

Full Length Research Paper

Evaluation of initiatives for spatial information system to support Turkish agriculture policy

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Accepted 9 November, 2009

Turkish agricultural policy has long been affected by the European Common Agricultural Policy. In 1992, the European Union dramatically changed its policy and since then it has been engaged in finding feasible solutions for the management of related spatial data in this context. Turkey, as a candidate country, has initiated important projects for the management of agricultural and agri-environmental measures in close relation with the European Common Agricultural Policy. In this paper, the initiatives under these projects are introduced, discussed and evaluated in view of their relationship with spatial data. As a result of the evaluation, it is concluded that, in spite of its current drawbacks, the Turkish Land Administration System should be considered, especially in the long term, as the basic spatial data source for the implementation of agricultural policy in Turkey.

Key words: Agricultural policy, land administration system, spatial data infrastructure, land parcel, Turkish agriculture.

INTRODUCTION

The implementation of the Turkish Agricultural Policy has been in a transition stage in order to comply with the implementation of the European Common Agricultural Policy (CAP). Accordingly, the use of spatial data has been affected by the developments in the European CAP. In fact, the European CAP has been in a development stage. In 1992, the European Union (EU) dramatically changed the subsidy regime of the CAP from the previous production support system to the current decoupled Direct Payments (Beard et al., 2001; EC, 2007). Following this policy shift, there was a focus on agri-environmental measures within the Rural Development scheme (DG Agri, 2006b; Zalidis et al., 2004). As a consequence, for the management of related information, countries in the EU have been using the Integrated Administration and Control Systems in order to admini-

ster agricultural, agri-environmental and rural development subsidies. In this context, the Land Parcel Identification Systems (LPISs) emerged and evolved for spatial data management (Kragh, 2000; Delince, 2001; JRC, 2001; Relin et al., 2003; Kay and Milenov, 2006; Inan and Cete, 2007). Current LPISs differ among EU member states and generally require the use of Digital Ortho Photos or Digital Ortho Images as a basic ancillary spatial data. In some cases, cadastral data and large scale mapping coverages are used as ancillary data sources in demarcating agricultural fields in conjunction with the declarations by farmers (Kay and Milenov, 2006; Inan and Cete, 2007).

In Turkey, both with the commitments to the World Trade Organization (WTO) and as a preparation for the European CAP, a number of nationwide and regional projects have been actively introduced since 2000 in an attempt to determine best practices and organize spatial data in order to support agricultural policy implementation. In this respect, this paper will introduce and discuss initiatives for spatial data within three main projects. These projects will not be discussed as a whole;

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Table 1. List of agri-environmental measures.

Agri Environmental Measures	Description
Direct Income Support (de-coupled Direct Payments)	Improvement of existing or formulation of new grass meadows
Alternative crops (or Farmer transition)	Application of organic production
Land consolidation	Application of good agricultural practices
Land improvement	Establishing permanent plant coverage
Erosion combat	Controlled use of pesticides and fertilizers
Drainage	Prevention of excessive grazing
Stone collection	Protection of pastures and meadows

rather the focus will be on the initiatives for spatial data.

MATERIALS AND METHODS

Background: The Turkish agricultural sector

In the economic and social development of Turkey, the agricultural sector plays an important role. In addition to producing food and thus providing essential nutrition, the agricultural sector is responsible for 15% of the Turkish national income and holds 35% of the total labour force (Eraktan, 2002; Ucak, 2006). According to the statistical data provided by the Turkish State Institute for Statistics (SIS, www.tuik.gov.tr) for the year 2003, in Turkey, agricultural land comprises one third of the total area of the country, 26 million ha. Of this total area, sown land, fallow land, vegetable gardens and land reserved for agricultural plants (e.g. fruit trees, olive trees, vineyards, nuts and tea plantation) are 17.6, 5.0, 0.8 and 2.6 million ha, respectively (SIS, 2005). According to the results of the 2001 General Agricultural Census Village General Information Survey, 5.2 million ha of land is irrigated (SIS, 2004).

