Cultivated, multifunctional and integrated forest landscapes? An overview of the factors influencing forest management in the 'Pontenx' case study (Landes de Gascogne, France)

Arnaud Sergent, Philippe Deuffic, Vincent Banos, B. Hautdidier, M. Maindrault

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Table of contents

Tables

Figures

1 INTRODUCTION

The 'Pontenx' case study area is the landscape selected by Irstea and EFI-Atlantic for their common work in INTEGRAL. Defined by the boundaries of 13 municipalities (or *communes*, *i.e.* LAU2: local administrative units Level 2), it is built around an E-W oriented watershed, covering 102 000 ha. Located in the heart of the 'Landes of Gascony' forest region (or *Massif des Landes de Gascogne*), this area was chosen because it encompassed a diversity of forested landscapes that was representative of this greater forest area. The choice made in this report is that a fair share of the discussed material will relate not only to the 'Pontenx' case study *stricto sensu* but to the whole 'Landes of Gascony', as the latter appears as the most relevant master frame and scale to identify and analyse the social, political and economic processes influencing forest management at the landscape level.

'Landes of Gascony' is a 1.5 Mha forest area of southwestern France, interfacing Northern Europe and the Iberic peninsula. It is bordered by the Atlantic Ocean on the west and the large urban areas of Bordeaux and Bayonne respectively north and south. From an administrative perspective, 'Landes of Gascony' is located in the NUTS-2 region of Aquitaine, intersecting three NUTS-3 regions: Gironde, Landes and Lot-et-Garonne (Figure 2). It is composed of 52 local administrative units Level 1 (LAU1) and 400 LAU2s. While not an administrative region in itself, it is a predominantly wooded area of which identity and coherence are built around three main features: (i) a biophysical unit with podzolic sandy soils and shallow ground water levels; (ii) a dominant forest cover of 66%, compared with agricultural and built-up areas respectively amounting to 18% and 7% of the area in 2009 (Teruti data in (Mora et al., 2012)). Primarily composed of maritime pine (*Pinus pinaster* Aiton), the forest is often described as the largest cultivated and privately owned (92%) forest in Europe. (iii) A significant economic weight throughout a regional forestry-wood chain, based on a large number of SMEs (logging, sawing, furnishing and packaging) co-existing with major international industries (pulp and paper, panel). The specificity of this forest-based sector is that the two processing stages are almost entirely connected to the local wood resource of maritime pine and localized in the same territory.

The 'Landes of Gascony' area is also embedded in a multi-scale of social, political and economic processes which could be studied at three levels (regional, national and European). This is all the more important to take into account that Gascony forest and its related activities are currently facing structural changes and rescaling process. Throughout its history[1], this region has underwent important socio-economic and landscape changes but forestry and its related industries have always adapted with valuating of different products and good derived from pine forest (pine-tapping, softwood, pulpwood and, nowadays, fuelwood and green chemistry). Recent changes suggest a multi-scale regulation that include but also extend well beyond the forest-based sector: storm damages (1999 & 2009), population growth with urbanization and new attractiveness of this region, emergence of energy issues and a more broad-based range of economic activities in rural areas. Along with sector trends, such key drivers lead toward a multiplication of -potentially contradictory- socioeconomic representations and uses regarding the Gascony forest. In this respect, 'Landes of Gascony' appears as a relevant complementary scale to analyse the 'Pontenx' case study and address INTEGRAL research challenges: the competition of diverse demands for multiple forest ecosystem goods and services under changing environmental, economic and social conditions.

[1] If pine forests have a long history in Gascony, the afforestation process was being systematized from a law which in 1857 requesting all municipalities to clean and replant their wetlands. This had led to a sharp increase of the Pine forest area, from about 200,000 ha in 1850 to 750,000 ha in 1875. In 1950, pine forest covered "only" an area of 400,000 ha due to important forest fires (Sargos, 1997).

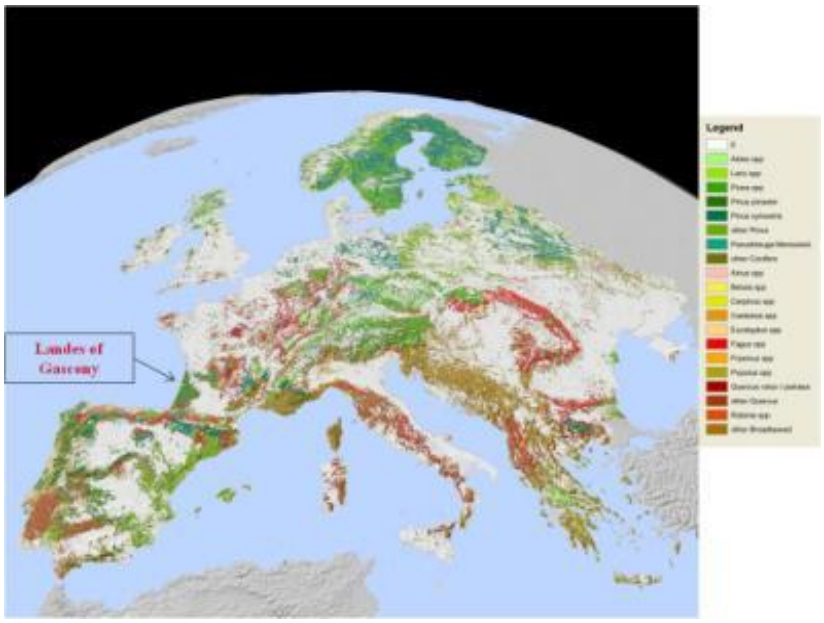


Figure 1: 'Landes of Gascony' in a tree species map of European forests

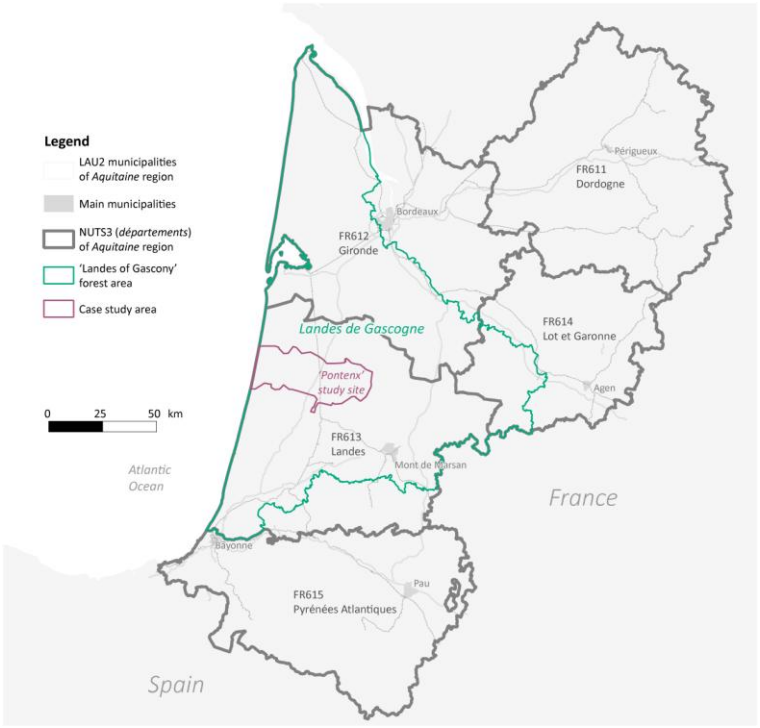


Figure 2: The French case study area in its context
Source : IGN, BD Carto

Table 1: Reference data about INTEGRAL French case study area

	Scale	Names	# of LAU2s	Area (km²)	Forest cover (%)
Case study areas	**INTEGRAL case study area (landscape)**	'Pontenx' case study	13	102	78 %
	Surrounding forest area	'Landes of Gascony'	410	15,000	63 %
	NUTS-3	Gironde	542	10,000	46 %
		Landes	331	9,242	60 %
		Lot-et -Garonne	317	5,361	23 %
	NUTS-2	Aquitaine	2,295	41,289	43 %
	National	France	36,566	543,965	28 %

2 METHODS

In order to make the conceptual framework operational, a set of topic-specific research questions has been implemented by each of the topic teams (see the handbook for the researchers). To answer these questions, three types of data have been used:

- Bibliographic information
- Websites information
- Empirical data coming from a set of interviews with stakeholders and forest owners.

More methodological details are given in chapters dealing with each topic, but we shortly describe here the main methodological stakes of WP 3.1.

2.1Desktop and website research

2.1.1 Desktop research

A large deal of the data collected during the desktop research came from the French national service of statistics (INSEE) and from several regional services in the Aquitaine region (NUTS-2). These services produce online documents as annual reports, assessment reports, and statistical surveys. These documents were useful to show the dynamics of different structural factors (as demography, forest economy, and technological development) on a medium or long term (at least the last 20 years)

However, after the Hurricane Klaus in 2009, several statistics had to be updated following the severe damages due to the windthrow (updates of the amount of forest damages, the volume of marketed or marketable timber, the amount of public subsidies for forest cleaning and re-afforestation…). Thanks to the rapid reaction of the regional forest services, most important forestry data were updated in 2010-2011. When we began our own survey for the Integral project, many documents were already available as the report for the ministry of agriculture dealing with the re-afforestation of the Gascony forest (Laffite and Lerat, 2009) or the experts reports done at a regional level by several scientific and technological institutes (INRA, FCBA, CRPF Aquitaine).

Another important source of data comes from a land-use forecasting study (Mora et al., 2012) that had been carried out in the NUTS-2, and more precisely on the Gascony forest (*Landes de Gascogne*) by the national institute for agricultural research (INRA) during almost three years (2010-2012). Two members of Irstea have participated to this study and a research fellow involved in the study joined our research team to work on the Integral project in 2012.

2.1.2 Web site research

For the data collection, many national and regional state administration web sites have been consulted

- the national service of statistics for the topics demographic developments (*www.insee.fr/*)
- the website of the ministry of agriculture (agriculture.gouv.fr/) , of the regional service of forest and agriculture (*draaf.aquitaine.agriculture.gouv.fr/*) and of the regional center for

private property (www.crpfaquitaine.fr/) for the topics "ownership structure" and "forest policy regime"

- the website of the institute for wood technology, building and furniture (www.fcba.fr/) for the topics 'technological development"

2.2 Forest stakeholders and forest owners' interviews

Concerning the interviews, two guides – one for forest managers and the other for stakeholders – have been implemented as planned in the Handbook for researchers.

The surveys have been carried out between September 2012 and February 2013. 16 forest stakeholders had been interviewed and 26 forest owners and managers.

Table 2: List of interviewees

Stakeholders		**Forest owners or managers**	
Code	Profile	Code	Profile
S01	Politician	F01	Forest advisor
S02	politician	F02	Forest advisor
S03	Politician	F03	Forest advisor
S04	Politician	F04	Forest advisor
S05	Politician	F05	Forest manager
S06	Politician	F06	Forest advisor
S07	Forest administration	F07	Forest advisor
S08	Forest administration	F08	Forest advisor
S09	Forest administration	F09	Forest contractor
S10	R&D	F10	Forest owner
S11	Environmental NGO	F11	Forest owner
S12	Industrialist	F12	Forest owner
S13	Industrialist	F13	Forest owner
S14	Industrialist	F14	Forest owner
S15	Industrialist	F15	Forest owner
S16	Forestry Union	F16	Forest owner
		F17	Forest owner
		F18	Forest owner
		F19	Forest owner
		F20	Farmer/Forest owner
		F21	Farmer/Forest owner
		F22	Forest owner
		F23	Forest owner
		F24	Forest owner
		F26	Forest owner

Unlike quantitative survey, the methodological principles underlying these qualitative surveys were not to ensure a demographically-balanced and representative sample of the forest stakeholders or forest owners' population but its diversity. It is the reason why the choice of the interviewee was guided by two principles:

- We firstly interviewed forest stakeholders whose main field of action was settled at a regional level. These actors had a good overview of the main issues concerning the forestry sector. They also participated into many public debates and often tried to put at the political agenda some strategic issues for their activities;

- We secondly interviewed forest owners at a local scale and some forest advisors. If some of them are in relation with the regional forest stakeholders, a majority are only members of local networks (see the chapter on "actors' networks" and "actors' behaviours"). In order to to be both retrospective and future-oriented, we also used some interviews that had been carried out the year before and after the Hurricane Klaus in 2009. Thanks to this set of interviews, we have been able to analyze which main changes of forestry practices were induced by the normal evolution of innovations and which ones were induced by the storm itself.

In both cases, our qualitative survey consists of semi-structured, tape-recorded and face-to-face interviews. Due to the lack of time, interviews carried out in 2012 were partly retranscribed.

To achieve the typology of forest owners, we mobilized the answers to the different questions that were proposed in the interview guide for forest managers (as described in the handbook for researchers in November 2012). We tested their responsiveness to structural factors (demography, public opinion and discourses, economic development, technological development, ownership structure and tenure arrangements, forest policy regime) and the impact of agent-based factors (social networks, political resources).

Finally, we performed a two-stage content analysis of their discourse (structural and theme analyses). The first part was the structural analysis which consisted of coding, clustering, and labelling individual extracts from interviews into differently themed categories (structural analysis). The second part was the thematic analysis, which involved studying the different opinions expressed by all interviewees on the same topic (a category or a concept labelled in a thematic item). The aim was to reveal the arguments and the system of values used to accept or reject a specific item (opinions on forest policies, on factors influencing forest management… for more details, see the chapter § 5.2).

3 STRUCTURAL FACTORS

3.1 Demographic developments

3.1.1 The total population

'Landes of Gascony' (LG), first regarded as a "desert" in past centuries (Aldhuy, 2006; Sargos, 1997) then as a rural area dedicated to forest and agricultural activities, has progressively become an attractive landscape and living environment for an increasing number of people. In 2009, the estimated population was 840,200, representing almost a 60% increase in forty years (Table 3 & Table 4 below). This growth is not only well above national (26%) and regional (27%) averages, but also is constantly rising: + 8.2% during the period 1990-1999, + 10.5% during the period 1999-2006 (Bergouignan et al., 2011). These demographic trends are based on a combination of three factors: urbanization spread, in particular around Bordeaux and Bayonne, attractiveness of the coast and, nowadays, rural resettlement (Mora et al., 2012).

Table 3: Population of the LG and others areas during the 1968-2009 period

Scale	Areas	1968	1975	1982	1990	1999	2009
Case studies	Pontenx	14,689	15,889	15,957	15,693	15,590	16,321
	LG forest area	534,214	598,313	646,637	706,026	763,264	840,200
NUTS-3	Gironde	1,009,390	1,061,480	1,127,546	1213499	1,287,334	1,396,758
	Landes	277,381	288,323	297,424	311,461	327,334	362,827
	Lot et Garonne	290,592	292,616	298,522	305,989	305,380	329,697
NUTS-2	Aquitaine	2,460,170	2,550,241	2,656,544	2,795,830	2,908,359	3,119,778
National	France	49,723,072	52,600,000	54,335,000	56,577,000	58,496,613	62,465,709

Table 4: Population growth rate in LG and others areas during the 1968-2009 period (%)

Scale	Areas	1968-1975	1975-1982	1982-1990	1990-1999	1999-2009	1968-2009
Case studies	Pontenx	8.17	0.43	-1.65	-0.66	4.69	**11 %**
	LG forest area	12.00	8.08	9.18	8.11	10.08	**57 %**
NUTS-3	Gironde	5.16	6.22	7.62	6.08	8.50	**38 %**
	Landes	3.94	3.16	4.72	5.10	10.84	**31 %**
	Lot et Garonne	0.7	2.02	2.5	-0.2		**13 %**
NUTS-2	Aquitaine	3.66	4.17	5.24	4.02	7.27	**27 %**
National	France	5.79	3.31	4.2	3.36	6.75	**26%**

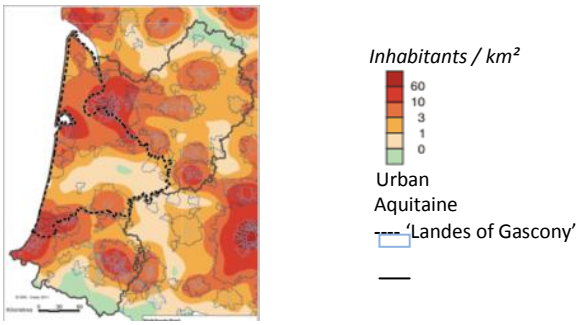
3.1.1.1 Population density

In 2009, the average population density across 'Landes of Gascony' was 58.1 inh./km². This density is far lower than that regional (77.6), national (114) and European (116) averages (Table 5). Moreover, 50% of local administrative units Level 2 (LAU2), *i.e.* local units or municipalities, have a population density less below 30 inh./km². This threshold is used by INSEE, the French statistical institute, to define the category of '*Espaces à faible densité*', *i.e.* rural peripheral area. But, since 1968, average population density has increased of 64%. Furthermore, average density is only a process of grouping small territorial units into larger aggregations. In our case study, this aggregation hides great spatial disparities (Figure 3). For example, urban areas located between Bordeaux and the coast could have population density greater than 150 or 300 inhabitants per km².

Table 5: Average density during the 1968-2009 period (inhabitants per km²)

Scale	Areas	1968	1982	1990	1999	2009
Cases Studies	'Pontenx'	16.8	18.5	18.13	17.99	19.81
	LG forest area	35.6	43.03	46.98	50.79	58.12
NUTS-3	Gironde	101	112.8	121.4	128.7	143.5
	Landes	30	32.18	33.7	35.42	41.04
	Lot et Garonne	54.2	55.68	57.08	56.96	61.5
NUTS-2	Aquitaine	59.6	64.31	67.68	70.41	77.61
National	France	91.4	99.89	104.1	107.6	114.8

Figure 3 : Annual variation of population density in Aquitaine (1999-2008)



Source : (Scarabello, 2011)

3.1.1.2 Rural and urban areas

A. The OECD approach : An (up-to-date) definition

The definition of OECD is based on population density and, until 2009, on a two-step approach: First, local units (*e.g.* municipalities) are identified as rural if their population density is below 150 inhabitants per square kilometre.

Table 6: LAU2 with population density below 150 inh./km² (%)

NUTS	Areas	1968	1990	1999	2009
	LG	94,6	91	90,6	88,4
NUTS-3	Landes	97,3	95,2	95,2	94
	Lot et Garonne	95,3	94,1	93,4	92,2
	Gironde	88	81,08	81,08	77,5

Table 7: Population living in local units with population density below 150 inh./km² (%)

NUTS	Areas	1968	1990	1999	2009
	LG	60,4	48,2	48,6	46,9
NUTS-3	Landes	76,2	66,7	66,3	65,2
	Lot et Garonne	57,4	52,9	54,6	51,7
	Gironde	34,5	28,8	29,1	27,6

Then, NUTS-3 regions are classified in one of the 3 categories:

- Predominantly Rural region (PR) : if more than 50% of the population of the region is living in rural local units (with less than 150 inhabitants / km²)
- Intermediate Region (IR) : if 15% to 50% of the population of the region is living in rural local units
- Predominantly Urban region (PU): if less than 15% of the population of the region is living in rural local units.

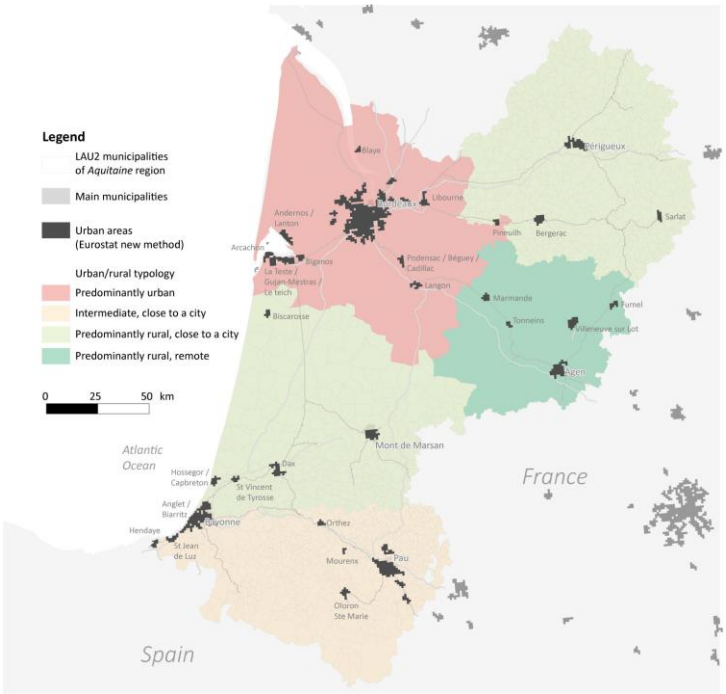
To further refine the typology, this second step considers also the presence of large urban centres:

- If there is an urban centre > 200,000 inhabitants (in EU) representing no less than 25% of the regional population in a 'predominantly rural' region, it is re-classified as 'intermediate'
- If there is an urban centre > 500,000 inhabitants (in EU) representing no less than 25% of the regional population in an 'intermediate' region, it is re-classified as 'predominantly urban'.

Based on this classification, it can be concluded that 'Landes' and 'Lot et Garonne' are 'Predominantly Rural regions' (NUTS-3). 'Gironde' would be classified as an 'Intermediate Region' (IR) but is re-classified as 'predominantly urban' because Bordeaux is an urban centre around one million inhabitants representing more than 70 % of the regional population.

According to Eurostat and DG Regio recent methods, urban/rural typologies are now defined on the basis of gridded maps of population density (we used the national INSEE RFL2009 survey instead of the older Europe-wide population density map from EEA). Urban areas are equated with continuous patches of 1-km² pixels with a population above 300, reaching a total of 5000 inhabitants. NUTS-3 regions can then be qualified according to the proportion of their population residing in 'rural' grid cells: 'predominantly rural' if above 50%, 'intermediate' if between 20 % and 50 %, predominantly urban if less than 20 %. A 'remoteness' criterion has been recently proposed as well: a region should be qualified as remote if less than half of its residents can drive to the centre of a city of at least 50 000 inhabitants within 45 minutes (Dijkstra and Poelman, 2011). The 'Gironde' NUTS-3 region (*département*), with the presence of Bordeaux, is qualified as 'predominantly urban'. The urban areas of Bayonne/Anglet/Biarritz & Pau lead 'Pyrénées Atlantiques' to be defined as 'intermediate'. The three other *départements* of Aquitaine are 'predominantly rural'. But interestingly, only 'Lot et Garonne' is also qualified as 'remote'. The 'Landes' *département* has indeed one the lowest population densities of metropolitan France, but an accessibility by road (and rail) allowing a strong influence of the largest regional urban areas (Bordeaux and Bayonne, but also the Arcachon bay, Mont-de Marsan and Dax).

Figure 4 : Regional typology overview



Source: Hautdidier, 2013

B. National approach : INSEE definition

Rural areas are defined by INSEE, the French statistical institute, in contrast with urbanized areas, themselves equated with the concept of *unités urbaines* (urban unit): one or several *communes* covered by a continuously built-up area, with no distance between habitations greater than 200 meters, and a total population above 2,000 inhabitants. A *commune* is defined as 'urban' if more than 50% of its population is covered by the built-up area. If not, it is a 'rural' local unit[2].

Table 8: Percentages of "rural" local units (2010)

Scale	Name of the areas	%
Cases studies	'Pontenx'	84
	LG	81
NUTS-3	Landes	84
	Lot et Garonne	82
	Gironde	66
NUTS-2	Aquitaine	82
National	France	79

Table 9: Population living in "rural" local units (%)

Scale	Name areas	1990	1999	2009
Cases studies	'Pontenx'	/	/	44
	LG	/	/	32.5
NUTS-3	Landes	45.2	42.1	40.2
	Lot et Garonne	40.2	38.4	36
	Gironde	23	19	16.8
NUTS-2	Aquitaine	35.1	29.3	27
National	France	27	24.5	22.5

In 2010, rural areas still covers 81% of the French territory and 79%[3] of LAU2 are rural municipalities. These percentages are even more significant in Aquitaine. Countryside make up over 88% of this region and 82%[4] of LAU2 in Aquitaine are rural municipalities (Table 8). But, the percentage of population living in these rural local units is relatively low compared with the size of rural areas: 22.5% in France, 27% in Aquitaine. Moreover, these proportions are decreasing steadily (Table 9). That does not mean that rural exodus continues but rather that rural municipalities are absorbed by the expansion of urban areas. For example, in France, 1368 rural local units turned into urban unit during the period 1999-2009; while only 100 Local units became rural LAU2s (Clanché and Rascol, 2011). In Aquitaine, during the same period, 105 rural local units turned into urban units; while only 6 LAU2s became rural (Bernard, 2011). In 'Landes of Gascony', almost a quarter of urban units have emerged during the period 1999-2009. These dynamic suggest the decisive importance of the challenges linked to urbanization; including for a low density area as our case study.

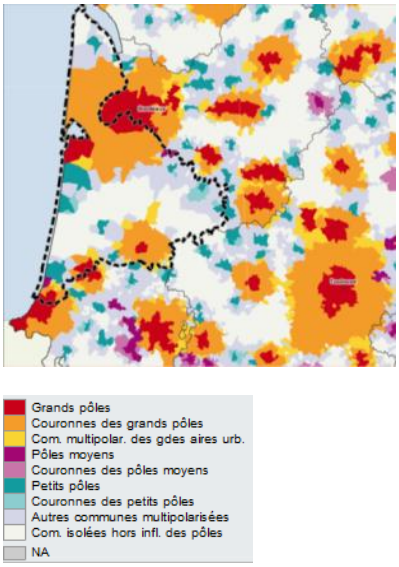
3.1.1.3 Other functional zonings

To take into account the dynamics of periurbanisation, approaches of urban/rural processes centered on employment and services were progressively introduced. The latest version—*Zonage en Aires Urbaines* (ZAU 2010), a joint product of INSEE, INRA and DATAR—was issued in 2010

The 'large urban pole' (*grand pôle urbain*), the first component of this analytical classification, is defined as an urban unit providing at least 10 000 jobs. The 'large urban area' (*grande aire urbaine*) is built in an iterative way around urban poles, by including all communes, rural or not, whose 40% of potential workers have jobs in the urban area. The 'space under influence of large urban area' (*e.g metropolitan area)* is the aggregation of 'large urban areas' and 'multipolarized communes' (whose at least 40% of workers are attracted to *several* large urban areas).

[2] http://www.insee.fr/fr/methodes/default.asp?page=definitions/unite-urbaine.htm
[3] In France, there are 36 570 LAU2 and 7 700 of them are classed as urban units.
[4] In Aquitaine, there are 2296 LAU2 and 498 of them are classed as urban units.

