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**PRESENTATION OF THE BASIC FARM STRUCTURE SURVEY 2000
USING GIS
A CASE STUDY IN SOME REGIONS OF GREECE**

Supporting paper submitted by National Statistical Service 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 new CLC seems to provide a good mapping base for Greece. However, 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.

1. Introduction

From the agricultural point of view, an important development nowadays is that agricultural activities are more and more combined with other activities such as environmental care, maintaining the landscape, forestry, preserving recreational and tourist areas as well as small scale of agricultural products, aquaculture, fisheries, etc. A sustainable reform should keep productivity high, so that, farmers remain competitive. 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 population, and particularly, on landscape and land use. Note that most of the statistical data used for policy purposes are related to populations, activities, features and other events, which are by their nature, spatial in form. The management, the process and the display of statistical data associated with spatial locations that vary geographically is therefore, largely, a spatial process. In agricultural terms, the management of agricultural resources is increasingly complex as conservation and environmental concerns play an expanding role for making conclusions. 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 [1].

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 the statistical data required in the development and/or calculation of some more reliable indicators for the determination of the state and quality of the environment, able to measure the effect of the agricultural economy, across regions and countries. The use of indicators as an aid to policy decision-making in the agri-environmental context is a relatively recent phenomenon and still a developing field, however, indicators are perceived to have considerable potential as policy tools. Most policy makers concerned with agri-environmental issues at the national level are confronted with fragmented information and it is accordingly difficult to use the information in a way that effectively contributes to policy decision making.

An unavoidable 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 territories. Most statistical data in 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 the sizes and shapes, but also over the time. In addition, this geographical level is not appropriate to carry out certain environmental studies. The need of spatial analysis and of the production of environmental indicators requires delineation of the land use data according to their natural depiction on a geographical map, beyond the administrative distribution. 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, bio-topes, etc.

This study presents an interface between the 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. As a result it cannot be applied to show trends. However, different 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 some of the indicators based on CLC show only a snapshot rather than a trend in land use.

The developed interface is able to display on a map, accurately, the combined spatial descriptive statistical data along with 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 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 much better acquisition period (Landsat-TM 1998 to 1999) which is the same with 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 addressed in the case of Greece. Section 3 is particularly addressed to the modified CLC geographical nomenclature providing the new classification scheme. Also, in this section, the original CLC nomenclature is discussed briefly. Section 4 presents linkage between the two nomenclatures and way it has been achieved, by means of application development. Section 5, presents the results from the comparison of the related nomenclatures and finally, in the last section the conclusions and the prospects of this work are presented.

2 The FSS database

2.1 Main issues

The effective and balanced implementation of the reformed Common Agricultural Policy requires detailed objective, quantitative data of the structure and performance of the agricultural, rural and environmental sectors. In this context the development of the structure of the agricultural holdings allows analysis of the agricultural sector and its impact to other sectors as the rural sector and the environment.

The FSS is the main source to provide 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 the 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 farmer and farm labour inputs, the legal status of holder including tenure arrangements and finally other social demographic characteristics of holders.

The FSS data are collected on a regular basis by the Member States and are forwarded to Eurostat, which stores them in the Eurofarm database. In order to harmonize information at the Community level, legal frameworks (Regulation and Decisions) define the methodological framework and the contents of the FSS questionnaires. [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'. All the specifications and terms are defined precisely by the Regulation 571/88 as amended by the Regulation 2467/96 and the related Decisions of the Council of the E.U.

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). In particular, the Greek FSS system aims to collect data relating to:

- The number of agricultural and livestock holdings in the country, at national, regional and local level.
- The geographical position of the holdings.
- The legal status and management of the holding.
- The agricultural training of its owner.
- The keeping of account books.
- The land uses (arable crops, permanent crops, kitchen gardens, permanent pasture-meadows and rough grazing and other areas).
- The type of ownership of the utilized agricultural area.
- The number of fields constituting the total utilized agricultural area.
- Successive crops, combined crops, irrigated crops, etc..
- Livestock raised on the farm.
- Agricultural machinery and milking equipment used.
- Employment of members of the farm owner's family.
- Employment of family members in other gainful activities besides agriculture.
- Employment of permanent, seasonal and other workers.