As far as farm structure is concerned, over 65% of the holdings are small size classes (0 - 5 ha) and the majority (94%) of the farm holdings are smaller than 20 ha. The majority of larger and more specialised farms are located in the Aegean and Mediterranean regions of Turkey. In view of social structure, subsistence and semi-subsistence farming is an important aspect of Turkish agriculture. This type of farm is characterised by very low productivity, high hidden unemployment and low competitiveness. These farms, however, are crucial for providing income security and a livelihood for the majority of the rural population in Turkey (DG Agri, 2003).

Agricultural and agri-environmental measures

In the EU, agricultural and agri-environmental measures originate from basic principles such as increasing the competitiveness of the farmers, increasing productivity and reducing adverse environmental impacts. These principles are laid down in the European CAP. In time, the CAP has been experienced many evolutions aimed at better management of rural areas and at the same time betterment of social and economical condition of rural population (DG Agri, 2006a). The CAP includes two main elements (pillars), the Market Policy (first pillar) and the Rural Development Policy (second pillar). Both include different types of measures and these measures are considered for different types of payments to farmers. So, in the implementation of the CAP, the focus has been directly to subsidies instead of measures. Measures are expected to be implemented indirectly through farmers by subsidizing them. The same strategy prevails in Turkish Agricultural Policy.

In Turkey, some agricultural and agri-environmental measures that are closely related to the governmental relations both with the

WTO and the EU have been adopted. These measures, when compared with those adopted by the EU member states, are restricted and especially deal with the Market Policy and include some specific agri-environmental measures related to the Rural Development Policy. The majority of these measures were introduced within the Agricultural Reform Implementation Project and in the Turkish Agriculture Law No 5488 (Table 1 shows a list of measures).

Some of these measures are planned only for specific application areas. There are some regions, in Turkey, without any measures. This is mainly caused by the fact that a full fledged Turkish Rural Development policy and thus detailed measures have not been adopted yet. Moreover, the majority of the measures have been inadequately implemented because of the lack of nationwide spatial data for this purpose.

RESULTS

Initiatives for spatial data sources

Two government organisations in Turkey have been involved in the initiatives for spatial data in support of Turkish Agricultural Policy. These organisations are the Ministry of Agriculture and Rural Affairs, and the General Directorate of Land Registry and Cadastre. There have been three central projects initiated and directed under the responsibility of these two organisations. One of these projects is the nationwide Agricultural Reform Implementation Project (ARIP) (URL-1, 2008; WB, 2001; WB, 2005), initiated in 2001 by the Ministry of Agriculture and Rural Affairs with financial support from the World Bank and completed at the end of 2007. Another main project is the Land Registry and Cadastre Information System (Turkish acronym, TAKBIS) initiated by the General Directorate of Land Registry and Cadastre for the purpose of the modernization of Turkish Land Administration System (LAS), this project dates back to 1990's. The last, in this context, is the project titled Preparation for the Implementation of EU CAP. This one was planned in 2004 and initiated in 2007 by the Ministry of Agriculture and Rural Affairs.

Under the above stated three projects, there are five main initiatives (Table 2) for the improvement or better organisation of spatial data required for the implementation of Turkish Agricultural Policy. They are introduced

Table 2. List of initiatives and related projects.

Initiative	Project
National Registry of Farmers (NRF) System	ARIP
Registration of Un-Registered Land and the Improvement of old LAS Data	ARIP
Digital Ortho Base Production	ARIP
Land Registry and Cadastre Information System	TAKBIS Project
Establishment of a Functional LPIS	Preparation for the Implementation of EU Common Agricultural Policy.

and discussed in the following sections.

