Methodology for Inventorying and Characterizing Non-Industrial Private Forestry

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Key words: census, survey, forest owners.

ABSTRACT

The existing information of the socio-economic characterization of forest farms is scarce, especially compared to that of agricultural land uses. Several works and initiatives by international institutions have not been able to reach an agreement on terminology, contents, and typification of forest owners or forestry farm sizes.

Aware of this problem, an agreement was signed between the Galician Institute of Statistics (IGE), the Ministry of Environment of the Xunta of Galicia and our research group in order to design a methodology for inventorying and monitoring forest ownership and study its socio-economic characteristics in Galicia (an autonomous region in the northwest of Spain). This information will be used as a base for Forest Certification and the application of Sustainable Pan European Criteria.

The proposed method has two parts. Firstly, the elaboration of a forest owner census, by implementing a GIS (Geographic Information System) on a certain forest area. In order to define its land uses we evaluate comparatively, in terms of cost and accuracy, three methodologies based on aerial photography and remote sensing. And, secondly, a stratification of the forest owners, based on their level of forest production (wood cut and estimate of annual production), in order to carry out a survey.

Finally, with these results, a farm forestry type will be selected to build a network for monitoring the socio-economic of farm forestry. At present, the model is being applied to a municipality.

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1. INTRODUCTION

Forestry is one of the main activities of the Galician economy, in the last years it has experienced a slow and progressive development becoming of great importance for rural development. The expansion of the forested area involved the growth of production up to the 221 million €in 1998 (Meixide, 2001), 12,4% of the final agricultural production of Galicia. The forested area covers almost 1,300,000 Ha which supposed, with the 800,000 Ha of brushwood, 69% of the total area (Ministerio de Medio Ambiente, 2001). The ownership in Galicia is nearly exclusively private, 96.6% of the area. The individual ownership represents two-thirds parts of the forest land, distributed into several pieces of small size, so there are many forest owners. Different sources and authors estimate the number in the range between 425,000 (www.eurosilvasur.org, 2001) and 673,000 (Xunta de Galicia, 1992).

However, in spite of its importance, there been a reflection in statistical studies of the sector, and forestry has been considered so far as a sub-sector of the agriculture and industry. This deficit is expected to be overcome in the short term by several institutions. Within the plans for the years 2001-2004, the National Institute of Statistics (INE) has designed an study entitled "Statistics of the forest farm structure", that will develop technical and economic indicators of forestry for different types of ownership.

The future of forestry will mostly depend on the producers, this makes necessary to generate accurate information with quantitative and qualitative data on which future policies will be based. As a result the Laboratory of Projects and Planning of the University of Santiago de Compostela brought up a proposal presented to the Galician Institute of Statistics and the Regional Ministry of Environment. A methodology for inventorying forest ownership in Galicia has been developed together with an empirical application in the district of Western Mariña, in the North the Galicia.

2. OBJECTIVES

The objective of this study is to know two aspects of forest ownership: the number of private forest owners in Galicia, and its socio-economic characteristics. With these aims in mind, a methodology has been designed and then validated for a municipality.

3. BACKGROUND

The study has been organized in three phases:

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- Review of previous studies, specially those applied in Europe with the same goals.
- Analysis of the types of forest ownership in Galicia.
- Study of the methodologies applied so far in Galicia as well as those related to rural ownership and forest land.

3.1 State of the art in Europe

Statistical compilations have historically focused on the national scale, following local needs, and limiting the application of international principles (Chijien, 1998). International organizations gathering forestry data from several countries and along time are (Kuusela, 1994):

UN-ECE/FAO	United Nations Economic Commission for Europe.
EUROSTAT	Statistical Office of the European Union.
FADN	Farm Accountancy Data Network
DG VI	Direction General VI of the European Union

There are several publications that compile forestry data at the same scale for the countries included:

- IWG (Intersecretariat Working Group)
  This is a group within the UN-ECE Timber Committee that has brought together methodologies and works developed by UN-ECE/FAO, Eurostat, and DG VI. An outcome has been the FRA (Forest Resource Assessments), published in 1990 and 2000 (Chijien, 1998). The second is a revision of the former and collects the agreed definitions in forestry and used by the aforementioned organizations.