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

Every ten years an exhaustive survey (Basic FSS or Agricultural Census) is carried out. The first Agricultural Census conducted in 1950, after the second World War. Agricultural Census of 1991 was the last census carried out at the same time with the General Censuses for population, households, agriculture etc.. However, 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 October 1st of year t-1, to 30 September of year t, i.e. the survey year. 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 the machinery and 1st November for the livestock.

The statistical unit for the F.S.S. is defined as an agricultural or livestock holding¹ which during the reference period comprises at least one of the following:

- at least 0.1 ha of utilized agricultural area or at least 0.05 ha of greenhouse area, regardless of its own ship and location, or
- at least one cow, or
- at least two other large animals (oxen, buffaloes, horses, etc.), or
- at least five small animals (sheep, goats, pigs), or
- at least 50 poultry birds, or

¹ **Agricultural holding** is a single unit both technically and economically which has single management and which produces agricultural products. The holding may also provide other supplementary (non-agricultural) products and services.

Geographical location of the holding: All collected data concerning land uses, livestock breeding etc. are register to the place where the residence of the holder is (natural person), or where the headquarter is situated, if the holding is legal person.

- at least 20 beehives.

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, of 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 aim to gather 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 [3]. 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 precision of the CLC database is 100m.

The CLC database has recently become available for most of the territory of the EU and several PHARE countries (AL, PL, CZ, SV, RO, HU, BG, SI, EE, LV, LT). Although its exploitation is just starting, it offers the potential for a wide array of uses. It can be used on its own for simple cartographic or statistical presentations and as a base for European-wide landscape analyses or more generally in combination with other data sets (spatial analysis, modelling, etc.).

3.2 The new CLC database of Greece

The 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 in the basic categories of land use is concerned. These statistics are included in the preparatory work carried out in the context of every Agricultural Censuses. The aim is to prepare the census and to obtain data covering all the territory of Greece.

Until Agricultural Census of 1991, this work was done by completing seven (7) 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 resting fallow for 1 to 5 years.
- Communal or municipal pasture land.
- Other pasture land (owned by privates, State, monasteries, etc.)
- Forests
- Areas under water (lakes, marshes, seashores, river beds)
- Build-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 the state-owned land, which is mostly, forest and pastures. Nevertheless, since the

agricultural census is carried out by interviews of farmers it concerns only private lands that is somehow agriculturally used.

In the light of the recent developments concerning land use statistics, NSSG decided to use an up-to-date methodology using GIS techniques in order to produce more objective information on this sector. Therefore, the use of spatial analysis is required. 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 with which the theme information drawn up, is the comparative photo-interpretation of the 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 field works are also defining 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 (16) 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

The new CLC geographical database for the country's area has numerous advantages, the most important of which are the following:

- It provides a land use/cover map covering all Greece for 16 categories, compiled with the seven land use classes in the above mentioned pre-census questionnaire of the NSSG.
- The new geographical database takes into account the FSS nomenclature and definitions.
- It enables comparability between the two sources of information, namely census versus photo-interpretation. In the case of Greece the acquisition period of the data is spread over 2 years for both, the CLC (Landsat-TM 1998 to 1999) and the FSS 1999/2000, (reference year the 1998-1999 crop year).

- It enables the integration of the chrono-geographical co-ordinates of the satellite images sources of CLC. This will help in the identification of districts for which CLC's image interpretation is one year apart (minus or plus) from the census year (1990 or 2000, respectively). In addition, using the intermediate FSS data that correspond closely to the date of the satellite image it will be possible to mitigate the effect of time.

4. Linking the two databases

As it has been pointed out, the linkage of the two nomenclatures, by means of the FSS the CLC databases require computer-based application software able to display maps and descriptive data in a tabular form. This has been achieved using geographical information from CLC database linked with tabular information of the multi-dimensional tables of FSS (Table 2). The user becomes part of the GIS without the necessity of specific skills and intimate knowledge of the data used.

