The Slovak Republic

The Study for Sustainable Development of Agriculture in Zahorska Lowland and Protection of Natural Resources

Final Report

Geographic Information System (GIS) Operation Manual

March, 2003

Pacific Consultants International

AFA
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03-18

THE STUDY FOR STAINABLE DEVELOPMENT OF AGRICULTURE
IN ZAHORSKA LOWLAND AND PROTECTION OF NATURAL RESOURCES

FINAL REPORT

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Geographic Information System (GIS) Operation Manual

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1. INTRODUCTION

Geographic Information System and digital maps were used in the Study as tools to assist the preparation of the Guidelines. Thus, the first objective of the Manual is:

- to demonstrate the capabilities of GIS in planning sustainable development of agriculture.

The Study's technical output is the Guidelines. The Guidelines is designed to help planners and officers in their work. For some part of their work, as going to be demonstrated, GIS can be utilized. However, in many cases, experts know about the capabilities of GIS, but they are not familiar with the use of GIS. Therefore, the second objective is:

- to guide non-GIS experts through GIS database development and the concepts of analysis with GIS.

For non-GIS experts a more detailed description on the database and analysis results are presented in Appendix D of the Supporting Report of the Guidelines.

Nowadays, the utilisation of GIS is common, but its practical usage is limited to GIS experts. The through advantages of GIS can be reached when non-GIS experts are capable of making use of GIS databases and GIS applications more commonly.

Meanwhile, GIS databases and GIS applications are still needed to be developed by GIS experts. Therefore, the third objective of the Manual is:

- to provide GIS experts with the information required to maintain and further develop the GIS database (data sources, content and characteristics, processing and analysis techniques, simulations).

1.1 Structure of the Manual

The structure of the Manual follows the flow of the Study. Meanwhile, with documenting the work, it aims at demonstrating the capabilities of GIS, as well. Therefore, the structure of the manual is intentionally presented as a pyramid structure overlaid on a data pyramid (Figure 1.1.1). The data pyramid aims at underlying the dependencies of data levels and the time and resources needed to complete each level of the Database.
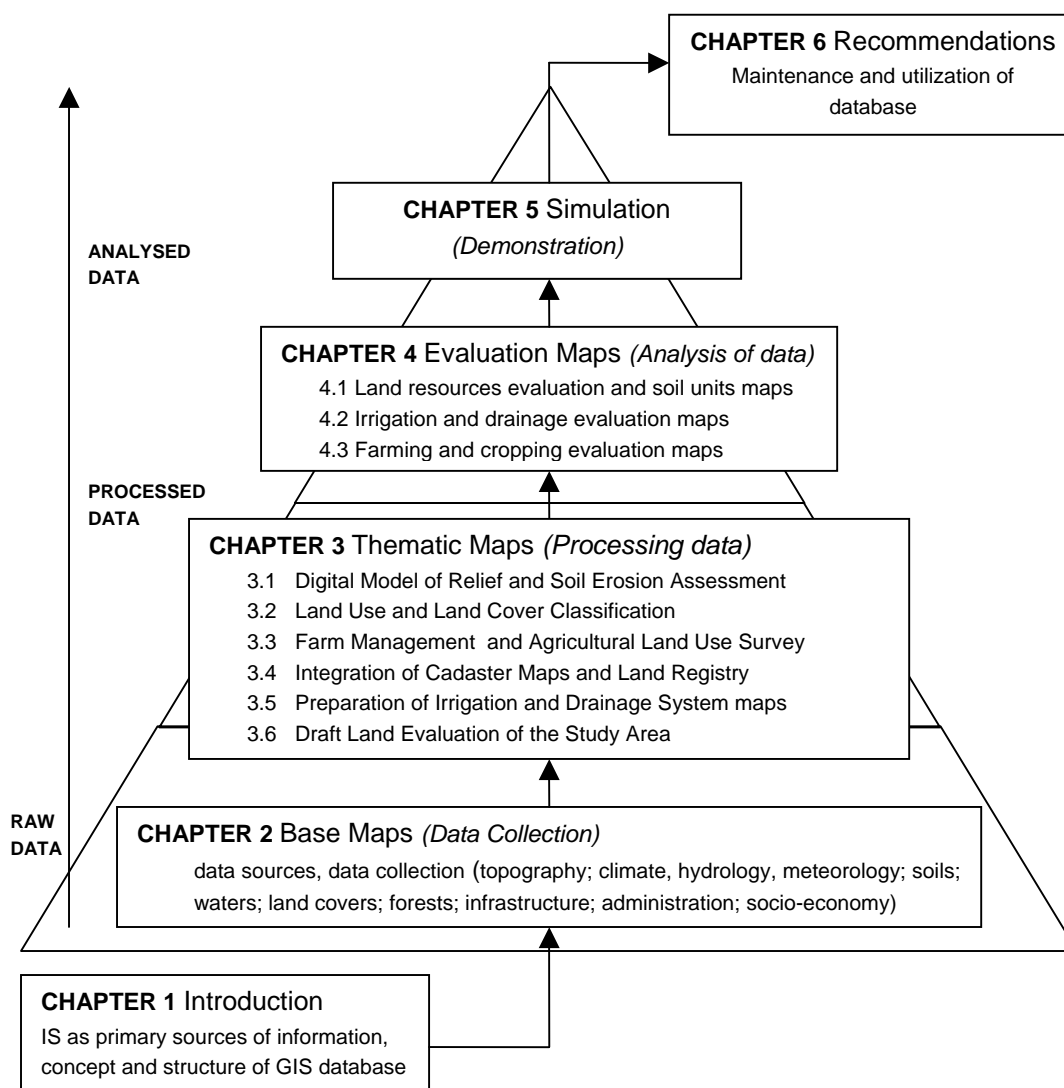
Figure 1.1.1 Flow of GIS Database Development

