

Analysis of Domestic GIS Applications and the Identification of Domestic Best Practices

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1. Introduction

Geographic Information Systems (GIS) have become increasingly important for many aspects of our life and business, especially in regional and spatial planning. In fact GIS and related technologies became popular in Eastern Europe and Bulgaria relatively late, after the fall of the communism, when those countries were enforced to conduct dramatic and painful reforms of their economies and administration. The so called “Central planning system” was terminated and the new approaches to spatial and regional planning were introduced. The new approaches needed new tools and GIS naturally became popular among the planners. But because of many factors, the process of implementation and using of GIS has been accompanied by some serious problems, which became crucial not only for the development of the GIS, but affecting the whole planning system and reducing its effectiveness.

This report is one of the results of the assignment “Survey on the nationally accessible data sources relevant to the implementation of the Rio Conventions and preparation of information dataset and a guidebook text”. The main objective of the assignment is to be carried out a detailed survey of domestic experience in GIS and related technologies use relevant to the integration of the objectives of the three Rio Conventions (on biodiversity, climate change and land degradation) in development, spatial planning and environmental protection plans and programs at the national, regional and local level since 2002 onwards. The report is outlining some of the main issues, related to the development of GIS applications in the fields of environmental protection management, regional and spatial planning, as well as giving some examples of best GIS practices and recommendations for future work.

2. Methodology

For the purposes of the report, a Best Practice generally is defined as: a high-performance way of achieving specific goals and objectives that solves problems, creates opportunities, and improves results. For a Best Practice (BP) to be effective it must allow for the easy transfer of ideas, knowledge, and standards. Best Practices must also be flexible and adaptable to change if needed.

The report covers 6 best practices, identified after the conducted survey. They are selected mainly based on the criteria outlined above, as well as on the results achieved by the GIS applications /project: how the GIS applications are supporting the organizations and the activities, for which purposes they are designed and how they are helping people and organizations to realize benefits. The selected best practices are covering the following thematic areas:

- Regional and spatial planning
- Sustainable local development
- Environmental change and protection
- Management of protected areas
- Management of natural resources
- Urban planning

The thematic areas listed above were identified as possible “crossing points”, where the Rio conventions on biodiversity, climate change and land degradation could relate with the regional policy, regional and spatial planning and management.

In order to select the 6 best practices, a detailed survey was conducted. The survey aimed at identifying the key “players” on the Bulgarian geo-information market and to gather enough qualitative and quantitative information about the GIS applications, data and services, which they are developing.

Based on their activity profile, the surveyed institutions could be divided as follows:

- Governmental Institutions (32 including the units from the different ministries)
- Local government institutions (municipalities) (10)
- Non governmental institutions (6)
- Academic institutions (2)
- Specific projects with mandate (2)
- Specialized companies and business organizations (2)

After the preliminary selection, a short-list of organizations (12) were visited or called and detailed interviews were performed, on which basis the 6 best practices were identified.

3. GIS applications in Bulgaria- situation analysis overview

3.1. Background information: There are many definitions of Geographic Information System in the literature and vendor brochures. Generally GIS is composed of:

- Human factor – the users of the system;
- Software – the basic GIS software platform;
- Applications – specialised modules and programs people use;
- Data – the information needed to perform analyses, produce various outputs (support applications);
- Hardware – the technical environment on which the systems run.

The “father” of GIS technology Roger Tomlison says - “GIS stores spatial data with logically linked attribute information in a GIS storage database where analytical functions are controlled interactively by a human operator to generate the needed information products” (Tomlinson, 2003).

The human factor is the most important component, although some would argue for the data. Information systems, geographic or not, spring from the needs of people in organizations to do work, answer questions, and generally interact with the world and the people and organizations in it. The Geographic Information System exists to support them and their tasks.

The software component includes different GIS licenses: advance server based GIS, spatial data engines, internet map server, heavy-weighted and light-weighted GIS clients, specialized software extensions, mobile GIS software, etc. The software in any GIS system could include also various databases, drawing, statistical, imaging and other applications.

The applications define the work that needs to be done. In each organisation people need to create all kinds of reports, make all sorts of decisions, and generally apply their skills so the work gets done. The applications arise out of the mission and goals of the organization and require well-defined, consistent method to produce accurate, reproducible results.

GIS applications need data to work. ***Data is*** one of, if not, the most important component of a GIS system. Statistics have shown that approximately 80 percent of the costs of implementing a system are typically accounted for by the cost to develop the data in the system. Usually these high expenses of data are related to the relatively long time periods for digital data generation. Any GIS is

built around an integrated database that supports the functions of all units that need spatial processing. The availability and accuracy of data can affect and define the result of any task or analysis.

The hardware component affects processing speed, ease of use and the type of output available.

3.2. GIS in regional and spatial planning: general requirements

GIS is a product of the contemporary technology and the main driving force for its development is the constant aspiration geographical data to be compiled, generated and demonstrated in order to optimise the processes, related to the investigation, respectively, the management of the territory. The paper maps are simply not sufficient for the description of the complex natural and social systems. They are registering the geography in a specific moment of time, for specific place and have limited scale and characteristics of the features. Therefore, the dynamic time today is forcing us to use more complex GIS technologies for gathering of geographic data, its processing and the generation of geographic information.

