Spatial Analysis Methodology for the Italian Coastal Landscape: Features and Dynamics Evolution

Donatella Cialdea, Luigi Mastronardi

***Abstract*—**This study aims to propose a methodology for the analysis of the Coastal Landscape, especially in relation to the tourism activity. The analysis revealed a high environmental vulnerability due to the strong seasonality of tourism, with negative consequences on soil, biodiversity, water and energy resources. The main problem is the preservation of nature in the Italian coastal areas, and its correlation with the landscape quality aims that new Plans need, in according with the New Code for Cultural and Landscape Heritage. The Authors developed a new multi-criterial approach in order to summarize interaction models for the investigated phenomena, supported by the G.I.S. technologies, implemented in their L.a.co.s.t.a. Laboratory (Laboratory for Activities Connected with Territorial and Environmental Development) in order to develop an innovative spatial analysis that take into account all territory features and all spatial information types, applied to the New Landscape Regional Plan for the Molise Region in the South of Italy, which they are developing.

***Keywords*—** Landscape Planning, Tourism, IDW, CCA, GIS, Spatial analysis

I. Introduction

The Italian Coastal Line is a part of the land over the years more and more threatened by many factors, and its landscape features are very interesting from the Planning Decisions point of view. This study has developed a method to underline the interconnections between the various factors, in order to define a useful contribution to planning, in particular to the landscape one.

The landscape is a factor of reorganization and territorial competitiveness [1] (which produces ecological, environmental, cultural, social and economic values [2], through which it is possible to recognize and recover the identity of places [3]: therefore it represents the instrument to design a model of integrated and sustainable territorial development [4]. The quality of the landscape and of the natural resources represents the necessary basis in the tourism sector [5]. Tourism, in fact, is an inherently territorial activity, related to the specificity that each place is able to express [6], in terms of environmental diversity, architectural coherence, cultural and social wealth [7]. The case-study of Campomarino in the Molise Region was identified: it is a location of residual dune areas and strongly interested by the anthropization and the exploitation for tourism purposes. Coastal areas assume a strategically importance at social, economic and environmental levels, but they are afflicted by biophysical and human interrelated problems [8] which impact on the landscape [9], on the use of resources and on the biodiversity [10], from which descends the need to establish a management model oriented to sustainability and to renewability [11]. The Mediterranean coastal areas, in fact, are subjected to a series of pressures and a severe degradation of its resources [12], mainly due to a significant and non-coherent urban development [13], but also to a considerable pollution of agricultural - industrial origins and to activities such as tourism [14]. The main issues affecting the coastal zone may be related to: i) urbanization and infrastructure; ii) population density; iii) erosion; iv) salinization of groundwater aquifers; v) climate change; vi) diffuse pollution; vii) loss of biodiversity.

However, tourism is in itself an environmental paradox [15], as it contributes to the realization of socio-economic and cultural objectives through the preservation of natural resources, but it can produce an environmental degradation.

In particular, the relationship between tourism and environment takes on three different aspects [16]: i) the co-existence; ii) the conflict; iii) the symbiosis. In the first case, between tourism and environment a relationship of detachment is established, with very few, irrelevant, points of contact.

In circumstances where there is conflict, tourism and environment will affect each other and tourism determines unquestionable environmental damages [17]. The third type of relationship occurs when the tourism and the environment are mutually supportive getting each other utilities: tourism in this case provides a value of existence, a price, to the natural

This work aims to illustrate the work leading to the definition of the methodology used for the creation of the Landscape Plan of the Molise Region. This project was entrusted to the University of Molise's L.a.co.s.t.a. Laboratory by the Molise Region. The fine-tuning of this methodology is the result of the substantial experience in research within the territory matured by the members of the L.a.co.s.t.a. laboratory, both in Italy and abroad. The methodology's strength and originality stems from the fact that it can function as a system for territorial analysis applicable to all types of territory and be used other in countries.

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environment of the destination, resulting in positive externalities.

The tourism model mainly present in the coastal resorts is called *sol y playa* [18], which is characterized by the seasonality of the tourist flows which determine over-exploitation of natural resources, saturation of roads, overcrowding and thus worsening of the quality of life.

Our methodology aims to verify the real tourism enterprises distribution: it was proposed for the New Landscape Plan for the Molise Region (Italy).

It could contribute to the landscape features conservation, to the recovery and rehabilitation of degraded areas, and to the appropriate transformation in the landscape context.

In the Italian framework planning, the Landscape Plan is a normative reference of particular importance, which has been refined in recent years by the additions of the so-called "Urbani Code", that is the New Code for Cultural and Landscape Heritage. Great attention was paid not only to the areas where it is accepted high landscape value, but also to "those significantly compromised or degraded", to emphasize the need to provide "lines of urban development and construction are compatible with the different levels of value recognized", pointing out the requirements for the protection of UNESCO World Heritage sites but also for the "agricultural areas", which for the first time are taken into strong consideration.

II. Spatial Analysis Methodology

Our research on regional coastal territory, through the use of GIS software for spatial analyses, wants to investigate major changes due to the settlement on the territory along the coast, especially in relation to tourism factors.

For this purpose, the methodological approach - that we named the "Integrated Economic Environmental Territorial Layout" - takes into account the following aspects: 1) territorial transformations; 2) features and dynamics of the tourism activity; 3) tourism impacts on the landscape and natural ecosystem (see Fig. 1). GIS is a powerful tool for analyzing spatial data [19]-[20]-[21] and establishing a process for decision support [22], [23] and policy [24]. However, it is a very useful method for assessment of changes and development of ecosystems in the landscape [25]. Geo-information technologies are specific information technologies used for processing of geo-data and geo-information. A Geographic Information System integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.

2.1 Territorial and Landscape Aspects

In the context of National Planning Tools, the Landscape Plan represents a normative important reference: the already mentioned New Code, defined in 2004 and its subsequent revisions, paid great attention to the main characteristics of the landscape and the definition of its quality aims. The New Plan, in fact, aims to carry out interventions on the landscape, oriented to the conservation, to the rehabilitation or to the sustainable development. Our experimental methodology aims to fit the structure of the New Landscape Plan – currently carrying out for the Molise Region by the L.a.co.s.t.a. Laboratory - through the identification of conservation measures of the connotative features of the landscape, the determination of recovery and re-qualification interventions of the significantly compromised or degraded areas, the identification of the necessary measures for the proper insertion of the territory transformation interventions into the landscape.

In our case-study in the Italian Molise Region the perspective of reaching a framework of the landscape quality objectives was realized in order to control the transformation's dynamics and its indicators for each Resource System (physical, cultural, demographic and productive systems). They highlight the relationship between the condition of the landscape of the identified field and its local context, the impact that some components have on the environment and the establishment of a framework of potential quality aims [26], [27]. Moreover the specific objectives are defined through qualitative and quantitative analyses of the elements previously identified in each local area and provide the basis for defining the conservation, compatible development or redevelopment interventions that are expected to be provided to each local context. Therefore we are studying interventions and actions to transform the territory and at the same time we are investigating methods for the attenuation of the impacts produced by the interventions on the environment and on the local context. About our case-study, the Molise's circa 35 km of coastline is characterised by notable environmental diversity with an alternating presence of coastal marshes, delta systems, sandy shorelines and dunal systems. The inland area, which is mainly hilly and today under intense cultivation, is characterised by water courses with respective flood plains and banks which still conserve their particular natural characteristics, constituting a series of important ecological corridors which from the deltas develop towards the inland areas. The disappearance of the beach is proof confirming that operations linked to the development of tourism, if not well planned, often causes heavy geo-morphological changes to the territory and alterations in the naturalness of the coastal system, which due to its being highly specialized is extremely fragile with respect to the changes and transformations induced, more or less rapidly, by man.