- EFI (European Forest Institute)
  This institute was created to promote the European cooperation in this area and contains the EFICS (European Forests Communication and Information System), whose mission is to regulate and homogenize forestry statistics in the European Union. It has also developed the MOSEFA (Monitoring the Socio-Economic Situation on European Farm Forestry) Project that carried out a study of the socio-economic situation of the forestry estates in Europe.

3.2 Types of ownership

There are two different types of ownership:, public (municipal, from the autonomous region and state-owner) and private (individual or collective). The collective forests belong to the neighbors living in a village (Balboa, 1995).

The main sources for the study of private forest ownership are the Land Registry, Rural Property Cadastre, Agriculture Censuses and Forest Inventories.

- **Land Registry.** Governmental office where land ownership records are kept (Muñoz, 2001). The information unit is the registry entry. This practice is entitled as a volunteer

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and, since it is not a binding act for the owner, a great number of rural parcels are not registered.

– **Rural Cadastre.** Collection of economic and physical data of the rural and urban land and its owners (López & Lázaro, 1993). Among the functions prescribed by law, the Cadasdre is a database managed to be used for other statistical purposes (Castanyer & Canet, 1990).

– **Agriculture Censuses and Surveys.** Regular statistics of large-scale operations, with the farm as information unit (INE, 1999), and only take into consideration forestry states belonging to agriculture farms.

– **Forest inventories.** An application of this statistical technique to this field, evaluating forest stocks and state indicators (Rábade, 1991), with the stand as information unit. There is only a property analysis for the main types of property.

3.3 Evaluation of information sources

From these data sources we may draw some considerations regarding the situation of European forestry:

– The present definitions of forest estate and owner are not easily applicable to all European nations.
– The present system of agricultural accounting does not allow to derive the socio-economic structure of the individual forest owner and, the characteristics of small-properties. Data obtained is referred to farms with forested land.

From the Spanish sources the following considerations are drawn:

– Land Registry cannot be considered as a data source which fulfills our objectives.
– The information from Cadastre, Agriculture Censuses and Forest Inventories are too generic to follow all changes that take place in the rural area. The information is dissimilar, non-continuous and obsolete for potential planning.
– Cadastre supplies valuable information on the parcel and ownership structure (after an intensive study) but is not sufficient for its socio-economic characterization.
– The present methodologies are expensive, rigid and low-effective, do not optimize last techniques and do not allow their co-ordination.
– None of the methodologies allow to define and characterize the private forest owners in Galicia.
– There are no data on the spatial distribution of forest land in Galicia.
– The existing information is not based on technical-economic units, except Agricultural Censuses, and is very limited for the forestry sub-sector.

These questions point out the need of designing a new methodology to achieve the planned goals, based on the valid elements of the already existing.

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4. METHODOLOGY

The proposed methodology is represented synthetically in **Figure 1** and developed in the next sections.

4.1 Land ownership parcels

Objective: To understand the physical attributes and infrastructures of parcels, as well as the characteristics of the forest landowners.

Sources: The cadastral digital information at scale 1:2000 will be the base for the work attached to the maps at scale 1:5000.

Method: It has been split into four phases:
- Design of software to treat the thematic cadastral databases.
- Use of a specific software for the interpretation of cadastral mapping.
- Union of spatial and thematic databases.
- Union of layers with different thematic information

Results: The outcome is a file with information on cadastral parcels, their physical attributes and infrastructures, as well as information on cadastral owners, as it may be seen in **Figure 2**.

4.2 Land use-forestry

Objective: To identify the forest area, its attributes and distribution over the region.