1.2 Primary Sources of Information

In most cases data are owned by the state and managed by its organisations. The Government regulates the generation, updates and distribution of data.

(1) Information System of the Agricultural Sector

The Ministry of Agriculture is responsible for the development of the Information System (IS) of the Agricultural sector. Starting in 1999 the Ministry has prepared a series of programming documents: analysis – strategy – concept – and operating programs that includes individual projects as well. These documents provide a solid base for IS development till 2005.

As the results, the following components are going to be developed:
- Central Data Storage of the Sector,
- Market and Price IS,
- Integrated Geographical Information System of the Sector,
- Integrated Subsystem of the Agricultural Research,
- Integrated Subsystem of Economic Information,
- Integrated Subsystem of Scientific and Technical Information,
- Integrated IS of Consultancy in the Sector,
- Integrated Subsystem of Specialised State Administration of the Sector.

(2) Environmental Information System (ISZP)

The main aim of the Environmental Information System is to gather, process, store and provide information on the environment for decision-makers, researchers, as well as for the general public. The Minister of the Environment was appointed by the Government to establish ministerial and governmental agreements to provide information for the system. The Minister assigned the responsibility of developing and maintaining the system to the Slovak Environmental Agency (SEA). Thus, SEA is in charge of co-ordination and integration, as well. The main characteristics of the ISZP to be developed are: open, distributed and GIS oriented.

The Environmental Information System of the SR includes the Monitoring Information System and Land Information System, as well.

1.3 Structure of GIS Database

The approach in establishing the GIS database of the Study was highlighted in the Inception Report. The database had to be developed by the "full use" of available data from both the counterpart organisation (Slovak Water Management Enterprise Branch Office of Irrigation and Drainage) and other state and private organisations.

Therefore the flow of information is divided into two spheres: external databases and the GIS database of the Study. The sphere of external databases is the primary source of data for the system. The external databases are the fundamental components of independent ISs of organisations and companies. In addition to external databases, data sources include additional data from field surveys, questionnaire interviews, farm unit surveys, etc. carried out by the Study.

The Study received data directly from the IS sub-systems (GIS databases). In some cases permissions were required from the co-ordinator of higher level IS to have full access to the systems.

The obtained raw data are stored in separate folders in their original form. Data can be updated by simple data transfer from sources whenever needed. They also served as a backup storage of the project.

To support specific applications the raw data has to be often converted to other formats that are more suitable for analysis. In the Study raw data were converted to the formats required by ArcView GIS data manipulation and analysis tools.

At the level of processed data, data are organised based on thematic topics, such as soils, waters, agriculture, etc. The structure is almost identical to the sub-systems of external databases maintained by organisations specialised on specific fields, such as soils science, geological survey, hydro-meteorology, etc. The processed data are already in the suitable form for analysis and incorporates both data of additional surveys and digital data generated (mainly digitalisation) by the Study.

The database is used for analysis and evaluation. The analysis derives new data and value added information. This is fed back to the database keeping it under continuous development. Thus data are updated, maintained and developed from both external and internal sources.