Figure 5: ZAU 2010



----- 'Landes of Gascony'

Source: Scarabello, 2011

Table 10: Distribution of local units in accordance with ZAU 2010 typology (%)

		LG	Aquitaine	France
"Metropolitan areas"	*Grands pôles*	8.4	10.6	8.9
	Couronnes	31.1	24.6	33.5
	Communes multi polarisées	3.6	5.9	10.8
	Total	**43.1**	**41.1**	**53.2**
"Middle urban Areas"	*Pôles moyens*	1.2	1.4	1.2
	Couronnes des pôles moyens	0	1.6	2.2
	Total	**1.2**	**3**	**3.4**
"Small urban areas"	*Petits pôles*	4.6	4.8	2.4
	Couronnes des petits pôles	3.1	1.6	1.6
	Total	**7.7**	**6.4**	**4**
"Others areas" (*Rural*)	*Autres communes multi polarisées*	26.5	24.1	19.2
	Communes isolées	21.4	25.5	20.2
	Total	**47.9**	**49.6**	**39.4**

ZAU 2010 also distinguishes:

- 'Middle urban area' (*moyenne aire urbaine*) that is built in an iterative way around "middle poles" (between 5,000 and 10,000 jobs), by including all communes, rural or not, whose 40% of potential workers have jobs in the urban area.
- 'Small urban area' (*petite aire urbaine*) that is built in an iterative way around "small poles" (between 1,500 and 5,000 jobs), by including all communes, rural or not, whose 40% of potential workers have jobs in the urban area

ZAU 2010 Typology is a statistical classification but it helps us to enhance the understanding of urban dynamics in our case study (Figure 5). 'Landes of Gascony' and Aquitaine (NUTS-2) have almost the same urban structure: 'metropolitan areas' are important, but less than at the national scale, while 'small urban areas' and 'others areas' are more significant than in France. So, if 'Landes of Gascony' remains a predominantly rural area, more than a half of its local units are actually under urban influence (Table 10). 'Metropolitan areas' of Bordeaux, in the north, and Bayonne, in the South, are the two main drivers of these urban dynamics. Currently, Bordeaux area has a population of around one million and Bayonne became the second most populated urban areas in Aquitaine (250 000 inhabitants).

3.1.1.4 Key factors and spatial distributions of the population growth

Currently, the increase of population in France is mainly natural, whereas migration is the key factor of the population growth in Aquitaine and, even more, in 'Landes of Gascony' (Table 11). In our case study, the annual natural growth rate (births less deaths) fell steadily at least since the seventies: 0.3% during the period 1968-1975 (0.6 % in France); 0.1% during the period 1999-2006 (0.4 % in France). If this indicator stays still positive, it is solely due to the expansion and the influence of the large urban area of Bordeaux (Figure 6). Conversely, annual population growth brought by migration has a rate of faster than 1% per year during the period 1999-2006 (0.3 % in France). It is almost exactly the same as it was between 1968 and 1975 but its spatial distribution is different (Figure 7).

Table 11: Average annual population growth rate during the period 1968-2006 (%)

Scale	Areas	Average annual population growth rate	1968-1975	1982-1990	1990-1999	1999-2006
Forest area	Landes of Gascony	Natural	0.3	0 .1	0.05	0.1
		Migrations	1.3	1	0.8	1.3
		Total	**1.6**	**1.1**	**0.9**	**1.4**
NUTS-2	Aquitaine	Natural	0.2	0.05	0.01	0.07
		Migrations	0.3	0.6	0.4	0.9
		Total	**0.5**	**0.6**	**0.4**	**1**
National	France	Natural	0.6	0.4	0.4	0.4
		Migrations	0.2	0.1	0.01	0.3
		Total	**0.8**	**0.5**	**0.4**	**0.7**

Source : (Bergouignan et al., 2011)

Figure 6: Average annual natural growth rate in LG

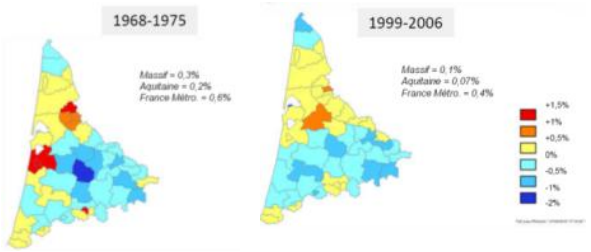
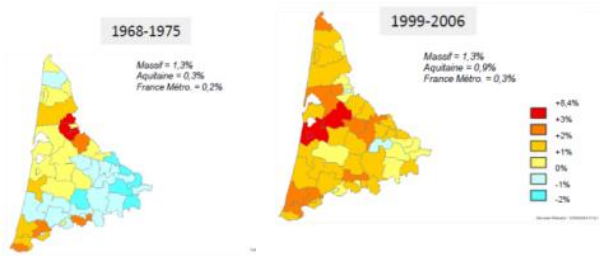


Figure 7: Average annual net migration in LG



Source : (Bergouignan et al., 2011)

Periurbanisation :

During the period 1968-1975, population of the LG forest area has grown at an annual rate twice that of the population in France: 1.7% vs 0.8% (Table 11). At this time, periurbanisation was the key factor of the population growth (Besserie, 2007). Indeed, in the early 1970s, migrations have particularly concerned rural local units located near growing urban areas (Figure 7). Like in many others regions, the need to acquire more spacious housing and offices, the affordable land prices in the outskirts, the widespread use of private car and road facilities but also the social demand for a living environment closer to the nature scatter of both employment and property ownership towards periurban areas located further and further to urban poles. Urban sprawl was (and still is) especially strong around Bordeaux, in the north of LG, but also Bayonne and Mont de Marsan, in the south of our case study. Presently, these urban dynamics are ongoing but they are not the only factors to be considered.

Attractiveness of the coast:

Attractiveness of the coast is not a new phenomenon. But, we can consider that, in the in the early 1970s, it was especially linked to the expansion of urban area (Figure 7). Obviously, these interactions between attractiveness of the coast and periurbanisation are ongoing and are essential to understand the challenges of urbanization in 'Landes of Gascony'. These dynamics explain the scale and the speed of urban spread surrounding Bordeaux and how Bayonne became the second most populated urban areas in Aquitaine (Bernard, 2011). However, whole of the Aquitaine coastline is nowadays concerned by the influx of newcomers and, moreover, these areas have the most important net gain from migration today. In Aquitaine, seven local units, with more 5 000 inhabitants, have a population growth above 20% during the period 1999-2006. These small poles are all located on the coastline (Breuil, 2009).

Rural resettlement:

In France, whereas urban[5] population has risen by 4.6% between 1999 and 2007, rural population grows by 9% during the same period (Clanché and Rascol, 2011). This process of rural resettlement is also observable in 'Landes of Gascony'. Today, almost all the rural LAU1 have a positive net migration whereas many of these rural local units had a negative net migration during the period 1968-1975 (Figure 7). It is a significant shift for a low density area which was faced with the challenge of rural exodus until 1970s. Like at the national scale, this process can be explained primarily by the longer distance between homes and workplaces. In 'Landes of Gascony', 55.2% of the inhabitants live in one Local administrative unit level 1 (LAU1) and work in another, compared with 54.7% in Aquitaine and 56.8% in France (Talbot, 2001). But, more fundamentally, the key factor of the rural resettlement is a reversal in the values and representations associated with rurality. While not so long ago, rural areas and values could be seen negatively and as an obstacle to the local development, countryside becomes nowadays synonymous of nature, cultural heritages, pleasant landscape, living environment and rurality are meaningful values providing future prospects (Mora, 2008; Mormont, 2009).

3.1.1.5 Social changes in the total population

Population growth produces social reconfigurations, since 2/3 of new permanents residents come from outside 'Landes of Gascony'. As at national and regional scales, ratio of farmers and workers (factory, construction…) in the labour force fell steadily at least since the seventies and percentage people aged over 65 are increasing. But, the spatial distribution of these dynamics is not homogeneous. Pensioners are over-represented in coastal and rural areas, while percentage of highly qualified workers is increasing in urban and sub-urban areas. Moreover, more than a half of dwellings in coastal areas are actually second homes or cottages (Bergouignan et al., 2011).

A. Age group and aging index

The significant decrease of the share of persons under 18 since 1970s result of the ageing of population in 'Landes of Gascony' as at the national and regional scales (Table 12). Currently, people aged over 50 account for 38.5% in the total population (38.4% in Aquitaine; 34.7% in France), whereas they represented 30.7% in 1968 (30.4% in Aquitaine; 27.8% in France). Demographic ageing, which refers to an increase in the relative weight of the elderly in the total population, seems more pronounced in Aquitaine and in 'Landes of Gascony' as in France. This is confirmed by the ageing index, defined by the INSEE as the ratio of the number of persons aged 65 and over, to the number of persons under 20, expressed per 100. This ageing index reaches 83 in the LG and 86 in Aquitaine, compared with only 67 at the national scale. An ageing index around 100 indicates that persons aged 65 and over and people aged under 20 are present in the same ratio. More the index is high more the result is favourable to the elderly.

Table 12: Population by age group in 1968 and 2006 (%)

Scale	Areas	0-17		18-24		25-34		35-49		50-64		+ 65	
		1968	2006	1968	2006	1968	2006	1968	2006	1968	2006	1968	2006
Forest area	Landes of Gascony	29	20.9	9.9	7.5	11	11.3	19.4	21.8	16.2	19.7	14.5	18.8
NUTS-2	Aquitaine	28.4	20.3	10	8.2	11	11.9	19.2	21.2	16.7	19.1	14.7	19.3
National	France	30.2	22.2	10.6	9	12.2	13	19.2	21.1	15.2	18.1	12.6	16.6

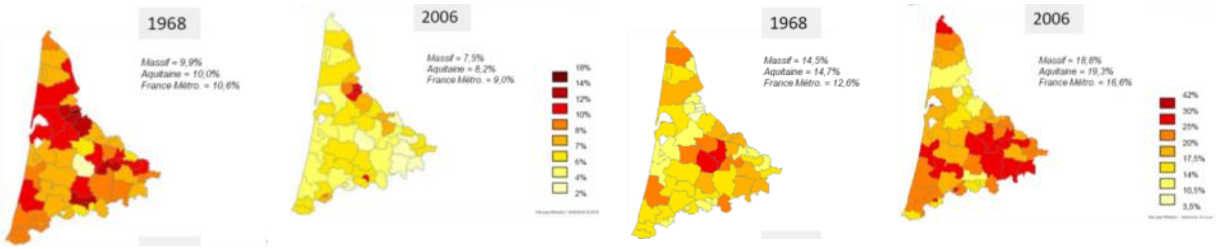
Source : Bergouignan et al, 2011

[5] INSEE classification

Peoples aged over 65, which were especially present in countryside in 1968, stay today the main age group of these areas but are also over-representing in the coastal areas (Figure 9). The age group 18 to 24 is currently concentrated near the urban poles, whereas it was rather scattered in areas where families lived in 1968 (Figure 8).

Figure 8: Age group 18 to 24 in 1968 and 2006 (%)

Figure 9: People over 65 in 1968 and 2006 (%)



Source : (Bergouignan et al., 2011)

B. Social groups and occupations

France remains affected by a significant decrease in the number of active farmers, even if the rate of this decrease seems currently to be slowing down. Currently, farmers account for 1.8% in the French workforce, whereas they accounted for 9.8% in 1968 (Table 13). The ratio is almost the same in 'Landes of Gascony'. The percentage of workers also declined, even if this professional group remains the most important in our case study. This relative decrease of workers, compared to the national scale, may be linked inter alia to the persistence of food processing and wood-industries in 'Landes of Gascony'. But, as at the national and regional scales, this area has witnessed an effective increase of skilled professional groups like employees or managers (Table 13). The activity rate of women in Aquitaine, which is traditionally weaker than in France, has also risen: 46.3% in 1990; 67.8% in 2008. Even so, it was much lower than the activity rate of men: 75%. Half of Aquitaine women are employees (Nadeau, 2012).

Table 13: Occupational distribution of the workforce in 1968 and 2009 (%)

Scale	Areas	Farmers		Workers		Employees & intermediate professions		Managerial & intellectual occupations	
		1968	2006	1968	2006	1968	2006	1968	2006
Forest area	Landes of Gascony	10.1	2.1	26.5	22.4	7.6	21.6	3.9	9.8
NUTS-2	Aquitaine	15.1	2.7	26.4	20.7	8.4	21.4	4.2	11.1
National	France	9.8	1.8	29.5	20.9	10.9	21.7	5.2	13.7

Figure 10: Share of farmers in the workforce (1968 / 2006)

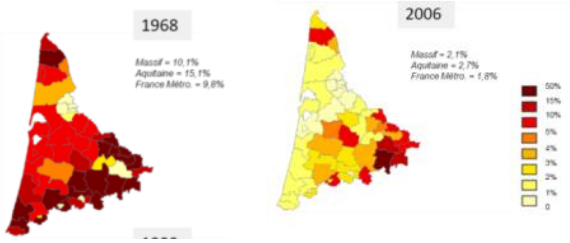
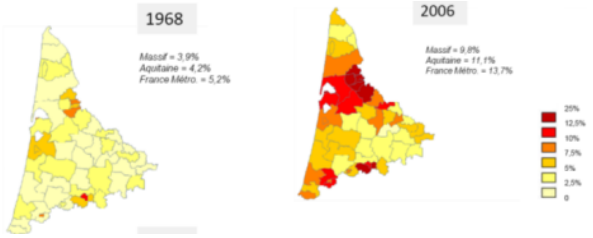


Figure 11: Share of managers in the workforce (1968 / 2006)



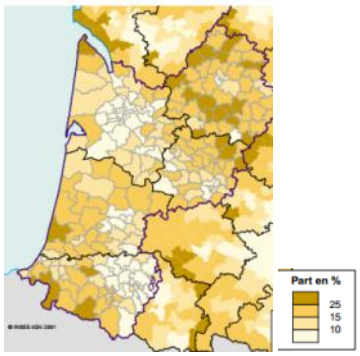
Source: (Bergouignan et al., 2011)

The spatial distribution of these social and professional groups is not homogenous. For example, the ratio of farmers in the workforce remains important only in the center and the East of our case study, *i.e.* predominantly rural areas, whereas the ratio of managers in the workforce becomes significant in the sub-urban and the coastal areas (Figure 10 and 11). Linked to the ageing population but also the attractiveness of Aquitaine, the ratio of pensioners is increasing faster in these areas than in France. In the early 2000s, pensioners accounted for almost 25% in the population of this region and this ratio is still rising. During the period 1990-1999, new incomers account for 58% of the new pensioners in 1999 (Chatel, 2001).

Table 14: Percentage of pensioners in the total population (1990, 1999)

Scale	Areas	Pensioners	
		1990	1999
Forest area	Landes of Gascony	18.3	24.7
NUTS-2	Aquitaine	19.3	25.3
National	France	16.3	22.12

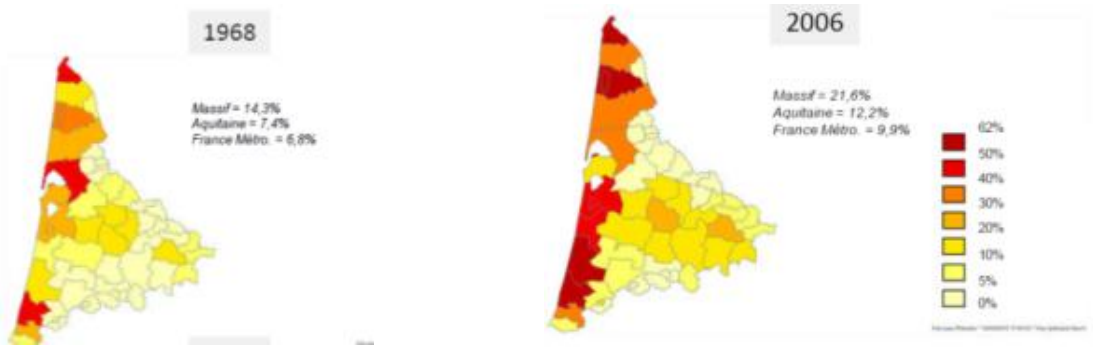
Figure 12: Percentage of pensioners in new incomers (1999)



C. *Permanents residents / "present" population*

One key implication of attractiveness and mobility, especially for tourism and leisure, is that the people who are temporally present on a territory have nowadays an increasingly important role to play in the local development. In 2006, second homes or cottages account for 21.7% of the dwellings in 'Landes of Gascony' (12.2% in Aquitaine; 9.9% in France), whereas they accounted only for 14.3% in 1968 (7.4% in Aquitaine; 6.8% in France). Although this percentage begins to diminish with the population growth, it reaches more than 50% on the coastal areas (Figure 13).

Figure 13: Share of second homes in 1968 and 2006 (%)



Source : (Bergouignan et al., 2011)

More generally, the distinction between permanent residents, *i.e.* people who live in the territory, and the "present" population, *i.e.* people who are in the territory at a given time, becomes very important to understand income flows, especially from tourism and leisure (Terrier, 2009). It is even more significant in the cases of attractive areas. Indeed, during the summer, the maximum "present" population in the Landes is more than double that the number of permanent residents (Table 15)

Table 15: Permanent residents and 'present' population in three territories

NUTS-3	Permanent residents	Average 'present' population	Maximum 'present' population
Gironde	1,331,000	1,338,000	1,478,000
Landes	341,000	368,000	698,000
Lot et Garonne	310,000	310,000	338,000

Source : (Terrier et al., 2005)

3.1.2 Demographic development: forest owners

There are still too few studies about forest owners in France and when the statistical data exist, they are often scattered in different collection methods and different calculation modes. For example, the first National census about forestry and ownership structure (1976-1983) takes into account all the forest owners (Cavalier, 1987) but the second National survey (1999-2000) is only based on forest owners who have more than one hectare (Agreste, 2002). Moreover, a recent regional survey about ownership structure in 'Landes of Gascony' takes into account only the forest owners who have at least four hectares (Garnier et al., 2012). All of this limited the availability of long time series and required to refer to specific and timely data (CRPF Aquitaine, 2005; Deuffic et al., 2010; Poissonnet et al., 2007) and stakeholder's survey. Give the overwhelming part of the privately owned in French forests (75%) and even more in 'Landes of Gascony' (92%), this section will focus on the private forest owners.

3.1.2.1 Average size and legal nature of ownerships

A. Average size of private properties

The Landes forest is shared among some 58 000 forest owners. The average owned area is 13.9 ha (compared with 3 ha in France and 7.7 ha in Aquitaine) and even 27 ha if we consider only forest holding at least one hectare (compared with 8.8 ha and 13.3 at the regional and national scales). So, despite the homogenous appearance of the pine forest, the structure of property is typified by high disparities in 'Landes of Gascony'. If 50% of the forest owners have less than 1 hectare, they hold only 1.2% of the private forest area (Table 16). Moreover, of the 29,000 forest owners who have at

least one hectare, 18,000 hold between one and ten hectares. About 1,600 forest owners, who have at least one hundred hectares, share 58% of the private forest estate. For one hundred fifty forest owners, the surface of the property is larger than five hundred hectares. These forest owners hold more than a quarter of the private forest in 'Landes of Gascony' (Deuffic et al., 2010).

Table 16: Surfaces and numbers of forest owners in the 'Landes of Gascony' forest area (2006)

	Areas		Forest owners	
	Hectares	**Percentage**	**Numbers**	**Percentage**
0 to 1 ha	9,698	1.2	29,141	49.9
1 to 4 ha	26,559	3.3	12,594	21.5
4 to 10 ha	41,445	5.1	6,435	11.0
10 to 25 ha	75,333	9.3	4,745	8.1
25 to 50 ha	84,307	10.4	2,386	4.1
50 to 100 ha	109,041	13.4	1,544	2.6
100 to 500 ha	288,043	35.5	1,446	2.5
500 to 1000 ha	81,497	10.0	119	0.2
More than 1,000 ha	96,300	11.9	39	0.1
Total	**812,223**	**100**	**58,449**	**100**

Source : (Drouineau and Borios, 2006)

At the scale of the 'Pontenx' case study, the average owned area is 31 ha and even 53 ha if we only consider the forest owners who have more than one hectare. If, about 60% of the forest owners have less than four hectares, they hold only 1.5% of the forest area (Table 17). Less than 6% of the forest owners, who have more than one hundred hectares, share some 70% of this area.

Table 17: Areas and numbers of forest owners in the 'Pontenx' case study area

	Areas		Forest owners	
	Hectares	**Percentage**	**Numbers**	**Percentage**
0 to 1 ha	271	0.4	881	40.8
1 to 4 ha	751	1.1	354	16.4
4 to 10 ha	733	1.1	263	12.2
10 to 25 ha	4085	6.0	254	11.8
25 to 100 ha	14,071	20.8	279	12.9
100 to 500 ha	22,588	33.3	115	5.3
More than 500	25,283	37.3	11	0.5
Total	67,782	**100**	2,157	**100**

Source: (Poissonnet et al., 2007)

At the national scale, 83% of the forest owners have between 1 to 10 hectares, amounting to 30% of the private forest area. In the 'Landes of Gascony' forest area, these ratios fall to 65% and 8.5%; and even 48% and 2% at the scale of the 'Pontenx' case study. Conversely, forest ownerships of more than 100 ha amounts only to 25% of the private forest at the national scale but 58 % in 'Landes of Gascony' and even 71% at the scale of the 'Pontenx' case study.

Table 18: Ratio of areas and owners for forest properties over one hectare (%)

	1 to 10 ha		10 to 25 ha		25 to 100 ha		More than 100 ha	
	N	**A**	**N**	**A**	**N**	**A**	**N**	**A**
France (1999)	83%	30%	11%	18%	5%	27%	1%	25%
Aquitaine (1999)	75%	19%	16%	18%	7%	24%	2%	39%
LG Forest area (2006)	65%	8.5%	16.5%	9.5%	13%	24%	5.5%	58%
'Pontenx' (2006)	48%	2%	20%	6%	22 %	21%	10%	71%

N: Numbers; A: Areas

Forest owners' incomes depend on various factors, among which the surface of the property ranks first. In fact, it is widely agreed that to be able to make a living with their property, Landes owners should belong at least 300 to 500 hectares (Deuffic et al., 2010). For most of them, forest is not the main income but rather a family inheritage, a capital tie up and, potentially, an additional income. Indeed, if for 90% of the Landes owners, wood production is the primary objective of the forest management, they are less than 10% among those who have between four and ten hectares to consider that incomes from sale of wood are significant (Garnier et al., 2012). Moreover, for 90 % of the Landes owners who have less than twenty five hectares, forest accounts for less than one quarter of their income. It is a little bit different for the owners who have between 100 and 500 ha. Among the latter, one in ten considers that forest ownership provides one-half of their income. Forest taxation system could be also interesting and attractive, especially for the largest owners and legal persons. Forest owned is an investment which helps to reduce, for example, the income tax. But, in the end, 75 % of the Landes owners seem to think that forest costs more than they actually gross (Garnier et al., 2012).

B. Legal nature of privately owned forests

In early 2000s, 96 % of the French private forest owners, which have more than one hectare, are natural persons and have 82 % of the forest area. These ratios are to 97 % and 87.3 % in Aquitaine, The average size of an ownership held by a legal person in this region is 55 ha, compared to only 12 ha for a natural person. These figures are higher than average sizes in France (Table 19).

Table 19: Legal nature of privately owned forests

		Natural person			Legal person[6]		
		N	A	Average Size	N	A	Average size
National census on ownership at least 1 ha (1999)	Aquitaine	97 %	87.3	12 ha	3 %	12.7	55 ha
	France	96 %	82 %	7.5 ha	4 %	18	43 ha
Regional Survey on ownership at least 4 ha (2012)	LG forest area	92 %	76 %	38 ha	8 %	24 %	260 ha

N: Numbers; A: Areas

In 'Landes of Gascony', 92 % of the forest owners are natural persons and have 76 % of the private forest. The average size of an ownership held by a legal person in this area is 260 ha, compared to 38 ha for a natural person (Table 19). But, these data derive from a regional survey conducted only on the ownerships over four hectares. So, these results do not challenge that forest ownership is traditionally a private family matter in this area; even if it is also a more and more attractive

[6] Legal person could be companies interested in finding and evaluating promising investment projects but also a forest community established by forest owners who want to avoid the fragmentation of ownership.

investment for legal persons. Indeed, two societies on five have been set up for less than ten years (Garnier et al., 2012). At the scale of the 'Pontenx' case study area, 30 % of the private forest is actually held by legal persons (Poissonnet et al., 2007).

3.1.2.2 Socio-demographic information: age, gender and occupation

There is very little socio-demographic information about forest owners (natural persons) in France and even fewer at the scales of the INTEGRAL case study area (i.e. Pontenx but also for the whole 'Landes of Gascony' forest area). However, some ideas could be given. First, at the national scale, the average age of forest owners is increasing since 59 % of them are aged more than 60; they were only 41 % twenty years ago (Agreste, 2002). At the regional scale, 64 % of the forest owners are aged more than 60 and they hold 67 % of the private forest (Table 20). By comparison, this age group represents only 22 % of the national population and 25 % of the regional population. In 'Landes of Gascony', the ageing of forest owners seems more sensitive since near half of forest owners are more than 70 y.o. and only 3 % of them have less than forty years. Average age to become forest owners is 43, generally through inheritance or gift (Garnier et al., 2012). Finally, at the scale of the 'Pontenx' case study, the average age of forest owners (natural persons but also legal persons) is 62 and 60 % of them are aged more 50 (Poissonnet et al., 2007). The ageing of forest owners is matter of concern which has been particular mentioned during the interviews by many stakeholders, forest experts and managers but also representatives from industries, cooperatives, devolved State services and regional authorities.

Table 20: Areas and numbers of forest owners by age group (%)

Scale	Areas	30 to 39		40 to 49		50 to 59		60 to 69		70 to 79		80 and more	
		N	S	N	S	N	S	N	S	N	S	N	S
NUTS-2	**Aquitaine**	1	2	18	14	16	16	38	32	20	27	6	8
	France	5	5	16	14	19	20	27	28	24	24	8	9

N: Numbers; S: Surfaces
Sources: Agreste, 2002

Then, at national scale, three forest owners out of ten are women. They hold areas closer to those of men. These ratios are almost the same in Aquitaine and this figure has not changed significantly over the past 30 years (Agreste, 2002). Among matrimonial communities, forest management is made by man in nine out of ten cases.

Finally, at national scale, 57 % of the forest owners, who have more than one hectare, are pensioners and 60 % at the regional scale. In both cases, they hold more than a half of the private forest. The percentage of pensioners among forest owners has risen steeply since twenty years (Agreste, 2002). Farmers are the second largest group, in numbers (12%) and surfaces (13%), but they have fallen steadily since thirty years. Currently, they are catching up by the groups of employees and this of managers both at the national and regional scales. Forest owners who belong to the forest based sector are still few (between 1% and 2%) but the average size of their ownerships is often the most important. Finally, worker account for 2% of the forest owner at the national scale but there is no worker among forest owners at the regional scale (Agreste, 2002).

