The Contribution of Forest Owners Associations for the Forest Cadastre Implementation

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Key words: Forest Cadastre, CyberTracker, SiNErGIC, Forest Owners, Forest Intervention Zone

SUMMARY

Forests in Portugal cover 38% of the total land surface. Eighty seven percent of this area is privately owned, 10% is vacant or owned by local communities and only 3% belongs to the Portuguese Public Sector. The lack of forest management, the excessive land fragmentation, the rural exodus, the escalation of forest fires, among other reasons, led to the creation of Forest Intervention Zones (FIZ), as a mean to solve those problems. One of the structural elements required for the creation of a FIZ is the existence of a real property cadastre, geometric or simplified, of all the members' parcels or in the absence of it, an inventory of the property structure in an appropriate scale for its identification. However, due to the lack of cadastre for approximately half of the territory, there might be the need to acquire cadastral data of the forest holdings with the exclusive purpose of creating a FIZ and that is often not considered as real property cadastre. To overcome the lack of cadastral data, we intend to evaluate the possible contribution of the Forest Owners Associations (FOAs) for the forest cadastre execution within the FIZs in the scope of the National System for Managing and Exploring Cadastral Data (SiNErGIC). From the early 90's until the present, about 169 FOAs have been created to assist forest owners in the sustainable management of their forest holdings. Several FOAs were asked about the methodology used to perform parcel surveys and their interest, in exchange of mutual benefits, in adopting the SINERGIC technical specifications in those surveys. The main objectives are the harmonization of the data collected by all FOAs, the creation of a unique and seamless database with the attributes required for the characterization of all parcels within a FIZ, and consequently the inclusion and/or update of those parcels in the Portuguese real property cadastre. To collect data in the field, an application, thought to be used by all FOAs as a standard, was developed with the free CyberTracker software. This application, which can be installed in a smartphone or a PDA, allows real time collecting of the vertices of the property borders (with a GPS attached) along with their attributes. This procedure enables not only a faster data acquisition but also the collection of both geometry and alphanumeric data in digital format, which constitutes an added-value for the implementation of the real property cadastre. The data collected with this application might also be integrated in the real property registry offices, tax offices and city councils database.

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1. INTRODUCTION

In Portugal, forest covers about 3.5 million of hectares, corresponding to 38% of the national land territory. It represents 3% of the gross value added (GVA) and employs about 3.3% of the active population. Related to the ownership profile, 87% of this area is privately owned, 10% is vacant or owned by local communities and only 3% belongs to the Portuguese Public Sector. The Portuguese forests are made up of a significant richness of species, although the maritime pine, the cork oak and the eucalyptus occupy around 2/3 of the forest coverage corresponding to the basis of three main industrial chains of production. Nowadays, the Portuguese forest is threatened by factors such as forest fires, land fragmentation, rural exodus, climate changes and lack of forestry cadastre. To prevent some of this causes, the government approved the legislation that establishes the creation of Forest Intervention Zones (FIZ), Decrees-law n.º 127/2005, August 5 and n.º 15/2009, January 14 (revision). A FIZ is a continuous delimited territorial area, consisting mostly of forest areas, submitted to a management and wildfire protection forest plan and managed by a single entity. The main objective of creating a FIZ is to promote the grouping of small forest holdings in order to a dimension that enables efficiency gains in terms of management. The creation of a FIZ presupposes an incentive for land consolidation of properties and a disincentive to its fractionation. Furthermore, it intends to promote the rehabilitation of the forest areas affected by wildfires and the reduction of the ignition conditions and the propagation of wildfires. The existence of FIZs allows the coordination of the different instruments that exist for land use management.

One of the structural elements required for the creation of a FIZ is the existence of a real property cadastre, geometric or simplified, of all the members' parcels or in the absence of it, an inventory of the property structure in an appropriate scale for its identification. However, present cadastral data is only available for half of the country. Once the creation of a FIZ involves the delimitation of the forest holdings boundaries belonging to one or more landowners, cadastral data has to be acquired with the sole purpose of creating a FIZ. However, and according to the FIZ´s legislation, the territorial delimitation of a FIZ must comply with the boundaries of the rural cadastral parcels. This type of geographic data (forest holdings boundaries) are currently been acquired by the Forest Owners Associations (FOA). The FOA's appeared in the early 90's, after some failed attempts to create extension services under the public programs co-funded by the European Union, to give technical support to the private forest owners. Presently, there are about 169 FOA's in Portugal which mission's should be to help forest owners in the management of their forest holdings. The FOA's supply several services to the forest owners, namely preventive forestry, technical and legal support, and forest perimeter surveys. The perimeter surveys are performed by the FOA due to the lack of real property cadastre.

Despite of several attempts to implement a cadastral system, Portugal is one of the last countries in Europe where a unique real property cadastre does not exist. To overcome this situation, a project designated by SiNErGIC (National System for Managing and Exploring

Cadastral Data) was created to establish a common platform regarding cadastral information (Council of Ministers Resolution n.º 45/2006, May 4). The main aim was to endow the country with a proper cadastral base to grant the knowledge of parcel boundaries and the property owners. This allows the creation of a parcel unified identification for all public administration.

The objective of this work is to evaluate the contribution of the FOA for the forest cadastre implementation in the scope of the project SiNErGIC. First, through a questionnaire, several FOAs were asked about the methodology used to perform parcel surveys and their interest in adopting the SiNErGIC technical specifications, in exchange of mutual benefits. The analysis of those questionnaires allowed the identification of the main attributes used by the FOAs to characterize each rural parcel and also the identification of the survey methods adopted when collecting forest holdings limits. Based on the results of the analysis, all the information collected by FOAs was harmonized with the purpose of creating a unique and seamless database to be used by all FOAs. This database is intended to contain not only the attributes required for the characterization of each forest holding within a FIZ, but also for the characterization of each parcel as defined in the SiNErGIC. This will allow the establishment of partnerships among FOAs and with entities involved in rural cadastre. Another goal of this work is to develop a freeware application, to be installed in mobile devices with the purpose of simplify the collection of data in the field.

