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GIS in the Agricultural Economy and the Business Applications

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Abstract

We introduce some from the wide spectrum of the scope of geographical information systems which are included in our training programs and important areas of different research works. Information and analysis produced with the use of GIS applications efficiently support the work of the users of the software and decision makers. We primarily discuss the major agriculture applications (LPIS, NRPIS, precision agriculture) from the aspect of the sector which may save time, energy and money for its users. Another application area is the GIS business uses which are the only fledgling in Hungary but it is mostly typical in the U.S. and Western Europe.

LPIS, the Hungarian Land Parcel Identification System, is exclusive national land parcel identification system of the procedures of agricultural subsidies. The data of this identification system can be used in the applying of European Union subsidies which are available in a geographical information system.

The National and Regional Planning Information System (called TEIR in Hungary), which can help such organizations, which deal with planning and developing activity and controlling at a sector level in decision making in connection with regional development and land use planning.

On the one hand farmers apply remote sensing data during precision farming and on the other hand they use satellite positioning equipment which can help them optimize the agricultural produce processes.

In a business life next to agriculture it is widely practices the application of GIS. Technologies like these are used by banks, insurance companies and commercial entities as well, which analyze spatial data from the clients' address and use it to make their business decision. The logistics also likes to use GIS software to optimize the delivery of tasks.

Keywords: LPIS, TEIR, precision agriculture, business use of GIS

1. Introduction

Information and analysis produced with the use of GIS applications efficiently support the work of the users of the software and decision makers irrespectively of they are a single person or the Hungarian Government. We primarily discuss the major agriculture applications - Land Parcel Identification System (LPIS) and National and Regional Planning Information System (TeIR) - from the aspect of the sector which may save time, energy and money for its users. Then we show some example for precision agriculture applications and the use of GIS in the business sector.

LPIS is exclusive national land parcel identification system of the procedures of agricultural subsidies. The data of this identification system can be used in the applying of European Union subsidies which are available in a geographical information system.

TeIR can help such organizations, which deal with planning and developing activity and controlling at a sector level in decision making in connection with regional development and land use planning.

By applying GIS technology in agricultural operations are able to manage resources and responsibilities more efficiently, devise data portals that store vast amounts of agricultural data and interactive maps, and support farming communities.

2. Land Parcel Identification System

The Land Parcel Identification System is the exclusive land nationwide identification system of the EU's agricultural subsidies. LPIS is one of the most important pillars of the IACS. The LPIS is used for registration of agricultural reference parcels considered eligible for annual payments of European Common Agricultural Policy (CAP) subsidies to farmers. The historical relationship between farmers and land ownership has led to slightly different procedures for LPIS creation, resulting in a range of different types of LPIS in the EU. Today, four major types of LPIS exist in Europe (such as physical blocks, agricultural parcel, farmer block, cadastral parcel). The most frequently used LPIS in the EU is the "physical block" because it is stable over time and, consequently, easy to update (Csekő - Csornai, 2004; FÖMI, 2005; Inan - Cete, 2007).

LPIS system in Hungary is based on physical blocks with natural boundaries (Figure 1.), which was found to fit the best to the country's agricultural utilization characteristics. There are approximately 300 000 physical blocks in Hungary. The average size of the blocks is 32 ha, including all land cover categories (www.mepar.hu).

The red lines mean the boundary of the physical blocks. Inside the blue lines there are the not aided area (trees, buildings, wasteland, etc.) which have to be subtracted. Every physical block has its' own identity (example: C1U75-X-08; the last two number show the date when the orthophoto was taken) and its' measure (example: 27.56 ha) which we can see in the black circle.

Figure 1: Physical blocks in the LPIS (www.fish.fomi.hu)

A physical block, which is bigger than the land parcels, is the reference frame of parcel. This is because in Hungary the user of lands, the cultivated plants and the border of cultivation can change year by year so the registration per parcel is unthinkable. Because of these fact in Europe are used such units which are bigger than parcels and their border are not so changeable. So the agricultural parcels are collected in bigger block called physical block, which are the basic unit of LPIS. In connection with agricultural cultivation it is relatively stable, and it has identified boundaries such as roads, railroads, edge of the forest, canal. In the yellow circle on the second figure we can see an example to the variety of the land use. Institute of Geodesy, Cartography and Remote Sensing (called FÖMI in Hungarian) has identified the physical blocks in Hungary. These orthophotos is from 2005 which was programmatically covering Hungary.

Figure 2: Frittered Agricultural Parcel in a physical block (Csekő - Csornai; 2004)

The LPIS database digital orthophotos maps must be less than five years old because of the EU regulation. The maps are continuously updated every year approximately 1/3 of the surface (www.mepar.hu).

