СУЧАСНІ ГЕОІНФОРМАЦІЙНІ СИСТЕМИ І ТЕХНОЛОГІЇ

K. Gawroński, K. Noga
Agricultural University of Cracow

POLISH EXPERIENCE OF IMPLEMENTATION OF THE INTEGRATED ADMINISTRATION AND CONTROL SYSTEM (IACS)

The paper presents Polish experiences of creating and implementing the Integrated Administration and Control System. Particularly the article shows the basic modules of the system, the Land Parcel Identification System (LPIS) and the use of digital orthophotomaps in the Integrated Administration and Control System. The elements of IACS, which are important from the point of view of land-surveying work, cartographic studies and land and buildings' registers, are presented as well.

1. Introduction

Polish accession into the European Union and its participation in the common agricultural policy required adjusting Polish administration structures to European Union standards. Modernisation of Polish farming during the period of integration with the European Union will mainly take place using the financial means of the member states. That is why the EU gives strict conditions concerning the placement of the funds devoted to developing Polish agriculture. In order to use the common agricultural policy efficiently and in a complex way the member states had to create a relevant system of managing the EU financial means and the control of their proper use. On the grounds of the Ordinance of the Council of Europe from 27th November 1992 and the Ordinance of the European Commission from 23rd December 1992 each European member state had to create the so called Integrated Administering and Control System used to manage and control chosen European Union aid programmes.

The system was created and implemented in Poland as well and it concerns the whole area of the country. It is primarily used to administer and control the direct subsidies for agriculture. Potentially each farm is entitled to use the payments due to agricultural production. However, practically the aid means may be used by a farm the area of which is bigger than 1ha and the land parcel which is entitled to subsidies cannot be smaller than 0.1ha [Zarudzki and Zimnoch 2001].

Developing and implementing the system was charged to the Agency for Restructuring and Modernisation of Agriculture (ARMA). The agency is a government institution, the main function of which is supporting the activities serving the development of agriculture and rural areas.

Due to the creation of the Integrated Administration and Control System relevant legal regulations were introduced in Poland. Those were two laws on the level of Parliamentary Acts, i.e. the law from 18th December 2003 on direct subsidies for agricultural lands [Law …2003a], and the law from 18th December 2003 on the national system of the register of producers, the register of farms and the application forms for granting subsidies [Law …2003b].

The aim of this study is a presentation of Polish experience on creating and implementing the Integrated Administration and Control System. In particular it is a presentation of the basic modules of the system, the Land Parcel Identification System (LPIS) and the use of a digital orthophotomap in the Integrated Administration and Control System. The elements of IACS, which are important from the point of view of land-surveying work, cartographic studies and land and buildings' registers, are presented as well.

2. Basic assumptions of the Integrated Administration and Control System

The Integrated Administration and Control System (IACS) is a complex administration-information system enabling efficient distribution, administration and control of the financial subsidies transferred to Polish agricultural sector by the European Union. Implementing that system and its use gives a guarantee that financial transactions from the European Fund for Agricultural Orientation and Guarantee will be performed fairly and according to Polish and European Union law. The Integrated Administration and Control System prevents creating incorrectness and possible abuse owing to the used advanced mechanisms of register and control.

The Integrated Administration and Control System is comprised of the following elements:

- a computerised database which allows for entering data included in the subsidy application forms for each farm,
- the Land Parcels Identification System (LPIS),
- a system of identification and registering animals allowing for current control and verification of the incoming applications. The system includes those groups of animals which are valid for payments. Currently a farmer may apply for a subsidy on behalf of breeding cattle, sheep or goats. The identification is based on marking the animals, entering them into the farm register and sending the information to the database.
- application forms for the programmes supporting rural areas, forest areas and animal farming development,
- an integrated system of control enabling administrative supervision and field control.

The present study describes the chosen elements of the IACS, which are important from the point of view of land-surveying work, cartographic studies and registers of land and buildings.

The computerised database contains information on each farm, of which the producer applied for a subsidy. According to the requirements of IACS the database must be uniform and constant in the whole country i.e. contain the same information range. The proper model for this database is a relation type model of information organisation allowing for non-collision administering of information included in the system database [Konieczny 2004].

The data which is indispensable to create a properly functioning database of the IACS will come from land and buildings' register. It means that the land and buildings' register database is the database of reference for the system.

There are various techniques of creating cadastral maps in Poland and they have a various degree of accuracy. Their quality is relatively high generally and most of them were and are transformed into digital cadastral maps. The accuracy of cadastral maps in Poland is defined by the Ordinance of the Minister of Regional Development and Building from 29th March 2001 [Ordinance … 2001]. It says that the difference between the location of a point on the map in relation to the nearest elements of the geodesic network cannot exceed +/- 3m.

