International Conference on Whole Life Urban Sustainability and its Assessment
M. Horner, C. Hardcastle, A. Price, J. Bebbington (Eds)
Glasgow, 2007

OIKOS: AN INTEGRATED APPROACH TOWARDS SUSTAINABLE SPATIAL PLANNING AND MANAGEMENT

M. Olazabal *, A. Urzelai, G. García, K. Herranz, B. Abajo, E. Feliú, O. Santa Coloma, I. Aspuru

Urban and Industrial Environment Unit. LABEIN Tecnalia,
Parque Tecnológico de Bizkaia, Edificio 700, 48160 Derio, Bizkaia. http://www.labein.es

ABSTRACT

This paper presents OIKOS, an Integrated System to support spatial planners and developers in the decision making process towards sustainability with significant emphasis on public participation as a key element to reach a full and comprehensive integration of sustainability criteria in the formulation of plans and programmes at the very early stages of spatial planning. On the other hand OIKOS could be used as a decision-making tool (IDSS-Integrated Decision Support System) by the authorities in the Plans and Programmes Approval Stages, as a tool to validate and complement SEA (Strategic Environmental Assessment) results.

OIKOS is conceived as a coherent set of tools, approaches and methods to be used by territorial managers to support the implementation of sustainable territory management strategies on local and regional scales in the Basque Country based on the state of the art of knowledge and experience concerning physical, ecological, social and economic parameters and the overall decision making process involved.

OIKOS aims to answer the following questions: a) How to pursue the aim of designing a Sustainable Planning Integrated System, b) how to achieve the integration of sustainability criteria from early stages of planning c) how to measure sustainability integrating the environmental, social and economical aspects and, d) how to make stakeholders to be interested in and to actively participate in the process.

System configuration follows a tool box (multi-instrument) approach utilising ‘state of the art’ planning and GIS based methods, which will be complemented with several modules (Data Management, Concept Model Development, Indicator Set Definition, and Multi-Criteria Analysis) and integrated together with Stakeholders Participation Tools all along the OIKOS implementation process. The system will ultimately be validated through scenario based case study dealing with the spatial planning of the urban-periurban area of Vitoria-Gasteiz (Basque Country)

Key words: IDSS, GIS, MCA, Urban-periurban areas, Participation tools.

1 INTRODUCTION

> *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland Report, 1987).*

In spite of the lack of clarity on what the term “sustainable development” means in operational terms (Terry A.,2006; Rennings, K. and H. Wiggering, 1997) (what are the aspects to be sustainable? / in which degree?), sustainable assessment is scientifically accepted as an evaluation process which must take into account the social, economic, cultural, and environmental interactions which take place in a territory as well as the governance processes and the stakeholders and managers interests and opportunities.

Sustainable territory development is a process continually changing that necessary lies within the ecological carrying capacity of the territory itself (Auty R.M. and Brown K., 1997; Constanza, 1991)

At the same time, this development trajectory must be socially acceptable, politically viable, economically feasible and technically possible (Shipworth, 2002). All these factors are essential and must be considered during the assessment process.

Many times it becomes easier to understand the concept by defining the reverse situation: the symptoms of unsustainable spatial development patterns (EEA, 1999). From this point of view, the European Commission has a number of policies relevant to the urban environment such as Air Pollution (CAFE programme), Clean Urban Transport, Energy Efficiency in Buildings, Green public procurement, Noise, Sustainable Construction, Urban Regeneration and Waste.

From the adoption of the Thematic Strategy on the Urban Environment on 11 January 2006, across Europe there is an increasing common challenge to identify instruments and tools to improve the quality of life in urban areas assuring a sustainable urban planning. This involves different topics such as air quality, noise, odour, waste, safety, employment, security, social cohesion, urban rehabilitation… etcetera.

This challenge implies the integration of sustainability in urban planning processes. Common problems for this task are the unclear role that sustainability assessment has for politicians and other actors, the poor communication between stakeholders, the lack of references towards the figure of a sustainable community, and the most important, the lack of research in terms of opportunities that urban sustainability could offer according to the stakeholders. (Doppelt B., 2003)

Besides that, the technical side has not been widely and sufficiently approached by the international community and there is a lack of experiences and integrated approaches to support the results and the relevance of sustainable urban planning assessment (De Marchi et al, 2000, Eggenberger and Partidário, 2000), even though there is a wide range of tools that are being used under this framework (Therivel and Wood, 2005).

The capacity of integrating the aspects that sustainability has to take into account (economic, environmental, social, public participation, governance processes...) with the own particular aspects of spatial management, will enhance the possibilities of developing and implementing efficient action plans from an integral point of view.

