

The role of Institute of Geodesy, Cartography and Remote Sensing (FÖMI) in the National GIS and RS Program

Achievements and Perspectives

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1 Administrative structure

The national mapping in Hungary is controlled by two organizations.

Geodetic control networks, production of large scale base maps including cadastral maps, large scale (1:10,000) topographic mapping fall under the responsibility of the Ministry of Agriculture and Regional Development (MARD). Topographic mapping for all purposes in scales 1:25,000 up to scale 1:250,000, as well as production of maps for defence requirements including those for NATO is controlled by the Ministry of Defence. The two supervisory bodies of the ministries are the Department of Lands and Mapping (DLM) of MARD and the Mapping Service of the Hungarian Defence Forces (MS). This division of labour has been documented in Act No. LXXVI of 1996 on Surveying and Mapping Activities (later: the Act on Surveying).

1.1 The Act on Surveying

The Hungarian Government had decided to define the tasks and projects related to land surveying and mapping activities as well as to create the conditions to meet the national demands for map supply in a cost-effective way and in accordance with uniform professional standards. The primary aim of the Act was to regulate

- a) The basic tasks of the government in respect of land surveying and mapping;
- b) Mapping of the country's territory based on surveys of uniform principles;
- c) Establishing and maintaining horizontal and vertical controls serving as a basis for all land surveying and mapping activities;

- d) Establishing map bases for the land registers and for geoinformation systems, bringing about conjunctions among them;
- e) The system of management, utilisation and supply of national geodata;
- f) The conditions of performing land surveying and mapping activities;
- g) The system of land surveying and mapping administration;
- h) The resources of the expenses arising in connection with the basic tasks of the government in respect of land surveying and mapping.

The Act was passed by Parliament in October 1996, and entered into force on 1 April, 1997.

1.2 The Lands and Mapping Administration of the Ministry of Agriculture and Regional Development

The Hungarian governmental organisational framework is acting under the supervision of the Department of Lands and Mapping at the Ministry of Agriculture and Regional Development (MARD/DLM). It is responsible for establishing, maintenance and supplying of the geodetic control networks, the large scale base maps including the cadastral ones, the land registry, land protection and valuation, the topographic maps of selected scales and the remote sensing. Special emphasis was given to the tasks related to the implementation of the National Programme of the Adoption of the Acquis Communautaire.

The Department of Lands and Mapping is organised into three divisions:

- Division of Surveying and Informatics, which supervises the tasks relating to control point networks, national cadastral and topographic maps, technical upgrade of land offices and remote sensing.
- Division of Land Registration, which supervises tasks relating to real property registration, land area data supply, carries out legal measures pertaining the dept, and revises the appeals against land office decisions.
- Division of Land Protection and Land Valuation, which supervises the tasks relating to licensing of non-agricultural use of croplands, control of utilization obligation of croplands, support of land restoration and land use as well as supervises tasks relating to land consolidation and related activities.

The above mentioned works are carried out by the following organizations:

- Institute of Geodesy, Cartography and Remote Sensing (FÖMI),
- 19 County Land Offices (CLO) and the Budapest Land Office,
- 116 District Land Offices (DLO) and the Capital Districts Land Offices,
- Office for National Cadastral Program, as non-profit organisation.

The FÖMI provides research and development, and also technical and administrative support to the institutional frameworks as well as supervises the government contracts in mapping and surveying.

The 19 County Land Offices and the Budapest Land Office are responsible for the budgeting, administration, quality control, and the hearing of appeals against District Land Offices decisions. The main tasks for them are as follows:

- Managing and supervising of district land offices,
- Acceptance and quality check of cadastral data,
- Cadastral, land and survey data supply,
- Value added data supply.

Main tasks of the 116 District Land Offices and the Capital Districts Land Offices are as follows:

- Land and real property registration activity,
- Surveying and mapping maintenance,
- Tasks concerning land classification and protection,
- Public data supply

In 1997 the National Cadastre Program started to produce cadastral maps in digital form. This program is being separately funded by the Office for National Cadastre Program (NCP) using credits guaranteed by the Hungarian Government.

