# Towards an Integrated Cadastral System Fulfilling LPIS Requirements

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**Key words**: Hellenic Cadastre, Land Parcel Identification System (LPIS), Integrated Administration and Control System (IACS), Greek Payment Agency (OPEKEPE), Common Agricultural Policy (CAP).

## SUMMARY

The paper presents the findings of a recent focused comparative research, on the Land Parcel Identification System (LPIS) and the ongoing Hellenic Cadastre (HC). The LPIS is the key-element of the Integrated Administration and Control System (IACS), introduced in 1997 by the European Union (EU) for all its Member States, within the Common Agricultural Policy (CAP) framework. According to the LPIS, an "agriculture parcel" is defined as a continuous piece of land, constituting of one or several cadastral parcels or sub-parcels, with a single crop cultivated by a single farmer. On the other hand, a "cadastral parcel" is defined as a contiguous area of land, owned by one or more persons ab indiviso, thus constituting the basic reference unit of all cadastral information. Although the LPI system registers farmers, while the cadastral system registers land owners, the two systems present physical similarity, since cadastral parcels can be further divided into sub-parcels according to different land use types within the same parcel or, can be part of a greater single crop agricultural area cultivated by a single farmer. This overlap between the LPIS and the HC, results in expenditure duplication, especially for countries like Greece, with cadastral system not yet completed, being required to take into consideration the LPIS specifications.

The methodology followed for this research, first includes, the evaluation of the two systems by comparing their features, technical specifications and results thereof. Furthermore, a case study is focused on three areas of different characteristics: a flat low-lying area, an area of intense relief and an island agricultural area. As resulted from the comparative research, cases where agricultural and cadastral boundaries provided by the two systems coincide are less than 10%. It is therefore suggested that, both systems should be better coordinated, so that the HC acts as source data to the LPIS, while for the delineation of rural areas not yet included into the ongoing cadastral project, the LPIS maps can be used as base material for the surveying work.

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## 1. INTRODUCTION

The European Union‘s (EU) Common Agricultural Policy (CAP) is operated by the European Agricultural Guarantee Fund (EAGF) and the European Agricultural Fund for Rural Development (EAFRD). The EAGF finances direct payments to farmers and measures to regulate agricultural markets such as intervention and export refunds, while the EAFRD finances the rural development programmes of the Member States. The basic rules for the financial management of the CAP have been laid down by the Council of Ministers (Regulation (EC) No 1290/2005, OJ L 209, 11.8.2005). Under these rules, the Commission itself does not make payments to beneficiaries; this task is delegated to the Member States, who work through national or regional paying agencies, accredited on the basis of criteria laid down by the Commission (EC DG Agriculture, 2007).

All direct payments to farmers are covered by the Integrated Administration and Control System (IACS) of Member States, consisting of different elements which are needed in order to receive and process aid applications. A key element of the IACS is the Land Parcel Identification System (LPIS) containing a register of all agricultural land. Each Member State defines its own reference parcel in the LPIS, using its land administration/ cadastral system or a purpose-built system. According to Commission’s Regulation 796/2004, the “reference parcel” is defined as a geographically delimited area retaining a unique identification as registered in the GIS in the Member State’s identification system. Therefore, the identification system for agricultural parcels operates at reference level as cadastral parcel, production block (as a continuous area of land having natural boundaries and may include a number of cadastral parcels) or ilot (as a single portion of land with unique farmer but several crops). “Agricultural parcel”, according to article 1.4 of Regulation EEC 3508/1992, is defined as a continuous area of land on which a single crop group is cultivated by a single farmer (EU, 2006).

## 2. IMPLEMENTATION OF THE IACS IN GREECE

The responsible organization for implementing the rural development programme payments for rural beneficiaries is the Hellenic Agricultural Payments Organization (OPEKEPE). This paying authority of Common Agricultural Policy (CAP) is a private legal entity operating since 2001, accredited and supervised by the Hellenic Ministry of Rural Development and Food. OPEKEPE's main task is the control and payment of beneficiaries, according to European and national Laws. Every year almost 900,000 beneficiaries benefit approximately 3 billion, from community subsidies. Beneficiaries are mainly farmers and also farmer associations, export companies, investors of the agricultural sector, manufacturing enterprises etc. (www.opekepe.gr). O.P.E.K.E.P.E. is audited by an independent Certifying Body as well as the National Court of Auditors.