National registry of farmers system

The National Registry of Farmers System (NRF) is one important sub-component of the Agricultural Reform Implementation Project. After the introduction of this project in 2001, it concentrated largely on the establishment of an NRF system for the implementation of Direct Income Support (WB, 2001). At the very beginning, the NRF only contained farmers' personal information and the area of land used for any kind of agricultural activity. Later, the information content has been extended gradually. The NRF system currently includes farmers' personal data, types of agricultural activity, type of products, geographic regions and payments as basic information content (Figure 1). The system is based on declarations by farmers, which are dependent on the land registry (the titles of their agricultural land) if the land is registered under the LAS. The NRF system operates on an internet based central software application. It enables the provincial directorates (of the Ministry of Agriculture and Rural Affairs) to enter and update the information submitted by farmers. An iterative system development method was used to further modernize the system by taking into account user needs. In addition, the ministry engaged a private sector company to develop a professional NRF system during the last project year (Figure 1 show the conceptual design of the NRF database).

Although the Agricultural Reform Implementation Project is now completed, the NRF system is still active and used for national support schemes, Direct Income Support, subsidies for agri-environmental measures, farm product insurance systems and also for bank credits to farmers. So far, within the NRF system, 2.76 million farmers (about 68% of the total) and 16.71 million ha of land (about 75% of the total) have been registered (WB, 2005).

Considering all five initiatives (Table 2), the NRF is the unique one being nationwide and fully functional. This is largely because of the fact that the NRF itself is still an alpha-numeric central database and therefore, does not yet include any spatial data component (Inan and Yomralioglu, 2006). Indeed the remainder of the initia-

tives concentrate (explicitly or implicitly) on spatial components which are required to support the NRF or similar systems.

Registration of un-registered land and improvement of old LAS data

This initiative is also a sub-component of the Agricultural Reform Implementation Project. It is mainly aimed at supporting the NRF system with spatial data. In fact, when rural land is registered under the LAS and the farmers are registered in the NRF system, with the title information of their agricultural land, complete administrative cross-checks (see regulations EC No 1782/03 and 796/04) are possible just by taking the advantage of the unique numbers of land parcels in the Turkish LAS. On the other hand, in the absence of title information, some misuse of the situation was encountered especially during the early years of the NRF implementation. The determination of such misuse has neither been possible for the central nor provincial administration unless complete on-the-spot checks (field visits) (see the regulations EC No 1782/03 and 796/04) are executed. Technically, the execution of these kinds of checks is completely dependent upon the availability of spatial data. In the case of the NRF system, Digital Cadastre Map coverage preferably together with Digital Ortho Base (Photo/Image) coverage is required.

Considering the need to resolve the issue of misuses, the Ministry of Agriculture and Rural Affairs allocated some fund from the budget of Agricultural Reform Implementation Project for both the completion of cadastre works and the improvement of the available old LAS records in 20 pilot provinces. These provinces are situated in the eastern part of the country and they are the provinces where the most problematic cases have been encountered during the initial application of the NRF (WB, 2005). This initiative was planned in 2004 and largely implemented in the three following years (2005 - 2007). However, because of some unexpected barriers (e.g. reaction to the registration of forests), it has not yet been completed in some areas.

Before this initiative, the General Directorate of Land Registry and Cadastre used its own technical equipment and personnel to carry out the ordinary process of land