2 Institute of Geodesy, Cartography and Remote Sensing (FÖMI)

The Institute of Geodesy, Cartography and Remote Sensing (FÖMI), was established in 1967.

FÖMI, as a governmental institute, has a national mandate in land management, surveying and mapping, and also plays the role of an authority in these areas. FÖMI belongs to the Ministry of Agriculture and Regional Development (MARD) and operates under the direct professional supervision of the Department of Lands and Mapping.

At the beginning, the Institute was responsible for the tasks in organisation, management, supervision, state border survey, R+D activity, and also central data and map archiving of the entire surveying sector in Hungary.

The field of FÖMI activities has gradually been extended to programmes relating to:

- satellite geodesy, from the mid-70s,
- remote sensing for the utilisation of space imagery and aerial photography, from 1981,
- computer based central land registration, from 1988,
- development of geoinformation in the sector of lands and mapping, and also central quality management, from 1997.

Further FÖMI competencies are:

- collection, archive and distribution of documents on surveying and mapping activities,
- running the technical library, editing and publishing scientific journals and proceedings.

Executing its official, operative and R+D activities, FÖMI became a respected participant and organiser of various national and international co-operations. The R+D achievements of FÖMI have been recognised internationally. Also, the Institute plays a significant role in higher professional education - FÖMI hosts two university departments and a space geodetic laboratory.

FÖMI's successful professional activity is honoured by several memberships in scientific commissions, various national and international associations of geodesy, cartography, remote sensing, geoinformatics and space research.

Besides of the directorate's Department of Law and Human Policy, Department of Economy and Finance, independent Department of Quality Management and Supervision, the FÖMI is structured into the following Centres:

2.1 National Centre of Surveying Management, and Data Resources (SMDRC)

In line with Act LXXVI of 1996 on surveying and mapping activities and its enacting clause, the Centre is responsible for the production of the unified horizontal and vertical control point network covering the whole area of Hungary and that of the national base maps of EOTR (Unified National Map System).

In addition to the organisation and management of the surveying and mapping tasks, the activities of the Centre include the maintenance of the existing products as well as the registration and widespread supply of data.

In close co-operation with the competent partner authorities, an independent organisational unit of the Centre is responsible for surveying, mapping, maintaining and recording the Hungarian state boundary.

The Centre fulfils the tasks through the following organisational units:

- Department of Surveying Management,
- Department of Data Resources and Map Archives,
- Department of State Boundary Surveys.

2.2 Lands and Geoinformation Development Centre (LGDC)

The Centre was established in 1997 to serve as an R&D background unit for organizations of the Hungarian land management sector. The Centre has its focal point to make developments, to support utilization of developments needed in changing word of the entire system of land management and mapping. It also co-ordinates the extension training and continuing education for the land offices' staff, and provides technical documentation for the land management sector.

Major tasks of the Centre are:

- to support the land offices in operating and developing the newly introduced information systems
- to elaborate the system specifications and improvements arising from the continuous development of the TAKAROS system (national computerisation of the map-based cadastral system), running, maintenance and development of TAKARNET (networking of the TAKAROS information systems - intranet connection among DLO-s, CLO-s throughout FÖMI) services,
 - to elaborate plans for ensuring the countrywide unification of data and services in surveying, mapping, geoinformation, digital land registration, and land management, as well as to execute and co-ordinate the relevant R&D tasks,
 - to elaborate and maintain standards, instructions and technologies,
 - to produce, maintain and supply mapping, cadastral, land information and geoinformation databases as well as value-added products, with special attention to the potential applications provided by the TAKAROS and TAKARNET systems,
 - to collect documentation of the systems, products and services produced during development activities, as well as maintain and run the central technical library of the sector,
 - to organise the necessary training and continuing education within the framework of the sector's institutional systems,
 - to represent Hungary in common activities of the surveying and mapping agencies and bodies of the EU member states as well as in the European standardisation of geoinformation.

The Centre, co-operating with other units of the Institute, takes part in the professional education provided by the College of Surveying and Land Management, at the University of Sopron.