From a technical point of view the complete databases were taken from the county centres of geodesic and cartographic documentation, then verified and checked for cohesion. The activity aims at systemising the databases and takes place fully automatically. The final assumption of the system functioning is integrating the land parcel on the map with the information about its owner and the parcel area contained in the descriptive part of the database. The database of that type allows for, among other, direct and immediate data checking concerning at least a few years by a relevant office of the member state. Additionally, the database holds e.g. the reference data indispensable for running an inspection within eligibility (a right for subsidies), consistence of the declared surface area of the parcels, information on the executed field inspections and the sums of the granted subsidies. The data of the Integrated Administration and Control System (IACS) will be stored in two separate server rooms in order to keep the system fully infallible.

3. The Land Parcels Identification System (LPIS)

One of the basic elements of the Integrated Administration and Control System (IACS), particularly for the solutions adopted in Poland is the so-called Land Parcels Identification System (LPIS). It is a system which allows for an easy and nationally univocal identification and localisation of a particular land parcel. The system is used to run inspections of the correctness of the declared surface area and to assess its eligibility for subsidies.

It is created on the basis of maps or mortgage register documents or other cartographic references. It uses GPS technique and comprises aerial views or spatial orthophotomaps in the standard giving a guarantee of at least the same exactness as cartography in the scale of 1: 10,000.

Land Parcels Identification System administers two types of parcels:

- ♦ a land parcel, defined by the farmer which may be changed each year,
- ♦ a reference parcel which is used by the farmer to identify and define the location of his land parcels (it is a base for calculating the reference surface area for various aid elements).

The reference parcel is a continual piece of land used to localise the land parcel defined univocally with the use its individual identification number and a vector format. It allows for identifying the parcel in an alphanumerical and graphic way. The reference parcel may be a land parcel, a cadastral parcel, an entrepreneurial parcel and the so-called physical block. As a result of the analysis run in Poland it was decided that a cadastral parcel would be a reference parcel in the Land Parcels Identification System. The solution was supported by the fact that that land and buildings register is valid on the area of the whole country in a uniform way and it is continually updated by land surveying offices. The borders of parcels are depicted on cadastral maps, which are exact enough. Furthermore, the borders of cadastral parcels are univocally identified in the field for most agriculturally used land and they are relatively stable. The cadastral model was also supported by the fact that the documents used in registers and parcel numbers were known to the farmers.

Within Land Parcels Identification System a great deal of data corrections for the IACS are performed and analyses of relations between this data are given. The Land Parcels Identification System (LPIS) databases, and particularly the reference database, which is a descriptive part of land and buildings register, and cartographic data together with the orthophotomap, are a source of data that is indispensable to field inspection and the data for creating personalised applications together with map attachments.

The following data originating from the descriptive part of land and buildings register are used for the administrative control and data quality control:

- ♦ the register unit (id, surface area, name);
- ♦ the register premises (id, register surface area, name);
- ♦ register unit (name, the type of right for the real estate);
- ♦ the cadastral parcel (id, surface area);
- ♦ land use type and soil bonitation classes within the parcel (the way of use, the type of land, the register surface area).

The system was built in two main stages. The first concerned the period until 2004 and included introducing the descriptive part of land register with a map raster and parcel numbers into Land Parcels Identification System. The second stage has been going on in since 2005 until 2007 and concerns building of a final shape of the system, in which the reference base are:

- ♦ a descriptive part of land and buildings register;
- ♦ a digital orthophotomap of the agricultural production space;
- ♦ a raster of a register map together with parcel numbers;
- ♦ vector borders of cadastral parcels;
- ♦ vector borders of the area not eligible for subsidies.

The use of the data originating from the land and buildings register concerns the descriptive (alphanumerical) data from the elaboration of land and buildings register. It means that the numbers of register parcels and the surface area sizes of land parcels given by a farmer in the application are compared to the data included in the reference databases system. The arable land in the Land Parcels Identification System was classified in two groups - as the ones eligible for subsidies and the ones not eligible for such subsidies. In the case when a register parcel is univocal considering its type of use and it is a use excluded from agricultural use permanently, the whole parcel is qualified as not eligible for subsidies (e.g. a road, a built-in area, a forest and other). However, if there are areas eligible for subsidies and areas not eligible for subsidies within one parcel it is only the surface area of those parts which are eligible for direct subsidies that is added together.