Ultimately, GIS is used to produce information needed during the processes of planning, which information usually is used as basis for the decision support. Therefore, we can say that GIS is working towards limitation of the intuitive moment in the decision-making processes and in that sense, supports the planning and management activities in order to achieve higher efficiency in solving the problems, related to the social and economic policy, or to the efficient use of the natural resources.

In relation to the written above, we can define most important tasks of the GIS application in the field of the environmental management, regional planning and development:

- Providing the necessary updated, accurate and complete data, needed by the administration during the processes of planning and management;
- Generation of the necessary information for the regional planning and management, based on the integrated analysis of various data in one modelling environment – GIS.

Based on the above information, we can define the main requirements to the data into the system:

Validity – the data should be gathered only from official sources of information;

Completeness – this requirement is defined as the quantity of information in conformity with the existed normative criteria;

Reliability – this requirement could be defined as the correspondence of the data with real world phenomena, which the separate datasets are describing;

Efficiency- it could be defined as operative provision of data, regarding the condition of the resources;

Organization and „data share”- refers to the establishment of a reliable operative protocol for organization of the gathering and the provision of operative data and information resources, needed in the decision making processes within the administration.

4. Key findings:

4.1. General problems of GIS implementation in Bulgaria:

The design and implementation of a GIS is a major, long-term undertaking. The entire process, from when an organization first becomes aware of the technology till when a system is finally operational commonly takes one or more years. Often the reasons for the failure of such expensive initiative are more or less related with the following:

- **General awareness of GIS:** Geographic information systems can be considered to be relatively new to transitional countries like Bulgaria. Potential users are not fully aware of the functionality of GIS that they can benefit from. Organizations with potential to become major spatial data producers like the NSI need to be involved in systematic initiatives aiming to raise awareness of the application of geo-information solutions in different spheres of social life.

- **Not enough or narrow introduction of the GIS capabilities:** More often this problem occurs when the “carrier” of the idea for GIS implementation is a narrow specialist. In that case he or she is strictly “holds” on his own expertise and usually underestimates or even ignores the other areas, in which GIS could be applied.
- **Not enough or not good investigation of the needs for geographic information in a given organization:** very often such a step is even not taken, which leads to low efficiency of the GIS application and which is usually used only for solving of a short list of problems.
- **Poor or bad planning of the development and implementation of the GIS application.**
- **Problems with the capacity of the personnel:** On one hand, those problems could be related with the lack of specialists, who are responsible for the management of the GIS application. On the other hand, if the personnel are not aware with the capabilities of GIS and how to use it in their own work, it may cause “internal resistance” against GIS, which may discredit the whole initiative.
- **Absence of unified governmental standards** for Geographical Information: the absence of standards is one of the major problems for successful GIS implementation in Bulgaria. Very often this is resulting in designing and implementing of an inappropriate GIS applications or data, which is limiting their effectiveness for decision making purposes.
- **Problems with map projections and coordinate systems** - 17 years after the transition started, in Bulgaria the problems with the coordinate systems are still present. They are generated from the fact that in the country is still used the so called projection 1970, whose parameters are known only by a limited number of surveyors and which is not in the list of projections in all commercial GIS packages. That is causing additional expenditures by the organizations for projection transformation of the datasets.
- **Institutional Capacity:** experts, along with software, hardware and data are an inseparable part of any contemporary GIS. A problem, typical to the country is related to the education and training of the GIS specialists. There is an obvious lack of capacity in the institutions, including NSI to work with contemporary geo-information systems, and the main reason for this is the insufficient training and education. There is only one MSc degree programme in the country (at Sofia University “St. Kliment Ohridski”), and only a few offered training programs. This is resulting in a shortage of qualified specialists and self-training is still the most preferred form in the Bulgarian institutions.
- **Spatial Data Infrastructure:** The National spatial data infrastructure (NSDI) encompasses policies, standards, and procedures for organizations to cooperatively produce and share geographic data. The NSDI in Bulgaria is relatively weak. There is a noticeable lack of coordination in the production and use of data in the country and the region in general. Several conferences and workshops addressing spatial data infrastructure issues took place during the past years without serious outcome. No efforts have been made for the coordinated data production within the country and the region as a whole. An initiative of the Joint Research Centre of the European Commission – the INSPIRE (Infrastructure for Spatial Information in Europe, <http://inspire.jrc.it/>) addresses matters of geographical data infrastructures across 32 European countries. The major problems outlined in the INSPIRE report for the state of the art of the Bulgarian spatial data infrastructure are the very fragmented GIS sector and the absence of a single national mapping agency in the country.
- **Problems related to Software Products and Data Formats:** It is clear that there is an important link between the way in which data are structured in a geographical database and the type of functions that can best be employed. Furthermore, restructuring geographical data is time consuming and error prone. Vector data which is the main one used within the statistical offices needs to be appropriately structured, so that it is suitable for further analytical procedures. Another very important issue in this aspect, a topological model has to be applied for all spatial objects, so that geometric relations found in the real world are followed accurately and errors are discovered and corrected once after they have occurred. Harmonization and standardization of data as produced by multiple producers is an urgent issue. Interoperability of the GIS software and the