Therefore, an integrated system of decision support on sustainable spatial planning and management should follow a triple aim:

- To structure the initial information allowing the identification of potential key elements on the study area.
- To instrument the information, dissemination and participation processes
- And, to facilitate the development of action plans (by means of orientating the strategy and the action lines) in order to improve the quality of the territory under analysis.

This paper presents results and conclusions from the development and validation of an integrated approach focused on sustainable spatial management which aims to be used by territorial managers on the implementation of strategies and plans on regional and local scales but also to set goals and management action lines.

The approach, named as OIKOS, was designed in answer to the following questions:

a. How to pursue the aim of designing a Sustainable Planning Integrated System which is actually considered a challenge for public administrations.
b. How to achieve the integration of sustainability criteria (environmental, social and economical) from the initial phases of the formulation of plans and programmes.
c. How to measure sustainability and integrate the environmental and social aspects taking into account that usually economical aspects are already involved in the planning design and processes
d. How to make stakeholders to be interested in and to actively participate in the sustainable management decision making process.

With the intention of answering to these needs, the OIKOS IDSS (Integrated Decision Support System) has been conceived as a toolbox which is developed from an integrated perspective that considers both, integrated analysis tools for environmental, economic and social factors, and the tools used to facilitate the consultation and participation processes at different level of implication.

The design and implementation of integrated analysis models of sustainability require the application of a wide range of techniques and methodologies (participatory techniques, multicriteria techniques, cost-benefit analysis, data management, quantitative and qualitative models building applications, etcetera.). From this perspective, it is stated the need of an integrated and multidisciplinary perspective from the scientific-technical point of view.

The use of the Information Technologies helps the progress in the comprehension of environmental processes and new planning concepts, which include real public participation. Thus, the above mentioned mechanisms and Participatory tools have been developed for 1) end-users involvement in the design and development of the set of methodologies and tools which will form the system and 2) also for real public participation at different levels of the decision making process per se towards a "collaborative decision making".

Modules and tools are articulated with different levels of integration and are supported by a GIS technology that allows data management, processing and analysis as well as visualization and map generation.

A prototype of the system has been implemented and validated in a case study (see Chapter 3: Application of the OIKOS IDSS and conclusions)

2 OIKOS MODULES AND METHODOLOGY

2.1 System Architecture

The System is structured in the following modules:

- ***Mathematical Model Module***. The Conceptual Model Development Module allows the comprehension of the processes that operate in the territory, the definition of the problem, the identification of the key system elements and to structure the available information.
- ***System of Indicators Module.*** The Module will determine the design of alternatives throughout the selection of the best and the most suitable indicators classified under sustainable criteria.
- ***Multicriteria Decision Analysis (MCDA) Module***. For integral assessment and evaluation of the environmental, economic and social factors that may influence spatial planning decisions taking into account the valorisation criteria and preferences expressed by the different stakeholders and interest groups. MCDA constitutes the central option for the integration and weighting of different aspects of sustainability.
- ***Data Base Management System DBMS*** to store and manage thematic and spatial data; On the other hand it allows the generation of resulted information obtained throughout the information processing.

- ***GIS Framework.*** It allows data interoperability; spatial analysis; geo-statistical analysis; reports and graphics generation; visualization and display of information in form of maps.

Mechanisms and participation tools have been developed to be used along the process, both during the final users' intervention and along the public participation processes in the decision making stage.

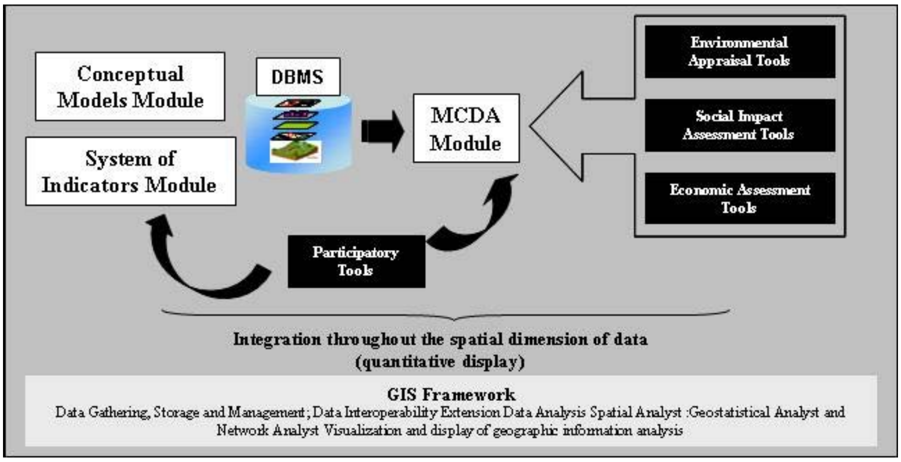

Figure 1 OIKOS IDS System Architecture (García et al., 2006)

