

# **MODEL OF OPTIMIZATION OF THE DECISIONS RELATED TO “NATURE 2000 NETWORK”**

Consellería de Medio Ambiente  
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## **1. Background, objectives and area of application of the model**

There are specific territorial areas which possess an outstanding natural value and in which, simultaneously, economic exploitation occurs or so is wished. So there arises a conflict between the two options: conservation of the environmental quality as opposed to the exploitation of the resources.

In view of the difficulties which occur in the compatibility among different economical activities it becomes necessary to offer a model, which helps us to make decisions.

In Galicia there are a group of territories, recognised as being areas of outstanding natural beauty, which have been proposed to form part of the “nature network 2000”. Their area accounts for 11% of the total area of the GALICIAN region.

The decision, which has to be made about these and other areas of outstanding natural interest, is not simple nor is it obvious. It should be preceded by a cost-profit analysis of the different options.

The Galician authorities, who are aware of this, are promoting an assessment of a model which allows us to make decisions about the territorial areas with characteristics as mentioned above, with a view to integrating all the elements and factors that are involved in the territorial organization and possible proposals for a sustainable development of these.

For this reason a working group was formed in which all of the sectorial departments are represented from different areas: environment, territorial organization, industry, rural development, tourist development, town council representatives: the Galician committee for environmental integration and co-ordination.

In the context of the mentioned committee the elaboration of a methodological proposal was promoted in order to consider an environmental dimension in the processes of economic planning, in the framework of the concept of a sustainable development. the undertaking of this proposal and its application to a specific area of study constitutes the objective of the work, which is summarized in this document.

The way to a basic approach for this methodological proposal was the development of a support tool for decision-making, which would allow the integration of a social and environmental variation in the decision process set up by all political sectors. This tool was elaborated with an economic base, which incorporates classic accounting to the economic assessment of the environment.

As a pilot geographical area for the development or application of the model the area of the Courel Mountains (and surrounding area) which is one of the eastern mountain ranges of the Galician region, was selected given the fact that the following conditions occur:

- There is an extraordinary natural wealth both in ethnography and national heritage. the importance of its environmental value allows the inclusion of a large portion of this territory in the proposal for the “nature network 2000”
- It has numerous resources of economic interest ( geological, hydraulic,

etc.) in quantity and quality and there is significant pressure at present towards its exploitation.

The area of study is completely within the province of Lugo ( its southeast extremity) and occupies a total area of 103.992 hectares ( 1.040 square km.) the approximate total population in the area of study is 15.280 inhabitants.

**\*Surface: 1.040 square km**

3.5% of the total area of Galicia

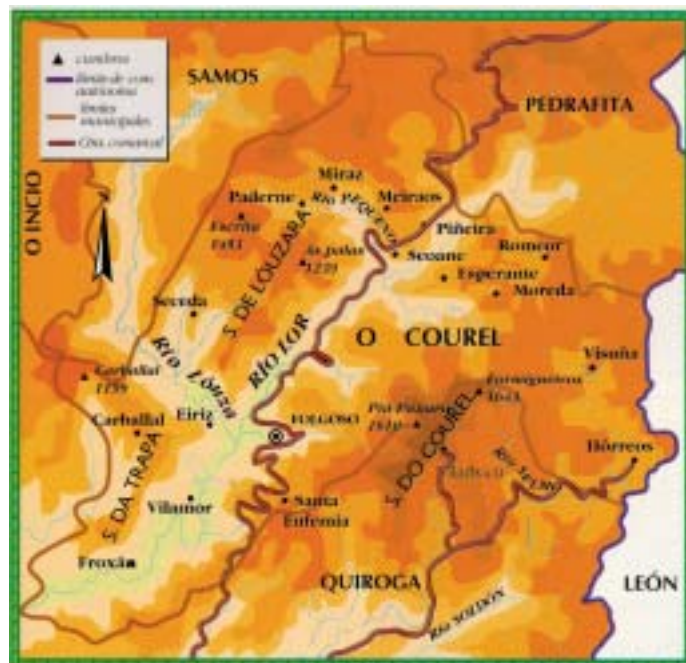
10.6% of the total area of Lugo

**\*Population 15.280 inhabitants**

14.7 inhabitants per square km.

0.54% of the population of Galicia

4.1% of the population of Lugo.



The area of study forms a relatively homogeneous unit from the point of view of the physical geography, due to the mountainous character of most of the zone.

The maximum altitude obtained in the area of study is 1.647m ( Pico Formigueiros) and the minimum altitude is 350m.

More than half of its ground (53.5%) is proposed to form part of “Nature Network 2000”.