Method: Three different sources were used: aerial photographs, remote sensing scenes and maps from the Spanish Forest Inventory (Mapa Forestal de España) and applied photointerpretation and image processing techniques.

4.2.1   Photointerpretation

Land coverage can be identified in a photograph through the interpretation of the variable tones and the contrast between patches.

Objective: Firstly identify all the land uses in every parcel and, then differentiate within the forest land the species.

Sources: Vertical aerial photographs at scale 1:20,000, stereoscope and the rural parcel map at the same scale.

Method: It has been split into four phases:

- Definition of a legend according to the goals.
- Photointerpretation in four phases that synthesize the 10 suggested by Zonneveld (1995):
    - Image examination
    - Image analysis

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- Interpretation
- Map tessellation

- Data integration in a geographic information system and further analysis, as seen in **Figure 3**, through:
  - Digitizing with a tablet and supported by a CAD program
  - Coding of digital parcel map by means of the editing capabilities of the GIS

- Result verification with a confusion matrix (Chuvieco, 2000) and fieldwork. This method allows a quality control of the process and estimate the level of precision obtained (**Figure 4**).

4.2.2 Remote sensing

Remote sensing is a technique closely linked to GIS and both allow to produce cartography and study the territory with a low cost and in shorter time (Baules, 1997).

Objective: To generate a land use map at levels I and II (form the legend of CORINE), and then compare the results with those from photointerpretation.

Sources: Scenes from Landsat 5 TM, with a spatial resolution of 25 m and a spectral resolution of 6 bands, processing was carried out with ERDAS 8.3.1.

Method: It has been split into four phases:
- Selection and analysis of areas belonging to land use levels I and II, obtained through photointerpretation and cross-tabulated with those form fieldwork in a confusion matrix.
- Definition and evaluation of the training sites.
- Classification.
- Confusion matrix and verification by comparison with those from photointerpretation.

4.2.3 Forest map of Spain

The Forest Map of Spain (FMS) is the most comprehensive information about forest land uses available for the whole country (Villaescusa, Vallejo y de la Cita, 2001).

Objective: Evaluate the FMS suitability as a data source compared with the results obtained by means of other techniques.

Sources: FMS in digital format and land use maps obtained with other data sources.

Methods: the procedure to follow is nearly alike.
- Adaptation of the FMS legend to those used in photointerpretation.
- Analysis of the levels I and II for the whole area of study.
- Confusion matrix and cross-tabulation with results from photointerpretation.

The results for the same level of categorization in photointerpretation are shown in **Figure 5**.

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4.3. Union of parcel and owner databases

Objective: Produce a forest owner census for the area of study.

Source: Parcel and owner databases obtained as a result of processes in 4.1 and land uses in 4.2.

Method: It has been split into two phases:
- Union of parcel and land use databases.
- Selection of owners of forested parcels.

As a result, a Census of forest ownership is obtained with comprehensive information of all parcels, specially of those with forest uses. **Figure 5** is an example for a holder.

4.4. Study of the socio-economic attributes of the forested land owners

Once the Census of forest ownership, land use map and physical attribute of the parcels have been elaborated, the final step is to carry out the socio-economic study.

Objective: To define the socio-economic situation of the forestr land holders.

Source: Field surveys followed by its statistical analysis.

Method: It has been split into six phases:

- Analysis of the census results.
- Stratification of the census of holders based on the forestry production criteria.
- Design and application of a pilot questionnaire.
- Analysis of the results from the pilot questionnaire.
- Design and application of a final questionnaire.
- Analysis of the results of the final questionnaire.

5. RESULTS

- The number of forest owners is 3,031, from among 3,967 rural owners.
- Among the forest owners, 750 have more than 1 Ha of productive forest land, considering this as those forested parcels with eucalyptus and pine. A case of the area belonging to a forest owner is in **Figure 6**.
- Having the productive forest land as a reference, the owners with more than Ha, stratified based on a potential annual harvest, are distributed in four strata, as shown in **Table 1**.
- For a level of confidence of 95%, an error of ±5%- and applying the equation of minimal variance of Neyman, we get a sample number of 68 owners to survey that are distributed in strata as shown in **Table 2**.