2.2 System functions

Taking into account the spatial planning and management framework for implementation of this Decision Support System, the functions covered are:

- Use of Sustainability Indicators Set, data base structured.
- Conceptual Model design, throughout a tool for the specific relationship design
- Scenarios Development, which allows the definition of alternative spatial models (in progress).
- Sustainability Assessment throughout a Multicriteria Analysis Tool to facilitate the participatory decision making processes.
- Data Base Management System, for the storage, manipulation and categorisation of data.
- Cost Benefit Analysis Tool, to valuation of the social and environmental aspects in economic terms (in progress).
- Geographic Information System for the manipulation of geo-referenced information.
- Follow-up Function, which allows the evolution control of the sustainability on the territory which has been assessed.

2.3 Methodology: steps of the process

Three main phases have been identified in the system implementation process:

INITIAL or DEFINITION PHASE: a prospective study is carried out in order to identify the main challenges, criteria and indicators for the sustainable management of the territory under analysis, and the first contacts with the stakeholders to define the problem and object of study. Information about the area of study is also collected.

DESIGN PHASE: Constitutes the scientific-technological development phase of the system. Most of the modules are implemented in this phase, as it shows figure 2. Each module operates independently from the rest, allowing a flexible data flow. This characteristic makes possible to select those modules more appropriate for the study case. It means that for a particular decision making process it is possible to implement some modules without implementing the complete process.

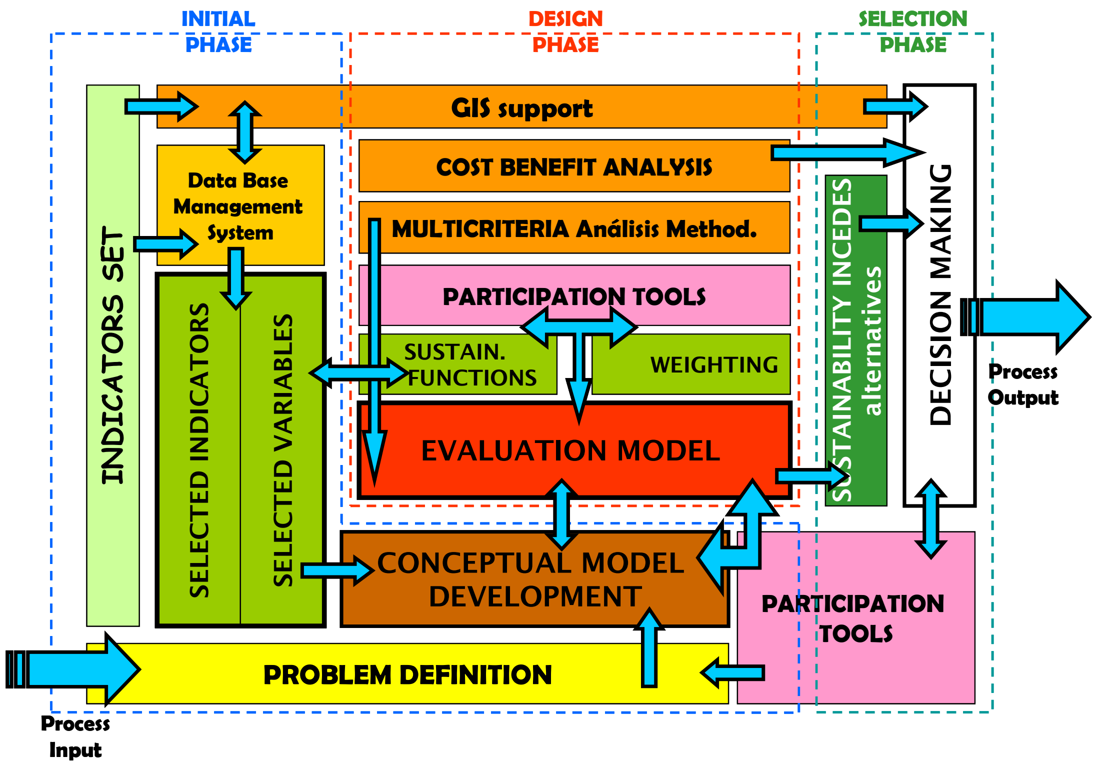

Figure 2 OIKOS Methodology Flux Diagram

SELECTION PHASE**:** It is the final step of the decision making process, once the evaluation process is finished. The sustainability index is calculated for each one of the alternatives considered during the process, and other results are generated (parallel studies) with interaction and participation of the stakeholders implied.