3. National Land Development and Land Management Information System

The TeIR is such an electronic information system which was create according to the 1996/XXI. regulation about land development and land management in Hungary. VÁTI (Hungarian Public Non-profit Limited Liability Company for Regional Development and Town Planning) which is a non-profit organization worked out this system and in 1998 the nation level was ready, in 2002 the county level as well and from 2002 services and data are enriching (Barkóczi, 2000; www.teir.vati.hu).

With help of this system users can make diagrams, cartogram, which is a thematic map which shows statistical data of geographical land, analysis based on informatics, they can collect data (Barkóczi, 2000).

Aim of the TeIR is to supply the land development and management offices and the public too with a digitalized mapping data placed in an authentic and up-to-date database. This database contains the different regions and settlements of the country and the member states of the EU demographical, economical and the status of the environment. TeIR ensure effective tool to process this database (Barkóczi, 2005).

Single areas can be illustrated with different colours, so they can form several statistical value limits. The system facilitates the activity e.g. in planning, development, research and decision-preparation.

The TeIR is an informatics system based on geoinformatics which have a uniform nationwide database and guarantee the web services in order to access and process data.

Of course documents connected with areas developing and managing are available for everybody and in addition to this with the help of professional website meta database of the system and basic data on the web are accessible as well. Identification of users passes to Client Gate of Central Electronic Service System (www.teir.vati.hu).

4. Precision agriculture

Precision farming or precision agriculture is an agricultural concept relying on the existence of in-field variability. On the one hand precision agricultural means the application of remote sensing data from space, on the other hand it means the application of satellite positioning equipment. In Europe, and slowly in Hungary as well, this type of farming is widely practiced because even more famers know the advantages of these methods. All sectors of the agriculture industry can use geographic information system (GIS) technology to share data, increase yields, predict outcomes, improve business practices, monitor market trends and predict weather. All these are among the many responsibilities required to reduce the risk of loss and increase profitability (Internet2; Tamás, 2001,).

Farmers now have the ability to visualize their land, crops, and management practices in unprecedented ways for precise management of their businesses. Today, accessing spatial data has become an essential farm practice. Digital map placed in a mission control, with GIS and real-time GPS system is easy to manage the fleet of an agricultural company. If we know exact location of all the machines and the amount of performed work, we can calculate for example the total length of the work, we can redirect them to another workspace and we can control their operation. Not negligible aspect is that the machines have GPS-based automatic steering significantly reduce the load per driver (www.sorvezeto.hu). This technique saves time, energy and not incidentally money for its users, while the quality of work and circumstances change to positive way. Disadvantages for these systems are the great deal of investment and maintenance costs. The soil quality of an infield is not constant. Consistently achieve a good yield useful to know how much fertilizer to be dispatched from the places, what density at sowing the seeds into the ground and depending on the location of the harvest yield can also register. For pest control, suppose that a certain proportion of corn insects to attack. If this is a computerized map of the area and can be distinguished from the carrying out spraying aircraft or helicopter navigation system able to leverage the coordinates of the area, the spraying can be done without unnecessary areas desensitisation, thus saving time and money to the company (http://en.wikipedia.org/wiki/Precision_agriculture).

5. Business use of GIS

Business use of GIS is even more widely spread which is designed to support sales activities. There are a lot of business scopes such as insurance, transportation, telecommunications, finance, marketing, broadcasting, service activities, mail services, health care, banks, restaurants and supermarket chains. Banking is a competitive business. Market share and brand recognition alone aren't enough to attract and retain customers. To be more effective, many banks, credit card companies, credit unions, and other financial services organizations are turning to GIS to help them understand their data better than ever. In case of a bank the first step is to select the settlement, which complies with the conditions imposed by business management. After that we choose the appropriate location within the settlements. It is very simple situation for the institution, which opens the first branch in the town. The unwritten rule is that everyone has at least one branch in the city. For example, Debrecen, where 500 meters of the main street, nearly all banks are represented at least one account (Figure 3).

We can use GIS systems to select where to open the following account, if the conditions wouldn't suitable. For example there are no properties for sale. Aspect of GIS data is an excellent opportunity for the banking sector, as each client's give personal information about them (GIS address the most important). The Bank can determine, where and who has got big capital and cash flows in what kind of area. With this information campaigns can be targeted to expand the range of customers, and the constant increase customer satisfaction. Banks have another important area for the placement of ATM machines, and use of its data. After the GIS system analyzes the business done and examines the spatial position of the costumers, the system can determine the exact place of the new ATM machines. I examine that how many from the bigger Banks use map software on their Internet site to help the costumers for finding the ATM machines! I found that nearly half of the large banks use the map display, as a service to its clients. However, among these sites there is a huge difference in connection with the services, for example, the details of the data of the maps.