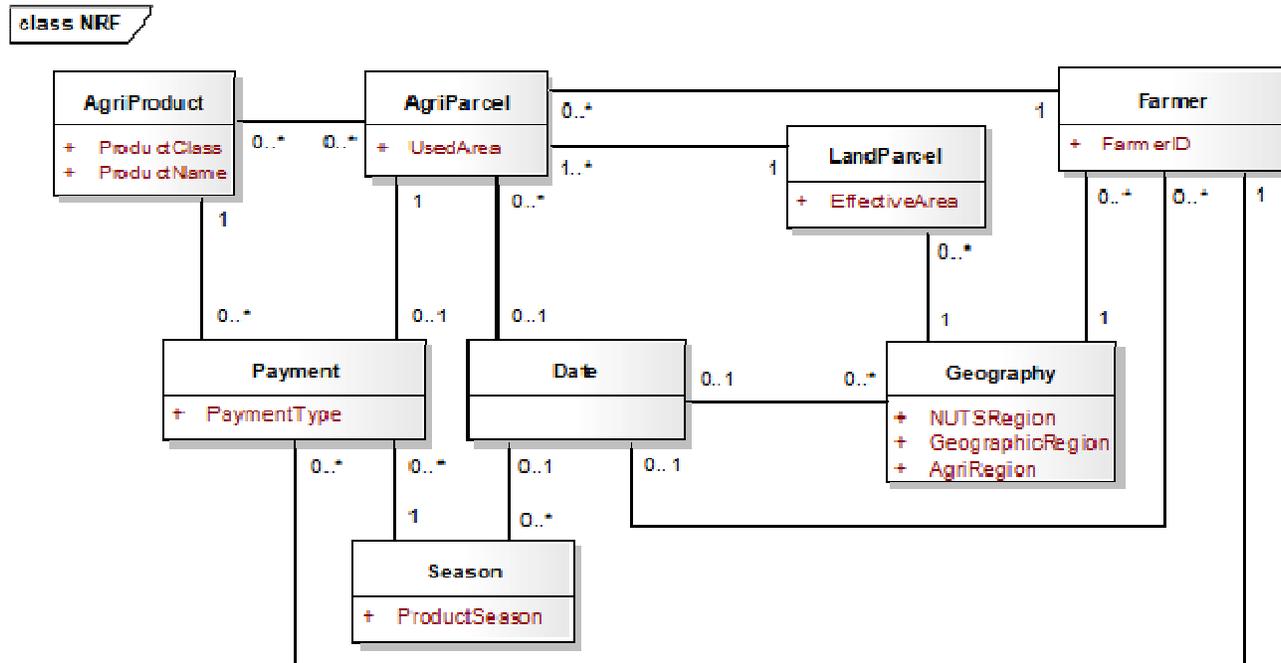


Figure 1. Conceptual schema (UML class diagram) of the NRF database.

registry and cadastre works. Within this initiative, the inclusion of private surveyors for the technical part of cadastre work has increased the speed of the process (Cete and Uzun, 2005). In addition, the directorate indicated its commitment to complete all cadastre work in Turkey by allocating extra fund from its revolving budget. Thus, in 2005, a new style of cadastre work processes started in Turkey largely with the initiatives triggered by the Turkish Agricultural Policy. By contracting private surveyors, the directorate largely completed the remaining 15% (Kokturk, 2002; Demir et al., 2008) of the cadastre work in four years (2005 - 2008).

It should be noted that, during this initiative, more attention was given to the completion of cadastral work and less attention to the improvement of the available old LAS data (by producing Digital Cadastre Maps and computerising land registry or renovating both the cadastre and land registry). In fact, there has been continuous work all over the country on the improvement of land registries especially within the Land Registry and Cadastre Information System project. However, this is not the case for the spatial data because the digitization of the current cadastre map sheets is not an easy task and the process was underestimated.

Digital ortho base production

It is another sub-component of the Agricultural Reform Implementation Project. In the NRF system, Digital Ortho Base (Digital Ortho Photo or Digital Ortho Image)

coverage has yet not been used as ancillary data. However, this kind of data has proved to be a main source of information especially for the interpretation of the agricultural land use patterns (JRC, 2001). In fact, in many European countries, related organizations use such coverages for the control procedures of farmers' declarations (Kay and Milenov, 2006). Since the NRF system relies on the information by farmers but does not have an integrated spatial control mechanism, it is in need of such spatial coverage as basic ancillary data.

