Presentation of the Basic Farm Structure Survey 2000 using GIS
A case study in some regions of Greece

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Abstract

This work presents an interface between the statistical and geographical databases, by means of the Farm Structure Survey (FSS) and an improved version of the CORINE Land Cover (CLC), and provides a comparison between them. The comparison requires the determination of the aggregation level of the classes for which the correspondence has already been set. Thus, after the reclassification of the above data, common classes are created and presented on a map using an embedded GIS environment. The user is able to relate the above data sources in order to find the best matching. The statistical data used has been provided from the last Census of Agriculture and Livestock breeding in Greece (Basic FSS) 1999/2000 database. To achieve compatibility between census and photo-interpretation the geographical data used has been provided by a recently developed version of the CLC geographical database of Greece. The new geographical database takes into account the FSS nomenclature and definitions, reorganizes the 44 classes of the original CLC into 16 general classes that meet the needs of the Land Use/Cover statistics in Greece and provides better acquisition period. The new CLC is based on comparative optical photo-interpretation of satellite images, gathered in 1998-1999, in order to update the original CLC, compiled in 1987, and to produce thematic maps of land use/cover for 1999 at a scale of 1: 100 000.

To validate the comparison of the respective surface areas of the related classes, as well as, to test the interface and provide the appropriate links between certain classes of the two nomenclatures the Greek regions are used in the pilot study. These regions are the island of Kriti, and the three regions of Makedonia. As it appears, the linkage between the two databases shows the existing differences between the tested administrative areas. The developed software tool is able to relate data from different sources and to display on a map accurately, the combined spatial statistical data along with the geographical information of the area of interest in order to find the best matching. Thus, although the new CLC seems to provide a good mapping base, the imposed minimum mapping unit of 25 ha results in an overall underestimation of the diversity of landscapes, something which is particularly important in the case of Greece for which the average size of the holdings is 4,5 ha.

Keywords : Farm Survey Structure; Corine Land Cover; spatio-temporal analysis; interoperable geo-object; landscape diversity.

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1 Introduction

From a rural land use perspective, an important development in Europe is that agricultural activities are more and more being combined with other activities such as environmental care, maintaining the landscape, forestry, preserving recreational and tourist areas. Assessing the agricultural policies and their impact on the countryside is still a crucial factor. Thus, there is a strong need for statistical data on rural populations, and particularly, on landscapes and land use, which are by their nature, spatial in form. The management, the processing and the display of such statistical data is therefore, largely, a spatial process. In this respect, GIS is considered necessary in the production of census maps, for dealing with census logistics, for monitoring census activities, and for data dissemination (Deichmann, 1997).

With the advent of GIS, an extremely wide range of spatial analysis methods has been developed for carrying out data transformations between different spatial structures. These methods help to present the data in a more meaningful and consistent manner and enable different data sets, based on different geographical units, to be brought together and overlaid. They also facilitate the spatial analysis of statistical data required in the development and/or calculation of more reliable indicators for the determination of the state and quality of the environment, and the ability to measure the effect of the agricultural economy, across regions and countries.

A necessary step in the assessment of agricultural policies and of their impact on the countryside and landscapes is the study of spatial units that constitute the underlying structure of these areas. Most statistical data in the European Union (EU), by means of the Farm Structure Survey (FSS) data, is organized and presented on the basis of NUTS (Nomenclature des Unites Territoriales Statistiques) system, to provide a single, uniform breakdown of a country. Nevertheless, these units are geographical areas that may vary substantially not only in their size and shape, but also over time. In addition, this geographical level is not appropriate to carry out certain environmental studies. To produce environmental indicators requires delineation of the land use data according to natural attributes, beyond that of administrative function. As a result, NUTS system cannot be applied in its present form to units that are more relevant from a geographical point of view, such as drainage areas, landscape units and bio-topes.

This study presents an interface between statistical and geographical databases and provides a comparison between them by means of the FSS and CORINE Land Cover (CLC). As a first step, the spatial disaggregation of the FSS data into an accurate geographical level requires an interface between the two nomenclatures. To reallocate the FSS data into sustainable areas a question arises of how the digital CLC map could be used to describe agro-environmental statistical structures. Note that CLC has so far been focused on land cover, rather than land use and it has been carried out once. Different European countries carried it out in different years, over the period 1985- 1995. Plans already exist to upgrade CLC based on the IMAGE 2000 image data set provided by the JRC. The result is that the indicators based on CLC currently show only a snapshot rather than a trend in land cover.