Facing the annual changes in the location of land parcels and the identification of the type of farming the method of gaining information about the state of affairs should base on elements that are known to the farmer and easy to identify in the field. It is enabled by the type of the orthophotomap depicting the agricultural production space. That is why in 2005 Poland introduced obligatory use of cartographic materials of that type for the needs of the Land Parcels Identification System.

4. Basic problems connected to the use of the orthophotomap to create the Land Parcels Identification System (LPIS)

The orthophotomap is a cartographic tonal image of the area created as a result of processing an aerial photograph into an image referring to the orthogonal projection on the reference surface presented in a relevant copy and shape of the sheet. An orthoimage is a result of orthocorrection of a single aerial picture. The basic place of storing aerial pictures is The Main Centre of Geodesic and Cartographic Documentation functioning within The Main Office of Geodesy and Cartography. The office both assesses the usefulness of pictures and scans the materials. The gathered collection contains about 1.5 million aerial pictures originating from the years 1995-1999 taken for the PHARE project [Kurczyński 1998], [Kurczyński 1999].

Fig. 1 shows an example of an orthophotomap with vectorised borders. Such a cartographic technique will greatly raise the assessment of eligibility, i.e. the eligibility for subsidies as in a tonal image it will be easy to state if the land inside the given parcel is used for farming purposes or not. The figure depicts the area reference in red colour. The areas covered with orange hachure were excluded from the area of the register parcel as the ones not eligible for subsidies (the afforested area with a habitat). The part covered with a yellow hachure creates the area eligible for subsidies, i.e. the so-called register-farm field.

Within the Land Parcels Identification System the following nine types of land use were identified on orthophotomaps and aerial photos: a habitat, a communication area, a forest, permanent greenery, an industrial or urbanised area, water, an afforested or shrubbed area and other area not suitable for agricultural production. In the computer system of the Land Parcels Identification System there is a tool, which allows for measuring the areas non eligible for subsidies within the parcel and an initial assessment of correctness of the placed application, e.g. information on taking into consideration and deducing the area of non agricultural land (e.g. shrubbery, self-sown areas, sand patches or access roads) from the area eligible for subsidies.

The standard of an orthophotomap for the needs of the Land Parcels Identification System requires the scale of the orthophotomap to match the scale of the cadastral map, which appeared to be a difficult task to meet. General assumptions of the EU in the subject were formed in the Council of Europe’s Ordinance from 1992 (Ordinance n° 3508 from 1992) and amended in 2000. As it is implied by the above legal regulations, general assumptions concerning the orthophotomap for the needs of LPIS are the following:

- the field pixel of the orthophotomap ≤ 1.0 m
- an mean error of situational elements localisation $m_p \leq 2.5$m

The suggested smallest objects included in the map are:

- for the map in the scale 1 : 10,000 - 0.1 ha (3 x 3 mm on the map), the object measured with a ten-metre-wide band
- for the map in the scale 1 : 5,000 - 0.03 ha (3 x 3 on the map) the object measured with a five-metre-wide band.

In Poland there a great scattering of cadastral parcels and cadastral maps of land exist in the scale of 1 : 2,000 and 1: 5,000 and in the south of Poland, i.e. on the area of the former Austrian occupation during the partitions period there are maps with the scale of 1 : 2,880. Two standards were suggested taking into consideration those conditions and the fact that the area of Poland is particularly difficult for developing an Alphanumerical Terrain Model and that it is afforested in its large part [Preuss and Kurczyński 2002]:

♦ standard I:

- the field pixel of the orthophotomap 0.5 – 1.0 m
- the mean error of situational details localisation m_p = 1.5 – 2.5m

♦ standard II:

-the field pixel of the orthophotomap 0.25 m
- the mean error of situational details localisation m_p = 0.75 m

The process of building the Land Parcels Identification System (LPIS) was made dependant on creating an orthophotomap for the whole area of the country together with the border adjoining areas for which it was decided to use satellite imagining originating from IKONOS satellite and its competing satellite - QuickBird. Using satellite imagining for the areas adjoining the borders was difficult due to air raids into these areas.

Using the cadastral land maps and an orthophotomap is connected with a lot of technical problems that are due to creating topologically correct subject layers. Chosen substantial technical problems connected with creating the spatial information system for the needs of land parcels identification are presented below.

The following typological layers are being created: register units, register districts, cadastral parcels, land use boundaries, soil bonitation classes and buildings. The above information must be integrated with proper register descriptive data.

