Prospect of Integrate Monitoring: A Multidimensional Approach

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Abstract. The paper shows as "Strategic Environmental Assessment (SEA)" can be considered as an essential "decision support system", supported by a systematic process for evaluating the environmental issues of plans and programs. It is shown how in coastal areas, with strong characters of mutability, the assessment procedure must be able to adapt environmental protection and local development and monitoring of feedbacks assumes critical importance. The issues of monitoring and modeling with spatial data infrastructure have been applied to the Coastal Plan of the Apulia Region: a possibility has been explored to implement the analysis of environmental sensitivity and propensity to Coastal erosion due to the level of human pressure on land. The system is based on assessing pressures due to different land uses; such assessment can be integrated without great difficulty with the analysis of criticality and sensitivity provided by the plan. Essential tools to aid the monitoring system are represented by an effective geographic information system for consulting and obtaining the necessary data and analysis from a methodological point of view by AHP. M. Selicato wrote the first paragraph, C. M. Torre wrote the second and the third paragraphs and G. La Trofa wrote the last paragraph.

Keywords: Monitoring, AHP, Coastal management, SEA, GIS.

1 Introduction

In history, the coastal areas have been an important pole of development of civilization. The ability to use the sea for transport and trade and the abundant availability of food derived from high-productivity coastal waters have encouraged and fostered the development of settlements.

The costs can be defined as the element of relationship and interaction between land and sea, and is considered a resource not only from an environmental perspective but also from social and economic.

Coastal areas and their natural resources play a strategic role in potentially meet the needs and aspirations of European citizens today and tomorrow.

The human pressures threaten to destroy habitats and coastal zone resources and consequently the ability of these same areas to carry out many of their essential functions.

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Low-impact targets are often replaced by others that are in intensive and profitable in the short term but that the distance undermine the potential costs of reducing the "resilience".

It is unfortunately difficult to stem the spread of inappropriate uses of coastal areas and indeed, the growing number of residents and visitors, the pressure increases to unsustainable use.

It is clear that a sustainable development perspective, economically efficient and socially equitable use of coastal areas need to define strategies to correct these weaknesses. The definition of such strategies and their implementation in the "Strategic Environmental Assessment '(SEA) is an essential" tool of decision support "that is configured as a systematic process for evaluating the environmental consequences of plans and programs: SEA" permeates "the plan and becomes a constructive element, management and monitoring. Many authors [1] [2] [3] had recognized the need to follow the next steps for approval, but Fischer [4] find as many scholars treat it, define what it is, what must be done or how it is done in practice.

Partidario and Arts [5] argue that the implementation of the SEA can not be limited to what is prescribed, what should be done in the manner described in RA, accompanied by environmental monitoring carried out by means of appropriate indicators.

These aspects are still unclear, especially the transition from theory to practice, because there is still a theoretical debate about definitions, key concepts, approaches, tools, methods and techniques.

Morrison-Saunders, Marshall and Arts [6] introduced, to indicate the post-decision phases, the term follow up and provide a definition, identical to the EIA and SEA, that "the monitoring and evaluation of the impacts of a project or plan for management and communication of environmental performance of the project or plan."

The monitoring, evaluation of compliance, management and reporting of impacts are also elements of the follow-up according to Marshall [7].

In a direct follow-up can be defined as "what happens after" stages of approval, however the practice is not as simple as thinking about what might happen at the project level may be easier and easier to administer, at the project context, size, timing and predictable are well defined, while in the field of strategic decisions is very difficult to see the foreshadowing that are considered decisions based on the intentions or actions planned but provided long-term, you do not have much in reference to what will happen, what will be the embodiment and implementation, if there is a change in current policy and new policies, if implemented will be a project or program, and what will be your address.

As pointed out by Morrison-Saunders, Marshall and Arts [6] a strategic initiative can go in all directions, not necessarily in a linear fashion and not with the same amplitude, we add that the representation of planning as a linear or cycling is a simplification of reality.

Partidario and Arts [5] suggest that the follow up can be seen as an ex-post evaluation of the consequences of actions and can have four different approaches: compliance, performance, uncertainty and dissemination.

