Conception and Possible Results for Interdisciplinary Planning of Landslides Areas From Romania

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Abstract: *The beginning of the third millennia finds man kind in the face of a considerable number of unsolved problems. One of the most concerning, through the immediate long term effects, is tied up to the environment. Man kind is more conscious of the profound significance natural hazards have in its development. In the classification of natural hazards, the landslides are considered "geomorphologic hazards", being phenomenon's which occur on a terrain surface. This article describes an interdisciplinary project in GIS – supported ecological planning of land slides areas which is currently undertaken by some institutes from Romania. The conception and first results are recomanded to be introduced. Investigations include the innovative interdisciplinary approach to the planning model and how GIS can support the latter, modern cartographic visualization techniques and the potential use of basic geodata sets.*

Keywords: *environment, landslides, GIS, cartographic visualization techniques, geodata sets.*

1. Introduction

The importance which is given on international landslides research is reflected in numerous scientific manifestations (congresses, conferences, etc.) and in organizing of some sort of collaboration methods made to direct research in this domain.

Under the UNESCO it has been built the International Union of Geological Science in which the International Union of Geological Sciences-Working Group on Landslides works.

In traditional spatial planning processes usually not the best results are achieved due to the sectoral approaches of the disciplines being involved. These approaches can be characterized by the different evaluation methods applied to different information about the planning area, and varying procedures of data processing. Furthermore, it happens that the decision – makers do not take into account the results of a planning process.

For these reasons, the implementation causes shortcomings and risks.

For instance, traditional land slides and flood defence is planned without taking ecological constraints into account so that the land slides and flooding by rivers threatens property and develop an improved planning methodology which merges the sectoral approaches into an integrative one.

An integrative planning process has to meet the following requirements:

1. Identification of conflicts as early as possible in the planning process.
2. Documentation and presentation of the conflicts.
3. Resolution of conflicts.
4. Presentation of solutions.

Between the years 1990-2000 it has been declared The International Decade of Diminishing Natural Disasters in which the UNESCO committee for Landslide Research was born. The main objective for this committee represents the elaboration of the strategy and the way of recording, forecasting, analyses and preventing landslides.

At the middle of the International Decade of Diminishing Natural Disasters we can see an increasing preoccupation for research and preventing landslides in every country and upgrading the organisational and informational domains of land sliding all over the world.

In research, the most valuable data among the physical-mechanical parameters of the rocks affected by instability, hydrogeology and climate are gathered from landslides already produced. The data which is obtained though is not important for using it in areas where a landslide is possible.

For orientating the activity of preventing and reducing the effects of landslides among the environment, in general, and over economical and social sites, especially, The Public Buildings and Territory Managing Minister, has approved with the Order Nr.18/N from 19.02.1997 “The Guide through identification and monitoring of landslides and finding solutions for preventing and reducing their effect, for satisfying the safety measures in building construction sites repairing and protecting the environment. (Shortcut GT 006-97).

The first and third requirement demands the application of an adjusted scale of measurement for the evaluation of planning alternatives. Such a scale can only be derived through discussion between the disciplines. The logical approach to enable conflict identification, documentation and presentation of resolutions are a geo–information system (GIS) and cartographic visualization.

2. Concept for an Integrated Planning Process

In Chapter I the requirements for an interdisciplinary approach to land slides and floodplain area development have been developed. A general schema of the reference model for this approach is shown in Figure 1. First of all it is necessary to establish a general evaluation background from which the data model and the required methods are being derived.

The planning approach is based on the working hypothesis that there is a spectrum of objective for land slides and floodplain area development which are located between the contrasting objectives ‘protection of use by man’ and ‘sustainable development of nature’.