In the case of finding inconsistencies within the scope, especially the inconsistencies between the descriptive and geometrical parts in the borders of cadastral parcels, boundaries of land use areas or bonitation classes of soils there an obligation of notifying the county starost about the inconsistencies and he must undertake action to remove the above inconsistencies.

In the process of using cartographic register materials and the orthophotomap one should create an alphanumerical description of buildings boundaries on the basis of buildings' contours bends coordinates contained in the materials coming from the national geodesic and cartographic resources. When such coordinates do not exist it is necessary to achieve them in the way of digitising the basic map or other large-scale maps. Figure 2 shows an example of a map with digitised bends of buildings' contours.

If a comparison of a cadastral map in a raster form to an orthophotomap or a spatial model shows that there have been changes in the borders of e.g. roadways in reference to the state contained in the register elaboration and there are no documents about the course of events in the national geodesic and cartographic resources, in the process of digitisation one should accept the data on cadastral parcels depicting roads on the basis of the cadastral map raster. Similar solutions are used in reference to other elements of the cadastral map. For example, if a comparison of a cadastral map to an otrthophotomap shows that e.g. shorelines of surface water table have been changed the borders of cadastral maps are accepted on the basis of cadastral map raster.

An important issue connected with using an orthophotomap while creating the Land Parcels Identification System (LPIS) is a problem of photo resolution and the measurement of the surface area of the parcels with a certain tolerance. In order to accelerate the analysis of the producer declared surface area compatibility with the surface area measured during inspection visits a simple method of buffering around the parcel border was used. Because the width of the buffer depends on the resolution of the orthophotomap, each measured parcel (during an inspection visit) has its circumference and surface area calculated. Next, by multiplying the circumference by the tolerance we can get the surface area of the buffer. If the difference between the declared surface area and the measured one is smaller or equal as the buffers area it is accepted as compatible with the agreed tolerance. Hejmanowska (2003) showed the tolerance of parcel surface area depending on the width of the buffer.

5. The main rules of surface control check of the declared area of agricultural land

The surface control checks aim at checking the compatibility of the data declared in the application for granting direct subsidies with the real situation in situ. According to the law from the 18th December 2003 on direct subsidies for agricultural lands [Law … 2003], the farms of minimum 1.00ha surface area of agricultural land (kept in a good agricultural state), comprising of agricultural parcels of at least 0.10ha surface area are the only eligible ones.

The aim of surface area check is:

- setting the borders and the surface area of the parcels;
- checking the species of the grown plants or the type of land use on a given land parcel;
- defining the eligibility of the parcel for direct subsidies;
- verifying the minimum requirements concerning keeping the land in good farming culture.

The inspections within area checks may be performed:

- by a field (in situ) inspection method;
- by a photogrammetric method (in the case of direct payments).

The check up by a field (in situ) inspection method is performed by a check up team consisting of at least two people. The check up includes a comparison of the data declared by the agricultural producer in the application for a direct subsidy to the actual state in situ. The surface area check up by a field (in situ) inspection method consists in a physical inspection of at least 50% of land parcels declared by a given farmer. In the case of finding out inconsistencies the check up must extend to 100% of the declared parcels. The visit in the field includes (among other) the following actions:

- recognising the species of the grown plants or the way of land use on the inspected parcel
- setting the boundaries of crops or land use, the measurement of the surface area and the circumferences of land parcels;
- creating layout drawings of the inspected parcels;
- stating if minimum requirements concerning good agricultural practice on the declared parcels are kept;
- the measurement of the surface area of land within the parcel where keeping the land under good agricultural practice does not apply;
- taking suitable digital pictures of each inspected land parcel.

The measurement of the surface area and the circumferences of land parcels may be executed by the following two methods, i.e. GPS technology measurement or the method of vectorising the orthophotomap.

No matter which measuring tool is used while measuring the surface area by the above mentioned methods one must take into consideration the following measurement tolerance:

- for GPS receivers the measurement tolerance cannot exceed the surface area which is a product of multiplying the circumference of the land parcel by the width of the buffer area around the borders of the parcel, i.e. 0.35m or 1.25m depending on the type of a GPS receiver used;
- while measuring on a digital orthophotomap the tolerance should not exceed the surface area of the buffer zone calculated as a product of the circumference of the land parcel and the width round its borders (the maximum value of the buffer zone depends on the size of the pixel on the digital orthophotomap in the field measure and is 1.5 pixels);
- the tolerance for the measurement with an electronic tachometer should not exceed the surface area calculated as a product of the circumference of the land parcel and the width of the buffer zone which is 0.35m;

- for measurements with the use of a measuring tape it was foreseen to use the following percent tolerance: 5% for the parcels with the surface area of up to 5ha and 3% for those of more than 5ha.