Another environmental risk factor is that created by the expansion of residential construction, as observed near the tourist port of Campomarino Lido where a plan has been drawn up for allotting terrain for the construction of a building complex "Il Porticciolo". Work began at the beginning of August 2005 in the area between the beach and the parallel road running between the SS 16 road and the line of dunes. The realization of an access road to the building site and the construction work have completely flattened the dunes and obliterated them for ever (see Fig. 2).

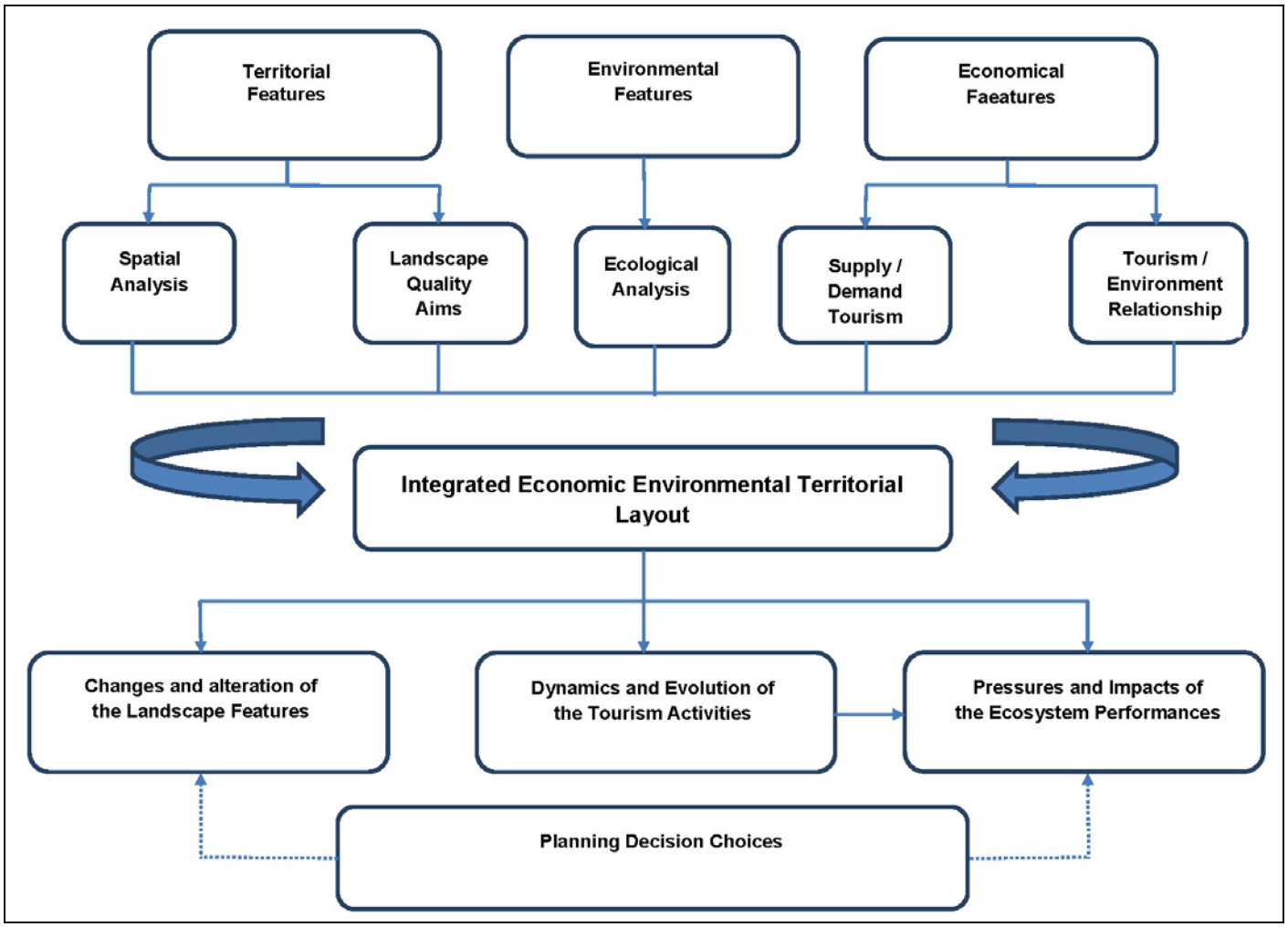

Fig. 1 The Methodology Layout

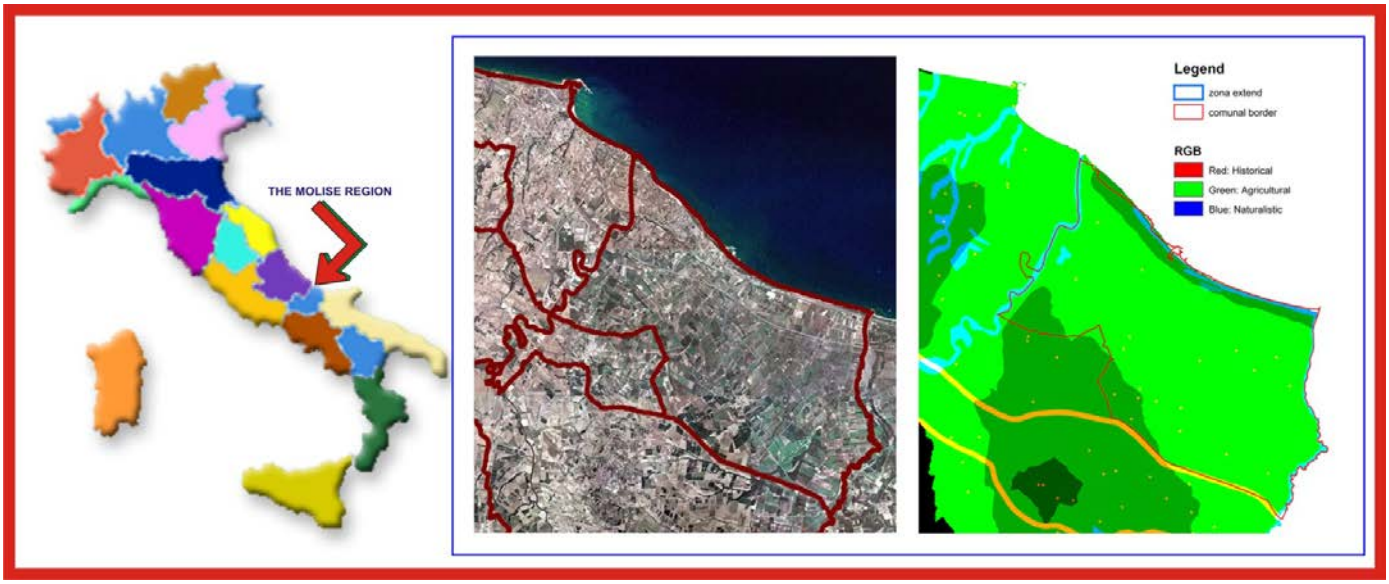

Fig. 2 The case-study: the coastal zone in the Molise Region in Italy and the Municipality of Campomarino

It is still possible to think of “soft” forms of development through the creation *greenways* parallel to the coast or *blueways* parallel to the rivers, where eco-tourism and low impact eco-tourism can be promoted which will consent both sustainable fruition and habitat maintenance.

Therefore, the protection of the coastal shoreline is to be undertaken through detailed mapping of the dune systems and areas of autochthonous vegetation which results as fundamental within the ambit of territorial planning aimed towards the undertaking of those positive actions which see the protection of the coastal dunes as the focal point for the defence of the coastline and the natural environments they constitute. A departure point for territorial planning is to forecast which areas can be destined for “light” development projects and those which, due to the exclusive characteristics of the natural environments, must be safeguarded and protected by rigid regulations.