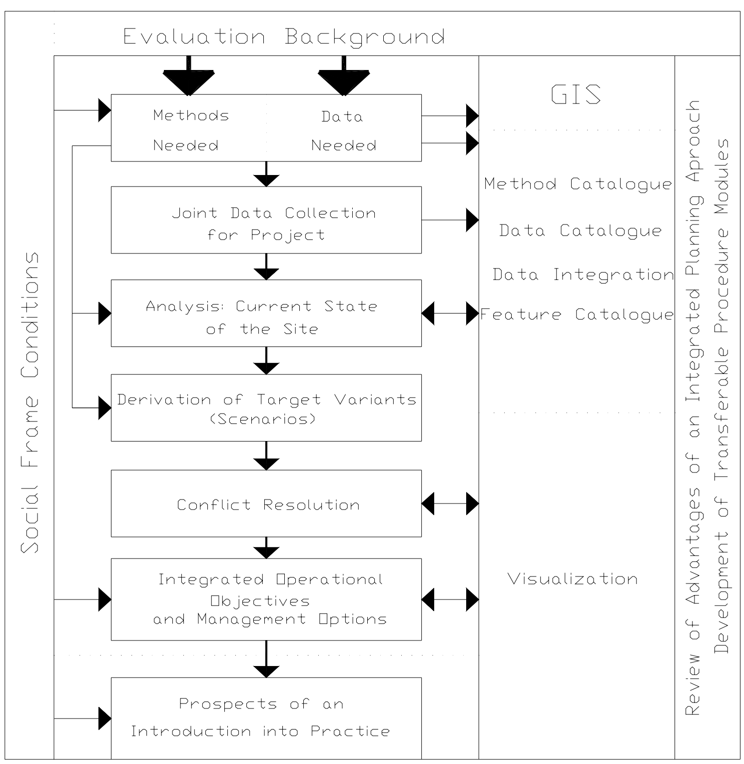

Fig. 1. Reference Model for an Integrated Planning Methodology

On the basis of the established methods not only the current state of the project area is assessed but also the objective variants being derived in certain planning scenarios. The GIS as the link between the disciplines plays an integrating role during the ongoing communication and resolution of conflicts. The scale of the planning model has been set to 1:10.000.

3. Logical and Tehnical Concept of the GIS-Implementation

3.1. Investigations for the Implementation of the GIS-Database

A central requirement for an interdisciplinary GIS – project is the development of a common data model which includes all types of data needed by the project partners. It is represented by the integrated feature catalogue. Starting from a basic geodata feature catalogue such as given by MM (Minister of Medium) (see next paragraph), the latter is extended the new types of objects to be integrated into the existing geodatabase.

3.1.1. Concept of Basic Geodata

The Digital Landscape Model 25/1 (DLM 25/1) used in the project is a basic geodata set. It is part of the Authoritative Topographic – Cartographic Information System (ATKIS) and readily available in its first implementation DLM 25/1 from the surveying and mapping agencies and describes the landscape in an object – structured way from a topographical point of view [1,3]. It consists of the 2-D Digital Situation Model 25/1 (DSM 25/1) and Digital Terrain Model 1:5.000 (DTM 5) and is based on an hierarchical feature catalogue. The latter classifies the environment into topographic objects of seven domains of feature classes (control points; settlements; transportation; vegetation; hydrograph; relief and areas) which again are subdivided into several groups of feature classes, e.g. the feature class domain ‘vegetation’ is subdivided into the groups ‘areas of vegetation’ and ‘individual trees and bushes’. The feature class groups then contain the actual feature classes such as ‘individual tree’ which are described further by various attributes, e.g. indicators for vegetation. The data base and the GIS is designed to serve as a basic geodata set in order to provide other disciplines basic information and a common reference frame for their discipline – specific data.

3.1.2. Concept of the GIS

The concept of the GIS is illustrated by Figure 2. Due to the different views each discipline establishes its own primary model of reality, and describes the latter on the basis of geometrical, semantically and temporal information including interrelations between them.

This leads to the Digital Discipline – Specific Models (DDSM) of the subject areas, in this case models of the landscape planners and the civil engineers. The combination of DLM (see above) and DDSM leads to the Digital Object Model (DOM) which serves on the one hand as input for analysis and modelling calculations on the basis of methods implemented in the GIS, on the other hand it is used for the computer – assisted cartographic design process. The result of a cartographic design process leads to the Digital Cartographic Model (DCM) which is a virtual secondary model of the environment; it has to be transformed via DA – conversation to a suitable analogue secondary model of reality.

3.1.3. Required Geodata

The information to be integrated into the planning model was chosen according to the requirements of data of the project partners. The data base may be derived consistently from the evaluation background. This approach is state-of-the-art in landscape planning and recommended by various authors. The general data requirements of the landscape planners have been supplemented according to the specific aspects of floodplain areas. Due to lack of resources and time some restrictions on data collection and evaluation had to be made.

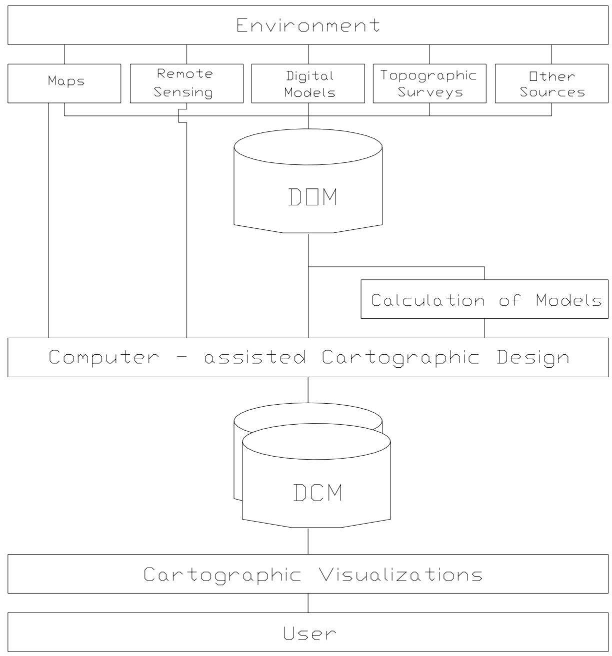

Fig. 2. Concept of the GIS

The information needed for an operational water resource management is based on the Federal Law refers to the main legislation regarding the prevention of the land sliding and suggests a model in order to create maps with land sliding of great risk.