Since the 1st of January 2005, an important reform on the distribution of EU agricultural policy subsidies, concerning their structure and the requirements of the IACS, changed the simple alphanumerical identification of parcels to a new Land Parcels Identification System (LPIS). This was the result of a new Regulation (EC 1782/2003 of the Council, later complemented by 796/04 of the Commission), which modified the identification system to make it more efficient. According to this regulation, land parcel identification is established on the basis of maps or land registry documents or other cartographical references, using computerised geographical information system (GIS) techniques and including aerial or spatial orthoimagery, with an accuracy equivalent to 1:10,000. The establishment of the new system can be adapted to each Member State, however following the recommendation for using recent orthoimagery.
To align with the IACS Regulation, Greece developed new LPIS-GIS, using recent orthoimagery and complying with the technical requisites. The new digital LPIS was finally installed in 2009, carried out by Agrogi SA, a non profit private company recommended by the Ministry of Rural Development and Food, at a cost of 10 million euros. From 2009 onwards, the farmers' aid applications are being entered into the new computerized cartographic database. Under the new LPIS, the on-the-spot checks for assessing the fulfilment of the EU criteria are exclusively conducted by the OPEKEPE.

## 2.1 Methodology and Accuracy of the System

Greece, as other Member States, adopted as parcel reference for its IACS, the block unit system. Blocks, as previously defined, are continuous portions of land delimitated by geographical irregularities, roads, or other elements of discontinuity, that can accommodate different agricultural uses, exploited by several different farmers. The other option for the LPIS, the ilots system, constitutes of continuous portions of land, farmed by only one farmer with several crops of the same or different land use type. In both systems, IACS must verify that the sum of the areas declared, does not exceed the total area of the parcel of reference area.

The block units used by the system, are identified and digitalized on orthoimagery, conducted by the corresponding national institution, to reflect the required level of detail.

In Greece, the new LPIS for the Integrated System covers the total country area, also comprising mountainous areas and steep landscape with agricultural activities (approximately 60% of the country), with 1,540,000 ilots and 9,800,000 sub-ilots digitized.

The LPIS project comprises orthoimagery provision, quality control of orthorectification and vectorization of ilots and sub-ilots (based on natural blocks).
According to the planning manager of Agrogi SA, (Kountouris, 2009), the methodology for constructing the new LPIS includes:

- Computer Assisted Photo-Interpretation (CAPI) of orthocorrected satellite images combined with terrestrial control of disputable areas.
- The orthocorrected images are distributed in the Greek Distribution Grid of 1:5,000 (Hellenic Military Geographical Service HMGS) in EGSA '87 (Greek Geodetic Reference System)

- The process complies with the Guidelines for Quality Checking of the Ortho Imagery (EC 18/2/99)
- The quality of geographical data is described according to ISO 19113:2002 (Background Information, quantitative quality information assessment, non-quantitative quality information)
- Compliance of the quality of deliverables with the Contract Specs according to ISO 19114:2003 Standard.

In the new LPIS, each parcel declared, is characterized by a unique 13-digit cartographical code, indicating its location according to the 1: 5,000 HMGS distribution grid in EGSA '87 geodetic system. Each agricultural unit (block) is assigned a 10-digit number, derived from its centroid's coordinates within the relevant grid. A 3-digit number extends the block's code number, thus forming the contained agricultural parcel's unique code. For example, in figure 1, the block's code number is 445-301-7471 (derived from its centroid's coordinates: X = 445.741 and Y = 4.301.713) and the parcel's 13-digit cartographical code finally assigned is 445-301-7471-001.