This manuscript is organized in six sections. Section two describes the evolution of the Portuguese cadastral system, its current situation, the legislation concerning the cadastral registration and the description of the SiNErGIC project. Section three describes briefly the Portuguese forest, mentioning its current situation, its main products and the threats that forest has faced in the past years. Section four is related to the Forest Owners Associations (FOAs) and their role in the forest management. The scope of the creation of Forest Intervention Zones (FIZs) and their importance, as an instrument to improve forest productivity and allow a sustainable forest management, are also pointed out in this section. The following section, section five, describes the methodology adopted in this case study, consisting on three steps: preparation of a questionnaire to be sent to several FOAs, with the main purpose of evaluating what kind of attributes are used to characterize each member parcel and the way the perimeter surveys are performed; development of a standard database with common attributes for all FOAs and also interoperable with the database purposed by the SiNErGIC project; and development of an application to simplify the data collection in the field. In section six, the results of the questionnaires are analyzed and the contributions of the developed data model and freeware application to the forest cadastre implementation are discussed. Finally, in session seven some conclusions are drawn.

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2. CADASTRE IN PORTUGAL

The Portuguese cadastre, as many other in Europe, was inspired by the French Napoleonic model. This initiative was purely to tax significant economical parcels which, at that time, were mainly rural parcels. The establishment of the Cadastre in Portugal only started in 1926. Previously some attempts had been made, but never went beyond preliminary studies or decrees. Until 1995, the Geometric Rural Property Cadastre (GRPC) was implemented for fiscal purposes, but also to serve the reform of the property structure. The GRPC covers roughly 50% of Portugal mainland territory, corresponding to only approximately 14% of the estimated total of rural parcels, which have not been regularly updated. This rural cadastre had no link to the real property registry, and it was intended that it would progressively replace the fiscal registry.

In 1995, with the Decree-Law 172/95, July 18, a new model was developed to implement a multifunctional cadastre. The main focus had at the time changed from a fiscal to a legal cadastre, in which new planning and management issues were also being considered. Due to multiple factors, such urban growth, new natural resources exploitation and the lack of connection with the real property registry, the cadastre became homogeneous with no distinction between rural and urban parcels, multifunctional and with additional legal value - the real property cadastre. For the first time, activities regarding the cadastre were open to the cooperation with other organizations, including private sector, under the supervision of the Portuguese Institute of Cartography and Cadastre (*Instituto Português de Cartografia e Cadastro* - IPCC). In the real property cadastre, that no longer includes property valuation (implicitly left to the fiscal administration); a cadastral identifier (*Número de Identificação de Prédio - NIP*) had become mandatory for all public administration organizations. The cadastral identifier was meant to create a link among all parcel-based inventories: the new cadastre, the real property registry and the fiscal registry. Even though data acquisition was made in five municipalities, this cadastre is not yet public and updated, due to legal, organizational and technological problems.

Through the Resolution of the Council of Ministers 45/2006, May 4, a project designated by SiNErGIC was created in order to establish a common platform regarding cadastral information. The main aim was to create, under the coordination of Portuguese Geographic Institute (*Instituto Geográfico Português* - IGP), former IPCC, the unique parcel information according to the shift of paradigm in Public Administration towards integrated, articulated and add-value solutions. With a one-to-one link with the real property registry, giving additional legal and factual value to cadastre, SiNErGIC is based in a spatial data infrastructure (SDI) philosophy, integrating in a single infrastructure the cadastral, real property registry and fiscal information systems (Figure 1).

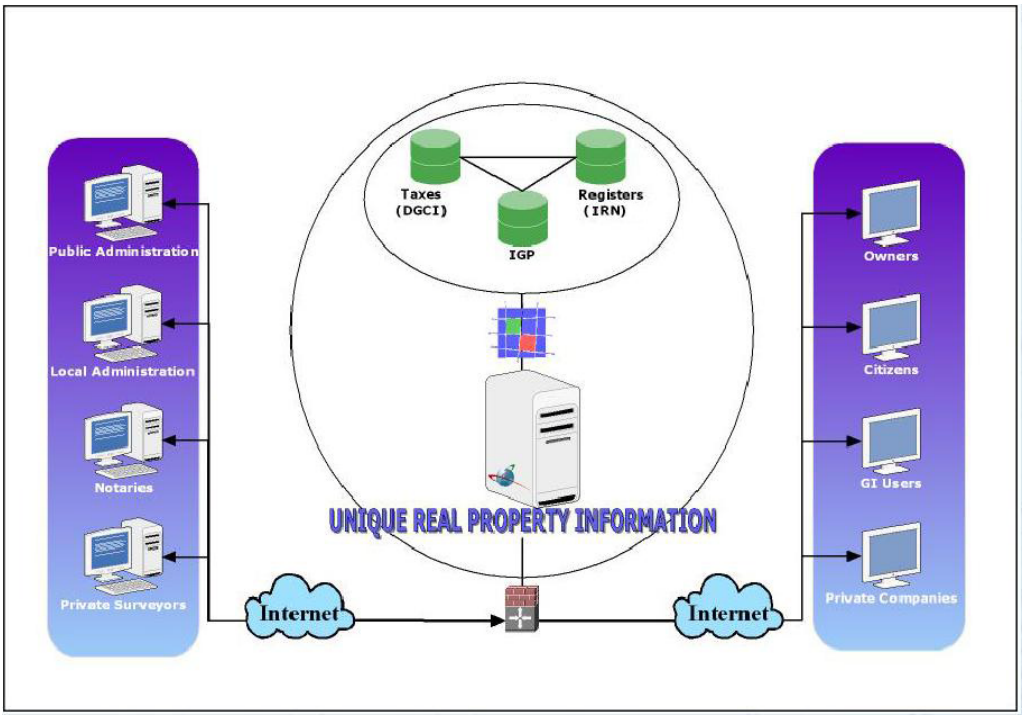

Figure 1. Beneficiaries of SiNErGIC project, adapted from Neto, 2006.

The technological infrastructure being built in the scope of SiNErGIC will manage the two types of cadastral systems. The rural property cadastre will rely on a strong interoperability between cadastre and finances due to its fiscal purposes. The real property cadastre has a broader vision and pretends to assure the interoperability between organizations directly related with the real estate market to assure a unique and complete identification and characterization of all parcels with legal value. Therefore, four SiNErGIC strategic stakeholders were considered with different roles in the legal real property market (Table 1).