Furthermore, the technical tolerance should not exceed the unquestioned value of 1.00ha. However, as the minimum value of tolerance one should assume 0.01ha. The buffer zone should be understood as a belt of land adjoining the boundary line of the parcel [Zimnoch 2005].

The inspection of the surface area using the photogrammetric method consists in vectorising the borders of land parcels on the orthophotomap, i.e. on projecting the terrain performed on the basis of an aerial photo, which was transformed into a metric shape. It means that this type of a photo may be used to run such measurements like: reading the co-ordinates, measuring distances, measuring surface area. Thus, such an aerial photo fulfils the accuracy standards corresponding to the map created in a classical way. In the orthophotomap image it is possible to recognise the field cover and differentiating the terrain covered by forests, built-in areas, roads, ditches, shrubberies, afforested areas, water areas, etc. After finishing the analysis of an orthophotomap and gaining data from a field survey, one should create a report of inspection activities and hand in its copy to the agricultural producer.

6. Conclusions

The presented considerations allow for forming the following general conclusions. Firstly, creating a digital map for creating LPIS is quite a complex task as the requirements which are given to such a map demand the knowledge of basic geodesic standards and own intuition of the creator. It is implied by the fact that cadastral land maps are neither technically homogenous nor their cartographic projections are univocal in Poland. That is why the work of comparing the parcel and land use borders to the orthophotomap together with a proper elaboration of the land use map are the most complicated and laborious jobs.

Secondly, there are big problems connected to the fact that certain surface areas of parcels and the land use types in them are often different from their surface areas shown in land cadastre. One should claim that such inconsistencies will be eliminated successively as a result of land cadastre modernisation in Poland. Thus, the data about a given parcel will be much more accurate.

Thirdly, the Integrated Administration and Control System based entirely on a homogenous land cadastre will be improved taking into consideration the accuracy of information about parcel surface area.

Moreover, the digital map, developed for the needs of the Integrated Administration and Control System, will be used while modernising the land cadastre in Poland.

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Recenzował: Prof. dr hab. inż. Mirosław Żak

УДК 528.92

О. Дорожинський, І. Колб, О. Дорожинська
Національний університет «Львівська політехніка»

ГЕОІНФОРМАЦІЙНІ ТЕХНОЛОГІЇ В РЕАЛІЗАЦІЇ ЗАВДАНЬ МУНІЦИПАЛЬНОЇ ВЛАДИ І РЕКРЕАЦІЙНОЇ ДІЯЛЬНОСТІ

На теоретической платформе проблемного картографирования и геоинформационного моделирования предложено объединить муниципальную и рекреационную сферы деятельности в единой ГИС. Практическая реализация осуществлена на примере рекреационного объекта Украинских Карпат в ходе выполнения пилотного проекта по программе INTERREG III B –CADSES.

It is proposed to unite the municipal and recreational spheres of activity in one GIS based on theoretical platform of problem mapping and geo-informational modeling. Practical implementation is performed as a pilot-project in the INTERREG III B –CADSES program on a recreational object in the Ukrainian Karpathians.

Постановка проблеми і зв'язок із важливими науковими чи практичними завданнями. В загальнонауковому напрямку, що носить назву «проблемне картографування» знаходить своє місце тематика, пов'язана з раціональним використанням ресурсів та охороною природи. Картографічні моделі природокористування сприяють розвиткові території, прийнятті науково і методологічно обґрунтованих управлінських рішень, економічному зростанню регіону.

В деяких районах Українських Карпат, де слабо розвинена промисловість і, як наслідок, збережена природа в її первозданній красі та чистоті, повинна розвиватись і вже розвивається рекреаційна діяльність.

Аналіз останніх досліджень і публікацій. Виходячи із теоретичних засад проблемного картографування, зокрема вивчення та картографічне відображення проблем, що виникають у взаємодії суспільства і природи [3], на особливу увагу заслуговує геоінформаційне картографування. Об'єктом дослідження в рекреаційному аспекті є відповідна територія з повним, достовірним і глибоким інформаційним змістом, а саме тематичним скеруванням створюється можливість використання території для рекреаційних цілей.

З багатьох праць вітчизняних та закордонних дослідників відомо, що геоінформаційне картографування є джерелом і засобом (одночасно) отримання, аналізу, використання інтегрованих відомостей про досліджуваний об'єкт ти «видобування» нової інформації для прийняття рішень, скерованих на розвиток об'єкту досліджень зі збереженням загальносуспільних інтересів.