Figure 3: Banks in the main street in Debrecen

Now, we would like to show two other examples, for using GIS solutions.

6. Case studies

DHL in Sweden operates 1,400 vehicles. Delivery represents 40 percent of the total cost of the company's daily operations. Each morning, DHL drivers spent, on average, 30 minutes of their shift or tour sorting goods that needed to be delivered. At that time, packages were sorted by postal codes, resulting in piles of shipments shared by four or five vehicles. Drivers spent valuable time looking through the piles, then moving the packages to their gates. This translated into a long searching and loading time with too much room left for human error. GIS can help to deal with these problems.

First, data entry staff enters the information for the next day's deliveries into the main computer system. The information is automatically loaded into the GIS program, where shipment addresses are geocoded and checked against a map to determine the zone to which each shipment belongs. The zones are created based on routes and drivers. These zones are then clustered and optimized into tours based on allocation rules and driver input. All data is accessible to staff via handheld computers and LAN radio at any time and across the whole facility. Once the tour plans are created, delivery notes and sort code files are synchronized with shipments. As a result of the new system, deliveries are now placed at the correct gates by the time drivers arrive at the terminal. Even after double-checking and loading, the drivers are out of the terminal in half the time it took before the system was implemented. Being able to optimize the number of tours per terminal helps DHL minimize its fleet and the driving distances of each vehicle. Routes can be optimized daily, which greatly reduces the effort and resources needed during peak shipment periods such as the winter holiday season. Before using GIS, DHL could only sort to a group of vehicles, leaving a lot of room for error and taking too much time at the terminal. After implementing GIS, DHL is able to sort to each particular tour instead of a larger, less specific postal code. This reduced the time spent and manpower needed to sort, search, and sequence the loading area by 50 percent. The time savings are equivalent to 30 minutes per tour per day. Currently, DHL Express operates 1,200 tours per day from the terminals. Creating an optimum network configuration means a lower total transportation cost and minimizes the distance driven by each vehicle (Hesslin, Moche, 2008).

We would like to mention another example for using GIS systems how to reduce the companies' costs. There is a small office supply company based in Vinton, Iowa. The company, created in 1986, serves east central Iowa, which has a population of approximately 300,000 and includes two major cities. The company brings services and products to 1,500 active customers and has a delivery radius of approximately 80 kilometers. The company runs five routes and makes approximately 200 deliveries a day.

Before using GIS the driver manifest was printed after the orders were entered into the system, then it was up to the drivers and delivery manager to decide how to schedule delivery. This process took time, and orders were not always delivered in the most efficient manner. Drivers had fixed routes, so a new request would slow down the entire delivery process or drivers would be unable to complete assigned workloads. A continuing concern was that there wasn't enough time allotted for deliveries, which was a problem for customer service and driver safety.

These problems led the company to use GIS which might make more effectively the delivery of the products. GIS allows the company to use the same standard office procedures to process delivery orders each day. After they implemented GIS, delivery is more efficient because each night, orders are transmitted to system, which creates routes and prints invoices along with driving instructions including the stops for each truck. In the morning, drivers pick up the printed invoices that the system has organized by order of delivery. The company found the real power of the system when deliveries could not be made due to inclement weather or other unforeseen problems. Instead of laboriously rerouting all deliveries by hand, the system can easily reroute and include these deliveries the next day. Using GIS allows the company to meet its customers' expectations, even when faced with unforeseen circumstances.

The consequences of the GIS software implementation have been extremely positive. Drivers no longer speed, because they have confidence the system has allowed them enough time. Deliveries are more efficient. Cost savings from the system have been significant. The company has decreased fuel usage by 5 percent, reduced labor hours by 18 percent, and cut drive time by an average of 7.5 percent (Internet1).

7. Conclusion

In conclusion, the examples in the displayed items, point out the usefulness of GIS. The GIS is mainly spread in the Western European countries and the U.S. either. Presently in some areas in Hungary is still only emerging in a wide range of GIS application, although in many places we can apply it.

We joined to the European Union in 2004, but the previous period of preparing for the accession was a significant charge on our country's economy. EU's CAP required that we must set up an Integrated Administration and Control System (IACS) in order to we can access the EU's agricultural subsidies. IACS's main pillar is the LPIS which ensures the well functioning system of area based aid application related tasks for the farmers. Since 2004, there are over 270 000 farmers using the LPIS system during submitting the annual area-based aid applications in every year.

In business life in connection with logistic tasks the fleet managers need to make sure daily fleet movements and maintenance schedules run efficiently without compromising quality customer service. GIS solutions can help its users to save 10 to 30 percent in operational expenses through reduction in kilometers, overtime, and routing planning time. Kilometers savings translate into reduced fuel use and a smaller carbon footprint, which will advance the companies' goals for green operations

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