The developed interface is able to display on a map, accurately, the combined spatial descriptive statistical data and the geographic information of an area of interest. Thus, the user is able to relate the FSS and the CLC data in order to find the best matching. The developed interface is able to query a database, aggregate / disaggregate the data and plot the results on a map. The comparison requires to determine the aggregation level of the classes for which the correspondence has already been set and to validate the result by comparing the respective surface areas of the related classes. After the

reclassification of the above data, common classes are created and presented on a map using an embedded GIS environment.
To test the interface and provide the appropriate links between certain classes of the two databases the three regions of Makedonia and the region of the island of Kriti have been chosen. The statistical data used has been provided by the Basic FSS of 1999/2000 (Census of Agricultural for Livestock Breeding or simply Agricultural Census). However, to achieve compatibility between census and photo-interpretation data a recently developed, improved version of the CLC geographical database has been used. The new CLC takes into account the FSS nomenclature and definitions and has provides a much better acquisition period (Landsat-TM 1998 to 1999) which is the same as the census reference period (1998 to 1999). The linkage between the two databases shows the existing differences between the administrative areas of the pilot regions.
The structure of the paper is as follows: Section 2 describes the main characteristics of the FSS nomenclature, particularly as addressed in the case of Greece. Section 3 describes the modified CLC geographical nomenclature providing the new classification scheme. Also, in this section, the original CLC nomenclature is discussed briefly. Section 4 presents the linkage between the two nomenclatures and the way it has been achieved. Section 5 presents the results from the comparison of the related nomenclatures and, finally, in the last section the conclusions and the further development of this work are presented.

2 The FSS database

2.1 Main issues

The FSS is the main source of data on various characteristics relating to agricultural holdings on a regular basis. These data refer to the number and size distribution of the agricultural holdings by type of enterprise, as well as to land improvements, crop and livestock rotations and farm practices (machinery, equipment etc.). They also refer to other structural data such as the educational level of the farmer and farm labour inputs, the legal status of the land holder, including tenure arrangements, and finally other social demographic characteristics of land holders.
The FSS data are collected on a regular basis by the Member States of the EU and are forwarded to Eurostat, which stores them in the Eurofarm database. Table 1 shows the FSS nomenclature, which distinguishes the detailed agricultural land use classes.

2.2 Methodological issues of the FSS in Greece

The FSS is carried out in Greece within the framework of the Community Program for the ‘Statistical Surveys in the Agricultural Sector’. The FSS is intended to collect statistical data on the structure of agricultural and livestock holdings and the employment of the population on them. The data make it possible, besides the classical tabulation of the results, to generate tables, which show the economic size and orientation of the farms (typology).
A sample FSS is carried out every two years, in the years ending with an odd number. The National Statistical Service of Greece (NSSG) carried out the first sample survey of the Structure of Agricultural and Livestock Breeding in 1966/67, when Greece was still an associated member of the EU. The next sample survey took place in 1977/78. After the accession of the country into the EU further surveys were carried out in 1983, 1985, 1987, 1989, 1993,1995 and 1997 i.e. every two years. Note that every ten years an exhaustive survey (Basic FSS or Agricultural Census) is carried out. The first Agricultural Census was conducted in 1950, after the Second World War. The Agricultural Census of 1991 was the last census carried out at the same time as the

General Censuses for population, households, agriculture etc.. However, the Agricultural Census 1999/2000 was the first census carried out before the General Population Census 2001, under the title “Basic Survey for the Structure of Agricultural Holdings 1999/2000” and it was based on the Farm Register.
The reference period for the data collected on crops and employment is from 1 October of year t-1, to 30 September of year t. Exceptions to this are a farm’s livestock and machinery, questions relating to which have a reference date of 30 September in the year t, for machinery and 1 November for livestock.
The FSS is carried out by filling in a special questionnaire after interviewing the owner of the agricultural or livestock breeding farm. The sample survey is carried out by applying the method of multi – stage stratified area sampling.
In the most recent Agricultural Census (1999/2000) the Basic FSS covered all agricultural and livestock holdings in the country, approximately 814.000 holdings.