At this point, the present work is focused on the design and application of a survey that will allow to understand the socio-economic variables of the forest owners in the study area.

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BIOGRAPHICAL NOTES

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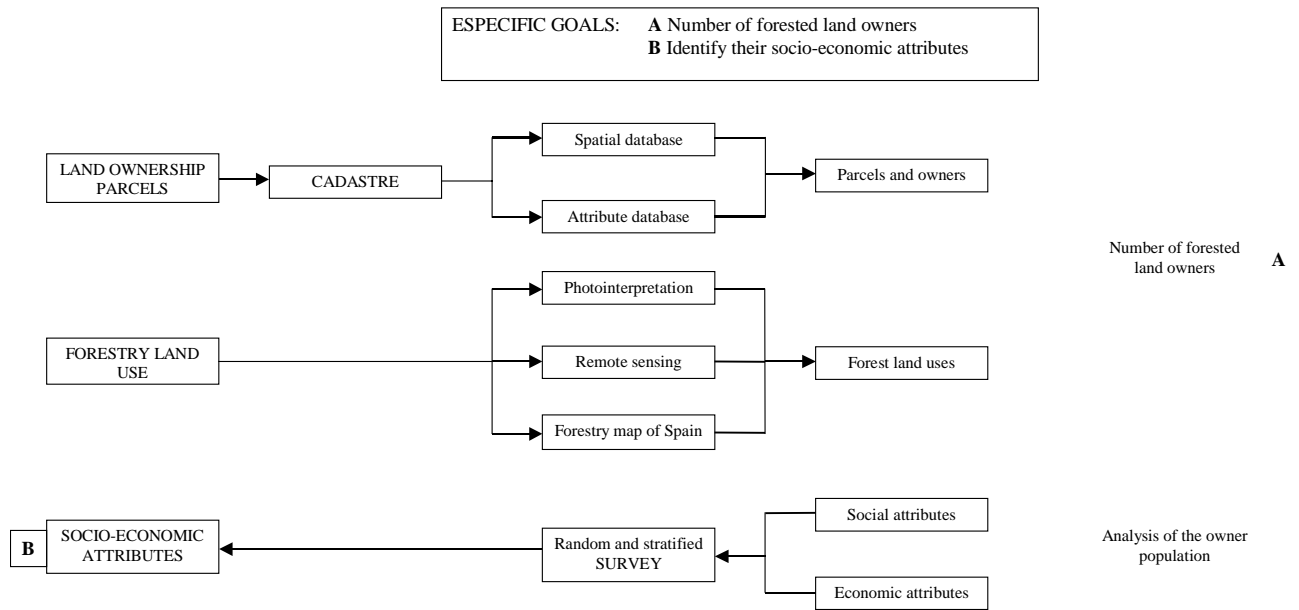
Figure 1. Methodology
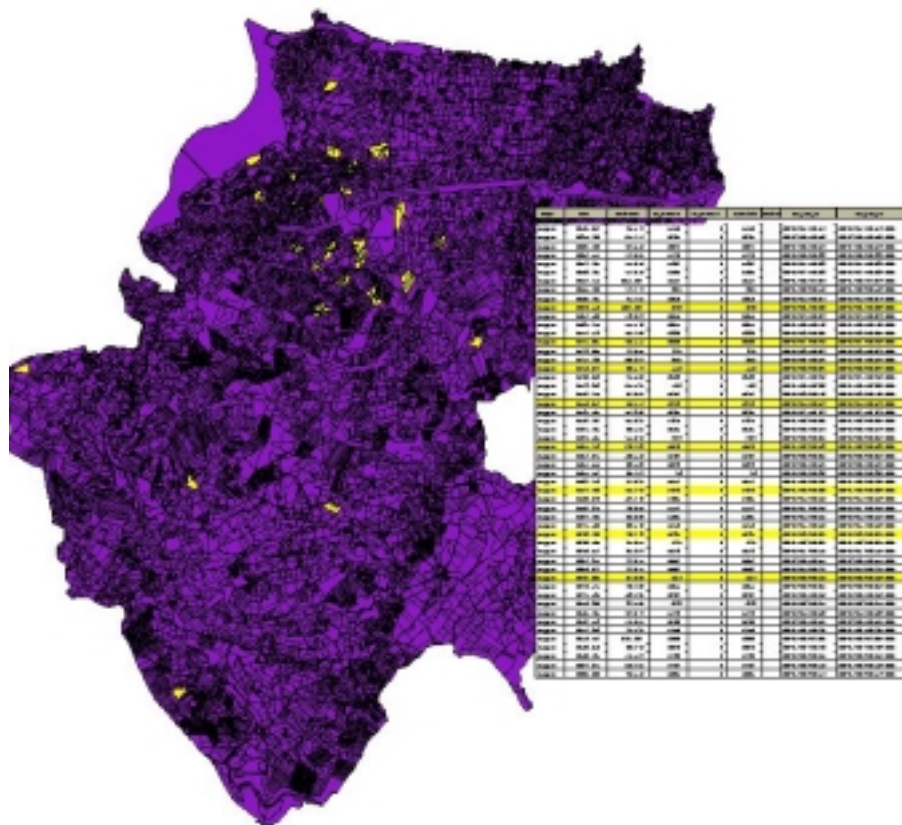
Figure 2. Results from cadastral information