The GIS tool used for CLC database construction is the 'ESRI ArcInfo' software. This tool stores a set of tables in DBF format, containing both the spatial and descriptive information about map's features, which are logically organized into themes of information. Each theme consists of topologically linked polygons along with the associated descriptive data. Generally, X-Base formats, such as DBF, DBT, MOD, DIF, SDF, etc., cannot easily aggregate, desegregate, isolate, and combine CLC data with other sources. Furthermore, due to severe limitations associated with the temporal component of data in the GIS raster databases, a comparison between geographical data obtained in the past is very difficult in practice [2].

To support the exchange of heterogeneous data into an integrated database environment a conceptual model is required [5]. The design of such a model has to take into consideration to load and refresh the descriptive geographical data for each attribute of the GIS, at any time it will be required, and then to link them with the information derived from other sources such as FSS data.

To test the application software a preliminary study, using the 1991 Basic FSS data of the island of Kriti has been prepared (Figure 1). The island of Kriti is a region (NUTS II level) and consists of four districts (NUTS 3 level); Chania, Rethimno, Iraklio and Lasithi. Note that Figure 1 is based on the original CLC database (1991) and is constructed using the Hellenic Geodetic Reference System 1987 (HGRS 87). Any additional geo-data used such as roads, lakes, contour lines are constructed using World Geodetic System 1984 (WGS 84). In addition, the basic geographic layer is constructed using detailed geographical data, such as coastlines, contour lines, roads, airports etc. Details of the method followed in order to develop the interface may be found in [6] and as it may be observed one may easily incorporate the new CLC and FSS data of the 2000 year. The actual procedure followed in order to produce the final map is shown in Figures 2 and 3.

5. Results

Table 2 presents the linkage between the 2000 FSS and the new CLC nomenclatures. Although the new CLC nomenclature has been harmonised 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 of a comparison between the respective areas of the related classes, and has been allowed to make proposals for a future work. The available data from the 2000 FSS has been based at Municipality/Commune level (NUTS IV), whereas the data has been drawn from the new CLC 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 deviations in the agricultural areas. Generally, the examined agricultural areas in new CLC are greater than the corresponding agricultural areas in the 2000 FSS. The problem of large deviations is caused mainly because of the difficulties in correlating the pastures areas between the two databases, whereas the differences of the arable areas and the areas under permanent crops are related to the different methodologies.

The results found so far are presented in Tables 3 to 6. Table 3 presents the differences (%) in arable areas, areas under permanent crops, and cultivated areas (aggregation of D+E), as they recorded in the districts (NUTS III) of the examined regions, between the two nomenclatures. Positive sign is in favor of the new CLC nomenclature, whereas negative sign is in favor of the FSS nomenclature. Note that the actual differences in the above classes are not as high as they are in the remaining classes, namely pastures and meadows (Table 4), heterogeneous areas (Table 5) and agricultural areas (Table 6). To facilitate the comparison for the last cases the actual values are presented.

As it may be observed (Table 3) the above differences (%) in the regions (NUTS II) are generally smaller from the corresponding inter-regional ones (district level; NUTS III). This is due to the fact that the mapping unit of 25 ha in the new CLC is not able to identify parcels of smaller size. This is the case of Greece, in which the average holding size is around 4,5 ha and the average parcel size is around 0,7 ha. 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 headquarter (legal person) of the holding. In the following some preliminary comparison of these results are summarized:

- *Arable areas*
Region comparison shows that the difference for the region of Kriti is about 66% in favor of the FSS nomenclature. However, the differences in the regions of Makedonia are not as high (at most 33%) and are in favor of the new CLC nomenclature (Table 3). Generally, the differences in the arable crop areas are moderate and are in favor either of the FSS nomenclature or of the new CLC nomenclature (NUTS III level). Interesting to note that in some districts of the regions of Kentriki and Dytiki Makedonia the results are almost the same.
- *Areas under permanent crops*
In general terms the situation is opposite of the one described in the arable crop areas. As it may be observed from Table 3 in the region of Kriti the differences (%) between the two nomenclatures are very small (about 6%). In the regions of Makedonia these differences (%) are moderate (at most 61%) and are in favor of the FSS nomenclature (NUTS II). Furthermore, in the districts of some regions these differences are substantial and/or in the opposite direction (e.g. districts of Evros -93%, Rodopi 89%, etc.).
- *Pastures and meadows*
The total areas of pastures and meadows are generally larger in the new CLC than the corresponding areas recorded by the FSS. In all regions (NUTS II) the differences are very high. In the region of Kriti, the two districts of Rethimno and Chania the recorded areas in the new CLC are smaller than the corresponding areas of FSS. This is because only the private areas are recorded in the FSS, whereas all pastures (such as state-owned pastures, private pastures, etc.) are recorded in the new CLC.
- *Heterogeneous areas*

FSS and new CLC present very high actual differences in the class of the heterogeneous areas. Even the two nomenclatures are harmonized there is still a methodological problem of how to relate the two nomenclatures. In particular, in the FSS the survey unit is the agricultural holding, which comprises of at least 0,1 ha. Therefore the heterogeneity (combined crops) of these areas is referred to this small area. In new CLC the heterogeneity is examined within the mapping unit of 25 ha. Under these circumstances a polygon in the new CLC that includes different parcels of a single crop is recorded as heterogeneous area, whereas in the FSS the corresponding parcels are recorded as single crops.

- *Agricultural areas*

All the Agricultural Areas (AA=D+G+F) resulting from the new CLC nomenclature show larger values than the corresponding areas in the FSS nomenclature, particularly in the districts. The differences are generally high with exception of two districts of the region of Kriti. As it has been pointed out previously, the large deviations observed between the agricultural areas as they recorded in the new CLC and the FSS are due to the large deviations in the pastures.

- *Cultivated areas*

Given the problems of the large deviations in the total agricultural areas that are caused mainly from the pastures, the aggregation of the arable areas and the areas under permanent crops into the new class of “Cultivated areas” shows that the differences presented in this class are not significant.

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 appeared 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 the holdings in terms of area of production (mixed holdings), the small size of the holdings (average size 4,5 ha), 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).

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 of 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.

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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) | D+G+E | G=G01+G02+G03+G04+G05+G06+G07 |
| | 2.3 Pastures (Areas under meadow or pasture) | | 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.

| Regions (NUTS II) | Districts (NUTS III) | Pastures and meadows (ha) | | |
|------------------------|-------------------------|---------------------------|----------------|----------------|
| | | 2000 FSS | new CLC | Difference |
| ANATOLIKI | DRAMA | 1,294 | 31,380 | 30,086 |
| MAKEDONIA | KAVALA | 760 | 19,810 | 19,050 |
| | EVROS | 4,353 | 13,870 | 9,517 |
| | XANTHI | 81 | 11,910 | 11,829 |
| | RODOPI | 1,733 | 13,520 | 11,787 |
| TOTAL | | 8,221 | 90,490 | 82,269 |
| KENTRIKI | IMATHIA | 860 | 9,840 | 8,980 |
| MAKEDONIA | SALONIKI | 473 | 25,020 | 24,547 |
| | KILKIS | 5,310 | 40,680 | 35,370 |
| | PELLA | 2,458 | 25,910 | 23,452 |
| | PIERIA | 3 | 6,570 | 6,567 |
| | SERRES | 6,246 | 28,520 | 22,274 |
| | CHALKIDIKI | 2,780 | 5,330 | 2,550 |
| | TOTAL | | 18,130 | 141,870 |
| DYTIKI | GREBENA | 315 | 25,890 | 25,575 |
| MAKEDONIA | KASTORIA | 822 | 29,840 | 29,018 |
| | KOZANI | 794 | 70,610 | 69,816 |
| | FLORINA | 5,477 | 27,200 | 21,723 |
| TOTAL | | 7,408 | 153,540 | 146,132 |
| TOTAL MAKEDONIA | | 33,759 | 385,900 | 352,141 |
| KRITI | IRAKLIO | 36,412 | 69,070 | 32,658 |
| | LASITHI | 16,817 | 61,631 | 44,814 |
| | RETHIMNO | 62,470 | 53,241 | -9,229 |
| | CHANIA | 63,410 | 40,167 | -23,243 |
| | TOTAL | | 179,109 | 224,109 |

