

# An approach to a methodology for ecological valuation of environmental quality

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## Abstract

In Colombia territory planning depends on the natural resources on offer. Due to this offer and environmental quality, the most convenient uses of ground are fixed to satisfy the social demand, and the ecosystem sustainability. Often, natural resource quality valuation is managed from an analytical view, because it considers the natural environment as an independent sum of parts, that is water sources, ground, atmosphere, forest, amongst others. This way of natural resource management leaves apart the dependence relationship between natural resources, necessary for their sustainability. Ignorance of these relations implies serious implications in ground uses because relations between resources could be destroyed. This paper proposes an approach to a methodology for ecological valuation of environmental quality from an analytical and systemic point of view (considering relations between natural resources). The methodology allows us to estimate in a quantitative way the environmental values, such as intrinsic conservation value and relative conservation value, using environmental quality criteria and Colombia's environmental regulations.

*Keywords: natural resources, conservation value, environmental quality, territory planning.*

## 1 Introduction

Estevan [1] considers territorial planning as a basic element for Public Environmental Management, which allows environmental considerations in land use to be included in planning processes, then becoming a management instrument. Besides, it becomes an essential element to make decisions in relation to use, protection, defense, and improvement of natural resources.

Although Law 388, 1997 [2] has been a base for the country's territorial planning processes, it does not explicitly take into account a way to integrate the



complexity of natural resources to as a system. Although Strategic Environmental Assessment allows a reflection on the environmental variable to be made in the territory planning processes developed by governmental entities, it does not explicitly propose a way to think about the environmental quality of natural resources of an environment from a systemic point of view.

For territorial planning from a perspective which intends to include environmental considerations, the existence of an environmental inventory (the natural resources on offer) becomes a basic element. As human interference effects on the territory depend upon an ecosystem's capacity to support man's activity, ecosystem vulnerability becomes a significant factor in a decision-making process concerning use, improvement, protection, and defense of the environment. Such vulnerability is also dependable on the conservation degree of natural resources in the ecosystem. The conservation degree of a natural resource will be a decisive factor for existence of all other resources of an ecosystem and environmental services which man can provide. Conservation degree determines then all functions a natural resource could offer to both the total ecosystem and man. If we consider natural resources conservation from a theoretical economic point of view, it could be thought that its conservation degree determines functions which the resource "lends" to both the ecosystem and man; for this reason, conservation has a very important social value. This article shows a methodology which integrates environmental norms and conservation values of natural resources to be applied when estimating environmental quality of an environment. The methodology's importance is a result of a combination made when integrating analytical and systemic thought and approaches to the environmental quality assessment.

## 2 Methodology

The proposed methodology is intended to estimate the conservation value of natural resources. For this purpose, this methodology is based on two basic elements: environmental legislation and an environmental quality unit system. The first element deals with legislation defined for a specific context of a country or region in which a territory's intervention programs or plans are included (in governmental plans). The second element refers to a system which allows taking different environmental indicators to the same measurement system, in such a way that they can be measured and analyzed in order to determine the conservation value of natural resources and to make decisions in relation to use, improvement, defense, and protection of resources.

## 3 Conservation value of a resource

This refers to the ecologic value which is given to a resource due to its particular characteristics or intrinsic qualities, as well as for "services" it "provides" to the ecosystem. This results in two conservation values: intrinsic conservation value and relative conservation value.



### 3.1 Intrinsic value

This deals with the existence value which is given to a resource due to its particular characteristics, such as conservation, deterioration, singularity, rareness.

### 3.2 Relative value

In a specific environment, this refers to a resource value according to its functions and services it provides for preservation of all other resources. Thus, water existence is vital for existence of other resources of the ecosystem, such as flora (forests and pastures), fauna, soil, etc.

In order to determine a resource's conservation value, quality parameters defined by environmental norms for each resource should be considered.

## 4 Environmental quality units

As each resource has different physical parameters which allow the determination of its conservation status, these parameters should be included in a unified system which makes it easy to compare quality parameters (indicators) of each natural resource with the conservation status of several resources of an ecosystem. For that purpose, transformation functions are used to express the status of a natural resource as environmental quality units.

## 5 Conservation value estimation

In order to determine intrinsic conservation value, a hydrospheric element will be depicted. This element includes all water forms which are present in the analysed environment, as well as its availability and quality. After indicators have been defined by environmental legislation, an environmental quality unit system is used to take contamination amounts into an E.Q.U. (Environmental Quality Unit) through some transformation functions proposed by Conesa [3]. From environmental quality units, the environmental conservation value of the place to be analyzed is determined. Table 1 shows a value estimation of water intrinsic conservation in three different basins which will be called A, B, and C.

When intrinsic conservation value has been determined for each natural resource of the territory to be analyzed, the importance of each natural resource should be determined (according to its intrinsic conservation value or its environmental quality) in relation to the existence of each other natural resource in such an environment. To carry out this procedure, quality indicators for each resource are taken. Table 2 shows relative conservation value of natural resources from C basin, in relation to all other resources of the environment.