3 Description of the geographical nomenclature

3.1 The CLC geographical database

CORINE (Co-ORdination on INformation of the Environment) Land Cover (CLC) is a geographic land cover/land use database encompassing most of the countries of the European Community, with the aim of gathering information associated with the environment on certain priority topics. It describes land cover (and partly land use) according to a nomenclature of 44 classes organized hierarchically in three levels (Dueker, 1979).
CLC was elaborated based on the visual interpretation of satellite images (*Spot*, *Landsat TM* and *MSS*). The smallest surfaces mapped (mapping units) correspond to 25 hectares. Linear features less than 100m in width are not considered. The scale of the output product was fixed at 1:100.000. Thus, the location of precision of the CLC database is 100m.

3.2 The new CLC database of Greece

A new CLC database has been developed in Greece in order to cover the needs of land use/cover statistics as far as the distribution of the total area of Greece into basic categories of land use is concerned. These statistics are included in the preparatory work carried out in the context of every Agricultural Census. The aim is to prepare the census and to obtain data covering all the territory of Greece.
Until the Agricultural Census of 1991, this work was done by completing seven months before the Census a ‘pre-census questionnaire of total land area in the municipality or commune’, using estimates by the municipal or communal working parties set up for the census and with the help of local agronomists. To facilitate completion of the pre-census questionnaire, these groups had at their disposal the land distribution data from the previous census, as well as other auxiliary data held by the municipality or commune, such as land registers, land distribution tables, etc.
Land was divided up into seven basic categories of use:

- cultivated areas and fallow land remaining fallow for 1 to 5 years.
- communal or municipal pasture land.
- other pasture land (owned privately by the State, monasteries, etc.)
- forests
- areas under water (lakes, marshes, seashore, river beds)
- built-up areas (buildings, courtyards and roads, squares etc.)
- other areas (e.g. rocky areas, mines, etc.).

Note that the pre-census questionnaire was the only data source covering also state-owned land, which is mostly forest and pastures. Since the agricultural census is carried out by interviews of farmers, it concerns only private land that is used agriculturally.

In the light of recent developments concerning land use statistics and in order to produce more objective information on this sector an up-to-date methodology is adopted using GIS techniques. Spatial analysis of the information to be recorded is realized by determining the area of the minimum recorded surface, which is taken according to the proposed nomenclature, the methodology of use/cover definition, the requirements of 1:100.000 scale and the user needs. The method, by which the theme information is drawn up, is the comparative photo-interpretation of new satellite data collected in 1998-99 in relation to those of the time period 1997–98 used for the creation of the CLC database in Greece. The digital photo-interpretation of the new satellite data is made using image processing software and other data such as those from land recordings. The recording, planning and the use of the data from the fieldwork also define the reliability of the specific photo-interpretation.

The new CLC database is properly generalized as reference data and harmonized with the FSS nomenclature, by means of characteristics and definitions, linkage of the two databases to meet the needs of the NSSG. Thus, the distribution of the main land uses in Greece has been reorganized into the following sixteen classes:

- Artificial surfaces
  1. Urban fabric
  2. Industrial and commercial units
  3. Transport units
  4. Mine, dump and construction sites
  5. Artificial, non-agricultural vegetated areas, sport and cultural activity sites
- Agricultural areas
  6. Arable land
  7. Permanent crops
  8. Pastures
  9. Heterogeneous agricultural areas
- Forest and semi-natural areas
  10. Forests
  11. Transitional woodland /shrub
  12. Shrub and/or herbaceous vegetation associations
  13. Open spaces with little or no vegetation
- Surfaces under water
  14. Inland water
  15. Inland wetlands
  16. Coastal wetlands

4 Linking the two databases

4.1 Issues and problems in spatio-temporal analysis

As it is well known, data collection methods are optimized for a particular need and therefore the resultant data structures are not usually readily comparable in a cross-sectional study. Thus, although a particular census may be analyzed in detail comparing censuses with each other has proved problematical since they may use different administrative units, or they may use the same unit system, which includes many boundary changes that make the comparison difficult. To the best of our knowledge, three types of data incompatibilities have been distinguished so far (Frank, 1999), (Gregory, 2000) and will be described, briefly, below.

4.1.1 Differences in Data Models

Raster and vector data models are the GIS approaches for the spatial presentation of natural vegetation, the forest area and generally the presentation of land use. In a raster data model, a uniform grid, each cell of which is assigned a unique descriptor depending on the coordinate system used, represents space. Raster models can be directly imported into the software and immediately become available for use (Burrough, 1986). They are well suited for the representation of remotely sensed digital data and are commonly employed in the environmental sciences. In contrast, in a vector data model, the spatial data is based on geometric shapes of points, lines, and polygons. This model is object-oriented and is based on the coordinate system used. Vector GIS knows where the spatial feature (line, point, polygon) exists, as well as the relationship with the other features. For simultaneous use of data from both raster and vector models a conversion of one data set to the respective model of the other data set needs to be performed. Data conversions, however, are often ambiguous and typically result in a loss of information (Maffini, 1987). It is difficult, for example, to derive the best fitting vector representation from a given raster grid.