Table 1. SiNErGIC stakeholders and their role in legal real property market, adapted from Julião *et al*., 2008.

Strategic Stakeholders	Role
Portuguese Geographic Institute (IGP)	Cadastral data acquisition, management and renewal
Registry and Notary Institute (IRN)	Execute and follow real property registry policy; Grant regulation, control and inspection of notary activity
Taxes General Directorate (DGCI)	Manage heritage taxes
Local Government General Directories (DGAL)	Territory management agents

3. FOREST IN PORTUGAL

The Portuguese forest is a very old ecosystem, consisting of deciduous trees in the North and evergreen trees in the South. Currently, the Portuguese forest covers about 3.3 million hectares. Portugal has the highest proportion of forest area in Europe (38.8%), larger than the area covered by agriculture (32.9%) (Figure 2). The three representative species that cover 75% of the total forest area and have a high commercial value are: Maritime Pine, Cork Oak and Eucalyptus. There is a regional differentiation in terms of these three species composition: maritime pine is located mostly in the Northern and Central regions, whereas cork oak is in the Southern regions (Mendes, 2006). Eucalyptus has been planted in the western regions, both in the North and in the South, in some cases replacing pine forests that have been destroyed by forest fires. Wild pine represents the major share of forest areas, covering about 31% of the total area. Cork oak trees cover about 23% (713,000 hectares) while eucalyptus covers around 21% of the forest area. The main forest products are cork, wood and paper pulp, cellulose and wood for furniture among others.

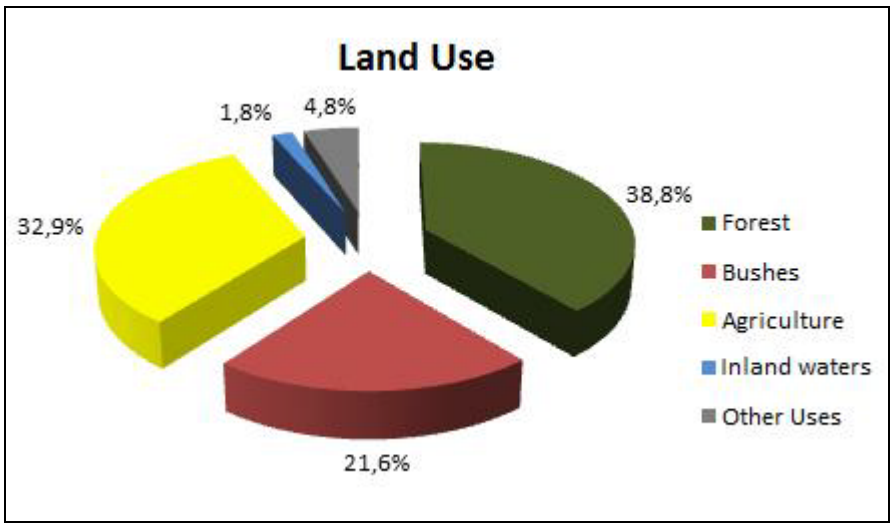

Figure 2. Land Use in Portugal, adapted from AFN (2010).

Forest-based industry is a sector of structural importance to the Portuguese economy, corresponding, in 2010, to exports of approximately 3.5 billion Euros, representing 10.3% of Portugal total visible exports. According to the latest National Forestry Inventory (IFN), released by the National Forestry Authority (*Autoridade Florestal Nacional* - AFN) in 2010, the mainland forest area had a slight increase of 3% from 1995 to 2005. In this period of time some relevant changes in its composition were verified: areas covered by maritime pines have increased about 68%, cork oaks had an increase of 15% and eucalyptus an increase of 10%. In terms of forest ownership, 87% percent belongs to private owners, 3% percent belongs to the

state and the remaining are common lands. According to Mendes (2006), the Northern and Central regions are the home of small scale forestry, with about one half or more of the forest land with holding areas up to 10 ha, while in the southern regions, especially in Alentejo, forest holding areas are mostly above 100 ha.

Currently, the Portuguese forest faces some threats such as the excessive land fragmentation, the existence of a large number of privately owned forests, most of them with low profitability, deforestation, forest abandonment and traditional agricultural practices, rural exodus among others. These factors led to the lack of forestry management and the increase of biomass and combustible material, both responsible for the scourge of fires, which has taken the proportions of calamity in the recent years. These issues that are, directly or indirectly, connected are causing the forest destruction. It is important to mention the fact that the Portuguese forest represents 3% of the GVA and that employs about 3.3 % of the active population, so, in the end, the Portuguese forest has potential not only in terms of its products but also in terms of the labor force that employs.

4. FOREST ASSOCIATIVISM AND FOREST INTERVENTION ZONES

During the 90's, an important associative phenomenon among forest owners emerged in Portugal, mainly in the Northern and Central regions where small scale forestry is largely predominant. In the beginning, the FOAs had as main objective to assist the forest owners in the applications for financial support coming from programs co-funded by the European Union and in the implementation of the approved afforestation and forest management plans. The FOAs are Non-Government Organization (NGO) and their profits came from the services provided to the associates. Along the past years, they have become more active and have provided more diversified services. The importance of these organizations should be recognized not only because they are filling a gap in the provision of private services for forest owners, for which a price can be charged, but also because they are making an important contribution to a sustainable forest management. FOAs contribute to the provision of several public goods (such as union of private forest owners used to to operate individually, mitigation of forest fires, production and dissemination of information about sustainable management or use of forests) which benefit the whole society and where collective organization of the forest owners is needed (Feliciano, 2006).

Currently, there are 169 FOAs distributed throughout the country, mainly in the Northern and Central regions where small scale forestry is largely predominant. These FOAs support the governmental entity, the AFN, in the protection and management of the forest. The FOAs are divided into four levels of action: national, regional, municipal and complementary (Figure 3). The national and regional FOAs are essential to the technical and juridical support to the

municipal and complementary FOAs. The main purpose of the last two is to supply direct services to the forest owners.