Aware of this need, the Ministry of Agriculture and Rural Affairs has commenced a pilot initiative in four provinces (Ankara, Sivas, Manisa and Sanliurfa). This initiative intends to produce Digital Ortho Images of the pilot rural areas situated in these four provinces. Indeed, the ultimate aim of this initiative is to develop reliable control methods similar to those in Europe (cross-compliance, administrative cross-check, on-the-spot check; see EC No 796/04) for the management of agricultural and agri-environmental subsidies administered via the NRF system. For this aim, Digital Ortho Images of the pilot areas were digitized by visually interpreting land use types (agricultural parcels) and farmer declarations were checked spatially in these pilot areas by overlying digitized land use patterns and Digital Cadastre Map coverages (spatial LAS data). As a result of checking procedures, anomalies between farmer declarations and real world land use pattern were resolved. However, for the countrywide implementation of such control procedures, considerably long time is required because the application is dependent on the availability of Digital

Ortho Bases as well as Digital Cadastre Map coverage.

Land registry and cadastre information system

Unlike the previous three initiatives, which are subcomponents of the Agricultural Reform Implementation Project, this initiative is not directly caused by the Turkish Agricultural Policy. Rather, it is an initiative for the modernization of the Turkish LAS in the long term. However, it has been involved in the developments in the area of agricultural policy.

In 1925, the first cadastre work was started in Turkey, which is a large country with an area of 78 million ha. As of this date, almost 32 million land parcels covering 85% of the land subject to registration were intermittently surveyed and registered by the end of 2000. However, being the products of this long lasting registration process, some of the existing cadastre maps produced in different times with different methods, coordinate systems and scales have technically lost their applicability and need to be improved or renovated (Kokturk, 2002; Cete and Yomralioglu, 2004; Demir et al., 2008). With the awareness of that situation, the General Directorate of Land Registry and Cadastre planned and initiated a project in the 1990's. The title of this project is, as previously stated, the Land Registry and Cadastre Information System (Turkish acronym is TAKBIS). The general objective of this project is to establish the Spatial Data Infrastructure (SDI) for the Turkish LAS services throughout the country. Such an SDI will enable to organise, maintain and share the LAS data in an interoperable way. Pilot studies of the project were carried out in selected regions in the province of Ankara, the capital city of Turkey. After the 1999 Marmara Earthquake, this region, covering an area of 935,100 ha of land and being an industrial region with intensive settlement, was the first area of implementation (Ercan, 2003). The main purposes of this project are: (a) To provide reliable land information required for land-related activities; (b) To regulate such activities in accordance with the principles of GIS/LIS in the framework of OpenGIS/ISO standards; (c) To update and re-evaluate information within the scope of information technologies, and (d) to provide spatial data for use in central and provincial public organizations (Mataraci and Iker, 2002; Cete and Yomralioglu, 2004; Demir et al., 2008). The full extension of the project to the whole country has not yet been completed.

Unless the Land Registry and Cadastre Information System project is completely realized, effective resolutions for many land related issues will not be obtained. Some of these issues can be given as the determining of unproductive areas, inventory analysis of the relationship between the public and real estates, land readjustment, supervision of land use, development of land-based credit market, resolving land-based conflicts,

realizing rational investment plans, fair taxation, prevention of tax losses, increasing real estate revenues, fair and rapid expropriation, improvement of the shanty areas, tourism planning, coastal use and the determination of administrative boundaries (Cete and Yomralioglu, 2004; Ercan, 2003). Although not developed specifically to meet the needs for the management of agricultural and agri-environmental measures, this initiative will, among others, definitely play a crucial role in this area as well. In fact, the current NRF system is based on land registry data and definitely needs digital cadastre data. However, the availability of computerized land registries or digital cadastre data with conventional data sharing procedures is not adequate for a convenient implementation of the NRF system. Yet, a National SDI for the Turkish LAS as a result of the initiative of the Land Registry and Cadastre Information System will definitely contribute to the further development of the NRF system to meet the requirements of the Turkish Agricultural Policy and also of the European CAP.