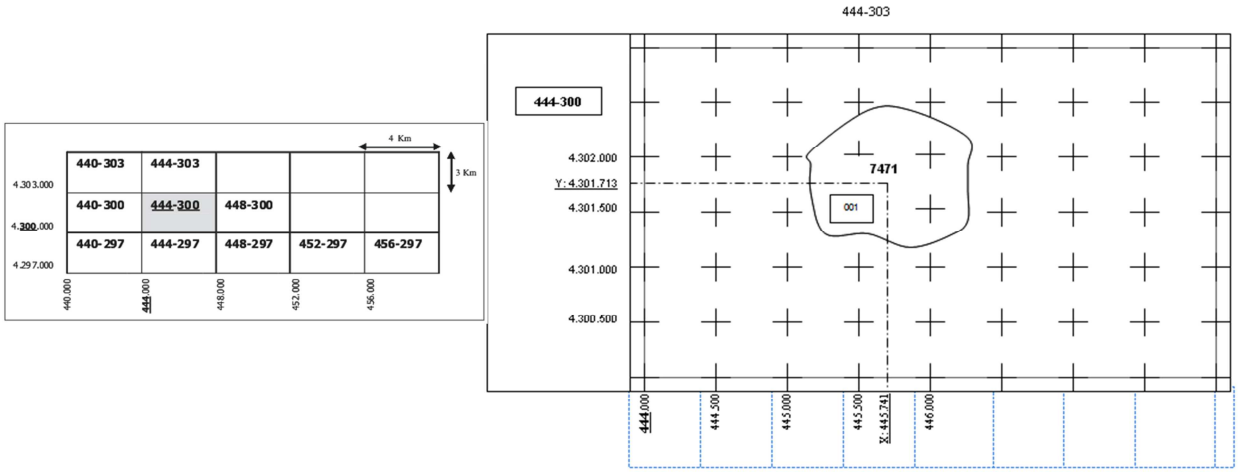


**Figure 1**. Agricultural parcels' codification system *(Source OPEKEPE)*

Concerning the accuracy of the system's background, it should be noted that, before the system's renewal, the orthophotomaps used were photogrammetrically produced by aerial photographs at a scale of 1: 40,000, thus practically resulting in a product accuracy of 1: 10,000. The new LPIS, is based on 9,670 orthophotomaps at a scale of 1: 5,000, produced by recent VHR satellite imagery (between 2006 and 2007), while for the rest of the country, high accuracy orthophotomaps, already developed for the Hellenic Cadastre project were used.

## 3. HELLENIC CADASTRE PROJECT

The Hellenic Cadastre Project (HCP) has been in progress since 1993, designed as a parcel-based land information system, serving as a legally recognized record of land ownership. The principal aim of the system is to guarantee titles to all parcels brought on to the register by the adjudication process. The HCP is currently in transition between the old system of register of

deeds and the new Hellenic cadastral system of register of titles. The HCP is executed by the Ktimatologio S.A. (founded in 1995) in co-operation with private consortium firms (Zentelis & Dimopoulou 2001)

According to the chairman and CEO of Ktimatologio SA, Dr Arvanitis, the HCP is operational for 18.11% of total estimated 37 million property rights, covering 6.14% of the territory, while a new program and a 3rd generation of cadastral surveys are in progress. So far, all legal and spatial information registered, is maintained in a digital database, the Hellenic Cadastre IT System (SPEK), where 95 cadastral offices are connected through the Internet. As of 2008, 107 urban regions have been included in the new program of cadastral surveys, actually registering 8 million property rights for the 2/3 of the country's population. The 3rd generation of cadastral survey studies have been declared, concerning peri-urban and rural areas with approximately 6.8 million total property rights. For the most part of these rural areas, land redistribution and consolidation work has undergone. The new generation of cadastral surveys use improved technical specifications, aiming at reducing cost and accelerate the cadastral survey process. In this context, the current effort for the project is to use existing information of different public administration resources, such as the land redistribution and consolidation analogue archives kept by the Ministry of Foods & Rural Development, as well as the rural subsidies database of OPEKEPE. (www.ktimatologio.gr)

Under the 3rd Community Support Framework (CSF), a series of supporting actions and infrastructure data are implemented for modernizing the ongoing HCP. These actions include among others, the development of a mapping infrastructure for the entire country, comprising digital orthophotomaps of high accuracy with a pixel size 50 cm (20 cm pixel for urban areas). This material enables the identification of the registered properties' location and representation and can be further used as a model basemap that can cover the needs of other public or private agencies and organizations working in relative fields.