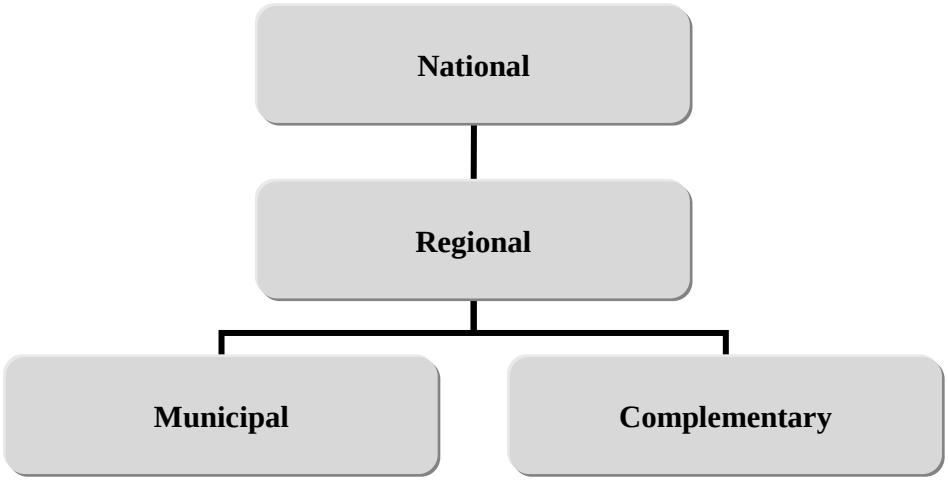

Figure 3. FOAs hierarchy in Portugal.

In August of 2005, the government approved the legislation that establishes the creation of Forest Intervention Zones (FIZ), Decree-law N.º 127/2005, August 5 and Decree-law n.º 15/2009, January 14 (revision). The FIZs were created considering factors such as the increase of the forest potential, encouraging favorable ecological conditions and diversification of the forest industry, the economic non viability of small owners and the reduction of the forest fire risk. The main objectives of the FIZs are to promote an active and permanent management of the forest areas, to protect the forest areas and associated rural areas in an efficient way, to promote the rehabilitation of the forest areas affected by forest fires, to reduce the ignition conditions and the propagation of forest fires, to allow the coordination of the different instruments that exist for land use management and to contribute to a better land use management. Nowadays, there are 143 FIZs covering a total area of 737, 709 hectares (8.7%) of the national territory. According to the AFN (2011), FIZs are actually managed by the FOAs (90%) and by private companies (10%). One of the structural elements required for the correct delimitation of a FIZ is the rural cadastre. However, due to the lack of it, the alternatives are to perform a geometric and simplified cadastre of all the parcels belonging to the FIZ members or to perform an inventory of the property structure in an appropriate scale for its identification. As already mentioned, most of the FIZs are located in the North and Center of Portugal where land fragmentation predominates. However, those are precisely the regions of the country where real property cadastre is missing (Figure 4).

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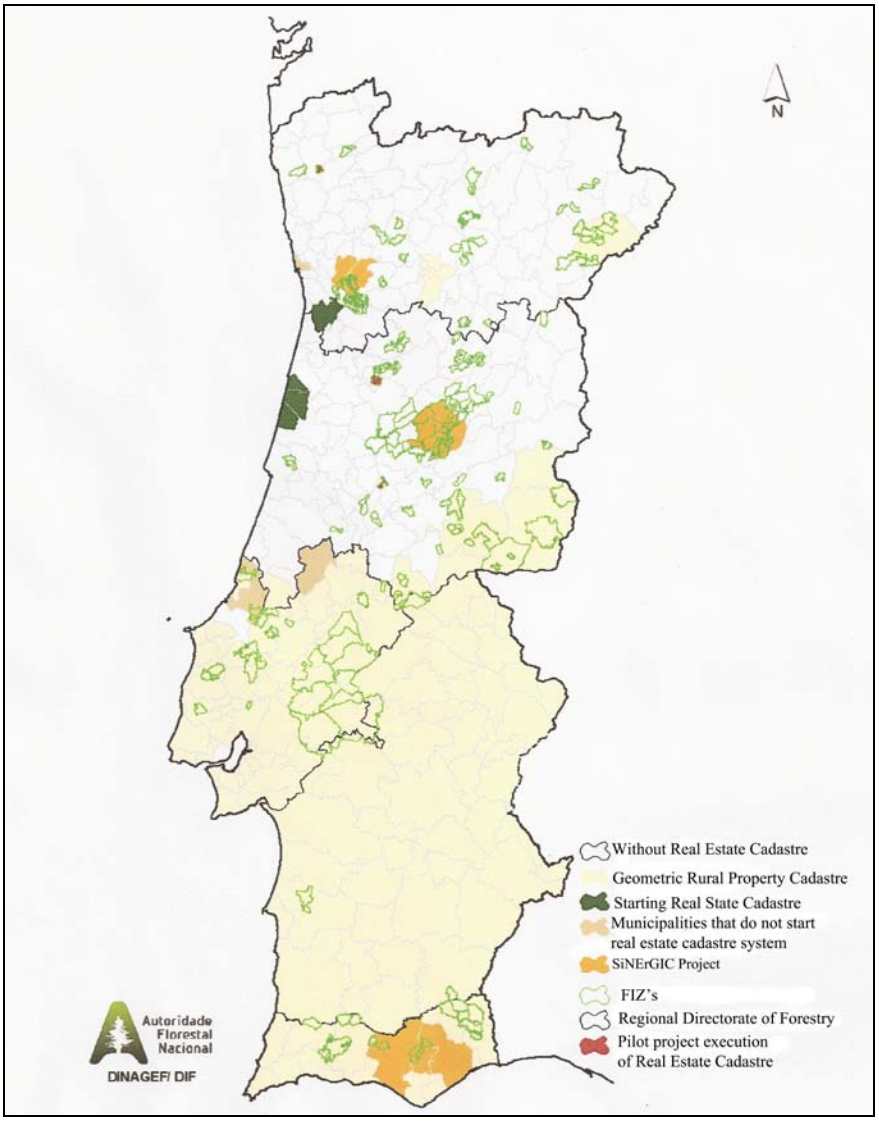

Figure 4. FIZ boundaries and the present situation of Real Estate Cadastre, adapted from AFN (2011).