Therefore, the following steps would be undertaken:

1. Problem Definition and alternatives (Stakeholders-Experts Sessions)
2. Conceptual Model

   - **a.** Model Development Workshops (Participatory Tools interaction) with the stakeholders and experts. Possibility of adaptation from other developed models which have been carried out for a similar area typology (i.e. urban-periurban area with strong rural character)
   - **b.** Model consensus.
3. Evaluation Model Development (Multicriteria Analysis Tool)
   - **a.** Selection of Indicators
   - **b.** Development of Structured Evaluation Models
4. Definition of the tools and elements for the MCA
   - **a.** Sustainable Functions Calculation: Variable Selection
   - **b.** Weighting System Definition: workshops with participation of stakeholders in order to establishment the indicators weights (CBA results Integration)
5. Sustainability Indices Calculation from the results of the sustainability functions and the weighting process. It is introduced in the evaluation models that have been developed for the case study.
6. DECISION MAKING INPUT:
   - **a.** GIS support: data processing and visualization
   - **b.** Data Base General System for the actualization and management of the old and new data.
   - **c.** Results related to the most suitable alternative according to the Sustainability Indices calculated in the MCA.
   - **d.** Physical areas and qualitative aspects where the sustainability results are lower. Alert System.
   - **e.** Proposal of parallel actions to increase the sustainability of the alternatives taken. (i.e. social services planning in relation to the new population demand)
   - **f.** Proposal of correcting measures in relation to the alternative taken.

3 APPLICATION OF THE OIKOS IDSS AND CONCLUSIONS

3.1 The case-study

The case study, the “Plan Parcial de Ordenación del Sector 19: Aretxabaleta-Gardelegi” (Partial Planning of Aretxabaleta-Gardelegi), is located in the urban extension of Vitoria-Gasteiz, in Araba which is one of the three regions in the Basque Country, and the one with the highest rural component.

Figure 3 Vitoria-Gasteiz Municipality. See at the bottom (South): Arechavaleta (Aretxabaleta)

The southwest rural area of Vitoria is the denomination for the area where this planning is going to be carried out, and it covers a high number of “concejos” (villages) belonging to the municipality of Vitoria. The population of this southwest area reaches the 1300 citizens (2004) distributed in 15 “concejos”.

Vitoria-Gasteiz is surrounded by a Green Ring, made up of four parks that represent the lungs of the city. Our case study is surrounded by two of them: Armentia and Olarizu.

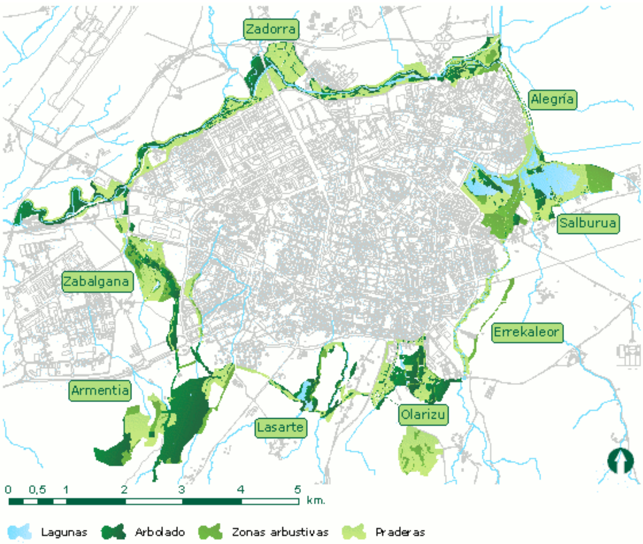

Figure 4 Green Ring of Vitoria Gasteiz. Source: www.anilloverde.vitoria-gasteiz.org

The total surface of the area (Aretxabaleta-Gardelegi) is 813.853,83 m², where 340 citizens live. The aims of the planning are:

- Reurbanization of the present thoroughfare from Aretxabaleta to Gardelegi.
- Proper integration of the existing blocks in Aretxabaleta
- Linking of the main common public areas with the reurbanization of the present thoroughfare.
- Getting a permeable urban fabric both in relation to the pedestrian zones and to the road traffic.

2210 new dwellings are planned (1606 in blocks and 604 houses).