In order to analyze the evolution of the land use in this coastal area, we realized the Map of the Evolutional State, which described through a comparison between two representations of the territory made from 1954 and 2006. The aim is to highlight the main changes in land use within the region. It is clear from the comparison of the different temporal horizons that considerable changes in vegetation cover and use of the terrain have taken place. The vegetation map of the Molise region was created according to first temporal horizon in the post-Second World War period (indicative reference date: 1954), in the beginning of the 1990s (indicative reference date: 1992), in the 2000 (Corine Land Cover 2000) and in the 2006 (Corine Land Cover 2006) (see Fig. 3).

With reference to the land use evolution, our next step was the identification of the landscape quality aims, in particular for the sustainable development, which is what is more closely connected to the potential of the tourism activities [28].

The final result of this process will be a methodology for the reading and analysis of the territory which can be applied to the entire region in order to generate a regional landscape plan based on the same method of reading and interpreting the data. The universality of this methodology will be one of the new plan’s major strengths.

2.2 Environmental and Economic Aspects

The analysis of tourism features and dynamics involved the analysis of “supply” and “demand”, with particular reference to the seasonality.

Tourism in the seaside resorts originates quite remote [29]. However, it since the 50s of last century, which in the coastal resorts took shape the process of intensification of tourism in its facet of "mass" and featured a typically seasonal demand. The model of the tourist seaside resorts is in fact characterized by high peaks in the summer months leading to over-exploitation of natural resources, the saturation of roads, overcrowding and consequently the worsening of quality of life. The impacts of tourism on the environment can be summarized in a few critical points described below.

The first of them, called the “over-development”, is caused by an overgrowth and inadequate accommodation, which create a visual impact on the landscape. Even the equipment intended for recreational activities - such as water parks or golf courses - are characterized by excessive use of land and other natural resources. In the last decade, urbanization has affected a larger and larger share of its coast and the coast was too often havoc by excessive overbuilding that did not take account of environmental conditions. Urbanization and its road infrastructure have produced, in the coastal areas, environmental degradation also due to tourist reasons: it is, in fact, along the coast that concentrates the largest number of tourist activities (accommodation, leisure, beaches, nautical). Through the construction of infrastructure, accommodation (hotels, campsites, residences) and areas available for recreational activities, the land was attacked even if it is non-renewable and therefore needs special attention. The land extreme use produces negative impacts, such as loss land for agriculture use, reduction of biodiversity, hydrological alterations, and deterioration in quality of the landscape. Another phenomenon connected to a disorderly overbuilding and inadequate planning is the phenomenon of second homes, often linked to forms of illegal building. The use of these dwellings occurs only during short periods of the year and, what is more, the load resulting from the systems for the disposal of waste and septic tanks is often higher than the absorption capacity of the natural environment.

A second problem is related to the loss of biodiversity, due to urbanization and the development of productive activities. It 'just in coastal areas that are natural habitats of particular importance, often inserted into ecological focus areas, such as salt marshes, sand dunes and cliffs, home to rare bird species. Loss of habitat is often linked to the process of coastal erosion. Erosion is a serious threat to the coast and beaches. To counter this event, some parts of the coast were protected by breakwaters that, very often, produce a negative impact on the landscape and also prevent the right use of the beach. About 25% of the Italian Adriatic coast shows trends of erosion. Other causes related to erosion are the depletion of sediment of rivers to the sea and the subsidence accentuated for the extraction of hydrocarbons and inert in areas near the sea.

A third set of problems is related to the depletion of the environmental system in periods of peak congestion tourism. In particular, water resources, subject to intense pressure caused not only by the local people, but also by the presence of tourists in the summer season, are strong elements of criticality [30]. It 'just during the summer that the availability of water touches minimum levels due to the amplification of tourism demand and the demand from sports and recreational activities such as swimming pools, water parks, golf courses.

The average water consumption attributed to tourism and about 250 litres per capita per day; in second homes equipped with swimming pools and garden, water consumption can rise to 600 litres to reach a demand of between 500 and 800 litres in a top hotel. There is also a problem of inadequate sanitation and sewage. Only 30% of sewage from coastal cities is treated before being discharged into the sea.

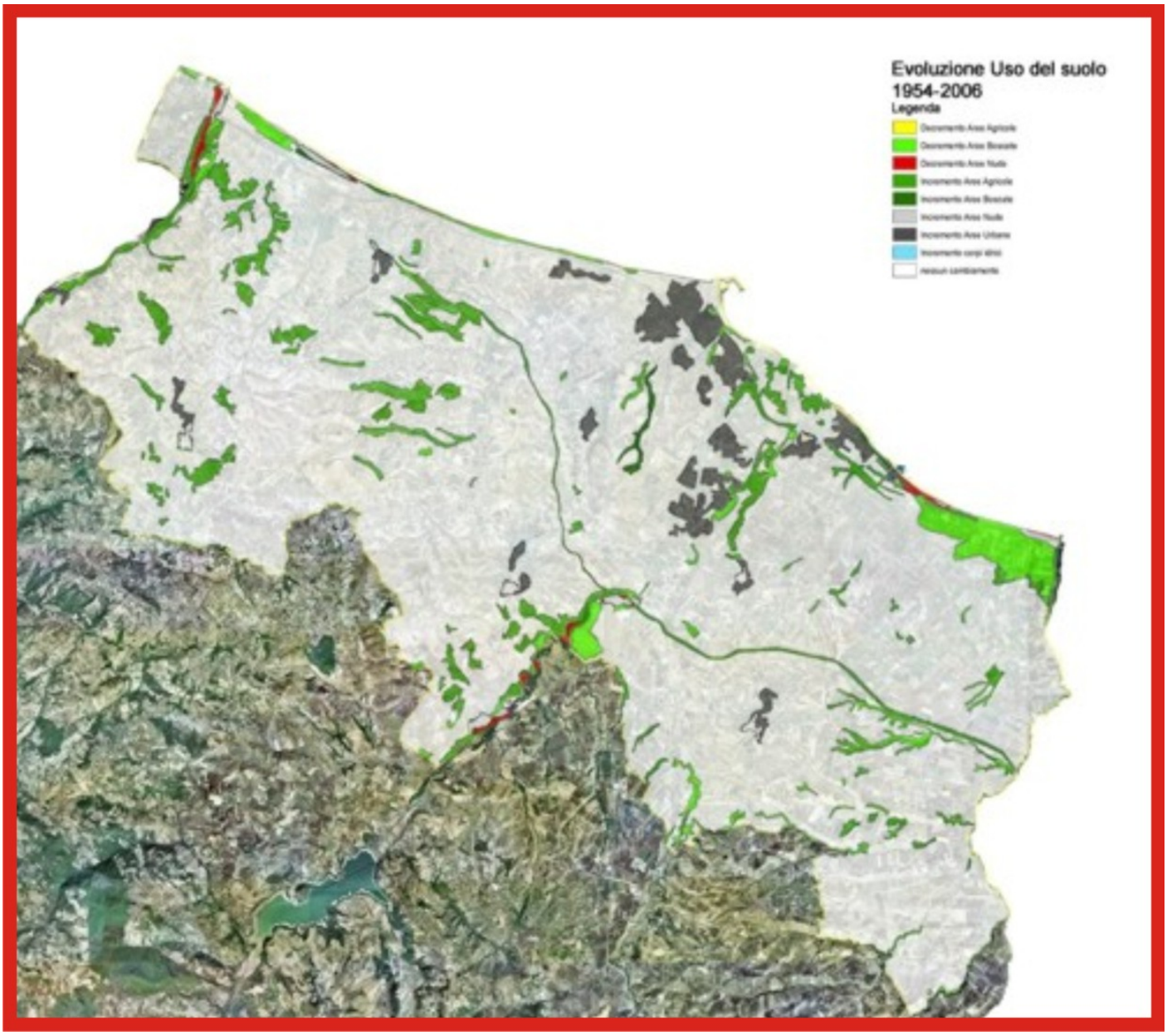

Fig. 3 The Map of the Evolutional State in the land use of the coastal area

This has clearly negative effects on coastal bathing. Other forms of pressure seasonal concern the consumption of electric energy, charged to hotel accommodation and complementary, in addition to that resulting from domestic use as well as the production of waste. The concentration of tourism, in peak periods, has a direct effect on the increase in solid waste, whose disposal is often inefficient, due to inadequate facilities. Besides the costs involved in such a disposal fall on host communities. The waste problem is also closely related to the more general pollution. A little careful planning to the problems of the tourist resorts may cause pollution of the air and sea.