From the point of view of the political-territorial division the area of study is assigned to several parishes and councils although not in an integral way. In order of territorial importance (percentage of the area of study assigned to a given council), the zone belongs to: Quiroga (27.7%), Folgoso do Courel (18.9%), A Pobra de Brollon (13.8%), O Incio (12.8%), Samos and Pedrafita do Cebreiro (9.3%), As Nogais ( 2.6%), Bóveda ( 2.4%), Triacastela (1.7%), and Sarria (1.4%).

From the demographic point of view, the area is characterized by having gone through a chronic recession in its population. In the administrative area of Folgoso do Courel the present population constitutes 30% of the existing population in 1940 or 50% of the population in 1970. On the other hand it is also a very aged population. In all of the administrative areas (except Sarria), the portions of the population with more pyramid effect of age is above 60 years of age.

The basic social-labour data, which describe the situation in the study area, are the following:

- Active occupied population: 4.365 people (28.6% of the total population)
- Occupation of the active population in sectors: 40.9% in agriculture, 17.4% in industry, 8.5% in construction and 33.2% in services.

The area of study was *divided* into smaller zones called *micro-areas* (12). The criteria used to determine the micro-areas is based on the consideration

of the hydrographical basin with the visual basin. The advantages offered by this division has something to do with the fact that the compatibility-incompatibility of certain uses normally occurs on this scale and to the fact that they allow an individualized planning.

## 2. Methodological basis of the model

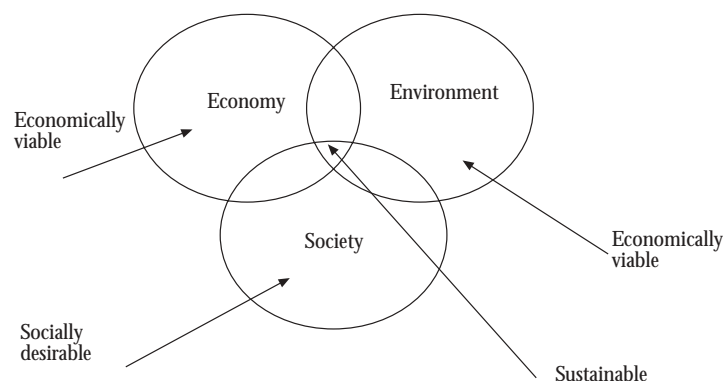
### THEORETICAL FOUNDATIONS

The model of development for the Courel mountain range is enriched by internationally authorized theoretical concepts and approaches, which are used at present in the areas of development and environmental economy. They are summarized as follows.

#### *Sustainability. Concept and interpretation*

The definition of basic development assumed by this model is that which is expressed by the world commission for the environment and development (more renowned as the Bruntal commission.)

*Sustainable development is a process, which enables us to satisfy the necessities of our present society without jeopardising the future generations' capacity to satisfy their own necessities.*



From an economic point of view, development is a process, which allows a society to use its natural capital without diminishing it but rather increase it and improve it.

These definitions enable us to deduce that development requires a balance between environmental, social and economic values. Campbell and Heck represent this with a graph in the following way:

The answers for sustainable development of terrestrial systems are found in the intersection of the circles, which represent the three basic components of sustainable development. Sustainable development is only obtained when the processes and projects are simultaneously viable, both economically and ecologically as well as socially desirable.

The intersection of the circles represents the solution of commitment, which ensures the sustainability of a process or project.

In this intersection there are also numerous opportunities for new activities or businesses but to place themselves in this space also means to renounce an uncontrolled production or consumption which would only lead to the extinction or running out of the resources.

### **The EAB model**

The main source for the model of sustainability for the Courel mountains is found in a theoretical discussion developed by Professor David Pearce of the University of London in his study about the Economic Assessment of Biodiversity (EAB). This focus proposed by Professor Pearce and massively used internationally in the field of environmental economy. For example, the World Bank uses this methodology in the assessment of the projects it undertakes.

The model of sustainability takes into its totality the theoretical basis of the EAB model and it applies them to the particular specific conditions of the geographical area of the study: the natural resources, the socio-economic characteristics, the potential resources, etc.

The authors of the EAB model use as a starting point the fact that the market economy leaves a lot to be desired when assigning the real value to

natural resources and that this lack of awareness makes the decision-makers promote destructive policies which are not sustainable in time.

Professor Pearce assures that the value of biodiversity and of the natural resources can be calculated with greater precision than has been calculated so far and he therefore introduces the concept of total economic value of the resources (TEV).