## 4. CADASTRE AND LPIS

The Cadastre is a comprehensive registration of real property and other registrable rights that physical persons and legal entities have on land ownership. The cadastral survey, as the first stage of the HCP, is a procedure of recording these rights on real properties of the area under cadastral survey. The data collected, derive from ownership declarations, and are further processed by the competent cadastral authority, in relation to the associated land parcel. Then follows the suspension of cadastral data and anyone interested can confirm or apply for corrections, which are judged by a special committee. Upon completion of the cadastral survey, the Cadastre becomes operational in the area and the initial registrations can only change by court decision, if not concerning obvious errors. Therefore, the Hellenic Cadastre records –and guarantees- rights on real estate properties, depicted on cadastral maps at a scale of 1: 1,000 – 1: 5,000 for the past cadastral programs or orthophotomaps for the new programs. For the identification of each cadastral parcel, a 12-digit unique code is assigned, in accordance with the administrative division of the country in prefectures, municipalities and cadastral sectors.

It is obvious that the structure and mission of the Cadastre is quite different from the LPIS's, aiming at administering and controlling EU's agricultural aid to beneficiaries. In case of

Greece, both the HCP (since 2008) and the new LPIS use orthophotomaps at a scale of 1: 5,000 as basic cartography. The IACS identifies agricultural parcels with a single crop cultivated by a single farmer, while the HCP identifies cadastral parcels owned by one or more persons ab indiviso. So, the LPIS deals with farmers, while the HCP deals with owners that do not necessarily coincide. Furthermore, the two systems use different unique reference code number for their land parcels. Although the two systems present different characteristics, they do share physical similarity; cadastral parcels can be divided into sub-parcels with different types of land use or, can be part of a greater single crop area cultivated by a single farmer, thus constituting an agricultural parcel. Greece has to take advantage of the two systems' common features, in order to avoid overlap and expenditure duplication. As Mirón Pérez states (2005), the basic product that the Cadastre "exports" to the LPIS is the delimitation and area of the cadastral parcels; additionally, the main product that the Cadastre can get from the LPIS is information on land uses as well as changes in crops and uses.

## 5. CASE STUDIES

For the evaluation of the two systems, concerning their cartographical background and their accuracy in registering and presenting spatial data, three study areas were selected. The selection was based on the areas' characteristics, including geographical location, land fragmentation and topography. Therefore, a flat low-lying area, a seaside area of intense relief and an island agricultural area have been finally chosen. The selected areas are included in the first cadastral projects and the respective cadastral offices are nowadays fully operational. It is worth mentioning that in all three cases, the cadastral parcellation is based on cadastral diagrams, while the agricultural parcels are presented on recent orthophotoimaps.

In particular, the study areas selected are the following:

1. An area of 230,000 m2 in the municipality of Filippiada, located in Preveza, Epirus, presenting the characteristics of continental landscape with intense relief.
2. A seaside area of 380,000 m2 in the municipality of Lehena, located in Ilia, Peloponnese, a flat area of very low altitude, without any particular natural vegetation mainly consisting of agricultural crops.
3. An area of 240,000 m2 in Vassilikos, located in the island of Zakynthos, also with intense relief, consisting of pine forest and agricultural crops.

### 5.1 Data Collection

Data collected from OPEKEPE for the three study areas comprised:

- Orthophotomaps derived from VHR imagery with a pixel size 1m (2006-2007).
- Diagrams depicting LPIS's agricultural parcels in EGSA '87 geodetic reference system (in dxf format).
- Composition of the above material; overlay of agricultural diagrams on orthophotomaps.

Data collected from Ktimatologio S.A. for the three study areas comprised:

- Orthophotomaps with a pixel size 0.5m (2007)
- Cadastral diagrams in EGSA '87 geodetic reference system (in dxf format).

Furthermore, updated cadastral diagrams were provided by the Hellenic Mapping and Cadastral Organization (HEMCO), presenting the current situation of land parcellation for the study areas.

## 5.2 Case Study 1: Filippiada

The LPIS agricultural parcels included in Filippiada area (figure 2), represent a percentage of 31.8% of the study area, while the rest 68.2% is not registered in the system.