5. METHODS

5.1 Forest Cadastre Questionnaires

FOAs develop their members and corresponding properties databases based on alphanumeric information characterizing the owners and on geographic information regarding the perimeter surveys. How both data are collected can vary from FOA to FOA, leading not only to inconsistencies among their databases but also between each FOA database and the real property cadastre. The main goal of the inquiries was to identify what kind of attributes were used, by the different FOAs, to collect and store information describing each parcel. This information will allow the definition of a generalized conceptual model for a standard database to be used by all the entities involved in the forest management. The questionnaire that was send to 169 FOAs has a total of sixteen questions with multiple choices and fill-in answers.

The first question is about the use of GPS receivers in the perimeter or cadastral surveys. In case of a positive answer, one should follow to the next question; otherwise is redirect to the final question of the questionnaire. In the last question one is asked about what kind of attributes are collected to characterize each member, how does the location and the geometry of each forest holding are obtained (in case they are considered), how data is stored and what are the reasons why the GPS technology is not used. This latter aspect is important since it limits the interoperability with neighboring FOAs databases. Whenever the GPS technology is considered in the surveys, one should follow directly to question two. This question is related with the way that both alphanumeric and graphic data are collected in the field. Three options are available: GPS and analogical forms (paper), GPS and digital forms or just GPS. This gives an insight of the proportion of time spent in the field (data collection) and at the office (data insertion and processing). The second option allows a faster alphanumeric data collection since attributes are directed inserted in digital format.

The third question is about which software is used by the FOAs to store the geographic information such as Geographic Information Systems (GIS). Several packages are listed, namely ESRI ArcGIS, Quantum GIS, gvSIG among others. The answer to this question clarifies whether the FOAs are using licensed or open source software. Following to question number four, FOAs technicians are questioned about the kind of GPS receiver is used in the field for data collection. The level of accuracy of the rural parcels limits depends on the type of GPS receiver configuration used in the perimeter survey. According to Karsky *et al*. (2000), when the satellite constellation is good, the inexpensive hand-held receivers will provide relative accurate positions in the open and under a medium canopy, while when the satellite constellation is poor or under a heavy canopy, more accurate GPS methods and/or receivers are required. The two next questions, question five and six, are concerned, respectively with the type of differential correction that is applied and with the degree of accuracy of the collect data. Post-processing data increases positioning accuracy, thus it is

more efficient to collect uncorrected data and post-process the information rather than to collect real-time (Karsky *et al.*, 2000). Both questions allow us to evaluate the GPS knowledge level of the FOAs technicians that perform the surveys.

Question seven lists several types of data used as the basis for the delimitation of the forest holdings. Among these are orthorectified aerial photos, satellite imagery, topographic maps, Google Earth imagery, Bing Maps among others. For many FOAs large-scale digital base cartography is hard to get mainly due to budget constraints, so alternatively data downloaded from Google Earth and/or Bing Maps are used instead. The types of land use for which perimeter surveys are performed are addressed in question eight. The most common land uses are: forestry, agriculture, agro-forestry, community lands and in some cases urban areas. To be aware on how perimeter surveys and owners information are stored, in question nine, three options are considered: analog archive, digital archive and GIS. Data in digital format avoid data deterioration along the years and allow, in the case of GIS, the association of alphanumeric data to graphic data.

The means by which property rights owners are identified (legal property registry or fiscal registry) are considered in question ten. In question eleven, the FOA's technicians are asked to list the attributes, and their corresponding descriptions, which are used to characterize each forest holding, besides perimeter and area. This question allows to identify all the attributes required by all FOAs and consequently to define a common data model. In the next question, twelve, FOAs that manage one or more FIZs should indicate how its, or their, delimitation is done. In this question three options are considered: (1) perimeter delimitation of contiguous forest patches, (2) perimeter delimitation of contiguous forest patches considering the type of land use and (3) perimeter delimitation of contiguous forest patches considering not only the type of land use but also the exclusion of non-forestry areas. Question thirteen is related to the FOA's interest in collaboration in the SiNErGIC project. If so, FOAs are asked if there are any willing to obey to the rigid technical specifications of the project and what kind of compensations they are interested in. The key objective of question fourteen is to realize the eventual interest of the FOAs in using a customized application developed with the purpose of making the data collection easier and faster. Finally, question fifteen was thought to comprehend what kind of services is provided by the FOAs to their members.

5.2 FOAs Database Implementation

After analyzing the answers to the questionnaires, the main attributes used by the FOAs to characterize each forest holding were identified. FOAs usually store information such as "owner's name", "owner's address", "parcel's address", "member's number", "species type", "land type", "area", "perimeter" among others. Each FOAs perform its perimeter surveys as a mean of locating each forest holdings, however the attributes used to characterize each parcel

differs from FOA to FOA. To overcome this inconsistency between the different databases, the solution is to develop a generalized conceptual model with common attributes to all FOAs. Furthermore, in order to contribute for the forest cadastre performed in the scope of the SiNErGIC project, other entities have also to be considered. Those are mainly the ones, in the SiNErGIC data model, that allow the establishment of relationships with the real property and tax information.

The basis upon the SiNErGIC information system was created is that each stakeholder manages and updates their own databases in respect to each parcel characterization they are responsible for (Julião *et al*., 2010). IGP is responsible for the collection of spatial data (parcels boundaries), IRN for the parcel and owner registry, DGCI for the tax data and the municipalities for land management data. In a single interface users can access parcel geometry and its physical, legal, economic and fiscal features. Each user, according to its privileges, is given access to data from the land registry, tax system and cadastre. The conceptual data model developed for the FOAs includes attributes that are useful in terms of taxes calculation once, for each forest holding, the area covered by different species and land uses is calculated. This data model might also contain the attributes to validate the real property owner allowing the identification of all parcels with legal value. This conceptual model also considers a new stakeholder, the AFN, since FOAs showed interest in gathering data regarding the different types of species and land uses, their corresponding areas, the dominant class age and other forest parameters when performing a perimeter survey. Figure 5 shows the relationships among the typical stakeholders involved in the process of cadastral development.