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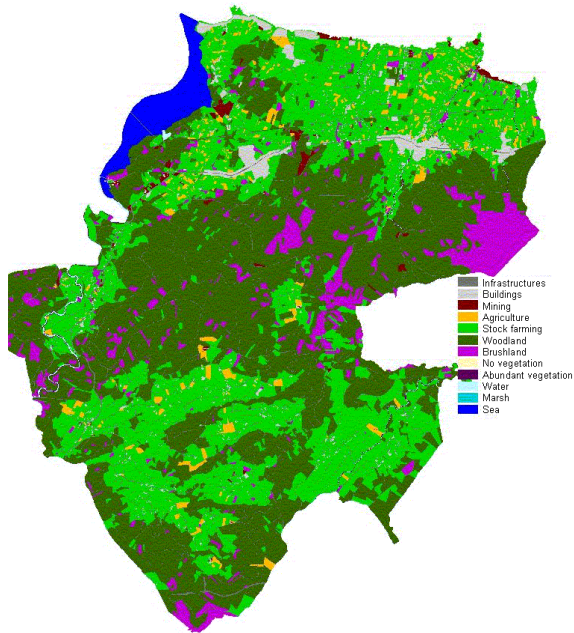
Figure 3. Results from photointerpretation
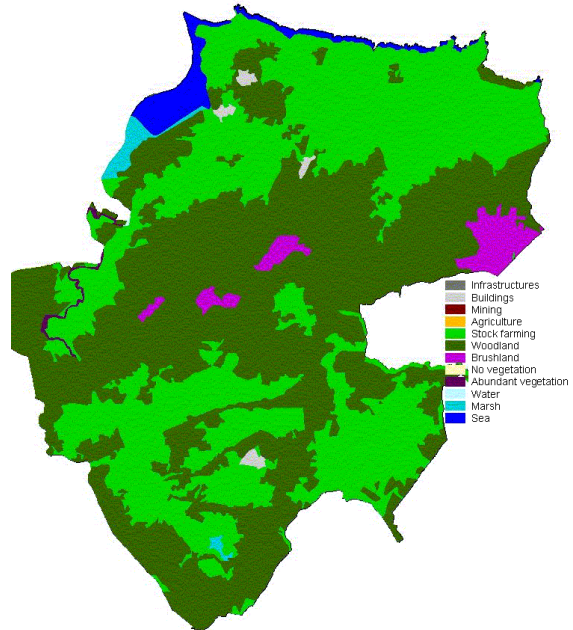
Figure 5. Information from SFM

