Management of Farmers' and Farmland Information: A Case Study in Turkey

Ismail DURSUN, Abdurrahman GEYMEN and Omer Faruk INAN, Turkey

Key words: Farmer, Farmland, Land Registry, Cadastre, Web Services

SUMMARY

The use of an integrated approach has become a need for the application of the precautions taken in the context of agricultural policy, the production of yearly agricultural statistics with reliable methods and meeting common data needs of different foundations/users. In order to meet this need, a dynamic data structure on farmer and agricultural land is required as a prerequisite. In this context, with a national project no. 112Y027, it is aimed to develop a dynamic data model which makes possible the collection, integrity and use of data on farmer and agricultural land from different sources by providing inter-foundational collaboration, service/responsibility share and interoperability. In this study, based on this continuing project, a pilot application was carried out in Elagoz district of Kocasinan County, Kayseri Province in order to reflect the project advancement, present the data collected and also some sample applications indicating both the need for model development and future capabilities. In this pilot application, data on civic and address information of inhabitants, cadastre parcels data, ownership data in land registry, farmers', farmland and agricultural crop data declared by farmers previously and agricultural land use/cover dataset were used. All available data was analysed, developed by reclassifying or collecting additional information, and converted into a standardized data structure in the cases this is required. For spatial data management sub-parcel data structure was used. For attribute data, different levels of agricultural land classifications and also agricultural product classifications were used. As the second part of the pilot application, three sample web services were currently developed for related institutions.

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1. INTRODUCTION

As a result of the dramatic change in The Common Agricultural Policy (CAP) of the European Union in 1992 from coupled to de-coupled payment system, establishment of Integrated Administration and Control Systems (IACS) and Land Parcel Identification Systems (LPIS) as the spatial part of IACS have been required to manage related agricultural land information (Kay, 2002; Kay and Milenow, 2006; Inan, 2010; Inan et. al., 2010; Sagris et al, 2013). Similarly, IACS/LPIS like systems (Farmers Registry System, Farm Registry System, Agricultural Monitoring and Information System) in Turkey have been developed since the early 2000s (WB, 2005; Goeman et al., 2007; Inan, 2010). Yet, they are largely dependent on the declaration information by farmers. So, they cannot include all farmers' and farmland information which makes them inadequate for the needs of different institutions which serves not only for agricultural policy but also for other sectors. The Turkish Statistical Institute had the leading role in this context for the production of reliable agricultural statistics in a convenient way by collaborating with the Ministry of Food, Agriculture and Livestock for further development of current systems, which is still not adequate for meeting the needs of other institutions.

In this study, in order to serve for similar yet different data requirements, a pilot application in Elagoz district of Kocasinan County, Kayseri Province, Turkey were carried out within a national project (no 112Y027) financially supported by the Scientific and Technological Research Council of Turkey. In this pilot application, access to all available data sources (through web services or by replication depending on the database structure and services available) which include civic and address information of inhabitants, cadastre parcels data, ownership data in land registry, farmers', farmland and agricultural crop data declared by farmers previously was established. In addition to available data sets, an agricultural land use/cover dataset produced previously within the project is used for the determination of agricultural land to be visited. All available data was analysed, developed by reclassifying or collecting additional information, and converted into a standardized data structure in the cases this is required. For spatial data management sub-parcel data structure was used. For attribute data, different levels of agricultural land classifications and also agricultural product classifications were used. Temporal data management issues were discussed. Deficiencies (in some rare cases) of the methodology used in the pilot application were also discussed. As the second part of the pilot application, studies in order to serve farmers' and farmland information to related institutions via web services were carried out. In the development of web services availability of data content and use rights were designated in accordance with the needs of the related institutions. In this context, three sample web services was currently developed for the Turkish Statistical Institute.

2. AGRICULTURAL CLASSIFICATINS

Different agricultural products and agricultural land classifications are used by different institutions and organizations. The following is information about some of the information about national/international standards which has been developed in this area.