2.3 Remote Sensing Centre (RSC)

The Remote Sensing Centre has the following major tasks:

- as national centre, it is responsible for acquiring, archiving, pre-processing and

distributing satellite data, imagery, and aerial photographs, and it supports the users through training, consultancy and distribution of information leaflets and brochures,

- it implements application oriented R+D projects, as well as develops technologies, both at national and international level, mainly for use in agriculture, environmental protection management, water management and cartography,
- the RSC is active in the work of national and international scientific bodies,
- as a basic unit of the institutional network of the Hungarian Space Office, the RSC is active in running national and international research programmes.

The Remote Sensing Centre is the national distributor of Landsat, SPOT, ERS, IRS, Cosmos and IKONOS satellite data.

The Remote Sensing Centre maintains the satellite data archives, which contains several hundred satellite images, runs the computer system and colour photo laboratory to process satellite data and aerial photographs.

The Remote Sensing Centre has three departments to perform the above listed tasks:

- Department of Remote Sensing Applications in Agriculture,
- Department of Remote Sensing Applications in Environment
- Department of Sales and Archives of Remote Sensing Data

The RSC, in co-operation with other units of the Institute, takes part in the higher education activities of the Faculty of Geoinformatics at the University of West Hungary.

2.4 Satellite Geodetic Observatory (SGO)

Major tasks of the Observatory are to learn the international results of space technology applications developed for use in geodesy and perform the related R+D works in Hungary. The Observatory introduces the results obtained into practice, continuously maintains and develops the national higher order geodetic network. The Observatory, as a basic unit of institutional network of the Hungarian Space Office, implements national and international research programmes. As an external department of the Eötvös Loránd University (ELTE), it operates a space geodetic laboratory

Major tasks and themes of research and development are:

- development and maintenance of the national GPS (Global Positioning System) network,
- co-ordination of operations in the Hungarian higher order (horizontal and vertical) geodetic and GPS networks and performing tasks coming from international obligations,

- determination of the geoid surface for Hungary,
- running a permanent GPS station information service,
- geodynamic investigations in international, regional and local relations using GPS techniques,
- space-VLBI research and software system development,
- providing highly accurate time service.

3 Role, activities and results of FÖMI

3.1 Status of the Geodetic Control Network

3.1.1 Reference System

A reference system called Hungarian Datum 1972 (HD-72) was introduced in 1972 based on independent adjustment of Hungary's astrogeodetic network. Its reference ellipsoid is the IUGG Geodetic Reference System 1967.

3.1.2 Projection System

A projection system for civil use called EOVS (Uniform National Projection System) was introduced in 1972. The reference ellipsoid of EOVS is the IUGG GRS67. Type of the projection: oblique-axis reduced (secant) cylindrical projection. The whole territory of the country is represented on one strip of cylindrical projection.

To meet the requirements of the domestic and international professional community a Description Directory of Hungarian Reference and Projection Systems has been issued in 1995 by FÖMI. The Description gives an overview on the EOVS parameters, the HD-72 definition, the Hungarian vertical system and the relation of HD-72 to the WGS-72 and the EUREF-89 (WGS-84) systems.

3.1.3 Geodetic Control Networks

Based on HD-72, we established

- Uniform National Horizontal System (in Hungarian called: EOVA),
- Uniform National Height System (in Hungarian called: EOMA)
- Uniform National Mapping System (in Hungarian called: EOTR)
- National GPS Network OGPSH (1153 sites of the OGPSH measured all over the country)

Parameters of connecting the Hungarian control network to the EUREF and ED-87 systems have already been measured, computed and finalised.

For high order scaling a new, 864 m long Standard Baseline near Gödöllő city (about 30 km from Budapest) has been measured with Väisälä interferometric method and Kern Mekometer in cooperation with Finnish Geodetic Institute in 1987 and 1999. This very stable baseline with 5 pillars is accredited for EDM calibrations, for national and international use.

The 3D spatial coordinates of the OGPSH sites are referred to the EUREF-89 reference frame, as well as determined in EOVS projection system for home mapping purposes. The superior accuracy of the GPS network (OGPSH) allows to analyze the traditional EOVA network as a whole.

A digital database of Geodetic Control Networks containing the data of control sites was created by FÖMI. These data are: number of the sites, co-ordinates, location of the sites (county, settlement, sheet number), date of determination, measurement and control of the sites, textual and scanned description of the surroundings.