In the tourist centers, the air quality is often threatened by emissions of air conditioning from the facilities, but also by the discharges of pollutants from transport. The pollution of the sea, for example due to maritime accidents causing spills of oil or chemicals, leads to the disappearance of the marine flora, resulting in a loss of biodiversity; Also the pollution load carried by rivers leads to the deterioration of the quality of the marine environment. Finally, it is useful to remember that the tourism industry in the coastal areas is threatened by the phenomena linked to climate change.

In detail, issues related to tourism are shown in Table1:

Table 1 The Main Tourism Impacts in the Coastal Areas

Accommodation and infrastructures Erosion Overbuilding Flora and Fauna Loss Special Natural Interest Areas Damage Visual Impact Soil Consumption	**Transport** Congestion Soil Consumption for Road Infrastructure Noise/Air Pollution Climate Change
Water Use Consumption increase Conflict Tourism/Domestic Use Wastewater treatment Plants Inadequacy	**ElectricEnergy Use** Consumption increase Climate Change
Waste Seasonal Increase Water Pollution Solid Waste Digestion	**Boats** Noise Pollution Water Pollution by oil and antifouling paints Air Pollution Visual Impact
Tourism Flows Natural Resource System Pressures Seasonality and Congestion Cultural Identity Loss “Enclave” Effect	

The information used for the statistical analysis is quite varied and we collected them from official sources and from direct information in situ.

The variables were selected based on the information currently available. The time horizon is represented by the years 2003 and 2010. The territorial unit of reference is the entire Municipality area. The complete information framework is shown in Table 2.

First of all, we used these data to take a picture of the situation in the last year of reference in order to make, subsequently, the diachronic comparisons. Information relating to tourism derived mainly by the Province of Campobasso Tourism Authority. Data were used to illustrate the dynamics of supply and demand for tourism (arrivals and presences). The unit reference time is the year or the month. In some cases, we used additional information derived by ISTAT (Italian National Statistical Institute), from the Archives of Local Authorities and Local Municipalities, or acquired through interviews with witnesses. Data on waste arise from the archives of the Province of Campobasso and Municipalities of the study area. Data on water consumption were provided by Molise Acque Agency referring to the annual and monthly consumption.

The information on energy consumption has been extrapolated from the databases and ENEL (National Electricity Board) affecting overall consumption, consumption of hotels and restaurants and domestic ones. The data are available by year and month.

The information used for the analysis of the coastal and marine system has been made available by ARPA (Molise Environmental Agency) and by the Harbour Authority.

Spatial data derived from multiple information sources. ISTAT data are of a census, while the Municipalities are for 2003 and 2010. Data processing was aimed at the application of methods of interpretation of the transformations occurring in the study area, methodologies relevant for understanding the relationships between tourism, the environment and the territory.

Through spatial interpolation techniques in G.I.S. (Inverse Distance Weighted, IDW) it was possible identify the distribution of tourist facilities (beds for sq km) in the study area. Inverse distance weighted (IDW) interpolation determines cell values using a linearly weighted combination of a set of sample points. The weight is a function of inverse distance. The surface being interpolated should be that of a location dependent variable.

This method assumes that the variable being mapped decreases in influence with distance from its sampled location. The IDW function becomes a common weighted average which involves the known points in a neighbourhood of an interpolating point, where the weights are represented by the inverse of distances from the selected point.

A general form for the interpolated value TAD*(x0) for the Tourist Accommodation Density (TAD) for x0 based on samples TADi = TAD (xi) for i = 1,2,… N using IDW is an interpolating function:

$$TAD^*(x) = \frac{\sum wi\,(x)TADi}{\sum wi\,(x)}$$

$$\text{if } d(x,xi) \neq 0 \quad \forall i$$

Table 2 The Variables Framework

FIELD	VARIABLE	SOURCE
TOURISM DEMAND	Annual Tourist Arrivals	Province of Campobasso Tourism Authority
	Monthly Tourist Arrivals	
	Annual Attendances	
	Monthly Attendances	
	Annual Hotel Arrivals	
	Monthly Hotel Arrivals	
	Annual Extra-Hotel Arrivals	
	Monthly Extra-Hotel Arrivals	
	Annual Hotel Attendances	
	Monthly Hotel Attendances	
	Annual Extra-Hotel Attendances	
	Monthly Extra-Hotel Attendances	
	Annual Italian Arrivals	
	Monthly Italian Arrivals	
	Annual Italian Attendances	
	Monthly Italian Attendances	
	Annual Hotel Italian Arrivals	
	Monthly Hotel Italian Arrivals	
	Annual Extra-Hotel Italian Arrivals	
	Monthly Extra-Hotel Italian Arrivals	
	Annual Hotel Italian Attendances	
	Monthly Hotel Italian Attendances	
	Annual Extra-Hotel Italian Attendances	
	Monthly Extra-Hotel Italian Attendances	
	Annual Foreign Arrivals	
	Monthly Foreign Arrivals	
	Annual Foreign Attendances	
	Monthly Foreign Attendances	
	Annual Hotel Foreign Arrivals	
	Monthly Hotel Foreign Arrivals	
	Annual Extra-Hotel Foreign Arrivals	
	Monthly Extra-Hotel Foreign Arrivals	
	Annual Hotel Foreign Attendances	
	Monthly Hotel Foreign Attendances	
	Annual Extra-Hotel Foreign Attendances	
	Monthly Extra-Hotel Foreign Attendances	
TOURISM SUPPLY	No. Accommodation Facilities	Province of Campobasso Tourism Authority and Direct Information in Situ
	No. Hotel Facilities	
	No. Extra-Hotel Facilities	
	No. Agritourisms	
	No. Camping and Villages	
	No. Houses	
	No. Beds	
	No. Hotel Beds	
	No. Second Homes	
WASTE	Annual General Wastes	Italian National Statistical Institute and Municipal Archives
	Monthly General Wastes	
	Annual Separated Wastes	
NATURAL RESOURCES	Annual Water Consumption	Molise Acque Agency
	Monthly Water Consumption	
	Total Annual Electricity Consumption	National Electricity Board
	Annual Domestic Electricity Consumption	
	Annual Electricity Hotels and Restaurants Consumption	
	Monthly Electricity Consumption	
	Monthly Domestic Electricity Consumption	
	Monthly Electricity Hotels and Restaurants Consumption	
COASTAL AND MARINE SYSTEM	Coliforms	Molise Environmental Agency
	Faecal Coliforms	
	Streptococci	
	No. Accidents at Sea	Harbour Authority

	No. Harbours	
	Harbours Surface	
	No. Boats Landed	
	No. Boarding	
	No. Landings	
	No. Beach Resorts	State Property Office
	Coastal surface	Italian National Statistical Institute and State Property Office
	Coastal Protected Surface	Italian National Statistical Institute and Molise Region
	Beach Resorts Surface	State Property Office
LAND	No. Residents	Italian National Statistical Institute
	Territorial Surface	
	Total Protected Surface	Italian National Statistical Institute and Molise Region
	No. Dwelling	Italian National Statistical Institute and Municipal Archives
	Camping Site Surface	Direct Information in Situ
	Dwelling Surface	Italian National Statistical Institute and Municipal Archives
	Dwelling Unoccupied Surface	

$$TAD^{*}(x) = TADi$$

$$\text{if } d(x, xi) = 0 \quad \text{for some i}$$

where

$$wi\,(x) = \frac{1}{d(x, xi)^{p}}$$

is a simple IDW weighting function and x denotes an interpolated (arbitrary) point, x_i is an interpolating (known) point, d(x,xi) is a given distance (metric operator) from the known point x_i to the unknown point x, *N* is the total number of known points used in interpolation and p is a positive real number, called the power parameter. IDW relies mainly on the inverse of the distance raised to a mathematical power.