2.1 Product Classification

Product classifications are designed to categorise products (goods and services)that have common characteristics. They provide the basis for preparing statistics on the production, distributive trade, consumption, foreign trade and transport of such products. In this context, the United Nations is an international standard in 1992 as a result of the work of making Central Product Classification (CPC) has published. These data were presented as a recommendation to all countries. United Nations said that these data according to their own wishes and stated that regulations should be change (URL-1, 2014). The CPA is part of an integrated system of statistical classifications, developed mainly under the auspices of the United Nations Statistical Division. This system makes it possible to compare statistics produced in different statistical domains. The CPA is the European version of the CPC, and the purposes it serves are in line with those of the CPC. Whilst the CPC is merely a recommended classification, the CPA is legally binding in the European Union. In addition, specific survey classifications must be linked to the CPA, unless the CPA itself is used as a survey classification. The main purpose of two classification is to classify goods and services. The main purpose of the two classifications is as a result of economic activities to classify goods and services. CPA prepared as detailed in 1993, updated in 1996 and 2002 and the latest version has emerged in 2008 (see Table 1 for basic classes).

01.1 Non-perennial crops	**01.14 Sugar cane**
01.11 Cereals, leguminous crops and oil seeds	**01.15 Unmanufactured tobacco**
01.11.1 Wheat	**01.16 Fibre crops**
01.11.2 Maize	**01.19 Other non-perennial crops**
01.11.3 Barley, rye and oats	01.19.1 Forage crops
01.11.4 Sorghum, millet and other cereals	01.19.2 Cut flowers and flower buds; flower seeds
01.11.5 Cereals straw and husks	01.19.3 Beet seeds, seeds for forage plants; other raw vegetable materials
01.11.6 Green leguminous vegetables	
01.11.7 Dried leguminous vegetables	
01.11.8 Soya beans, groundnuts and cotton seed	**01.2 Perennial crops**
01.11.9 Other oil seeds	**01.21 Grapes**
01.12 Rice, not husked	**01.23 Citrus fruits**
01.12.1 Rice, not husked	**01.24 Pome fruits and stone fruits**
01.12 Rice, not husked	01.24.1 Apples
01.12.1 Rice, not husked	01.24.2 Other pome fruits and stone fruits
01.13 Vegetables and melons, roots and tubers	**01.25 Other tree and bush fruits and nuts**
01.13.1 Leafy or stem vegetables	01.25.1 Berries and the fruits of the genus vaccinium
01.13.2 Melons	01.25.2 Fruit seeds
01.13.5 Edible roots and tubers with high starch or inulin content	01.25.3 Nuts
	01.25.9 Other tree and bush fruits n.e.c.
01.13.6 Vegetable seeds, except beet seeds	Etc..
01.13.7 Sugar beet and sugar beet seeds	

Table 1. CPA 2008 Agricultural Product Classification

2.2 Classification of Agricultural Land

The decision of the Council of Europe and land use / cover CORINE with studies to determine the performance of transactions and their related databases updating task has been given to the European Environment Agency (EEA). Turkey is a member of EEA. (Karagüllü and Kendüzler, 2008). CORINE project has ben launched to determination of environmental change on land, natural resources management and environmental policies rationally for the purposes of establishing the same basic data collection and standards for the creation of a database in European Union member countries.

- The collection of information regarding the state of the environment for European Union member countries,
- Data collection and harmonization of information in the member countries or at international level,
- To ensure consistency of information and compatibility of data,
- To create "Land Use" for criteria of European Environment Agency (EEA).

CORINE land cover classification includes three levels;

- Level.1; To representing the land cover consists of five main categories in 1:500 000 and on a smaller scale,
- Level.2; consists of 15 categories for use 1:100.000 and 1:500.000 scale.
- Level.3; can be used for the project consists of 45 categories in 1:100.000 scale (see Table 2 for sample classes).

