Scientific Research and Essays Vol. 6(2), pp. 422-429, 18 January, 2011
Available online at http://www.academicjournals.org/SRE
DOI: 10.5897/SRE10.934
ISSN 1992-2248 ©2011 Academic Journals

Full Length Research Paper

Evaluation of national farmers' registry data in geo-information context: Case study of Trabzon, Turkey

Halil Ibrahim Inan[1]*, Tahsin Yomralioglu[2] and Nihat Enver Ulger[3]

[1]Department of Geomatics Engineering, Faculty of Engineering, Erciyes University, 38039, Melikgazi, Kayseri, Turkey.
[2]Department of Geomatics Engineering, Faculty of Civil Engineering, Istanbul Technical University, Maslak, Istanbul, Turkey
[3]Department of Geomatics Engineering, Faculty of Engineering and Architecture, Okan University, Istanbul, Turkey.

Accepted 30 December, 2010

For the management of agricultural subsidies, information on farmers and farmland in Turkey is registered in the National Registry of Farmers (NRF) system. However, the system currently does not include any integrated spatial data. This hinders the population of necessary information on the actual agricultural land and thus, makes it impossible to correlate farmers' declaration with the actual agricultural land use. In this study, NRF data in two pilot areas in the province of Trabzon, Turkey were evaluated using digital cadastral data and ortho photo/image (ortho products). For the evaluation, the actual land use patterns of study areas were extracted from ortho products and then the areas of actual land use patterns were compared with the corresponding areas in the registries. As a result, it was determined that nearly 70% of the actual agricultural land was not registered in the NRF system. In addition, parcel based comparisons between registries and corresponding actual land use pattern uncovered considerable un-systematic anomaly between the reality of agricultural land use and farmers' declarations. It is suggested that the current system should be further developed in terms of geo-spatial data by integrating digital cadastral data and ortho products.

Key words: Digital cadastre data, national registry of farmers, ortho photo/image, agricultural subsidy, spatial data.

INTRODUCTION

In Turkey, information on farmers and farmland is registered in the National Registry of Farmers (NRF) system. The NRF system is used for the administration of different types of agricultural subsidies to farmers including de-coupled direct payments (Beard and Swinbank, 2001). The NRF system is based on declarations by farmers, which depend on the land registry and related land use rights (title, land use contract, consent from first order relatives or notary statement) as proof of right for agricultural activity. The system operates on a centrally managed web-service that enables the provincial directorates of the Ministry of Agriculture and Rural Affairs (MARA) to enter and update the information submitted by farmers. It was planned as a sub-component of the Agricultural Reform Implementation Project (WB, 2001; Inan and Cete, 2006), which was introduced by MARA with financial support from the World Bank. The NRF was first introduced in 2000 as a pilot application. As of 2001, the reform project has been implemented throughout the whole of Turkey (Inan and Cete, 2006; Inan and Yomralioglu, 2006). During the first years of the NRF implementation, the registry only included farmers' personal information and the area of land. Later, the NRF was developed through Feedback

*Corresponding author. E-mail: hinan@erciyes.edu.tr, hibrahim77@hotmail.com. Tel: +90 3524374901/32656. Fax: +90 3524375784.

Abbreviations: NRF, National registry of farmers; **IACS,** integrated administration and control system; **LPIS,** land parcel identification system; **MARA,** ministry of agriculture and rural affairs.

from administrators at different directorates of MARA throughout the country. Now, the NRF system includes several types of information including; the farmers' personal information, area (total and used) of agricultural land accompanied by the proof of land registry information (title), the type of right (ownership, lease, consent etc.) for land use, the type of agricultural activity, the seasons for the activity types, the geographic and agricultural region, and the productivity information for the agricultural region. However, the NRF is still based on an alphanumeric database structure and does not include any integral spatial information.