Indicate that you can follow five paths to follow in the later stages of the SEA:

1. monitor the actual changes;
2. assess achievement of stated objectives;
3. evaluate the performance of strategic initiatives;
4. test the compliance of the resulting decision making with strategic initiatives and the SEA;
5. monitor and evaluate the real impacts on the environment and sustainability strategic initiative.

These five approaches allow us to "confront and manage" the complexity of the later stages of an SEA. Each approach has different characteristics and require different resources have different objectives and techniques. You can use the approaches by using them individually and mixing them in different phases depending on the context, purpose.

Regarding the steps after making the Directive explicitly provides only monitoring and not provide information on evaluation activities, management and communication with regard to the impacts component part of the follow-up but they are implicit and connected to the first.

According Kornov [8] one can distinguish an assessment of environmental effects can be defined as normative evaluation, where the impact is assessed in relation to the objectives of sustainability, and a descriptive assessment in which the effects are described.

Although the Directive seems to emphasize the descriptive assessment, where the base-data plays an important role in defining the consequences, the correct approach to the SEA, according to the author, should be to describe the effects but then relate them to sustainability objectives; at each stage of planning the two evaluations have a specific function and must be made. Regarding the type of monitoring is required only monitoring of significant effects, but if you want to link the plan with its effects is necessary that they know the terms and timing of implementation, this means that monitoring must cover Also the plan.

The Directive 2001/42/EC is now the driving force to focus on later stages of the SEA, as with the provisions of Article 10 gives you a way to follow them, explicitly providing for monitoring of significant environmental effects of implementing plans and programs and the possibility of mitigation measures in the application but it is considered appropriate to "broaden the picture," not limited to environmental monitoring, explaining that it stems from it and what is required for the SEA has efficacy and is required when evaluation whose results are to be integrated in the post decision, yet also "limit" to monitor key indicators and environmental issues deemed most critical and sensitive that's a step for follow up.

Although the signs of the Directive on monitoring are limited and have limited the indications from the European guidelines. This applies even more if we refer to the Legislative Decrees 152/2006, 4/2008 and 128/2010: it is necessary to establish guidelines and criteria for monitoring so that the same is effective and VAS with it.

In reference to the construction and operation of the monitoring system are considered important indications of Mc Callun [9]:

- Plan in advance the necessary activities: what needs to be done, by whom and how, stakeholders and coordinate activities;
- Be clear about what you are doing;
- Manage information so that they are produced and made available;
- Provide adequate resources;
- Maintain the credibility of those involved in the process.

And of Partidario and Arts [5] that focus should be:

- First on the strategic nature of the initiative and its impacts on the direction, timing, scale and consequences of the initiative, the tangibility and concreteness and measurability so on;
- Secondly, objectives, implementation and controlling changes, learning, informing and communicating;
- Third on significant issues and approaches necessary: whatever the approach, the monitoring should follow the key indicators, identify areas sensitive to changes due to strategic initiative but first of all be aware of the information available.

To implement an effective monitoring system and adhering to the contents and meanings of the European Directive is necessary to verify the existence of a number of conditions, ie you must be methodological and contextual elements, as observed by Fischer and Gazzola [10] for those in Italy, a system based on rigid procedures and clear, with prescriptive rules, with an authority whose duties and responsibilities are clear with distinct roles evaluators / planners, policy makers, inspectors and must be primarily a definition of the thresholds of compatibility. All this implies effects also on the monitoring for which should be a clear procedure and at the same time flexible in order to change the controlled parameters where this has been a need, however, the same authors consider at the same time that in Italy it is very dangerous to give flexibility to the system.

2 A First Results of the Study: Criticality and Sensitivity

Having acquired the necessary data to define the state of the coastal territory and their interconnections were defined as "criticality" and "sensitivity" of the study area.

By the term criticality has been indicated the greater or lesser propensity to erosion of the coastal area, in addition to the causes that generated it; with the term sensitivity has been indicated a level of frailty associated with environmental features of the context.

The critical erosion of sandy coastline has been classified into high, medium and low. This was defined according to three indicators: the historical evolution trend of the coast, the evolutionary trend recently and the conservation status of dune systems.