used data formats have been subject to worldwide discussions during the past few years. It is very important when developing time-consuming and expensive systems like GIS. Regulative bodies working towards the standardization of spatial data have been established on regional and global scale. The main organization involved in interoperability activities worldwide is currently the Open GIS Consortium (www.opengis.org), which is a member-driven, non-for-profit international association that is involved in the development of geo-processing interoperability computing standards. Very few Bulgarian organizations are members of the Open GIS Consortium at present. Old formats of spatial data still exist within the country's infrastructure, particularly within the cadastre. Parts of the Bulgarian cadastral system are contained in simple ASCII text files (ZEM files), containing coordinates and attribute values. Specific software is developed for manipulating those outdated files. No contemporary software product like ESRI's ArcGIS or Geomedia's Intergraph can handle those spatial data sources. Such problems complicate the normal exchange of information between governmental agencies.

- **Problems with Metadata:** Metadata is crucial for the normal building up of a countrywide geographic data infrastructure. There is no metadata standard for spatial data being created in Bulgaria. This fact seriously affects data users who can not smoothly exchange and use spatial information. National standards should be adopted and their use must be obligatory. The provision of metadata must be well structured and widely accessible. An appropriate example of metadata standard is the one developed by the United States Federal Geographic Data Committee (FGDC, <http://www.fgdc.gov>). Other example is ISO 19115 (Adopted in 2003) Geographic information - Metadata. The objective of ISO 19115 is to provide uniform rules for describing digital geographic data. This ISO is intended to be used by information system analysts, program planners, and developers of geographic information systems as well as others in order to understand the basic principles and the overall requirements of standardization of geographic information. Similar standards need to be adopted in Bulgaria because this is the first step towards improving the Bulgarian spatial data infrastructure. The National Statistic Institute as an organization involved in spatial referencing, by integrating various data, should be one of the first to initiate the building up of a countrywide metadata standard.
- **Limited public access to Geographic Information:** generally governmental institutions are not providing adequate public access to the geographic information, which they are collecting.

As a general conclusion here, we can say that the problems with GIS implementation in Bulgaria are more often organizational, not technological in nature.

4.2. Specific problems the field of GIS implementation in the regional and spatial planning in Bulgaria, identified in the detailed survey:

- There is only one GIS application, designed specifically for decision-makers in regional planning process; (Described as Best Practice 1: Prototype GIS for South Eastern Planning Region - collaborative project between TIME foundation and Bulgarian foundation "Biodiversity", funded by Swiss Agency for International Cooperation (SAIC)) Others GIS, used for purposes of regional analyses (in MRDPW, NCRD, Sofia University) are developed for use in specialised departments by GIS specialists and are not suitable for use by planners and decision makers.
- There are two functional GIS applications for urban planning - master plans of Sofia and Varna (under development) municipalities. Like in case of regional planning, in the survey were identified several cases of GIS use in the process of planning and preliminary analysis, also for map producing. (Plovdiv, Sozopol, Sliven etc.);
- Only the Sofia Master plan is available online and together with the cadastral map of the municipality could be accessed through specially designed ArcGIS server (ArcIMS);

- There is a variety of different GIS applications and data, collected from different organizations, in different time periods, different coordinate systems and scale. The data is structured, maintained and use in different ways within ministries, their directorates and units;
- There is no unified standards within the organizations for the data and very often are used even different file formats (For example Rila and Pirin National Parks are using ESRI platforms and Central Balkan national park is using AutoCAD Map format);
- Most of the public institutions (about ¾ of the surveyed) are only consumers of geographic information, counting on external deliverers;
- Practically all of the surveyed institutions are viewing GIS as an important issue for future development, but only 15-20% are using GIS for spatial analysis and modelling. That clearly indicates that in Bulgarian public sector GIS are mainly regarded as environment for **data collection and not as a decision making tool**;
- The MOEW is the institution with the largest number of different GIS applications. There are separate and independent GIS applications identified in the: Executive Agency for Environmental Protection, Water Resources Directorate and the four Basin Directorates, National parks, National Service for Nature Protection, etc;
- The MRDPW has a set of administrative data and some environmental – Natura 2000, Corine Land Cover, Water recourses. There are some modules and functionality developed. The problem is that everything is located in one department with restricted access to the data. A lot of experts even don't know about what the Ministry has.
- Very often even in one unit of MOEW are used different data formats – for example the 4 basin directorates are using different formats for data storage (geo-database, shape files, MS Excel, MapInfo Tab, MS Access, ZEM, text files);
- In the majority of the surveyed cases, the designed GIS applications or the results from them, are not publicly accessible and only in few cases the GIS data could be downloaded (UNDP Rhodope project, Natura 2000, etc.) or provided free of charge (CORINE project and Prototype GIS for South Eastern planning region – TIME foundation). From what is said so far it is evident that one of the most problematic issues in the Bulgarian GIS sector is the absence of adequate information and the data access. This is leading very often to “capsulation” of the GIS application, which is causing the absence coordination between policy-making institutions;
- The surveyed specialized GIS applications in the field of environmental management, regional and spatial planning are not related at any level, they are independent and there is no exchange of information resources. That often results in incorrect information and data and generally limits the quality and the functionality of the GIS applications;
- In almost all responses, the problem with the shortage of qualified and trained people is present. That is another common problem for the entire GIS sector in Bulgaria. The problem is even deeper, because the majority of the GIS specialists are qualified in the field of data collection and data processing, and there is a very serious deficit of specialists in the field of spatial analysis, generation of information and spatial decision support. This is reflecting in narrowing of the efficiency of the GIS applications.