Establishment of a functional LPIS

It is a fact that the NRF system currently does not have all functionalities required by the European CAP. The most important drawback of the NRF is the lack of spatial data content (Digital Cadastre Maps and Digital Ortho Bases). Therefore, the Ministry of Agriculture and Rural Affairs was encouraged to design a new type of system as an alternative to the current NRF system in an attempt to immediately start the required preparations for EU's CAP. In fact, beyond the drawbacks of the NRF system, the core motivation of this initiative was the facts that LAS data is believed not to be useful in the management of agricultural policy, it can not reflect real world agricultural land use, it complicates the control procedures and few countries (Spain, Italy, some states in Germany and Poland) in the EU use it (Kay and Milenov, 2006).

As a result of the above stated motivations, a project (preparation for the Implementation of EU CAP) was on the agenda in 2004. However, partly because of contracting procedures, the project, lasting one year, did not start until the beginning of 2007. One of the main purposes of the project was to design a functional Integrated Administration and Control System and prepare for the establishment of an institutional capacity in line with EU *acquis* and practices (EC, 2004). The project was implemented in selected areas in two provinces (Agri and Tekirdag) with the contribution of selected farmers in these pilot areas.

During the implementation of this project, a special attention was given to Land Parcel Identification System (LPIS) design and the establishment of a prototype. In this process, physical blocks (Figure 2 shows other types of reference parcels) were used as basic reference parcels and agricultural parcels are used as secondary spatial units. Further information on physical blocks and

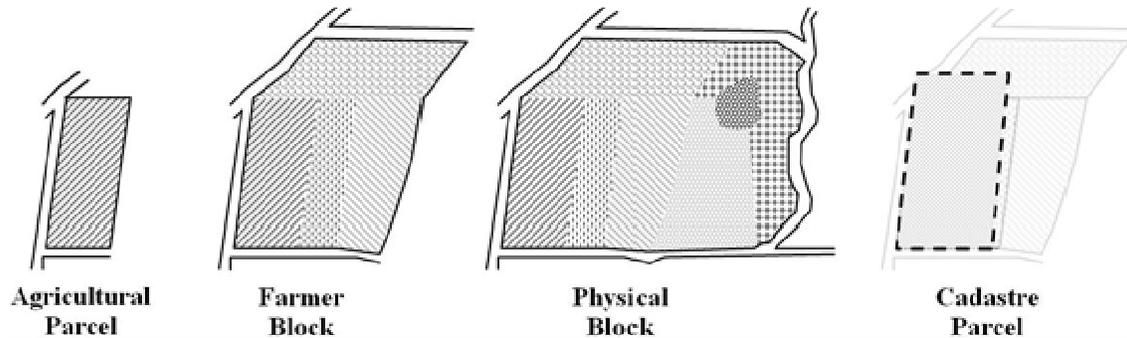


Figure 2. Different reference parcel types used for LPIS applications and their relation (adapted partly from JRC, 2001).

agricultural parcels can be found in JRC (2001). The digitization of both types of spatial units was carried out using Digital Ortho Images as the basic cartography. The boundaries of physical blocks consist of physical objects (roads, rivers, borders of different permanent land use patterns etc.) that have a little probability of change in time; therefore, there was no need for any other cartographic material or any other intervention for the boundary determination. For agricultural parcel boundaries, they were determined with the help of the farmers who use the land. In some cases, GPS field measurements were also used.

After the creation of the reference parcels, special farmer surveys were carried out in order to derive information about both the farmers and their agricultural activity on their lands. Furthermore, a prototype LPIS database and user interfaces were developed for demonstration purposes.