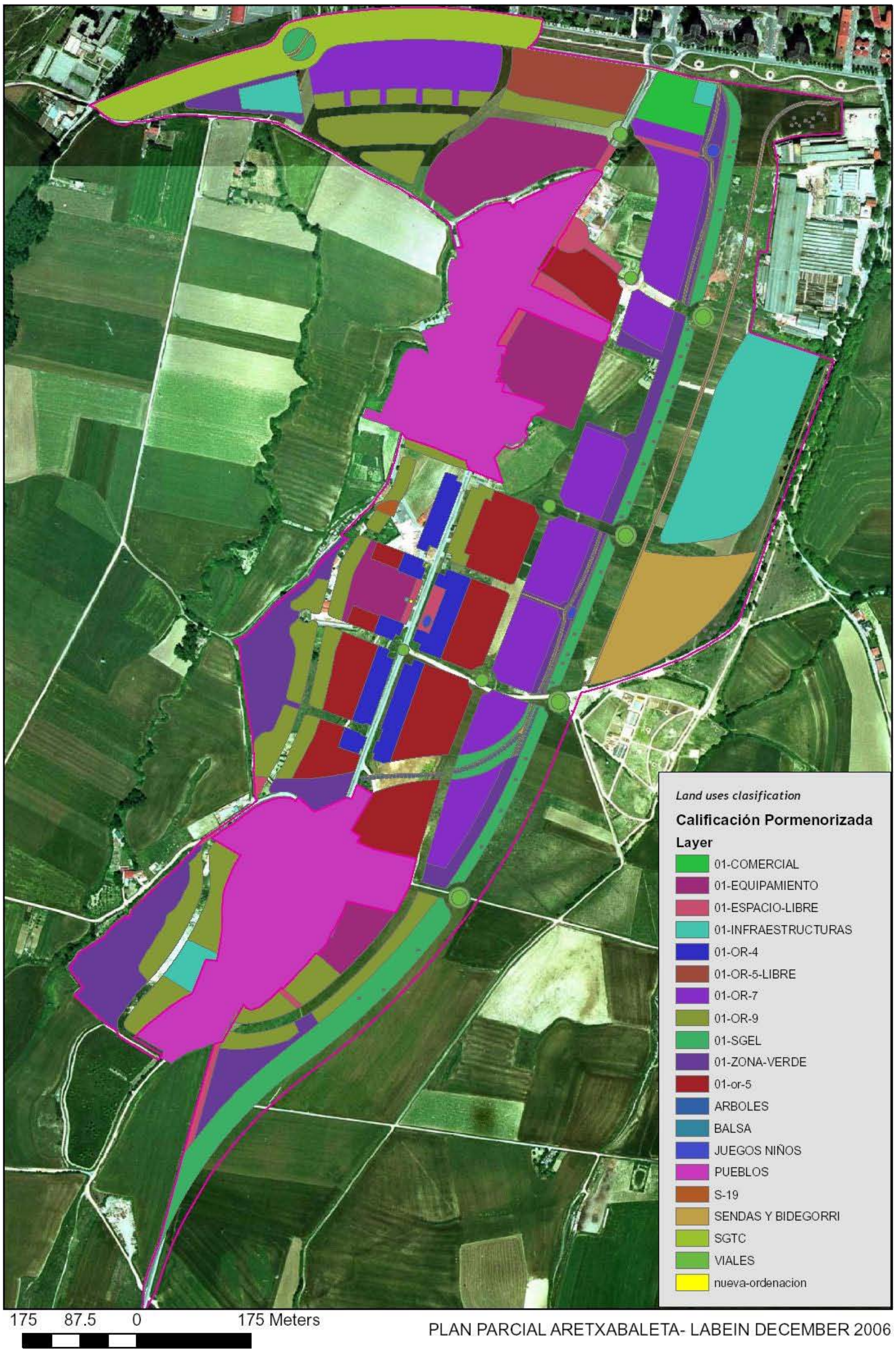

Figure 5 Partial Planning of Aretxabaleta Gardelegi.

The election of the Partial Plan of Aretxabaleta-Gardelegi as the validation study case has been resulted from the following key points:

1. Its suitability for the validation of the proposed methodology. It is a study case where an urban planning development is being considered.
2. Location: The characteristics of the area (high rural component, natural areas surrounded, urban-periurban area …) are considered as an added value for the results of the validation.
3. Information Availability: Vitoria-Gasteiz has available an Environmental Information System and the Environmental Studies Centre which allow the information capture.

3.2 Development and validation

For the development and validation of the OIKOS IDSS several activities were carried out: initial information recompilation and processing, area surveillance, working sessions in order to develop the conceptual model which describes the interactions in the area, working sessions on the development of evaluation models and sustainability functions, weighting establishment workshops… among others.