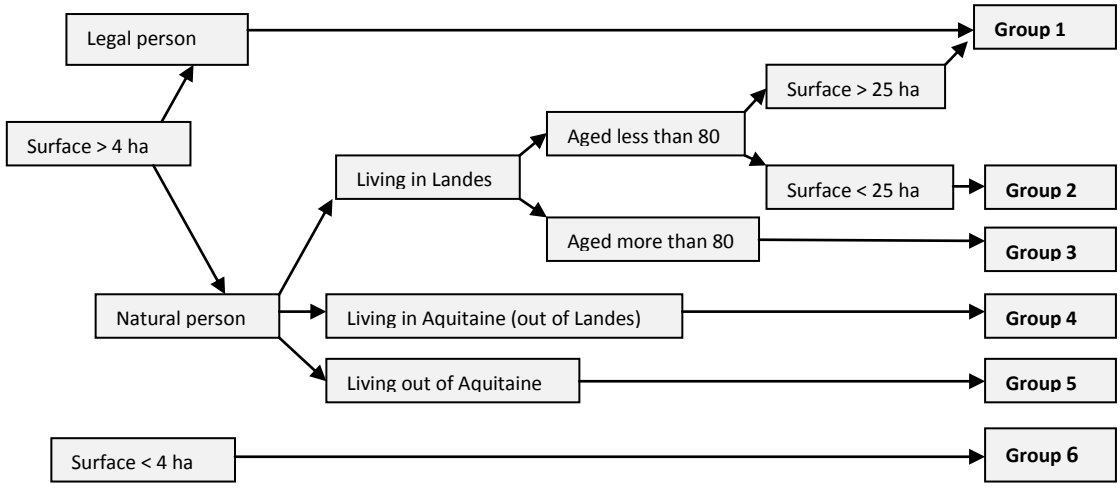
3.1.2.3 Nationality and place of residence

At the national scale, 99% of the forest owners are French citizens. Almost all of the 1 % remaining is citizen of one of the European Community Member States and hold only 0.8% of the French forest area. Third-country citizens are very few (0.1 %) but the average size of their ownership is around 39 ha. A half of these forest owners are legal persons.

At the national scale, forest owners live mainly in rural areas since 63% of them live in local units less than 2,000 inhabitants (Agreste, 2002). Forest owners who live in the Paris region are few (3 %) but hold some 10% of the forest area. However forest owners live close to their forests. The situation is about the same at regional scale and in 'Landes of Gascony'. Four out of five owners live in the same NUTS-3 region ("*département*") as their forests. However, most regional and local stakeholders point out a withdrawal and, more generally, lack of interest for forest management from "new" owners. These opinions are difficult to confirm but there are eminently clear arguments in favor of that. First, as we have seen, in most cases forest management cannot be considered as the main source of income. Secondly, mobility plays an increasing role in ours societies. Peoples go farther away from home to build their career and lives. Thirdly, gift making and inheritance remain the most dominant mode of transmission; with consequences in terms of fragmentation of private forest holdings. A combination of these factors leads to think that "new" owners who are not living close to their forests could increase. Besides, the largest owners, and even more the legal persons, have often a remote home or head office location. For one-half of them, it is in the Paris region. In this case, delegated forest management is applied.

In the frame of the European project FORSEE (2007), a typology of forest owners has been proposed for the 'Pontenx' case study. This typology, which is based only on socio-demographic information, is presented below. There is no link between this classification and the typology built around forest owners' behaviours (Cf. § 5.2.3).

Figure 14: Typology of private forest owners, at the scale of the 'Pontenx' case study (FORSEE, 2007)



Owned areas and numbers of private forest owners, by FORSEE groups at the scale of the 'Pontenx' case study

	Numbers (%)	Areas (%)
Group 1	14.3	56.9
Group 2	10.6	3.7
Group 3	2.6	10.1
Group 4	7.1	17.8
Group 5	5.5	9.5
Group 6	59.9	2.0

Source: (Poissonnet et al., 2007)

To read this typology (examples)

- **Group 1:** 14.3 % of the forest owners are either legal persons who have more than four hectares or natural persons who are aged less than 80 and have more than twenty five hectares. This group belong 56.9% of the private forest at the scale of the 'Pontenx' case study.

- **Group 5**: 5.5 % of the forest owners at the scale of the 'Pontenx' case study are natural persons who have more than four hectares and are living out of Aquitaine. These forest owners belong 9.5 % of the private forest at the scale of the 'Pontenx' case study.

3.1.3 Impacts of demographic development

Population growth based on net migration and urbanization mark an important shift in a low population density area which is dedicated to a production forest for a long time. For most of the stakeholders we met, these demographic changes seem to have more negative than positive impacts. First, forest stakeholders but also environmental NGO point out that urban sprawl and transport infrastructure projects could threats the integrity of this forest region. At the 'Landes of Gascony' scale, annual building-up rate is 2.3 % (1.8 % in France) during the period 2006-2009 (Mora et al., 2012). Furthermore, statistical data does not allow claiming a significant decrease of forest land in our case study since twenty years (Mora et al., 2012). However, these are only global and average views that do not take into account local land-uses change and, above all, consequences of urbanization in terms of fragmentation. Secondly, many stakeholders and forest advisers assume a connection between fire risk increase and population growth, whether this process implies urbanization or recreational activities in forest increase. But, others prefer to remember the efficiency of the regional fire prevention system (DFCI). Outdoor activities are also often being pointed at as the cause of degradation (damaged trails, litter, mushrooms picked…), even if Gascony forest was (and still is) traditionally an "open space" with tolerance of private owners. More generally, the surveys suggest that a cultural gap could widen between pines forest management and news socials demands toward forest as archetype of "nature", pleasant living environment and landscape (see § 3.2). But, it is also necessary to remain prudent because if some problems could exist between forest owners and new inhabitants, especially about "clear cut", these conflicts remain for the moment very occasional and mainly located on coastal areas. As a matter of fact, most mayors we met stressed the key-role of the forest in a building of a common heritage and, nowadays, the attractiveness of the region. For a forest administration of the Regional Council, if the Gascony forest must remain a production forest, it is also necessary to improve recreational functions and, more generally, ecosystem services (especially biodiversity and carbon capture and storage). But, if there is a consensus to consider forest as a regional asset, the question of "what kind of forest?" remains over and could become an increasingly significant issue.

For the moment, very few forest stakeholders interpreted population growth as an opportunity for the production forest, whether in terms of growing demands for timber products or employment. But, it is also clear that they seem more concerned by socio-demographic changes in the forest owners population that in the total population. The ageing of former owners, the increasing geographical remoteness of "new" owners (natural and legal persons) and more generally the decline of incomes related to forest ownership are trend which may raise concern. These structural factors could imply a lack of interest and engagement for the forest management. In this context, storms damages have even more shaken the confidence of owners. All this is viewed by stakeholders as a threat in the medium/long term for the Gascony forest (fire and plants risks) but also for the forest-based sector. This has to be seen in perspective since 90 % of the forest owners would

continue to have investments and operating expenses (Garnier et al., 2012). It is however clear that there is an improving forest management delegation. While family patrimony and individual management are often considered as a genuine characteristic of forest ownership in 'Landes of Gascony', forestry cooperatives supervise the forest management or 15 % of this area (Garnier et al., 2012).

3.1.4 Concluding assessment

Patterns of population growth in 'Landes of Gascony' are particularly important to take into account because these demographic developments are the result of three factors: urban sprawl, especially around metropolitan areas, attractiveness of the Aquitaine coastal area and, nowadays, rural resettlement. If these demographic trends continue unchanged, 'Landes of Gascony', which is a predominantly forest territory and a regional rural centrality, could become a fringe of census metropolitan areas (Mora et al., 2012). For the moment, 'Landes of Gascony' remains a low density area but demographic developments already challenge the unity of the Gascony forest. Indeed, socio-economic issues and local development projects do not necessarily remain the same in the coastal, sub-urban or rural areas. This forest territory is increasingly heterogeneous. Increasing built-up area and fragmentation of forest ownership are important issues to manage at the landscape scale. But, it is not only the consequences of the new attractiveness of this region. Greater residential motilities, tourism and leisure also transform the economy and territories governance. "Residential economy" becomes the main driver of rural development. Residential sector, i.e. income flows associated with residential and tourist services, accounts for 63 % of rural areas incomes, while primary production sector only reaches 13% (Mora et al., 2012). At the political level, rural governance increasingly depends on metropolitan powers governing, on the one hand, and the strengthening of local authorities in connection with decentralization on the other. More generally, influx of new incomers, who have others socioeconomic profiles, change perceptions and attitudes to forest. Traditional practices are gradually being superseded by social demands about, recreational and environmental services but also pleasant environment living and landscape. There is an accumulation of multiple and potentially contradictory visions and uses with regard to the environment.

For forest stakeholders, these demographic changes seem often to be experienced and promoted as constraint or threat and not really as an opportunity for the forest management or the forest-based sector. For the moment, these stakeholders still do not seem to make a connection between population growth and emergence of new markets (timber but also recreational and environmental services) at the regional scale. But it is also clear that they are more worried by demographic trends in the forest owner population than in the regional population. Indeed, a numbers of factors (ageing, geographical remoteness, fall of confidence after two storms…) could point a lower involvement of forest owners. In the worst case, that could lead toward the end of forest investment and management but more likely to improve forest management delegation. Even though there are also many structural factors that lead to inertia, we may be seeing a paradigm shift in the behaviour of forest owners at the 'Landes of Gascony' scale.

3.2 Public opinion and discourse

3.2.1 Some elements of methods for a complex issue

What do people think about the Gascony forest? What are their opinions and expectations towards landscape and the forest? Behind the apparent simplicity of these issues, studying the public opinions and discourse supposes to define precisely several aspects:

- Firstly how do we define what is the "public"? Does this category only integrate people who manage the landscape and the forest, that's to say forest owners and farmers? Are rural inhabitants living into or near the forest also a part of this category? Do we also study the public opinion coming from city dwellers that live at the margins of the Gascony forest, inhabitants from large urban areas as Bordeaux or Bayonne? Does the category "public opinion" also integrate tourists who are million on coastal areas of the Gascony forest? Even more, as 2/3 of new incomers come from elsewhere, do we have to take into account opinions and discourses about forest at the national scale? Given such complexity, we chose to focus on the social construction of a master frame related to Gascony forest on the one hand, and on some on-going debates about this forest on the other. We aim at pointing out the existence of some different representations and stress points, without pretending to be exhaustive or representative.

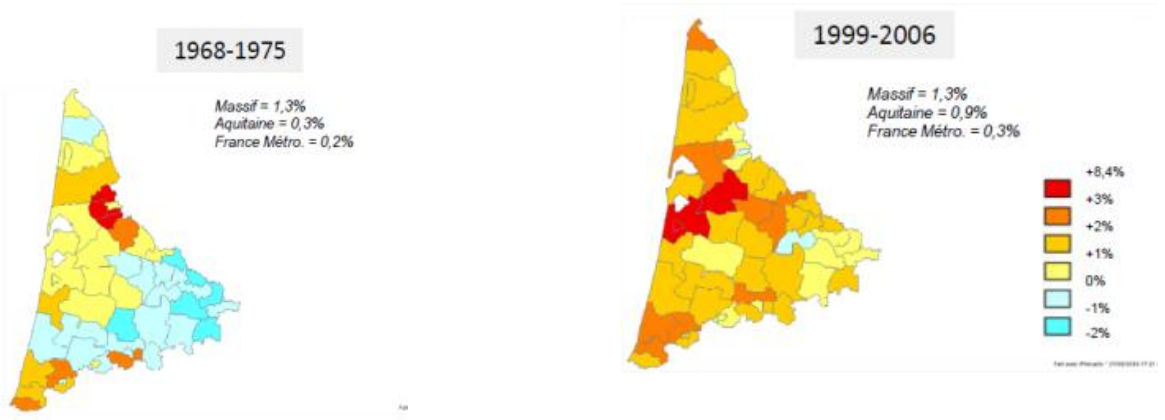
- Opinions and discourses are also not easy to analyse as data are often dispersed and come from very different sources (regional press, web pages, statistical surveys, qualitative researches on some specific social groups). Moreover, it is not common to find surveys that deal with the opinion of the whole population on a specific geographical unit as the Gascony forest. It is often easier to address issues in small parts. In the Aquitaine region, studies about tourism practices and tourists are regularly implemented in the coastal zone or in the most significant tourist sites but less in the core of the Gascony forest. As consequence, we have deliberately chosen to base an approach from existing synthesis (Bouisset and Dehez, 2009) (Mora et al., 2012) and main qualitative survey on the Gascony Forest dealing with representation and social construction about maritime pine. Some examples of these works :
    - The history of the social construction of the Gascony forest : from desert to the planted forest (Dupuy, 1996; Manciet, 1981; Nougarède, 1995; Ribereau-Gayon, 1993; Sargos, 1997; Sargos, 1949);
    - The landscape perception of forest by city dwellers (Bouisset et al., 2010; Pottier, 2010b) and inhabitants (Bouisset and Pottier, 2009; Pottier, 2010a; Ribereau-Gayon, 2001).
    - Forest owners' practices and preferences (Deuffic et al., 2010; Drouineau and Borios, 2006; Nougarède, 1995).

- Finally, opinions are interesting if they are also related to practices. But what people do in forests? What are their practices? Which uses will be described? How will they be legitimated or not? Which registers of justification will be mobilized to legitimate (or deligitimate) some functions or social uses? There are still very few studies on this issue and, when present, are often limited to tourism and recreation. However as leisure time and individual mobility increased, so too did the tourist industry, but also the residential activities. Holiday home sometimes becomes the main residence since 35% of the Aquitaine's inhabitants do tourism inside the Aquitaine region (CRTA, 2009) and some of them spend their holidays inside or near the Gascony forest. The lines between tourism,

leisure and environment living are now becoming blurred. Moreover, the Gascony forest is a very traditional place of living for many inhabitants who walk into the forest, who could earn their living from forestry management and have recreational activities (as hunting, mushroom picking). So, we will begin this topic with some updated result of one of the few studies about this issue of outdoor activities at the regional scale (Dehez, 2012).

More generally, if there is a master frame derived from maritime pine forestry and its related industries, there is also a cultural identity built around Gascony forest. Many traditional inhabitants show a strong attachment to this forest and theirs trees. However, demographic changes, and especially enhanced migrations, modify perceptions and attitudes to production forest. Traditional practices are gradually being superseded by social demands about recreational functions and environmental services but also pleasant environment living and landscape. Even if new incomers prefer to settle on coastal or sub-urban areas, a part of this migration of population occurs in the remote rural areas in the core of the Gascony forest (see Figure below). Better transport networks, cheapest land and houses partially explain this rural resettlement, but not only. We also assume that the old fashioned image of these remote rural areas has fundamentally changed since the last two decades. Whereas rural values could be seen negatively not so long ago, they become nowadays synonymous of nature, cultural heritages and pleasant landscape; meaningful values that providing future prospects (Mora, 2008) (Mormont, 2009). As the regional scale, surveys show that new incomers tremendously appreciate the quality of living environment, the lower population density and the cultural identity. Moreover, forest is nowadays seen as a paradigm of nature (Eizner, 1995) and a safe place for fauna and flora. A national survey conduct in 2003 points out that 82% of the French people consider as a priority to improve the preservation of forests and their environmental attributes, whereas they are only 24% to give priority to wood production (Dobré et al., 2006). Do the local inhabitants, and especially forest owners, share the same images? In a short or medium term, is there not a risk of a cultural gap between the traditional images and practices of the Gascony forest and the new ones?

Figure 15 : Average annual net migration in 'Landes of Gascony'



Source : Bergouignan et al, 2011

3.2.2 Leisure practices

In 2006, almost eight out of ten Aquitaine inhabitants go to forests during their leisure time, compared with 61 % to beach and 87 % to countryside (Dehez, 2012). There would consequently be about eighty millions of annual visits in Aquitaine forest. Contrary to a widespread belief, these people are not only tourists. 75 % go forest during the week-end, 50 % during the week and only 40 % during holidays (Figure 16). Moreover, 66 % go in every season with a slight preference for spring

and autumn. Even more importantly, a quarter of the respondents claim to “live in forest” and the most visited forest is located less than 23 km. If 53 % use car to go to forest, 38 % walk (IRSTEA, 2013)[7]. So, apart from the summer period which generates an increasing of tourist numbers mainly in coastal forests, outdoor activities remain largely doing by people who were close to it. This assessment is supported by the detailed analysis of activities practiced in forests (Figure 17). Indeed, motorised vehicles used for leisure purposes are often criticized by forest stakeholders as the archetype of new urban uses. But, this kind of activity remains still in minority (6 %) compared with walking (90%), nature observation (74%), rest (71%), mushroom picking (67%) or cycling (40%) and jogging (20%). It is approximately the same figures as surveys that are carried out at national level. Besides, peoples like to go to forest in group, either with their families (87%) or friends (41%). Conversely, traditional activities as fishing (14%) or hunting (11%) are rarely raised by respondents. Can we not see this latter result as a sort of decline of these traditional activities? For the moment, it is a just an assumption that should be checked with the help of others data sources.

Figure 16: When do people go to forest?

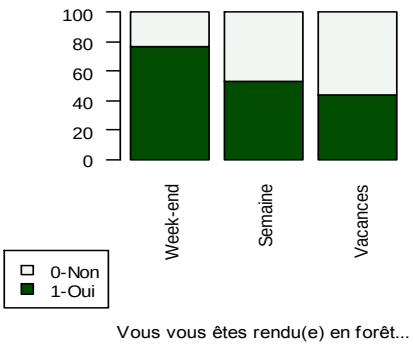
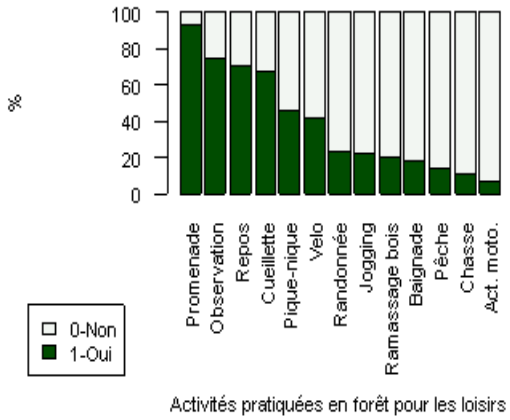


Figure 17: Activities practiced in forests



Source: IRSTEA, 2013

This regional survey provides also some information about attributes which are appreciated or disliked. Even if we need to remain prudent with these kinds of qualitative data from a quantitative survey, some of the results are interesting. Quietness (96%), presence of animals (90%), clear under-storeys (80%), water (80%), hardwood and mixed forests (75%) are among the most popular attributes (Figure 18). Conifers landscapes are only the 9th item (60%), which implies a significant difference with the item ‘broadleaved forest’ (a gap of 15 points). People seem appreciate a bit less even age plantation (30%). It could be a signal of an ambiguous interest for the maritime pine model because this assessment is reinforced by the combination of two items: less attraction for conifers and even age plantation. However that should not conceal some contradictions between respondents' answers. Indeed, while people suggest a less attraction for even age plantation, they claim also to appreciate clear under-storeys.

Waste (90%), motorized activities (70%), overcrowding (50%) and hunters (47%) are the “attributes” seen as the most unpleasant (Figure 5). In this perspective, hunting appears as a potential source of conflict. But, “motorized activities” is also an interesting item, since they seem criticised in the same way both forest stakeholders and visitors. It is more interesting if we consider in the same time that forestry activities (20%) and conifers (5%) are disliked by a minority of respondents. This could mean that points of frictions are perhaps more important between visitors than between visitors and forest

[7] These updated results have not yet been published. We wish to thank Jeoffrey Dehez (IRSTEA), the coordinator of this regional survey, for his contribution.

owners or managers. In conclusion, these results suggest that if hunting is called into question, forestry activities seem to be accepted.

Figure 18: Appreciated forest attributes

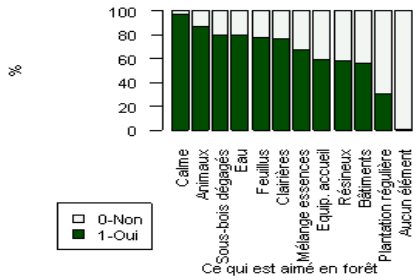
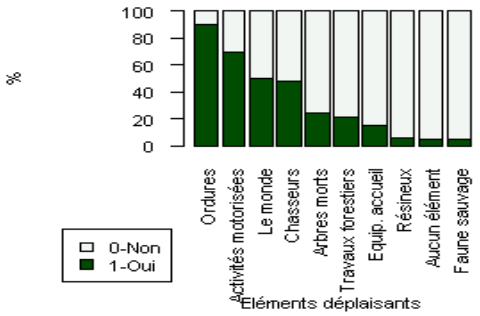


Figure 19: Unpleasant forest attributes



Source: IRSTEA, 2013

A last interesting result of this regional survey comes from forest landscape preferences (Figure 20). However, in this case more than elsewhere, we need really need to be careful. Indeed, there are many methodological limits of quantitative survey for a complex item as landscape. What do we mean by landscape? At which scale? Which elements are perceived and assessed by respondents? In particular, landscape typology use in this survey is perhaps too directed. Similarly, official designations are certainly far from the vernacular naming of forests by the interviewees. Despite these important precautions, we can observe that broadleaved forest (the first three items: near to the rivers, lowland and mountains) are mostly appreciated. Then, there are mountain forests and sand-dunes forests. The "cultivated pine forest" still ranked at the last place. At the national scale, these results would not be surprising. Indeed, many studies show that social demand is currently focused on ecosystems or areas with wide range of natural environments (Boutefeu, 2007; Dobré et al., 2006). At the 'Landes of Gascony' scale, this ranking must be treated with caution. In fact, it would come to the conclusion that there is a lack of interest for pines forest. But, respondents live in Aquitaine and, so, not necessary in 'Landes of Gascony'. Accordingly, it is also possible to assume that this spatial distribution influences preferences revelations.

Table 21: Ranking of forested Landscapes

Forest Landscapes typology	**Respondents**	**Percentage**
Riparious woodlands [*Forêt en bords de rivières et de fleuves*]	295	92,1 %
Broadleaved lowland forests [*Forêts de feuillus en plaine et plateau*]	292	91,37 %
Mixed broadleaved/conifer upland forests [*Forêts mélangées (feuillus et résineux) en montagne*]	279	87,42 %
Coastal dune forests [*Forêts de dune du littoral*]	274	85,78 %
Fir upland forests [*Forêts de sapins en montagne*]	270	84,49 %
Cultivated Pine Forests [*Forêts cultivées de pins*]	202	63,17 %

Source : Irstea, 2013

3.2.3 Shared traditional values and dominant ideas

The social construction of the Gascony forest and its related sector as a regional, and perhaps a national, master frame is an outstanding but nonetheless complex process. Its main strength comes from its ability to succeed as an obvious cultural heritage and regional wealth despite many debates and conflicts throughout its history. However, rather than go back over these old conflicts, we will focus on some persistent shared values and dominant ideas to after point out some currently debates about them.

Afforestation process in Gascony, which was being systematized from 1857[8], is often cited as a symbol of the conquest and the victory of human beings on hostile environment, diseases and poverty (Manciet, 1981; Sargos, 1949). Even nowadays, the hypothesis of a forest loss is locally perceived as a threat of a possible return to unhealthy marshes. Although this historical process was also accompanied by privatization of commons and enrichment of some privileged classes (Dupuy, 1996), it remains mainly the cultural heritage and the pride of having taken part, even it by proxy, in this human adventure. This adventure and its many accounts have shaped the inhabitants' sense of belonging to the same community and territory (Nougarède, 1995). Indeed, if Gascony forest belongs first and foremost to private owners, it is also seen as a collective heritage. This traditional paradox expresses itself notably in the accessibility of space. Although forest is mainly privately owned, it is not a fenced area but rather seen as an "open space", accessible to everyone, and especially hunters, with tolerance of owners (Ribereau-Gayon, 2001). Today, this social construction of the Gascony forest is enhanced by forest stakeholders who talk about this areas as "*the biggest private owned forest in Europe*", "*planted*" and "*cultivated*" forest (in opposition with natural forest). Similarly, maritime pine is often pushed as "the" most *appropriate tree species to biophysical characteristics of the region*"; still the best tree. Its robustness but also its ability to have contributed to the forest based-sector in many ways, despite its reputation of poorly processed wood, implies that few alternative species has been imagined (Mora et al., 2012).

Beyond cultural and ecological registers of justification, the social construction of a regional master frame related to pine forest is perhaps and above all based on economic aspects. Although the time of "*the golden tree*"[9] has long since passed, forest based sector are still seen as a regional asset and the main source of rural employment. Indeed, despite current demographic developments but also sector-based trends, the dominant idea remains that there could not be any other plausible economic activities in rural areas. Accordingly, the forest-based sector would remain the key factor to economic wellbeing in these areas through employment and the re-spending of income derived from forestry and its related industries. For example, policy makers and regional politicians still emphasize on the 30,000 jobs related to forest activities and industries.

For a long time, pine forest is an important component, with sand-dunes and beaches, of the attractive coastal landscapes. But, more recently, even the image of the core of the Gascony forest as a remote rural area is changing and becoming one of the key drivers of the regional attractiveness. The former defaults become tremendous qualities: silence, quietness, low population density or forest landscapes are in steps with new social demands toward hectic life, nature and pleasant environment living. Similarly, forest seems currently more promoted by policy makers and regional authorities than others land uses (ex: agriculture) because of its cultural and economic role but also, nowadays, its low impact on the environment or its role in biodiversity and carbon storage.

[8] In 1857, a national law was passed requesting all municipalities to clean and replant their wetlands.

[9] "*The golden tree*" expression Sargos, J., 1997. Histoire de la forêt landaise. Du désert à l'âge d'or. L'Horizon chimérique, Bordeaux. refers commonly to the golden era of resin-tapping (1860-1920).

In the end, for the most forest stakeholders we met, Gascony forest remains first and foremost a production forest. For one hundred and fifty years, this traditional viewpoint is supported and legitimated by the social construction of a homogenous territory and a regional master frame related to maritime pine (Nougarède, 1995). However, these shared values and dominant ideas are nowadays challenged by new registers of justification. Indeed, if they strengthen the legitimacy of the forest land use, they could also appear contradictory with a cultivated and planted pine forest. Moreover, in the same time, traditional registers of justification are challenged by demographic developments, sector trends and climatic events as storms (1999&2009).

3.2.4 Emergence of contradictory discourses on the Gascony Forest

It is difficult to claim that proliferation of contradictory discourses is structural or cyclic, linked in particular with storms damages (1999 & 2009). However, the aim of this section is to point out some current divergences between new social demands and production forest but also the gap between the traditional master frame related to pine forest and change in its forestry and its related industries.