Data Sources ──→ **Obtained Raw Data** ──→ **Processed Data** ──→ **Analyzed Data**
data transfer   *data conversion*   *analyzes*

IS of MoA
- GKU → from GKU
- SWME - PD → from SWME - PD
- SWME - ID → from SWME - ID
- Lesoprojekt → from Lesoprojekt
- others

IS of MoE
- SHMI → from SHMI
- SSCRI → from SSCRI
- GSSR → from GSSR
- SAZP → from SAZP
- others

- others → field surveys
- institutes
- companies
- universities
- others

topic n - FORESTS
...
topic 2 - WATERS
topic 1 - SOILS

Projects
- AV (.prj)
- MGE (.mge)

Graphics
- AV (.shp)
- MGE (.dgn)

Tables
- dBASE (.dbf)
- Access (.mdb)
- Excel (.xls)

Images
- ERDAS (.img)
- Tiff (.tif)
- AV grid
- ASCII (.asc)

Texts
- ASCII (.txt)
- Word (.doc)

ANALYSIS / EVALUATIONS

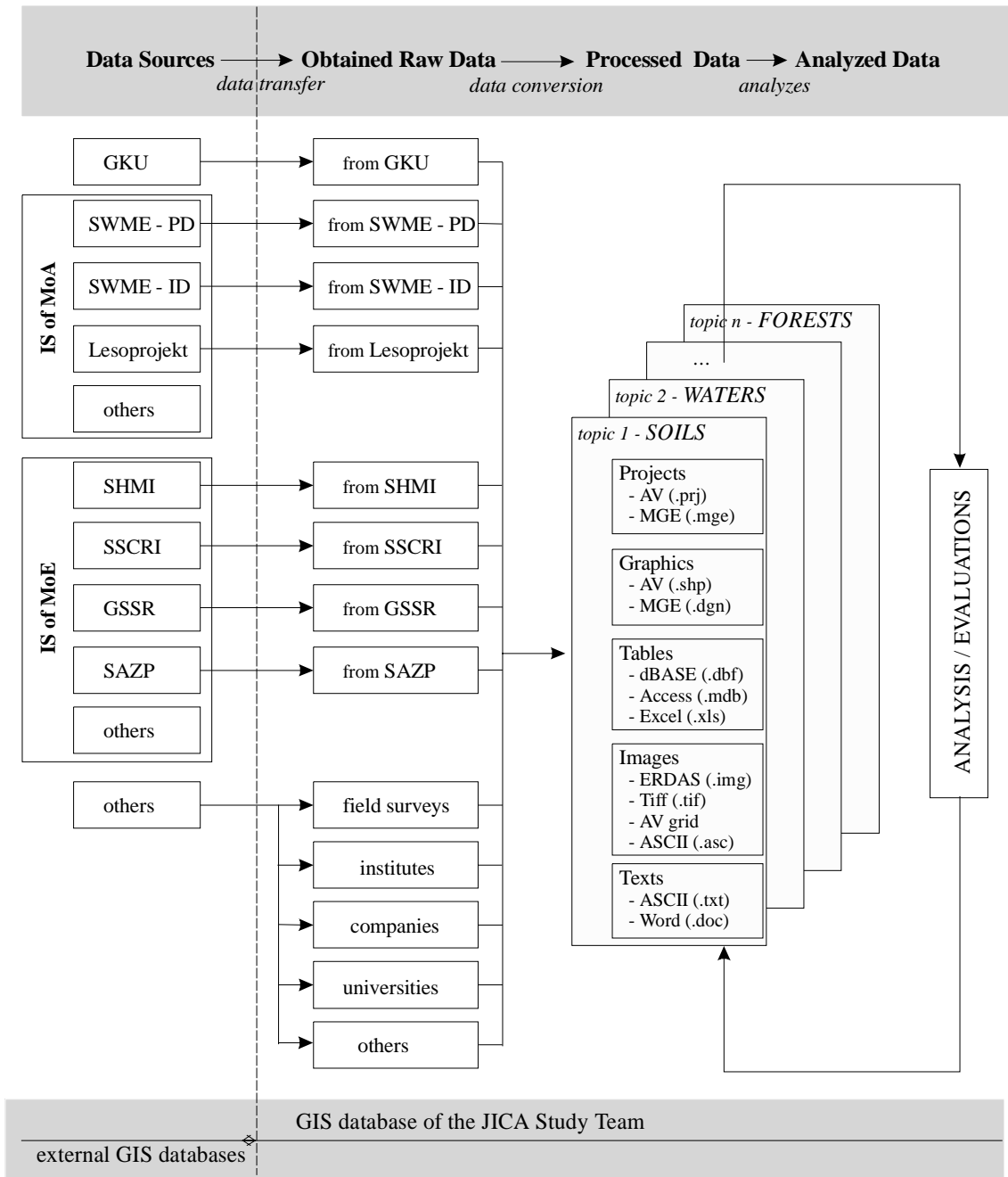GIS database of the JICA Study Team

external GIS databases

Figure 1.3.1 Schematic Framework of GIS Database

2. COLLECTION OF BASIC DATA AND PREPARATION OF BASE MAPS

2.1 Data Sources and Organisations

GIS databases are developed by organisations participating in the development of IS of different sectors. To ensure the broad utilisation of data, summary information including the description of availability, main characteristics, price, contact person, etc. is organised in a so called "Metadata IS" (catalogue of data sources). Metadata systems are used to navigate users among data sources and information providers.

Primary, there are two electronic sources of information about data regarding agriculture and natural resources: the Information System of the Agricultural Sector organised and maintained by the Ministry of Agriculture, and the Environmental Information System established by the Ministry of Environment but maintained by the Slovak Environmental Agency. Both Information Systems include a "Metadata" information sub-system.

The metadata base of the Ministry of Agriculture can be accessed only in Slovak language at the website: http://www.mpsr.sk/slovak/mis/index.php .

The metadata information site managed by the Slovak Environmental Agency is accessible from the: http://www.sazp.sk/english/tematika/stav/ed11/index.html website in English language as well.

GIS databases related to agriculture development and natural resources management are developed by the following organisations:

(1)   Institute of Geodesy, Cartography and Land Registry (IGC) http://www.gku.sk – basic topographic and administrative structures maps, databases and maps of the land registry;

(2)   Slovak Water Management Enterprise – Branch Office Danube River Basin (SWME-DRB) http://pdpr.pod.sk – water management maps and databases;

(3)   Slovak Water Management Enterprise – Branch Office Irrigation and Drainage (SWME-ID) http://www.vumki.sk – irrigation and drainage maps and databases;