European countries, since 1992, have been using a more sophisticated system called Integrated Administration and Control System (IACS) for the registration of agricultural land and administration of agricultural subsidies. Within IACS, a spatial sub-component called the Land Parcel Identification System (LPIS) is used for the identification and control of actual agricultural land used by farmers (JRC, 2001; EUR-Lex, 2009a: Article 17; Kay and Milenov, 2006; Inan, 2007; Inan et al., 2008). LPIS is first introduced in 2000 and started to be used throughout the EU on voluntary basis, it was 2005 when the use of full structured LPIS became compulsory. The current structure of the NRF system in Turkey is similar to that used by European countries between 1992 and 2000 before the introduction of LPIS as a spatial sub-component. In Turkey there was an initiative for the use of cadastral data in pilot areas in the provinces of Ankara, Manisa, Sanliurfa and Sivas in order to incorporate spatial data in the NRF (Kalkay, Ministry of Agriculture and Rural Affairs, General Directorate of Agricultural Production and Development, personal communication in May, 2008). However, this initiative did not result in any robust outcome. There has also been an initiative for the establishment of an IACS/LPIS structure in Turkey in different pilot areas in the provinces of Tekirdag and Agri (EC, 2004). Although, the latter one is decided to be implemented throughout the country, its implementation has been postponed several times due to a variety of reasons. Therefore, when managing agricultural subsidies in Turkey, it is currently not possible to implement on-the-spot field checks (EUR-Lex, 2009b: Section II) and checks with ortho photos/images (EUR-Lex, 2009b: Article 35).

In this study, NRF data were evaluated using digital cadastral data and digital ortho photo/image data as the basic spatial data sources. The evaluation was carried out in two selected study areas in Trabzon Province. In the evaluation, the areas of actual land use patterns were compared with the corresponding areas in the NRF registries.

The main aim of this study is to have a clear understanding of the current drawbacks of the NRF system in terms of completeness and required geo-information (spatial information) specifically in the two study areas and also in Turkey. A further aim is to contribute to the future development of the NRF system. In terms of pilot application, this study is restricted to a specific region in Turkey. The reason for this fact is restrictions on the availability of required spatial data sets, and this fact is properly considered when making evaluations both specific to the region and also for whole of Turkey.

MATERIALS AND METHODS

Study area

In this study, NRF data was evaluated in relation to two pilot study areas; Işıklar town in Akçaabat county, and Bengisu village in the Central county both in the Province of Trabzon, situated in the Eastern Black Sea region of Turkey. The study areas are shown in Figure 1.

Işıklar town has a total area of 2,500 ha out of which only 340 ha of land is subject to ownership and registered by cadastre. According to the address based census data of 2009, this administrative unit has a total population of 2,723. Bengisu village has a total area of 270 ha which is totally subject to ownership. The census data of 2009 indicates a population of 1,261 for this administrative unit.

The data used for the evaluation

The data used for the evaluation was acquired from relevant institutions and previous studies. Their production dates may differ and some of them seem to be too old. Yet, it is not always possible to use contemporary data in such studies largely because of unavailability of them. The use of un-contemporary data in a certain extent is scientifically acceptable especially for the application of agricultural policy (JRC, 2001). Data sources and their basic qualities are as follows:

(i) The NRF data both for Işıklar town and Bengisu village were obtained from the NRF project group of MARA. This data set consists of the information on the use of agricultural land recorded in the NRF system for the year 2006.
(ii) The digital cadastre map of Işıklar town was adapted from Atasoy (2004). It was acquired by digitizing cadastre map sheets of the region and represents land parcels as polygon features. It includes 2,406 land parcels and covers an area of 340 ha.
(iii) The digital cadastre map of Bengisu village was provided by the Land Registry and Cadastre Directorate in Trabzon Province in 2008. It was adapted for this study by transforming its data structure into polygon features. The map includes 954 land parcels and covers an area of 270 ha.
(iv) The digital ortho photo of Işıklar town and the digital ortho image of Bengisu village were adapted from Inan (2004). The map was produced in compliance with the basic standards introduced by the JRC (2001). In the production of the digital ortho photo of Işıklar town, two frames of 1/16 000 scale colour infrared aerial photos taken in 2002 were used. For the digital ortho image of Bengisu village, a sample frame of pan-sharpened IKONOS imagery remotely sensed in 2004 with 1 m pixel resolution was used.