As a conclusion, we can say that in Bulgaria there is a general absence of coordination between the institutions in their work in the field of GIS. Most of the institutions are collecting and processing geographic information independent of each other and without any general rules and standardised procedures. There is no information exchange or data between the different institutions which costs a lot of money to the taxpayers. One of the possible decisions for this problem could be the establishing of a Central Body independent of the Government, which can provide focus and forum for common interest groups in the geographical information area, undertake promotional activities and review progress and submit proposals for developing a national policy. Its members should come from all interested groups and it should maintain strong links with the Government.

5. Suggested Domestic Best Practices

1. Prototype GIS for South Eastern Planning Region- collaborative project between TIME foundation and Bulgarian foundation “Biodiversity”, funded by Swiss Agency for International Cooperation (SAIC)

General data

Programme Area:

Regional policy

Funding

Swiss Agency for International Cooperation (SAIC)

Partners

TIME foundation

Bulgarian foundation “Biodiversity”

Project start: February 2005

Duration: 1 year

Objective

The main project objective was to build a prototype GIS application as decision support instrument for the Regional Development Plan for the South Eastern Planning Region.

Other supplementary objective was to promote the GIS system, as useful information technology to other planning regions and the MRDPW.

Description

The prototype GIS application contains three main elements:

- GIS database with common and specialized data
- GIS analytical tools
- GIS training materials

The GIS database is containing the following layers:

- Digital elevation model (100 m cell)
- Administrative units - the boundaries of districts, municipalities, zemlishta and settlements
- Hydrography
- Geology
- Soils
- Land cover
- Protected areas
- Transport network
- Specific regional development zones and projects

From a functional point of view the GIS application is designed to support the following processes:

- Data collection and integration of data from variety of sources and formats;
- Storing and management of geographic information;
- Updating the geographic information;
- Performing of analysis and modelling of the geographic information;
- Exchange of information;

- Training the personnel.

There are four GIS analytical tools (modules) designed to work with data in the geodatabase:

- Transport accessibilities
- Analyses on demographic potential
- Analyses on potential erosion
- Module for suitable place for waste disposal

The data is organized in a unified and a topologically correct database with common coordinate system - UTM zone 35N, WGS1984.

The analytical tools are organized in a Model builder environment, which makes them usable for different data sets. The toolbox is containing models for accessibility assessment, geomorphological risk assessments, assessment of demography potential and location - allocation analysis. The tools are working automatically, with an own interface and an adequate support documents.

The training documents are in the form of a training manual with training data. The emphasis is on the hands-on exercises, which are covering all major aspects of GIS. The language of the materials and their level are relevant to the average capacity level of the personnel in the three district administration- Sliven, Yambol and Burgas.

Relevance of GIS use:

The GIS application was delivered to the three district administrations (Sliven, Yambol and Burgas) under a contract with SAIC, which regulates the update of the system and to guarantee the access to the information resources.

These tools can be a rich helper for decision makers in few popular cases. GIS system utilizes tasks of everyday work (preliminary investigations) in following cases:

- Calculation time for reaching a planned object by places and share of population that could use that service.
- Analyses (calculations) of demographic potential of the area of some activity or decision (on municipality level)
- Analyses of potential erosion on a whole managed area
- Evaluation of advantages and disadvantage in decision for new waste disposals for the settlements in the area

In all cases the analyses could be printed as maps of the area and tables with figures.

The officials from 3 district administrations (Regional policy and planning departments) reports that they use GIS and with help of guide book can produce thematic maps.

Replication potential:

The developed GIS application is fully functional. It could act as a model for designing of an easy interface in GIS environment for use by decision makers.

The system gives some important advantages for future development:

- Analytical modules are easy to use by non GIS professionals
- No need of huge investments on hardware and basic software
- Easier actualization of data
- Easier extension of data and functionality

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2. Conservation of Globally Significant Biodiversity in the Landscape of Bulgaria's Rhodope Mountains - project GIS database – UNDP and Ministry of Agriculture and Food supply**General data****Programme Area:**

Energy and Environment, Policy

Funding

Global Environment Funding (GEF)

Ministry of Agriculture and Food Supply (MAF, MAFS)

Ministry of Environment and Waters (MOEW)

Ministry of Regional Development and Public Works (MRDPW)

UNDP Bulgaria

Swiss Government

Partners

Ministry of Agriculture and Food Supply (MAF, MAFS)

Ministry of Environment and Waters (MOEW)

Green Balkans Federation

Bulgarian Society for the protection of birds

Project start: June 2004**Duration: 5 years****Objective**

The goal of the UNDP/GEF Rhodope Project is to protect globally significant biodiversity and to promote its sustainable use in the Rhodope Region. The project aims to conserve the unique natural and anthropogenic mosaic of habitats, species and land uses that form the Eastern and Western Rhodope landscapes. Activities are focused in areas with sensitive ecosystems and landscape components, such as priority conservation areas, buffer zones and corridors, as well as more general forest, pasture and agricultural lands.