(4)   Slovak Hydro-Meteorological Institute (SHMI) http://www.shmu.sk – climate and meteorology data, surface and groundwater quality and quantity data;

(5)   Soil Science and Conservation Research Institute (SSCRI) http://www.vupu.sk – soil maps (small scale maps for Slovakia, large scale maps for the agricultural soils) and derived indicators, indexes;

(6) Geological Survey of Slovak Republic (GSSR) http://www.gssr.sk – data of geology and hydrogeology, boreholes, and database of the geochemical atlas program;

(7) Slovak Environmental Agency (SEA) http://www.sazp.sk – land cover data and data of protected areas, as well as clearing house of environment-related data (basically indicators and indices);

(8) Forest Management Institute (FMI) http://www.lesoprojekt.sk – information on forests including forest soils;

(9) Other institutes and private companies that carry out field surveys and field measurements, provide consulting services on agriculture and land use plans other state and private organisations.

More detailed description about data and information managed by the organisations can be found in Appendix A or through the Internet at the internet addresses provided above.

2.2 Data Collection

The approach in establishing the GIS database was based on the full utilisation of already available data from both the counterpart organisation and other state and private organisations. Based on the reviews of existing databases and sources the tentative content of GIS database was presented and discussed with the counterpart organisation at the 1st Workshop. Data collection was implemented based on the mutually agreed concept.

GIS data acquired by the Study Team are listed in Appendix B. Data are grouped in thematic classes and accompanied by Tables containing more detailed descriptions. The main thematic classes are listed below, and the structure of data tables is presented as well in Table 2.2.1:

Table 2.2.1 Description details of obtained data

Data set	Name of data	Ref. No.	Reference number
Contact person	Name of contact person	Source	Source organisation
Origin	Origin of data/ generation briefs	Format	File/ data format
Spatial coverage	Area extent of data	Scale	Scale
Temporal coverage	Representative years of data	Projection	Geographic projection
Spatial coverage	Area extent of obtained data	Topology	GIS structure
Attributes/ Main items	Additional information related to vector graphics		
Processing	Processing required before application		
Usage	Recommended application of data		
Path in GIS database	File(s) specifications, location in database		

(1) Topography

(1.1) Topographic Map of Slovakia (Table A2.1.1)

(1.2) Digital Elevation contours of the Study Area (Table A2.1.2)

(1.3) Satellite images/ SPOT Panchrometic (2000) and Multispectral (1999)

(2) Climate, meteorology, hydrology

(2.1) Hydrological and Meteorological observation network data (Table A2.2.1)