Table 4: Results showing the actual values and the corresponding differences in the class of pastures and meadows as they recorded by the 2000 FSS and the new CLC nomenclatures.

| Regions (NUTS II) | Districts (NUTS III) | Heterogeneous Areas (ha) | | |
|--------------------------------|-------------------------|--------------------------|----------------|----------------|
| | | 2000 FSS | new CLC | Differences |
| ANATOLIKI MAKEDONIA | DRAMA | 16 | 8,000 | 7,984 |
| | KAVALA | 17 | 14,820 | 14,803 |
| | EVROS | 9 | 35,040 | 35,031 |
| | XANTHI | 2 | 9,010 | 9,008 |
| | RODOPI | 3 | 11,130 | 11,127 |
| TOTAL | | 47 | 78,000 | 77,953 |
| KENTRIKI MAKEDONIA | IMATHIA | 324 | 39,420 | 39,096 |
| | SALONIKI | 19 | 65,020 | 65,001 |
| | KILKIS | 5 | 38,510 | 38,505 |
| | PELLA | 313 | 86,260 | 85,947 |
| | PIERIA | 21 | 29,440 | 29,419 |
| | SERRES | 26 | 16,140 | 16,114 |
| | CHALKIDIKI | 9 | 42,210 | 42,201 |
| TOTAL | | 717 | 317,000 | 316,283 |
| DYTIKI MAKEDONIA | GREBENA | 0 | 19,220 | 19,220 |
| | KASTORIA | 6 | 25,540 | 25,534 |
| | KOZANI | 24 | 4,020 | 3,996 |
| | FLORINA | 0 | 18,360 | 18,360 |
| TOTAL | | 30 | 67,140 | 67,110 |
| TOTAL MAKEDONIA | | 794 | 462,140 | 461,346 |
| KRITI | IRAKLIO | 143 | 54,339 | 54,196 |
| | LASITHI | 12 | 34,433 | 34,422 |
| | RETHIMNO | 159 | 33,372 | 33,213 |
| | CHANIA | 14 | 32,420 | 32,406 |
| TOTAL | | 328 | 154,564 | 154,237 |

Table 5: Results showing the actual values and the differences in the class of heterogeneous areas as they recorded by the 2000 FSS and the new CLC nomenclatures.

| Regions (NUTS II) | Districts (NUTS III) | Agricultural Areas (ha) | | Agricultural Areas (% difference) | Average parcel area (ha) |
|----------------------------|-------------------------|----------------------------|-----------|-----------------------------------------|--------------------------------|
| | | 2000 FSS | New CLC | | |
| ANATOLIKI MAKEDONIA | DRAMA | 47,193 | 104,720 | 122 | 0.78 |
| | KAVALA | 44,860 | 92,390 | 106 | 0.55 |
| | EVROS | 150,252 | 231,060 | 54 | 0.64 |
| | XANTHI | 37,214 | 69,940 | 88 | 0.69 |
| | RODOPI | 74,941 | 121,230 | 62 | 0.62 |
| TOTAL | | 354,460 | 619,340 | 75 | 0.64 |
| KENTRIKI MAKEDONIA | IMATHIA | 53,894 | 95,690 | 78 | 0.82 |
| | SALONIKI | 129,483 | 222,840 | 72 | 0.79 |
| | KILKIS | 106,027 | 172,420 | 63 | 0.90 |
| | PELLA | 77,660 | 151,640 | 95 | 0.61 |
| | PIERIA | 45,543 | 74,950 | 65 | 0.75 |
| | SERRES | 144,947 | 234,670 | 62 | 0.58 |
| | CHALKIDIKI | 77,274 | 147,270 | 91 | 0.77 |
| TOTAL | | 634,828 | 1,099,480 | 73 | 0.72 |
| DYTIKI MAKEDONIA | GREVENA | 41,432 | 93,810 | 126 | 0.80 |
| | KASTORIA | 24,887 | 74,260 | 198 | 0.58 |
| | KOZANI | 88,170 | 166,260 | 89 | 0.58 |
| | FLORINA | 52,952 | 90,960 | 72 | 0.55 |
| TOTAL | | 207,441 | 425,290 | 105 | 0.60 |
| TOTAL MAKEDONIA | | 1,196,729 | 2,144,110 | 79 | 0.67 |
| KRITI | IRAKLIO | 139,733 | 221,982 | 59 | 0.40 |
| | LASITHI | 37,864 | 127,252 | 236 | 0.44 |
| | RETHIMNO | 101,182 | 115,842 | 14 | 0.87 |
| | CHANIA | 109,191 | 116,472 | 7 | 0.83 |
| TOTAL | | 387,970 | 581,548 | 50 | 0.57 |