4.1.2 Inconsistencies of areal units

Comparing census data with other data sources of some specific area of interest may not be the same, either because of boundaries changes over time or because of the different definition of administrative/areal units used for the data collection (Xie et al, 1995). Two key issues need to be addressed in terms of areal unit comparability. One is related to data integration and map overlay (non-matching areal units). The other is related to data analysis and statistical comparability of areal units of different sizes and shapes (modifiable areal unit problem).

4.1.3 Non-matching Areal Units

Integrated analysis of spatial and attribute data is based on map overlay operations. Non-matching areal units require a transformation of data from one system of areal units to another in which data values are apportioned to the newly created spatial units. Then, the newly created zones allow data overlay and analysis. These transformations are known as “areal interpolation”.

4.1.4 Modifiable Areal Unit Problem (MAUP)

Generally, the statistical data, whose distribution and characteristics are not well known, are presented by an appropriate aggregated variable of some higher class. In addition, censuses base their statistics on well-defined areal units that tend to vary in size and shape leading to inconsistent and misleading statistical results. This is known as a Modifiable Areal Unit Problem (MAUP) (Openshaw, 1984). A possible approach to deal with this problem is re-aggregate the available data into homogeneous subunits as well as to increase the spatial detail, using ancillary land cover data in order to display the census data on a map (Yuan et al., 1997) .

4.1.5 Temporal incompatibilities

Data collection of land cover data and monitoring of physical changes relies on remote sensing via aircraft or satellites. Coverage cycles, for example, for the different LandSat orbiters (Lillesand et al., 1994) range from 8-14 days. This data density, however, may be deceptive since data for certain regions is usually available for much fewer dates due to the fact that frequent cloud cover prohibits data collection. In the case of agricultural cultivations, the above problem has to be considered in more detail since the cultivations are usually visible on specific periods over the year.

4.2 Methodology

To describe the methodology adopted in the problem we are studying, one has to take into account the non-matching areal units and the MAUP problems mentioned in section 4.1. Note that, the temporal incompatibilities problem and the procedure of matching the data points by non-matching due to collection cycles is not considered here.

Starting with the non-matching areal units problem, as this appears in the pilot case, a new object, called '*interoperable geo-object*' is introduced. This object includes all the required procedures in order to solve the following two problems.

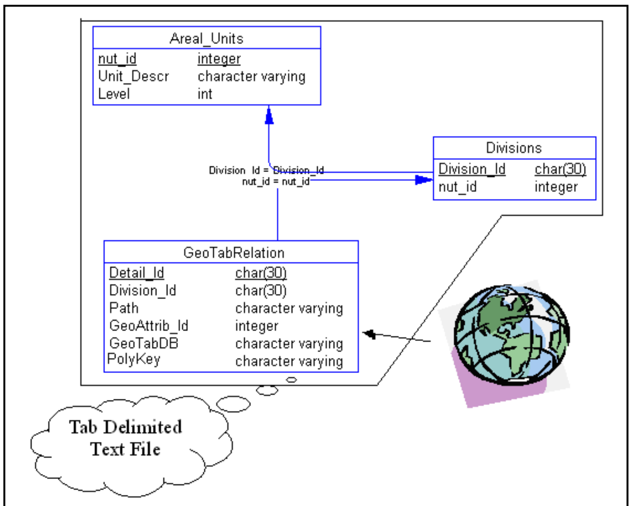

Figure 1 Link between the spatial and descriptive information

- The different boundaries definition of the administrative units that have been used during the collection of the FSS data (1991, 2000) in the pilot regions (NUTS II and NUTS III).
- The geodetic datum used in order to represent jointly the statistical and the ancillary geographical data on a map.