Since they have important roles in the evaluation process, further information on the digital ortho products used in this study is presented here. The digital ortho photo of Işıklar town was produced using the stereo model of two photo pairs and the digital contour map. In the production of the ortho-photo, first, each of the photos was geo-corrected using the digital contour map. Later, the two geo-corrected photos were combined by mosaic operation, and

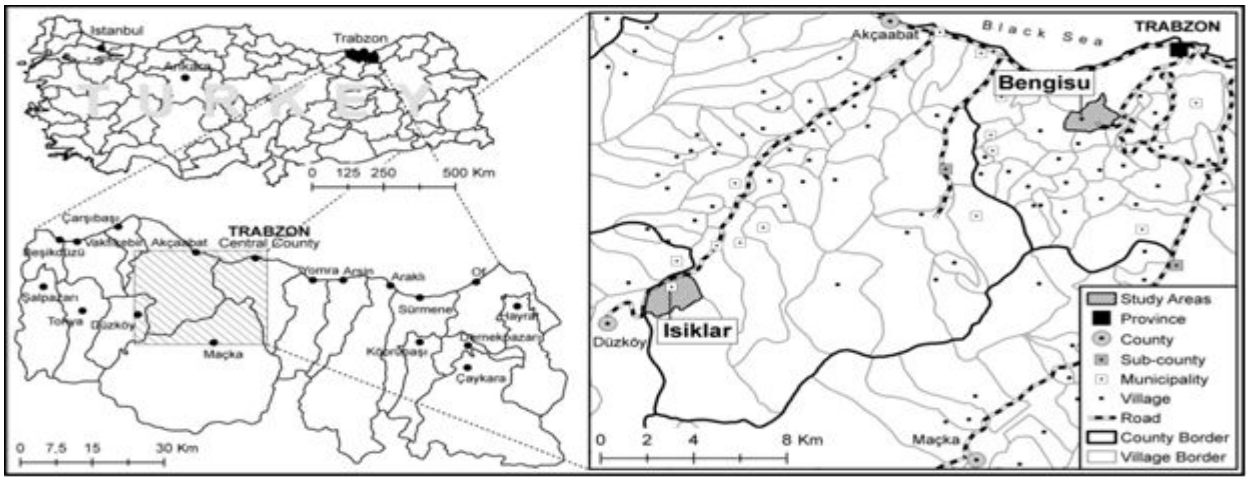

Figure 1. Location of the pilot areas in Trabzon Province of Turkey.

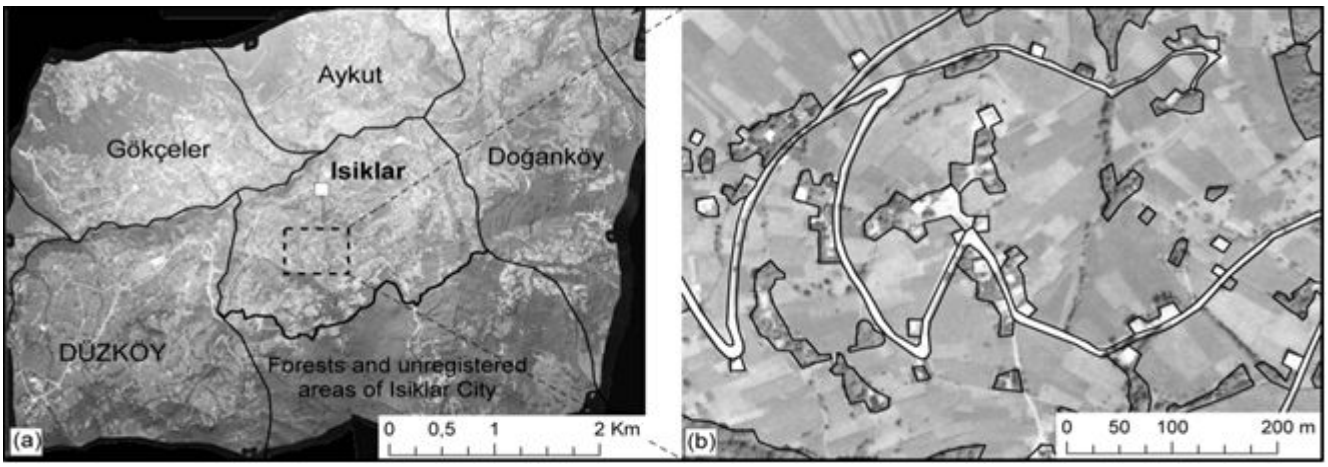

Figure 2. (a) Digital ortho photo of Işiklar town, (b) Land-use details digitized.

re-sampled. The pixel size of the final digital ortho photo is 0.586 m, and it covers an area of 6.0 x 4.7 km^2 (Figure 2). As for the digital ortho image of Bengisu village, geometric correction process was carried out using simple warping method to produce the digital ortho image of Bengisu village from Ikonos image. The RMSE of the warping process was 0.77 pixels. The pixel size of the final image is 1 m, and it covers an area of 2.7 x 3.3 km^2 (Inan, 2004) (Figure 3).