Table 6: Results showing the actual values and the difference (%) in the class of agricultural areas as they recorded by the FSS and the new CLC nomenclatures, It also shows the average parcel area,

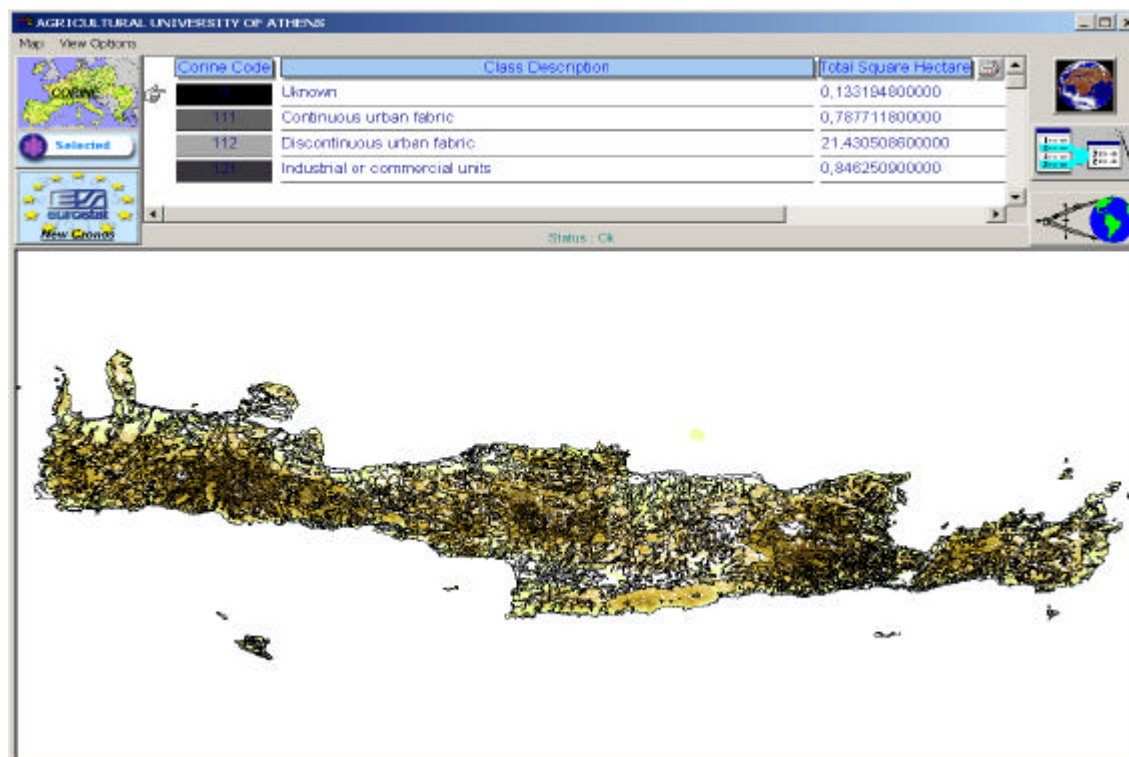


Fig. 1 Main window of the application

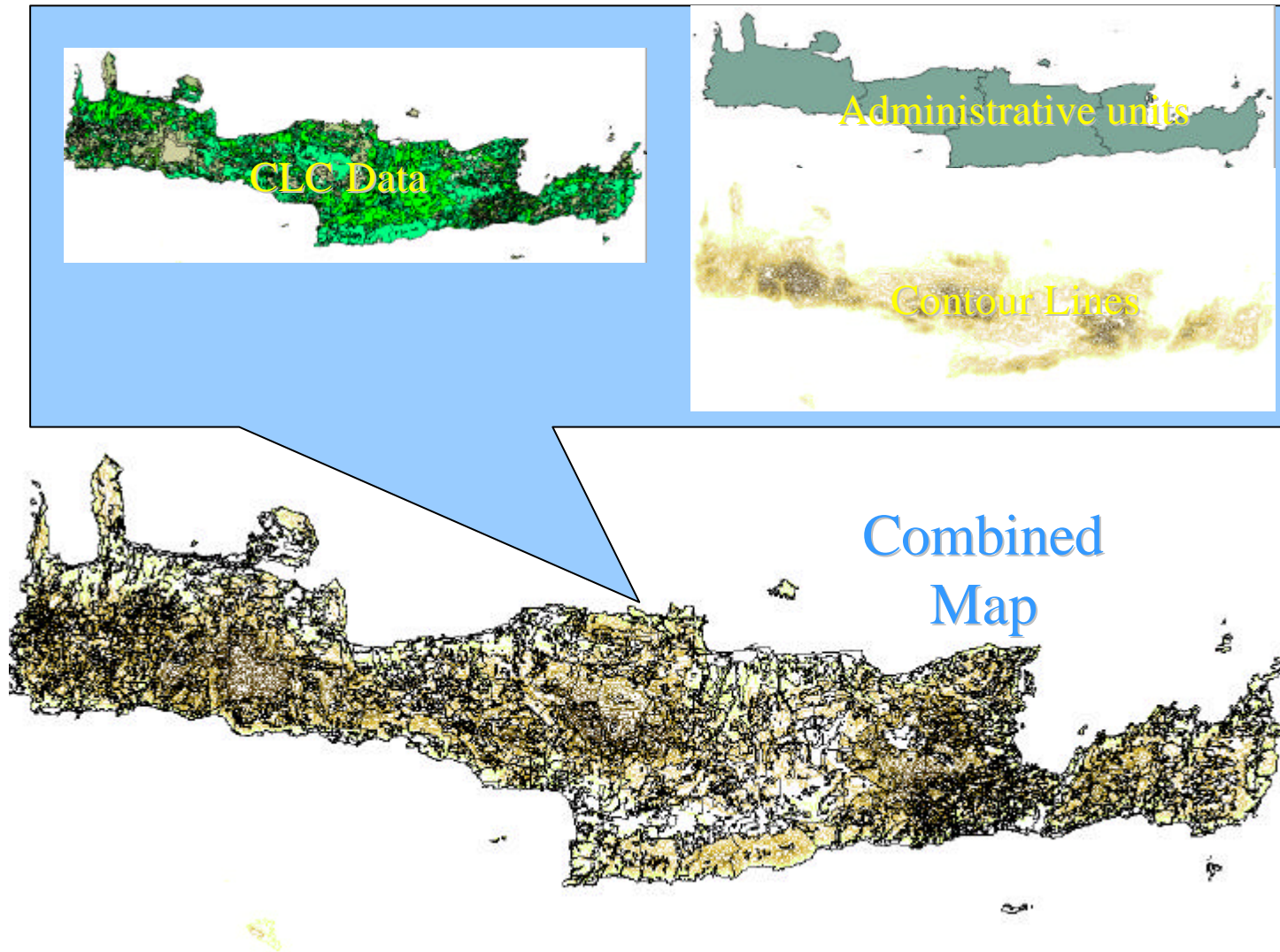