One of the major activities is focused on GIS database development, which is good fundament for building of whole GIS applications in the field of Environmental protection and management as well as regional, spatial and local planning and development. The project is an example of “good GIS practice” because of two main reasons:

- In almost all activities and assignments, there is a requirement the reports on the findings to be presented also in GIS format.
- Basic GIS datasets is open to the public and could be downloaded from the project website.

Description

A geographic information system (GIS) is created for the entire Rhodope Mountain, which is permanently enlarged and updated with information, resulting from the project assignments and activities.

From structural point of view, the GIS database is divided based on the administrative territorial division of the region - a separate dataset for every municipality is created, containing basic spatial data and information. The content of every dataset is as follows:

- CORINE Land cover data

- Forest data, presented by scanned forest maps, provided by the National Forest Agency
- Relief – basic elevation data in vector and raster format as well as derivative data- slope, aspect etc.
- Administrative division- municipality, “zemlishta” and settlements
- Hydrography
- Roads
- Protected areas

The datasets are projected in UTM 34N and 35N projection, datum WGS1984, which makes the data easy to use with standard commercial GIS packages. The data is developed in ESRI ArcGIS file formats with good metadata support.

The major limitations of the datasets are:

- The forest data is presented in tiff format - it has only presentation functions without analytical applications;
- In the downloadable datasets, the protected areas, as well as the results from most of the assignments are not included, which is limiting the use of the datasets for planning purposes;
- There is a difference between the initial scales of the data, for example the data about the administrative divisions is digitized from 1:5000 maps and plans, while the rest of data is digitalized mainly from 1:100000 maps. That could cause some errors in data and information processing.

The main advantage of the provided datasets is that this is one of only few GIS datasets with free online public access.

Relevance of GIS use:

The project works extensively for strengthening the information basis for the region, collecting information on natural resources through the implementation of large scale scientific field surveys of habitats (covering more than 200 000 ha) and species (8), as well as through the field monitoring. The collected information is being inputted into the GIS developed by the project, which GIS is widely promoted as a modern tool for territorial planning among planners.

In relation some activities have been held.

- Several meetings and trainings of municipal administrations and other relevant bodies have been held
- The Project implemented series of surveys which aimed to integrate nature conservation concerns into local planning and in the production sectors and use of information systems like GIS and information collected during the project.
- A guide book “GIS – the world around us” is published. The main topics in the book are implementation of GIS and functionalities that could be used in planning process in the Rhodope Region in the field of human impact at the nature, evaluation of potentials of territory, forest and water management, sustainable development, nature risk protection etc.

“The data, published on Internet site of the project are very up-to date and useful. We have used the GIS data to confirm results from one of our projects” (Kristina Mandova from “ETP Foundation”).

Replication potential:

Two main facts could be expressed as a most important in the future development.

- Planners, decision makers and experts from more than 40 municipalities were trained to use GIS in their daily activities. Capacity built during the project is a good basis for future contemporary way of planning.

- GIS developed under the project is a good tool for large scale of planers and could be basis for future development and upgrade.

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3. Corine Land Cover 2000 (CLC2000) - program of the European Environment Agency (EEA) and its member countries in the European environment information and observation network (Eionet).

General data

Programme Area:

Environment

Funding

European Environment Agency (EEA)
 Ministry of Environment and Waters (MOEW)

Partners

Ministry of Environment and Waters (MOEW)
 Executive environment agency at the MOEW - Project coordinator
 Datecs Ltd

Project start: September 2002

Duration: 2 years

Objective

The project CORINE (Coordination of information on the environment) programme has four main objectives:

- to compile information on the state of the environment with regard to certain topics which have priority for all the Member States of the Community;
- to coordinate the compilation of data and the organization of information within the Member States or at international level;
- to ensure that information is consistent and that data are compatible;
- To produce accessible and usable GIS database of the Land cover and land cover change in Europe;

Description

In order to determine the Community's environment policy, assess the effects of this policy correctly and incorporate the environmental dimension into other policies, there is a need of a proper understanding of the different features of the environment:

- the state of individual environments,
- the geographical distribution and state of natural areas,
- the geographical distribution and abundance of wild fauna and flora,
- the quality and abundance of water resources,
- land cover structure and the state of the soil,

- the quantities of toxic substances discharged into environments,
- Lists of natural hazards, etc.

A further objective of the CORINE programme is to bring together all of the numerous attempts which have been made over the years at various levels (international, Community, national and regional) to obtain more information on the environment and the way it is changing.

Two main types of complementary action have been taken to meet the programme's objectives:

- devising procedures for collating, standardising and exchanging data on the environment in the EC Member States;
- creating a geographical information system to provide the information on the environment which is essential when

Corine Land Cover 2000 (CLC2000) is an update for the reference year 2000 of the first Corine Land Cover database which was finalised in the early 1990s as part of the European Commission programme to COoRdinate Information on the Environment (Corine). It provides consistent information on land cover and land cover changes during the past decade across Europe.

CLC2000 is based on the photo-interpretation of satellite images by the national teams of the participating countries. The resulting national land cover inventories are further integrated into a seamless land cover map of Europe.