Class	Name	Class	Name	Class	Name
111	Continuous urban fabric	**213**	Rice fields	**331**	Beaches, dunes, and sand plains
112	Discontinuous urban fabric	**221**	Vineyards	**332**	Bare rock
121	Industrial or commercial units	**222**	Fruit trees and berry plantations	**333**	Sparsely vegetated areas
122	Road and rail networks and associated land	**223**	Olive groves	**334**	Burnt areas
123	Port areas	**231**	Pastures	**335**	Glaciers and perpetual snow
124	Airports	**242**	Complex cultivation	**411**	Inland marshes
131	Mineral extraction sites	**243**	Land principally occupied by agriculture, with significant areas of natural vegetation	**421**	Salt marshes
132	Dump sites	**311**	Broad-leaved forest	**422**	Salines
133	Construction sites	**312**	Coniferous forest	**511**	Water courses
141	Green urban areas	**313**	Mixed forest	**512**	Water bodies
142	Sport and leisure facilities	**321**	Natural grassland	**521**	Coastal lagoons
211	Non-irrigated arable land	**323**	Sclerophyllous vegetation	**522**	Estuaries
212	Permanently irrigated land	**324**	Transitional woodland shrub	**523**	Sea and ocean

Table 2. CORINE 2006 Land Cover Classifications

3. IMPLEMENTATION

In this study, Farmers and Agricultural Land Management Model is made for creating applications for the provision of implementation of agricultural policies in Turkey, the production of agricultural statistics and data requirements. According to ongoing survey results, the data model will be developed. At this stage of work, the basic functionality (skills) of the data model have been identified by using experiences of the project team and literature information. They are listed below.

- Model should be analyse each parcel include which is how much parcel of land use/cover classes (land use/cover specified sub-parcels),
- Sub-parcel data should produce for as a graphic overlay analysis of multiple land use/cover classes to coincide with parcels,
- If spatial changes such as land use/cover, the formation of new cadastral parcels and cadastral parcel of the cancellation (whether changes/in which parts of the changes, as known polygons of which died and which came into place or must be analysed with temporal data management), it should give the opportunity to monitor temporal changes, be able to monitor temporal changes/ to do automatic updates,
- Temporal changes in land cover of the parcel should be able to do queries. For example, has a parcel of land cover changed over 10 years? What changes has changed?
- Located on each parcel of land cover classes and the number of sub-parcels and areas of queries should be able to do,
- Parcels and sub-parcels for visualization layer should also be used together. Every parcel may have with in sub parcels with land cover, so can't be visualized land cover with only parcels. However, Sub-parcel layer will be sufficient for the visualization for not produced as a sub-parcels graph for parcels with homogeneous land cover. Hybrid visualization is required, temporary data generation method can be selected for this display,
- Land use/cover data must conform to the sub-parcel data model. Besides, should be defined exceptions to be recorded to created agricultural land outside the cadastral parcels.
- Land use rights Declarations of farmers should be taken with land use right documents indicating whether or not. However, as to whether the right to use information must be able to manage structured data model,
- During the same period of the same land registration declaration must be the name of a different person (Agricultural support of the transfer of rights as real as possible for the different representations can be found. Sub-parcels is 1-1 relationship between a data model approach is not correct. 1 - Many relationship data model is a more realistic approach. Declaration of a record even be able to manage information should be seen as active or transferred to someone else).
- Data should be able to do queries and should be provided with web service for institutions to need. (Which parcel or sub-parcel of the declaration that is used completely or partially, which is also not declared),
- Declared or partially declared sub-plots with areas of agricultural activities that are compatible or incompatible with the administrative cross-checks can be made. Detecting errors within acceptable limits or not. Errors must be corrected to achieving the declarant, support of spatial data and necessary to eliminate errors with field works,
- Determination of land suitable for agricultural activities of undeclared or partly declared.

To reach people which owners or people with agricultural activities in this agricultural land,
- Land use/cover classes convert to other classes (more general) should be serve web services for need to institutions,
- Declared agricultural products according to different classification systems to organizations in need should be provided with web service.

Project pilot area, which is made in Elagoz district of Kocasinan County, Kayseri Province, Turkey practices. The data was collected from relevant institutions for the example practices.

3.1 Used Data

Satellite Image: Very high resolution (VHR), made of image fusion (PanSharpended) archive image on the 2010 and 2013 satellite images WorldView2 were used for the determination land cover/use. Kayseri Metropolitan Municipality with other organizations supporting the project, satellite images taken in 2010 and 2013, has been used in the framework of the project.