The first problem has been solved with the appropriate transformation between different spatial structures. This transformation determines the process of the aggregation and the dis-aggregation within nested, non-nested and neighbouring polygons. To overlay the data the conceptual model showed in Figure 1 has been designed. This model contains and maintains all the polygons and the related geometric data (lines, nodes etc), representing the areal units. To link the descriptive and the spatial information, the data of the geographical area has been divided into smaller parts in order to

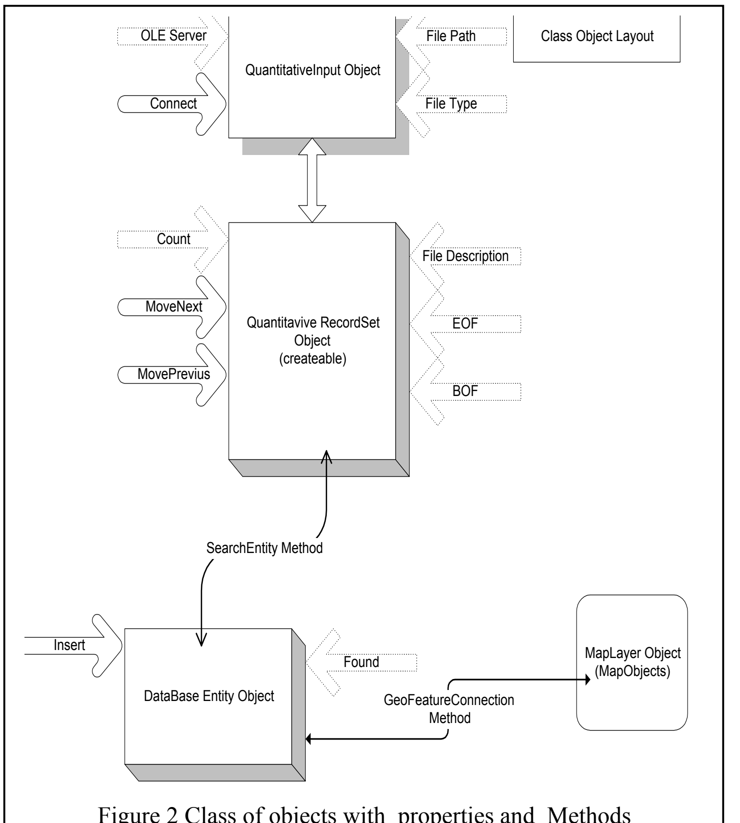

Figure 2 Class of objects with properties and Methods

determine the field that identifies the specific entity (‘*PolyKey’*), which has been used as a reference key to the GIS. Also, a set of spatial queries has been developed to carry out the above transformation.
To represent jointly the statistical and the ancillary geographical data on a map a common geodetic datum has been developed. Finally, an automated procedure has been developed to convert the data from the original to the target geodetic datum.
The MAUP problem has been faced using ancillary geographical data (Flowerdew et al. 1994) such as contour lines, lines representing rivers, or polygons representing lakes etc. This allows the synthesis of geographical data along with the statistical data. Further, it allows the combination of different scenarios to be considered in order to simulate the plotting of the statistical data on a map. For validation and / or prediction purposes, the results have been compared visually with other spatial quantitative information or sampling data presented on thematic maps. To achieve the connection between the file containing statistical data (usually in text format) along with geographical data (ancillary and statistical), the class of objects as it appears in Figure 2 has been created.

4.3 Software Development – A Case Study

As it has been pointed out, the linkage of the two nomenclatures, by means of the FSS the CLC databases, require the development of a software tool able to display maps and descriptive data in a tabular form. This has been achieved by linking the CLC geographical information with the tabular information of the multi-dimensional tables of the FSS (Table 2). Thus, the user becomes part of the GIS without the necessity of having specific skills and intimate knowledge of the data used.
To begin with, a step-by-step analysis of the software design is required. The appropriate design steps are described below:

1. On the CLC’s geographic layer of the area of interest is added the ancillary geographical features, for example contour lines, roads, cities, lakes and rivers. This will help to localize the CLC data.
2. From the FSS database only themes, associated with agricultural products have been selected. Note that the use of the ‘*Geo-Objec*t’ offers the capability to work at different levels of administrative units. However, in the pilot case, the FSS data have been selected at prefecture level (NUTS III), in thousands of hectares, as they are reported in the 1991 and 2000 census.
3. We develop the entity relationship model as well as the relational database of the software tool, based on the data provided by the FSS and CLC databases.
4. The CLC data have been stored in some database tables of the software tool, using some especially developed functions. Further, the *OLEServer* method of the *QuantitativeInput* object has been used with the appropriate DLLs, which have been provided by the FSS, in order to transfer the FSS data into the database.
5. We define the appropriate functions and queries, and we developed object classes in order to achieve uniformity at both the user and the developer levels.
6. We developed an application in which the RDBMS, the GIS and the pre-mentioned object class have been used. The basic capabilities offered by this application are the following:
    - Ability to compose (aggregate) a new FSS theme by selecting one or more CLC classes, and vice versa.
    - Ability to decompose (disaggregate) an existing FSS theme to one or more CLC classes, and vice versa.
    - Ability to correspond (relate) the new FSS themes to CLC classes.