Main ancillary data, used in the project are:

- Aerial photographs (georeferenced and orthorectified) at scale 1:5000, 1:16,500, and 1:40,000.
- Digital topographic maps at scales 1: 5 000; 1:25 000; 1:50 000; 1:100 000 and 1:200 000.
- Digital city and thematic maps.
- Vegetation map at scale 1:600 000
- Tourist maps at scale 1:50 000
- National statistical data

The resulting European database is based on standard methodology and nomenclature. CLC2000 shows the land cover changes in ecosystems such as forests, lakes, pastures etc. and the impact of human activities (such as housing, food production, transport etc.) on land use. Forty-four land cover classes are used to map changes over time, all of which tell their own story of how decisions made across Europe have led to alternations in the landscape.

In Bulgaria the Executive Environmental Agency is the responsible institution for the CORINE project and the contracted organizations are Space Research Institute at Bulgarian Academy of Sciences and DATECS Ltd.

As a result from the projects are delivered the following major products:

- **Product 1:**
Individual satellite orthorectified images with 25 m resolution
- **Product 2:**
National processed image IMAGE 2000: national mosaic based on the national map sheet nomenclature for all spectral bands with 25 m resolution
- **Product 3:**
National CORINE Land cover GIS database CLC2000 for year 2000, generalized in 44 classes of land cover with 25 ha minimum mapping area. The data is stored in vector and raster formats.
- **Product 4:**
National Database for the differences (bigger than 5 ha) between CLC 1990 and CLC 2000 in vector and raster formats.

According to the signed agreement between Bulgarian Ministry of the Environment and Water (Executive Environmental Agency) and European Environment Agency (EEA) access to the products is free of charge for non-commercial purposes following the filling in of both the **Declaration for use** and **Standard request form for provision**.

In accordance with the EC I&CLC2000 project, the CLC2000 Bulgaria project gave as results the following products:

- National CLC2000 and Revised National CLC90 database;
- National CLC 1990-2000 change database;
- National CLC2000 metadata.

Relevance of GIS use:

One of the main objectives of the project is to produce accessible and usable GIS database of the Land cover and land cover change in Europe. The photo-interpretation of satellite images is impossible to be done without using powerful technology like GIS system. The resulting national land cover inventories could be further integrated into a many other GIS application in European, national, regional and local context.

Most of surveyed institutions report that they have data from CORINE project and use them in their research.

“MRDPW: Corine dataset is part of GIS and is used for producing maps and analyses. (Svetla Guncheva, GIS expert)”

“NCRD, MRDPW: Classification of Land use types could be used not only for regional, but also for local and urban planning. (Stoycho Motev, architect, regional and urban planer). “

Replication potential:

Land use cover is characteristic of the territory, used in a lot of analyses. Actually, according to survey, the results of the project are part of all GIS application used for various planning purposes.

The replication of data is assured by following facts:

- Unified classification of land use type on European level.
- Easy access to the data
- Huge interests of planners and researchers to the data
- Inventory of the territory was planned to be done every ten years with allocations of land use changes during the period.

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4. Rila National park GIS for the management plan implementation

General data

Programme Area:

Management of protected areas

Funding

Ministry of the Environment and Water

Rila National Park Administration

USAID

Project start: 2000

Duration: permanent

Objective

The main objective of the created GIS database is to support the decision making process in the implementation of the Management plan of the National Park. Therefore the GIS application is based on:

- A detailed GIS database for National Park Territory
- A set of GIS analytical tools and protocols, relevant to the operational activities of the management plan

Description

The GIS database of this specialized GIS application contains the following datasets:

- Digital Elevation Model with cell size 12 meters (ESRI GRID format)
- Contours, digitized from 1:25000 paper maps
- Hydrography
- Roads and path network
- Forests
- Geology
- Soils
- Protected areas
- Habitats
- Tourist and other technical infrastructure
- Special zones and areas

The database is in the coordinate system 1970, but also data can be provided in UTM 34N, WGS1984. Majority of the data is topologically correct, but some of the data is with limited analytical functionality, because of the fact, that initially it was created in AutoCAD map format without attributive tables.

The tools, which are available for the park administration's GIS directorate, are:

- Surface spatial analysis tools: statistical surfaces creation, interpolation, morphometric measurements;
- Conversion tools - for coordinate and projection transformation, file conversion etc.
- Overlay analysis tools

Relevance of GIS use:

The application is good example of GIS practice, because the application is using not only for planning and visualization purposes, but also for operational day-to day management and administrative activities.

The GIS data is strictly for internal use, with limited exchange with other institutions (mainly within the system of MOEW).

Replication potential:

The application is having good replication potential in the following subject areas:

- The GIS application and related GIS database are developed according the standardized rules and procedures for creation of such specialized applications (so called “Tomlinson” approach). The planning process is closely related with the Management plan of the Rila National Park and all stages from introducing the idea for the application through the planning, database creation, training of the personnel and the final implementation of the GIS application are conducted in collaborative environment, formed between external consultants and the park administrations;
- The created GIS database is accompanied with specialized tools for spatial analysis and information generation which is making the GIS fully functional;

Tatiana Malehevska from Rila National Park Administration reports: “Without GIS application the management of park will not be effective and inventories of forests, areas, habitats, etc. would be impossible to be kept up-to-date.”