Firstly, if there is a traditional attachment for a tree as the maritime pine, there are more ambiguities about attachment for pine forest landscapes (Ribereau-Gayon, 2011). Theses landscape may be denounced not only by environmentalists or tourists but also inhabitants and few forest owners as *"*too homogenous, monotonous, and artificial*";* a bit boring on large scale (Deuffic et al., 2010; Pottier, 2010a). In the same way, *ligniculture* that does not tolerate under-storey (Maugé and Léonard, 1969), forest which must be cleaned out or forest stands are sometimes compared not with a scenery but as a visual barrier and a curtain that hides the intimacy of the forest. In few qualitative surveys, including among forest stakeholders, the term of "pine field" can be used (Arnould et al., 2002). These ambiguities are nothing new but it is perhaps an issue of growing importance given such current demographic developments but also intensification of forest practices since 1960 and even more 1999. The case of "clear-cut" is another example of these two contradictory trends. Indeed, when there is an opportunity for clearings, it is done at a scale that is impossible to embrace with a single glance as clear-cuttings become still larger. The minimum size required by forest contractors increases from 5 to 10 ha and sometimes more. Those radical transformations of scenery are less accepted by new incomers mainly on coastal areas but also nowadays in the core the Gascony forest. Even these conflicts remains very occasional, they could be crystallized in the creation of local environmentalist association that confronts abruptly with forester managers or infrastructures planners (Bouisset and Pottier, 2009). As a coastal and urban area as Arcachon, landscape guidelines could be imposed to forest owners. The 'Bassin d'Arcachon' urban planning document (SCOT) is also interesting. A the scale of this coastal and sub-urban area, forest is overall described as an opportunity for the local development, but at the landscape scale, not all the forests are seen as equivalent. Indeed, there is a ranking between broadleaved forests, sand-dunes forests and planted forest whose management "*reduces its ecological benefits and product homogeneous landscape*" (SYBARVAL, 2009 in (Pottier, 2010b)). This line of argument in an official planning document is relatively new and altogether more than suggestive. Conversely, the most forest stakeholders express regularly their concerns about growing built-up area but also risk fire and degradation ownership linked to outdoor activities increasing, especially during summer. In August 2009, after a forest fire, the forestry union president said in local media: "*to my mind, it is scandalous that forest owners and managers should suffer and face to such a level of social pressure (…) Forest is accessible to everyone, but forest owners and managers no longer have the resources to support and manage alone all the risks"*. Indeed, the shared traditional value of Gascony forest as "open space" is regularly challenged, even if this threat seldom manifests itself. But, this argument contributes to enhance the debate on payments for recreational and environmental forest services (Bouisset and Dehez, 2009).

Secondly, some forest owners and manager seems to express concerns over *Pinus pinaster*. Sometimes, it is not only perceived at the most appropriate tree but more as "*tree by default*"; the most adapted to the local environment but not so invincible and not resistant to anything (Deuffic et al., 2010). These forest owners recalls a long list of natural hazards and its fragility to a various amount of natural hazards (wind in 1976 and 1984, storm in 1999 and 2009, drought in 2003, large scale fires in 1949 and 1991, winter frost in 1962 and 1986….). Recent storms have probably reode the absolute trust in this species. In the same time, majority of forest owners keep confidence in technological innovation and the strength of the traditional maritime pine master frame should not be underestimated. However, it is also clear that many forest owners are concerned about forest management practices and its related income in an uncertain context for the future of the forest-based sector. These forest owners could be also at a crossroads (Cf. § 5.1.4): some forestry models lead to a hyper intensification of forestry management (ex: bioenergy) as others suggests to choose a more extensive model (sustainability: carbon capture and storage, biodiversity, outdoor recreation).

Thirdly, current divergences are also linked to forest-based sector changes, in particular the decline of some sub sectors, like furniture or panelling manufacture, a concentration process in the crushing industries, like pulp or panel, and the emergence of bioraffinery activities producing energy and green chemical products (Cf. § 3.3.1.2). With storm damages, these increasing demand for pulpwood and, nowadays, fuelwood cause rising tensions around forest resources. This idea of "*tensions around forest resources*" becomes a regional frame which often used to delegitimize and stop the influx of new economic operators, mainly linked to energy projects. Moreover, this situation led some major regional industrialists and forest cooperative to consider that traditional viewpoint of forest ownership as family heritage and capital tie-up is not competitive enough. For these stakeholders, the renewal of forest resources needs to be speeded up. Conversely, many forest owners considers that income related to these new forest-based sector guidelines still remains not profitable enough. Beside, some local authorities begin to express concerns about the contribution of forestry and its related industries in their economic development projects. They argue that 'Landes of Gascony' has become an increasingly heterogeneous territory. Indeed, if in some areas, the forest production sector remains the greater contributor to rural economic well-being; in others, the local community no longer benefit of employment or income derived from forest-based sector (Mora et al., 2012). However, these local authorities might not necessary the end of production forest, but rather being more involved in this management and its economic development. They are working on issue to know how local forest-dependent stakeholders and households living in a tree-rich environment could contribute more to the emergence of a more broad-based range of economic activities (tourism, personal and business services…but also high-tech industry) in rural areas, in particular for these which are under the influence of coastal and urban areas.

The last point concerns debates in connection with the improving of forest as archetype of nature and, more generally, its ecosystem services (biodiversity, carbon capture and storage…). For example, the images of unhealthy marshes are now evolving; they could be seen as wetlands and a source of "remarkable biodiversity". Even more, their ecological richness is sometimes compared with the presumed ecological poverty of the maritime pine forest. Beyond the increasing social demand for a relative diversification of tree species as the gallery forest along rivers, sand dunes forest or broadleaved woodland, this reversal in ecological values can lead to preserve areas that, up until now, was fought. Moreover, this proliferation of natural reserve, and more generally, protected areas could more and more affect forest management in the future (Deuffic et al., 2010). So, if at the regional scale, environmental NGOs can engage with forest stakeholders to defend forest against others land-use, in particular agriculture; at the local scale, traditional forest practices can be contested. Finally, even if regional authorities have just set up a carbon fund to a reforestation of damages stands, there are also current debates, especially among scientific community, about carbon cycles, and more generally, environmental services in the case of this cultivated pine forest and its related forestry (Mora et al., 2012).

3.3Economic developments

In order to avoid further overlaps, the following 'topic' chapter is organized around the main forest products and services of the *'Landes of Gascony'* area: industrial and timber wood, wood-energy, amenities, hunting. For each product, we present an overview of the regional supply and demand sides, of their interactions, trends and changes. [See § 3.2.4 but also mainly § 5.1.1 and § 5.1.2 for more details and a long-term perspective about the evolution of ecosystem services in 'Landes of Gascony']

3.3.1 Main products and services

3.3.1.1 Pinus pinaster wood

The main forest product of the forest area is, and by far, *P. pinaster* wood, harvested from planted private forests (92%). The dominant use is industrial (pulp, particle boards...) followed closely by timber (pallets...). Energy use of pine, only a recent trend, is still marginal but on the rise.

The key drivers of the regional market dynamics of Pine wood are the massive effects of the 2009 storm damages, with volumes amounting to a one-year country-wide harvest. Considering the impact of the previous storm Martin, (Colin et al., 2010) estimated than in ten years, the standing volumes of pines in Gascony have dropped from 130 Mm^3 to a mere 80 Mm^3.

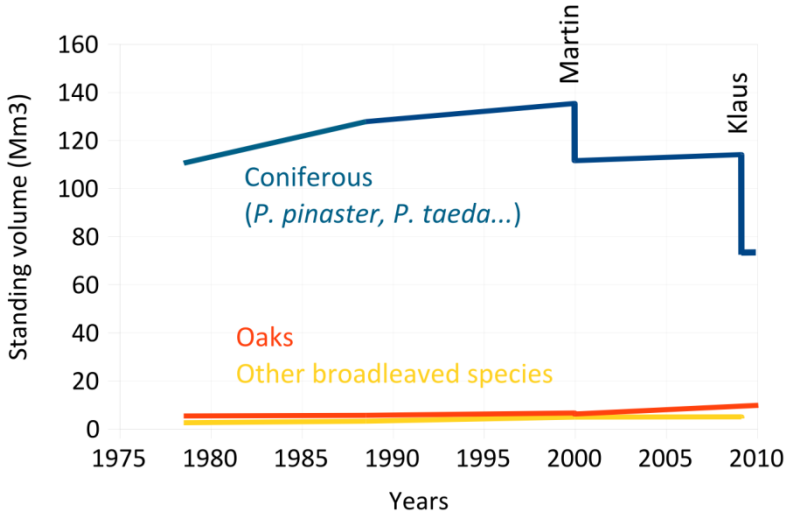


Figure 20: Evolution of estimated standing volumes, 'Landes of Gascony'. Adapted from (Colin et al., 2010)

As a consequence, regional markets have been heavily influenced since then by the handling of the harvest as well as by the restoration of the resource. As it appears on Figure 21, loggers have been able to harvest the 2009 windfalls in a much more efficient way than in 1999 (faster pace, higher volumes).

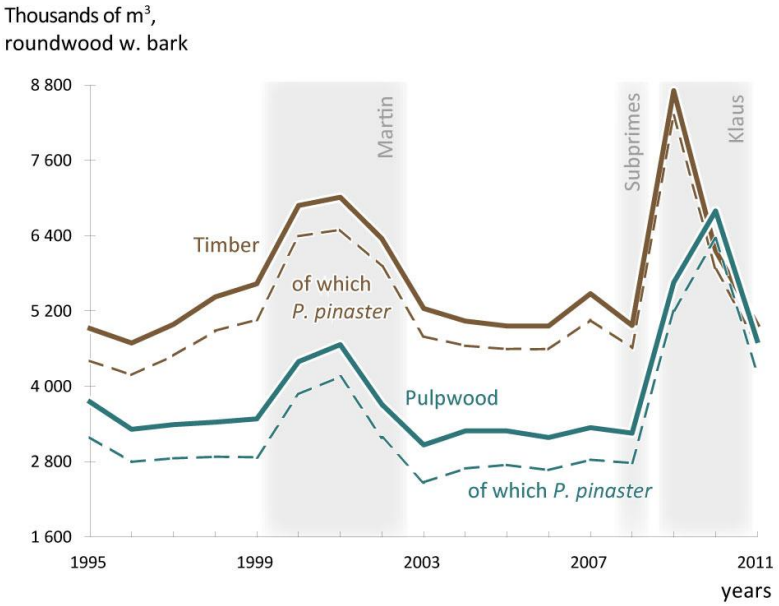


Figure 21: Evolution of timber and industrial wood harvest, Aquitaine region, 1995-2011.Adapted from (DRAAF Aquitaine, 2013). Source: Agreste - *Enquête annuelle de branche exploitation forestière*

Even with the setting up of several stockpoints throughout 'Landes of Gascony', important losses were to be considered. Moreover, the logs that were affected by blue stain, unchanged in their physical properties, became unsellable as timber. Massive product losses also occurred in 2010-2011, with sanitary attacks on standing trees by bark beetles (mostly *Ips sextantus*) for example virtually wiping out the stands of *Pinus taeda*, scattered in Gascony, that had yet behaved rather well in the storm.

An important feature of Figure 21 is that in 2010, the pulpwood volumes crossed the timber volumes, here signalling that the crisis may also have acted as a turning point in the inner dynamics of the regional Pine wood market. This shift of the demand from timber to industrial roundwood is to be put into a wider perspective by Figure 22.

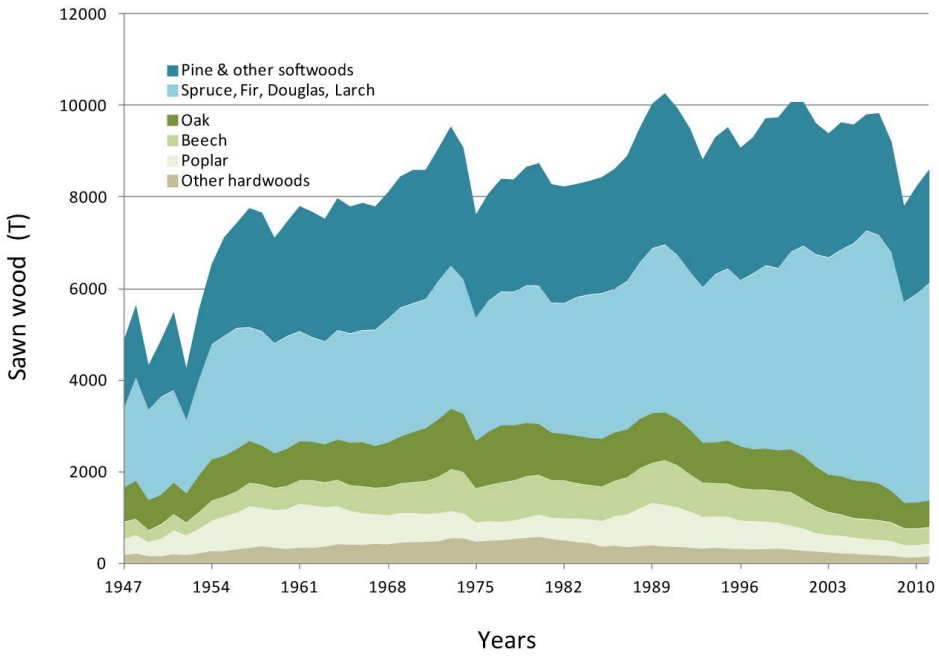


Figure 22: Long-term evolution of dimensional timber production, France, 1947-2011. Source: (SSP, 2013) *Enquête annuelle de branche scieries (Sci002 : Produits de sciages -séries longues)*

The trend is more marked in Aquitaine, as sawmill operators are particularly under pressure (due to shorter rotations, quality concerns, competitiveness) but is also the result of a long-term national evolution. Spruce and Fir woods have indeed gradually superseded pine wood in the French sawnwood industry over the last 50 years. Mostly imported, labelled as northern fir (*Sapin du Nord*), these dominant products have seriously challenged the competitiveness of local pine timber industries. As a result, the stakeholders interviewed in Aquitaine seem to share grim prospects for the future of regional sawmills. Scattered in the 'Landes of Gascony' area, they still are large suppliers of wage employment (see Figure 23). But restricted to low added-value products (some by choice but most by necessity), they take a heavy toll from the consequences of Klaus: *"In the commercial balance of the Aquitaine region, the forestry-wood chain is in trade surplus. But if we look in detail, we have a surplus for industrial wood and paper but a deficit for pallets and other wood products"* (Interview S08).

Construction timber is for example acknowledged as a difficult challenge: "*There is a growing regional demand but industrialists are not structured to meet the demand, and are unable to get enough volumes... In terms of [wood quality], we are also blocked by some normalisation labs."* (Interview S08) Another stakeholder also has an example in mind: "*There is an operator in 'Landes of Gascony' who has tried to specialize in* P. Pinaster *wooden frameworks for home-making. But quality dimensional timber was scarce, then came the storm and the concurrence with parquet-making sawmills… Now he is importing Douglas fir from the* Limousin *region…"* (Interview F02)

"In the forestry wood chain, there are very contradictory interests, but I do not think that all actors are pushing their resources to get their deals." (Interview S01) For several actors, the regional wood market has thus been increasingly driven by paper mills: "*50% of the harvest goes into the pulp & paper industry. So they are setting the market price. And if Gascogne* [the second largest paper mill of the region, see Figure 23] *goes down, there will be a monopolistic situation."* (Interview S01) Another, more national, imbalance in timber markets is denounced by a local stakeholder though: "[Suppliers of wood products] *are at the mercy of large resellers. Basically, they have walked down the stairs with the storm, but now they cannot climb it back.* […] *With large resellers, prices have always a downward trend, but it is never the case for the final consumer*." (Interview F20)

These trends may act as strong incentives for further intensifications of forest management. As expressed clearly by a local industrialist: *"We have an interest in the intensification of the management, [...] as it allows to develop our 'process' industries and reduce our costs* [...] *the competitiveness of the industry is based on a proximity with the resource."* (Interview S15) The consequences of these intensification patterns are unsurprisingly denounced by regional ENGOs: "*Forest biodiversity (even in planted forests) is much higher than in agriculture, because human disturbances are much less frequent. But if the pace of silvicultural interventions increases, this 'ripening' of biodiversity won't occur. When you cut pine timber over the whole year, you have a lessened quality, and are blocked from some uses, then the demand drops… it is a vicious circle. One thing is for sure: would the industry give better prices for large timber, it would be easier"* (Interview S11).

Two new tools that may affect the future price of wood are currently discussed in the *Aquitaine* region: insurance and 'contractualisation'. The latter could be equated with a formalization by contract and is increasingly considered in the area as a medium-term anticipation on buyer/seller agreements. It is assumed by some to be a potential important driver for the re-orientation of regional silvicultures (Interview S09). Several stakeholders consider that 'contractualisation' is already a reality in the forest area. One of the industrialists is yet wary of its conflation with insurance: *"*[…] *should you want the contract to play the role of an insurance? Because when there is a fire in a house, it is not the rental contract between the owner and the tenant that will pay*

anything. If we include too much of the risk component, those who have applied will be totally in deficit with the others. Risk should be managed by insurance, while contractualisation is mostly a matter of cost reductions" (Interview S15).

Insurance is basically absent in the region but is nevertheless called for by several stakeholders: "*In parallel with the shortening of rotations, it would be relevant to have insurance offers covering at least half the capital. It is a need because some owners may leave the business aside."* (Interview F08) Neither the development of insurance nor the abandonment of forest areas have been witnessed by this stakeholder but he considers there might have been a masking effect of the subsidies for the post-storm recovery. This view is backed by another actor, who places much hope in 'institutional' innovation: "*What we need is to have some progress on an insurance system that really works. For each risk, there should be a return. The R&D should be able to design tools allowing the anticipation and the calibration of those risks (eg. nematode, storm…)"* (Interview S09).

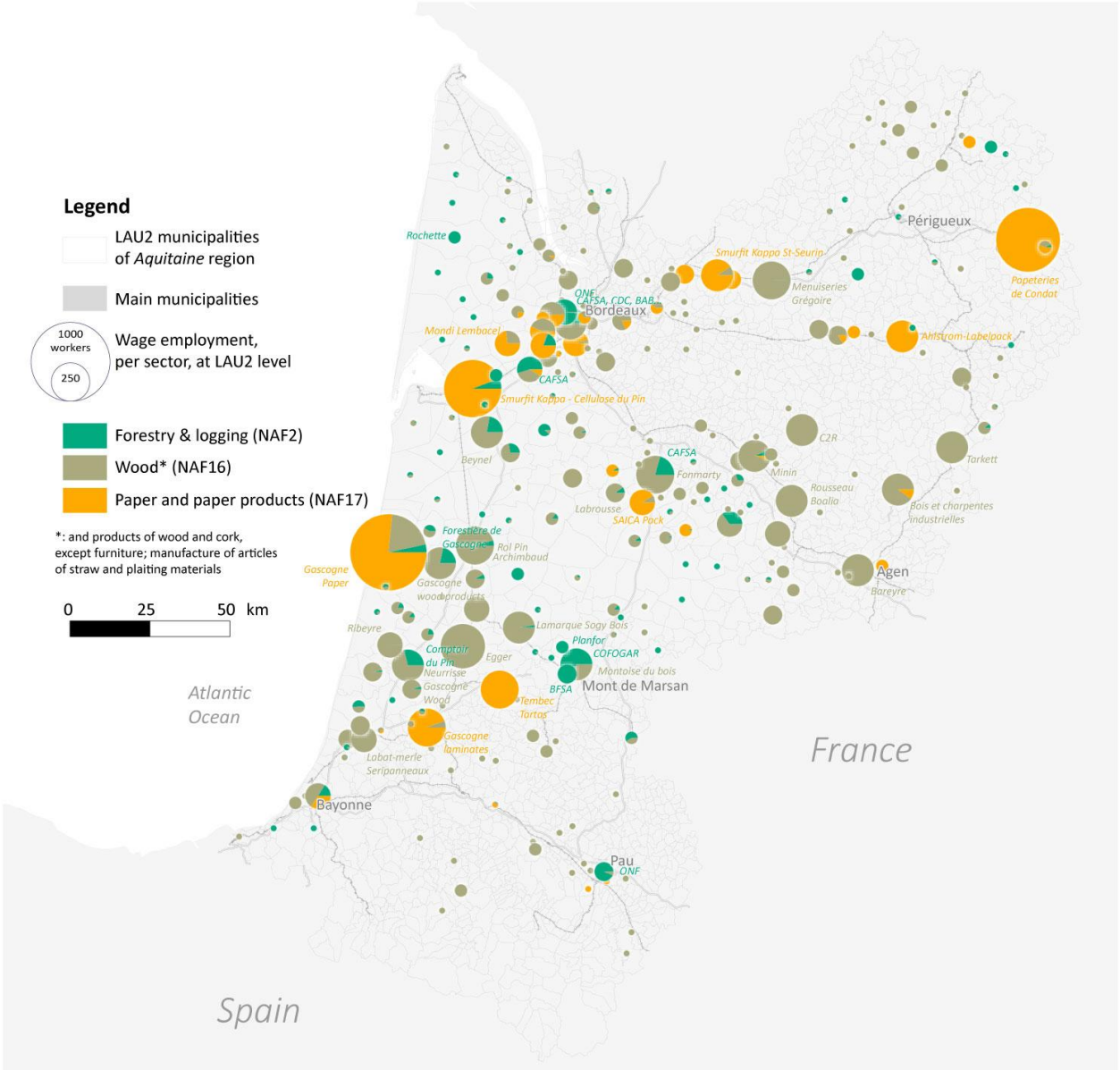


Figure 23: Wage employment in the Forestry-Wood sector in municipalities of the Aquitaine region, 31st dec. 2010. Source: INSEE, CLAP 2010 survey

3.3.1.2 Woody biomass

Wood energy is acknowledged by the vast majority of stakeholders as: "*an opportunity to be considered. We have resources, energy needs, cost increases. But still, there are concurrence problems on wood uses."* (Interview S07). Indeed the emergence of a regional wood-energy market (with an explicit regional target of 2000 kT for 2015) is perceived as a threat by other industries in the post-Klaus context, as it would increase the concurrence for roundwood and woodchips.

The latest invitations to tender for biomass plants (*appels 'CRE',* Cf. § 3.7.1.4) have led to tensions between regional users of the woody resource. The following view from a member of the administration sums up the worries of a noticeable part of local-level stakeholders and landowners: t*he industrialists have had a doublespeak: they have always claimed that there were opposed [to the development of wood-energy] as it would represent too much of a toll on the resource... but who did apply for the 'CRE' projects? You bet it, it was the large paper mills. And when you see the volumes they need and the current production, even with by-products, they will need to get resource from Dordogne or Pyrénées, or put wood that has nothing to do in a boiler. To protect their project, they need us to protect* their *resource, this is unfair.* (Interview S01)

As a possible answer to these concurrence problems, the idea of a 'hierarchy of uses' had been discussed and defined at national and regional level. The growing debate around the non-food uses of biomass led to the following preferences: food > biofertilisers > raw materials > molecules > biofuel > gas > electricity. This hierarchy was later endorsed by the 'Grenelle' concertation, followed by the national sustainable development strategy. (Alexandre et al., 2012) The view from the representative of the regional 'competitiveness cluster' is illustrative of such thinking: "*Incineration should be the very last resort* [...] *We would like to prevent people from putting roundwood in boilers. It is a practice we already have for particle boards.* [...] *Wood energy would be OK, but only with by-products.* [...] *Many actors are wondering: do I send my by-products to the paper mill or the cogeneration plant if it pays more? This is the current debate, and it was previously a taboo* [...]. *Materials, chemistry, more added value should be put on the wood by-products that are now used for energy or paper mills"* (Interview S10)

This perspective is considered by a stakeholder close to the pulp and paper industry, as regards the real behaviour of the regional markets, as being too much of a wishful thinking: "*A hierarchy of uses? This is bulls**t. What will lead a given piece of wood to a plant or another is the price that the industrialists will be able to pay, no matter whether this is for a boiler or not."* (Interview S15) The industrialist largely agrees on the relevance of a development of a regional wood-energy chain, as it can allow them to reduce their own carbon footprint. They also agree on the need for zonings, or at least on giving priority on resources without any concurrent uses.

Their most vocal critic is in fact linked to the level of subsidies: **"***Wood-energy is an administered economy. No unit is built without public spending. When in some cases the subsidy amounts to 80% of the investment, we are clearly in the distortion of competition with other uses*. *We have chosen to rely on stump harvesting because we are able to judge the consequences of this development on our own wood process. But if another operator says 'I don't care, if I find a woody resource that is compatible with my business plan, I will invest and compete with the existing players'. What we should not forget is that this installation is made possible by public subsidies. This is unfair.* […]" He then ends on a worried note: "*Wood energy should not necessarily remain a by-product, provided there is a synergy with other uses* [....] *But there is a paradox. With the latest 'CRE4'* [*biomass tenders*]*, wood energy could become more profitable than industrial wood. So yes, it may turn the problem upside down."* (Interview S15)

Well aware of these difficulties, members of the administration would like to reconcile contradictory interests: *"Should* [the public bodies] *subsidize wood energy? It's rather a yes. But by keeping an eye*

on broad equilibriums, by checking whether it is possible to regulate uses so that everybody can keep their margins. We shouldn't compromise whole areas of the regional economy with the development of woody biomass." (Interview S09)

Among local stakeholders, wait-and-see policies seems to be prevailing. Some are suspicious of a general orientation of markets and technical choices that they disapprove: *"The factory would like to get the resource for nothing, here lies the problem. Biomass, for what? for whom? For factories? There won't be many left soon. We have a 25-30 years gap. We have to plant before thinking to harvest biomass. And as they have planted exactly as it was before, it's too late" (Interview F09).* Others have fewer concerns, if only for the volatility of the market: **"***Wood energy, we cannot tell what it will be worth in 5-10 years, because for now we have no real price. We are happy to have another market opportunity, but it doesn't exist yet, it is only hope. We have seen at Forexpo some nice equipment able to produce 100€/T wood chips but we know that the entry point for the forest manager is at 0€... So we will wait until it is profitable.*"(Interview F20)

3.3.1.3 Recreation, amenities, social and shadow values of the Aquitaine forest

The importance of social and shadow values of Aquitaine forests are acknowledged by most interviewees: "*Forest is the green jewel box of Aquitaine. It benefits the forestry-wood chain indeed, but many activities/amenities depend on this green matrix, e.g. the value of housing estates, the daily life of local inhabitants or tourism. It contributes to the overall image of the Aquitaine region."* (Interview S07) Public forests, mostly concentrated on littoral dunes and owned by state, absorb the larger share of regional recreational visits (Dehez, 2012), composed of tourists and inhabitants. A dedicated infrastructure ('*plans plages*') allows restricting the size of parking lots and funnelling the pedestrian traffic in equipped paths. Yet, visits are also common in the private forests of the hinterland: Cf. § 3.2.2 for recent survey results related to leisure activities in Aquitaine's forests.