- Ability to classify (sort) the results by date, county (region), or by CLC class.
- Ability to observe the results plotted on a map and to classify these by some geographical characteristics (e.g. allocation of the selected growth by elevation).

5 Results

Although the new CLC nomenclature has been harmonized with the FSS nomenclature, there are still some problems related to the two different methodologies. The analysis of the above problems has been carried out throughout by a comparison between the respective areas of the related classes. The available data from the 2000 FSS is based at the Municipality/Commune level (NUTS IV), whereas the data drawn from the new CLC is at the district level (NUTS III). The data of two databases has been compared in a pilot study of four regions of Greece at a district level (NUTS III). The comparison shows large difference between them in the agricultural areas. Generally, the agricultural areas in new CLC are greater than the corresponding agricultural areas in the 2000 FSS. The differences are because of the difficulties in correlating the pastures areas between the two databases, whereas the differences in the arable areas and the areas under permanent crops are due to the different methodologies used. Note that the observed differences (%) in the regions (NUTS II) are generally smaller than for the corresponding inter-regional ones (district level; NUTS III). This is due to the fact that the mapping unit is 25 ha in the new CLC. Moreover in Greece, the average holding size is around 4,5 ha and the average parcel size is around 0,7 ha. Finally an additional reason is that in FSS all the holdings are recorded at the place of residence of the holder (natural person) or of the headquarters (legal person) of the holding.

6 Conclusions

This study has been based on the provisional data of the 2000 FSS and the new CLC databases and it may be considered as a first step in the direction of present geo-reference statistical data. The difficulties in the linkage of the two databases can be generally explained from the following:

- The different methodology used as far as the data collection methods and the coverage are concerned. In particular, the FSS is a census using as a reference unit the farm, whereas the new CLC is based on photo–intepretation of the whole area of the country using as a reference unit the mapping unit of at least 25 ha. In addition, CLC has so far been focused on land cover, rather than land use.
- The minimum size of 25 ha of CLC mapping units presents the difficulty of identifying parcels of smaller size. Thus, a number of non-agricultural areas are classified as agricultural whereas they are only partially agriculture. This is a common problem in areas with forest and olive-trees. Besides, areas classified as non-agricultural areas in CLC may include part of an agricultural area. This explains a number of differences within the agricultural classes. For example, part of meadows or permanent crops can be included in areas with arable crops and conversely.
- Despite the harmonization between the new CLC and FSS nomenclatures there are still problems as far as pastures and heterogeneous areas are concerned. In the new CLC, the non-agricultural classes defined by the codes 11, 12, and 13 (“Transitional woodland/shrub”, “areas with mixed shrub/grass vegetation” and “areas with little or no vegetation” respectively) may include surfaces classified

as “permanent meadows and pastures” in the FSS. Furthermore the FSS does not record the state-owned meadows, which in the new CLC are recorded under the code 8 (“areas under meadow or pastures”).

- The special features of Greek agriculture that is marked by the diversity of holdings in terms of area of production (mixed holdings), the small size of the holdings (average size 4,5 ha) and the fragmentation of their area (6 parcels approximately per holding and average parcel size of 0,7 ha). In quite a number of cases the parcels of the same holding are normally located far away from the farmhouse or from the headquarter, but they are recorded at the place of the farmhouse or the headquarter (by definition).

- The combination of the RDBMS technology and the OOP logic is ideal to relate heterogeneous data into an integrated geographical environment in order to compare the results from different sources. Furthermore, the system’s capability to display and compare simultaneously results of different years assists the user to reach in more reasonable conclusions.

7 Summary and future work

The work presented so far is a pilot study merging, by means of a software tool, the statistical data, available at the administrative level, with the geo-referenced land cover in order to identify and explain the most significant differences encountered between the aggregates of agricultural land cover classes. This has been achieved with the use of the 2000 FSS and the new CLC databases already under development in Greece.