### **Definition**

The EAB model starts on the basis that an environmental resource can be valued economically or that the mentioned value (total economic value or TEV) has two components: One derived from the use of the resource (value of use or VU) and another inherent in the resource and independent of its use. (non-use value or NUV).

The use value is divided into two types of more specific values:

- The value of direct use (VDU), which corresponds to the economic value of the market goods which are obtained from the exploitation of the resource (for example the value of wood which is obtained from a forest plantation).
- The value of indirect use (VIU) which shows the benefits derived from particular functions of an environmental nature (environmental wealth) of the resource which do not have a market value such as the environmental functions of the forest as a drainage system for CO<sub>2</sub> as a generator and protector of the soil, as a dwelling place for different species.

The non-use value is divided into:

- Optional value (OV) is what the consumers would be willing to pay for a wealth that is not used at present, simply in order to avoid the risk of not being able to use the resource in the future. For example, the value which is assigned by society for deferring the usage of a forest for a given time.
- Inherited value (IV) is the value, which measures the benefit, which any individual gains from knowing that others will benefit from the resources in the future. For example, it is the economical value which an

individual would attribute to ensure that his/her children and grandchildren will know species which are today in danger of extinction.

- Passive value (PV) of a resource, also called existential value, is a timeless value which is attributed to a resource simply because it exists in a particular place. For example, the PV of the Amazon for the Galicians would be given by the economic contribution that these people would be willing to give for conservation in this zone even though the majority have never been nor will ever go to the Amazon.

As a consequence the Total Economic Value of a resource can be expressed with the following equation:

$$\begin{aligned} \text{TEV} &= \text{VU} + \text{NUV} \\ \text{TEV} &= (\text{VDU} + \text{VIU}) + (\text{OV} + \text{IV} + \text{PV}) \end{aligned}$$

### **Discount rate**

The Total Economic Value of the resources will be calculated in a defined time limit (20 years). The introduction of variable time implies introducing within the TEV equation a discount rate. As a result, the TEV will be calculated as present TEV or present net TEV in the following way:

$$VET(t) = \sum \frac{X_t}{(1 + \text{discount rate})^t}$$

Where X represents each of the two terms which comprise TEV (VDU, VIU, OV and IV).

### **Scenes for the TEV calculation**

A scene is a setting which a resource adopts. The scene is made up of a graphic representation of the geographical distribution of the resource in the area of study and of numerical information which represents the present TEV to 20 years.



For each one of the resources considered in the model there are two types of scenes which are modelled.

- A referential scene, which contemplates the projection of the present situation on the limit of the study.
- Development scenes, which are hypothetical scenes of evolution that are set bearing in mind the possible evolution of a resource.

The setting of hypothetical scenes of development constitutes a tool which allows the model to make visible possible planning strategies for the area.

### **Suitability to usage**

The setting of scenes is subject to a restriction: that of suitability to usage. The usage of a resource can only be developed or promoted in an area when the resource exists or may exist there. This fact can be translated in an elaboration of a plan of suitability to usage for every resource.

### **Other variables of the model**

The determination of the Total Economic Value of the natural resources of the Serra do Courel constitutes one of the most relevant contributions and one of the key elements of the model as it deals with a quantitative variable which is reflected in monetary units, apart from the classical economical component (values of direct usage), other environmental and social aspects (values of indirect usage and values of non-usage).

However, relevant economic, social and environmental aspects exist for decision-making, which the TEV function does not internalize, either for being non quantifiable or for being difficult to quantify in monetary terms (environmental impacts, generated by an activity etc.) or for not fitting directly into the concept and definition of TEV (direct and indirect employment, creation of added value to the area of study, contribution to the endogenous development etc.)


As a result, to complete the analysis, a series of complementary variables of an economic, environmental and social nature are taken into account.

The assessment of these variables is done qualitatively by the quantitative assignment of a range from 1 to 4 (value 1 is the least favourable and value 4 is the most favourable)

### 3. Strategies, Methods and Tools of Assessment of the Variable of the Model

#### Sources of information

As a systematic strategy with regard to sources of information the following can be used in order of preference.

Economic variables	Total costs of activities	Economical profitability (TIR) Durability of the activity Generation of added value Sales income Pay-offs
Environmental variables	Costs of the prevention, minimization and correction of negative environmental impacts Magnitude of the negative environmental impact Character of the negative environmental impact (reversibility and recuperability) Loss of environmental quality	Benefits of the used environmental functions (VIU) Optional, hereditary and passive values (PV, OV, HV)
Social variables	Subsidies received Health risks   F(f) Function of time (discount ratio)	Fiscal income Generation of direct and indirect employment Salary levels Contribution to the resident's income

Source: Santos (1998)

- Administration authorities (regional and local)
- Scientific publications
- Residents' opinions

As a first option, first hand information was obtained regarding the area of study. When this was not available information from the province of Lugo was turned to and, as a last resort, to data of Galicia.