The environmental sensitivity was defined as a complex multivariable function that represents the physical state of the coast, according to the system of legal protection standards that emphasize the environmental importance .

The sensitivity represents the state of the coastal environment from a historical perspective and for this reason have been identified a number of criteria, weighted appropriately, help to define it:

- The hydrography with a buffer zone of 300 meters on both sides;
- Sites of Community Importance (SCI), Special Protection Areas (SPAs);
- Protected Areas and the scope in the Putt;
- Other areas of the extended Heritage Plan;
- Distinguishable Areas of Regional Landscape Plan:
- The historic settlement patterns;
- Use of agricultural land.

The criteria are "weighted" by analyzing hierarchical AHP, proposed by T. L. Saaty [11] The acronym stands for AHP Analytic (decomposes the problem into its constituent elements) Hierarchy (structure of the constituent elements in a hierarchical manner to the main objective and the sub-goals) Process (processes the data and evaluations in order to achieve the result final).

Using the method AHP (by the use of the software Definite) and with the aid of "ratings experts", to each element of the hierarchy has been associated with a weight through the pairwise comparisons between the different alternatives.

The criteria were included in a matrix where each row contains the comparison of criterion present in the first cell in the row with the same criteria in the first row of the matrix: the comparison is knowing that you have respect for each of the 9 values of preference according to the scale of Saaty. Towards the end of the software calculates the weights attributed to each of the criteria by constructing a hierarchy between them. After each stretch of coast has been given a value given by

Value = i-th Σj (Score x Weight i-th criterion j-th):
Where i-th score is assigned based on the boolean method:

presence: Score 1 = i-th
absence: Score 0 = i-th

The result of this operation led to classify each part of the coast according to one of three values: high environmental sensitivity, environmental sensitivity medium, low environmental sensitivity.

The different levels of criticality and the erosion of environmental sensitivity were then crossed, giving rise to a classification with nine levels can provide reference information for the preparation of Municipal Coastal Plan (CCP).

In particular, the classification was as follows:

- C1S1. high criticality sensitivity and high;
- C1S2. high criticality and medium sensitivity;
- C1S3. high criticality and low sensitivity;
- C2S1. medium criticality and high sensitivity;
- C2S2. medium criticality and medium sensitivity;
- C2S3. medium criticality and low sensitivity;
- C3S1. low criticality and high sensitivity;
- C3S2. low criticality and medium sensitivity;
- C3S3. low criticality and low sensitivity.

Ultimately, the study has brought a significant contribution to the drafting of appropriate regulatory tools to ensure proper land management and the creation of a knowledge framework that must be continually updated.

For the purposes of the law classes have the critical task of conditioning the issuance of state concessions, while the classes of environmental sensitivity to influence the types of state concessions and how to contain its impacts.

3 Monitoring Values Change for Coastal Monitoring

3.1 General Data

The purpose of this second part of the study was to organize a monitoring system that can facilitate the control of the transformations on the coastal territory of Apulia Region: in particular, monitor and evaluate the real impact of the strategic initiative's plan on the environment and sustainability.

The methodology has been structured in relation to the objectives of the monitoring itself, so we opted for the structuring of an algorithm based on the feedback transmitter capable of communicating to the various phases and operate a continuous cycle.

It was considered to be appropriate for an assessment of "risk and vulnerability" for the most environmental, such as one arising from the plan, to ensure environmental aspects but also social and economic. The intersection between the classification of areas interested by the plan and the evaluation of the peculiarities and tendencies of development of the area at the base of the monitoring system so structured, allows a better understanding that facilitates the strategic assessment of the impacts of the initiative.

Briefly, the algorithm, starting from the evaluation of aspects such as to characterize the coastal areas (as classified by the plan based on criticality and sensitivity) from a point of view, socio-economic as well as natural, constitutes a “system of alerting”, relatively to transformations land in contrast with its peculiarities.

3.2 The Evaluative Approach of Classification of Pressure Areas

To test the system structured as it is taken into account two coastal areas with different characteristics, namely the coastal territory of Monopoli, a medium sized city (about 50.000 inhabitants). The inland areas are bordered by a buffer variable that takes into account the physical characteristics of the terrain as defined by the Regional Coastal Plan.