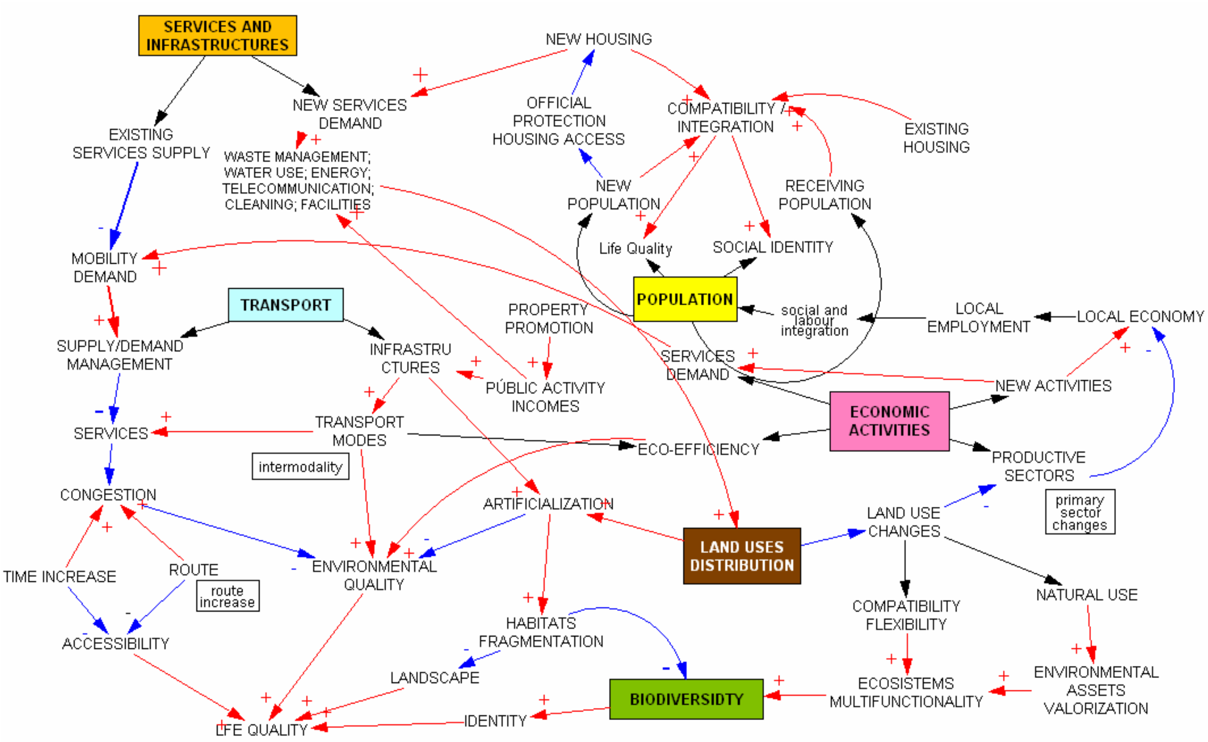

Figure 6 Conceptual Model defined through participatory sessions to identify demands and needs: ROLE PLAYING technique

These tasks resulted in the identification of three elements subject of analysis from which evaluation models where developed: Ecological-environmental resource Submodel (E1), Population and quality of life Submodel (E2) and Development and structure of the territory Submodel (E3). These three aspects where structured into two levels of criteria and indicators for which suitable variables were selected.

