by Palmer, Sese and Montano (2005) and concerns the examination of statistical methods that had been used in tourism studies. The writers consider that the statistical research methods used can become an indicator of the degree of the scientific progress that has been achieved in the tourism science discipline. In five years (1998-2002) 1790 articles in scientific journals were reviewed.

The research illustrated that in tourism studies, simple statistical methods are very widely used, such as simple (linear) regression, factor analysis, ANOVA, t-test etc, while cluster analysis was used only four point eighty eight per cent (4.88%) and fuzzy classification methods had not been used and/or they have a very limited use. These researchers concluded that statistical methods of multivariate analysis can study more effectively a complex system such as tourism. In this case, the use of FcM combined with GIS for the creation of a typology for Greek coastal tourism communities is an innovative practice.

DISCUSSION

Tourism planning in coastal areas aims at sustainable TD by formulating, evaluating and implementing policies. More specifically, planning for the Greek coastal area has the basic particularity and interest that it will take place in an area with great sensitivity and special administrative interest (because of the intensity and extent of human activities, the sensitive and rich ecosystem etc). In these areas there is the necessity for policy specification and support by experts for the decision-making process.

Within the framework for tourism policy formulation and implementation for the case of the Greek coastal communities, the typology created, has basic advantages. It can determine the optimal

number of managerial areas/types/clusters of with the use of specific criteria; it can determine those areas with spatial accuracy; the criteria can be changed when considered essential. Furthermore it is a tool that strengthens decision-making process by organizing large volume of quantitative and qualitative data available each time and it is able to contribute to the specialization of policy per produced administrative type/cluster, according to the criteria/indicators that are used in every case. Finally, it strengthens planning and sustainable TD in the area of interest.

Classification is essentially a process that contributes to the synthesis and analysis, as well as to the organization and comprehension of large volume of information. The hierarchy of destinations is particularly useful for the recognition of operations taking place in a destination and to the tourism flow to it (Pearce, 1995). Consequently, a typology, can lead to the creation of different zones of TD that have different strengths, weaknesses, opportunities and threats and they need to be approached in a different way. In this way, decision-makers will have at their disposal a "standardized" large volume of information and be able to examine alternative scenarios through the system and reach conclusions and formulate policies and actions representative for every type of TD.

For the development and the use of the system for the classification of the Greek coastal area, some basic conclusions, as discussed below, have been drawn. Firstly, the typology that came out from this process is reasonable, since, for example, the classic destinations of the country are few and known, while, on the contrary, in the wider part of the coastal area the tourism product decreased or showed very low growth when studied. The result that came out is representative, since no flubs were observed (from the examination of the system). For example, the city of Rhodes is found in the cluster consisting of the classic tourism destinations of the country.

The system can manage a big data volume in real time (short time of process), and gave positive results while two and more indicators were used. The architecture of the algorithm is open and flexible, so any other combination can be made. The system was applied to four indicators, (a four-dimensional space) and, consequently, the types of tourism areas resulted are differentiated with those four indicators as described above. The same system could be applied to any other combination of indicators and in this case it is possible to give different results. The same system can work in different scales, with different indicators and volume of data. The algorithm is altered very easily so to include larger number of indicators; larger number of observations than those used (1,323) in this

analysis; and different kind of indicators. The data were imported in the FcM algorithm without being normalized prior so that the picture of the system would not be denaturized.

Its use is simple and facilitates the focus on issues of analysis and not on issues of system operation. It is better than any other classification methods because of its efficiency and effectiveness, and facilitates the thinking organization in a spatial level. Critical assumptions for the system operation are not required. The use of the FcM algorithm through ArcMap simple due to the fact that has been appended in the form of a new "button" in the toolbox, but it is susceptible to more automatisms than the executable file that has been used.

GIS are proven an exceptional tool to record the existing situation in the Greek coastal area. They are able to process large databases in real time. They can visualize the information they contain in their spatial database and illustrate issues of pressure experienced from tourism activities in the coastal area. In this way, GIS can function as a Decision Support System and contribute to tourism planning. One of their most basic disadvantages is that they require specialized personnel for their use and they are not compatible with other cartographic software packages.

From the above findings, it comes out that in the period examined the wider part of the Greek coastal tourism communities was in the cluster of declining tourism growth. The very opposite to this is the cluster of classical tourism destinations, where there is a small number of communities. All other communities are in the intermediary types of produced typology. From the study of a relative figure (Figure 1), it can be extracted that there is a particularly heterogeneous picture on the Greek coastal area with regard to its tourism product. This heterogeneity leads to the conclusion that tourism planning is necessary for the coastal area of Greece at a national level.