Figure 2: The combined new CLC map of the region of Kriti

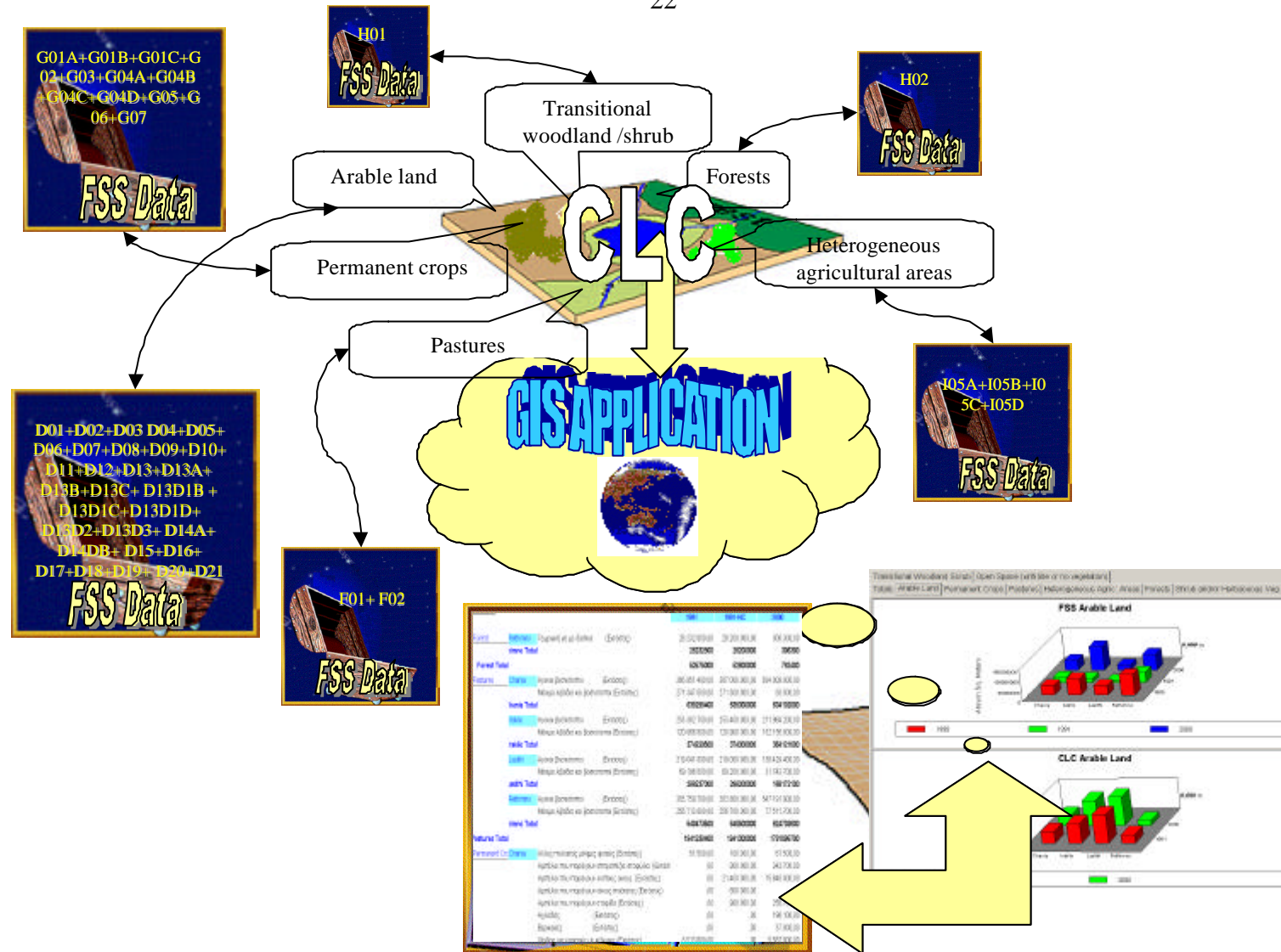


Figure 3: Merge of the new CLC and the 2000 FSS nomenclatures