The overall demand is mostly attributed to urban dwellers: "*I think that many people feel the need to recharge their batteries in 'chlorophyllian' areas, with plenty of space."* (Interview F08) But this need is also shared by the owners themselves, whose demography is evolving: "*Why do people want to buy forest land? For amenities, to be a landowner in the sun. It can be for the future, to have some land. You do not really know but it could be valuable someday. In a context of population growth, it also amounts to stocking a land that could soon be scarce."* (Interview F07)

Sofar, the prevailing 'multifunctional forest' model assumes that wood production 'pays' for joint services (*eg.* mushrooms, hiking...). The possibility that in a near-future such ecosystem services would become marketable is highly conflicting (Cf. also § 3.2.3 & § 3.2.4). Several actors, with very different backgrounds, seem yet to consider that compensations, potentially based on market mechanisms, could be interesting for forest owners: *"I don't know yet how the '*Aquitains' *could organize themselves to propose this function - and get a profit. But I am convinced that that it is on the rise, maybe compensating losses from the 'production' forest."* (Interview F08)

A representative from a regional ENGO puts it in another way: *"Free access to woodlands should be considered as an integral part of forest multifunctionality, even if for some current planted forests I don't really see their amenity values. It is true that this access has detrimental impacts: disturbance of the fauna, fire, pollution. And as the vast majority is privately owned, people should be more respectful.* […] *We should find systems where owners have* [an incentive for a more extensive silviculture], *where they would not only lose yield. The environmental services brought by forest ecosystems to urban dwellers (water and air quality, leisure…), they have a price* […] *that we cannot estimate yet. When this role will be acknowledged and valued, then it will be the renewal of Aquitaine's forests.* […] *Wood production would then still have a role, but much more minor in my mind."* (Interview S11)

A recent national report (Chevassus-au-Louis et al., 2009) has proposed MEA-inspired reference values for the ecosystem services associated with French forests. Reaching a total of 970€/ha/yr, these include provisional services (75€ for wood, 10-15€ for NTFPs), regulating (529€ for carbon sequestration and stock, 90€ for water quality) and cultural services: 55-69€ for hunting, 200€ for recreational visits. Interestingly, these tentative, incomplete and average values are evoked and appropriated by several of the local stakeholders: "*The other functions of forest? Well, amenities, you name it. In the context of the Carbon tax, those 800€, we could ask for it. These eco-savvy ladies and gentlemen, they might then be forced to admit that we have a real forest here,* [that is has merits of its own]*"* (Interview F07).

Another possible trend, evoked by some, could be individual-level restrictions to the current patterns of free access: "e*ven in private forests, you have large amounts of recreational visits. But owners are fed up and become vocal: people come, take all the mushrooms or else. After all, everyone could find a common benefit, but they are not civic-minded. […] Owners would be entitled to develop enclosures, if there are no efforts from neighbouring dwellers. This is what we already see with private hunting properties. But it would be ugly*" (Interview F02). Another concern for forest owners is a potential increase of fire risks with public access in their forests, and is thus one of the most common objection they raise to schemes, even with payments, of such a nature (Gadaud and Rambonilaza, 2010).

3.3.1.4 Hunting

In a survey commissioned in 2006 by the *Landes* hunting federation (*Fédération Départementale des Chasseurs des Landes* – FDC40), it appeared that for a large majority of new holders of hunting permits, favourite games were migratory birds (64%): mostly the common wood pigeon, locally known as *palombe,* as well as other *Columbidae* (Rock / Stock / Eurasian collared / Turtle doves), followed by waterfowl, woodcocks and skylarks (Fédération départementale des chasseurs des Landes, 2009).

Large game, mostly associated with forest ecosystems, was only preferred by 10% of interviewed hunters. Yet, as in other regions of metropolitan France, roe deer (*Capreolus capreolus*) and red deer (*Cervus elaphus*) populations are on the rise, causing potential concerns for young age stands. The situation is similar for wild boars (*Sus scrofa*), with damages (and compensation from hunting societies) largely concentrated on maize farming.

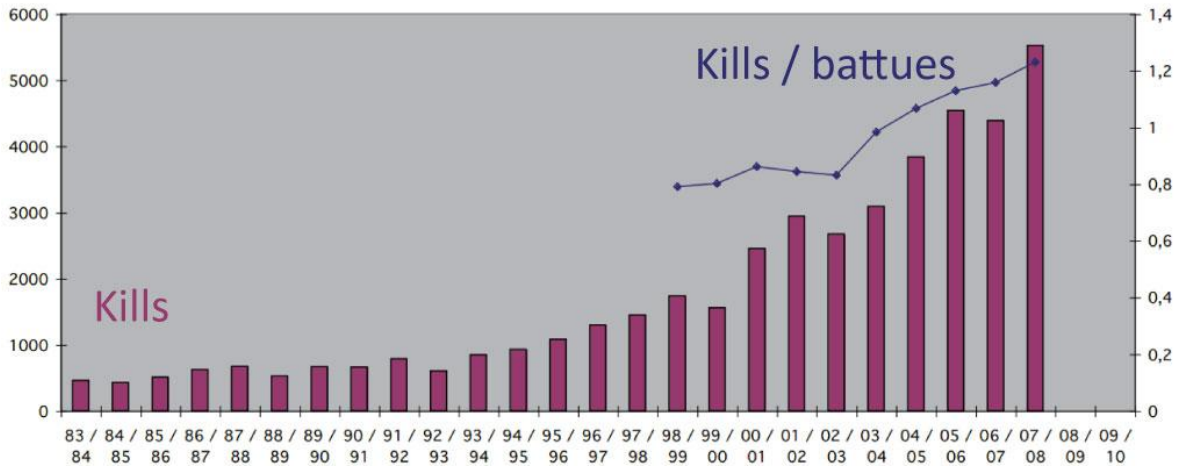


Figure 24: Evolution of wild boar kills in the Landes NUTS-3 region, 1983-2008. Adapted from (Fédération départementale des chasseurs des Landes, 2009).

Municipal-level associations, the ACCAs (for *Associations Communales de Chasse Agréée*), are the main structuring actors of hunting in the region. These associations are mandatory in municipalities of *Landes* and *Gironde*. In *Landes,* there are 324 ACCAs out of 331 municipalities. The remainder are seven municipal-level hunting societies with a private status (*société de chasse communale*) (Fédération départementale des chasseurs des Landes, 2009). In Gironde, the share of ACCA is lower: 333 ACCAs and 176 hunting societies, out of a total of 541 municipalities (Fédération départementale des chasseurs de la Gironde, 2012).

The members of these associations (usually but not always residing in the municipality) are entitled to hunting territories covering the whole municipality, minus zonal restrictions (150m buffer around housings, public forests and transport infrastructures, enclosed lands, 10% mandatory hunting reserves…) and oppositions from private owners, based on ethical or cynegetic grounds. The most common eligibility criterion for cynegetic opposition is a minimum area of 20 ha. It appears that while the largest owners could exert opposition rights, this situation is far from being prevalent in *Landes* and *Gironde*. Due to a very strong local preference for the traditional and popular nature of hunts associated with the ACCA model, private hunting areas are still uncommon. But their number is increasing (*Fédération départementale des chasseurs de la Gironde*, 2012).

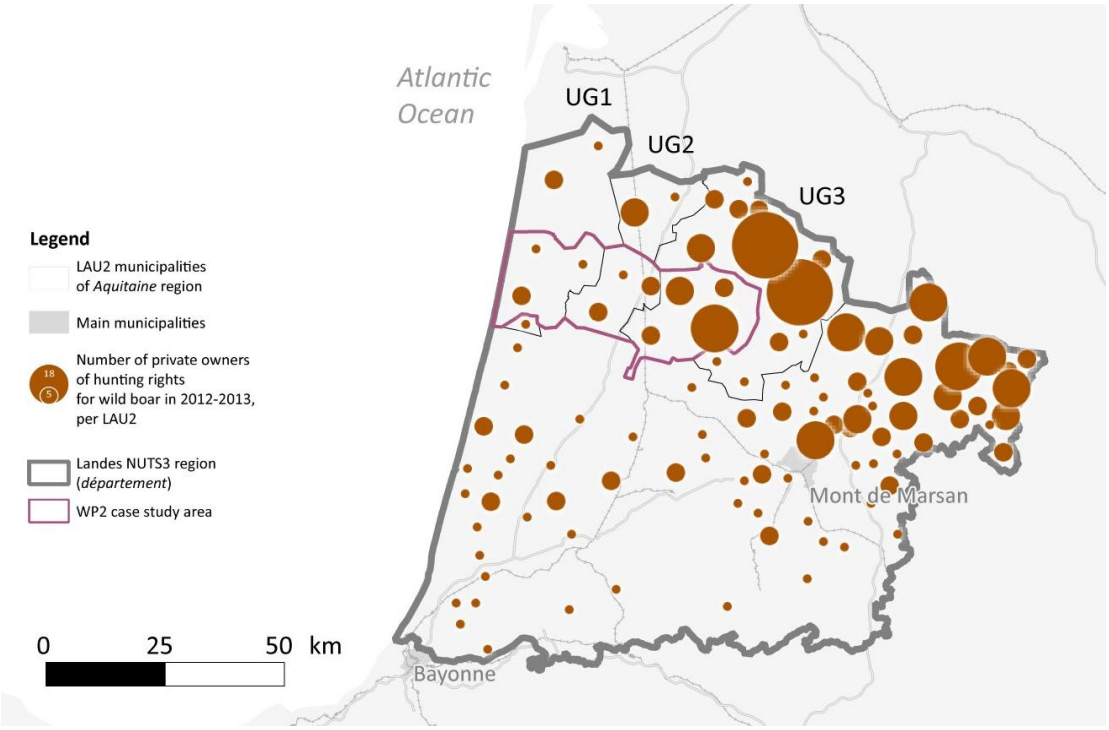


Figure 25: Private hunting rights allowed for wild boar in the *Landes* NUTS-3 region for the 2012-2013 season. Source: (Préfecture des Landes, 2012a)

The 'Pontenx' case study area is covered by three management units, where cynegetic objectives can be defined: *Born* (UG1), *Lande de l'Ouest* (UG2) and *Haute Lande* (UG3) (Cf. Figure 25 for the boundaries of management units). Table 22 describes for example the hunting objectives (lower and upper bounds for targeted kills) for deers, with a marked increase from 2011 to 2013.

Table 22: Cynegetic objectives for deers at in the 'Pontenx' case study.
Sources: (Préfecture des Landes, 2011, 2012b)

	Red deer 2011-2012	Red deer 2012-2013	Roe deer 2011-2014

Born (UG1)	110 - 137	114 - 144	1401 - 1751
Lande de l'Ouest (UG2)	81 - 101	110 - 137	1306 - 1632
Haute Lande (UG3)	78 - 97	92 - 153	4698 - 5872
Sub-total	269 - 335	316 - 434	7405 - 9255
Whole *Landes* NUTS-3 region	632 - 825	711 - 889	34406 - 43008

Wild boar and rabbit *(Oryctolagus cuniculus)* are qualified as 'vermins' (*nuisibles*) in the forest areas of *Landes département*, thus no upper bound is defined for these species. For wild boars, the formal requirements from the administration are authorizations delivered for *battues.* These authorizations can be delivered to private owners (as defined in (Préfecture des Landes, 2012a)). Figure 25 allows gaining an insight of the spatial patterns of these authorizations, with a steep gradient towards the North-East of the *département*, and the highest numbers in municipalities of the UG3 management unit. These dynamics should not be ovestimated but they show nevertheless a potential for the development of private hunting domains. Local foresters and hunters are obviously aware of this potential, with the example of Sologne in mind. Forested landscapes of this natural region located in the center of France have indeed been heavily affected by the development of enclosures and game-oriented forest management practices. Such a scenario appears still unlikely in Landes for the aforementioned reasons: preference for small game and municipal-level organizations.

If some stakeholders seem, by their relative silence, to consider that a 'Sologne' scenario would be rather unlikely, other see glimpses of possible future trend: "W*hen you cross the 'Landes of Gascony' westwards, you can see the development of huge private enclosures, with a hunting orientation. It is mainly a recreative purpose. And it shows that people are aware that if they want to offer large open areas* (grands espaces) *to their clients, there is a demand".* (Interview F08)

Using benefit transfer methods, a recent study allowed probing this potential. It estimated the average benefit associated with a large game hunting day in Aquitaine to be 61.44€ (Rakotoarison and Point, 2012). While the method was adapted from the North American context, the comparison shows a very strong individual preference of French hunters. The total number of hunting days is indeed 25/yr in France (and 35/yr in Aquitaine) vs. 14/yr in the USA. Accordingly, the average yearly spending is 1590€ in France vs. 390€ in the USA.

3.3.2 Impacts

Table 23: Impacts of forest-related and non-forest markets on forest management and land-use in the forested landscape

	Evident or presumed impacts on…	
	…Forest management…	**…Land-use in the forested landscape**
...of markets for forest products and services…		
Industrial wood	A key driver of the 'ligniculture' model	
Timber	Insufficient to back the upholding of long-term rotations	
Biomass	Could lead to various silvicultural models, from extensive birch to short term coppice.	May compete with other more agricultural feedstocks (*Miscanthus* sp., ...)
Recreation	Growing aversion to clearcuts and intensive practices, but also to 'traditional' hunting	Indirect effect on the prices of housing
Hunting	High deer densities can affect young stands	Impacts on agricultural land (boars), effect of possible enclosures
…other relevant markets (infrastructure, tourism, real estates, etc.)		
Real estate	Contradictory feelings of new dwellers towards forest management	Rising temptation for forest owners to sell their land to urbanization. Role of urban planning
Infrastructure	Fire risks can be increased by proximity of road traffic	Net area losses and fragmentation effects in the forested matrix. Role of green and blue ecological corridors infrastructure
Tourism	Cf. recreation and infrastructure. Focus given on riparious woodlands and coastal dune forests	Cf. real estate
Oil industry	Led to the disappearance of the resin-tapping economy	
Renewable energies	Cf. biomass	The bubble of photovoltaic fields blew in 2011-2012, but could make a comeback

3.3.3 Concluding assessment

The aftermath of Klaus has strong and lasting effects on the regional markets of forest products and services from 'Landes of Gascony', enhanced by the regional nature of the damages and the specific vulnerabilities of a monospecific ~1Mha forest area -and its forestry wood chain. Understandably, the views of stakeholders are heavily influenced by the recovery from the storm: beyond the urgent needs of the crisis management, a willingness to restore regional markets for forest products and services to their 2007-2008 levels. Yet, most actors acknowledge that this regional evolution should not downplay the influence of wider economical trends. Regional bifurcations, with or without external shocks in the near future (such as another storm) are possible and may be underway (*e.g.* industry wood vs. timber…).

3.4 Technological development

3.4.1 Main characteristics

The most relevant technological developments affecting the 'Landes of Gascony' forest area could be summed up in the following short timeline. After the Second World War, the advent of the cheap oil era doomed turpentine and the local resin-tapping economy. Since the 1960s, and under the influence of paper mills, most efforts have been put on the improvement of an intensive silvicultural 'package', often qualified of 'ligniculture' composed of the following operations: drainage, soil tilling, phosphate fertilization, mechanical and chemical scrub cleaning (see also § 5.1.1 & § 5.1.2 for an historical overview). Typically implying the use of planted (70% since 1999) improved genetic material, current dominant silvicultural scenarios include four thinnings and a clearcut. With an average yield now above 10 m^3/ha/yr and a rotation shortened to 35-40 yr, production has been multiplied by 2.5 in 40 years. These technological options have had a complex relationship with recent storm damages, as mechanized harvesters have been generalized among forest contractors in the aftermath of the Martin storm.

In the last decade, sawmills, technologically lagging, have been placing much hope in green wood finger-jointing processes. During the early 2010s, most questions revolve around the uncertainties about wood energy (cogeneration, 2nd generation biorefineries...) and green chemistry uses. Despite having been the subject of recent regional discussions, notably in the context of the INRA-led backcasting exercise (Mora et al., 2012), technological developments in the fields of green chemistry and biofuels have not been much cited by interviewed stakeholders. An interviewed member of a public body considers yet that: "*green chemistry could be the future of the regional forestry wood chain. It could create an interesting added value. But don't we also need markets with a lower added value but better prospects for jobs? The art will be to keep every* [sector], *with an harmonization between territories."* (Interview S09). In addition, some stakeholders express yet their doubts about what could be technological fads: "[Recently,] *the only thing interesting the politicians are the wood's new uses. Wood chemistry, biofuels. You can see that novelty is luring them like butterflies towards a light. But we are losing the fundamentals."* (Interview S15)

With regards to the formal organization of what might be the regional innovation system of the forestry wood chain, studied by (Bélis-Bergouignan et al., 2010) and (Mora et al., 2012), we can remind here the existence in Bordeaux of: (i) Xylofutur, a dedicated 'competitiveness cluster' (*pôle de compétitivité*); (ii) Xyloforest, an 'Equipex' investment scheme focussed on forestry research (Xylosylve-Ecosylve/Xylobiotech/Xylomic) and wood transformation (Xyloplate/ Xylomat /Xylochem)

We discuss below the following technological developments in further details: mechanization, genetic selection, stump harvesting, green wood finger-jointing, resin-tapping. We end with innovative forest management schemes, which may be labelled as technological innovations in a very broad way, as they still require research efforts and empirical evidence to be legitimated in the region.

3.4.1.1 Mechanization

Forest mechanization has a long history in the 'Landes of Gascony' area. The example of *rouleau landais*, a heavy smashing roll usually mounted on agricultural tractors, is telling in this respect. It was invented locally as early as in 1922 and is still presented by diverse actors as the most common and favoured tool among forest contractors and owners in the region.

Mechanization is present in every steps of the forest stand's life, from plantation to the final harvest.

Soil tilling has become a standard practice in 'Landes of Gascony'. It is usually advocated for: (i) the prevention of concurrent vegetation; (ii) the development of young trees' rooting systems; (iii) the mineralization of the soils' humus; (iv) the counterbalance of the phosphorous deficit with the appliance fertilizers.

A widely shared lesson of the impacts of the Klaus storm seems to be an obvious superiority of full ploughing (*labour en plein*) over a strip ploughing (*labour en bandes*). The stability of young pines would indeed be affected by the existence of an inter-row wedge. Some actors question the ploughing practice on a general ground (soil disturbance, quality of the rooting of young pines…), while others target specific other techniques (subsidized in the post Klaus context) that they consider detrimental in the maintenance of young Pine stands (de Montpron, 2010): *"*[The rooting system of maritime Pine] *is developing at a very young age, reaching quickly consequent lengths at shallow depths: A two-year pine has roots crossing the inter-row, i.e. more than 4 m. Using a disc plough equates cutting this dense network, weakening seriously the stability of trees, and in the end, pave the way with a public spending for their planned fall."*

Other critics of mechanization rely on 'when-you-have-a-hammer,-everything-looks-like-a-nail' arguments for the case of drainage maintenance: "*In the past, ditches were dimensioned according to drainage needs.* […] *Now it is the bucket's size of the mechanical digger that determines the depth of the ditch. Even if you need 50 cm, it will be 2 m. This is a perverse effect of the technique, and it modifies the structure of the forested landscape*." (Interview S11)

For the harvesting side, the mechanization trend has been very important in Aquitaine, but in a rather less controversial way. Trials were underway since the late 70s in Aquitaine for the thinning of *P. pinaster* stands (Laurier, 2010), but it was not until the late 1990s that mechanization of the harvest really started in France, with a steep increase of sales in 1997-1998. Aquitaine followed the national trend but it was the impact of the Martin storm that fostered dramatically the equipment rate of regional forest contractors in the early 2000s, with the help of public subsidies.

Nowadays, an estimate of 250 harvesting machines (harvesters and harvesting heads) is operational on the *'Landes of Gascony'* forest area. *"Mechanization has led to a steadier maintenance rate of forests. It maintains employment amongst the forest contractors specialized in plantation. But many businesses have invested a lot and now are faced with underemployed machineries."* (Interview F02) Some stakeholders have indeed adverse feelings about this nearly-saturated equipment rate: They acknowledge that it was clearly an asset for the quick handling of Klaus storm damages. But on the other hand, it forces regional actors to take into account the redemption of this equipment –and the associated jobs- when considering medium-term prospects for the area.

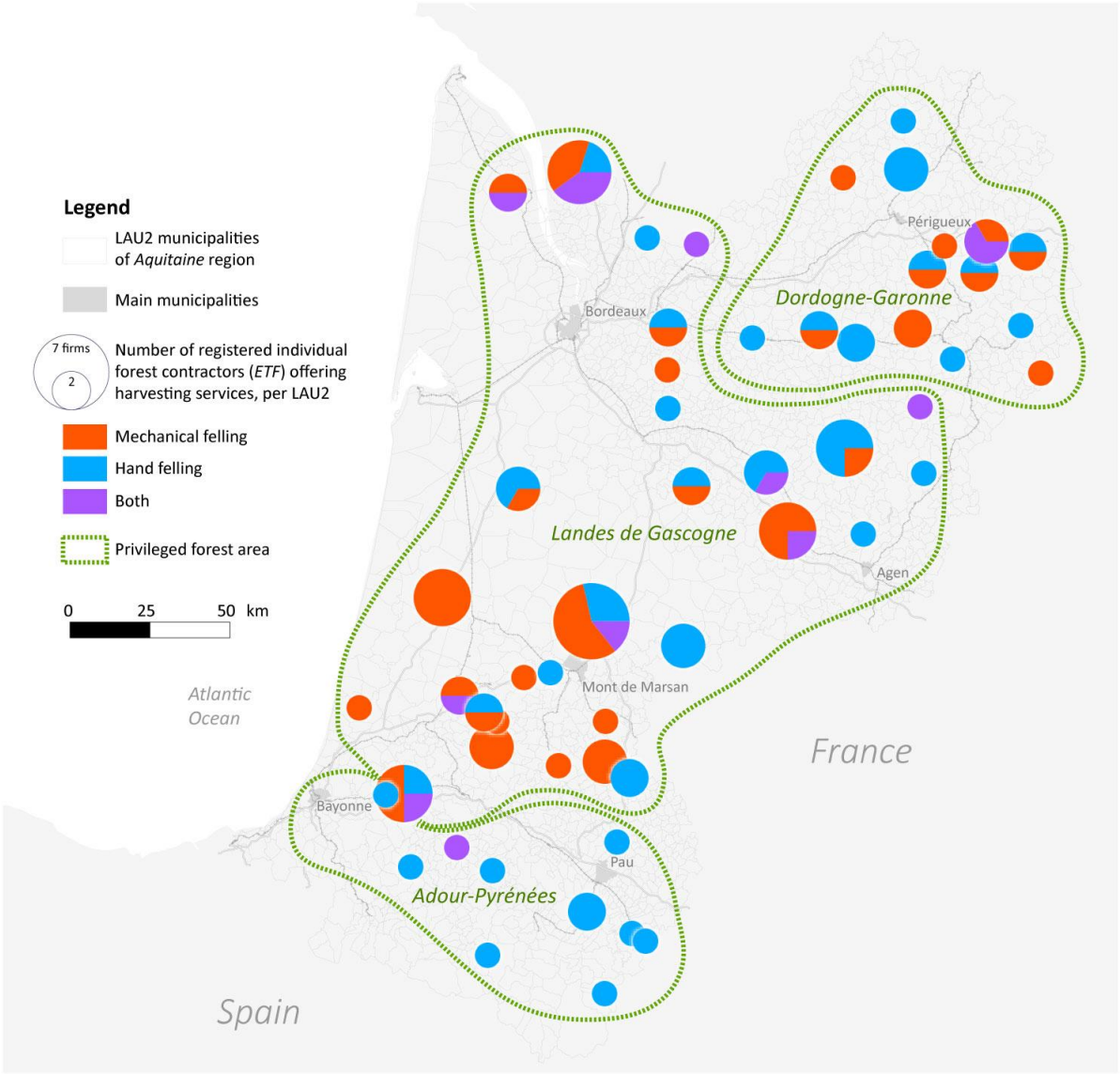


Figure 26: Forest contractors offering harvesting services in the *Aquitaine* region. Source: phone book of the *ETF Aquitaine* website (ETF Aquitaine, 2013).

Figure 26 shows the spatial distribution of independent loggers (*Entrepreneurs de Travaux Forestiers*) in the region, with their preferred forest areas. Loggers working in the *Adour-Pyrénées* area, due to the dominance of hardwood species and the mountainous context, remain mostly hand fellers (82%). The pattern is milder *Dordogne-Garonne* (55%), as a consequence of a better overall accessibility. The *'Landes of Gascony'* area is characterized by the largest attraction basin of the region and a much higher mechanization rate, reaching 66%. In the heart of the forest area, this share is obviously higher.

Because of the sandy context, the impacts on soils of heavy harvesters are not frequently evoked by stakeholders. Yet they might be underestimated: (Ampoorter et al., 2007) have demonstrated that skidding trails had notable effects on the compaction of sandy soils. Even if these effects are less important than in loamy-clayey textured soils, the very slow recovery of these soils can lead to a cumulative negative influence on tree root elongation.

3.4.1.2 Coarse wood debris, stumps… a broadening of the harvest

The intensification of forest management practices raised scientific concerns about the medium-term soil fertilities of *'Landes of Gascony"*s forest ecosystems (Trichet et al., 1999). For softwood species on sandy podzolic soils, a technical guide (Cacot et al., 2005) proposes for example a systematic fertilization after every harvest of coarse wood debris. The proposed rule of thumb is to compensate with at least 1.5X the exported mineral content, thus leading to the following fertilizing levels per hectare: 70 kg N, 20 kg P_20_5, 120 kg K_20, 120 kg CaO and 10 kg MgO.

The harvesting of pine stumps has been subject to recent R&D efforts and debates. This interest has been sparked by current operational needs: the supply plan of the Dalkia plant located in the *Smurfit Kappa / Cellulose du Pin* paper mill is for example mainly based on this resource. The rationale for such a move is to prevent conflicts with other industrial users. Yet, fertility concerns have been expressed and full biogeochemical assessments of silvicultural scenarios are still underway. The improvement and diffusion of adapted machineries, as well as 'preburning' processes were the objects of local efforts. A regional technical innovation has recently been claimed in this respect: new techniques were successful in reducing the content of sand in the stumps, a factor that was very detrimental to the maintenance and efficiency of boilers.

A few actors remain very dubious of the development of stump harvesting though: "s*tump harvesting, it is not a market"* (Interview F20). Some question moreover the very relevance of technical scenarios relying increasingly on the harvesting and processing of Pine non-timber wood products: "*the coarse wood debris should be left. We should stop here, fertility is maintained by leaves. For the harvesting of stumps, why not… but after the storm! Right now, it is a bit silly BUT profitable. But later, will it be the case?"* (Interview F02)

3.4.1.3 Genetic selection

A cooperative programme for the breeding of maritime pine, the 'GIS' Group '*Pin Maritime du Futur*', was set up in 1995 between research institutes (INRA, FCBA) and regional forestry institutions (CPFA, CRPF, ONF). The programme, later endorsed by the competitiveness cluster (*Pôle de Compétitivité*) Xylofutur, is funded under the project Fortius for the 2011-2014 period. Issued from 150 ha of seed orchards planted between 2003 and 2007, two new breeds have been recently put into markets, with an expected genetic gain close to 40% on volume and stem straightness over non-selected control stands: (i) *Landes* VF3 variety, in production since 2011; (ii) *Landes* x Corsica LC2 variety, in production since 2008 (Raffin and Alazard, 2013).