The considered areas have a substantial variation in the morphology of the coastline, since Monopoli comes with a rocky coast north and south becomes quite sandy, are observed in the middle stretches of rocky coastline with sandy beaches to foot.

The coastal territory has been divided into three homogeneous areas: a first north of the (Monopoli 1) characterized by rocky shoreline and the presence of significant industrial areas, corresponding to a second 'urban area with the presence of the port (Monopoli 2); third that extends south from the end of the municipality (Monopoli 3),

characterized by tourist sites of various kinds (holiday homes, villages, residences, beaches and entertainment venues) immersed in an agricultural and natural scenery of some significance given the presence of olive trees.

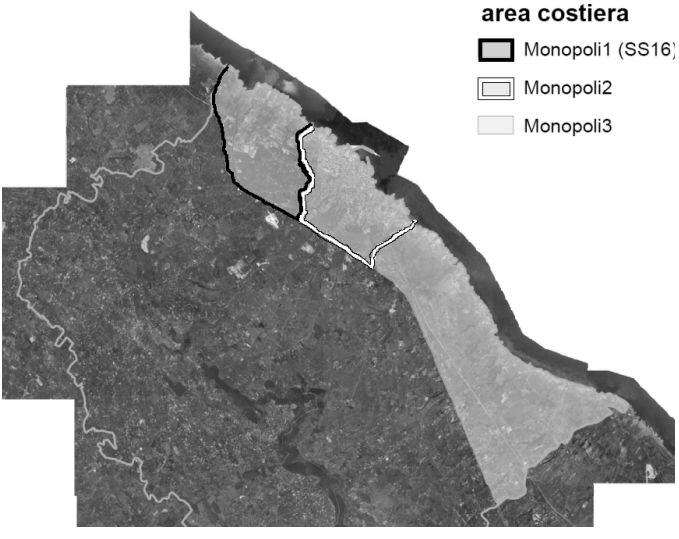

Fig. 1. The coastal areas of the case study (Monopoli 1, 2 and 3)

First step in the analysis of areas under consideration was the choice of data for the evaluation of naturalness of the characters, urban relevance, materiality port, agricultural relevance, importance of tourism, industrial relevance of the area.

To verify the effectiveness of the system are then assumed some plausible changes in the area, associated with the presence of e-planning dictated by the Municipality Plan. It is then evaluated the system's ability to read and grasp their greater or lesser compatibility with the regulatory classification of the plan.

Starting from classification based on the criticality and sensitivity, the following aspects are considered essential to characterize a coastal area:

naturalness (N),
relevance urban (U),
important agricultural (A),
industrial importance (I),
important tourist (T)
relevance port (P).

The choice of aspects to be monitored was made so that they are representing and explaining the action plan, simple and easy to interpret, based on readily available data and available, updated and upgraded at regular intervals, capable of showing the trend over time, sensitive and able to advise in relation to trends irreversible,

measurable and have a space or geo-referenced "footprint". Based on the above shapefile from the land use have been created other documents describing aspects N, U, A, T, P and I, the uses for grouping categories as follows.

N: urban green areas, deciduous forests, coniferous forests, mixed coniferous and deciduous forests, meadows and pastures lined with trees, natural pasture, grassland, uncultivated, bushes and shrubs, areas in sclerophyll vegetation, tree-shrub areas evolving; areas to natural recolonization, recolonization areas at artificial surfaces to dense grass cover, beaches and sand dunes, bare rocks, cliffs, outcrops, areas with sparse vegetation, inland wetlands, salt marshes, salt marshes, intertidal marine areas, rivers, streams and ditches, canals and waterways, docks without overt productive uses, lagoons, coastal lakes and ponds, estuaries.

U: Continuous residential fabric, old and dense residential fabric continuous, dense, more recently, low; residential fabric continuous, dense, more recently, high, installation of large systems of public and private hospital settlements, settlements of technological systems; yards, spaces under construction and excavations, sports areas, cemeteries.