3.1.4 Control Networks Recent and Follow-on Activities :

- Completion of the vertical network measurements using GPS technology and leveling.
- Major actions to connect the Hungarian geodetic fundamentals to EUREF and UELN.
- National GPS Observation Service for use in different applications.
- Maintaining and analyzing the Hungarian GPS Deformation Network.
- Participating in the International GPS Service.
- Participating in the EUREF Permanent Network activities.
- Adapting GPS technologies for application in different survey tasks.
- Using the Hungarian Gödöllő standard baseline for national and international calibrations.
- Participating in the European Vertical GPS Reference Network (EUVN) project.
- Improving of the present geoid solution for GPS-heightening applications.

3.2 The Cadastre and the Land Registration System

The Hungarian Land Registration System is a unified, multipurpose legal system, integration of the Cadastre and traditional Land Records. In the middle of the 90's there were over 7 million property records and 55 000 cadastral maps which were maintained by the District Land Offices and the Capital Districts Land Office. In the 90's a land compensation program has been enacted whereby land areas are redistributed to former owners or other compensation claimants and this has creating

an effective 2.1 million new land parcels, with more than five million hectares. All these has to be managed, auctioned, divided, set out, and the results assimilated into the land register. This situation required prompt modernization and computerization of Land Offices network.

After the political and economical changes the land privatisation affected more than half part of the country (5.6 out of 9.3 million hectares). All efforts have been made to keep the old cadastral maps up-to-date during the land privatisation process, however, a national-wide map renewal (data capture) programme was worked out to make it possible to unify and update the existing systems within framework of the National Cadastre Programme. New euro-conform professional standard and rules were prepared by FÖMI and issued by DLM of MARD for digital cadastral mapping. On 1st November 1996 the Ministry of Agriculture founded the National Cadastral Program Non-profit organisation (NCD NGO) in order to implement the mapping program and to handle the credit matters, which is guaranteed by the Hungarian Government. As one of the result of the activity of NCP NGO till the end of 2007 all cadastral maps of Hungary will be completely vectorized.

3.2.1 The Land Offices IT development

In the framework of the above task, the following actions are in effect or in preparation (realised or planned deadline in brackets):

- Installation of computerised Land Registration system (property sheet maintenance part) in decentralised form in the District Land Offices (1994) and in the Capital Districts Land Office (1996), connecting more than 2500 PCs in LAN supported by PHARE.
- Loading of all real and land property sheets data (about 7.5 million properties) into the system (1994 - 1997).
- Installation of TAKAROS (TérképAlapú KAtaszteri Rendszer Országos Számítógépesítése – Countrywide Computerisation of Map Based Cadastre) system is completed by the end of June, 2000.
- Completing an intranet type wide area telecommunication network TAKARNET (TAKAROS NETwork) for countrywide data access/supply, by connecting the Land Offices with each other and with FÖMI and DLM (1997) as well as with external users (banks, public notaries, local governments etc.) (2002.).
- The introduction of the TAKAROS/TAKARNET systems gives opportunity for the Land Offices to transform their information service requirements into proactive suppliers of structured spatial information. The County Land Offices are to be developed as the regional centres for spatial information, and this will involve development of marketing skills, product development, project management, and the definition of goods and services to be supplied. A marketing strategy was prepared in 1996-97 for this purpose.
- Development of County Land Office's META system funded by EU Phare Programme (MEgyei TAKAROS – County TAKAROS). In the framework of META created among others a Management Information System will be created

for monitoring, analysing, controlling and directing all of the activities of the Land Offices (2001-2003).

- Investigation of demands and opportunities for new market oriented services, and estimation of the expected income from such services (1997-).
- Development and installation of a central and county-level land use monitoring system, supported by META that enables MARD to harmonise the agrarian subsidy system with the EU Structural Funds (1999-2002).
- Review the legal basis of land management to reflect the requirements of the free market economy and modern technology in use for technical and administration procedures. This required that the law on land surveying and mapping was passed (1996), a new law on land registration was passed (1997), the concept of a law on land consolidation was proposed (1997) and the relevant legislation was completed (1998).
- Introduction of an up-to-date land consolidation procedure aimed at improving land property structure and increasing the competitiveness of agriculture (1999-).