The new CLC seems to provide a good mapping base for Greece, which could be improved further by using suitable satellite images that are able to produce scaled maps of at least 1:50000. Note that the imposed minimum mapping unit of 25 ha results in an overall underestimation of the diversity of landscapes something which is particularly important in the case of Greece for which the average size of the holdings is 4,5 ha.

Apart from CLC, additional sources may be used providing detailed complementary information, such as aerial ortho-photographs, the cadastral map of Greece, IACS (Integrated Administrative Control System), MARS (Monitor Agriculture with Remote Sensing), NATURA2000 database, or other ongoing analysis of the European landscape.

When the final data from the remaining regions of Greece will be available a quality analysis of the two databases will be carried out and a finer level of nomenclature will be examined. This will allow final conclusions to be drawn and further actions to be taken in the future.

As for the software tool, future research is to continue improving the idea of “*interoperable geo-object*” by adding methods and properties for uncertainty manipulation and to investigate requirements of GIS in a fuzzy object data model. Our final objective is to embody in the Geo-Object, the ability to generate and visualize transitions from one state to another, using the rules of an expert spatio-temporal system.

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D: ARABLE LAND	D01-D08: CEREALS	D01	Common wheat and spelt
		D02	Durum wheat
		D03	Rye
		D04	Barley
		D05	Oats
		D06	Grain maize
		D07	Rice
		D08	Other cereals
	D09: DRIED PULSES	D09C	Pulses-fodder peas
		D09D	Pulses-fodder field beans
		D09E	Pulses-other than fodder peas and field beans
	D10-D12: ROOT CROPS	D10	Potatoes
		D11	Sugar beets
		D12	Fodder roots and brassicas
	D13: INDUSTRIAL PLANTS	D13A	Tobacco
		D13B	Hops
		D13C	Cotton
		D13D	Other industrial plants
		D13D1	Other oil seeds or fibre plants
		D13D1A	Rape and turniprape
		D13D1B	Sunflower
		D13D1C	Soya
		D13D1D	Other oil seeds or fibre plants-others
		D13D2	Aromatic-medicinal and culinary plants
		D13D3	Industrial plants-others
	D14-D15: FRESH VEGETABLES, MELLONS, STRAWBERRIES	D14A	Fresh vegetables, mellons, strawberries-outdoor-openfield
		D14B	Fresh vegetables, mellons, strawberries-outdoor- market gardening
		D15	Fresh vegetables, mellons, strawberries under glass
	D16-D17: FLOWER AND ORNAMENTAL PLANTS	D16	Flowers and ornamental plants outdoor
		D17	Flowers and ornamental plants under glass
	D18: FORAGE PLANTS	D18A	Forage plants-temporary grass
		D18B	Forage-plants-other green fodder-total
		D18B1	Forage-plants-other green fodder-green maize
		D18B2	Forage-plants-other green fodder-leguminous plants
		D18B3	Forage-plants-other green fodder-others
	D19-D20: OTHER ARABLE CROPS	D19	Seeds and seedlings
		D20	Other crops
	D21: FALLOW LAND	D21	Fallow land
E: KITCHEN GARDENS	E: KITCHEN GARDENS	E	Kitchen gardens
F: PERMANENT PASTURES AND MEADOWS	F: PERMANENT PASTURES AND MEADOWS	F01	Permanent grassland and meadow-pasture and meadow
		F02	Permanent grassland and meadow-rough grazing
G: PERMANENT CROPS	G01: FRUIT AND BERRY PLANTATIONS	G01A	Fruit and berry plantations-temperate climate
		G01B	Fruit and berry plantations-subtropical climate
		G01C	Fruit and berry plantations-nuts
	G02: CITRUS PLANTATIONS	G02	Citrus plantations
	G03: OLIVE PLANTATIONS	G03A	Olive plantations-table olives
		G03B	Olive plantations-oil production
	G04: VINEYARDS	G04A	Vineyards-quality wine
		G04B	Vineyards-other wines
		G04C	Vineyards-table grapes
		G04D	Vineyards-raisins
	G05: NURSERIES	G05	Nurseries
	G06: OTHER PERMANENT CROPS	G06	Other permanent crops
	G07: PERMANENT CROPS UNDER GLASS	G07	Permanent crops under glass
H: OTHER LAND	H0103: UNUTILIZED AGRICULTURAL LAND	H01	Unutilized agricultural land which is no longer farmed, for economic, social or other reasons
		H03	Other land occupied by buildings, pleasure gardens, etc.
	H02: WOODED AREA	H02	Woodland
I: COMBINED AND SUCCESSIVE SECONDARY CROPPING, MUSHROOMS, IRRIGATION, GREENHOUSES	I01: SUCCESSIVE SECONDARY CROPS	I01A	Successive secondary crops-non fodder cereals
		I01B	Successive secondary crops-non fodder pulses
		I01C	Successive secondary crops-non fodder oil-seed plants
		I01D	Successive secondary crops-others total
	I02: MUSHROOMS	I02	Mushrooms
	I03: IRRIGATED AREA	I03A	Total irrigable area
		I03B	Irrigated once a year-total
	I04: AREA COVERED BY GREENHOUSES IN USE	I04	Area covered by greenhouses in use
	I05: COMBINED CROPS	I05A	Combined crops-agricultural-forestry
		I05B	Combined crops-permanent-annual
		I05C	Combined crops-permanent-permanent
		I05D	Combined crops-others