The Power parameter lets you control the significance of known points on the interpolated values based on their distance from the output point.

It is a positive, real number, and its default value is 2. By defining a higher power value, more emphasis can be put on the nearest points.

As the power increases, the interpolated values begin to approach the value of the nearest sample point.

Specifying a lower value for power will give more influence to surrounding points that are farther away, resulting in a smoother surface.

We have investigated about the optimal value for the power parameter calculating the differences between all the values (e.g. tourist accommodation densities) included in a neighbourhood around each point, assuming a searching radius equal to the Average Nearest Neighbour (ANN) for the whole study area (Molise region).

The observed mean distance was 3812 meters. Afterwards, we have plotted the differences along the vertical axis and the distances along the horizontal axis and grouped the values according to a fixed step depending on a measure for the observed variance in the plot; we chose step units of 1/2 deviation standard.

For each group, we have calculated the mean in order to interpolate the resulting points.

We assessed a high variability between points, so that we estimated in both cases (years 2003 and 2012) a polynomial curve of 4th order. This may be interpreted as closest points assume a very high weight than further points, so we assigned a power parameter of 4 (see Fig. 4).

Seasonality is generally defined as the tendency of tourism flows to be concentrated in a short period of the year and it is most problematic aspects related to tourism. Seasonality is a cyclical event that is repeated more or less every year and causes an imbalance temporal demand.

This imbalance is an expression of the size of some elements such as the number of tourists, tourist spending, road traffic and other forms of transport, employment.

The high concentration of tourism flows in certain periods of the year involves the congestion of physical carrying capacity and economic and consequently the degradation of the natural and built in the high season, as well as the limited use of financial and human resources in low season.

The study of tourism impacts on natural resources has used a set of 68 indicators that made it possible to confirm a multi-sector approach, the relationship between the tourism and the natural resources considered to be able to summarize the modes of interaction and to represent them adequately.

The investigated phenomena (macro-determinants) by the set of indicators are:

- Tourism Supply;
- Tourism Demand;
- Territory;
- Marine and Coastal System;
- Water Resources;
- Energy Resources;
- Waste.

The investigated phenomena are shown in Table 3 (Tourism Indicators) and Table 4 (Environment Indicators).

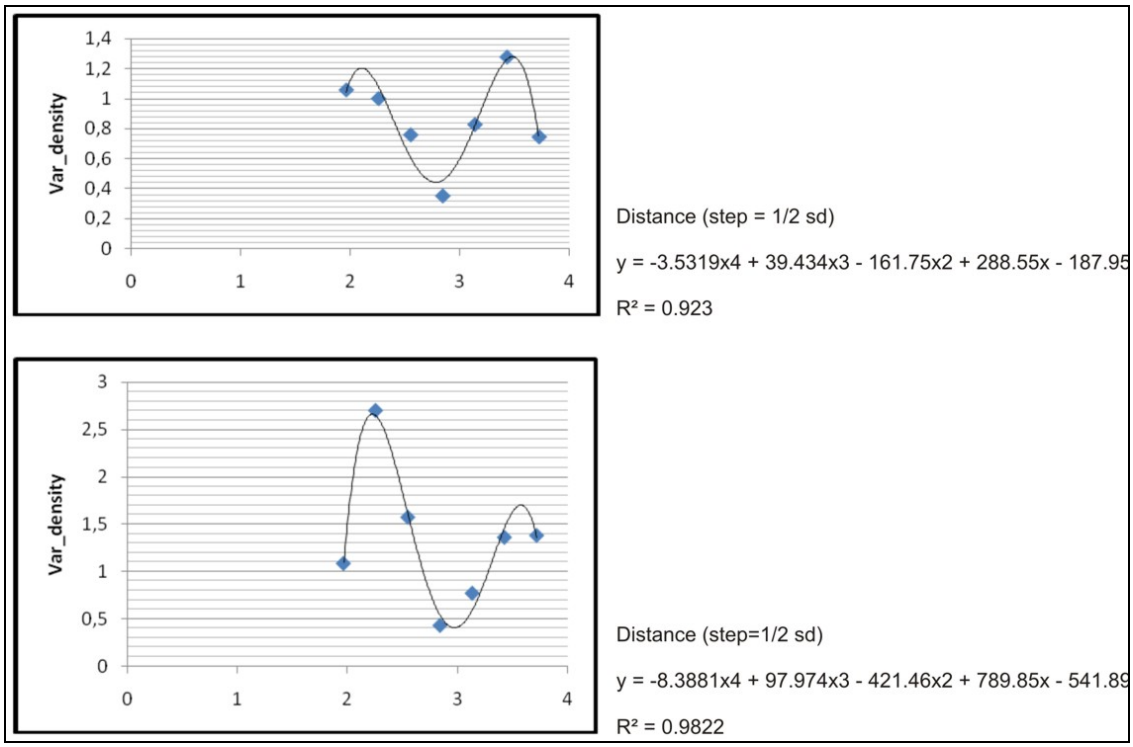

Fig. 4 Pattern Analysis, year 2003 and 2010

Table 3 Tourism Indicators and Table 4 Environment Indicators

TABLE 3 TOURISM INDICATORS

TOURISM SUPPLY		
	S1	No. Accomodation Facilities
	S2	No. Beds
	S3	No. Beds / No. Hotel Facilities
	S4	No. Beds / No. Extra-Hotel Facilities
	S5	No. Beds / Resident
	S6	No. Beds / Resident x 100 dwellers
	S7	% Second Homes
	S8	% Hotel Beds
	S9	% Extra-Hotel Facilities Beds
	S10	% Agritourism Beds (on extra-hotel)
	S11	% Camping And Villages Beds (on extra-hotel)
	S12	% Tourist And Hotel Residences Beds (on extra-hotel)
	S13	% Vacation Houses Beds (on extra-hotel)
TOURISM DEMAND		
	D1	No. arrivals
	D1	No. Arrivals
	D2	No. Attendance
	D3	% Hotel Arrivals
	D4	% Extra-Hotel Facilities Arrivals
	D5	% Hotel Attendance
	D6	% Extra-Hotel Facilities Attendance
	D7	% Italian Arrivals
	D8	% Foreign Arrivals
	D9	Average Stay (No. Attendane / No. arrivals)
	D10	No. Attendane / Beds
	D11	Tourist Arrivals / Residents
	D12	Rate of Seasonality
	D13	Seasonality Intensity
	D14	Factor of Seasonal Peak
	D15	MUS - Maximal Utilization constrained by Seasonality
	D16	SUF - Seasonality Underutilization Factor