The TAKARNET System

TAKARNET is an intranet-type network, which connects the institutions of the Hungarian land administration (MARD, land offices, and FÖMI) and it provides data supply for external users on Internet.

The network has hierarchical contexture. The central access point set up the data service, and the TAKAROS servers of the district land offices contact to it – across more hierarchical level –, as well as the external users can reach the data through this network.

Services of the TAKARNET for the land management sector are as follows:

- Electronic mail
- Supporting of the work in land offices
- Acceleration of the communication

Services of TAKARNET for external users:

- Information about the property sheets
- Copy of maps
- Handing of applications

Circle of the planned external users is as follows:

- Notaries
- Local authorities
- Banks
- Lawyers
- Property agencies

The physical network was set up in 1998, but the software was installed in the middle of 2000. The network is able to provide data service since 1st July 2000. The service is available in the whole country. External users can use the network after the ministerial decree on data supply and fees enters into force in the first half of 2002.

At the end of 2007 all cadastral maps will be available on the TAKARNET network for dedicated users in vector form.

3.3 Administrative Boundaries Database of Hungary

The Institute of Geodesy, Cartography and Remote Sensing initiated the compilation of the Hungarian Administrative Boundary Database (MKH) in 1998 for two reasons. Firstly, to find another application and new market to a part of data collected and owned by the Land Offices of the country, and secondly, to facilitate the integration process to the European Union.

For development of the database, in co-operation with the Land Offices, FÖMI has started the data collection of the boundaries between the urban and rural areas of the settlements. Now 95% of these boundaries have been collected.

The source of the database is the national cadastre, the directly measured co-ordinates of those boundary points, which represent in the same time administrative boundaries too. The output products are databases of different resolution gained by generalisation.

3.4 Gazetteer of Hungary (Database of Geographical Names, FNT)

FÖMI is responsible for the registration and supply of officially approved geographical names. Two versions of Gazetteers are available. The first one contains about 80.000 names of administrative units, relief, hydrography, natural conservancy areas etc. corresponding to the name density of the 1:100.000 topographic map. The second one refers to the topographic map in scale 1:10.000. Arranging of the names of this version is completed for about 55 % of the country, but not organized into database yet. The database of the first version is available in any RDBMS format.

3.5 Topographic Mapping

Before the Act on Surveying entered into force topographic maps were produced for governmental and military use. According to this, the status of the analogue EOTR topographic map sheets available at FÖMI is as follows:

- scale 1:200 000: 23 EOTR sheets (100%),
- scale 1:100 000: 84 EOTR sheets (100%),
- iscale 1: 25 000: 267 EOTR sheets (25%),
- scale 1: 10 000: 4098 EOTR sheets. (100%)

In the frame of the governmental EU-Harmonization Program the DLM of Ministry of Agriculture and Regional Development supported the scanning and georeferencing of 1:10.000 scaled topographic sheets. This task was carried out in 2000 for the whole area of Hungary. In frame of the EU-Harmonization Program of the MARD we started to create high resolution (5m x 5m regular grid interval) Digital Elevation Model on the base of the raster data sets of relief layer of topomaps at scale 1:10 000. 1400 sheets in scale have been already vectorised. The vector data are to be used for the production of DEM. The high resolution DEM served as a base for the digital

ortorectification of the aerial photographs, created in the frame of “National Aerial Photographic Program 2000 and 2005”.

The 1:100 000 scaled topographic sheets of Hungary are available in digital format, too. Recently, the following products of the 1:10 000, 1:100 000 and 1:200 000 Digital Topographic Map series of EOTR are available at FÖMI:

1:10 000

DTA-10

- raster data of
 - contour lines 4098 sheets (100%),
 - planimetry 4098 sheets (100%),
 - hydrography 4098 sheets (100%),
 - color prints 4098 sheets (100%),

- vector data of
 - contour lines 4098 sheets (100%)
 - planimetry 4098 sheets (100%),
 - hydrography 4098 sheets (100%),

DEM-10

preliminary high-resolution digital elevation model, based on vectorized contour lines for the whole country (DEM with 5m grid interval).