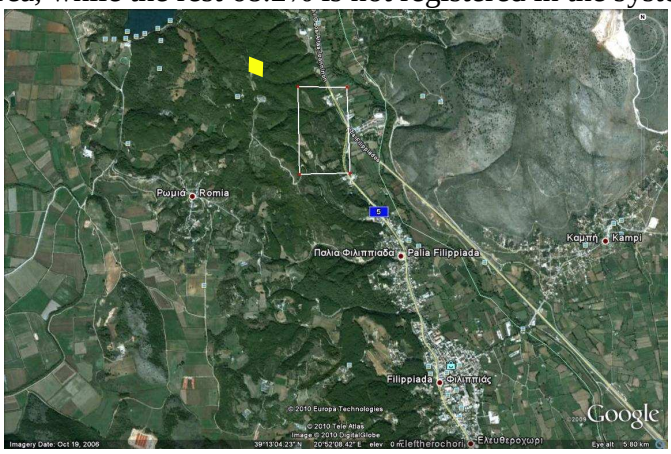


**Figure 2.** Study Area of Filippiada *(Source: GoogleEarth)*

In figure 3, a comparison between agricultural and cadastral parcels is presented. The average land parcel surface area is 7,000m2

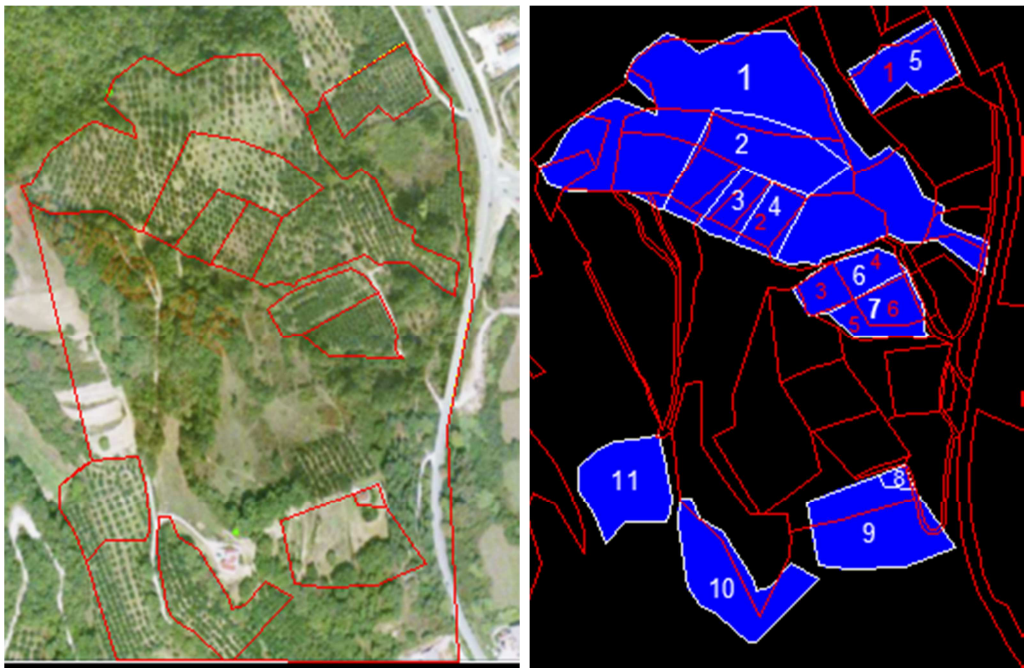


**Figure 3.** 11 agricultural parcels are overlayed on orthophotomap (left image) and compared to cadastral parcels (right image) *(Source: Ktimatologio SA & OPEKEPE)*

## 5.3 Case Study 2: Lehena

The LPIS agricultural parcels included in Lehena area (figure 4), represent a percentage of 91.2% of the study area, showing that almost all farmers applied for agricultural aid.

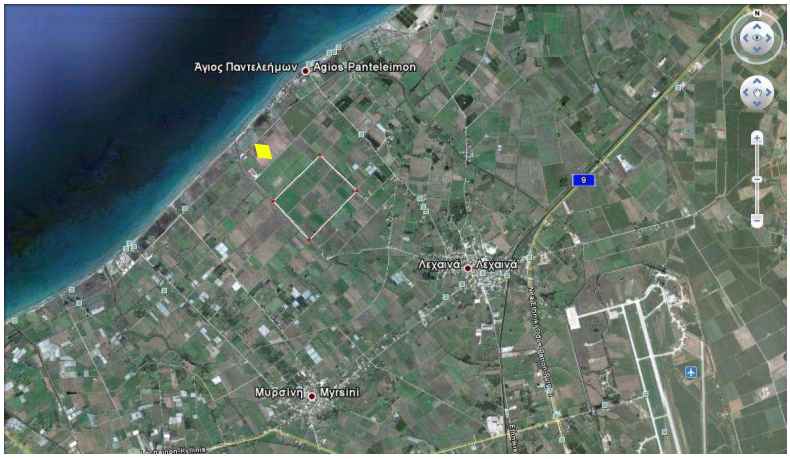


**Figure 4**. Study Area Lehena *(Source: GoogleEarth)*

In figure 5, a comparison between agricultural and cadastral parcels is presented. The average land parcel surface area for Lehena study area is 18,000m2