(3) Soils

(3.1) Soil Monitoring Database

(3.2) Bonited pedo-ecological unit (BPEU) map

(3.3) Geochemical atlas of Slovakia: soils

(4)   Waters

    (4.1) Water Management Map: River Network

    (4.2) Water Management Map: Water Areas

    (4.3) Water Management Map: Water Sources and Groundwaters

    (4.4) Water Management Basins

    (4.5) Groundwater Balance Units

    (4.6) Hydro-Ecological Maps

(5)   Land Cover

    (6.1) Atlas of Slovakia: Potential Natural Vegetation

    (6.2) CORINE Land Cover 1970

    (6.3) CORINE Land Cover 1990

(6)   Forests

    (6.1)   Forest Management Database

(7)   Infrastructure

    (7.1)   Irrigation and drainage database

    (7.2)   Irrigation and Drainage Maintenance Map

    (7.3)   Maps of irrigation and drainage project documents

    (7.4)   Water Management Map: Hydraulic Structures

(8)   Administrative Boundaries

    (8.1)   Map of administrative divisions of Slovakia

    (8.2)   Existing and Proposed Protected Natural Areas

(9)   Socio-Economy

    (9.1)   Statistical Office data

    (9.2)   Field surveys

3. DATA PROCESSING AND GENERATION OF THEMATIC MAPS

3.1 Digital Model of Relief and Soil Erosion Assessment

Input data:

1) raster elevation contours

(1) Topography analysis

Processing:

1) vectorization of elevation contours
2) preparation of data for interpolation
3) building digital model of relief and calculating relief parameters

Output data:

1) Digital Model of Relief:

- Elevation above sea level,
- Slope inclination
- Aspect
- Profile curvature
- Tangential curvature

(2) Soil erosion assessment

Input data:

1) Meteorological data
2) Bonited Pedo-Ecological Units
3) Digital Model of Relief
4) Literature data on Parameters

Processing:

1) deriving input parameters
2) calculating net soil loss (USLE and USPED models)

Output data:

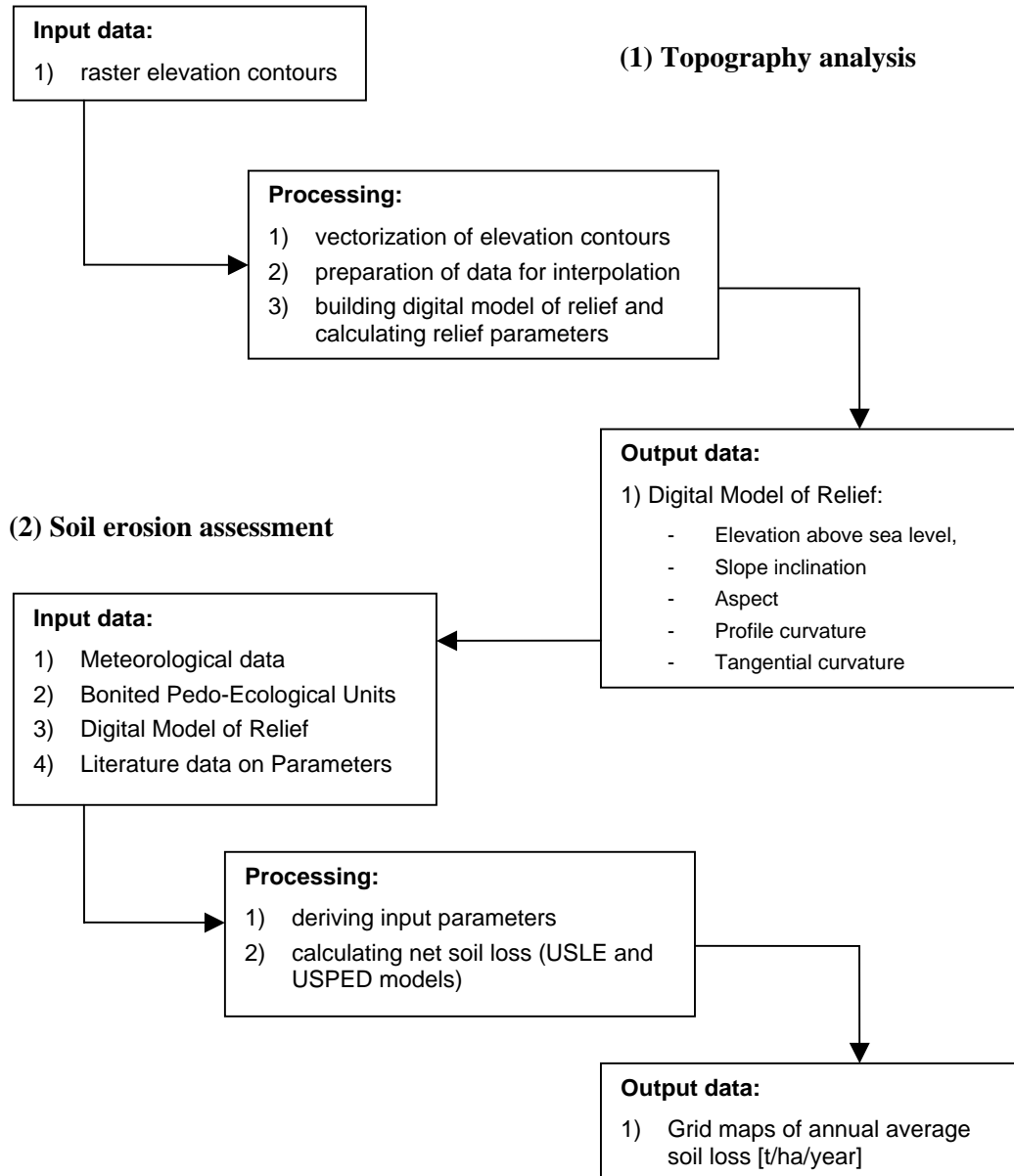1) Grid maps of annual average soil loss [t/ha/year]

