TECHNICAL ASSISTANCE FOR THE MINISTRY OF AGRICULTURE AND RURAL AFFAIRS FOR THE DESIGN OF A FUNCTIONING IACS AND LPIS IN TURKEY

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ABSTRACT:

This paper aimed to give information about recently completed EU Project with the overall objective; supporting Turkish Government in setting up functional Integrated Administration and Control System (IACS) in order to administrate agricultural supports in line with EU acquis and practices for nationwide implementation which is currently under construction. Project has two associated components which comprises technical and institutional activities. Technical phase applied in two pilot provinces where computer aided photointerpretation (CAPI) method is applied for GIS based LPIS creation, which is followed by farmer consultations realised on field in order to structure the link between farmers and agricultural parcels used by them. Based on the facts and examination of orthoimages, physical block decided to be used as reference parcel for primary digitalization and creating the geodatabase of eligible land..Linkage between the user and agricultural area through farmer consultations, are used to assess feasibility of creating a new system of direct payments that cuts the link between support and the production. The second component is the thematic phase including the projections for the establishment of whole system, integrating the outcomes of first phase and preparation of by-law drafts within the frame of legislative studies. This paper will focus on description of technical steps and will not concentrate on project activities of thematic phase. Since the project was the preliminary step before the establishment of IACS/LPIS in nationwide scale, the results and experience gained from the project opened the way to prepare the necessary technical and legislative framework for future implementations.

1. INTRODUCTION

With its technical, economical, social and political aspects, agricultural sector has indispensable importance with different characteristics than the other sectors. In addition to the importance of agriculture; stability of existing agricultural land, and furthermore the continuous decrease in total area due to use of land for non agricultural purposes or misuse, increased the importance of existing agricultural land registry (detailed inventory), registration concerning their qualifications and provision of usage in a planned manner.

IACS as a system covers mechanisms composed for the right administration and control of agricultural supports; while securing correct payments to farmers and preventing false declarations, enable real farmers, particularly the farmers who cultivate their lands, to be supported regarding their lands. Land parcel Identification System (LPIS) which is one of the components of Integrated Administration and Control System (IACS) has been used for the identification of agricultural land in EU.

The document is based on the studies and outcome of the project funded by The European Union's Programme and implemented by INTA Spaceturk in consortium with Ekotoxa S.r.o. and CS Systemes D'information S.A. namely "Technical Assistance for the Ministry of Agriculture and Rural Affairs for the design of a functioning Integrated Administration and Control System (IACS) and a Land Parcel Identification System in Turkey (LPIS)" (TR. 0402.08/002)

2. OVERVIEW

The project chose the approach to implement the IACS/LPIS first in two pilot areas of Tekirdağ and Ağrı Provinces. It was the assumption to observe there the implementation steps on a relatively small level before covering with the management systems to administrate direct income support the whole country. It was the main question to be answered by this project whether it is possible to implement the land parcel identification with the help of orthoimages in both areas. The hypothesis was if this proved to be possible, then it should not be too difficult from the technical point of view to extend the systems in the whole country.

All EU member countries at the beginning of the implementation of the IACS had to decide how to implement a Land Parcel Identification System (LPIS) in their country and on which practicable and reliable basis.

Based on visual interpretation from VHR satellite images and field verification, reference parcel alternatives are evaluated to be used as graphical linkage of agricultural support applications. Definition of reference parcels are given, evaluation made through spatial difference between the relevant reference parcel type and the currently used agricultural land in order to address direct income support to the practicing farmer and avoid problems between owner and user of the land.

To proceed successful with creation of LPIS database, it was necessary to prepare and draft a photo interpretation guideline,

containing description of the basic reference unit for digitalization, photo interpretation and digitalization rules. Each reference parcel has to have a unique code in the frame of whole Turkey which can be automatically attributed by the GIS software. Due to frequent changes of administrative ordering within Turkey, unique code is derived from geographical coordinates.

Next step was to test the usefulness and effectiveness of ortho photos and the LPIS database to locate and define the boundaries of the current year's agricultural parcels used by the farmers through consultation with the farmers on both pilot areas. The main objective of the consultation phase was the contact with the selected farmers and more specific to facilitate the location of their used parcels on the orthoimages, register them on LPIS database and to ask farmers to answer to a submitted questionnaire. Some interesting statistical figures are prepared as result of the consultation campaign, concerning differences in the areas declared by the farmers and those actually measured on the orthoimages. Following the consultation with the farmers in the field the outputs of this work was used in the database updating process.

Within the frame of the Project, a specific SW Turkish IACS Demo Software (TIDS) was created for the demonstration and simulation of selected IACS procedures. TIDS was one of the basic outcomes of the project aimed to implement project data for producing real results for IACS testing procedures in the Tekirdağ area and to train MARA staff for global IACS procedures. Real geographical data, real data of farmers' declarations and real on-the-spot control data are all integrated within the SW. Any simulation allowed because the objective was to produce real statistics about eligible land area and declaration anomalies.