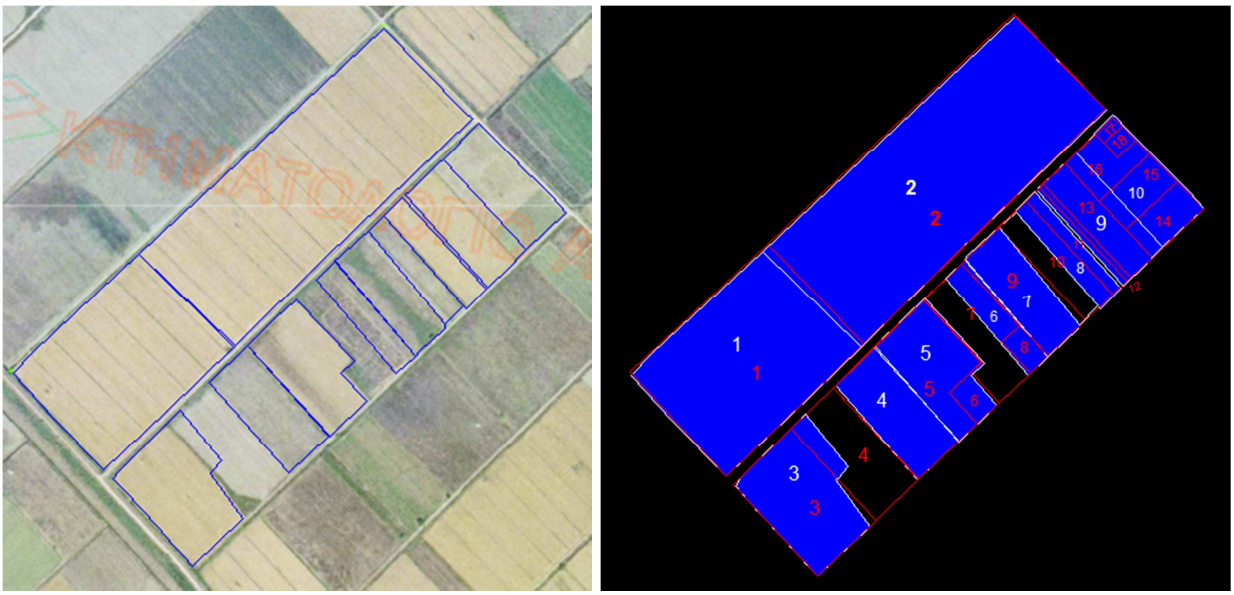


**Figure 5.** Agricultural parcels are overlayed on orthophotomap (left image) and compared to cadastral parcels (right image) *(Source: Ktimatologio SA & OPEKEPE)*

## 5.4 Case Study 3: Vassilikos

The LPIS agricultural parcels included in Vassilikos area (figure 6), represent a percentage of 74.4% of the study area, while the rest 25.6% is not registered in the system.

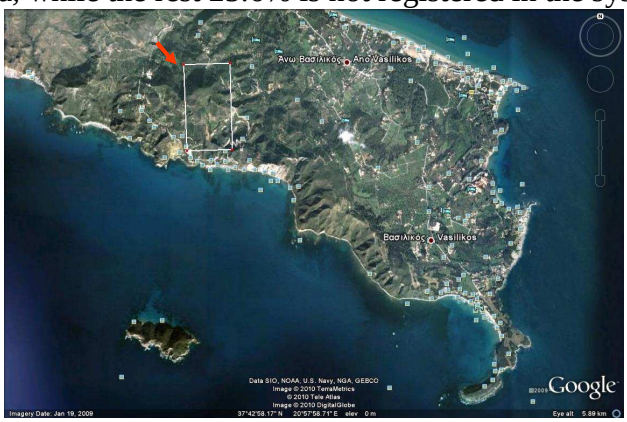


**Figure 6.** Study Area Vassilikos, Zakynthos island *(Source: GoogleEarth)*

In figure 7, a comparison between agricultural and cadastral parcels is presented. The average land parcel surface area for Vassilikos area is 10,000m2