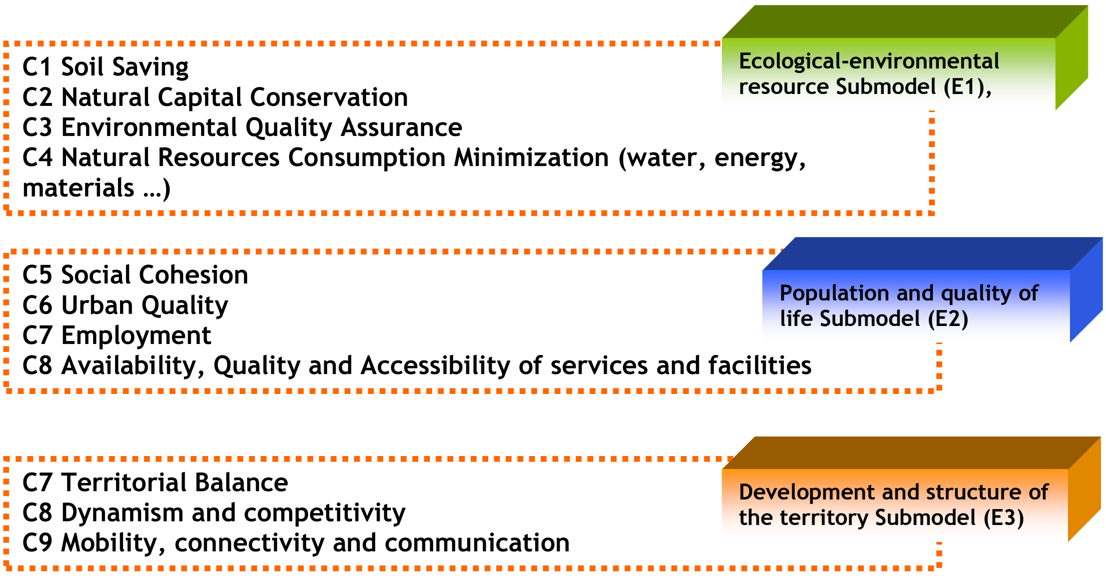

Figure 7 Criteria selected for each of the submodels identified

From the application of the MCA methodology (through participatory sessions to obtain the sustainability functions and weights, see examples Figure 8 and Figure 9) sustainability indices were calculate.

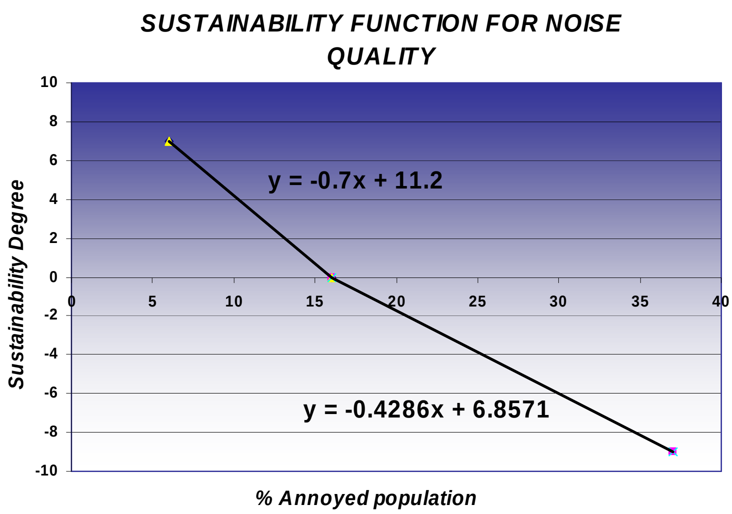

Figure 8 Sustainability Function for Noise Quality

Each Sustainability Function must be developed based on at least, 3 values (thresholds and an average value) according to existing legislation, relevant data, well-known projects or expert opinion. The variable selected for each indicator must be reliable and relevant.

E1. C3. ENVIRONMENTAL QUALITY ASSURANCE	I7. SOIL QUALITY	I8. AIR QUALITY	I9. NOISE QUALITY	I10. WATER QUALITY
I7. SOIL QUALITY	1	1/3	1	1
I8. AIR QUALITY	3	1	3	1
I9. NOISE QUALITY	1	1/3	1	1/3
I10. WATER QUALITY	1	1	3	1

Figure 9 Example of weighting results among the indicators selected for C3. Environmental Quality Assurance (E1 - Ecological-Environmental Resource Submodel)

4 MAIN CONCLUSIONS ON THE IMPLEMENTATION OF AN IDSS FOR SUSTAINABLE SPATIAL PLANNING AND MANAGEMENT

Main conclusions of the implementation of an IDSS for sustainability spatial planning and management could be summarised as follows:

In relation to the diverse typologies of territories, the differences between cultures, environmental, economical, and social aspects, as well as the participatory processes and governance ways of implementation, we can conclude that different spatial frameworks lead to different conceptual models which must offer a view of the key interactions which operate in that territory. Certainly, the development and use of base description (conceptual) models is essential for the characterization of the different typologies of territories and moreover for generation of a knowledge baseline on the relationships between the elements that converge in the territory.

The establishment of sustainability range and grades for the elements, subject of analysis (identified in the conceptual models), implies a high level of "subjectivity" as seen from the stakeholders´ view point. This task (the development of the sustainability functions) must be developed by a group of experts (on account of the definition of sustainability thresholds) and subsequently checked and modified (if needed) throughout a consensus process with the stakeholders.