Land Registry and Cadastre Data: General Directorate of Land Registry and Cadastre (Turkey) served by the land registry and cadastre data as a WMS (web map service) system has been integrated. Cadastral data due to national projection defined in international projection transformation is performed. Besides, all the land registry records from The General Directorate of Land Registry and Cadastre (LRCMP) regarding the study area were taken, comparison of these data with the surveying data and the data are checked for correctness.

Farmer's Declaration Data (FRS): Farmer and agricultural land system name given to the Farmer Registration System (FRS) is carried out by Food, Agriculture and Livestock Ministry and fulfils the following operations; (1) To kept of engaged in agricultural activities of farmers' personal information, which they use during activities of assets (land, animals, etc. entries.) Product crops, average yields, (2) To apply/monitor/control of agricultural support, (3) To profit in the creation of agricultural policy. System is based on the statements of the Farm and Farmer. We also benefited greatly from this study provide this statement. Data are available like that Farm or Farmer of the personal information, the agricultural land belonging to the spatial data, how much is done in the area of agricultural activity, agricultural land and agricultural products of the year, product types. This data is taken from the Food, Agriculture and Livestock Ministry.

Address Data (ABPRS): General Directorate of Population and Citizenship Affairs, Turkey's population belongs to all citizens and resident information electronically hold the name of the system is the Address Based Population Registration System (ABPRS). All people living in the study area address information is received from General Directorate of Population and Citizenship Affairs. Thanks to these data, how much of the land use control to experiencing in the study area can be made in farmer's declaration.

Address Numbering Data (for Municipality): Create zoning to provide services related to their field of study address from the address database information was obtained as spatial and

text data from Kayseri Metropolitan Municipality. Thus, population data and address data with municipalities is provided with control to accuracy.

Land Use/Cover Data: Land use/cover data set of Elagöz District was produced by using sub-parcel data model (see Inan et al., 2008), which incorporates cadastral land parcel data and ortho products (images or photos).

3.2 Sample Practices

Depending on functionality (skills) of the data model described above, the data model were tested. Some of these are described/presented below.

3.2.1 Detection of Land Use/Cover Data

Classes are determined by the method of visual interpretation depending on sub-parcel model. Then, Analyses were created for determining each parcel of the whole or a part. After this analysis, formed parcels save as different and it was associated with the cadastral parcels. Briefly, cadastral data has been associated with sub-parcels.

3.2.2 Creation of Sub-parcel

More than one parcel of land use/cover classes encountered them if they are registered as sub-parcels when performing visual interpretation with agricultural land parcel or cadastral parcel. Parcels has been associated with sub-parcels. This process was described for the overlay topology and who were treated by overlapping detection.

3.2.3 Changes of Data

In the project area is typical that changes in spatial data. In the event of changes in the sense of cadastral, land registry and cadastre data as WMS has a dynamic structure for what we received. However, we need to be old data in our model. So our model temporal data management is also included. In this way, when taken cadastral changes, network analysis has been established as where, how to be a change, what are the data that has lapsed, who knows what new data. Temporal change in the data base for data management clearly visible. Through this temporal data management, spatial notifications arising from changes in land use/cover will automatically transition effects were created. Land use/cover data of spatial data and tables automatically is updated.in transition and spatial changes. In addition, the old data store are also within the scope of temporal data management. Thus, an integrated exchange system is working and allowing instant updating. Finally, all changes are recorded, archived temporal data management activities can also be done through a system. For example, on a parcel of land cover change can be queried over 10 years and statistical studies about the related region is convenience.

3.2.4 Spatial Query

Numeric queries can be performed in the project area for all parcels and sub-parcels depending on this parcels. Such as certain regions of the parcel number, parcel size, parcel attribute (name / plot), parcels location on the map.

3.2.5 Information Query

Inquires regarding the information on the parcels can be made in the project area for all parcels and sub-parcels depending on this parcels. Information can be queried smoothly such as production, farmers information, land registry depending on farmer's declaration and land use/cover data.

3.2.6 Switch to inter-layers

Parcels and sub-parcels can be used together in different layers. Different land cover information can be found in sub-parcels. So, land cover data of parcels is not enough. Therefore, Under different layers or sub-plots data parcels may be used together to see different use/change in land cover. Provisional data visualization can be done without producing hybrids. Practise of this material could not be made at this stage because of not developed data model will produce temporary data. If we do it, the example will consist of a view similar to the first item.