DITAB-10v.0

In May 2007 we finished the vectorization of planimetric- and hydrographic layers of map sheets at scale 1:10 000, constructing a vectorized data base for the whole country.

1:100 000

DTA-100

- raster data of
 - contour lines 84 sheets (100%),
 - planimetry 84 sheets (100%),
 - hydrography 84 sheets (100%),
 - color prints 84 sheets (100%),

- vector data of
 - contour lines 84 sheets (100%),
 - planimetry 84 sheets (100%),
 - hydrography 84 sheets (100%),

- digital elevation model of Hungary (DEM with 100m x 100m regular grid interval)

1:200 000

DTA-200

- raster data of color prints 23 sheets (100%),

3.6 Remote Sensing

3.6.1 R&D plus operational applications

In the framework of the Hungarian Agricultural Remote Sensing Program (HARSP 1980-) supported by the National Committee for Technological Development (NCTD) and Ministry of Agriculture and Regional Development (MARD), 300 man years R+D was invested by FÖMI Remote Sensing Centre (FÖMI RSC). The original final objective of the program was to introduce remote sensing to the operational agro-information system in Hungary. The R+D phase (1980-96) of HARSP was fundamental to the operational CROPMON (from 1997 to date). In the CROPMON program that has been operational for 5 years, FÖMI RSC provides county and country level crop production forecast based on remote sensing, measuring the areas and expected yields of the 8 main crops covering a characteristic sub-sample (9) of all the counties (19). These crops together represent the 78-82 % of the entire Hungarian cropland. The area and forecasted yield data were reported by a strict calendar to the Ministry of Agriculture and Regional Development, 5 times in a season, synchronized to the existing traditional production forecast system of MARD.

The crop area assessment in CROPMON is based on the quantitative analysis of multitemporal high-resolution images (Landsat TM and IRS-1C/1D LISS-III.) providing precise crop area estimation at different levels: locally, in the counties (9) and through extrapolation, for the entire country. The actual standard crop maps were also provided to MARD. The crop yield forecast is accomplished by the application of FÖMI RSC developed model which combines high-resolution satellite (Landsat TM and IRS-1C/1D LISS-III. or SPOT) data and NOAA AVHRR time series. An HRPT receiving station had been installed and operated in FÖMI RSC from May, 1998 to provide secure and real time NOAA AVHRR data access for the models. FÖMI RSC provided yield estimates for the counties and expanded them to Hungary using a regional-historical correlation scheme. Because of the method applied, yield spatial distribution maps could also be reported for the major crops.

3.6.2 Maintaining and further development of the physical block based Hungarian Land Parcel Identification System (LPIS-Hu) for IACS

Past years justified the significance and advantages of a continuously evolving scientific and technological background of using remote sensing methods for agricultural purposes. Land Parcel Identification System (LPIS-Hu) and Control with Remote Sensing (CwRS) play important role in the system of the direct agricultural area-based payments in the EU Member States. The proceeding R+D phase and the operational years of the National Crop Monitoring and Production Forecast program (NCMPF, 1997-2003) that had been carried out by FÖMI provided a good basis for the establishment of LPIS-Hu and CwRS.

The LPIS-Hu (called MePAR in Hungarian) has been one of the ongoing main activities of the RSC since 2002. After the RSC completed the orthophoto background and the GIS database of the LPIS-Hu, and the system was integrated into the Agricultural and Rural Development Agency (ARDA) as one of the main components of the Integrated Administration and Control System (IACS), it was also successfully operationally introduced on maps, and used by the farmers for annual area aid applications of EAGGF from year 2004 on. As a pillar of the IACS, it provides several GIS and administrative support for the farmers during the procedure of area-based aid applications, and for the IACS institutes during the administration and different control procedures.

Area-based Subsidy Control with Remote Sensing (CwRS)

The methodology and technology basis of the NCMF can be used not only for information extraction at county and regional level, but also to extract information on the agricultural areas at parcel level. This allows the control of the agricultural subsidy claims with the use of satellite images.