Land-use data generation

In the two pilot study areas, taking the advantage of the digital ortho products, the actual agricultural land use patterns were digitized. In the digitization processes, three basic classes were used as shown in Table 1.

The land use patterns of Işıklar town were acquired mainly digitising on the stereo model formed prior to the digital ortho photo production. After stereo digitization, some missing details were added using the final digital ortho photo of Işıklar town (Figure 2b). After the completion of this process, the land use classes of the area were determined (Figure 4a). The land use patterns of Bengisu village were digitized on digital ortho image (Figure 3b). In the digitization process, the RGB spectral format of this digital ortho image enabled an easy and specific interpretation of land use boundaries. The digitized land use classes are shown in Figure 4b.

RESULTS

For the evaluation, basically two types of comparisons are carried out between the land use data and the NRF data. One is a general comparison where main land use classes are compared with the same type of summarized NRF data. The other is detailed parcel based comparison where farmer declarations and actual land use information are precisely compared by overlaying the

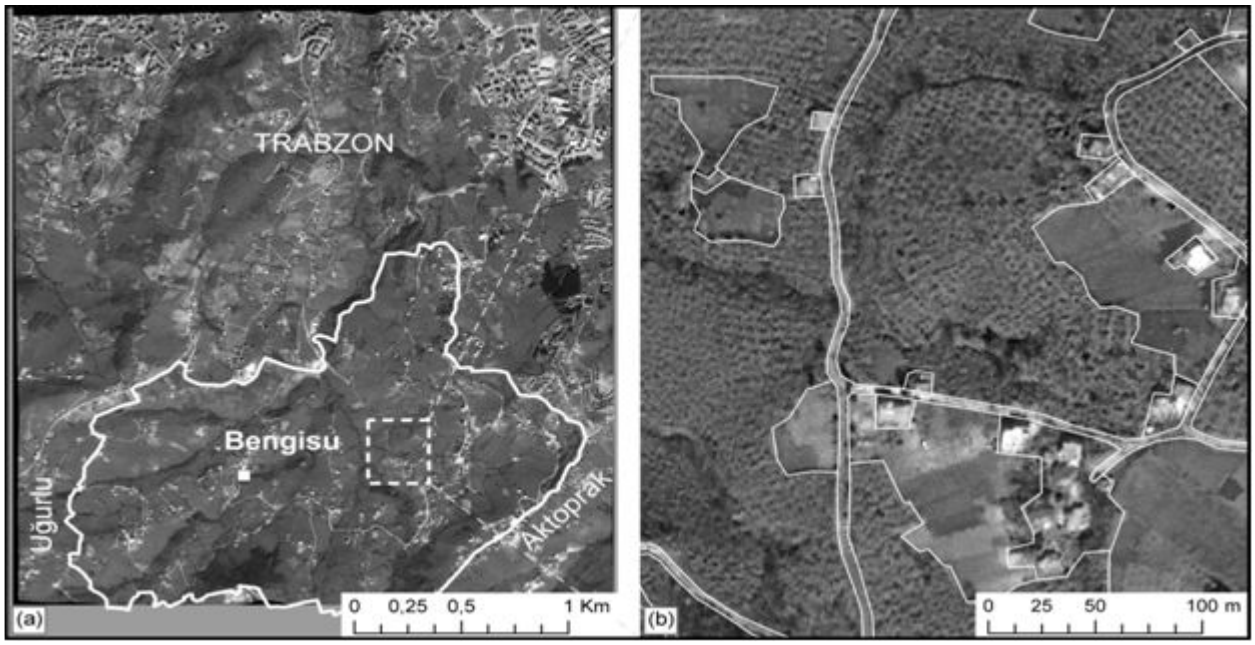

Figure 3. (a) Digital Ortho Image of Bengisu village, (b) Land-use details digitized.