3. EXPLANATION OF METHODS

3.1. Imagery acquisition and orthophoto creation

Very high resolution (VHR) Ikonos satellite images with a resolution (pixel) 1m for the pilot areas were acquired from and provided by INTA Spaceturk in the vast majority between spring and autumn 2006.

For the creation of the orthophotos the Erdas Imagine software was used. Every frame of acquired image was orthorectified using the Ikonos model and the rational polynomial coefficients (RPC) of the image. The precision of the RPCs was improved by applying a second order polynomial adjustment using precise ground control points (GCP). Sharp corners clearly visible in the image and well identified in the field (mainly cross roads) were selected to be measured in the field. In order to achieve a homogeneous distribution of GCPs within each pilot zone, a grid of 14 Km x 14 Km was used and one (1) GCP selected in every cell of the grid. The selected GCPs were then measured with geodetic GPS instruments to have a horizontal accuracy of about 20 cm.

The digital vector elevation maps of 1/25.000 scale topomaps were used to create the digital terrain model. The "create surface" tool of Erdas Imagine was used to create the digital terrain model (DTM) with 5m grid size.

The Ikonos level 2 scenes, with an average size of 300 km^2 were orthorectified using an average number of 20 GCPs per scene. The average root mean square error xy (RMSE) value of the orthorectification procedure obtained was <1,70 meters.

Orthorectified scenes were mosaiced to produce a single image for each one of both provinces. In Tekirdağ 44 scenes and 21 scenes in Ağrı were mosaiced. The "breakpoint color balancing" tool of Erdas Imagine was used to balance the color of all images in each province in order to produce a seamless color image.
The control of the visual appearance of the orthoimages was done by the optical verification of the images by experienced operators. In cases that some areas were identified as problematic in terms of visual appearance (as the phenomenon of "pulled" / "multiple" idols or the presence of degraded or "undulate" forms like "ghosting images", "wavy features", "smears"), they were further investigated for their possible causes and the orthorectifying procedure was executed again.

The control of the geometry precision of the resulted orthoimages was realized with the use of independent control points of higher precision than 1/3 of the required final precision (2,5m RMS), The coordinates that resulted from the measurements of independent control points were compared with those that resulted from the measurements of the x,y position of the relevant point on the orthoimages with a view to calculate the relative statistical figures which determined the level of precision of final products.

3.2. Selection of Reference Parcel:

Concerning the establishment of LPIS,, different reference parcel options have been thoroughly assessed particularly in terms of database homogeneity and compulsory use of GIS as stipulated by EU legislation. These options are:

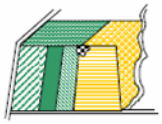
Reference Unit / **User** Based	Description
Agricultural Parcel 	One piece of land cultivated by one farmer with a single crop or a group of crops.
Farmers Block / Ilot 	One piece of land cultivated by one farmer with one crop or group of crops.
Physical Block 	One piece of land with permanent boundaries may contain several crops and farmers.
Reference Unit / **Owner** Based	Description
Cadastral Parcel	Piece of land with specific geometry that belongs to physical or legally identity

Figure 1 Definition of reference parcels

Due to fact that cadastre is concerning property rights, cadastral parcels may not correspond directly to the agricultural parcels (the location is correct but the boundaries and the area of cadastral and corresponding agricultural parcel they do not fit),

which are the ones required by the IACS regulation. Farmers' agricultural parcels are mostly fragmented, in most cases small in size and scattered. Agricultural parcels are easy to identify crop pattern during the LPIS creation and also easy to be identified by the farmers. However agricultural parcel as reference parcel have one big disadvantage, it is very expensive to keep updated records in the database, because they may change annually. Physical blocks are easy to create without farmers input at the beginning.

Based on the facts and examination of orthoimages, physical block decided to be used as reference parcel for primary digitalization and creating the geodatabase of eligible land.

3.3. Digitalization of Reference Parcel and Creation of LPIS Database

LPIS data established in accordance to some basic requirements; first is database homogeneity which defines the continuous projection of parcels without overlaps and artificial division. So a single, continuous cartographic representation has to be used for the entire system.Second requirement is the use of a geographic information system (GIS) for management of LPIS data which exludes the use of non-digital maps. Orthoimages as background for acquiring parcel-related geographic information are used while the minimum precision of the database has to meet cartographic standards guaranteeing accuracy at least 1:10.000 scale.

To proceed successful with creation of LPIS database, it is necessary to prepare and draft a photo interpretation guideline, containing description of the basic reference unit for digitalization, photo interpretation and digitalization rules. Computer aided photo interpretation (CAPI) method is used for digitalization or already existing update of landscape features based on visual interpretation of VHR satellite orthoimages.

The digitalization process take into account the temporal stability of landscape elements divided into categories with different level of temporality and priority during the building of physical blocks.

After all digitalization results went in to the quality control and were repaired and accepted, the final data processing, preparing of the database structure and the filling in of the attributes was done in ArcGIS environment

3.4. Establishment of the Link with Farmers

The main objective of establishing the link with a selected sample of farmers in the two pilot zones Tekirdağ and Ağrı was to test the usefulness and effectiveness of using orthophotos and the LPIS database to locate and define the boundaries of the current year's agricultural parcels used by the farmers. Herein, personal data (alpha-numeric) of the farmers were updated and the data about used agricultural parcels (both numeric and spatial) recorded. Number of farmers for which a link should be established was defined to be 500 per province.