This initiative is definitely an alternative for the NRF system because, in the Agriculture Law No 5488 which was enacted in April 2006, it is stated (in temporary article No 2) that the NRF system will be used until the establishment of the Integrated Administration and Control System. It is clear with this initiative that the intention is to dramatically change the NRF system with the so called Integrated Administration and Control System which is spatially based on newly designed LPIS. However, some important facts in this process have been neglected. Some of them are the possibility of further developing the NRF system (towards an Integrated Administration and Control system), the required time, fund and also labour force for countrywide implementation and data maintenance procedures and the responsible authority after the initial establishment of a new system.

DISCUSSION

The Turkish LAS operates on the basis of the registration of title to land (Dale and McLaughlin, 1988). Furthermore, the registration of land under the Turkish LAS is compul-

sory by law. In other words, when the state decides that cadastre work in a specific region is going to be carried out, the owners or rights holders are obliged to contribute to the process. As a result, all the land is surveyed and registered under the LAS, which provides a full coverage of spatial data (cadastre map sheets) on land parcels. Full coverage is itself a great advantage in spatially representing and locating land parcels. This can also be further refined for use as a tool for registering and managing the majority of land related rights. In fact, registering farming rights will definitely provide security of tenure for farmers (FAO, 2006) and can boost their investments on agricultural activities. In Turkey, the security of farming rights is achieved by registering them not directly under the Turkish LAS but in the NRF system in conjunction with LAS records; however, further development is possible and required for a better implementation of agricultural policy.

As for the disadvantages of the Turkish LAS, although the Land Registry and Cadastre Information System is intended for the establishment of a nationwide SDI for the management of LAS services and also for sharing LAS data with other organisations, conventional cadastre map sheets are currently not readily usable (Demir et al., 2008). Considering this fact, it can be concluded that the effort by the General Directorate of Land Registry and Cadastre in collaboration with the Ministry of Agriculture and Rural Affairs to complete the cadastre work to achieve 100% cadastre coverage will not be a complete solution in the short term. Even in the case of full cadastre coverage, there will be a mixture of new and also old cadastre map sheets. In this case, it is necessary to improve or renew old cadastre data (map sheets) in the long term. This view point does not mean that the LAS related initiatives under the Agricultural Reform Implementation Project did not and will not contribute to the improvement of the SDI for the Turkish LAS. On the contrary, these efforts have had and will have a crucial role in the creation of a robust nationwide SDI for LAS and thus in the implementation of Turkish Agricultural Policy. However, only these efforts are not sufficient for this. In fact, all over the country, the proportion of digital