A: productive agricultural settlements; simple arable unirrigated areas; vegetable crops in open fields, greenhouses and under plastic in unirrigated areas; simple crops in irrigated areas, vegetable crops in open fields, greenhouses and under plastic in irrigated areas; vineyards, orchards and berry plantations, olive groves, other permanent crops, temporary crops associated with permanent crops, cropping systems and particle complexes, areas predominantly occupied by agricultural fields with significant areas of natural areas, forestry, soils and reworked artifacts.

T (receptive): campsites, tourist accommodation in bungalows or similar commercial establishment.

T (residential): residential fabric discontinuous residential fabric and rarely nucleiforme; scattered residential fabric.

P: port areas.

I: industrial or craft space with outbuildings, abandoned settlements, big plants concentration and sorting goods, networks and areas for distribution, production and transport of energy, mining areas, landfills, junkyards in the open, cemeteries of motor vehicles.

Note that Shapefile T (residential) was created by grouping all forms of residential fabric discontinuous that in most cases in coastal areas represent second homes, in T (receptive) were included in all commercial installations, which as classified in the paper of land uses include large hotels with attached bathing in these coastal areas are clearly prevalent forms of settlement on the other.

In the specific aspects have been ordered with respect to the relevance of the extension (covering of soil) and, as a function of potential changes, because of the danger of the transformation with respect to the criticality with respect to erosion and environmental sensitivity.

$$X = (\Sigma_i \alpha_i \gamma_i) \times \omega_C + (\Sigma_i \beta_i \gamma_i) \times \omega_S$$
$$\omega_C = 1\ (C1) / 0.66\ (C2) / 0.33\ (C3);\ \omega_S = 1\ (S1) / 0.66\ (S2) / 0.33\ (S3) \quad (1)$$

To facilitate the operation of pairwise comparison between the issues are first three classifications were made to facilitate the judgments of semantic Saaty: one concerning the importance of the extension. relative hazards of the transformation with respect to the critical coastal erosion, another relative hazards of the transformation with respect to environmental sensitivity. After the identification of Saaty's weights, the value have been transposed from the typical normalized eigenvalues of Saaty Matrix, to a standardized score (Table 1):

Table 1. Coefficient of extension γ

Land use	N	U	A	T (tour.)	T (res.)	P	I
Extension γ	0.16	0.08	0.03	0.38	0.12	1.00	0.27

The tables with the pressure values calculated as described for each weighted area with the values of ω_C and ω_S, are the following:

Table 2. Coefficient of criticality and sensitivity

Land use	N	U	A	T	P	I
criticality α	0.06	0.62	0.15	0.26	1.00	0.77
sensitivity β	0.06	0.73	0.15	0.28	0.59	1

Table 3. Adjusted pressure areas according to weighted coefficient of criticality and sensitivity for monitoring the change due to City plan implementation

Area		N (α_N ,β_N)	U (α_U ,β_U)	A (α_A ,β_A)	I (α_I ,β_I)	T (α_T ,β_T)	P (α_P ,β_P)
Weights		γ_N	γ_U	γ_A	γ_I	γ_T	γ_P
Monopoli1(c_x,s_y)	(3.0, 2.6)	1.4800	0,3488	2.1258	0.5968	0.0000	3.5613
Monopoli2(c_x,s_y)	(3.0, 2.6)	1.8705	2.5808	1.5036	0.5538	1.7000	0.6102
Monopoli3(c_x,s_y)	(2.8, 2.2)	2.1152	0.1232	2.3502	1.4894	0.0000	0.0084

In the same way it has been possible to realize the matrices of the Saaty pairwise comparisons and determine the coefficients α_N, α_U, α_A, a_I, α_T, α_P, and the coefficients β_N, β_U, β_A, β_I, β_T, β_P, respectively for criticality and sensitivity (Table 3).

3.3 The Profiling of Coastal Municipalities

Based on this first trial, as part of a research project funded by the Region Apulia (identified by the acronym MOCA: Monitoring Of Coastal Areas), we proceeded to

the realization of a software able to integrate the routine evaluation concerned with GIS technologies in collaboration with Polytechnic of Bari and the company Geodata SRL. The software is designed to manage a georeferenced database, which will facilitate the reading of the ongoing changes and potential, arising from plans, programs or interventions compared unplanned criticality and sensitivity to issues highlighted in the Coastal Plan.