Expected results from the Fortius project should lead to the definition and trial of VF4 breeds in 2014, based on a broadening of selection criteria for *P. pinaster.* In addition to 'classic' traits (*i.e.* yield and straightness) and wood quality (density, spiral grain, branchiness), breeders now targets the adaptation to drought (dendroplasticity, cavitation resistance) and to pathogens. The latter would include Fomes (*Heterobasidion annosum*), *Armilaria* sp. and possibly Pine Wilt Nematode (*Bursaphelenchus xylophylus*) (Raffin, 2011). Dendroplasticity is defined as the ability for a given genotype to react differentially to varying environmental conditions, considered here as how the inter-annual patterns of growth rings are affected by climatic conditions (Raffin, 2010). Fittest trees are able to grow dense summer wood in case of severe droughts. As is the case with other traits, the question of whether this criterion can be included in the selection process is not fully settled.

Scientists involved in a similar breeding programme in Portugal concluded recently (Gaspar et al., 2009) that selecting maritime pine for growth could be achieved without affecting the following criterion: steady wood density, low spiral grain, increased radial modulus of elasticity, lower lignin

content. Yet, French breeders were less enthusiastic (Bouffier et al., 2009), considering that a trade-off with wood density remains when breeding maritime pine for growth. It can indeed be seen as a consequence of indirect selection on growth but also of a decrease of latewood proportion in the trees. The latter could be explained by the comparatively higher growth gains in earlywood but also more mechanistically by the higher share of juvenile wood in trees harvested at an earlier age. (Bouffier et al., 2009) underline moreover that a slight reduction of wood density is likely to lead to notable impacts on wood quality, relying on measures of physical properties (modulus of rupture and elasticity). Similar tradeoffs on quantitative traits are discussed in detail in (Lepoittevin et al., 2011), leading to a rather nuanced views of what might be the limits of genetic gains for VF3 and VF4 generations.

Most of the interviewed stakeholders express nevertheless a strong confidence in the positive impacts of *P. pinaster* regional breeding programmes, past and future. This confidence in technology has consequences on the forested landscapes they expect on a 30-50 yr timeframe that for many will remain in continuity. *"I believe a lot in the breeding of maritime Pine, as the work on 3rd and 4th generations will improve species in terms of quality and adaptation to climate change. Between what is planted now and what will be standing in 30-40 years, I am not upset. I even think that the whole 'Landes of Gascony' will look pretty much the same in 50 year as it is today - or at least as it was before january 2009."* (Interview S01). Much optimism is also placed by some in the broadening of selection criteria: "*I trust the work of scientists: "they will help us to fight hylobus, nematode and all the current dangers we face.* […] *Provided that we don't end with useless products with loads of branches, which would only be valuable for wood energy"* (Interview F20)

3.4.1.4 Green wood finger-jointing

Pragmatic difficulties associated with the competitiveness of pine timber are evoked by stakeholders: "*For the prospects of maritime pine timber, we have to look at the market, which is heavily dominated by Northern fir. Plus there are technological weaknesses"* (Interview S15). As a result most actors agree on the need for specific innovation on Pine products, especially timber: "*Innovation is needed, and specialization on products, because the maritime Pine from Landes is well… a pine, and not a siberian larch. On the other hand, this is a forest area that has been able to optimize its costs in an exceptional manner."* (Interview S14) Though, some stakeholders are easy to put the blame for this lagging situation on the lack of investment from the sawmill subsector: "*For 50 years, sawmills have earned their money with parquet and panelling, without asking themselves what else could be done with maritime Pine. So when other species arrived in a massive way... Now there is some interesting R&D but we are late, and maritime Pine has a bad image.* […] *But we have to convince people that maritime Pine is a good species. Xylofutur is helpful in this respect, noticeably thanks to this green wood finger-jointing process" (interview S01)*

ABOVE, a green wood finger-jointing process described for example in (Pommier and Elbez, 2006) may indeed be entering, with the support of the Xyloforest and Xylofutur schemes, in a pre-industrial phase in a near future. Such a process seems to win a large agreement among interviewed as a promising technique able to answer the needs of regional industries. A stakeholder (associated with the paper industries) remains interested but sceptical on the economic feasibility of such a technological process: "*If you want to make finger-jointed wood, you have to clear the 'industrialization' mark, master the gluing techniques, the drying... I do not feel that an industrial actor will be able to put 120M€ on the table for this. But there will be interesting developments of course, but not up to the expectations of the market on large dimensional timber. The demand is growing but the thresholds are too high. To interest the largest resellers and do-it-yourself stores, you have to bring 150 000 - 300 000 m3 of sawn wood, plus the quality control, etc... A regional market could emerge, but it would probably remain a niche."* (Interview S15)

Several sawmill industrialists expressed their general bitterness about the shortening of revolutions, as: "*There are EC norms on timber. If wood rings are above 1 cm, the timber won't be accepted. So the faster it grows, the worst it is* [for us]. […] *What they call timber, it's not more than 40 years. So it is not a good timber in any case. For me, they cut at midpoint*." (Interview S12)

The interviews suggest nevertheless that a process such as ABOVE would be widely accepted by the local sawmill industries. It would probably be considered as a stopgap solution, as it could validate in a way the evolution of the forest area towards the production of smaller and faster-growing timber: "*If dimensional timber were to be suppressed from Landes, we would have to go into this 'ABOVE' process. So we would finger-joint and paste… It would be different, less visually appalling*" (Interview S12)

3.4.1.5 Resin-tapping

As international markets for turpentine and gum rosin have become heavily dominated by China (followed by Indonesia & Brazil), the extraction of *P. pinaster* resin has remained at a residual level in south-western Europe. While the activity is still present in Portugal and Spain, it has totally disappeared in France since the 70s. Yet, regional interest has been recently reignited by a workshop organized in the context of an INTERREG project (SUST-FOREST), where optimistic accounts of a revival of the resin-tapping economy in Aquitaine were offered. In a medium-term perspective, the rise of labour costs in China and a post peak-oil context would offer new market opportunities. In this respect, European pine resins already have several comparative advantages (Blanchy, 2012): The first would be an easy and reliable eco-certification. The versatility of the European *P. pinaster* resin is also to be noted, as it is characterized a low content in Δ3-carene, an irritant usually incompatible with cosmetic uses.

Yet, considering the low productivity of resin extraction and the lack of maturity among regional industrial actors for an increased use of pine resin, an interviewed stakeholder involved in the FWC R&D remains sceptical of regional technological developments in this field: "*DRT* ['Dérivés Résiniques et Terpéniques', a regional company specialized in resin green chemistry], *considers that the production costs will remain higher than elsewhere. And if the price stays above 3€/kg, they will keep buying in Madagascar and China. We know that they are small projects here and there. So if you ask me whether resin-tapping can make a comeback, I would say yes, but only with small volumes and high added values*. […] *It could also imply political will*." (Interview S10) Even a representative from a regional ENGO is not overtly optimistic on such a move: "*A comeback of resin, I would be happy if it were possible. It would be an oxygen balloon for the local economy. But I don't really see how it could happen, only when oil will be scarce…"* (Interview S11)

Two trials were nevertheless underway in 2012 in Aquitaine: (Leneveu, 2012; Segouin, 2012): both were considering harvesting innovations (sealed plastic bags as collector, use of a activating paste), relying on partnerships with public actors (ONF, Le Porge's municipal forests) and on a niche strategy (wellbeing products for *Biogemme*, project for a 'controlled designation of origin' for *Domaines & Patrimoines*).

3.4.1.6 Feasibility and relevance of alternative forest management practices

The aftermaths of Martin and Klaus have led some actors to question the vulnerability of a large scale *P. pinaster* monoculture to storm damage and pests, leading to proposals including more room for broadleaved species and extensive management practices.

Regional actors have agreed on the general principle of giving a greater importance to broadleaved stands in the whole forest area, leading for example to biodiversity clauses in the subsidy schemes associated with the post-Klaus recovery. Yet, a detailed rationale for the design of landscape-level rules able to increase the overall resistance of forest stands to pests is yet to be achieved. The role allowed to hardwood species in the dominant pine matrix depends of course of the pests to be considered. While there is clear evidence that broadleaved-dominated edges are detrimental to the progression of processionary moths, the dynamics of other important pests such as the *Ips sextantus* bark beetle seem to be driven by more complex multiscale patterns (Jactel, 2011; Piou et al., 2011). Recent evidence on oaks suggests though that generalist leaf-feeding insect herbivores can have more damage with an increasing vegetation diversity (associational susceptibility), but also a decreased abundance of specialist insects (Giffard et al., 2012). Further works could help qualify these relationships for Pine, and establish the spatial patterns able to reach the best compromises with production objectives.

Another line of inquiry resides in the empirical assessment of an extensive forest scenario on longer rotations (Müller and Hazera, 2010). Qualified by its proponents as a 'natural and continuous silviculture', it still remains far from the irregular, 'close-to-nature' forestry usually associated with Pro Silva's technical proposals. Regular treatment and clearcuts are in particular kept as the usual features of the Pine model, but by adding a priority to natural regeneration, as well as a substantial overlap between generations. Regional debates have been fierce around these proposals, which remain marginal at the level of the whole forest area. Yet, as one of the local stakeholders' testimonies, there seems to be more common ground than previously thought: *"If you favour natural regeneration to limit the costs, you have to clear intra-plot access strips* (cloisonnements). *The harvester then gets the whole biomass in the inter-raws, so you can have a wood-energy output. So you can have both* [kind of products in a same plot]. *And by the way, you can also let the regeneration grow under large pines, and cut the understorey every 10 years. It is a bit utopian, but if the primary objective remains quality timber, you can do anything besides, provided you don't compromise this* [quality-oriented] *primary management objective*." (Interview F02)

The most common attributes of the forest scenarios asked for by managers and stakeholders are reversibility and choice: "*I think that the forest owner should always be able to keep a maximal array of choices, and that he/she would have access to reversible management options. This is what will enable a dynamic silviculture, maintained forest stands and a decrease in fire risks"* (Interview S07). This view is also backed by a member of the administration: *"We are talking of short but reversible silvicultural scenarios. The idea is to get something leaner, to have a better answer to markets."* (Interview S09) And for a manager, the perspective is similar: *"I want forest stands with as many potential outputs as possible. With the standard management, I can cut everything at year 15 for industrial wood or wait for timber."* (Interview S20) It remains then to be seen on how far these demands for a versatile forest management can be reconciled with other objectives.

3.4.2 Impacts

Table 24: Impacts of technological developments on forest operations, products and ecosystem services

	Evident or presumed impacts of technological developments on…		
Technology	*…the way forest operations are executed…*	*…the supply of and the demand for specific wood products…*	*…the supply or the condition of and the demand for other ecosystem services*
Mechanized tillage	Has become a typical component of the ligniculture 'package'	Is favoured for an easy installment of young pines	Is criticized for its destructuring effects on soils, and rooting patterns
Mechanized harvest	Has improved productivity and security for fellers	Has eased the profitability of thinnings and final cuts	Sandy soils, while not the most sensitive, are affected by heavy machinery
Green wood finger-jointing	Would be compatible with current or even shorter rotations	Would represent another outlet for small dimensional wood	Conversely, would be compatible with a decrease of slightly more biodiverse older stands
Green chemistry	-	Specialty cellulose implies a preference for long fibers, obtained from larger pines timber	
Genetic selection	Implies a mandatory plantation and a dependence from orchards	Should lead to increased (or at least maintained) wood yields	Potential vulnerabilities of monoclonal plantations (pest) Marginalization of extensive practices (Cf. tillage)
Resin-tapping	Would imply less intensive forest scenarios but a labour-intensive presence for the tapping	Could be a complement of a 'niche' supply based on dimensional timber	In addition to turpentine and gum rosin products themselves, regional interest for the cultural component of resin-tapping
Deciduous species	May imply a more complex access to forest stands	Would imply in the short term a reduction in production Potential outlet for biomass wood log	In addition to regulating services, could have potential effects on game

3.4.3 Concluding assessment

The dramatic productivity increases (maritime pine yields, work productivity of forest contractors) have self-reinforced a 'planted pine' model over the last forty years. Yet competing interests, within industrial uses, remain: the selection criteria and the shortening of rotations have been more positive for paper & particle board industries than for timber users. New alliances might emerge around specific niches between users of specialty cellulose and sawmills. Regarding wood energy, stump harvesting is for now a privileged option. Debates around the post-Klaus recovery exhibit strong patterns of **path-dependency**: tillage and plantation are identified by critics as determinants of storm vulnerabilities, while key actors of the area (contractors, cooperatives) have based their development on these options.

3.5Ownership structure and tenure

The Gascony forest being predominantly privately owned, one should refer to § 3.1.2 and § 5.2.3 for a full overview of private forest owners (demography, management styles…). We hereby focus in this topic on public ownership and on specific private tenure arrangements (institutional owners, management delegation).

3.5.1 Main characteristics

French forests are mainly private (70%) but this share is higher in 'Landes of Gascony', reaching according to a 2010 estimate of the national forest inventory 92% of the forest area (on SER *Landes de Gascogne, Dunes atlantiques, Bazadais, Double et Landais*).

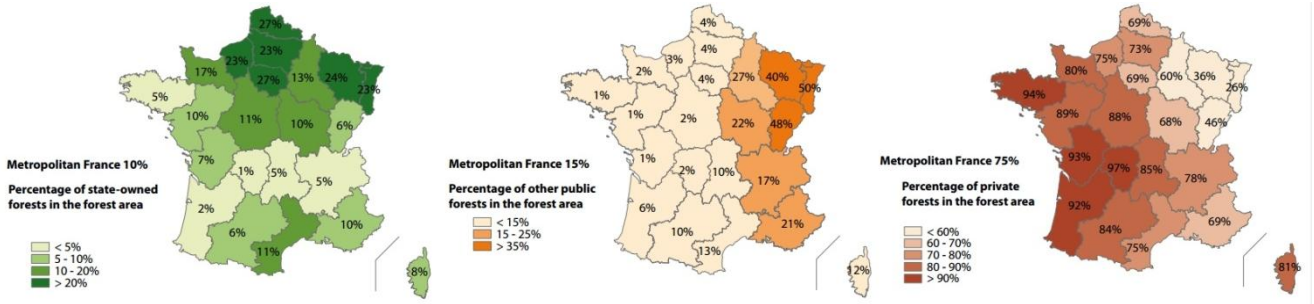


Figure 27: Percentages of private, state-owned and other public forests in metropolitan regions of France. Source: (French National Forest Inventory, 2010), survey years 2006 to 2009, forests available for wood supply

In 'Landes of Gascony', state-owned forests are mainly littoral forests, with only a few left in the plateau. There, municipality-owned forests are common. Both types are by default managed by the state-owned forest company ONF. It should be noted though that important shares of the area, while publicly owned, remains distracted from this management, either because they are devoted to military uses or because they are managed by LAU2 municipalities on they own by special dispensation (*Cf.* 3.5.2). A realistic estimate of public ownership in 'Landes of Gascony' could amount to 14% instead of 8% (ONF, personal communication).

As shown in

Table 25, public forests are mostly owned by State or municipalities. Except in Dordogne and Lot-et-Garonne, municipal forests even amounts to a clear majority of public forests in Aquitaine. Other schemes include public institutions, regions or inter-municipal groupings. The smaller settings of village communities forests (*forêts sectionales*), where village dwellers keep customary rights on their neighbouring woodlands; are uncommon and remain oddities in the regional context.

Table 25: Distribution of the ownership of the public forests managed by ONF in the Aquitaine region in 2012. Figures are areas in ha, with the number of estates in italics between brackets. Source: ONF, *forêts publiques d'Aquitaine* 2012, own GIS calculations

	Village communities	LAU2 municip.	Other local authorities*	Public institutions	NUTS-3 region	NUTS-2 region	State**	*Sum*
		268,6	299,6		345,1		2346,3	3 259,5
Dordogne		*(10)*	*(5)*		*(2)*		*(7)*	*(24)*
		27 961,7	14,7	1 361,7	1 052,9		22 875,3	53 266,4
Gironde		*(37)*	*(1)*	*(7)*	*(7)*		*(11)*	*(63)*
	12,5	30 666,4	25,0	553,6	1 539,9		26 513,3	59 310,8
Landes	*(1)*	*(129)*	*(1)*	*(7)*	*(3)*		*(9)*	*(150)*
		1 622,4	46,6				1 711,6	3 380,6
Lot-et-Garonne		*(12)*	*(1)*				*(1)*	*(14)*
	352,7	58 363,5	22 308,3		198,1	14,1	299,3	81 535,9
Pyrénées Atlantiques	*(1)*	*(190)*	*(23)*		*(3)*	*(1)*	*(1)*	*(219)*
	365,2	11 8882,6	22 694,2	1 915,4	3 136,0	14,1	53 745,7	200 753,2
Total for Aquitaine	*(2)*	*(378)*	*(31)*	*(14)*	*(15)*	*(1)*	*(29)*	*(470)*

*: Either a form of agreement between local authorities (via inter-LAU2 groupings, or *indivision* joint ownership) or unspecified status

**: excluding "military forests" distracted from ONF management, reaching at least 5868 ha in *Gironde* and 10 096 ha in *Landes, (ONF, 2006c)*

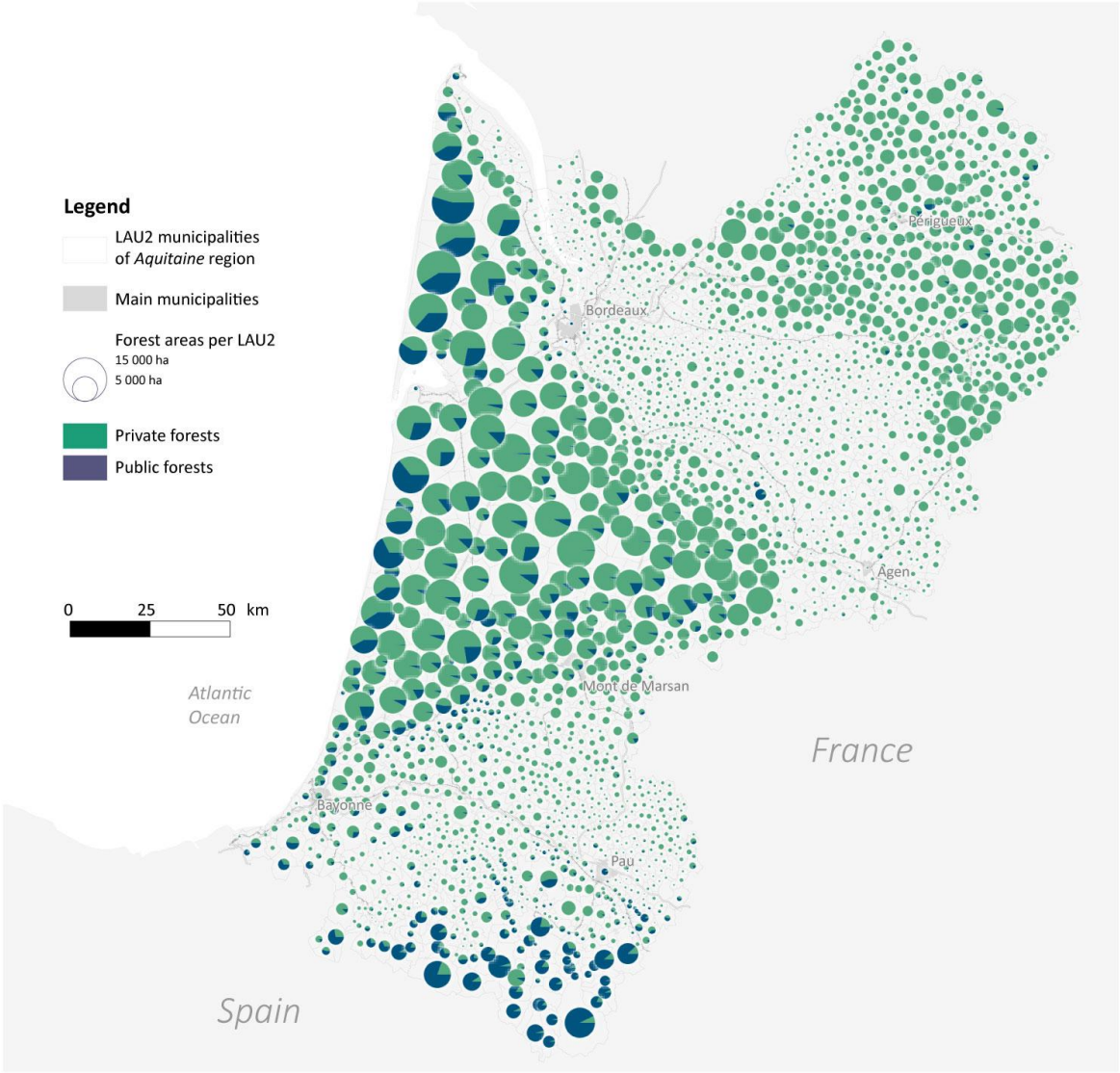


Figure 28: Forest areas, private and public, in Aquitaine municipalities. Source: Pigma *Géocatalogue*, CRPF analysis DGFIP 2009 cadastre data, here restricted to parcels classified as 'woods'

Figure 28 allows gaining an insight on the regional spatial patterns of private/public forest ownerships. The pie areas, designed to scale, display clearly the higher forest cover rates in 'Landes of Gascony', Dordogne (NE) and Pyrénées (SE). Public forest is dominant in coastal dunes and in the mountainous areas of Pyrénées-Atlantique. Elsewhere, private ownership is the norm.

One should refer to § 3.1.2.1 for a more complete overview of private owners and their properties. It can be reminded that private owners are very diverse, some of them being of an institutional nature. The public holding *Caisse des Dépôts et des Consignations* manages for example over 230 000 ha in France (including 45 000 ha in the greater southwest of metropolitan France), mainly on behalf of banks & insuring companies. A noticeable share of its own properties is located in the heart of Gascony, in the 'Pontenx' case study area (15 000 ha of the *Groupement Forestier de la Compagnie des Landes*).

Figure 29: Distribution of forest properties areas in NUTS regions and case study areas for the INTEGRAL French case. Sources: Pigma geocatalogue, CRPF analysis of DGFIP 2009 cadastre data, here restricted to parcels classified as 'woods'

A distinctive feature of forest ownership in 'Landes of Gascony', compared with other forested areas of metropolitan France, is the prevalence of large landowners. Figure 29 offer a glimpse of the distribution of the sizes of forest ownership at several levels in Aquitaine. A warning should be issued here: as the underlying data, based on cadastre, is processed and released by CRPF at the level of municipalities, the real size of the largest private properties is underestimated, as these may often be spread over several LAU2 municipalities. Another bias is to be found in the variability of the area of the municipalities themselves, which are notoriously larger in the heart of 'Landes of Gascony' than in other parts of Aquitaine. With those important limitations in mind, one can compare the shapes of distributions for the whole Aquitaine with those of the 'Pontenx' case study: the proportion of properties below 25 ha is much lower than in the regional average.

A Lorenz curve (Cf. Figure 30) of all (*i.e*. forest and non-forest) the cadastered land of the 'Pontenx' case study gives an even greater imbalance, where the 20 largest of the 10000 landowners (private and public) control more than 80% of the whole area.

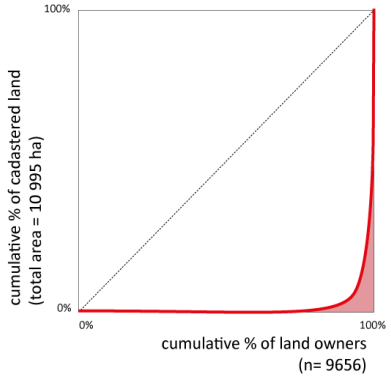


Figure 30: Lorenz curve of cadastered land - Pontenx case study. Source: DGFiP, provided by Pigma

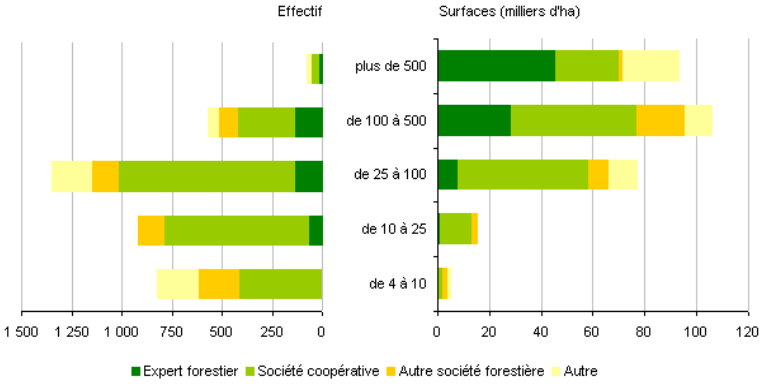


Figure 31: Management delegations amongst private owners in Aquitaine region. Source: (Garnier et al., 2012)

3.5.2 Changes and impacts

While ownership structures have remained rather stable, the most relevant changes resides in the development of the sharing or delegation of the forest management with external actors, as well as in the pooling with other landowners for specific operations. Owners may indeed delegate to various actors (forest experts, forest cooperatives, loggers and forest contractors) parts of their management tasks: management plan, harvesting and marketing... Different types of groupings are also linked with fiscal incentives or subsidies for smallholders. As described by Figure 31, delegations are made for substantial areas and -except for the very large domains- are preferentially contracted with forest cooperatives (in light green in the barplot). The local cooperative CAFSA (now merged in the 'Alliance' 'super' cooperative, see § 4.1.4.1), has become in this respect a key actor of the region.

The nature of the advice and consulting offered to forest owners is questioned by some stakeholders. Forest experts express for example their worries about the newly introduced status of 'Professional forest manager': *"A forest contractor will be allowed to advise the owner on the relevance of forest works – and to do the job! He will be judge and defendant, so it is a problem".* (Interview F08)

But most of the critics are targeted at the cooperatives, accused of having drifted from their initial aims: *"Cooperatives have been created to put together the smallholders and to give them an access to the forestry-wood chain. But in the end, this is not the main part of their activity, as Alliance has*

become an important tool of silviculture, forest logging and trade. […] To me, they are behaving much more like large forest loggers than anything else." (Interview F08) *"I have the feeling that [forest cooperative] is a bit of an incestuous business because they do everything: they advise, they sell the plantation work, the scrub cleaning, they buy the wood… In another industry, I wouldn't give so much power in the hands of one external actor […] it does not mean we do not want to make them work for us. [...] They are good for forest operations. But for this storm, they have not been fair; they've wanted to make money."* (Interview F07)

Another trend is linked to public forest, as a tension exists between ONF and some forest municipalities regarding the mandatory management that the public body offers to the latter as part of the 'national forest regime' (*régime forestier*). In the Landes *département*, hundreds of municipalities have been managing their forests on their own since the late 40s, without being 'subdued' (*i.e*. *soumises*) to *régime forestier*. Only present in another region of metropolitan France (Auvergne), this atypical situation has led to a tense setting in the context of the post-Klaus recovery: subsidies were reserved to private or 'subdued' forests, thus prompting mayors to join their forces to express legal claims to the state administration. In mid-2013, four municipalities had finally accepted the ONF management, while few others were aiming for a settlement from the Court of Cassation of what they considered as an unfair treatment.