Using FÖMI RSC's operational remote sensing technology, the remote sensing control of national area-based subsidies was performed on the sample of 4-6% of all the dossiers (160-180 000) between 2000 and 2003. In that period of time, the reference system for the applications and the control was the cadastral system, which clearly showed up that for the agricultural administration that reference system is not very useful. Namely, it needed every year a huge amount of digitisation of cadastral parcels from paper.

From the time of EU accession, the Hungarian Paying Agency, ARDA is responsible for the administration and control of applications of area-based subsidies. The legal basis also changed; the whole system (IACS) had to be fitted to the very strict EU Regulations.

2004 was the first year for FÖMI, when the CwRS control had to be run on the new, physical block type reference system, on LPIS-Hu. The new reference system, the technical requirements, specifications and recommendations of DG Joint Research Centre (JRC) needed some reconsideration of the previously used GIS technique of CwRS. From 2004, the total number of submitted claims in Hungary grew to about 210 000. The successful control of 8 660 dossiers within a very short period of time proved that in some cases the only feasible solution for the OTS (on-the-spot) checks (control of land use + area measurement) is the use of remote sensing + GIS techniques.

3.6.3 Additional applications implemented on the CROPMON basis

The CROPMON makes the implementation of other monitoring programs possible and very cost effective on the same data, infrastructure and know-how basis at the FÖMI RSC. Waterlog and impact monitoring program was launched for MARD that covered the most affected 4 (1998) and 8 (1999) counties of about 4 million hectares.

Reliable waterlog maps and area measures were derived. Beyond the static status assessment of the areas under water or having saturated soil, impact analysis on the crops and the dynamism of changes could also be monitored quantitatively. This assessment made use of high and medium resolution optical data, that is Landsat TM, IRS-1C/1D LISS-III and WiFS as well. The resulted GIS data base and printed maps were utilised by MARD intensively and proved to provide fast, operational information for decision makers. Moreover remote sensing can successfully be used at the parcel specific disaster compensation program for the control of claims.

In years 2000, 2001, 2005 serious flood event occurred on Hungary's second largest river, the Tisza, and several tributaries. FÖMI Remote Sensing Centre carried out remote sensing based flood monitoring operations with its available resources to help the combat providing real time satellite data for the disaster area. In addition to waterlog and flood, large area draught also hit Hungary in 2000 and satellite based draught monitoring were carried out for the detection of extension and intensity of the draught at regional level based on NOAA AVHRR data received at FÖMI satellite station. FÖMI provided a rapid draught report to MARD including county level draught maps and temporal profiles of the most affected crop (wheat) comparing actual data of 2000 to the data of previous years having normal (1991) or draught conditions (1992, 1993).

3.6.4 Hungarian National GIS Vineyard Register (VINGIS) in Accordance with the EU Requirements

According to the Act No. XVIII. 2004 on Viticulture and Oenology, the VINGIS is the Geographic Information System background supporting viticultural land registration and serving as a basis for the checking and supervision of grants awarded for the grubbing up, planting and restructuring of vineyards, and subsidies paid on a vineyard-basis.

According to the 3. Article of the 102/2004. (VI.3.) MoARD regulation, the VINGIS database includes:

- Layer of vineyards,
- uprooted vineyards,
- topographic layer,
- layer of the county's administrative boundaries,
- layer of administrative border of the vineyard community,
- layer of potential lands for vineyards.

These technical data were supplied by integrated external databases and the own internal database of the VINGIS database system. The experiences of the controller unambiguously justify that without these individual VINGIS maps the accuracy of the on the spot checks, and the identification of the target area cannot be satisfactory in every case. The controlling authorities on the base of these experiences, requested the production of individual VINGIS maps for the vineyard related subsidy claims

(uprooting and restructuring) of 2006. Further necessities were outlined regarding the subsidy control of 2007.

3.6.5 CORINE Land Cover 1:50.000

As part of fulfilment of the government resolution on the “Development of environmental information systems”, the implementation of the CORINE Land Cover database at scale 1:50,000 (CLC50) has started within the frames of the Acquis National Programme in 1999. The database supports Hungary’s accession to the EU in various programmes, such as the planning of sustainable agriculture, rural development, agri-environmental planning and nature conservation.