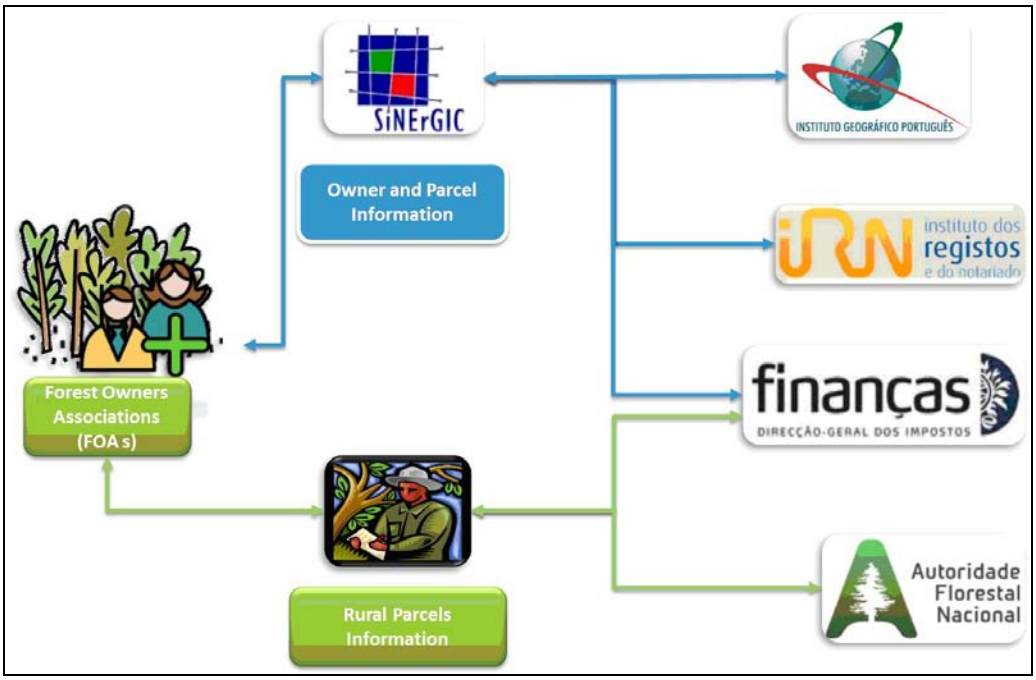

Figure 5. Database implementation schema.

5.3 Creation of an Application

To assist the FOAs in the acquisition of their owner's and parcel's information, an application was developed to support the FOA's database implementation. The software used to develop the application was the CyberTracker freeware. This freeware has a great potential for the development of customized applications. CyberTracker was designed in order to allow the development, in a simple manner, of several types of applications and with the purpose of monitoring natural resources. The application developed with CyberTracker might be installed in mobile devices (smartphones or PDAs) with operative systems based on Windows Mobile or Windows CE, allowing the real time collection of the vertices corresponding to the property's boundaries, whenever a GPS receiver is attached. It also allows the insertion, directly in the field, of all the attributes for each parcel characterization. This procedure enables not only a faster acquisition of data but also the collection of both geometry and alphanumeric data in digital format, which constitutes an added-value for the implementation of the real property cadastre and to the characterization of the land uses (Figure 6). In the end of the day, this application also increases the data transfer rate, from the field to the office, by two different means. These can be either by uploading data into a remote server or by transferring data locally in the office from the collecting device to the FOA database.

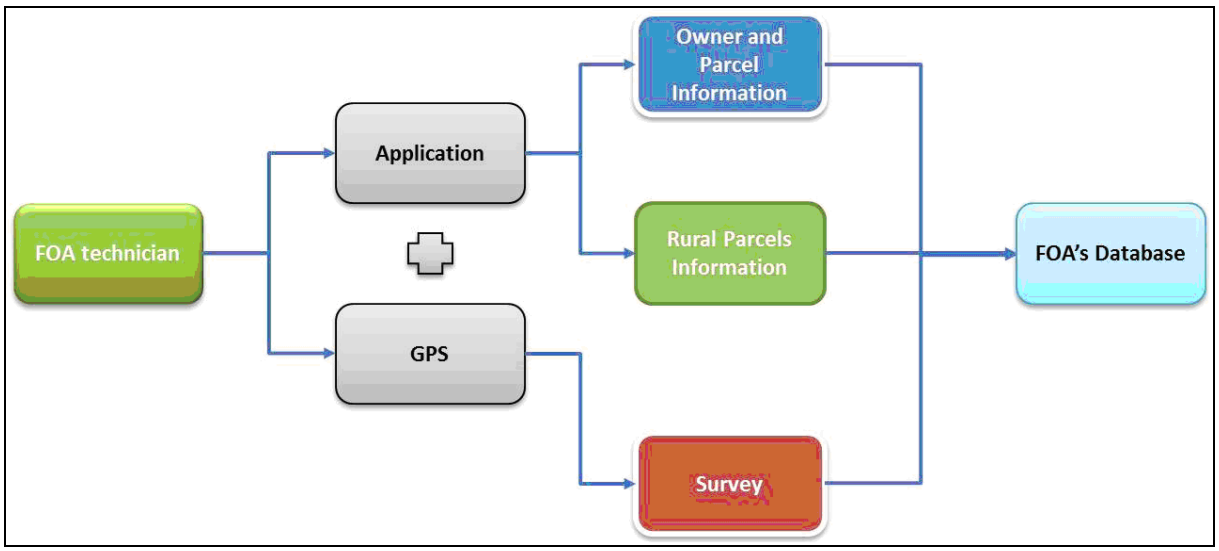

Figure 6. Data collection schema.