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5. JICA funded “GIS for integrated management of Waters”

General data

Programme Area:

Natural Recourses Management

Funding

JICA-Japan International Cooperation Agency

Partners

Ministry of the Environment and Water (Water Directorate),
West-Aegean Basin Directorate

Project start: 2006

Duration: 2 years

Objective

The project objective, concerning GIS is the development of GIS Database (GIS-DB) for storing all basic data and information needed for the river basin management. The GIS database and the integrated basin analysis model are effective tools for the development and update of the river basin management plan.

Description

The GIS-DB is designed to provide MOEW and related organizations with accurate and up-to-date geographic information, related to the river basin management.

The GIS-DB is designed to provide standardized information to MOEW and related organization, following the requirements of EU Water Framework Directive (WFD) and Bulgarian Water Act.

The GIS-DB is designed to provide information required by Republic of Bulgaria (MOEW) for reporting purposes to European Commission.

The main purpose of GIS-DB for MOEW is to create an effective geo-spatial database, using contemporary GIS principles and technologies, based on international and national standards and legislation.

The development of the GIS-DB is based on the existing information infrastructure (software, hardware) of MOEW and related institutions, but it will introduce and implement additional software products, technologies and procedures for use of geographical data.

The general functions for the use of the GIS-DB for MOEW are:

- Collection and integration of digital and non-digital data from variety of sources and formats;
- Storing of geographic information and other related non-spatial information;
- Actualization of the geographic and other related non-spatial information;
- Performing of analysis and modelling of the geographic information;
- Exchange of geographic information between the different informational databases within MOEW system;
- Exchange of geographic information with external systems (other ministries, governmental institutions, European commission);

The structure of the GIS-DB will be in MOEW (Water Directorate), EEA and four RBD's.

The GIS-DB model for MOEW includes the following components, regarding their place and functions in the ministry system:

- Central Informational GIS-DB in MOEW;
- Regional Informational GIS-DB in RBD's;

The internal structure of the central information GIS-DB includes:

- Integrated geodatabase;
- File base information;

In the central GIS-DB are stored all geo-spatial data, which are identified, as base map layers, as well as some generic specialized data for the territory of whole country. In the file base information are stored additional raster data (scanned topographic maps), satellite images, monitoring data, cadastral data (ZEM files) and other information if identified to be necessary. We can use the term "core data model" which will be shared within the ministry and four RBD's. The WFD data model is also stored on a centralized level in MOEW in order to collect, integrate and verify all the information, which should be reported to EC.

Relevance of GIS use:

- The GIS-DB is one of the first examples of National Standardized GIS database
- The GIS-DB is designed to provide MOEW and related organizations with accurate and up-to-date geographic information, related to the river basin management.
- The GIS-DB is designed to provide standardized information to MOEW and related organization, following the requirements of EU Water Framework Directive (WFD) and Bulgarian Water Act.

- The GIS-DB is designed to provide information required by Republic of Bulgaria (MOEW) for reporting purposes to European Commission.

Replication potential:

The GIS-DB application's replication potential could be summarized as follows:

- The whole project is a good example for planning and implementation of National level GIS database and application, offering methodological basis which could be used for all other cases where such GIS applications are necessary- regional planning, environmental management and planning etc.
- The gathered experience for data integration and sharing could be implemented in all applications where spatial data is coming from different sources and is with various genesis and characteristics.

Lubomir Markovski from West Aegean basin says: "With a powerful tool like "GIS for integrated management of water, the water resources could be managed in a more successful way."

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Ministry of Environment and Water,

JICA project "***Integrated management of Waters in Bulgaria***"

6. Varna Master plan GIS application

General data

Programme Area:

Urban planning

Funding

Varna municipality

Territorial urban planning organisation (TPO)

Partners

Territorial urban planning organisation (TPO)

National Centre for Regional Development

Project start: March 2006

Duration: 3 years

Objective

The GIS application is designed to support the analytical and planning processes, related to the development of the Master plan of the Varna Municipality. After end of the project GIS application could be basis for development of used oriented modules, open to the public.

Only two master plans in Bulgaria were based on real GIS applications (Sofia and Varna), but only the GIS application for the Varna Master Plan has all elements of specifically designed GIS application for planning.

Description

The project for the design and implementation of specialized GIS application for Master plan development and management of Varna Municipality is still in development. In fact, the idea is the functioning and the use of the application to evolve into a municipal Geographic Information System - which makes the application different from the GIS for Sofia municipality Master plan, and because of that it is a good example of GIS practice.

The GIS application is containing three interdependent modules:

- Basic GIS database
- Specialized GIS database- the Master plan
- GIS analytical tools

The basic GIS database of the municipality contains detailed data about:

- Relief
- Cadastre
- Infrastructure
- Demography
- Economy
- Social information
- Environmental data and information

The GIS analytical tools are the linking unit- based on the basic GIS database, data is processed and generated information is used to be built specialized GIS database.

All data is derived from detail paper maps (1:5000 to 1:10000), which makes the data very detailed and usable for all kinds of analytical operations. The data is available in projection 1970, as well as in UTM 35N if needed.

According to the intentions of the municipal administrations, the GIS database will be set on ArcGIS server, which will make it public and on-line accessible.