The indicator and criteria weighting process is carried out through workshops with the participation of the actors and stakeholders involved in the territory. These workshops should be planned in detail in order to get a dynamic and fluent atmosphere. Overall, it is obvious the complexity of achieving weighting factors for the indicators and criteria which the whole group of stakeholders agrees with, but this a high value qualitative process which constitutes a decisive factor in order to get relevant results for the planning process and territory management.

As mentioned before, the intensive involvement of participatory processes in a DSS implies the need of developing stakeholders' mapping exercises. The identification and selection of those stakeholders whose relevancy means a decisive factor, implies another added value in the tool application results.

Eventually, the higher and deeper the participation of stakeholders in the implementation of the IDSS, more possibilities of success will have the system during the sustainability planning and spatial management decision making process, as it will be seen as a reliable result.

To conclude, a high-quality and participatory implementation of an IDSS for Sustainable Spatial Planning and Management will help to achieve the challenge of integrating sustainability in urban planning processes, if the roll of the toolbox is seen by the stakeholders as a methodology and support to clarify the economic, social and environmental opportunities within the study area where they are involved. This common "building process" will allow the understanding of what sustainability is for each territory and will help in the identification of action lines in the planning process.

5 REFERENCES

Auty R.M. and Brown K., 1997. Approaches to Sustainable Development. Ed. Routledge.

COM(2004) 60 final. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. Towards a thematic strategy on the urban environment. Brussels, 11.02.2004

COM(2005) 718 final. Communication from the Commission to the Council and the European Parliament on Thematic Strategy on the Urban Environment. Brussels, 11.1.2006.

Constanza R., 1991. Ecological Economics: The Science and Management of Sustainability. New York: Columbia University Press.

De Marchi, B., Funtowicz, S., Lo Cascio, S., Munda, G., 2000. Combining participative and institutional approaches with multcriteria evaluation. An empirical study for water issues in Troina, Sicily, Ecological Economics , 34, p: 267-82.

Doppelt B., 2003. Leading Change Toward Sustainability: A Change-management Guide for Business, Government and Civil Society. Greenleaf Publishing.

EEA - European Environmental Agency, 1999. Environmental indicator: typology and overview. Report nr 25.

Eggenberger, M. and Partidário, M.R., 2000. Development of a framework to assist the integration of environmental, social and economic issues in spatial planning. Impact Assessment and Project Appraisal, 18: 201-207.

García, G., Urzelai, A. and Santa Coloma, O., 2006. Development of an Integrated Decision Support System for Sustainable Spatial Planning and Management. International Conference on Informatics for Environmental Protection. Graz (Austria).

Gomez, M, Barredo, J.I., 2005. Sistemas De Información Geográfica y Evaluación Multicriterio en la Ordenación del Territorio. Ed. Ra-Ma.

Rennings, K. and H. Wiggering, 1997. "Steps Towards Indicators of Sustainable Development: Linking Economic and Ecological Concepts, Ecological Economics, Vol. 20, No 1, January, pp. 25-36.

Santa Coloma O., Urzelai A., Aspuru I., García G., 2006. The integration of the sustainability in the urban and territorial planning. A look through the European and Basque approach. The 12th annual international sustainable development. Hong Kong.

Shipworth D., 2002. Environmental Impact Mitigation is not sustainable development. Book review in Building Research and Integration, 30: 139-142.

Terry A., Hill J., Woodland W. A., 2006. Sustainable Development: National Aspirations and Local Implementation. Ashgate Publishing, Ltd

Therivel R. and Wood G., 2005. Tools for SEA. Implementing Strategic Environmental Assessment. 24: 349-363. Ed. Schmidt, M, João, E., Albrecht, E. Springer.

Urzelai A., Olazábal M., García G., Santa Coloma O., Herranz K., Abajo B., Acero J.A., Feliu E., Aspuru I., 2006. Modelización de las interacciones socio-culturales, ambientales y económicas de un sistema territorial "urbano-rural" para la evaluación de la sostenibilidad de una zona representativa del País Vasco. I International Conference on Sustainibility Measurement and Modelling. 16-17 November, Terrassa, Barcelona.

Urzelai A., Santa Coloma O., Aspuru I., García G., 2006. Criterios para la gestión sostenible de las infraestructuras. Eusko News.

World Commission on Environment and Development, 1987. Our Common Future. Oxford University Press.

6 ACKNOWLEDGMENTS

This study is part of the project OIKOS – "Decision Systems for the Integrated and Sustainable Spatial Management".

The project has been partially supported by the SAIOTEK Programme the Basque Country regional programme of technological innovation support and the PROFIT Programme for Technical Research Promotion of the Spanish Ministry of Industry, Commerce and Tourism.