3.2.7 Non-Registry

Cadastral parcels outside of the cultivated land are recorded in the data model. Without cadastre and mode not aware land are available and agricultural activities can be made on this land. This land is defined in the data model. It is specified as undefined in cadastral parcel part and land use/cover information layers are located in sub-parcels. There is an example of query in Figure 4. In example, As a result of views, a plot of land that were found to be produced without cadastre as shown that "farmland".

3.2.8 Association Between Declaration and Sub-Parcels

Declarations obtained from farmers, has been registered as "text" data in the database. It also has been associated with cadastral parcels. Our data model must include all information about farmers and products. Sample applications/products are listed below.

- The same of the person who performed the landowner and land use is not important for us. However, information on right whether or not to use a system that has been created. Get right to use the declarations may submit only belongs to those. This case, some farmers don't give to prevent to declaration (see Figure 1)

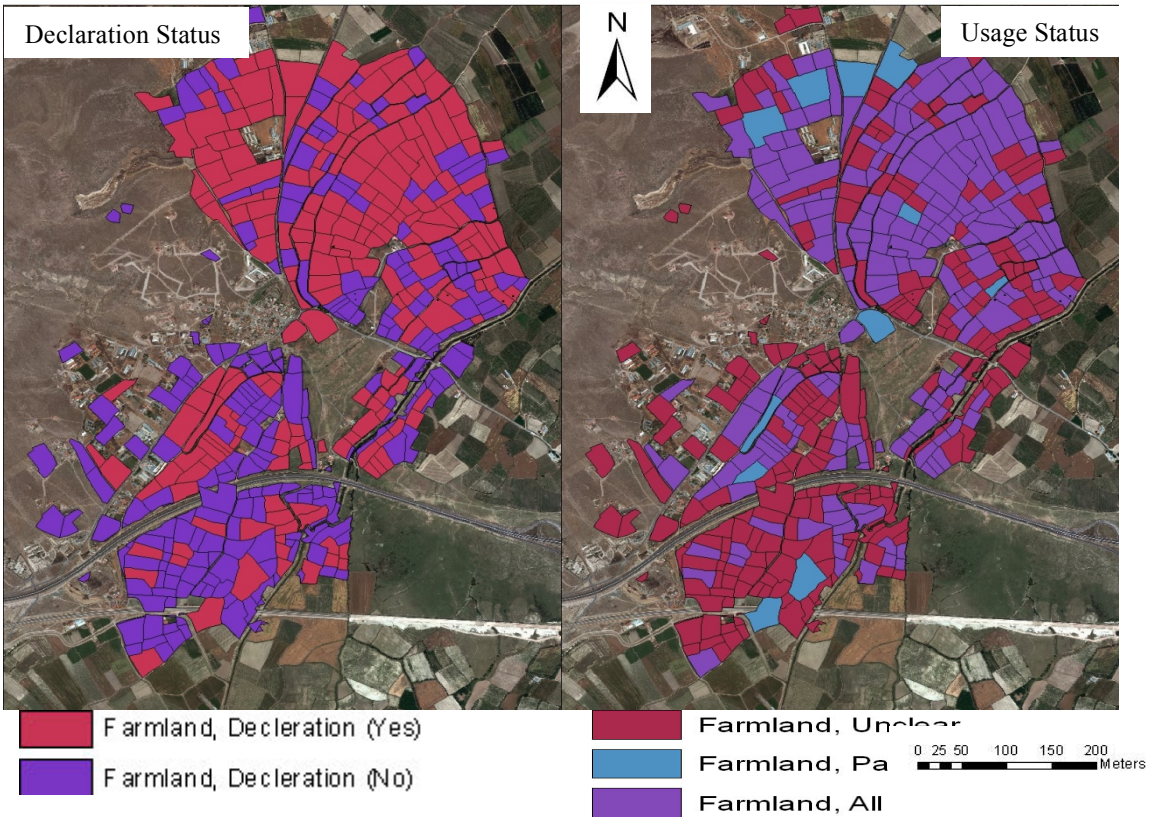

Figure 1. Declarations and use cases

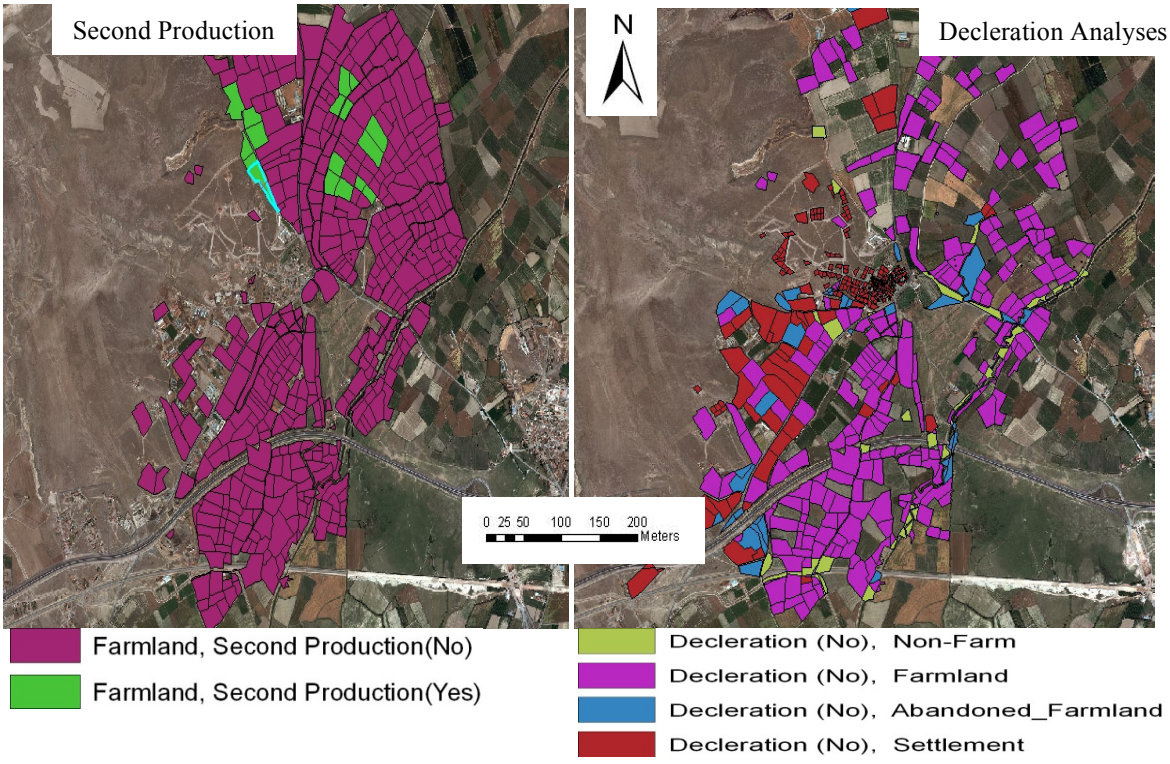

Figure 2. Declarations analyses and second production

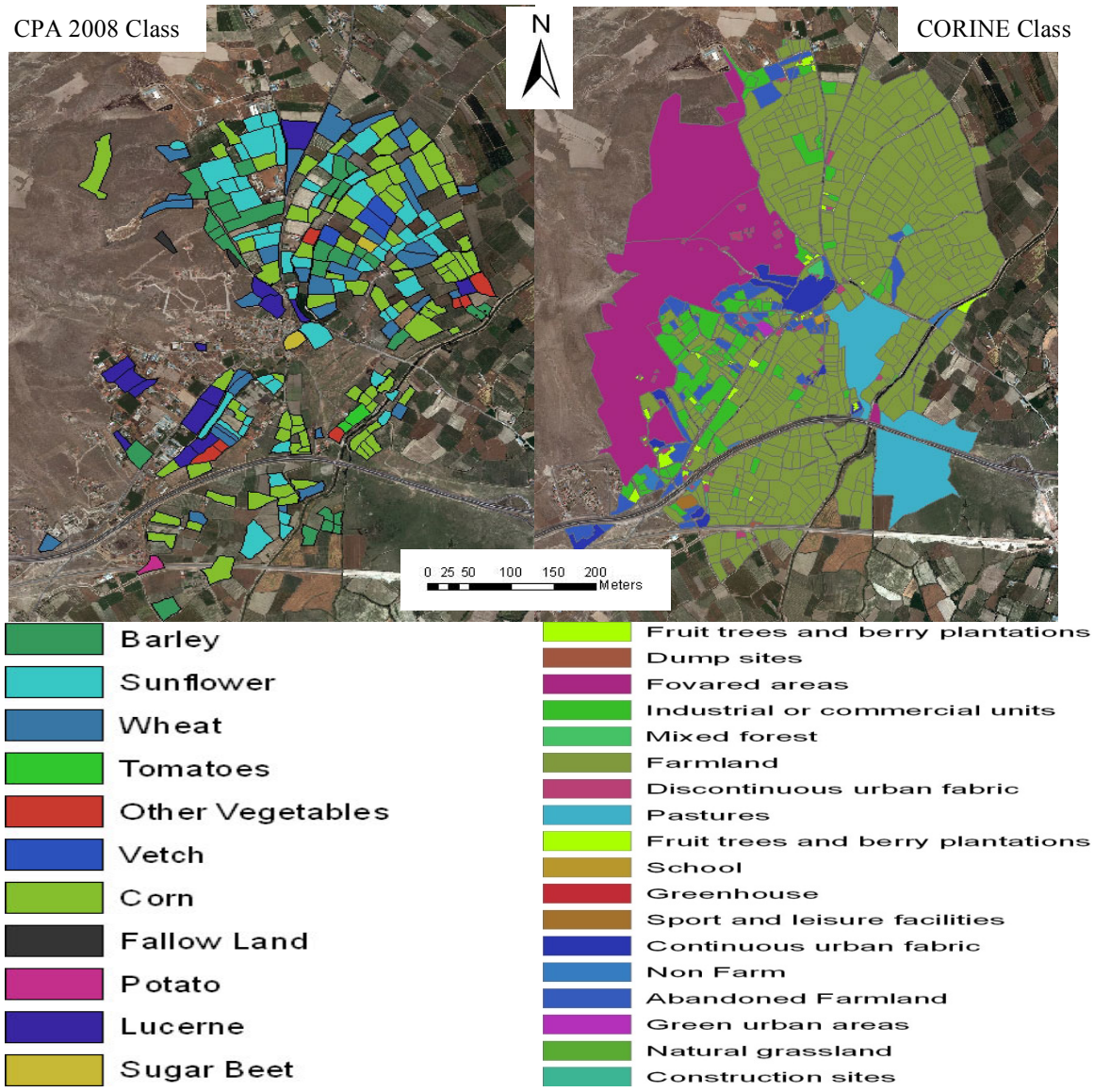

Figure 3. CORINE and CPA 2008 Classifications

- Different Declarations of the same parcels in the same period have been registered in the system. Thus, parcel or sub-parcel for a period of more than one production has been shown to do. 1 – Many relationship must contain between sub-parcels. Even, declaration includes information such as active or is closed is provided in terms of temporal data management (see Figure 2).

- Compatible or incompatible with the analysis that has been produced regarding to Declaration of sub-parcels. Declaration and acceptance criteria have been established by comparing errors. The error status can be checked through to land registry, Address numbering data and ABPRS. In addition, this data will help us in achieving to manufacturer or owner.

- Land use/cover classification system as based on CORINE classification and a demonstration was carried out by its (see Figure 3).

- Product classification system as based on CPA 2008 classification and a demonstration was carried out by its (see Figure 3).

3.2.9 Web Service

The generated data model of web services for needy institutions is also presented. For this purpose, open source script that "OpenLayersMap" is used. Kayseri Metropolitan Municipality (supporter of the project) server was used for domain and hosting service in web service. The following three simple examples were developed and published as WMS. They will be developed as WFS in the future for user interaction.