Relevance of GIS use:

Designing a master plan of big city like Varna is complicated and time-consuming task. In the planning process a lot of data are collected. The wisest way to save and use of data is to develop a GIS in the process of planning. In this way GIS system will play two main roles – as an instrument during the preparing the master plan and on the other hand – to be an additional result of it. GIS is not only a tool for producing excellent maps, but a powerful tool for future use and developing the plan.

Replication potential:

GIS of Master Plan could be a good basis for developing additional modules for:

- Public customer services like cadastral maps, parcel plans etc.
- Utilities infrastructures
- Calculation time for reaching a planned object by places and share of population that could use that service.
- Place allocations, etc.

Varna municipality representative said that they were proud to have a modern instrument for modern planning and management of modern city.

Research team representative said that they were investigated all positive and negative experience of Sofia Master plan GIS system and have get all proofed practices from it. Thanks to Varna municipality financial support and understanding of this big investment the team is sure that the final result will cover all the expectations.

Alexander Lazarov (Manger, Municipal Enterprise “GIS – Sofia”): “Every big city at present needs not only paper copies of plans and cadastre, but also a powerful system to manage every day changes and support in a best way the decisions of the administration. GIS System could improve public services of municipality. Now everyone could apply for a cadastre blueprint via Internet and monitor on-line the procedure of its issuance. “

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6. Preliminary conclusions

Based on the conducted survey and the investigated GIS applications in Bulgaria, as well as the good practice examples from other countries, the following recommendations could be made:

- There is an urgent need to be established national standards in the country for the geographic information. The absence of such standards often leads to incorrect GIS datasets, which could compromise the designed GIS applications (we saw such example in Rila National Park, where the initial GIS wasn't correctly developed and led to a bad functioning GIS application and the Park administration had to allocate an additional funding and practically developed a new GIS database in order the activities from the management plan to be accomplished).
- Especially in the field of regional planning there is only one and it is prototype GIS application (in the South Eastern planning region) designed especially for use of planners and decisions makers. That is resulting in:
 - Absence of a national system for collecting and processing spatial data and information for the regional planning purposes;
 - Very often the information background for the development of the different strategic documents is "suffering" from insufficient data and information resources. At the end the analytical and strategic part are not very related and are not leading to effective planning;
 - There is no good established, spatially based system for monitoring of the regional development;
 - Despite the fact that some of the so called "District master plans" ("Ustroistveni shemi") were developed in GIS environment (12 District Master plans from 28), this did not result in the development of methodological guidelines how to prepare those master plans.

What could be done to improve the situation?

Firstly, a general Concept for a national GIS for regional planning has to be prepared. Based on that and also on the experience from the regional planning district Master plans, methodological guidelines for the administrative structures should be developed. They have to give to the administrations the necessary "instructions" how to collect the data, how to input it into GIS, to process it and to provide it to the decision making levels.

After that, a National GIS for regional planning should be created and one of the most effective ways is this system to be internet based (like ArcGIS server applications) with two interrelated elements - for internal use and public.

- First, a general concept for National GIS for regional planning has to be prepared. Based on that and also on the experience from the regional planning district plans, methodological guidelines for the content and structure should be developed. They have to give to the administrations the necessary "instructions" how to collect the data, how to input it into GIS, to process it and to provide it to the decision making levels.
- One of the most effective way a National GIS for regional planning is this system to be created as internet based (like ArcGIS server applications) with two interrelated elements - for internal use and public. (There are some attempts in MRDPW started) That will secure one integrative and accessible GIS environment, where all necessary spatial data for regional (and spatial) planning will be collected, stored, analyzed and used for the various purposes. That will give to all administrative levels and planning authorities at least few advantages: 1) it will save financial resources for individual software licenses; 2) A national GIS database for the whole country will be created and it could be used not only by the regional planning authorities, but also from MOEW and its regional branches, Ministry of Agriculture and food supply etc;

3) Such system will catalyze the process of development of National GIS standards as well metadata standards; 5) The integrative GIS environment will give the opportunity for unified standards and procedures for data collection and processing; 6) Not at the last place - that will give the opportunity for joint planning actions between different municipalities, districts and regions.

- With the support from the Rio Conventions project the concept for such National GIS could be created and a pilot system could be initiated, which could be used as good basis for the building of this National GIS for regional development. The concept should give the clear structure and type of data. It should contain the vision of who should use the data; restrictions (if any); description of all necessary structured data and links between them; clarify the sources (based on this survey too); state the mandatory analytical modules functionality and graphical outputs etc. Existing data and experience in the departments of MRDPW should be kept in mind too. The pilot system would cover a part of territory – may be one of the 6 planning region. It should be placed (installed) in a MRDPW and serve as a tool in planning activity of the few MRDPW directorates. This system could be a basis for future development of functionality and data contents.
- It is absolutely necessary to be established a dialogue and exchange of information between the institutions, especially between MOEW and MRDPW. That will make the GIS applications more effective and will cut the expenditures significantly.
- Very important issue is related to the capacity of the administration to develop and use GIS applications. There is a shortage of people, able to work with GIS, especially to use GIS as analytical and decision support purposes. There is an urgent need for governmental initiative to establish training professional programs in the field of GIS.

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