### **Determination of the values of direct use**

The value of direct usage in the context of the Courel model can be used to show the economic profitability of the projects and activities. The first concept we can handle to represent it coincides with cash flow.

The VDU which arises on applying this concept is completed introducing a subtrahend as a negative external environmental aspect.

The introduction of this term has, as its objective, the penalization of theses activities which obtain high VDU avoiding having to make the necessary investments (in other words, costs) for the protection (prevention or correction of negative environmental impacts) of the environment. Therefore, the final VDU with external aspects can be determined as the difference between the VDU calculated with the previous formula less the value of the external negative environmental aspect.

### **Determination of the values of indirect use**

This was undertaken through techniques which, in scientific literature of the environmental economy, are called, generically, indirect or observed methods, as they explore the connection that exists between the environmental goods (that do not have market nor a price) and those private goods with which they are related and that do have a market and a price.

In the Courel model three types of indirect methods were used: a) the method of avoided and induced costs, b) the method of travelling expenses and, c) the method of hedonic prices.

The variables which were analysed by these methods were the following:

- Forest resource: drainage function of CO<sub>2</sub>, function of the prevention of erosion, function of the increase of water resources.
- Different uses and resources: landscape value, scientific, environmental value, specific chestnut grove, recreational value, recreational value of hunting, recreational value of fishing, aids to pollination, artistic and historic heritage and urban resource.

As a complement to the application of the methodology of travelling expenses a survey was done in-situ among the visitors to the Courel with the objective of estimating the most valued and least valued aspects of their visit. The technical data of the survey is resumed as follows:

**Technical data of the survey of visitors  
to the Courel Mountains:**

- Total Visitors to the Courel Mountains
- Type of random sample
- Rate of reliability: 95.5%
- Error limit: 5 %
- Number of surveys done: 90.

**Determination of the Non-use values.**

The OV, PV and the HV of the Courel resources was determined through a methodology of assessment of contingencies, (MAC) which is a survey technique that gets information from individuals regarding their preferences for obtaining material goods or services.

In particular the people who were surveyed answered the question about what they would be willing to pay (WTP) in a series of hypothetical situations that allow the deduction of the Option Value, or the Passive Value or the Hereditary Value of the following resources of the Courel area: autochthonous forest, water resources, traditional agrarian resources, craft production, art and popular architecture.

#### **Technical data of the survey of contingent assessment:**

- Galician people older than 18 years old
- Sample type: at random, stratified by social class
- Rate of reliability: 95.5%
- Error limit: 5%
- Number of surveys done: 400

#### **Applied discount rate**

The discount rate which is applied to discount the Value of direct usage is the social discount rate

In the practice the social discount rate is calculated on the difference between the growth rate of private consumption less the growth rate of the population. Applying these concepts, the social discount rate applied for the area of study obtains a value of 3.69%.

#### **4. Individualized Modelling of Natural Resources**

The first step in the application of the model will be the individualized modelling of each of the two resources present in the field of study.

The final results and conclusions of this individualized model arise from a multi-criteria analysis which contemplates, in a joint way, the TEV of the resources and the rest of the variables (components or partial indicators of sustainability) which describe it. The importance and specific weight that is finally assigned to each one of the individual variables will necessarily arise from a previous extensive debate between the different agents that are involved in the decision-making.

The results that the Model offers regarding the individualized modelling of the resources at this point in their development start out from a joint consideration and meditation about how each of the variables that describe the resource (the TEV and all the other economic, social and environmental variables) contribute to the sustainability.

The second step in the application of the model consists in the joint modelling of the resources that exist in the field of study and/or in each one of the micro-areas of which it is composed.

In this phase all the combinations of the viable scenes which were previously modelled in an individual way, resource by resource, are analysed with the objective of determining which is the best combination that would bring a greater value (maximum TEV) and a greater commitment of sustainability to the area of study.

When the scenes are combined and analysed in a joint way the restriction of compatibility-incompatibility is applied among the different uses and resources. Two resources could be:

- Totally compatible, when they can exist simultaneously in the same space-time (for example, forest resource and tourist resource).
- Partially compatible, when they have an exclusive ground occupation but they do not affect the resources situated outside the ground which is occupied by them. (for example, forest resource and agrarian resource)
- Incompatible, when the existence of a usage influences the development of other uses beyond the occupied ground (for example, eolic parks and mining areas).