TABLE 4 ENVIRONMENT INDICATORS

TERRITORY		
	T1	% SCI
	T2	(No. Beds/Resident) * 1 / Surface Area
	T3	% Surface Occupied by Second Homes
	T4	Tourist Arrivals / Surface Area (sq km)
	T5	% Camping Surface
MARINE AND COASTAL SYSTEM		
	C1	% Protected Coastal Surface
	C2	Total Coliforms
	C3	Faecal Coliforms
	C4	Spreptococci
	C5	No. Accidents At Sea
	C6	Beach Surface / Residents + Arrivals
	C7	Facilities Surface / Beach Surface
	C8	Harbour Surface
WATER RESOURCES		
	W1	Per capita Consumption
	W2	Annual Average Consumption
	W3	Average Consumption in summer
	W4	No-tourist Period Consumption / Tourist Period Consumption
	W5	Monthly Variability
	W6	Seasonality Intensity (per capita values)
ENERGY RESOURCES		
	E1	Touristic Consumption / Total Consumption
	E2	Domestic Consumption per capita
	E3	Domestic Consumption / Total Consumption
	E4	Annual Average Tourism Consumption
	E5	Average Tourism Consumption in summer
	E6	Non-Tourist Period Consumption / Tourist Period Consumption
	E7	Monthly Variability of Tourism Consumption
	E8	Seasonality Intensity Of Tourism Consumption (per capita values)
	E9	Average Annual Domestic Consumption
	E10	Average Domestic Consumption in summer
	E11	Domestic Consumption no-touristic Period / Domestic Consumption in summer
	E12	Monthly Variability of Domestic Consumption
	E13	Intesity of the Seasonality of Tourism Consumption (per capita values)
WASTE		
	P1	Waste per capita
	P2	% Waste Collection
	P3	Annual Waste Average
	P4	Waste Average in summer
	P5	No-tourist Period Waste/ Tourist Period Waste
	P6	Monthly Variability
	P7	Seasonality Intensity (per capita values)

We used the Multivariate Canonical Correlation Analysis, named CCA [31]-[32], which can be considered as a general case of the multiple regression, of the correspondence analysis and of the discriminant analysis. The CCA aim is the identification of the linear relations existing between two groups of quantitative variables observed on the same set of elements, so as to maximize the degree of correlation between the variables of the groups.

Formally, given a pair of vectors X = (X1 X2, ... XN1) and Y = (Y1 Y2 .... Yn2) formed by n1 and n2 variables, are to be found the linear combinations between X and Y that maximize the biunivocal correlations between the Xh, h = 1..n1 and Yp, p = 1, ... n2.

The multi-dimensional variables (each dimension or coordinate is associated to each Municipality) were represented in reduced form (two-dimensional) on a plane whose axes (CCA1 and CCA2), called principal components, are linear combinations of the initial variables. Points which are close to each other along the same axis are positively correlated, and viceversa; the intensity of the correlation grows from the center (origin of axes) towards the periphery of the distribution. The relative importance of each axis is given by its percentage of spread variance.

III Results

The Campomarino town is located in the coastal area of the Lower Molise. Even if is affected by significant changes in the demographic and economic arrangement [33], it safeguards its environmental situations worthy of preservation, evidenced by the presence of seven Sites of Community Importance identified under the Habitat Directive. They contain habitats which are typical of wet and riparian, coastal and ravines zones, as well as a fair number of animal species and two plant species of main interest: the *Stipa austroitalica* and the *Himantoglossum adriaticum* [34].

The coastal area under investigation reports a significant condition of development and has a clear seaside tourist attitude, which is accompanied by several environmental problems [35]. Moreover, in the area, there are the most intensive agriculture of the region, thanks to the favourable climatic conditions and the good irrigation availability.

It also presents the most important industrial center of the region [36]. Interesting from the historical and cultural point of view is the presence of the cattle tracks "L'Aquila-Foggia" and "Centurelle-Montesecco", in respect of which it is necessary to consider new management policies in the light of the most recent lines of sustainable development, finalizing them both to the recovery of what has remained unaltered over the time and to the promotion of compatible forms of fruition [37]-[38]. However rural landscape presents a growing tendency to fragmentation, induced by the development of road networks and infrastructure, resulting in lower surfaces, with the exception of arable land and urban and industrial areas, which, on the contrary extend and aggregate themselves. The transformations show a substantial persistence of agricultural activities. It should be emphasized the cultivation (deterioration) of areas previously characterized by natural vegetation, with a definite negative impact on the coastal landscape. The natural and semi-natural areas experience an increase of the surface, due to fragmented events of abandoning farmland on which are activated processes of secondary succession that lead to their complete transformation into woods.

The Campomarino town is correlated to the highest percentages of covered Sites of Community Importance belonging to the Natura 2000 Network (T1). They are related, particularly, to the SCI IT7222216 Mouth Biferno - Coast of Campomarino and IT7222217 Mouth Saccione - Ramitelli Reclamation Area, and of rural areas important for pauses and for bird's nesting and coinciding with SCI IT7222216 which houses rare wetlands at the mouth of the river Biferno and with the middle-lower course of the same river. Moreover this Municipality has experienced a strong population growth (+ 40% over the last thirty years), which has had an impact on the housing and consequently on the land arrangement.

Since the '70s, there was a continuous increase in the housing stock: the first houses registered, however, a minor increase compared to homes occupied by non-residents, which currently make up three-quarters of the total housing and cover almost 65% of the Municipal area. In the Municipality of Campomarino there are about 2,600 beds, in 2010, predominantly extra-hotel facilities beds (85%). The average size is 20 beds for hotels and 110 beds for extra-hotel. The average size is 20 beds for hotels and 110 beds for extra-hotel. In Campomarino there are also 14 beach resorts on 11 hectares of beach. Second homes represent a significant component of the receptive.

The surface area occupied by second homes is quite significant. In recent years, the scenario of tourist accommodation has a basically static. It 'important, however, the appearance of farm holidays and bed and breakfast can guarantee low prices. The result is a framework that highlights a tourism growth is not accompanied by the appropriate development of hotel accommodation. For spazialization of tourist accommodation density, we realize a map in which the highest density values (more than 20 beds for km2) have been observed in the coastal areas of Termoli and Campomarino. These are the main tourist sites of region where most part of hotels, holiday houses and camping is placed (see Fig. 5).

In the municipality of Campomarino the distribution of tourist facilities between 2003 and 2010 has substantially the same, highlighting the critical pressure of tourism on coastal ecosystems and habitat. Nevertheless, in the inner land has been found a widespread increase of accommodations density and it highlights a little rebalance of tourist offer between coast and inside territory (see Fig. 6).

In 2010, attendances are about 950,000 units, and they are substantially lower than in 2003. Tourism demand is the household type and seasonal, with intense concentration in the summer months.