Table 1. Basic classes of agricultural land use patterns used in digitization process.

Classes of land use	Description
Cultivated	Agricultural fields cultivated for yearly crops.
Planted	Agricultural fields with permanent plants. These fields stand for hazelnut areas in this study.
Non Agricultural	Settlement areas and the fields not used for agricultural purposes such as unproductive land, woody and bushy areas.

land use data layer with the cadastre layer.

General comparison

With the general comparison, it is aimed at determining the difference between actual and declared agricultural land use in the two pilot areas.

The land use data of Işiklar town shows that there is a total agricultural area (cultivated or planted) of 225.2 ha. On the other hand, in the NRF data of this study area, a total area of 56.4 ha was declared by farmers as being used for agricultural purposes (Table 2).

In Bengisu village, a very similar situation prevails. From the land use data, it was determined that there is a planted area (hazelnut) of 164.7 and 26.7 ha of cultivated area, giving a total agricultural area of 191.4 ha in the village. However, the NRF data records 64.7 ha planted (hazelnut) area, and 4.0 ha of cultivated area, a total agricultural area of 68.7 ha.

Table 2 shows detailed comparisons for the two pilot areas.

The differences between actual land use and the NRF data seem to be extremely high with only an average of approximately 30% of the land parcels being registered in the NRF system.

Parcel based comparison

This is a precise one to one comparison between land parcels registered in the land registry and cadastre system, and also in the NRF system. It aims at both comparing actual and declared agricultural land use and also the determination of the accuracy of farmer declarations. Since this method is only intended for matched parcels, this comparison covers 337 land parcels in Işiklar town and 147 land parcels in Bengisu village.

In Işiklar town, according to the NRF records, a total of 62 farmers declared that they use 369 units of land parcels with a total area of 62.3 ha, and that they use a

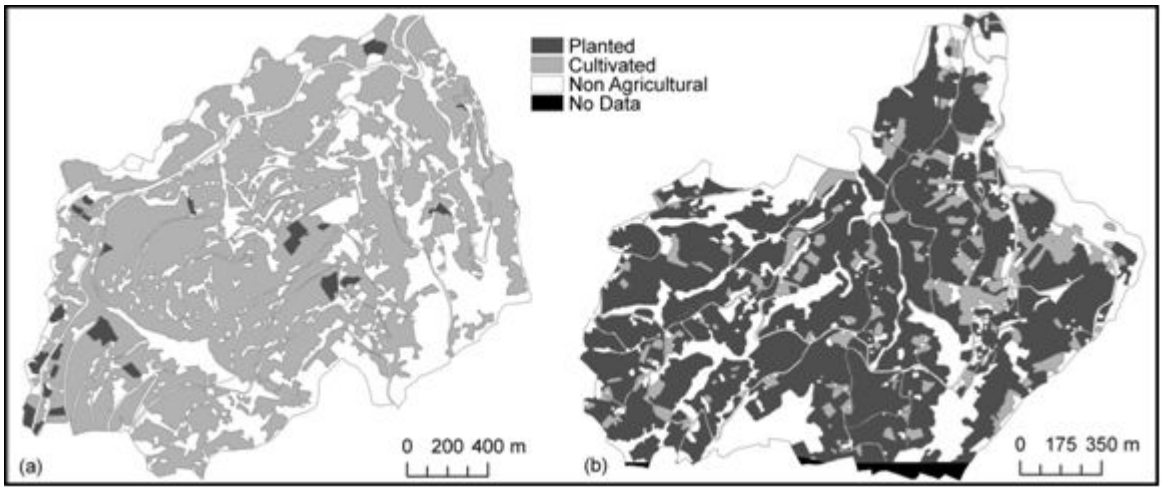

Figure 4. (a) Agricultural land use classes of Işıklar town, and (b) Bengisu village (partly adapted from Inan and Yomralioglu, 2006).

Table 2. Comparison of agricultural land use data with NRF data.

