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RISK MAPPING AND ECONOMIC VALUATION METHODOLOGIES TO CALCULATE ENVIRONMENTAL DAMAGE BALANCE SHEETS FOR THE MEDITERRANEAN KARST ISLAND OF GOZO

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ABSTRACT

Within the overall objective of preserving the fragile environmental resources on the karst island of Gozo, the issue of land degradation has been selected in this paper to demonstrate how to derive an environmental damage balance sheet applying concepts of risk assessment and natural resource economics. The approach combines the conventional source-pathway-target model for environmental management with the total economic value concept measured through so-called direct or indirect economic valuation techniques. The risk map together with the land-value map provide the reference maps needed for the calculation of environmental damage balance sheets. In an economic context, the directness of impact, the environmental resource interconnections and the damage to their regenerative capacity are therefore being considered.

1. THE CHALLENGE

Reference is made to two presentations by the same authors at this Symposium on the EU sponsored INCO-DC research project 'Resource management in Karstic Areas of the Coastal Regions of the Mediterranean'. Applied to the karst island of Gozo as a case study area, these presentations respectively dealt with the use of GIS, an information management tool for the assessment of the island's environmental resources; and the development of an environmental resource planning and management scheme for coastal karst regions.

As a further part of the project dissemination activities, a number of workshops were held earlier this year, in order to demonstrate the research results to the various local authorities concerned either directly or indirectly with the planning and management of environmental resources in the Maltese Islands. Interestingly, the final stages of the project coincided with the commencement of a major review of environmental planning policies with the objective to update the Structure Plan for the Maltese Islands issued in 1992. Hence, the final output of the project, which concerned the formulation of optimum response strategies to environmental resource degradation resulting especially from rapid, uncontrolled urbanization and a very high, seasonal influx of tourists, could be presented at a most opportune moment.

At the same time the construction of a GIS for Gozo proved of immediate value, e.g. to assist in devising a priority strategy for financial assistance to farmers to repair field boundary walls. Following the mapping of the entire length of field rubble walls, including their physical condition, the GIS enabled to objectively determine which areas warranted immediate attention and therefore priority financial assistance for the restoration of loose stone walls to combat soil erosion. Similarly, the Farmers' (Wine) Association could be offered assistance to identify the optimum, south facing slopes to plant new grapevines in Gozo through the combined use of the digital elevation model, information on soil types and their characteristics, and surface water drainage conditions.

A major focus of attention during the discussions with the local authorities concerned the aspired development of an airstrip on the island of Gozo, which would inevitably involve the destruction of large tracts of agricultural land. The suggestion was made to quantify the cost of the loss of agricultural land in the area. At present, this type of information is not included in the GIS, and the territorial reference units (RMM Units) do not directly present a solution to this "real life situation scenario".

The present paper therefore describes the additional research which has since been undertaken with the objective to add a "money value" layer to the GIS.

2. THE PROPOSED APPROACH

The idea emerged to combine two existing approaches: the conventional source-pathway-target model for environmental management and the so-called Total Economic Value (TEV) concept. The former approach is commonly used for the purpose of risk mapping, and is derived from three elements. The risk of land degradation for example, is based on a combined assessment of the hazard posed by any activity which may lead to land degradation, the vulnerability of the environmental resources to land degradation and the potential consequences of a land degradation event. With regard to the appraisal of the potential consequences, two options emerged: either to quantify the consequences from an economic perspective or else to restrict the appraisal, and hence the risk assessment to a quantification of the physical extent of the area expected to be affected by the land degradation. Here, this choice is purely academic since the objective is to determine the economic costs to the environment.

A further literature search on economic valuation methodologies advised on the use of the Total Economic Value (TEV) concept to measure the damage done to the environment. According to Pearce (1990), a decision on any proposed development should be based on a comparison between the costs of the proposed development, the economic benefits and the total economic value that will be lost by the development.

A decision to proceed with the development should be taken only if $(B_d - C_d - B_p) > 0$, where B_d refers to the benefits of the development, C_d refers to the costs of the development and B_p refers to the benefits of preserving the environment by not developing the area. Hence, the total economic value (TEV) can also be taken as measure of B_p, the total value of the asset left as a natural environment. The economic benefits and costs for the development can be expected to be relatively simple to quantify, because they are likely to be in the form of marketed inputs and outputs which have observable prices. This is clearly not going to be the case with the TEV, so we now needed to investigate ways in which the TEV or its component parts can be quantified.

Again, literature provided two options to measure the TEV: a so-called direct valuation, used whenever

the environmental gains can be identified and the money value of those gains is then established, or by means of an indirect valuation. The latter technique calculates a 'dose-response' relationship of the impact of the proposed development in terms of its effects on e.g. health, ecosystem balance, as may be relevant. In this instance, the money value is obtained from the valuation of the willingness to pay for the environmental benefit or the willingness to accept the environmental damage which will be suffered from the proposed development.

While these techniques have been gaining wider recognition and acceptance in recent years, effective implementation appears to have been achieved only in those countries or regions with a very high level of environmental awareness by the public at large. Yet, the techniques described above provided a new insight how to introduce a "money layer" in the GIS.

3. CHOOSING THE LESSER EVIL?

Returning to the issue which sparked off the present research, the construction of an airport on the island of Gozo is clearly not going to result in any direct environmental gains or benefits. Hence, this suggested the necessity to go for an indirect economic valuation of the effects of the proposed development on the environmental resources. Current environmental legislation does require an appraisal of the effect on air, water, soil, geology and biodiversity to be performed as part of the preparation of an environmental impact assessment. However, in the absence of records on e.g. air and surface water quality on the island, a quantification of the impact on these resources is commonly limited to an estimation of the areal extent and a descriptive indication of the magnitude of the potential effect. To improve on this, the 'dose-response' approach was considered useful as outlined further below.

It was observed that some chose to avoid a discussion on the necessity of the airport, and wished to limit the debate as to whether a domestic or an international airport is needed. In terms of land-take requirements this distinction translates into the need for a 1 to 1.5 kilometer landing strip, enabling fixed wing aircraft to land on Gozo from Malta International Airport, extended to about 2 to 2.5 kilometer if Gozo is to receive international flights directly. From a natural resource economics point of view, a selection between these two alternatives should be based on the evaluation of the damage to the natural environment that will be suffered in both scenarios. To maintain a closest relation to existing legislation, this evaluation should distinguish between the effects related to both the construction and operational phase of the two alternatives, as shown in Table 1.

Table 1 Environmental damage balance sheets

	Domestic / International Airport in Gozo	
Environmental resource	Construction phase	Operational phase
Air	√	√
Water	√	√
Soil	√	
Biodiversity	√	√
Geology	√	

Further, new impacts on the soil and geology resources are not envisaged once the airport becomes operational, but in all other cases, the 'dose-response' relationship between the two alternatives needs to be assessed.

Finally, it is proposed to use a land-value map as a reference basis to calculate the environmental damage balance between the two scenarios. Since this "money value" layer is best worked out in a “dynamic scenario”, i.e. a “seasonal scenario”, work has started on the processing of 4 Landsat images, each taken during a different crop season to enable the value of the crop to be estimated over one year.

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