The protected good 'use of floodplains by man/protection of man – made goods' has to be considered in particular. Therefore, it is necessary that simulation procedures are conducted to localize and assess any changes in water budget and transport. The respective parameters are included in the feature catalogue. Again, some restrictions have to be made concerning the modelling of water quality. However, the parameters affecting quality of waters will be taken into account during the inshore water structure mapping.

3.1.4. Development of an Integral Feature Catalogue

In accordance whit the required geodata, an integrated feature catalogue is under development. The landscape planners are evaluating a parameter-oriented description of the landscape where vegetation units, micro morphologic units and land-use are being mapped.

The civil engineers will contribute data, which is needed for the calculation of hydraulic models of the area. According to the general structure, new feature class domains have been set up and will extend be to fulfil the requirements of the planning approach. Additionally, it is investigated how other existing digital data sets may be integrated into a common database, e.g. data from the Geological Survey.

3.2. Development of a Method Base

3.2.1. Capture and Prognosis Methods

In order to analyze and process the basic data as described and the data catalogue as input for the evaluation methods, it is necessary to establish a set of methods for data capture and prognosis. This includes among others the deification of land-use, vegetation units and micro morphologic units, the calculation of water transport, determination of ground water level, flooding duration and frequency of occurrence, and soil characteristic such as wind and water erosion and to compression of the soil.

3.2.2. Evaluation Methods

At the planning model in hand, the evaluation of protected goods is conducted following the procedure of ecological impact analysis using methods from practice and others, partly modified or self-developed methods. The classification of shaping of parameters is based on ordinal scales for the individual process steps, and delineation of results is based on matrix operations and verbal-descriptive methods.

The methods may be divided into three sections, looking from the point of view of protection of "species and biotopes", "a biotic resources" and "land-use by man possibility of resources". One part the project deals with the project deals also with the implement ability of these methods in GIS.

3.3. Cartographic Visualization

3.3.1. Theoretical Background

The term "Cartographic Visualization" is more used in the field of cartography. The reason for this increasing use of modern computer technology for cartographic purposes. From software oriented point of view software techniques like geo-information systems (GIS), rending software products, video toolkits, multimedia environments and world-wide-web browsers give new tools to cartographers and map users, which are advantageous for the cartographic depiction of spatial data [10]. Therefore, MacEachren, showing the „space" of map-use as a cube, developed a new concept of map-use. (Figure.3).

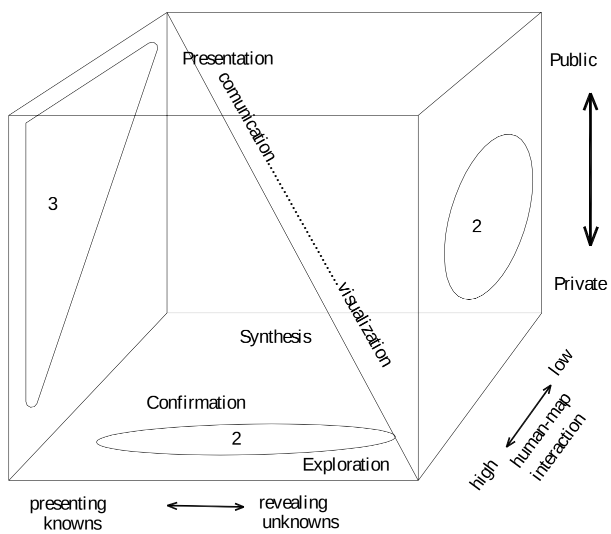

Fig. 3. A new developed concept of map-use

3.3.2. Project Related Objectives of Cartography Visualization

For the project in this paper, the above mentioned concept is an excellent framework for the positioning of the main visualization issues, which refer to the requirements of an integrated planning process as mentioned in Chapter 1.

Fig. 1 shows the visualization process s part of the GIS. The term "cartographic visualization" should be understood as a technical design process emerging maps (on paper or on display devices) on the one hand side and as human process of perception and cognition on the other. The intention of depiction of cartography is to find best solution for the spatial objects, relationships and phenomena in order to meet the demands of users. In the case of the project does this mean to give support by interactive and methods and tools.

4. Concluding and Remarks

Land slides are natural phenomenon, destructive, generators of serious loss of goods and loss of human lives. The destructive characteristic of a land slide represents the certain measuring unit of the phenomenon that, through it interaction with the building's structure can produce damage: the area of differential movement for slow slides, subsidiary movements for retrogressive growth, the kinetic energy of the sliding mass for fast slides.

The risk associated with land slides represents the material damage and loss of human lives potentially caused by the reaction of this phenomenon.

The map representing the land sliding potential is useful after the elaboration of the map showing the land slides because it allows the estimation of the sliding risk in the area where the factors that produce land slides haven't reached critical level. The detailed map of the potential of sliding is very important for us to be able to predict the stability of the land masses and especially in the large areas of artificial lakes, land communication means and in parallel with the level curves etc.

Currently, the analysis of the current state of the site and the subsequent development of different scenarios according to the varying objectives in lend slides and floodplain area development (see Fig. 1).

5. References

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