## 6 Discussion on results

According to the results shown in Table 1, the basin having the best conservation status is basin B, which value (subtotal) in EQU and in relation to water resource



Table 1: Intrinsic conservation value.

| Environmental Element | Measurement Unit | Basin |      |      |
|-----------------------|------------------|-------|------|------|
|                       |                  | A     | B    | C    |
| Hydrospheric          |                  |       |      |      |
| OBD                   | mg/l             | 0,2   | 0,36 | 0,28 |
| DO                    | %                | 0,98  | 0,28 | 0,2  |
| SS                    | mg/l             | 0,35  | 0,8  | 0,14 |
| Sub-Total (U.C.A.)    |                  | 1,53  | 1,44 | 0,62 |

OBD : Oxygen Biochemical Demand, five (5) days.

DO : Dissolved Oxygen.

SS : Suspended Solids.

is 1.44, while basin C shows the smallest conservation value. In order to define which basin has the best conservation status, environmental quality units of all other natural resources in each basin should be determined, so the total value can be estimated by adding environmental quality units. Once the value has been determined, a comparison among the three basins can be made.

Intrinsic conservation value allows the determination of the vulnerability of an environment (for example, a basin) to an intervention plan, program or project, in such a way that human actions in such environment can be directed in order to protect natural resources, then becoming a possible support for environmental management.

In relation to the three basins, partial results would indicate that if human intervention is necessary in one of them, the best thing is doing it in basin C, given its lower environmental quality.

Now, from the concept of intrinsic conservation, environment is conceived as being formed by an isolated aggregate of natural resources (water, air, flora, etc.) without any interaction. Consequently, dependence relations are not recognized among natural resources which form an ecosystem. From this conception, the need for a concept which allows the consideration of dependence relations in an ecosystem arises. Relative conservation value intends to consider the interaction of natural resources in an ecosystem; for this reason, the relevancy of the concept is important for determining the ecologic value of the environmental quality of a resource.

In Table 2, the relative conservation value of a basin can be found in which it is possible to identify that the natural resource having the biggest relative importance is soil (geospheric component). Therefore, it is possible to conclude that if projects implying damage of soil resource (atmospheric element) are carried out in that basin - such as a road construction- harmful results for the



ecosystem could be bigger than those for an intervention on other natural resources, for example in air (atmospheric element) or in water (hydrospheric component), etc.

Table 2: Relative conservation value.

| Element        | Atmosph | Geosph | Hydrosph | Biotic | Sum |
|----------------|---------|--------|----------|--------|-----|
| Environmental  |         |        |          |        |     |
|                |         |        |          |        |     |
| Atmospheric    |         |        |          |        |     |
| Noise Level    |         | 1      | 1        | 7      | 9   |
| Temperature    |         | 3      | 2        | 5      | 10  |
| Rainfall       |         | 3      | 1        | 2      | 6   |
|                |         |        |          | Total  | 25  |
|                |         |        |          |        |     |
| Geospheric     |         |        |          |        |     |
| Erosion        | 1       |        | 6        | 3      | 10  |
| Phreatic Level | 5       |        | 1        | 4      | 10  |
| Slope          | 6       |        | 2        | 1      | 9   |
|                |         |        |          | Total  | 29  |
|                |         |        |          |        |     |
| Hydrospheric   |         |        |          |        |     |
| OBD            | 1       | 1      |          | 8      | 10  |
| DO             | 1       | 1      |          | 5      | 7   |
| SS             | 1       | 1      |          | 4      | 6   |
|                |         |        |          | Total  | 23  |
|                |         |        |          |        |     |
| Biotic         |         |        |          |        |     |
| Native         | 1       | 3      | 5        |        | 9   |
| Birds (common) | 1       | 1      | 2        |        | 4   |
| Land           | 1       | 2      | 3        |        | 6   |
|                |         |        |          | Total  | 19  |

Atmosph : Atmospheric

Geosph : Geospheric

Hydrosph : Hydrospheric

Atmospheric: It refers to air quality and climate-related variables.

Geospheric: It refers to soil.

Hydrospheric: It refers to water.

Biotic: It refers to flora and fauna.

Consequently, relative conservation value is a supplement for the analysis resulting from intrinsic conservation value, because it allows guidance on basin C protection in relation to the type of human interventions.

For the aforesaid, it is possible to state that proposed methodology could become a support for territorial planning processes carried out by different governmental entities, as they allow the determination of the environmental vulnerability to human activities.

Likewise, it can be concluded that it is possible to achieve an approach to environmental quality issues of the environment from a systemic point of view through the use of quantitative methods which facilitate both analysis and decision-making processes in territorial planning programs, from an ecological vision.

As an approach, this proposed methodology is not intended to close the discussion on environmental quality assessment, but to encourage a debate on a very complex issue.

## References

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