AA = D+E+F+G (Utilized Agricultural Area).
AA+H = Total Agricultural Areas.
I repeat areas entered in classes D, F and G.

Table 1: Classification of land use in the 2000 FSS nomenclature.

New CLC		FSS	
LEVEL 1	**LEVEL 2**	**LEVEL 1**	**LEVEL 2**
1. Artificial surfaces (Man-made areas)	1.1 Urban fabric (Build-up areas, urban agglomerations)		-
	1.2 Industrial and commercial units (Industrial or commercial zones)		-
	1.3 Transport units(Communication networks)		-
	1.4 Mine, dump and construction sites (Mines, waste disposal sites and construction sites)		-
	1.5 Artificial, non-agricultural vegetated areas sport and cultural activity sites (Artificial or non-agricultural green areas)		-
2. Agricultural areas	2.1 Arable land (Areas under arable crops)	Utilized agricultural areas	D=D01+D02+D03+ D04+D05+ D06+D07+D08+D09+D10+ D11+D12+D13+D14+D15+ D16+D17+D18+D19+ D20+D21
	2.2 Permanent crops (Areas under permanent crops)		G=G01+G02+G03+G04+G05 +G06+G07
	2.3 Pastures (Areas under meadow or pasture)	D+G+E	F=F01+ F02
	2.4 Heterogeneous agricultural areas (Areas with mixed uses -mixed farmland)		I05A+I05B
3. Forests and semi-natural areas	3.1 Forests (Forested areas)		H02: only the private forests
	3.2 Transitional woodland /shrub		H01: only the private uncultivated areas for economic, social or other reasons
	3.3 Shrub and/or herbaceous vegetation associations (Areas with mixed shrub/grassy vegetation)		
	3.4 Open spaces with little or no vegetation (Areas with little or no vegetation)		
4. Surfaces under water	4.1 Inland water		
	4.2 Inland wetlands		
	4.3 Coastal wetlands		

Table 2: Linkage between the 2000 FSS and the new CLC nomenclatures in Greece

Regions (NUTS II)	Districts (NUTS III)	Arable Areas (% difference)	Areas under Permanent Crops (% difference)	Cultivated Areas (% difference)
ANATOLIKI MAKEDONIA & THRAKI	DRAMA	45	-93	42
	KAVALA	64	-45	31
	EVROS	24	44	25
	XANTHI	33	-67	32
	RODOPI	31	89	32
TOTAL		33	-27	30
KENTRIKI MAKEDONIA	IMATHIA	42	-91	-12
	SALONIKI	4	-49	3
	KILKIS	-7	-39	-7
	PELLA	-31	-77	-47
	PIERIA	-7	-79	-14
	SERRES	42	-81	37
	CHALKIDIKI	54	-9	34
TOTAL		15	-61	4
DYTIKI MAKEDONIA	GREVENA	20	-68	18
	KASTORIA	-21	-35	-22
	KOZANI	4	27	5
	FLORINA	-3	-44	-4
TOTAL		3	-14	2
TOTAL MAKEDONIA		18	-52	12
KRITI	IRAKLIO	-71	4	-4
	LASITHI	54	47	48
	RETHIMNO	-91	-7	-24
	CHANIA	-72	4	-4
TOTAL		-66	6	-3

Table 3: Results showing the differences (%) in arable areas, areas under permanent crops and cultivated areas (D+E) as they recorded by the 2000 FSS and the new CLC nomenclatures.