The last relevant changes are the inputs/outputs of wooded lands with other land uses. Figure 32 shows that for the whole Aquitaine, authorized clearings have been on the rise over the last decade. Agriculture remains an important sink, while urban areas took most of their share between 2005 and 2008. These regional patterns will deserve further investigations of LULC changes in the 'Pontenx' case study area, with alternate sources.

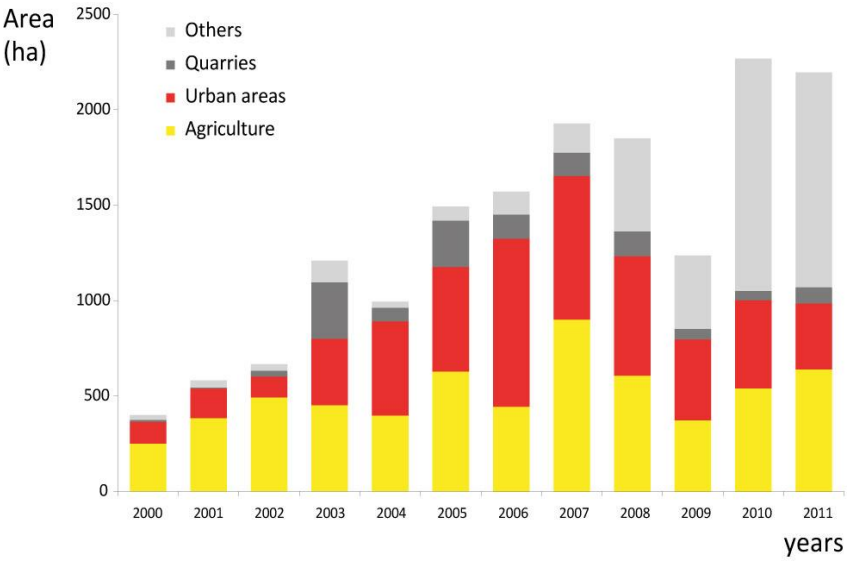


Figure 32: Clearing authorizations in the Aquitaine region. Adapted from (DRAAF Aquitaine, 2013)

3.6 Forest policy regime

In the policy change literature, the policy regime model is described as a framework which provides a multicausal approach emphasizing the interaction of actors, institutions and ideas (Hoberg, 2011) and combines a perspective on exogenous factors with a focus on political processes (Wilson, 2000). In fact, policy regime approach aims at grasping all the political dimensions of the policy making process related to the definition of rules, roles and power relationships around a specific issue area (i.e. a sector). Dealing with the political dimensions of the sector based regulation leads to conceptualizing the policy regime as a temporarily stabilized frame for the political work and as a potential target of the political work. Here, political work is considered as the cause of institutional changes (policy changes and policy regime reconfiguration).

We consider that political work (Jullien and Smith, 2008) relies on practices both concerning definition of the 'public problems' upon which policy instruments for collective and/or public action repose and processes of politicization which legitimize or delegitimize such problems and the policy instruments to which they give rise. Consequently, the components of a policy regime are 'political ideas', 'political mediation patterns' and 'political authorities'. First, the dominant political ideas shape the way 'public problems' are defined, the types of solutions offered, and the kinds of policies proposed. Second, the process of politicization entails the organization of collective action through political mediation patterns which include alliances or conflicts between stakeholders and discussions/negotiations with political authorities. Third, political work is oriented toward political authorities (Skogstad, 2003) and aims at influencing/orienting the development of public policies by convincing or forcing them to adopt new rules, regulations and routines.

3.6.1 Forest policy authority

The exercise of authority in the French forest sector has for a long time been devoted to the State. This dominant form of policy authority, based on the state-centered model of representative democracy, empowered the State to make legally enforceable decisions and to deliver policy outcomes which are considered as consistent with the general interest. The legitimacy of the legal authority of the state has long been reinforced by the expert authority provided by the forest administration which has been well recognized for his skills and knowledge in forest related issues.

Thus, considering the ongoing implementation of a 'reforming program of the general public sector', the question is whether the state monopoly of forest policy authority is eroding with the empowerment of regional and local governments, as well as private bodies and NGOs acquiring previously public responsibilities.

3.6.1.1 The authority of the State on the forest sector

The French Forest reform act of 2001 has reaffirmed that the political authority on the forest policy is entrusted to the State. The French State is responsible for overseeing the implementation and application of the legislation (Forest Code) and developing national strategies and policies. According to this legal framework, the French forest policy aims at regulating the activities related to the management of forest areas and to the economic development of the wood-based industry. The Forest policy also participates in the development and implementation of other policies including rural development, promotion of employment, fight against the greenhouse effect, preservation of biodiversity, protection of soil and water and natural risk prevention.

The main administrative body in charge of the Forest policy is the Directorate of Forestry and Wood, which is part of the Ministry of Agriculture. It is responsible for coordinating regulations of forest management activities (clearing regulation, management plans) and supports for forestry investments (incentives and tax reliefs), for fire risk and forest disease prevention, for game management and for international representation.

This State authority on the forest sector is organized through different levels of administrative deconcentrated services. At the regional level, the forest service is in charge of the local implementation of the national policy. This regional service is in charge of the administration of the EAFRD funds in accordance with the provision of the Hexagonal Rural Development Program (PDRH). At the NUTS-3 level (*département*), there is no dedicated forest service since 2010, but forest issues are treated in a transversal manner, and in most cases forest agents are now part of the 'environment' services.

State forest services are also responsible for the support programs for the primary manufacturing sub sector (loggers and sawmill) while support programs for the secondary manufacturing sub sector (paper industry, wood panel industry, furniture and wood building industry …) are assigned to the Ministry of Industry.

The State is also involved in the management of the forest of the country (both public and private one) by financing and contracting with two public bodies. First, the *Office National des Forêts* (ONF) is a national public forest enterprise which is in charge of the management of the public forest, i.e. the state-owned forests and the others public bodies-owned forests (mainly municipalities' ones). Since 1827, all these public forests have to be managed in accordance with the legal framework of the forestry regime. ONF has been created in 1964 to implement this forestry regime. ONF activities are of a twofold nature in so far as, on the one hand, it carries out an exclusive public mandate on the management of public forests (including general interest missions commissioned by the French state such as dune management and biodiversity protection) and, on the other, it is engaged in a commercial activity in competition with other market operators. Second, the *Centre National de la Propriété Forestière* (CNPF) is a national public body which both offers a technical support to private forest owners and is responsible for the approbation of management plans, compulsory or voluntary. It is a public institution under the supervision of the Ministry of Agriculture and Forestry. It was established in 2009 by the merger of 19 previously independent agencies: 18 Regional Centers for Private Forest (CRPF), National Professional Center for Private forest (CNPPF) and the Institute for Forestry Development (IDF). The CNPF provides training, to disseminate good practices in forestry, and to foster private owners' involvement regarding forest management progress.

In France, the institutional framework for the forest sector has remained quite stable over time. The State keeps the control on the regulation policy and is always involved in the management of public forests (ONF) and in the support of the management of private forests (CNPF and subsidies). However, this model of organization is now being questioned. In fact, the reforming programs of the general public sector lead to a decrease of the means devoted to forest policy (see Table 26). In this context new forms of authority are emerging. First, local authorities seem to be more and more involved in forest policy. Recently, regional councils have been designed as managing authority for the EAFRD funds for the period 2014-2020. Second, the PEFC forest certification system is well developed in France and has been reformed in 2012 to improve his credibility and his efficiency.

Table 26: Human resources devoted to State forest policy

	National scale			Regional scale (Aquitaine)
	1999	2010	Variation	2010
Ministry of agriculture (administration)	660	530	- 20 %	30
Public body in charge of private forest (CNPF)	?	464		40
Public body in charge of public forest (ONF)	12 600	10 200	- 20 %	200

3.6.1.2 Peripheral role of decentralized authorities in the forest sector

The legal context provides little decentralized powers to municipalities, *départements* or regions in forestry. However, these local political authorities have some forest and wood industry responsibilities at the margins of the sector.

Regional councils have the general skills related to economic development and vocational training (since 1983). As such, they have the ability to support wood processing companies through collective or individual devices and are responsible for training for careers in forestry or wood industry. In addition, Regional councils are more and more concerned by environmental issues, so they get involved in programs oriented on the promotion of wood energy and wood building activities (Regional Climate Plan). Finally, some regional authorities give subsidies to research and technological development programs. For example, the Aquitaine regional council is a partner of the national competitiveness cluster for innovations in forestry and wood industry (XYLOFUTUR – Products and materials for cultivated forests).

NUTS-3 level executive bodies (*Conseils Généraux* or *Départementaux*) and municipalities have regulatory powers relating to the protection of the environment and improving the quality of life, to land use planning and to management of the road network. First, *Conseils Généraux* are thus involved in the protection and development of agricultural and forest areas. They have the power to delineate areas within which they can exercise a right of pre-emption and implement Sensitive Natural Areas. To acquire the land and / or to manage it, they levy a tax on the granting of building permits. The councils are also responsible for the implementation of land development procedures (exchange and reallocation of properties) and for the regulation of afforestation. Then the regulatory power of municipalities over forest areas is mainly expressed in the context of land use planning documents; they can classify some forest areas for environmental reasons.

Finally, municipalities and *Conseils Généraux* are respectively responsible for municipal roads, NUTS-3 level and national roads of local interest, and are therefore affected by problems related to timber transportation.

Beyond this framework set by the decentralization process, local authorities are allowed to be involved directly in the forest sector policy. Consequently, most of the regional and *Conseils Généraux* have elaborated action plans dedicated to the support of the forestry activities. A share of these subsidies supplement State and European ones in accordance with the State-Region Contract Project (CPER) and the Hexagonal Rural Development Program (PDRH) but NUTS-2 and NUTS-3 levels authorities also intervene alone and follow their own strategy. However, the State remains the most important financial contributor of the forest policy (see Table 27).

Table 27: Estimation of public subsidies devoted to forest policy

			2000 - 2006			2008	
			Per year	%	Per year/ha		
Europe			50 M€	9 %	3 €/ha	60 M€	3.5€/ha
State	Ministry of agriculture	Subsidies for management of public forests	190 M€	80 %		180 M€	20 €/ha
		Others	190 M€		23 €/ha	130 M€	
	Tax relief (private forest)		80 M€		6.5 €/ha	80 M€	6.5 €/ha
Conseil Régional (NUTS-2)						*Aquitaine* 2.2 M€	1.2 €/ha
Conseil Général (NUTS-3)			60 M€	11 %	3.5 €/ha	*Gironde* (2007) 270 000 €	0.5 €/ha
Total			***570 M€***		***36.5 €/ha***		***32 €/ha***

3.6.1.3 Private regulation of forest management practices

PEFC France is an association which is linked with an international body (PEFC Council) based in Geneva. The purpose of the PEFC certification is to ensure the consumer that the product purchased is part of a responsible approach to sustainable forest management. The association has three colleges (producers, processors and users) involved in issues relating to the implementation of the PEFC certification including the definition of the French Forest Certification schemes reset every 5 years with the objective of continuous improvement. PEFC certification system is based on two complementary pillars: the application of specifications relating to the sustainable management of forests and the establishment of a chain of custody that ensures traceability and reliability of PEFC certified products. Based on these two pillars, the system consists of 3 separate certification schemes: the owners' certification, certification of forest managers and certification of companies in the wood industry. Since 2012, the PEFC France no longer relies on a single specification whereas previously PEFC France was divided into different regional entities (14), each of which defined its own criteria for sustainable forest management. Now, these regional entities are in charge of implementation and control of the national PEFC certification scheme.

At the beginning, development of the PEFC certification scheme in France has been slow, mainly due to inefficiency of regional entities and to mistrust of industry. Nevertheless, certified wood product markets are increasing and PEFC has received support from the French state which promote certification scheme through its government purchasing policy and favours PEFC for certification of public forests. In 2012, 5,000,000 hectares are certified PEFC in France: 42% of private forests (2 million ha), 30% of public forests (1.6 million ha) and 27% of municipal forests (1.4 million ha). This represents 17% of the private forest area (approximately 52,000 owners), 50% of the municipality forests and the entire public forests. In addition, 2,600 companies are certified under the control chain with 800 operators, loggers and sawmill industrialists, 500 printing companies and graphic chain. Note that the FSC (Forest Stewardship Council) in 2011 represented only an area of 16 000 ha certified for 17 owners and 10 loggers.

By comparison, the public system for the control of forest management practices concerns 7,000,000 hectares and 27% of the private forest area (2.8 million ha). According to some stakeholders, these two systems are redundant and it may be appropriate in the future to retain only the private one. Nonetheless, in a report published in 2007 some forestry experts said: *"Simplifications can be seen in the content of the documents or procedures implemented or through the establishment of one-stop devices. However, the substitution by the current certification system of the management documents provided by the Forest Code cannot be considered without caution and gradualism" (Bourgau et al., 2007)*.

Table 28: Main national interest groups of forest sector

	Description	Date of birth	Number of members (representativeness)
Forestiers Privés de France (FPF)	FPF is the National federation of unions of private forest owners. It gathers 18 regional unions and 78 NUTS-3 level or inter-NUTS-3 unions. It represents forest owners at the national level and shall take any initiative in favour of private forests. FPF is mainly financed by contributions from forest owners adhering to NUTS-3 level unions.	1943	Private forest owners 30 000 (2.7 %)[10] (2 million ha) (20 %)*
Centre National de la Propriété Forestière (CNPF)	CNPF is a public body administrated by representatives of private forest owners. In each region, there are Regional Center of the private forest (CRPF).		
Syndicat des Sylviculteurs du Sud Ouest (SYSSO)	SYSSO is a local union of private forest owners. It represents forest owners of the 'Landes of Gascony' forest region at the regional, national and European level. It is not a member of FPF but it has funded USSE (Union of Foresters of Southern Europe) in partnership with Spanish and Portuguese forest owners associations.	1917	Private forest owners 6 000
Fédération Nationale des Communes Forestières (FNCOFOR)	National federation of forest municipalities (FNCOFOR) regroups 45 NUTS-3 level associations and 10 regional unions. It aims to improve, develop and promote the municipal forest heritage by working for sustainable management and making the forest a strong element of local development. It represents the interests of municipalities with French political and administrative and it controls the execution of experiments or animation of networks: patterns of forest policy, forest charters, wood energy, Natura 2000.	1933	Forest municipalities 5 000 (45 %) (1.6 million ha) (60 %)
Compagnie Nationale des Ingénieurs et Experts Forestiers et des Experts Bois (CNIEFEB)	National agency of forestry and wood experts is an association of professionals who practice the profession of forestry advisor. It regroups 11 regional associations		Forestry advisors 170
Union de la Coopération Forestière Française (UCFF)	UCFF consists of 21 forestry cooperatives and forest management groups mainly in charge of forest management and wood harvesting and selling. It regroups forestry cooperatives in order to best defend their interests and those of forest owners, members of these organizations, with governments	1997	Forestry cooperatives 21 350 million € (turnover) 900 employees 108 000 forest owners (10 %)* 2 million ha (20 %)*
Fédération Nationale du Bois (FNB)	National Federation of Wood gathers the professional organization and unions of loggers and sawmills industries, as well as specialized agencies in the promotion of French wood species. It regroups more than 80 national and local organizations.		Firms 1 750 5 billion € (turnover) 40 000 employees
France Nature Environnement (FNE)	FNE gathers more than 3 000 environmental associations. It deals with many environmental issues. A part of his activity is devoted to forest policy (forest network)	1968	Civil society 850 000
Confédération française de l'industrie des papiers, cartons et celluloses (COPACEL)	COPACEL is a trade association which brings together French companies producing pulp, paper and paperboard, in order to promote economic development.		Firms 80 6.9 billion € (turnover) 15 000 employees
Fédération Nationale des Entrepreneurs des Territoires (FNEDT)	FNEDT is a trade association which gathers professional contractors in agricultural, forestry and rural works. The FNEDT now includes 80 NUTS-3 level unions and 20 regional unions	2003	Firms 21 000 80 000 employees
Union des Industries de Panneaux de Process (UIPP)	The UIPP, Union of Industries Process Panels is the trade association of manufacturers of wood-based panels (particle board, fibre board and OSB)		Firms 13 1.2 billon € (turnover) 3 000 (employees)

* Based on properties > 1 ha (1.1 million of private forest owners – 9 million ha)

3.6.2 Political mediation patterns

In France, forest policy issues are not present in the public debates. Many forest problems are related to key contemporary political issues like rural development, (re)industrialization, biodiversity conservation, climate change, nevertheless they are not regarded as urgent and rarely publicized by political actors. Different interest groups (See Table 28) are representing forest policy issues but they participate in a political work which is still dominated by a sector-centred logic of action. Most of this groups have representative structures at the local scale (NUTS-3, inter-NUTS-3, NUTS-2, inter-NUTS-2) but, except for the South-West France Forestry Syndicate (SYSSO), they are all grouped at the national scale.

In the 1980s', the forest sector political mediation patterns have been described as corporatist (Buttoud, 1983). Here, it is analyzed through the way sector based mediation arenas institutionalize political dialogue and the way sector based mediation practices contribute to the involvement of interest groups in the policy-making process.

3.6.2.1 Mediation arenas in the forest sector

The framework of every policy-making process provides some formal spaces of mediation dedicated to negotiation and formulation of policy contents. These mediation arenas are sector or inter-sector institutionalized structures which gather public actors and selected representatives of private interests and possess limited decision-making competencies. According to some scholars, they can be considered as strategies of 'administrative interest intermediation' (Lehmbruch, 1987) , with administrative actors driving the organization and coordination of private interests in order to increase governance capacities. This form of government has been criticized for not being pluralistic and not suitable for policy regulation in a context of evolution of State power and policy problems (Hassenteufel, 1990; Knill, 2001). In the context of the French forest policy, State administration still legitimate his action by organizing mediation arenas but decentralized (regional and local) and private (i.e. PEFC association) authorities also promote their own mediation structures.

The legal framework of the state forest policy provides some advisory bodies which are supposed to involve representatives of interest groups in the policy-making process.
First, according to the Forest Code, the Higher Council of the forest, forest products and wood processing (*Conseil Supérieur de la Forêt, des Produits Forestiers et de la Transformation du Bois*) is supposed to take part of the definition, implementation and evaluation of the national forest policy under the Minister's authority. This advisory body has been created in 1964, after many reforms which has contributed to increase the number of members, it is now composed of: 10 elected representatives; 10 representatives of relevant ministries; 5 representatives of public bodies (ONF, CNPF …) ; 29 representatives of interest groups (forest owners, industrials, environmental NGO's, architects, forestry advisors …) ; 5 forestry experts. This Council is intended to meet annually but since 2008 only 2 meetings have been organized (2009 and 2013). In 2007, it has been mobilized by the ministry of Agriculture to translate the '*Grenelle de l'Environnement'* objectives into forest policy by taking specific measures. This consultation resulted in the adoption of an action plan (20 concrete measures) but few of this measures were actually implemented. For example, a plan of 100 million € per year for five years should have been established to support wood mobilization, but it has not been funded yet.

In addition some similar regional commissions of forest and wood products (*Commission régionale de la forêt et des produits forestiers*) are responsible, since 1985, for the control of the implementation of the forest policy at the regional scale. In few regions the Commission meets regularly to keep all the regional stakeholders informed on the forest policy ongoing process. In practice, however, these Commissions do not hold regular meetings; most often they are only involved occasionally in the

elaboration of the Regional Forestry Orientations (ORF). These ORF, which are usually redefined every 10 to 15 years, are legal documents providing some regional guidelines for all management plans established at the scale of the property.

According to many stakeholders, these national and regional advisory bodies are not contributing to a better involvement of interest groups and non-state actors in the forest policy making process. As mentioned by the president of FNCOFOR in 2003: *"These two bodies are mainly administrative in character, even if they are now much more open to consultation with civil society. The role of the state appears sometimes confused with both a sovereign function, prerogatives related to its ownership and the role of arbitrator between the interest groups of the forest sector. The question is still the creation of real places of mediation and formulation of proposals on forest policy objectives and strategy, with the necessary operational resources" (Monin, 2003)* .

Then, the legal framework, related to the organization of the public bodies supporting management of private and municipal forests (CNPF and ONF), has also established some rules to guarantee the participation of the involved stakeholders. In fact, the CNPF, at the national scale, and the 18 CRPF, at the regional scale, have a management structure comprising a board of directors composed by elected representatives of private forest owners. This board directs and develops the production of private forests, approves simple management plans and contributes to implementation of major regional guidelines related to private forest policy. Considering the weak representativeness of local unions of private forest owners (Table 28), decision-making power in these institutions belongs to a small group of forest owners. For example in Aquitaine, the CRPF is mainly controlled by 'forest entrepreneurs' (Cf. the group G1 of our typology, § 5.2.3.1), owners of very large properties (from 500 to 15,000 ha) in the 'Landes of Gascony' forest region.

In the same way, ONF governance structure is getting more open to participation of representatives of municipal forests. The partnership between the ONF and the FNCOFOR is thus progressively structuring. First, in 2003, ONF and FNCOFOR have signed a Charter of the municipal forest (2003) to clarify roles and responsibilities of each partner. Then in 2007 the president of the FNCOFOR has been associated in the contract State / ONF (2007/2011). Finally in 2012, for the first time, FNCOFOR has signed the Contract of objectives with the State (Contract State / ONF / FNCOFOR (2012/2016)). FNCOFOR is becoming more influential in the forest policy-making process through this partnership but most of its political resources still rely on the support of the parliamentarians. The latter periodically advocate for public service values in the management of municipal forests. In Aquitaine, a regional association of forest municipalities has been created in 2011 but in 'Landes of Gascony', which is an area dominated by private forests, this stakeholder is not powerful. Moreover, in this forestry region many municipal forests are in a special position in relation to the legal framework because they have always refused to be involved in the forestry regime and the associated ONF management (Cf. § 3.5.2).

To compensate somewhat for the lack of openness of the state forest policy-making process, many regional councils provides, often in collaboration with the state, some formal contractual relationships between regional authorities and stakeholders. Through this agreements, called 'contracts of progress', they share a common diagnosis of the forestry situation in the region, formulate a strategy and elaborate action plans. In comparison with Regional Commissions on Forest and wood products, this mediation patterns are more oriented toward the traditional forestry stakeholders by involving only members of the regional joint-trade organizations (forestry and wood *interprofession*). Nevertheless it provides a framework for a better coordination both between the political work of stakeholders and between the actions of public authorities.

In a context of growing importance of territorial governance dynamics, forestry stakeholders have also been asked to participate in the local dialogue on forestry integration in rural development

issues. For that purpose, the Forest Territory Charter (CFT) was established in the national forest reform act of 2001. This new instrument is dedicated to the organization of a local participatory process, associating all interested stakeholders on a commonly defined action. Representatives of FNCOFOR invested a lot in the promotion of the CFT. They argue that CFT are a great opportunity for municipalities, but also for others local stakeholders, to promote a new forestry vision and policy strategy, less influenced by state and industrials discourses. The CFT was presented as important institutional innovation in terms of forest policy orientations but most of the studies dealing with their implementation are quite sceptical. For example Buttoud et al. (2011) noticed that: *"Today, the various assessments lead to the conclusion that most of the CFTs established have an increase of harvesting of timber and fuelwood as a central objective, although very few cases are promoted by different actors and very few cases concern non-productive utilities of the forests"* . In Aquitaine, Deuffic and Candau (2009) analyzed the deliberation process held in the framework of the CFT "*pays Adour-Landes Océanes*" and came to the conclusion that despite a weak involvement of non-sector stakeholders in the meetings, non-productive issues (i.e. recreational uses) were treated for the first time in the local debate.

These mediation arenas are mainly controlled by forestry managers and operators like CRPF, ONF and forestry cooperatives which have technical skills and good capacities of political lobbying. In fact, regional and local authorities need for this technical expertise to legitimate their actions in a context where their resources, capacities and competencies for addressing forest policy problems are lacking. However, in some regions (in Aquitaine or Rhône-Alpes for example), where forest policy issues are more publicized and politicized, representatives of private forest owners or wood-based industries can be more powerful and influential.

Finally, PEFC association governance structure also relies on mediation arenas. At the national scale and at the scale of each regional entity, these arenas are composed by 3 colleges representing forest owners and managers of private and public forests (college of producers), NGOs and members of civil society (college of forest users) and wood harvesting and processing industries (college of wood users). Each college is represented proportionally in the administrative board which is the political governing body of PEFC. It is important to notice that the involvement of FNE (as environmental NGO) in the PEFC association governance structure is quite controversial. According to some environmental NGOs (like WWF and Greenpeace), who support for the FSC certification scheme, FNE contributes to legitimate a certification scheme which fails to provide adequate guarantees that forest are sustainably managed.

To conclude, it is obvious that forest policy authorities have taken for granted that forest policy mediation arenas have to extend their scope to new stakeholders and new scales of representation. Forest management issues are becoming more and more intertwined with transversal problems (biodiversity, climate change, rural development …) but they are still mainly treated by sector based mediation arenas. Even if most of these arenas have been opened to new stakeholders (environmental NGOs, representatives of forest users …), it seems that the power imbalance between traditional forestry stakeholders (public and private forestry experts, representatives of wood-based industry, 'big' forest owners …) and 'new' representatives of forestry related interests has not changed so much. In the same way, local and regional mediations arenas have developed without challenging predominance of national priorities.

In fact, mediation arenas can be considered as sources of political resources (for State administration, PEFC Association, FNCOFOR or representatives of private forest owners) or technical resources (for regional council or local authorities) but in practice they have little influence on the forest policy-making process. That is the reason why it is necessary to consider that relationships between stakeholders and authorities take place also in a range of mediation practices.

3.6.2.2 Mediation practices in the forest sector

The ones who promote non-productive uses of the forest (e.g. FNE or others environmental NGOs like Greenpeace or WWF) or productive uses more oriented on local market development (e.g. FNCOFOR but also ENGOs) claim that the productive forest policy driven by the forest authorities is mainly influenced by representatives of wood-based industry (e.g. FNB, COPACEL, UIPP) and forestry operators (e.g. UCFF, FNEDT, Union of nursery growers). This 'productive' stakeholders group is considered to be well organized at the national scale and represented by strong professional organizations which are constantly lobbying state administration and lawmakers to severely limit constraints on their activity. The fact that their collective organizations are strongest at the national scale can explain besides why they are inclined to favour national mediation patterns.

On the contrary, members of this 'productive' group complain that the national forest policy is weak and fail to implement ambitious productive goals. They consider that the means devoted to forest policy are not sufficient and they perceive failings in the way the government administer sector based issues. According to them, forest policy decision-making process is more influenced by the Ministry of Finance and the Ministry of Environment than by the Ministry of Agriculture. In this configuration they feel powerless and unable to steer decision-making. Moreover, they are far from being unified in their view of forest policy strategy, many tensions and conflicts are pervading this 'productive' group.