The software can work on a database larger: in fact, the data relating to land use (aggregate indicators) are combined and joined together with other various useful to investigate situations of risk and danger as a local or ISTAT data relative to environmental components significant (disaggregated indicators).

The scales of analysis allowed by the software are different, the validation of the software was done working on a municipal scale, using the assessment of land use areas defined by administrative features.

A choice of this kind, however, involves the risk of evaluating the same manner similar transformations in the common characterized by a different "coastal character".

To remedy the problems highlighted above steps were taken in the testing phase to the implementation of data capable of characterizing simplicity with the characteristics of "coast-related" of each joint of the territory.

The means for this characterization is represented by a series of indicators, which are available and will be available for all common with part of the perimeter "wet". These are:

- Length of the coastline town;
- (Length of coast line city / municipal boundary) x 2;
- Sections of uniform classification legislation RCP / length of coast line city.

These indicators, suitably used in the routine evaluation help to relate the identified changes to the environment and coastal issues, "profiling" the territories of analysis.

If the first two indicators relate to the conformation of the analysis refers to the third floor as classified by the coast and serves to bind to each municipality impacts more or less probable because of the extent permitted by the standard resulting from the classification.

Very simply have been associated with each level of classification rules on the environmental sensitivity of potential impacts as follows. Levels of criticality has been connected the probability of occurrence of impacts identified.

The logical scheme implemented in the system is divided into the following phases:

- Identifying the scope of study;
- Definition of the coastal profile;
- Identification of potential impacts within the analysis (through classification of RCP);

- Combinations of land uses present on the CTR for N, U, A, T, P, I categories;
- Assessment of critical uses well defined with respect to coastal erosion and environmental sensitivity;
- Local and global analysis of variance;
- Local analysis of disaggregated indicators.

The software product, from both theoretical and practical gathered information, allows a uniform assessment of the environmental pressure caused by different land uses, with particular reference to critical coastal erosion and environmental sensitivity. The assessment may be conducted within the selected study, this according to some simple indicators is "profiled".

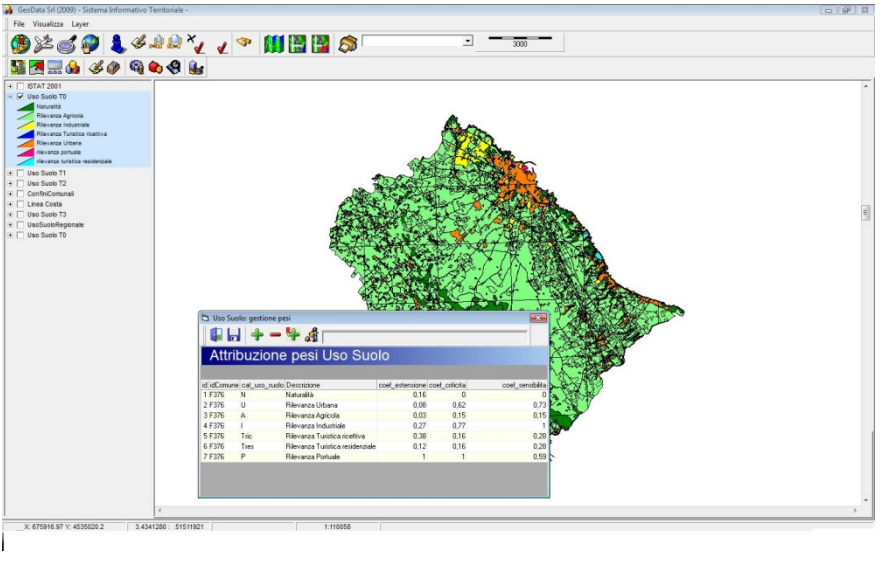

Fig. 2. The weighting of land use for the whole municipality area

The analyzes are thus relate field of study so as to be comparable between different areas. The assessment of the land use is a first information layer, follow this localized analysis of disaggregated indicators collected in databases that can be implemented continuously.

A significant aspect is related to adaptability to local contexts and coastal profiles of different sizes for analysis in different contexts and physical characteristics of size.