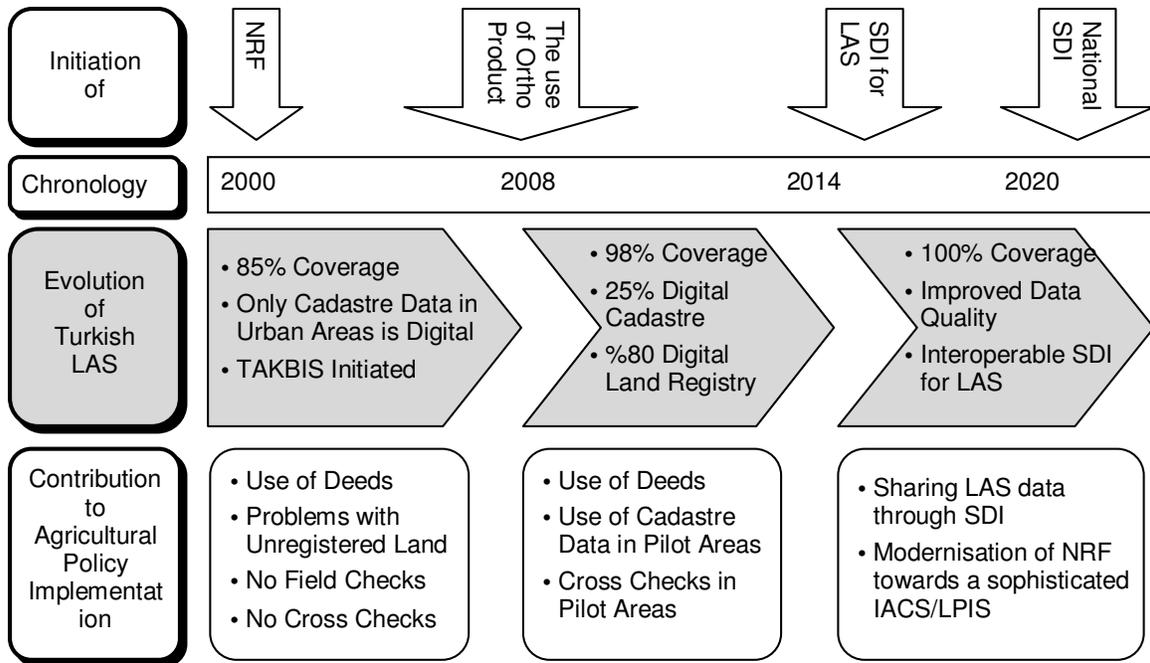


Figure 3. Proposed long term evolution of the Turkish LAS and its contribution to the agricultural policy implementation.

cadastre data coverage is not currently much more than 25% (Dursun and Ozdemir, 2008).

After reaching full coverage of cadastre data in Turkey, a specific strategy should be adopted both for the digitization of old cadastre data and also for incremental renovation of them (Figure 3 shows the proposed evolution of LAS). Only after completing this stage, will the Land Registry and Cadastre Information System or any other related SDI based on LAS be fully functional and then it will be possible for LAS data to be disseminated to other organizations. After this stage, a functional extension of the SDI for LAS for the implementation of agricultural policies will only be possible. In addition, the integration of Digital Ortho Bases as the main ancillary spatial data either with the basic SDI for LAS or with the extended version (modernised version of NRF) for the application of agricultural policy should be considered and required investments should be done accordingly. Currently in Turkey, disregarding this important strategy for a well structured SDI development for Turkish LAS, there has been an urgent expectation that Turkish LAS, in its current structure, meet all requirements and serve for agricultural policies. This expectation is mainly caused by either not considering or underestimating the required steps to have a robust SDI for LAS (by further developing the Turkish LAS) for this purpose. The developments in the Turkish LAS in the long term will definitely contribute to both the development of the NRF (or similar systems as in the case of IACS/LPIS) and accordingly to the agricultural policy

implementation (Figure 3).

Conclusion

It is evident that Turkish LAS and NRF currently have some disadvantages for the management of agricultural policy in Turkey. Partly as a consequence of this fact, there has been an attempt to establish an LPIS (independent from LAS data) in Turkey. This may be regarded as an indication of the dilemma that Turkish authorities face with. However, the collaboration between the Ministry of Agriculture and Rural Affairs and the General Directorate of Land Registry and Cadastre is promising for a better integrated solution to this problem. They try to integrate Turkish LAS with the NRF. However, they currently use conventional data sharing methods. To overcome this disadvantage, also with the help of the lessons learnt from the previous initiatives, the establishment of an interoperable SDI for the Turkish LAS, in the medium or long term, may be possible with a better coordination of the Land Registry and Cadastre Information System. The inclusion of Digital Ortho Base coverage within such an SDI will definitely add value to the Turkish LAS itself and makes possible to share this coverage together with LAS data with other parties such as the NRF system. Therefore, it is proposed that the NRF should be integrated with such an SDI instead of the conventional one. However, this proposed development is not an easy task and may only be realised in accor-

dance with a very well designed data integration model, which requires further study and also with a decisive government strategy. This may also be a good example for some other European countries suffering from similar problems.

ACKNOWLEDGMENTS

The authors wish to thank the staff of the provincial directorate of the Turkish Ministry of Agriculture and Rural Affairs in Trabzon province and the staff of central NRF management group in Ankara for their help and support. Also many thanks to OTB Research Institute of Delft University of Technology for their collaboration.

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