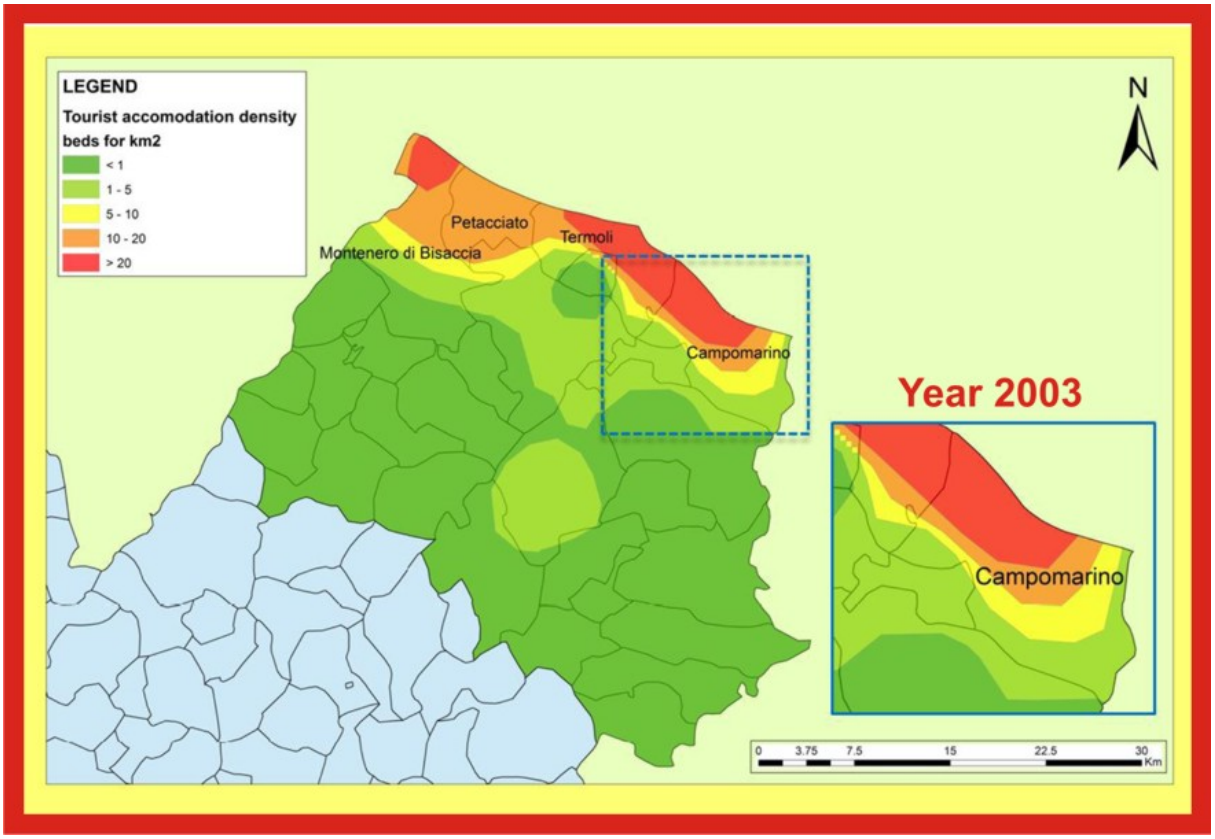

Fig. 5 Distribution of tourist facilities, years 2003

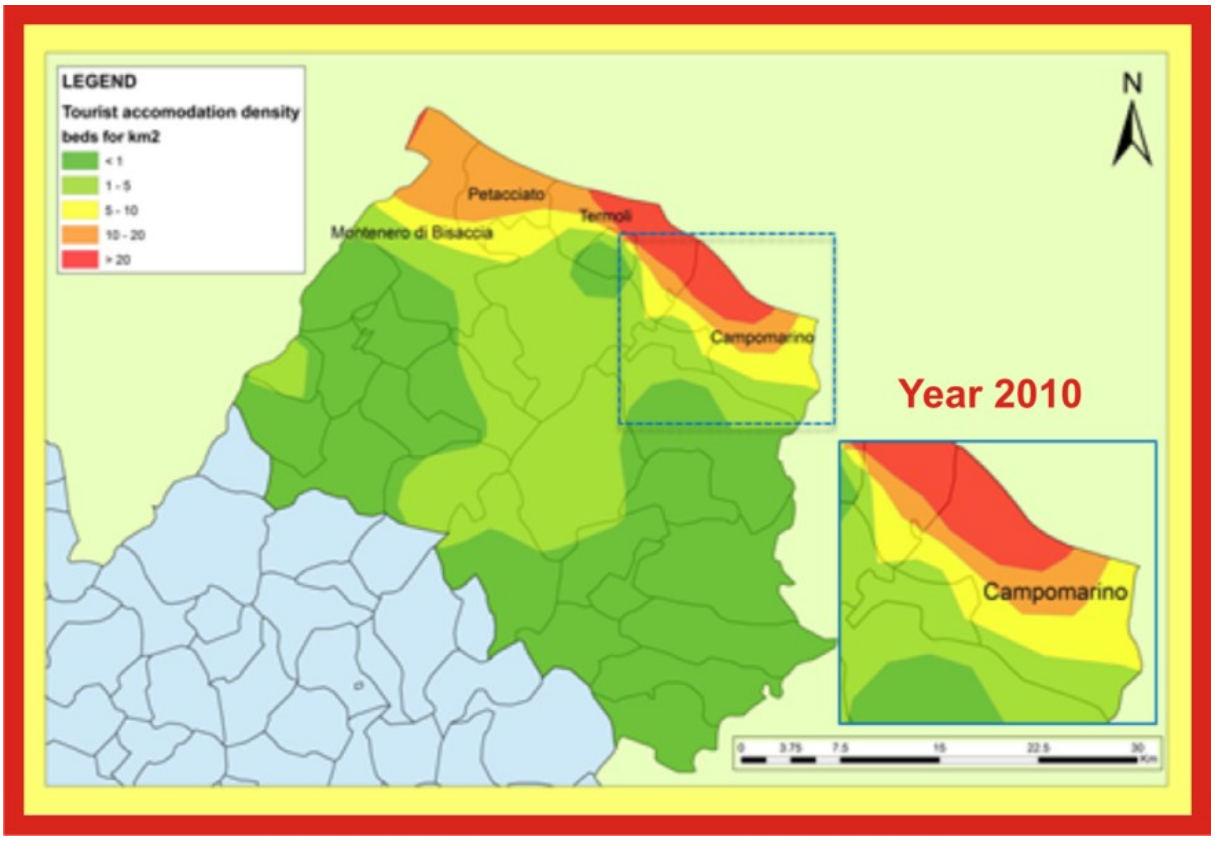

Fig. 6 Distribution of tourist facilities, years 2010

Fig. 7a highlights a strong concentration of attendances in August (51% in 2010) and it has a substantially increased compared to 2003, when the attendance in the same period amounted to 49% of the overall total.

The seasonality involves the crisis of the systems of environmental services (soil, energy, waste), as well as the little use of facilities during the year.

Water consumption (Fig. 7b) shows a high prevalence in the summer period, compared to the average of autumn than annual. The incidence of consumption of hotels and restaurants is quite significant (about 11% of the total). Fig. 7c shows the energy consumption. In 2010, waste per capita (Fig. 7d) are very high (837.3 kg of waste per capita) despite being a town of modest size.

The phenomenon is due almost certainly to the eloquent manifestation of second homes.

Arrivals are concentrated in hotels, while the presences are moving towards complementary structures. The average stay is quite low. The relationship between the arrivals and residents is high.

Tourism growth has not been accompanied, therefore, by a suitable hotel accommodation and thus it developed thanks to a sometimes excessive building, accompanied in some territories by phenomena of unregulated activities [39].

It is useful to remember that tourist houses do involve excessive land consumption, if compared with hotels. Figure 8 summarizes the results of the statistical CCA, which made it possible to identify the variables (indicators) that characterize to a greater extent the tourist-environmental system in the study area. It also helps to estimate the relationship between these indicators, thus allowing highlighting the context of the compatibility and conflict between human activities and the objectives of preservation.

Multivariate analysis revealed two factors can explain the total variability. First one explains, however, to a greater extent to the interpretation of the phenomenon (73% of the overall variance).

This factor identifies two different expressions of tourism and consequently highlights different modes of interaction with the system environment and territorial. With a positive sign, we note the presence of a receptive fabric based on second homes (S7), the high concentration of tourists than residents (D11), and the intensity of tourism demand (D13).

Other indicators that help to explain the factor are: a) T1 and T3 that signal the presence of second homes in the SCI; b) C3 and C4, related to the presence of forms of pollution of marine waters, C7 relative to the intensity of use of the coast (beaches) due to the bathing establishments; c) W6 about the variability of water consumption; d) E1, E2, E3 respectively about the consumption of energy; e) P1 - waste per capita and P7 - intensity of the seasonal nature of the waste. With a negative sign, it shows fewer significant variables that affect the incidence of agritourist farms (S10), the rate of seasonality of tourism demand (D12), water consumption during tourist and not (W4), consumption energy during tourist and not (E11), the collection of waste (P2), the production of waste in periods tourists and not (P5).

The factor seems to indicate a scenario where there is a strong incidence of second homes and beach resorts, and, therefore, appears to be more intense pressure on the territory, especially on the SCI and on the beaches. Moreover, it connotes a strong tourism demand in certain months, which are associated phenomena of marine pollution, excessive use of drinking water and electricity, as well as waste production.