Study area	Land use class	Area (ha)		Difference	
		Actual land use (A)	NRF (B)	(ha) (A-B)	(%) [(A-B)/A*100]
Işıklar	Planted	8.3	9.1	-0.8[a]	-9.6[a]
	Cultivated	216.9	47.3	169.6	78.2
	Total	225.2	56.4	168.8	75.0
Bengisu	Planted	164.7	64.7	100.0	60.7
	Cultivated	26.7	4.0	22.7	85.0
	Total	191.4	68.7	122.7	64.1

[a]:"-" indicates that there is more registry in the NRF than the reality. This may be caused partly by the use of un-contemporary data (NRF data for 2006 and digital ortho photo for 2002).

total area of 56.4 ha out of this for agricultural activities. In Bengisu village, the number of farmers is 53, who declared that they use 204 units of land parcels with a total area of 84.3 ha. From this total area, they use 68.7 ha of land for agricultural activities.

Some visual controls using the digital ortho photo of Işiklar town and the digital ortho image of Bengisu village indicated that the NRF data does not exactly represent the actual land use. In fact, some parcels were declared as if they were fully used for agricultural purposes when they, in reality, are not. On the other hand, some land parcels were not declared although they were used fully or partly for agricultural purposes. Examples of both of these situations in Işiklar town are presented in Figure 5. While users of the parcels number 1411, 1492 and 1884 claim full agricultural use, it can be seen that there are many land parcels that are unregistered in the NRF system and are, in reality, used for agricultural activities (Figure 5).

For the execution of a detailed analysis, the summarized NRF records were linked with digital cadastre maps of the study areas using unique land parcel numbers. With this linkage, the parcels which were declared as fully used for agricultural purposes, and the parcels which were declared as partially used were queried and classified as “full use” and “partial use” respectively (Figure 5a for an example in Işiklar town). Then, the areas declared to be used for agricultural purposes registered in the NRF system and the corresponding areas determined by overlaying the land use maps with digital cadastre maps of the study areas were compared. As a result, considerable anomalies between the areas declared in the NRF system and the actual areas were determined (Table 3). The figures in Table 3 indicate, for Işiklar town, that both the farmers who declared that they fully use their land for agricultural purposes and the farmers who claim a partial use on their land caused a considerable anomaly of more than one fifth of the NRF

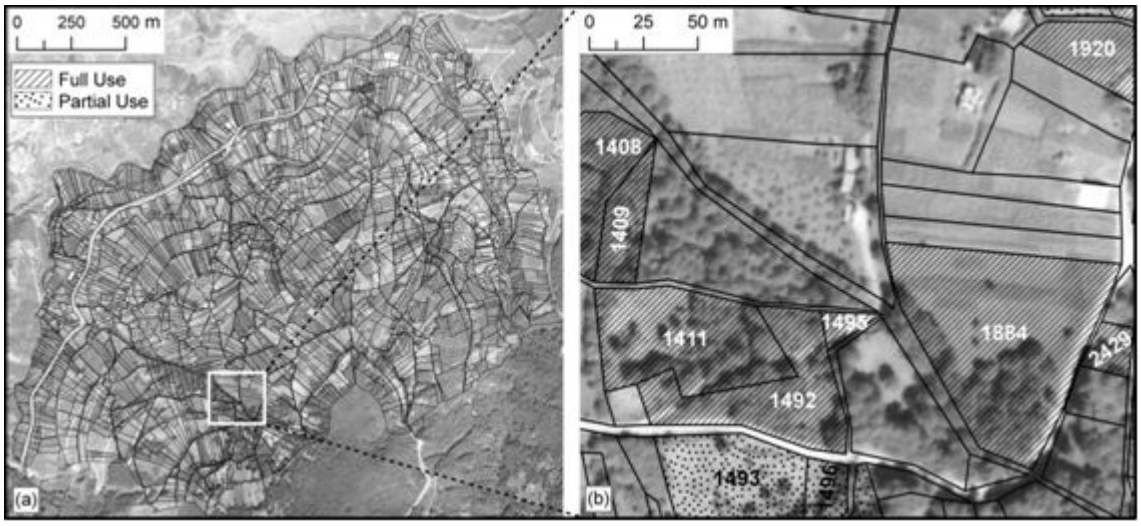

Figure 5. (a) Representation of "full use" and "partial use" of declared land parcels in the NRF system on digital cadastre map overlaid with digital ortho photo of Işiklar town (b) The difference between the real agricultural land use and the NRF records for some selected land parcels.