- Presentation of different land use/cover classes (In the form of agricultural land or not): http://cbs.kayseri.bel.tr/proje/Tarim_Potansiyeli.html
- Presentation of different product classes (field crops, horticultural crops, forage crops): http://cbs.kayseri.bel.tr/proje/Urun_Sinifi.html
- Presentation of declaration has already made on or not based on cadastral parcels: http://cbs.kayseri.bel.tr/proje/Beyan.html

4. DISCUSSION AND CONCLUSIONS

Given the international agricultural policy; "Land Management" on issues of importance given that all the world's, project is a great importance for our country. We focuses on an integrated system architecture which data can serve the needs of all institutions.

Some of the functionality defined data model, with case studies simply shown. Our data model is designed in a very integrated manner but it does not mean that the data model is perfect. Data model must be developed. In addition, the need to be continuously updated. Some examples about development of data model; First one is we said that "Sub-parcel data should produce for as a graphic overlay analysis of multiple land use/cover classes to coincide with parcels" is required but we produce sub-parcels for all parcels. Therefore model is should be developed. Other one is the lack of temporal data. When you complete temporal data model that it should work, there will not be any trouble as temporal data management.

Finally, the data model is never fully able to implement. Because differences may arise between theoretical data and practices. For discussion, it is known that it is not possible or difficult to the implementation of some things. We say some of them;

- If you don't give legal authority to produce the data is difficult to produce,
- If you have no legal authority, data is difficult to obtain,
- It is difficult to reach people in the field works,
- Temporal data management is indeed very important, but it is really difficult to create and

continuity of the system. Especially for land cover.

Finally, shortcomings stated above and the other ones which may be encountered later in the course of project implementation should be fixed or clearly addressed to be further studied in the future. In this context, model development and its implementation have been continuing.

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BIOGRAPHICAL NOTES

İsmail DURSUN; Born in Ilgın, Konya in 1985. Survey Engineer. Received a BS Degree in Geomatic Engineering from Istanbul Technical University in 2008. Continues MSc studies about Geographical Information Technologies in Erciyes University. Worked as engineer for 4 years in Ministry of Environment and Urbanization. Working as Land Registry and Cadastre Specialist in General Directorate of Land Registry and Cadastre. Married with 1 child. Speaks English.

Abdurrahman GEYMEN was born in Konya, Turkey, in 1973. He graduated with a MS degree in Geomatics Engineering from the Gebze Institute of Technology, Turkey, in 2000. He received a PhD degree from the Department of Geomatics Engineering, Karadeniz Technical University, Turkey, in 2006. He is working with the Department of Geomatics Engineering, Erciyes University as an associate professor. His research interests include Geographical Information System (GIS), Computer-aided Design, Software Development for GIS, Web based GIS and Spatial Data Structures. He has published a number of international journal and conferences article related to these areas.

Ömer Faruk İNAN works as a lecturar at Goksun Vocational School of Sutcu Imam University, Turkey. He got his Bachalors degree in 2004 at the Department of Geomatics Engineering of Karadeniz Technical University, Turkey. He is currently an MSc student at the Department of Geomatics Engineering of Erciyes University. His research interests are data structures, spatial data base management systems and spatial web services.

CONTACTS

İsmail DURSUN
General Directorate of Land Registry and Cadastre
Department of Cadastre
Dikmen Cad. No: 14, 06100 Çankaya
Ankara - TURKEY
Phone: + 90 312 551 44 06
Fax: + 90 312 413 64 02
E-mail: dursuni@tkgm.gov.tr
Website: http://www.tkgm.gov.tr/en

Abdurrahman GEYMEN
Erciyes University
Faculty of Engineering Department of Geomatics
Kayseri - TURKEY
Tel. +90 352 207 6666 Fax + 90 352 437 5784
Email: ageymen@erciyes.edu.tr
Web site: http://harita.erciyes.edu.tr/

Ömer Faruk İNAN
Sutcu Imam University
Goksun Vocational High School
Goksun Kahramanmaras - TURKEY
Tel. +90 344 280 2367
Email: ofinan@ksu.edu.tr; ofinan@gmail.com
Web site: http://goksunmyo.ksu.edu.tr/default.aspx