The CLC50 project has direct links to the standard European CORINE Land Cover project, however most elements of the methodology were upgraded according to the present level of technology in geo-data processing. The CLC50 nomenclature used has been developed from the standard (level-3) nomenclature and includes nearly 80 level-4 and level-5 classes, which have been adapted for Hungarian conditions. Orthorectified SPOT-4 satellite images taken in 1998-99 and computer assisted photo interpretation allow for high positional accuracy of delineation. The 0.04 km² size minimum mapping unit (0.01 km² for lakes) provides enhanced geometric detail. A rigorous internal supervision and an external quality control (performed by the National Park Directorates and the counties' Plant Health and Soil Protection Service) are other key elements of producing a high quality database. The CLC-50 database reflects the status of Hungary’s land cover in 1998/99. During the time passed since then, significant changes in land cover occurred in several parts of the country, as confirmed by an update feasibility study carried out by FÖMI in 2004, using support from the Hungarian Space Office. This justifies the updating of CLC50 for 2003/05, which will provide us a “snapshot” of Hungary’s land cover at the time of accession to the EU, an event likely to induce more profound land cover changes in the future. The updated CLC50 could serve as a basis for further land cover change analyses.

Beyond the above considerations, the importance of CLC50 updating is hardly arguable concerning EU initiative INSPIRE (Infrastructure for Spatial Information in Europe). INSPIRE – whose databases include land cover as well – will be represented on governmental level as an EU directive. In order to meet the requirements drawn up by the directive, land cover data will have to be kept timely. This will already be partly executed by recent CLC50 updating.

3.6.6 Digital Orthophoto Programme of Hungary (MADOP)

In the frame of European Harmonisation Programme of the Department of Land Administration and Geoinformation at the Ministry of Agriculture and Rural Development the project “Aerial photography of Hungary 2000” was finished successfully. Now in the archives of FÖMI about 7000 aerial photos at scale 1: 30 000 are available in analogue and digital forms.

A complete photogrammetric technology was elaborated for analytical and digital aerial triangulation to use the existing high accurate 4th order national triangulation network for determination of orientation elements of aerial photos taken in 2000.

The technology takes into consideration the creation of orthophotos on the base of DEM (derived from the vectorized contour lines of topomaps 1:10 000) and the orientation elements of aerial photos adjusted for the whole country.

An overall quality control was applied during the whole procedure and for every map sheets of digital orthophotos. The accuracy of aerial triangulation is characterised with ± 0.25 m in X and Y ground co-ordinates. The “MADOP” project was finished in June 2003.

The high resolution and quality checked orthophotos were archived (about 2.5 terabyte) as part of meta database, according to the 1:10 000 map grid and we started to distribute among end-users of several professions. The average accuracy of the orthophotos is characterised by 0.7 m in X, Y on the ground.

The digital orthophotos are suitable for several applications, as

- Creation the Hungarian Land Parcel Identification System
- Topographic mapping,
- Recording of statement of several agricultural plants,
- Establishing of land use categories,
- Delineation of wastelands,
- Surveying of soil map contents,
- Delineation of soil erosion areas,
- Mapping of inland waters,
- Regional planning,
- Forest inventory, management etc.

In year 2005. the “wall to wall aerial photography of Hungary 2005” was completed 6th September 2006. The program “aerial photography of Hungary 2005” was carried out according to the parameters of “aerial photography of Hungary 2000”. It means, that the scale is 1:30000; H = 4500 m; film – color diapositive; scanning aperture – 21 μ m; ground resolution of scanned images - ~ 0.60 m. Due to GPS navigation the co-ordinates of focal points of aerial camera during photography were the same as in year 2000 with accuracy about 50 m. The digital orthophoto with accuracy ~ 0.7 m was produced based on the same triangulation network and 5 m grid digital elevation model – HUN-DEM, used for MADOP-2000. The MADOP-2005 now available for use since January 2006.

In year 2007. for the eastern part of Hungary (about 34 % of the whole territory) we started a new project taking aerial photography with digital metric camera and to create orthophoto on the base of the new type of images. The project will be finished by the end of October this year.

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