6. DISCUSSION

From the 169 questionnaires sent to the FOAs, only 44 were received back. Among these, only 38 questionnaires were validated for analysis, because 2 of them were filled by national FOAs that are not directly involved in the services supplied to its members, 1 was not filled and the remaining 3 corresponded to FOAs that do not use GPS receivers. Most of the FOAs (92.7%) use GPS receivers to perform the perimeter surveys, while only 7.3% use available cadastral data. In terms of data collection, 36.8% of the FOAs only use GPS to collect data, 34.2% use a GPS and a paper form to collect alphanumeric data and 28.9% use a GPS and a digital form. The most common GIS software use by the FOAs is ESRI ArcGIS with a total of 81.6%. The most common type of GPS receiver used by the FOAs is GPS with internal antenna (89.5%) and most of the FOAs (86.8%) calculate the coordinates of the vertices that define the forest holdings boundaries in post-processing mode. Concerning coordinates accuracies, only 63.2% of the FOAs are aware of both planimetric and altimetric accuracies. Topographic maps and aerial photos are the most used as base cartography (57.9%) when compared to the other options. When questioned about which types of land use are delimited, all FOAs mentioned forestry and agro-forestry areas, 30 FOAs also mentioned agricultural areas, 24 FOAs refered to community areas as well and only 8 FOAs consider the limits of urban areas. Data is stored in a computer with a GIS database by 26.3% of the FOAs and the same amount was obtained for those that store data just in digital format in a computer. Ownership is proven based on the fiscal registry by 36.8% and based on the real property by

18.4% of the FOAs. The most common attributes mentioned by the 38 FOAs that have answered the questionnaire were: date, type of stand, land use, primary specie, primary specie age, secondary specie, secondary specie age, owner's name, fiscal identification number, area, type of road, member's number, stand rotation, compass, natural values, erosion evidences among others. In terms of how FOAs delimit their FIZs, 13.2% have answered that consider only the perimeter delimitation of contiguous forest patches, 34.2% consider the perimeter delimitation of contiguous forest patches plus the parcel´s type and 7.9% consider the perimeter delimitation of contiguous forest patches plus parcel´s type and the exclusion of non-forest lands. However, only 55.3% of the FOAs that have answered the questionnaire stated that they manage one or more FIZs. All FOAs are willing to contribute to the SiNErGIC project in exchange of training courses, cartographic data and payment of the services. More than half of the FOAs (60.5%) stated that are interested in using an application to turn data acquisition easier.

Answers to question eleven were fundamental to establish the common attributes to all FOAs and also those that were common to the SiNErGIC database. Results of this harmonization are presented in Figure 7 that represents the initial draft of the conceptual data model.

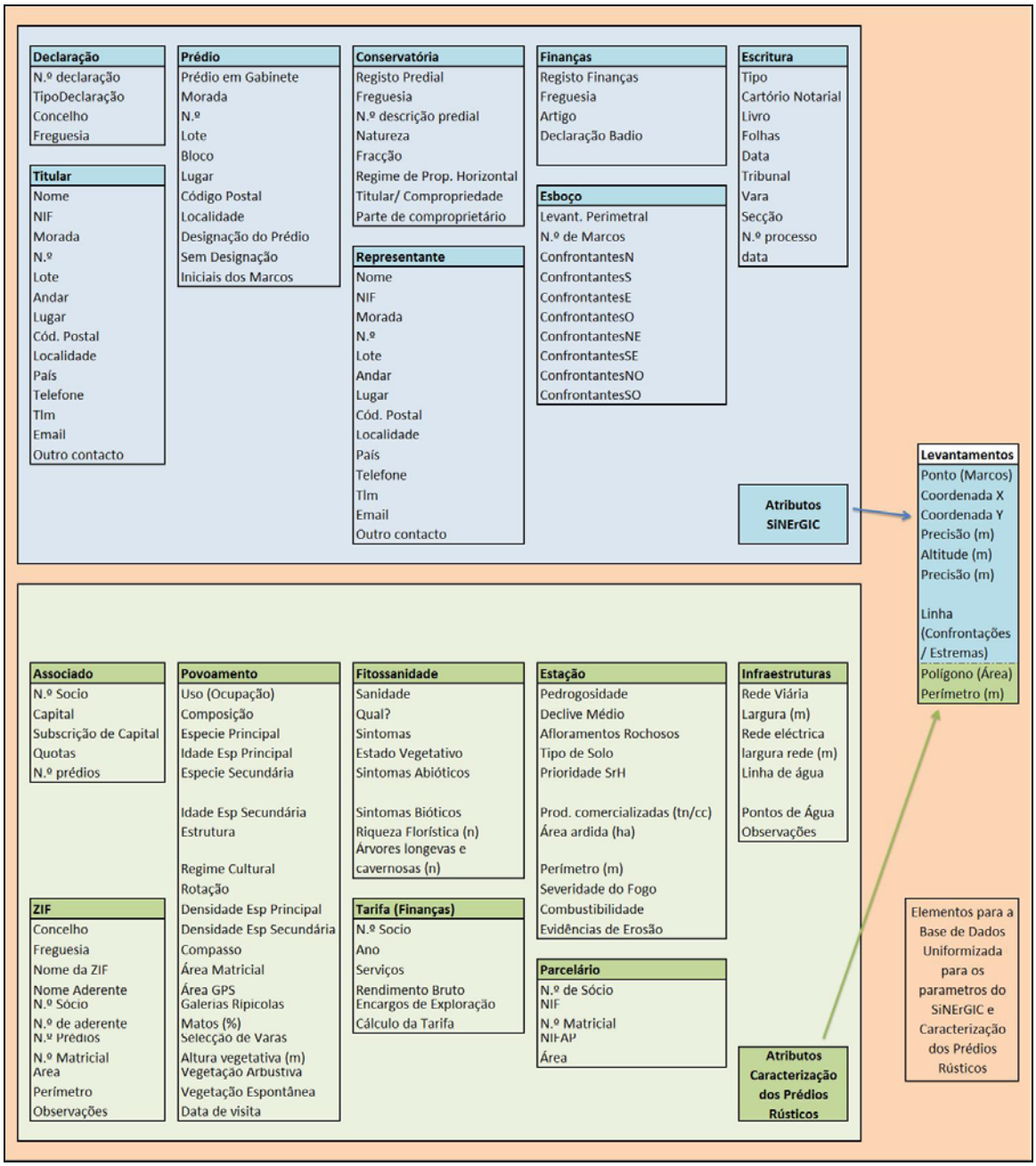

Figure 7. Inicial version of the conceptual data model with the common attributes.

In figure 7, the entities highlighted in blue correspond to attributes of the SiNErGIC database, whilst the ones in green are the ones used by the FOAs to characterize their parcels. Inside the boxes that represent the different entities are the attributes required to store the information regarding the characterization of each parcel for the real property cadastre and also for the forest management.