Table 3. Anomalies between declared (NRF) and actual agricultural land use patterns.

Study area	Type of declaration	Num. of parcels	Total area	Agri. area in the nrf (a)	Area by land use map (b)	Anomaly (%) [(a-b)/a*100]
Işiklar Town	Full use	237	34.8	34.8	25.6	26.4
	Partial use	100	24.5	18.4	16.1	12.5
	Un-matched	32	---	---	---	---
	Total	369	59.3	53.2	41.7	21.6
Bengisu village	Full use	90	36.4	36.4	30.2	17.0
	Partial use	67	32.8	18.9	25.8	-36.5
	Un-matched	47	---	---	---	---
	Total	204	69.2	55.3	56.1	-1.4

records. Interestingly, this is not the case for Bengisu village where there was a 17% over declaration for fully used areas. On the other hand, 36.5% of the area of partially used land parcels was not claimed by farmers (Table 3).

DISCUSSION

This study showed that an average of 69.6% (75.0 and 64.1% each) (Table 2) of agricultural land in two pilot areas was not registered in the NRF system in 2006, which means that there were undeclared land and thus farmers who did not gain any income through agricultural subsidies. Since there are only slight changes in the amount of registered land and numbers of farmers in the NRF system over a few previous years (Inan and Yomralioglu, 2006), it is possible to estimate that this ratio is more or less the same for future years. Therefore, it is clear that the number of registered farmers and the amount of farming land in the NRF system in two pilot areas differs enormously from the reality of land use. This may be generalised for the Black Sea region where subsistence and semi-subsistence farming is common (DG Agri., 2003). In fact, this style of farming may cause farmers not to declare their land for agricultural subsidies. This situation may be considered a trivial issue in view of agricultural subsidies, however, it may be very important for future agricultural and rural development policies because registration of farmers and farming land enable the related administration to prepare and apply more effective policies.

Parcel based comparisons in the two pilot areas shows that there are some considerable anomalies between the

declared (in the NRF) and actual land use types of land parcels which means that there were over-declarations as shown in the positive figures in the last column of Table 3 and thus, an unjust distribution of subsidies. As for the different percentages of anomalies determined in this study (Table 2), they may also be an indication of un-systematic nature of potential anomalies also for other regions. Land use types registered in the Land Registry and Cadastre system may be responsible for these unstable anomalies because no standard classification method is used to distinguish the type of land. Considering the fact that determination of this kind of anomalies in order to justify the management of agricultural subsidies is of crucial importance, it can be concluded that this issue should be resolved by further improving the current NRF system. The use of ortho photos/images may be a good way of achieving this. However, the cadastre data within the Turkish land registry and cadastre system is not currently ready for this improvement since the majority of this data are not in digital format (Demir et al., 2008).

In recent years, in conjunction with its institutional needs and also agricultural reform activities, the responsible authority (general directorate of land registry and cadastre) has already been working towards the production of digital cadastre data, it is estimated that this will take a considerable time. Therefore, it should be noted that further development of the NRF system is dependent on the development of the land registry and cadastre system, and accordingly measures should be taken in order to harmonise the Turkish land registry and cadastre system and the NRF system. Harmonisation of the two systems would ensure that the NRF system contains a true register of agricultural land in use and that anomalies in the registry are reduced to a minimum and also ensure that NRF can be used, in the longer term, to fulfil wider aims such as the development of effective rural development policies and planning activities in rural areas.

Conclusions

It is proven with this study that the current structure of the NFR system is not adequate for the management of agricultural subsidies within the agricultural policy because it does not include all of the agricultural land, it does not include required spatial data for the control of farmer declarations and for the determination of un-declared land. Therefore, development of the NRF system is required especially in terms of spatial data integration. Digital cadastre data is the crucial one because it is the basic spatial reference for land parcels and without it integration of ortho photo/image data will not be possible. For this reason, first off all, the land registry and cadastre system should be developed in order to make digital cadastre data widely available and make its share possible. After that stage, the integration of digital cadastre data and ortho photos/images with the NRF system will be possible, and also further system development for control procedures and sophisticated tools for data management and government control, which yield in more true register of agricultural land, the determination of unregistered and undeclared agricultural land, and also development of more effective agricultural policy and its implementation.