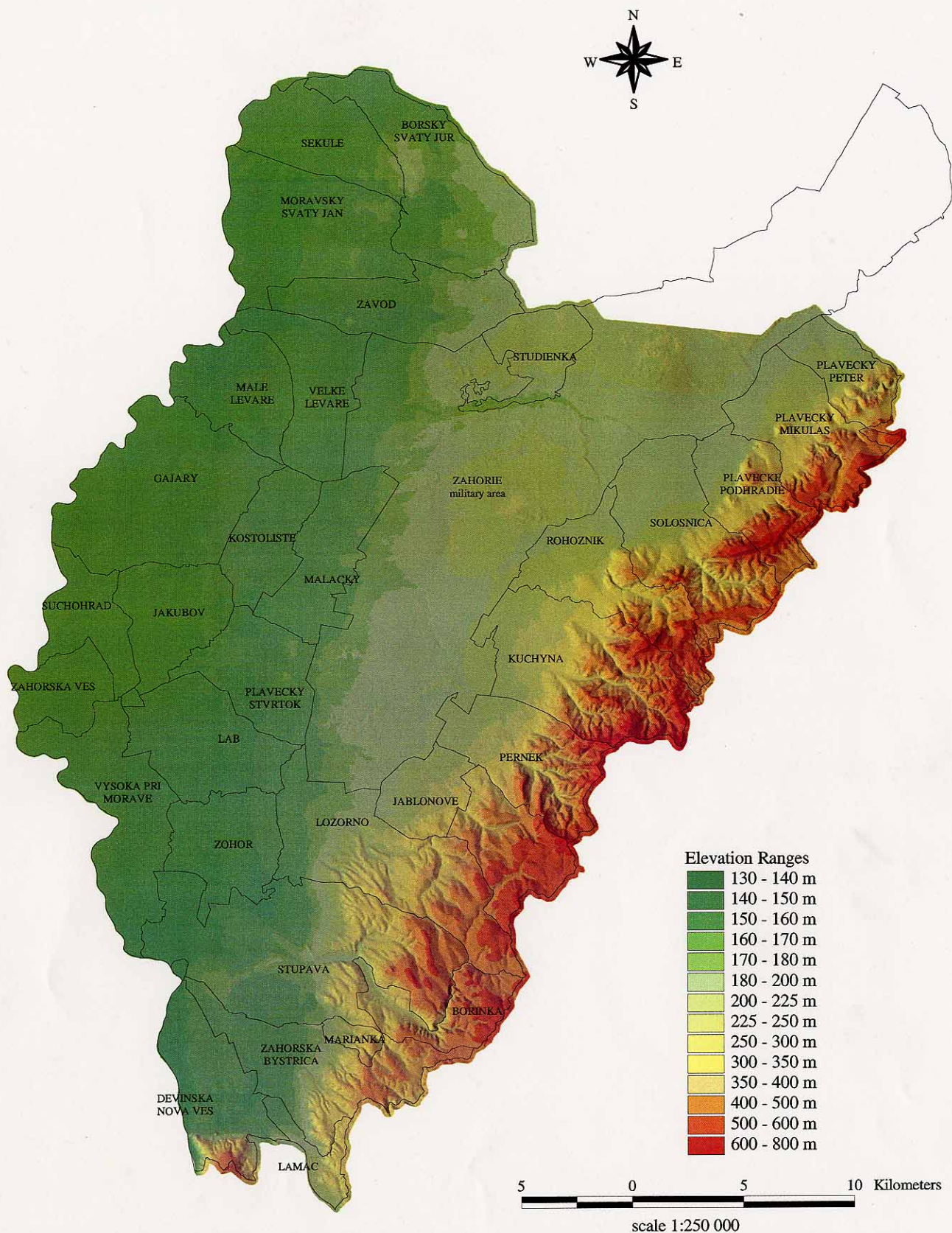Figure 3.1.1 Flowchart of Relief Modelling and Erosion Assessment