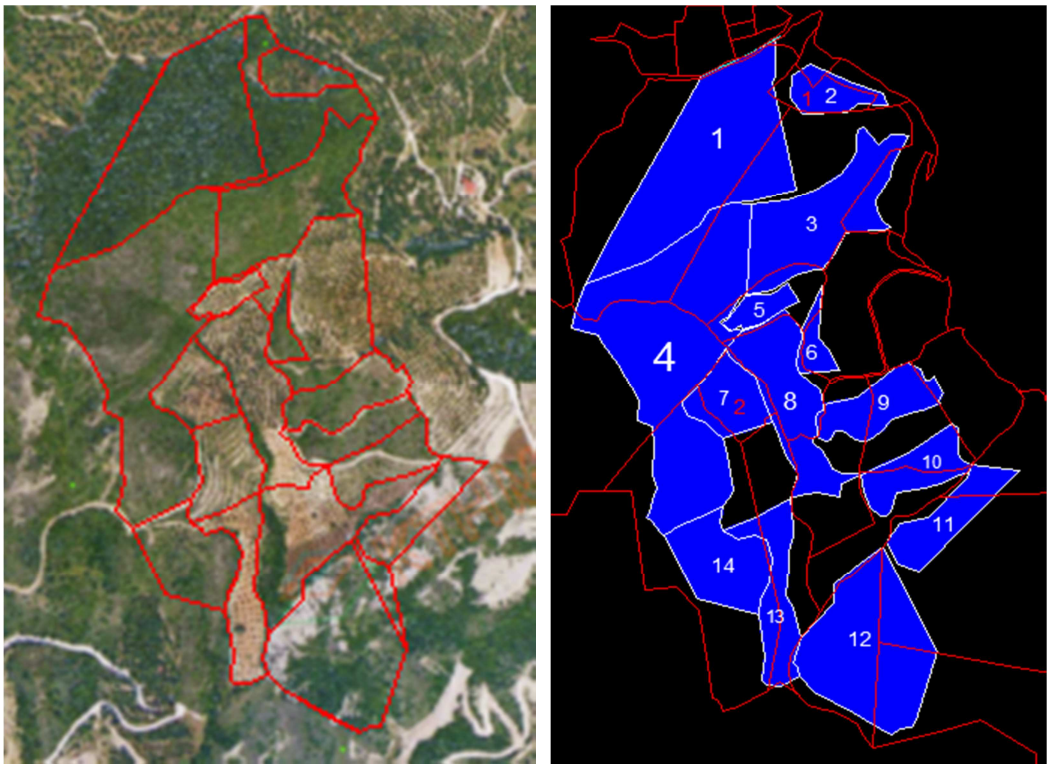


**Figure 7.** Agricultural parcels are overlayed on orthophotomap (left image) and compared to cadastral parcels (right image) *(Source: Ktimatologio SA & OPEKEPE)*

## 6. CONCLUSIONS

The main aim of this comparative research –schematically presented- is to identify the level of coincidence between LPIS and cadastral parcels. The above three case studies, have been extensively examined in our research, and the geometrical differences in all polygons were calculated. As a result, the degree of correlation between agricultural and cadastral parcels is less than 10%. An interesting result, concerns total surface areas of all agricultural parcels in each case study, matching with total surface areas of cadastral parcels. Finally, another interesting remark is that, in areas with low land parcellation and land parcels' size relatively large, almost all farmers register their land into the LPIS, in order to apply for agricultural aid. Consequently, in those areas, the system covers almost the entire agricultural land.

Concluding, it seems rather difficult to establish a direct collaboration between the two systems. The new LPIS and the new generations of cadastral survey projects are based on orthophotomaps -at a scale of 1: 5,000, produced by recent VHR satellite imagery. The use of the same cartographical infrastructural map data by both systems may be a challenge to a future coordination. In this case, the Hellenic Cadastre may well act as source data to the LPIS, while for the delineation of rural areas, not yet included into the ongoing cadastral project, the LPIS maps could serve as preliminary source data for the cadastral surveying work.

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## BIOGRAPHICAL NOTES

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