ACKNOWLEDGEMENTS

The authors would like to thank the staff of the Ministry of Agriculture and Rural Affairs responsible for the National Registry of Farmers system for sharing the Registry data for the pilot study areas. Thanks are also due to Land Registry and Cadastre directorates in Trabzon Province and in Akçaabat County for their help in cadastre data provision. Finally, we are grateful to the Inta SpaceTurk and Photogrammetry unit of the General Directorate of Forestry for the provision of IKONOS imagery and aerial photographs.

REFERENCES

Atasoy M (2004). Solving Forest Property Problems by Digital Photogrammetric Method in Cadastral Works (Eastern Black Sea Region Case Study). PhD Thesis (in Turkish). Karadeniz Technical University, Institute of Natural and Applied Sciences, Trabzon, Turkey. p. 190.

Beard N, Swinbank A (2001). Decoupled Payments to Facilitate CAP Reform. Food Policy. 26: 121-145.

Demir O, Uzun B, Cete M (2008). Turkish Cadastral System. Surv. Rev., 40(307): 54-66.

DG Agri. (European Commission Directorate General for Agriculture and Rural Dev.) (2003). Agricultural Situation in the Candidate Countries, Country Report, Turkey. November 2003 (Available at http://ec.europa.eu/agriculture/external/enlarge/publi/countryrep/turkey.pdf, accessed April 29, 2008).

EC (European Comission) (2004). Standard Project Fiche, Preparation for the Implementation of EU Common Agricultural Policy. Project number: TR 0402.08, Twinning number: TR/2004/IB/AG/01. (Available at http://ec.europa.eu/enlargement/fiche_projet/document/TR%200402.08%20Preparation%20for%20implementation%20of%20CAP.pdf, accessed May 09, 2008).

EUR-Lex (2009a). Council Regulation (EC) No 1782/2003. Official Journal (of the European Union) L 30(31/01/2009): 0016-0099.

EUR-Lex (2009b). Commission Regulation (EC) No 1122/2004. Official Journal (of the European Union) L 316(02/12/2009): 0065-0112.

Inan HI (2004). An Agricultural Database Application Devoted to Geographical Information System for Province Based Agricultural Production Planning. MSc Thesis (in Turkish). Karadeniz Technical University, Institute of Natural and Applied Sciences, Trabzon, Turkey. p. 83.

Inan HI (2007). The Importance of GIS in IACS Applications in the Context of the EU's CAP. Proceedings of TMMOB GIS Congress 2007, Volume 1, Trabzon, Turkey, pp. 413-420.

Inan HI, Cete M (2006). The Role of Cadastre in Agricultural Reform Applications of Turkey: Case Study of Trabzon Province. XXIII FIG Congress, October 8-13, 2008, Munich-Germany.

Inan HI, Yomralioglu T (2006). Examining Agricultural Reform Applications in Turkey from the View Point of the Need for Spatial

Data and Information: Case Study of Trabzon (in Turkish). J. Agric. Sci., 12 (4): 313-322.
Inan HI, Yomralioglu T, van Oosterom P, Zevenbergen J (2008). On the Level of Cooperation between Agricultural and Cadastral Parcel Registration. FIG Working Week 2008, June 14-19, 2008, Stockholm-Sweden.
JRC (European Commission Directorate General Joint Research Centre) (2001). Land Parcel Identification Systems in the Frame of Regulation (EC) 1593/2000 Version 1.4 (Discussion Paper) (Available at http://mars.jrc.it/mars/Bulletins-Publications/Discussion-Paper-Land-Parcel-Identification-Systems-in-the-frame-of Regulation-EC-1593-2000-archive-document-2001, accessed January 09, 2009).
Kay S, Milenov P (2006). Status of the Implementation of LPIS in the EU Member States. In: (S. Kay, A. Sima, P. Loudjani, Eds.) Proceedings of the 12th MARS PAC Annual Conference, Toulouse, France (November 27-29, 2006), pp. 41-47.
WB (The World Bank) (2001). Project Appraisal Document on a Proposed Loan in The Amount of US$600 Million to The Republic of Turkey for an Agricultural Reform Implementation Project/Loan. Environmentally and Socially Sustainable Development, Turkey Country Unit Europe and Central Asia Region, Report No:2121177-TU, June 6.