CONCLUDING REMARKS

The typology of coastal tourism areas is a dynamic tool not only for policy making and implementation but also it is a procedure of crucial importance for tourism planning. Typologies can illustrate the particularities that are apparent in every type/cluster of TD and, at the same time, can show and visualize the heterogeneity of the tourism product in the coastal area.

Planning and policy making cannot be related to the administrative boundaries of Prefectures or even Municipalities, due to the heterogeneity from which the form and the dynamics of tourism in the coastal area

suffer. Training, implementation and evaluation of policy will be concerned with every type of TD. In this way, policy will be efficient and representative for every type of TD. Simultaneously, other characteristics of coastal areas could be added to this typology so that this typology would become a model for an integrated management of coastal areas.

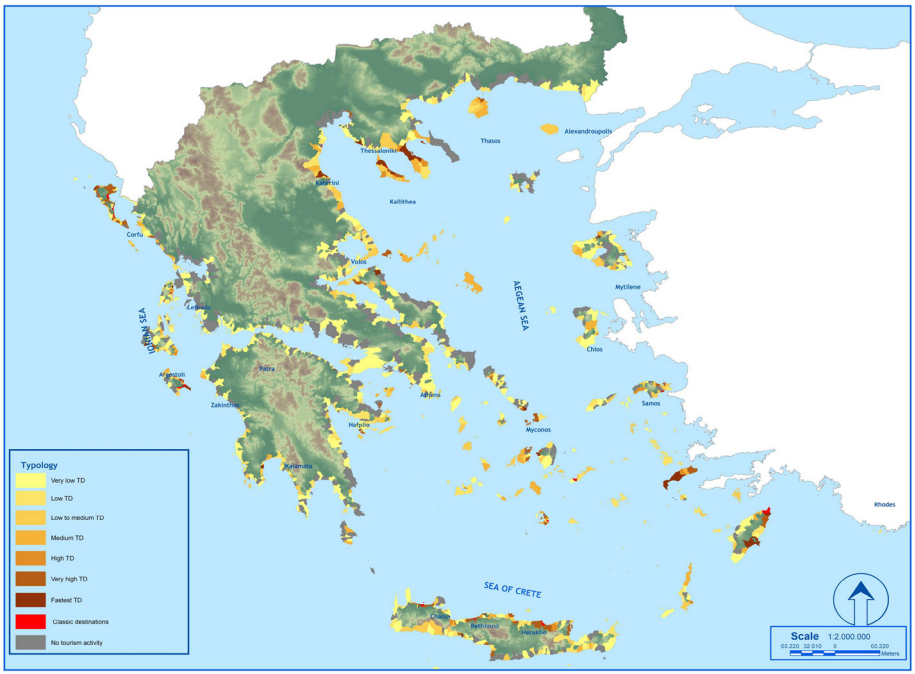
The typology that has been created is dynamic and enables its users to follow-up the system after the implementation of suitable policy per type of area (through feedback). Thus, it is possible to follow up the system and the development of the situation of tourism in the coastal area of Greece after the implementation of different policies and the behavior of communities in these coastal areas observed through the differentiation of tourism indicators.

The presence of explicitly and precisely determined information (statistical data) not only about tourism but also about the characteristics of the societies in coastal areas is basic and up to a point determines the success of the system, too. That is the reason why the existing problems with recording and the availability of relevant information about every case should be (re)solved.

In future, there may be a data collection depicting more precisely the existing situation of tourism in the coastal area and being related to second homes, occupancy rates, overnight stays of native and foreign tourists and, finally, being related to the precise recording of secondary accommodations. Currently the tool was used for coastal areas in a big scale but in future research can be tested in different scales and areas (eg. Mountainous, islands etc).

The primary objective of this research was to create a methodology and a tool for creating supply typologies. Typologies produced with the aid of this tool can better direct policy and can aid planning process by producing more targeted policies. It is a first step in in the use of GIS and Fuzzy Systems for creating typologies in a complex system like tourism. As a tool it is susceptible to further optimization and addition with different indicators, specifications, scales of application, etc. Tourism planning is only part of the wider system of the area under study. Plans and policies produced by this process should be incorporated in the strategic planning of the area in order to by effective. Planning as a process in the complex system of tourism can be aided by new and sophisticated tools like the one proposed but above all effective planning needs political will and capacity.

Figure1. Supply typology for the Greek coastal and insular area



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