FOTOINTERPRETATION

	a1	a1a8	a8	ap	c	cts	ed	fr	frma	ft	im	ma	ma1	ma1a8	mteu	pa	pd	ria	rio	rp	vr	Suma	E. Omisión	Riesgo productor %
a1			2																			2	2	100,00
a1a8			2																			2	2	100,00
a8			17										1									18	1	5,60
ap				2																		2	0	
c			1		3																	4	1	25,00
cts						9																9	0	
ed							22															22	0	
fr			1					3							1							5	2	40,00
frma									2													2	0	
ft																						0	0	
im											2											2	0	
ma												5										5	0	
ma1												1	1									2	1	50,00
ma1a8														1	1							1	1	
mteu												1			2							3	1	33,33
pa					1											27	1					29	2	6,90
pd										1							2					3	1	33,30
ria																		1				1	0	
rio																			1			1	0	
rp																				9		9	0	
vr																					1	1	0	
Suma	0	0	23	2	4	9	22	3	2	1	2	7	2	0	4	27	3	1	1	9	1	122	14	
E. Comisión	0	0	6	0	1	0	0	0	0	1	0	2	1	0	2	0	1	0	0	0	0	14		
Riesgo Usuario %			26,09		25,00					100,00		28,57	50,00		50,00		33,30							

Figure 4. Results from the confusion matrix for land uses

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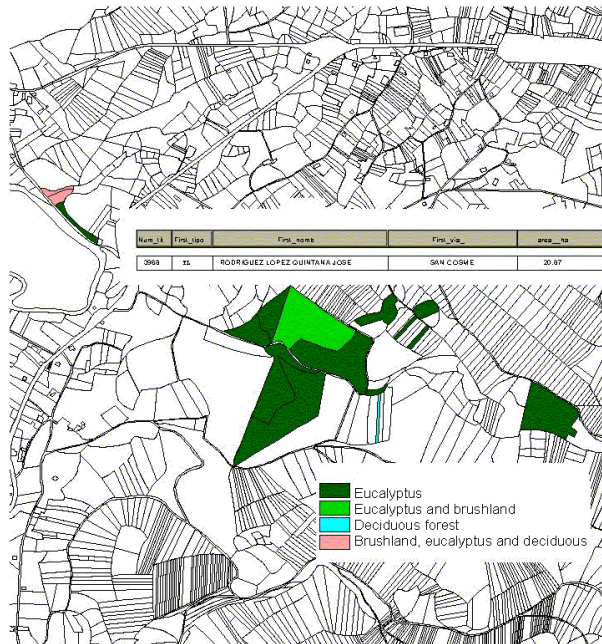
Figure 6. Information for an owner of forested land

STRATA			
1 **1-1.7 ha**	N	Valid	342
		Lost	0
	Mean		1,315
	Std. Dev.		0,193
	Variance		0,037
	Variation Coef.		0,147
2 **1.7-3.5 ha**	N	Valid	259
		Lost	0
	Mean		2,359
	Std. Dev.		0,499
	Variance		0,249
	Variation Coef.		0,212
3 **3.5-7 ha**	N	Valid	114
		Lost	0
	Mean		4,671
	Std. Dev.		0,979
	Variance		0,958
	Variation Coef.		0,210
4 **>7 ha**	N	Valid	35
		Lost	0
	Mean		11,871
	Std. Dev.		6,017
	Variance		36,202
	Variation Coef.		0,507

Table 1. Distribution in strata of the owners of forested land

Level of confidence	Error	k	n	n1	n2	n3	n4
0,95	0,05	1,96	68	9	17	15	27

Table 2 - Distribution in strata of the owners to potentially survey

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