Digital data which includes supplementary background information directly accessible in GIS environment such as orthophoto, topo-names and features etc.. helped consultants and farmers to find and identify in an easy way the used agricultural parcels. Also the boundaries of the reference parcel and the indication of maximum eligible area per reference parcel (herein physical block) prepared beforehand in order to enable the farmer to indicate the location of each agricultural parcel. Herein, declared parcel's boundaries precisely digitised and spatial data of the declared parcels linked with the attributes.

Declaration phase shall be completely supported by the Turkish IACS Software of which a demo version exists at the moment. All changes and new parcels shall be entered directly to the database. Software shall enable easy access to details of problematic parcels. When all parcels and information are checked, and all data shall be updated.

3.5. Digitalization of Agricultural Parcel

The consultation data were obtained from the field and included the farmer ID and the parcel ID information in addition to the vectors describing the parcels of the farmers. The farmer and parcel information in the consultation data was copied to the agricultural parcels layer using the "spatial join" tool of ArcMap.

Fig 2 Example of consultation vectors converted to point and overlaid with agricultural parcels

3.6. Use of data for On the Spot Checks (OTSC)

According to EU regulations in general at least 5% of the total submitted aid application of the farmers has to be checked every year with on the spot visits (general inspection of the parcel, area measurements, etc). On-the-spot checks consist of two parts; the first of which relates to verifications and measurements of declared agricultural parcels via remote sensing techniques (cross-check of graphic material, satellite imagery) This part is called as Control with Remote Sensing (CwRS). During CwRS, up-to-date time series of HR or VHR satellite images shall be used. Within the frame of the project, Ikonos sensor's 1mC (2007 images for different seasons) are used in VHR segment and SPOT-2 sensor's 20mC (2007 August archive) used in HR segment. Parcels having a difference of its declared and measured areas on the ortho images above a specified threshold shall be controlled within this scope. Multi temporal analysis based on radiometric level will reflect the discrepancy either in the form of spatial deviation (surface area difference) or non-compliance in terms of land-use check (crop type, inclusion of ineligible land-use type etc..).

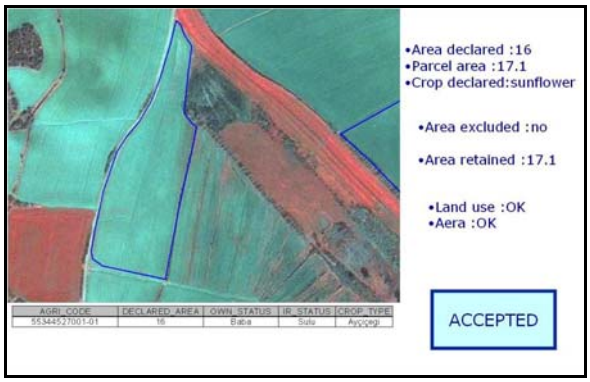


Fig 3 CwRS with multi temporal analysis from satellite images realised in Tekirdag within the frame of Project (TR 0402.08/002)

The second part consists of a physical inspection of the parcels to verify the actual size of the agricultural parcels declared and, depending on the aid scheme in question, the declared crop and its quality. The possible field visits are restricted only to those cases in which the CwRS categorizes the applications, according to specified criteria, to be doubtful or ought to be rejected. The objectives of the field inspection were to visit the problematic parcels and try to solve the occurred anomalies by examining the location of the parcels, measure their boundaries using a GPS device and check their crop type.

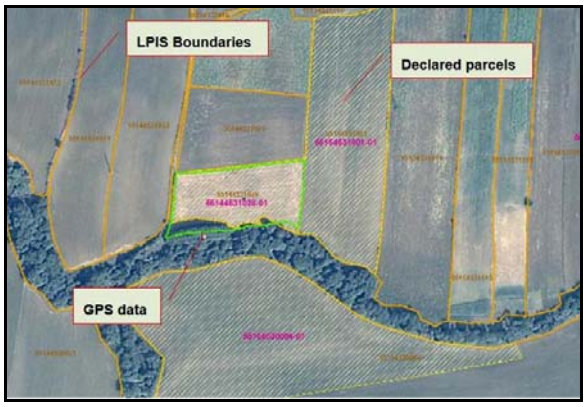


Fig 4 Sample of digital maps containing logs of GPS measurements around parcel's boundaries .

4. CONCLUSIONS

The main findings in the pilot areas of Tekirdağ and Ağrı were that, it is possible to implement IACS / LPIS as management tools in the pilot areas which are extremely different. If it is possible to use these tools in such different areas, then it is certainly also possible to implement the systems throughout Turkey. Since the project was the preliminary step before the establishment of IACS/LPIS in nationwide scale, the results and experience gained from the project opened the way to prepare the necessary technical and legislative framework for future implementations.

REFERENCES

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