The physical model implemented in the developed application relies in the principles designed at the conceptual level. After implementing the structure in the application, a first version with initial forms was conceived (Figure 8). This first version, that will collect data to be stored in the FOA's database, runs in Windows Mobile or Windows CE. The data collected in the field can also be uploaded to a remote database, depending on the PDA capabilities. The graphic user interface of this application is very user-friend and takes the advantages of all the capabilities provided by PDAs devices. Finally, the following step will be the implementation of this prototype application as a pilot study at the FOAs level to check both robustness and reliability.

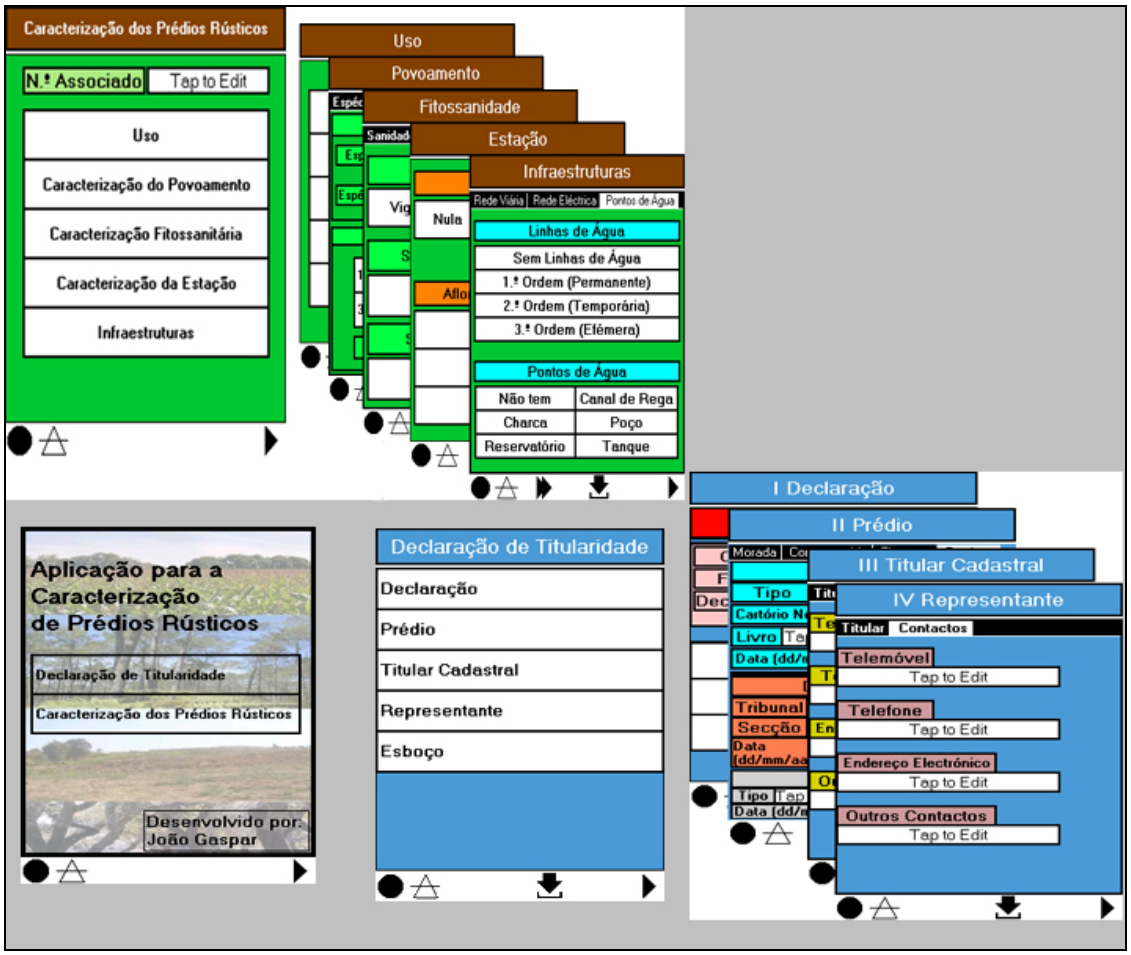

Figure 8. Some forms of the first version of the mobile application (Windows Mobile).

7. CONCLUSIONS AND FUTURE ACTIONS

In Portugal, forest is an important sector of exportation and is urgent to create mechanisms to promote the forest management. Two major factors have threatened forestry and forest resources over the years. The main threat is wildfires, affecting 150k ha/year in the past decade. Another significant threat is the lack of long term forest management planning. Contributing to this later problem is the absence of cadastre for about half of the country. Recently, FOAs have been playing an important role as a local agent for the technical and legal support to the forest owners. In addition, FOAs might also be of extreme utility for the cadastre execution due to the closer relationship with the property owners. This fact, along with the knowledge of the location of each member's parcel, will allow an easier demarcation of the rural parcels. Providing that all FOAs use the same technical specifications regarding to cadastral surveys and parcel's characterization attributes, the data acquired in the field will sustain not only the FOAs interests but also the SiNErGIC's.

The conceptual data model developed in this study includes attributes that might be useful to the DGCI, for the calculation of equitable taxes, and to the IRN, for the harmonization between the real property registry and the territory's physical reality, allowing the security of tenure. Besides, attributes describing the most relevant characteristics of each species might be particularly useful for the AFN in the elaboration of the national forest inventory. Consequently, the development of a unique and seamless database, to be used by all the FOAs, is a crucial factor for the establishment of the national cadastral information system. To accomplish such task, not only the attributes common to all the stakeholders' databases should be harmonized, but also the parcel's boundaries delimitation should be performed in agreement with the SiNErGIC technical specifications. Moreover, the freeware application, developed to be used by the FOA's technicians when performing the cadastral surveys, has the capability of allowing the simultaneous acquisition of graphic and alphanumeric data. In such manner, those parcels can be included and/or updated in the real property cadastre. Another aspect that should be considered is that FOAs demand for some compensation in return for the contribution to the forest cadastre implementation. Those compensations might be training courses on the SiNErGIC technical specifications, base cartography to support the parcel's delimitation and/or financial support. Finally, since several stakeholders are involved in the development of the cadastral system, it is relevant to define the data policy specifying the basic principles to be observed by individuals and institutions when generating, collecting, transforming, disseminating, and making use of data.

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The Contribution of Forest Owners Associations for the Forest Cadastre Implementation

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BIOGRAPHICAL NOTES

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