The possibility of identifying a field of study and the association of simple indicators for its characterization allows to opt for areas defined by administrative boundaries (as in the case of experimentation) but also through character definitions physico-morphological, sometimes more suited to 'analysis.

The following figure shows the computation of the coastal “shape coefficient” in the software.

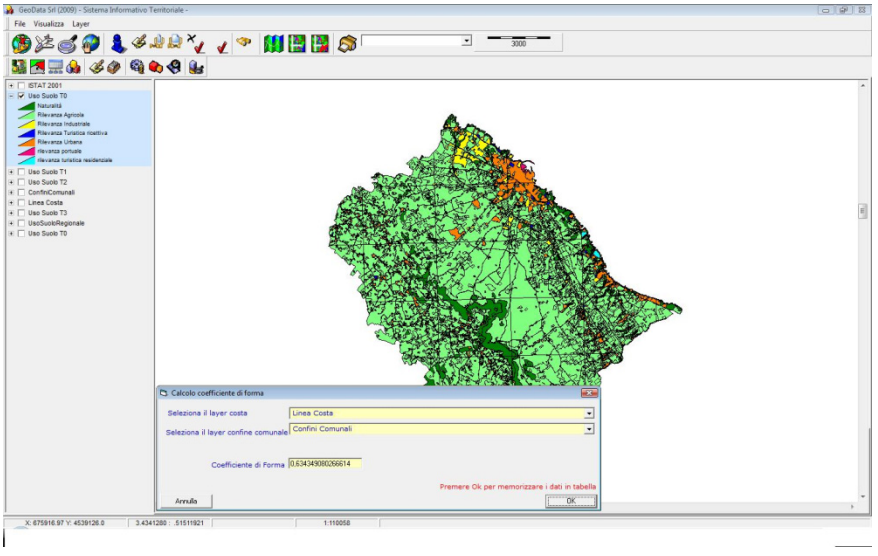

Fig. 3. The computation of the degree of coast influence on the municipality area, by the shape coefficient

The introduction of the "shape coefficient" allows, beyond the definition of the type of choice, of "weigh" the coastal character on the whole municipality area. The indicators chosen for profiling are valid for coastal areas of geometry and variable extension, this allows the possibility to perform the analyzes at any scale, relative to the needs identified.

The association to each area of a database allows disaggregated indicators in the areas of greatest interest, since they are subject to change or because exerting environmental pressure increased, more detailed analyzes. The indicators covered by this analysis may vary depending on the needs, because the databases are continuously updated and implemented. The cognitive maps produced by the software provides an excellent overview of the situations are monitored and very useful to guide the analysis of the disaggregated indicators.

4 Perspective and Remarks

The same theoretical and methodological steps taken to build the product are still replicable to other assessments, keeping fixed the basic knowledge on the classification of land uses.

However, it is not possible without an actual experimentation in other fields, to assess whether the routine structured as follows, although replicable, are the most appropriate for subjects of different nature. Either way, the product offers the possibility, through a simple user interface and at the same time flexible, to restructure the coefficients of impact in relation to different issues and to implement cognitive-different regulatory frameworks.

It seems clear, however, that only a professional, experienced in assessment methodologies, can consistently achieve a multi-criteria evaluation routines that can be imported into the system.

The evaluation system, fully implemented in software design, is sensitive to change in territory and allows an assessment with regard to global and local land use more or less compatible with coastal issues. It also allows you to render the results of analyzes using maps and cognitive evaluation.

Important results have shown the ability to monitor in addition to land use and classification of Coastal Plan (representing a fixed database and obviously updatable) any activity through indicators chosen appropriately according to local situations (in the trial were included but national statistic database nothing prevents you to widen or narrow the field of analysis as needed), the possibility of covering the entire region by comparing the analysis to settings with different coastal characteristics; the chance to work on different spatial scales, and finally by possibility to adapt the software to other developments in evaluations of different genres.

The analysis software can provide a useful framework to guide the synthesis and further analysis of the transformations, however, must be performed by competent figures.

Adaptability, flexibility, uniformity of analysis are the characteristics sought in the realization of the product, as tested meets these requirements.

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