Figure 3.1.2 Raster Model of Relief (10m x 10m)
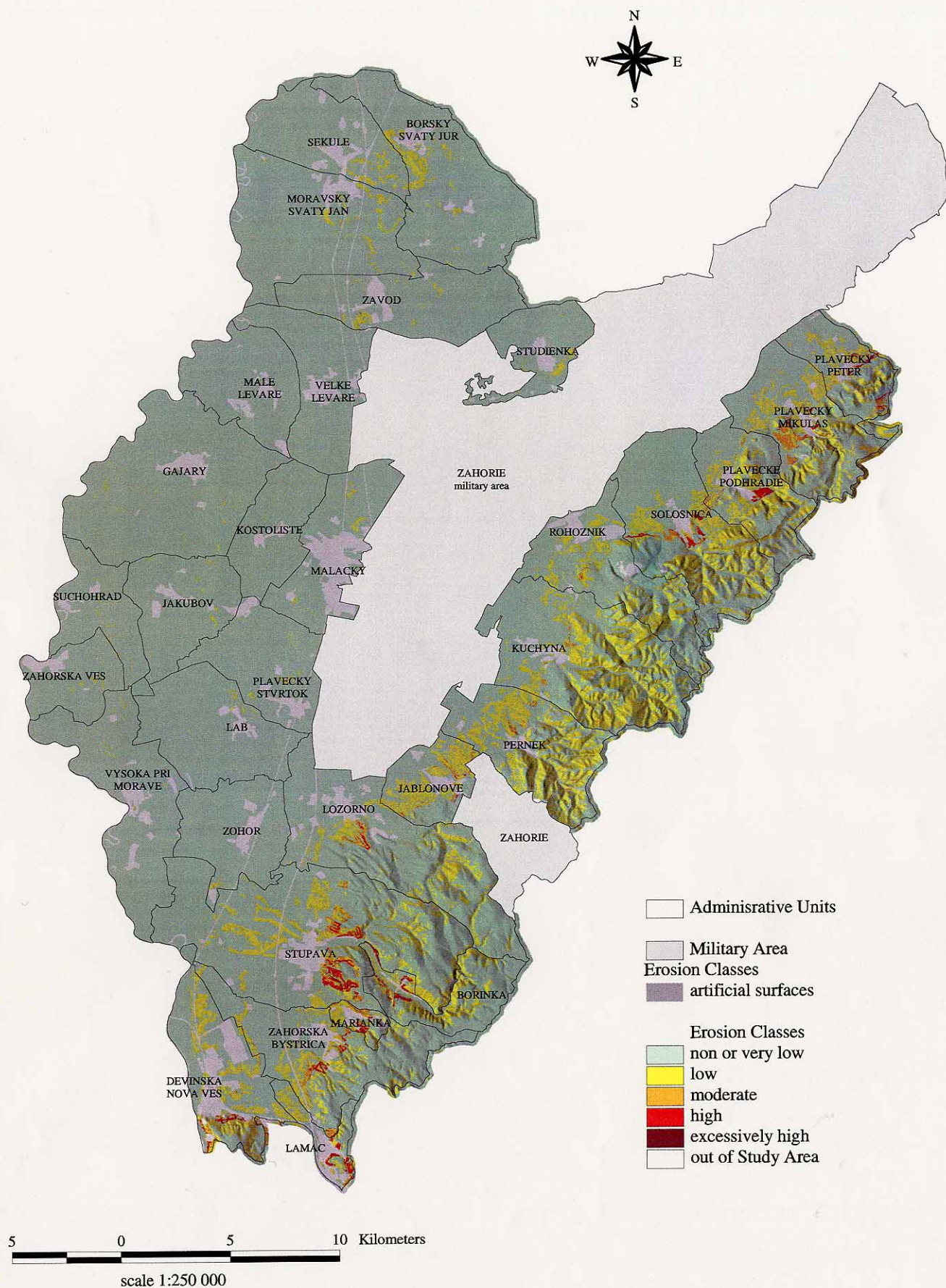
source: Study Team
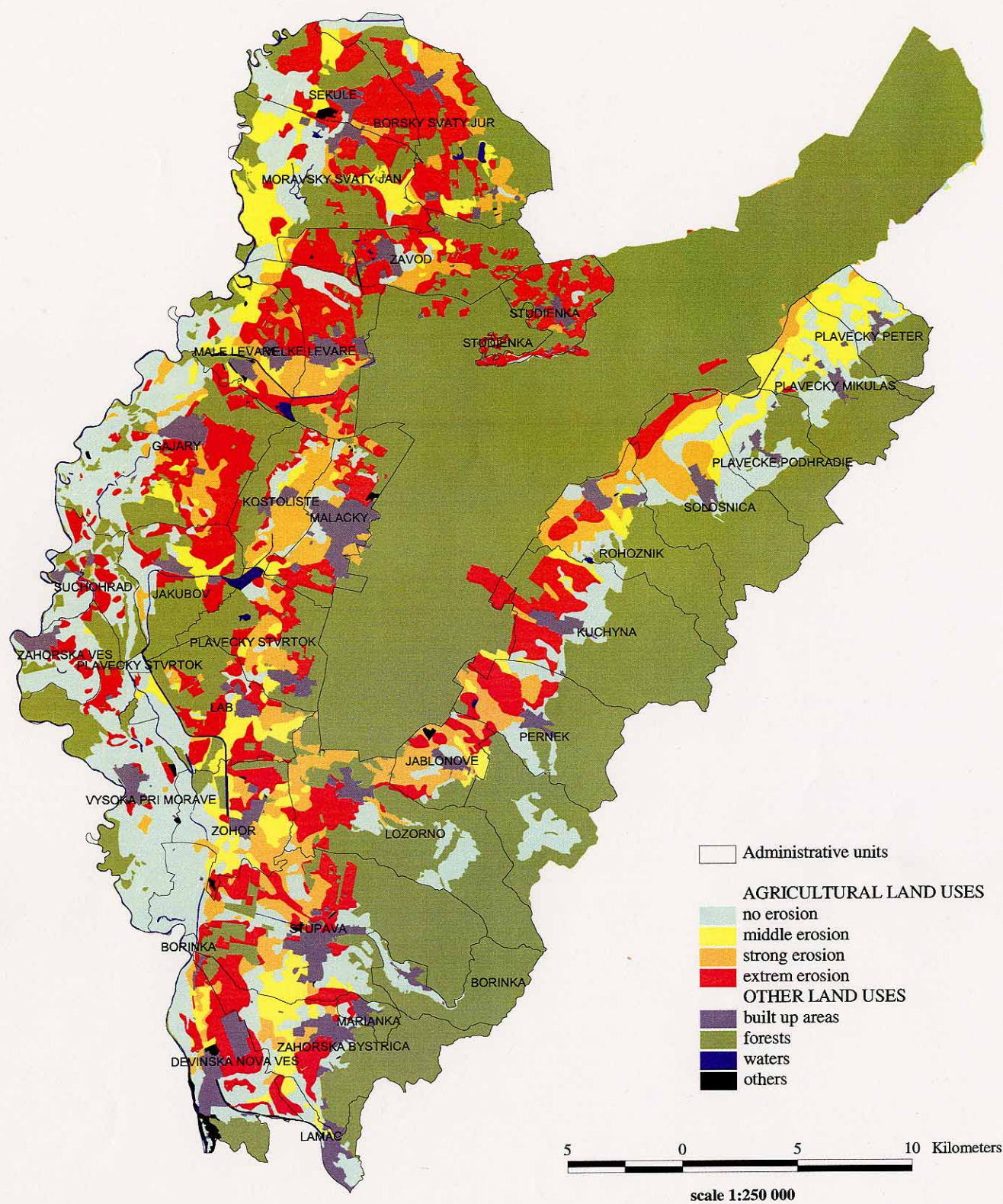
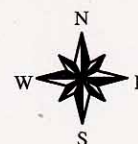Figure 3.1.3 Water Erosion Potential Map
source: Study Team

Figure 3.1.4 Wind Erosion Potential Map

data source: SSCRI