IV Conclusions

Our methodology, therefore, could support Local Authorities because the developed criteria can considered the guidelines to provide conservation, sustainable development or re-generation development actions, as well as the new Code of Cultural Heritage and Landscape suggests [40].

In Campomarino there is a type of accommodation choices based on second homes and tourist residences. To second homes, joins the pressure on land use and pollution of water bodies, as well as an impact on the consumption of water, electricity and waste production.

The tourist-hotel residences have, however, a lower environmental impact. The tourist demand is characterized by the phenomenon of seasonality, in relation to which there is a load capacity untenable.

Related to this condition, it is necessary to arrange local strategies aimed at the rehabilitation of tourism, by encouraging the development of accommodation facilities with low environmental impact (for example bed & breakfasts or agritourism) and deseasonalizing the tourism demand through the diversification of the tourism product.

The strength and the originality of this methodology developed for the New Landscape Plan are identified in the interdependence between some different indicators. In fact it can be a method of spatial analysis applied to each geographical area and exportable in other territorial contexts. The New Regional Landscape Plan must cover the entire region by defining specific limitations and forecasts for each homogeneous identified area. They could be organized in order to realize the maintenance of the landscape features and of the morphologies of the potential protected heritage.

Moreover it could provide new perspectives for urban and building development especially compatible to different levels of recognized values, and to the principle of the lower soil consumption.

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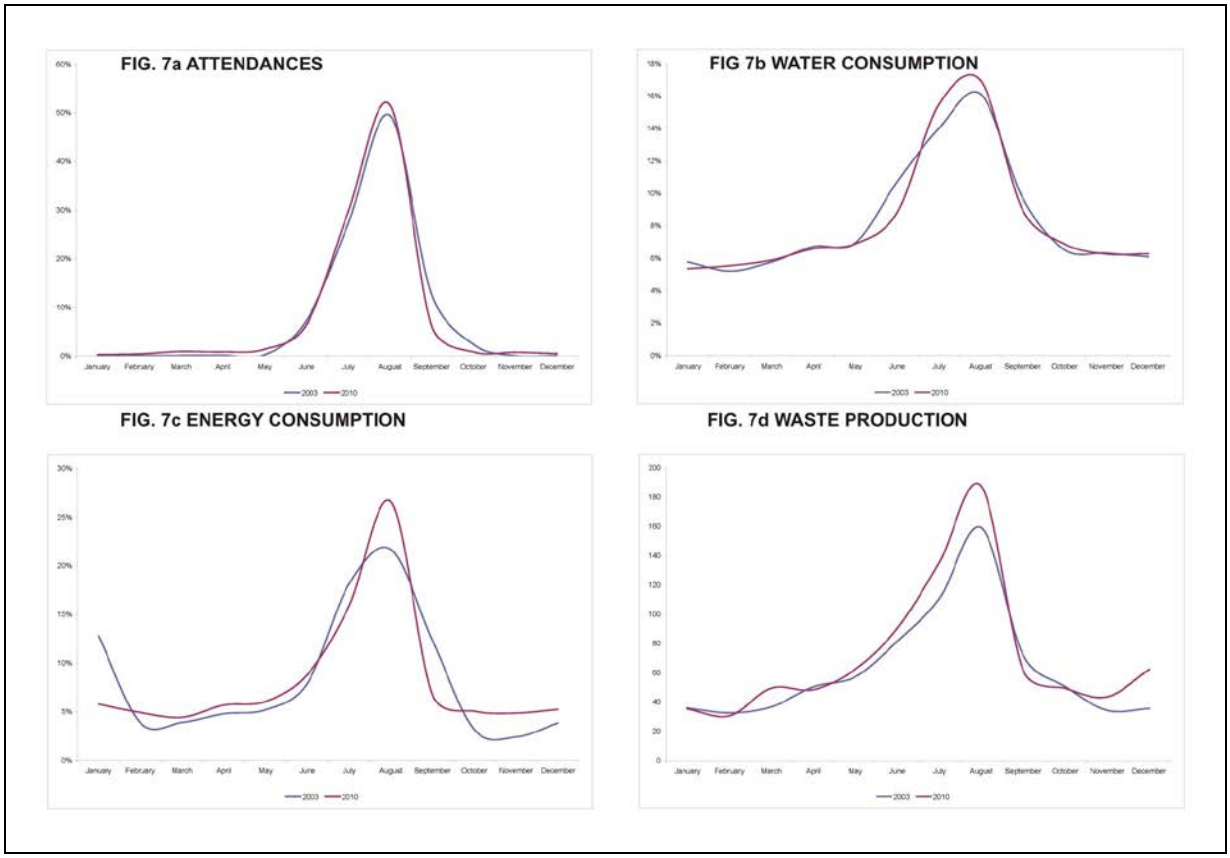

Fig. 7 Monthly Attendance, Water and Energy Consumption, Waste Production

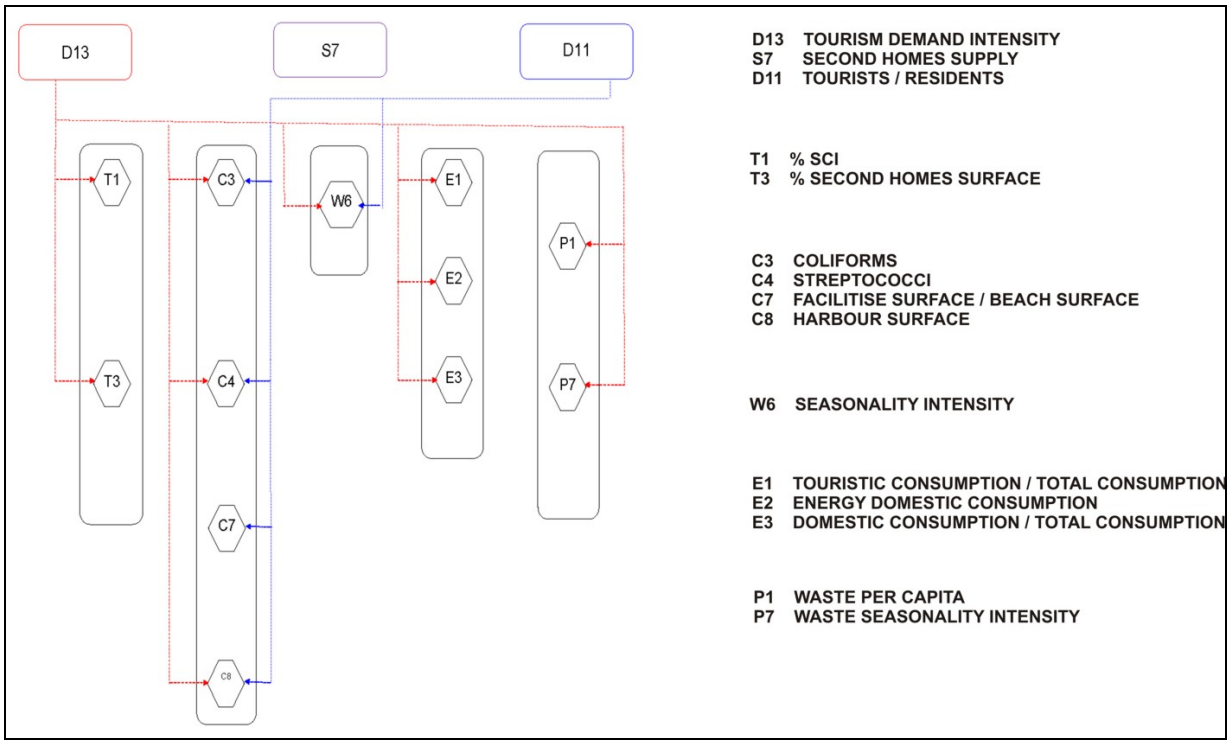

Fig. 8 Interdependencies between tourism and environmental systems

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