In this context, the position of representatives of private forest owners is more ambiguous. On the one hand, they tend to be in favour of a more productive policy orientation, are strongly opposed to every kind of environmental regulation and stress the need for a proactive wood mobilization policy. On the other hand, they are opposed to every reform which could limit their ownership rights and reduce their freedom of action. Their influence over forest policy authorities suffers from this ambiguity. In fact, these stakeholders are characterized by the low level of representativeness of their collective organizations and by the heterogeneity of their interests and motivation in forestry activities. Most of them are not concerned by forestry issues (2.8 million of private forest owners have less than 4 ha) or more focused on hunting issues than on silvicultural or harvesting ones.

In short, mediation practices conducted outside the frame of arenas are characterized by a lack of congruence between the different strategies of stakeholders. Collective mobilization and political work are mainly dedicated to the defence of particular professional interest. Considering the heterogeneity of political resources of the stakeholders, each group of interests leads his own political strategy and activate specific lever of political action (to pressure administrative officers or ministerial staff, to ask for parliamentarians support, to organize a press or communication campaign…).

This situation could be interpreted as an opportunity for the State to implement an unfettered policy but in effect the vacuity of the sector based collective action has traditionally hampered the effectiveness and legitimacy of the forest policy. Given its limited resources and capacities, forest authority has a general preference for a 'one-stop shop' when dealing with private interests. Rather than confronting heterogeneous and contradicting policy positions of competing groupings, forest policy makers prefers to interact with a position of private interests which are already co-ordinated. As a result, both state authorities and regional council are now supporting joint-trade forms of sector based dialogue and mediation practices. Regional councils have thus largely contributed to the development of regional '*interprofessions*'. The latter are involved in communication campaigns to promote wood based industry and wood products, they help regional councils with the implementation of some collective actions but they often fail to develop common and strong political positions. In the same way at the national scale professional interests have long been divided. Recently, the situation has evolved and two mains national joint-trade organizations have emerged.

The first one, called *France Bois Forêt* and created in 2004, brings together public and private owners and forest managers, nurserymen and forestry operators as well as all professionals of the primary manufacturing sub sector. The second one, called *France Bois Industrie Entreprise* and created in 2011, gathers all the representatives of wood based industries except COPACEL and wood energy industries. These two associations have elaborated together in 2012 a 'forest wood project for France' which consist in a proposal of a funding program for the forest policy financed by the attribution of carbon credits (derived from the auctioning of carbon quotas from 2013) to a Strategic Forest Carbon Fund. At present these carbon credits have been attributed by the government to another policy issue but state authority still encourage stakeholders to develop this kind of joint-trade mediation practices.

3.6.3 Political ideas

The French forest sector is usually seen as a closed social system which is quite isolated from the rest of the society. For a long time state forestry experts have feeding the thought that to prevent forest management from uncertainty and short-term oriented policy it was necessary to keep forest issues far from political debates. Nonetheless, as for every sector based policy, norms and values which guide forest policy orientations result from the tension between the sector based system of reference and the global one (Muller, 2000). From 1950' to 1980', the forest policy strategy was mainly influenced by the 'modernizing' referential (as in agricultural policy) which promoted afforestation and improvement of private forest owners' technical capacities. Since 1990', French forest policy guidelines principles are defined by the 'ecologization' referential (See Table 29) which refers to the process of growing integration of environmental concerns in policy goals formulation (Deverre and de Sainte Marie, 2008). This change is conducted in two stages: Sustainable management stage (1992 – 2007) and Green economy stage (since 2007).

Table 29: 'Ecologization' referential and main guiding principles of forest policy

	'Ecologization' referential	
	Sustainable management stage (1992 – 2007)	Green economy stage (Since 2007)
Multifunctionality	- Traditional forestry practices are compatible with sustainable management principles - All forest functions are of equal importance (focus on the ecological dimension of forest resources) - Multifunctionality goals can be reached in every forest spaces	- Implementation of intensive cultural practices can be necessary - Priority to wood mobilization (focus on the ecological dimension of wood-based economy) - Priority to some functions in selected forest areas *(to be confirmed)*
Liberalization	- Funding of ecosystem and recreational services by contracts concluding with public entities (State or decentralized authorities) - Forest investments supported by public funding (aforestation program after the 1999 storm) - Sustainable forest management control guaranteed by State administration	- Funding of ecosystem and recreational services by market-based instruments (Carbon funds, Water conservation private partnership, market for compensation of biodiversity loss …) - Decrease of public funding for forest investments (private insurance contract required) - Substitution by the current certification system (PEFC or FSC) of the management documents provided by the Forest Code *(to be confirmed)*
Economic globalization	- Logic of convergence with European competitors on traditional wood products markets (normalization and standardization of wood products, economy of scales) - Focus on SMEs (sawmill industry) - Support for specific wood products (AOC quality mark), regional cluster strategies (wood cluster in Aquitaine) and local wood-energy industry	- Logic of convergence with European competitors on traditional wood products markets and emerging ones (bioenergy, biorefinery) - Focus on large companies (sawmills, paper mills) - Support for national cluster strategies and large wood-energy industry

3.6.4 Concluding assessments

The French forest policy regime has been and is still strongly determined by the state-centered model of government. The State remains the dominant political authority, most of the mediation relationships take place at the national scale and attempt to influence state decision making process and political ideas driving forest policy strategy tend to be critically convergent with general trends undermining the capacity for action of public actors and promoting privatization and professionalization of natural resources based productive activities. The state-centered model of government is reforming but for now the forest policy regime change is not really implemented. New political ideas are emerging and contributing to challenge the hegemony of State facing budgetary problems and legitimacy contestation but no actor supports an alternative model. In fact, this policy field is not considered a priority for political party and forestry issues are rarely a subject of debate in the political arenas. Most of politicians still support the traditional model of government. Similarly, most of the forest sector related interest groups are reluctant to a radical forest policy regime change because they fear losing their political influence on the forest related policy. Meanwhile, the actual forest policy regime fails to promote a coherent and convergent policy framework as it relies on a more and more fragmented political authority and it fails to coordinate all the forest related interest groups.

3.7Policy coherence

3.7.1 Formal policy goals and instruments

Forest management issues are intertwined with a large number of policy fields. In this section we focus on the most relevant policy domains which explicitly deal with forest related goals and instruments. First State forest policy is presented as the main formal policy framework for forest management regulation and the policy implemented by the Aquitaine Regional Council as a complementary one. Second, the biodiversity policy which included a forest action plan illustrates the influence of the environmental conservation framework on the forest policy. Third, the rural development policy is described through forest oriented measures which aim at promoting local development of forested territories. Fourth, climate change policy is analysed as a new policy field which critically challenge and affect the forest policy strategy.

3.7.1.1 Forest policy goals and instruments

- State forest policy

The last Forest Reform Act (2001) stated that the State is still in charge of the forest policy (see 3.6 Forest policy regime). This policy aims to ensure the sustainable management of forests and natural resources, develop professional qualification for their sustainability, strengthen the competitiveness of the forest production, harvesting and processing of timber and other forest products and to satisfy social demands on the forest (2001 Forest Reform Act, Art. L 1st). Thus, according to the last Annual Finance Law project (2013), forest policy governmental strategy addresses 3 mains issues (formal goals): Increase of wood mobilization and improvement of competitiveness of the wood sector; sustainable management of public and private forests and more effective preservation of biodiversity; forecasting and adapting French forests to climate change. It is also mentioned in this project that the State focuses on preventing risks (fire) and enhancing forest protection.

Table 30: State forest policy goals and instruments

Policy field	State forest policy
Key policies	National Forest Program (2006-2015); Forest Action plan (2008); National Biodiversity Strategy (2011-2020); Speech given by the President of the Republic at Urmatt (2009); Multi-year objective and performance contracts (State-ONF-FNCOFOR 2012-2016 and State-CNPF 2012-2016); Forest Code (2001 Forest Reform Act and 2010 Law of Modernization of Agriculture) State-Region contract projects (2007-2013) and Hexagonal Rural Development Program (2007-2013)
Political decision-maker	National government and State administration (Ministry of Agriculture)
Formal goals of policies	– Increase of wood mobilization and improvement of competitiveness of the wood sector (Annual harvested and marketed wood: from 39.3 Mm^3 (2010) to 43 Mm^3 (2013) and 60 Mm^3 (2020)) – Conservation of forest resources and sustainable management of public and private forests and more effective preservation of biodiversity – forecasting and adapting French forests to climate change – preventing risks and enhancing forest protection
Specific types of instruments utilized	- Tax deductions and exemptions (wealth tax, property transfer tax, property tax, incomes tax) - Subsidies (operating funds to support public bodies activities and intervention expenditures for forest owners, forestry operators, sawmill and collective organizations) - Legislation (Management documents, Clearing regulations) - Regional plans for wood mobilization (Multi year regional plan for forest development – PPRDF in French)
Instrument specifications	The post-storm restoration plan (Klaus storm in 2009) concerns only the south-west (Aquitaine) of France for 2009-2016. Between 1999 and 2016, 2 post storm restoration plans have been implemented and funded (partly) by the budget devoted to the national forest policy for an amount greater than 700 M€ (approximately 50 M€/year). In 2013, more than 72% of the budget devoted to the national forest policy is allocated to the management of public forests and conservation measures (fire, mountain erosion), excluding fiscal spending associated with tax exemptions of the private forestry (source: 2013 Draft budget, http://www.assemblee-nationale.fr/14/budget/plf2013/b0251-tIII-a3.asp). Management documents are compulsory for forest properties > 25 ha ONF (State forest agency) is in charge of some General Interest Missions (MIG) which are funded by others budget programs: MIG 'biodiversity' is funded by the program 'Urban planning, landscaping, water and biodiversity' and MIG 'risks prevention' is funded by program 'risks prevention'.

- Aquitaine Regional Council forest policy

Aquitaine Regional Council (CRA) has been engaged for a long time in forest policy. The last Regional Planning and Sustainable Development Scheme (SRADDT - 2006) stated that forest activities play an important role in the regional economy through their impact on employment, and their role in environmental and economic valuation of rural areas. Moreover, the Regional Plan for Economic Development (SRDE - 2006) of Aquitaine put the emphasis on the growth potential of the wood based economy.

Involvement of the CRA in forest policy actions is established in the frame of the State Region Contract Project and the Hexagonal Rural Development Program following a logic of co-financing (Regional funds/National funds/European funds) and partnership between Regional Council and the State. Since 2008, the CRA funding program for the forest sector is also defined in accordance with a regional regulation framework. According to this framework CRA forest policy aims at: protecting the forest resources; supporting forestry operators and wood-based industries; investing in vocational training and innovation.

Table 31: Aquitaine Regional council Forest Policy goals and instruments

Policy field	Aquitaine Regional Council Forest Policy
Key policies	Regional Planning and Sustainable Development Scheme (SRADDT – 2006); Regional Plan for Economic Development (SRDE – 2006); Aquitaine Plan on Climate Change (2006); Regional regulation framework for the forest sector (2008) State-Region contract project (2007-2013) and Hexagonal Rural Development Program (2007-2013)
Political decision-maker	Regional council
Formal goals of policies	– protecting the forest resources; – supporting forestry operators and wood-based industries; – investing in vocational training and innovation
Specific types of instruments utilized	Subsidies (intervention expenditures for forest owners, forestry operators, industrials and collective organizations)
Instrument specifications	CRA participates to the 2009 post storm restoration plan (22 M€ for 3 years) CRA is involved in an innovative instrument for private forest investments (SODEF). SODEF is a Limited Company dedicated to the support of forestry funding by granting loan to private owners. CRA has established some territorial (NUTS-3 level) action plans to adapt silvicultural measures to local issues. In 2011, CRA devoted 2.7 M€ to forest policy actions (10 % of the 'agriculture, sea, forest' program). Additional funds are coming from 'Vocational training' and 'Economic development' programs. In 2012, CRA created the Aquitaine Carbon Association which aims at contributing to the funding of the post storm restoration activities through voluntary Carbon credit market. Aquitaine Association Carbone was given a fund of 500 000 € to fund the first reforestation projects.

3.7.1.2 Biodiversity policy goals and instruments (related to forest issues)

In July 1994, France ratified the Convention on Biological Diversity (CBD). The general principle of conservation and improvement of forest biodiversity was transposed into national legislation in the 2001 Forest Reform Act. In February 2004, France put in place a national biodiversity strategy which includes the broad goals of the CBD and is implemented by means of sector based action plans. In June 2006, in accordance with its undertakings given in the context of the Process of Ministerial Conferences on the Protection of Forests in Europe, France adopted a National Forest Programme (NFP) whose forest biodiversity policies have been translated into a Forest Action Plan. Forest habitats and other habitats linked to Metropolitan French forests account for 66% of all habitats listed in the CORINE Biotope European database as present on French soil, 90% of the number of habitats of interest to the Community and 93% of the number of priority habitats as defined by annex I of the EU directive on the conservation of natural habitats and of wild fauna and flora. The Ministry of Agriculture and the Ministry of Environment have resolved to coordinate their examination of forest biodiversity within a single working group in order to arrive at a set of measures that will contribute to the implementation of the national biodiversity strategy and form a biodiversity component within the National Forest Programme. The forest action plan has in this way been defined in conjunction with representatives of private and public-sector owners, managers, research and development bodies and non-profit associations for the protection of nature.

Table 32: Biodiversity policy goals and instruments

Policy field	Biodiversity policy
Key policies	National Biodiversity Strategy (2011-2020) and 'Forest' action plan implemented under the National Biodiversity Strategy (2006-2010); Rural Code; Town planning Code; Environmental conference and Laws 'Grenelle de l'environnement' (2007-2009); National Forest Program (2006-2015) State-Region contract projects (2007-2013) and Hexagonal Rural Development Program (2007-2013)
Political decision-maker	National government and State administration (Ministry of Environment and Ministry of Agriculture); Regional and NUTS-3 level councils
Formal goals of policies	According to 'forest' action Plan for biodiversity (2006-2010): – Better targeting of protection measures and quantification of their impact on biodiversity – Taking biodiversity more effectively into account in forest management at different levels – Adding to networks of protected areas and plans for the restoration of protected species; improvements to the effectiveness of such schemes – promoting management of Natura 2000 sites – Strengthening coordination and consultation at the closest possible level to the field plus a simplification of procedures – Informing and educating forest owners and other actors in forest management as it relates to biodiversity – Raising the awareness and information level of the general public State's commitments (2011-2013) – National Biodiversity Strategy (2011-2020): – Developing and supporting biodiversity measures implemented under the Forest Territory Charter (CFT) – Developing and implementing the 'potential forest biodiversity index' – Developing forest biodiversity data collection
Specific types of instruments utilized	– Regulatory tools (N2000 decrees, land planning and land use regulations) – Voluntary agreements (N2000 'forest' contracts and N2000 Charters) – Land planning documents (Regional Ecological Coherence Schemes) – Subsidies: N2000 'forest' contracts funded by EAFRD – measure n°227, Ministry of Environment and Regional/NUTS-3 level Councils. – Funding of the State Forest Agency (ONF) for 'Biodiversity' General Interest Mission (2.6 M€ in 2013)
Instrument specifications	– Highly protected areas: 195 000 ha (1.3% of the forest area in 2010) – Centre of National Parks, Nature Reserves, strict and managed biological reserves located in public forests – Share of forest area designated as sites of community importance (N2000 network): 18% (8.5% in Aquitaine) i.e. 36% of State Forests; 22% of municipal forests; 15 % of private forests (In Aquitaine: 13% - 47% - 6%) – For the period 2007-2010, 187 N2000 'forest' contracts were signed and 2.8 M€ were invested for forest measures. – The Regional Ecological Coherence Schemes are non-binding frameworks for elaboration of urban planning and development documents.

3.7.1.3 Local forest development policy goals and instruments (related to forest issues)

The Ministry of Agriculture has overall responsibility for rural development policy in France. The Rural Development Policy for France is defined in a National Strategy Plan (NSP) which reflects EU priorities according to the country's specific context in the framework of the second pillar of the Common Agricultural Policy. All of the measures funded by these schemes (EAFRD) are supposed to contribute to rural development because forests are considered as part of the rural areas. Nevertheless, in this section we focus on the goals and instruments specifically devoted to local forest development policy goals and instruments. For example, measure 341 A of the PDRH (Hexagonal Rural Development Program) provides some Local Forest Development Strategies. Moreover, local forest development issues are also basis for some projects dedicated to economic development actions for rural areas like Rural Centres of excellence (PER). In fact, PER are projects promoting the development of rural areas that receive as such partial funding from the State. The Centre of Excellence label is assigned to a rural economic development project located in a rural area and based on a partnership between local authorities and private companies. In 2006, 376 PER received the label and 43 of them were dealing with forest issues.

Table 33: Local forest development policy goals and instruments

Policy field	Local Forest development policy
Key policies	Multi-year objective and performance contracts (State-ONF-FNCOFOR 2012-2016 and State-CNPF 2012-2016); Forest Code (2001 Forest Reform Act and 2010 Law of Modernization of Agriculture) State-Region contract projects (2007-2013) and Hexagonal Rural Development Program (2007-2013)
Political decision-maker	National government and State administration (Ministry of Agriculture) Regional and NUTS-3 level councils Municipalities
Formal goals of policies	– To anchor the forest in the territory and to promote the forest as an instrument of sustainable development of the landscape – to support local wood sector
Specific types of instruments utilized	– Local forest development strategies (Forest Territory Charters and Forest Development Plans) – Rural centre of excellence projects
Instrument specifications	In 2006, 376 PER received the label and 43 of them were dealing with forest issues. In 2011, there were 119 CFT (a forest area of 4.15 million ha, or 27% of the forest metropolitan area). Between 2000 and 2010, 307 Forest Development Plans has been implemented (a forest area of 2.5 million ha)

3.7.1.4 Climate policy goals and instruments (related to forest issues)

Following on from the European Climate Change Program established by the European Union to tackle climate change issues, France has put in place a range of domestic actions which affect forest policy. In 2007, the '*Grenelle de l'environnement*' has been the key political step of the implementation process of the European framework. On this occasion, the working group on Climate Change issues underlined the potential of forest and wood-based industry to contribute to national climate change mitigation targets. Notably, biomass from forest sector (wood chips and sawmill by-products) and wood materials were identified as appropriate sustainable alternatives to fossil and non-renewable resources. Considering that the French forest resource is under harvested (approximately 60% of annual biological production is harvested) and the French wood industry has potential growth opportunities in coming years (the deficit in the trade balance of wood products is up to €6 billion), there is a large potential for increasing wood substitution in France and the forest sector is thus strongly challenged by climate policy.

- Biomass Energy policy

For France national target for the share of renewable sources in gross final consumption of energy in 2020 is 23%. To reach this objective, the annual national renewable energy production has to double from 18.4 Million tons of oil equivalent (Mtoe) to 37 Mtoe. National renewable energy action plan (2009-2020) has estimated that biomass should represent 45 % of the overall renewable energy effort. Currently, France is the leading European country in term of consumption of wood energy with more than 9 Mtoe / year, but it is essentially due to the use of domestic wood log (7.4 Mtoe / year). Given that the wood energy sector is still not well developed in France, the State action focus on subsidies and supports for investments in boilers and industrial equipments.

Table 34: Biomass energy policy goals and instruments

Policy field	Biomass Energy policy
Key policies	National renewable energy action plan (2009-2020) implemented under Directive 2009/28/CE; Multiannual Investment Program for power generation (PPIe) ; Environmental conference and Laws 'Grenelle de l'environnement' (2007-2009)
Political decision-maker	National government and State administration; Agency for the Environment and Energy Management (ADEME); Regional and NUTS-3 level councils
Formal goals of policies	Increasing wood energy production from +2.8 to +5 Mtoe/year in 2020 (National renewable energy action plan – based on figures for 2005) – Increasing production of electricity from biomass (not only 'forest' biomass): + 1 400 ktoe/year (17 000 GWh) in 2020 – Increasing production of heat from biomass: + 8 600 ktoe/year (+ 1 000 ktoe/year: individual heating of households; + 5 200 ktoe/year: collective and industrial heating; + 2 400 ktoe/year: cogeneration process)
Specific types of instruments utilized	Tax deductions (VAT on the sale of wood energy (7%) and heat (5.5%); tax credit for individual heating equipments) Subsidies: 'Heat Fund' and investments grants Feed-in-tariff and invitation to tenders (organized by the Commission for Energy Regulation) for green electricity produced
Instrument specifications	Since 2009, 'Heat Fund' supports development of renewable heat generation. Each year a call for tender (BCIAT) is organized by ADEME at the national scale for big projects (>1 000 toe/y). Small projects (between 100 toe/y and 1 000 toe/y) are managed at the regional scale. In 2011, biomass represents 50% of the aids delivered by 'Heat Fund' but 85% of the toe produced (toe from biomass is funded around 500€ / toe from solar is funded around 11 000€). 70-80 % of the supply plans of these biomass projects mobilize wood chips. For the period 2009-2012, the 'Heat fund' selected 375 biomass projects (740 ktoe/an and 400 000 t of wood). In France, there is 4 400 wood fired boilers (3 300 for industrial uses and 1 100 for collective heating). In 2011, decrease of the feed-in-tariff for renewable electricity generation (less than 60 €/Mwhe) Between 2005 and 2010, 4 invitation to tenders organized by the CRE (Commission for Energy Regulation), 88 cogeneration projects (1 200 MWe) have been selected. The average feed-in-tariff for these project is around 120-140€/MWh. In 2012 around 200 MWe from biomass cogeneration are actually produced.

- Wood use in construction policy

In France, the concrete industry dominates the building market. In value terms, wood accounts for approximately 10% of all raw materials consumed in France in the building industry, a percentage substantially lower than in Northern Europe or the United States. Building standards and traditions strongly influence in France the choice of construction materials and design. Few constructors have skills, experience and confidence for rapid, high quality wood construction. Increasing wood use in the construction sector has been promoted for many years by the government and professionals but no voluntary policies were implemented for that purpose and the share of wood in the building market is so far quite stable. Since 2009, national climate change mitigation strategy for construction has addressed new challenges to the building market which are supposed to provide opportunities for wood materials development.

Table 35: Wood use in construction policy goals and instruments

Policy field	Wood use in construction policy
Key policies	Law on air and rational utilization of energy (1996); 'Wood-Construction-Environment' framework agreement (2001); Environmental conference and Laws 'Grenelle de l'environnement' (2007-2009);
Political decision-maker	National government and State administration; Agency for the Environment and Energy Management (ADEME); Regional and NUTS-3 level councils
Formal goals of policies	'Wood-Construction-Environment' framework agreement in 2001 planned to reach 12.5% of wood in construction (instead of 10%) for 2010 'Grenelle de l'Environnement' Law (2009) art. 34 aimed at adapting the construction standards for the use of wood, including increasing very significantly the minimum rate of incorporation of wood in construction and supporting the establishment of a label.
Specific types of instruments utilized	Legislation (Minimum threshold of wood incorporation in new buildings; 2012 Energy performance in buildings Regulation) Technical support for wood materials standard-setting system implementation Introduction of a label for bio-based materials (2013) Guidance on the implementation of green public procurement

3.7.2 Policy coherence

At first glance, there are no major formal incoherencies in the goals defined by the actual forest-related policy framework. Since 2007 most of these policies are embedded in a process of convergence driven by the European and National roadmaps defined to tackle Climate Change issues. Considering the priority given to the 'green' productive role of the forest, all forest-related policies tend to focus on the goal of increasing the wood mobilization. However, it does not mean that the French policy process is totally coherent and obviously when you compare one by one the respective forest-related policy goals and instruments you can notice that this general framework is quite ambiguous. Firstly, the wood mobilization strategy, promoted directly by State Forest Policy and indirectly by Biomass Energy Policy and Wood use in Construction policy, strongly challenge environmental conservation objectives defined by Biodiversity policy and the local development aims. Secondly, it seems that many instruments implemented are inconsistent and fail (or could fail) to achieve the goals of increasing the wood mobilization, enhance the French wood-based industry competitiveness, improve biodiversity conservation and promote local development.

3.7.2.1 Incoherence of the multifunctional forest policy

In order to meet the increasing demand for wood due to the development of Biomass market, State authorities urge foresters on to intensify harvesting activities. Ambitious wood volume targets have been set by the Government to reach the national energy policy goals. In this context, local forest development goals are supposed to meet the national strategy by providing economic opportunities to rural areas to support forest sector development. As it is mentioned in the National Forest Program, local initiatives which are based on consultation extended to include all the partners involved in forest management can provide a good framework for consultative and contractual arrangements. So, we can notice that even if the national forest policy take local forest development actions into account, it mainly refers to their potential contribution to the implementation of the national strategy (sector based approach). This approach is quite incoherent with the objective of promoting alternative forms of forest development (territorial approach).

According to some experts the increase of wood mobilization, which mainly concerns private forests, requires improving the accessibility of forest plot, but it also involves implementing more intensive

silvicultural practices and further develop mechanization (Bourcet et al., 2007). All this forestry practices can have a negative environmental impact on forest ecosystems and challenge the French model of multifunctional forest policy. Opening new roads can lead to a fragmentation of forest habitats and disrupt water system; developing forest plantation and shortening forest cycle can reduce biodiversity; promoting mechanization can degrade soil quality. From this point of view, the 'harvesting turn' of the forest policy seems to be rather incoherent with environmental goals and biodiversity conservation strategy. As mentioned by WWF in a report on French forest policy (Neyroumande and Vallauri, 2011), incompatibilities between the goals of increasing the harvest and those of biodiversity conservation are evaded by public authorities and main forest stakeholders. As a result, most of the environmental objectives remain relatively vague and imprecise. In 2007, forest stakeholders (FNE – environmental NGO; FNCOFOR - National federation of forest municipalities; representatives of private forest owners) established an agreement entitled 'produce more wood while better preserving biodiversity' but nothing has been said about how to reach this goal. The same applies for the 'Forest' action plan implemented under the National Biodiversity Strategy (2006-2010) which focuses more on information and research issues related to forest biodiversity than on concrete biodiversity conservation targets. At the scale of the case study, NGO representative (S11) put the emphasis on the negative impact of mechanization but few stakeholders refer to this form of incoherence. In the Gascony Forest the level of mobilization of wood has long been very high that is the reason why the 'harvesting' turn is less problematic and conflicting than in others forest regions.

From one side, wood mobilization policy can be interpreted as incompatible with biodiversity goals but from another side, biodiversity policy orientations can be also seen as constraints for silvicultural and harvesting practices. In fact, according to some forest stakeholders environmental considerations often prevail over forest activities and wood mobilization issues. For example, at the end of the 1990' representatives of private forest owners associated with representatives of farmers to oppose implementation of Natura 2000 network. In 2002 the White Paper on Private Forest also claims that proliferation of environmental zoning is an 'endangering' phenomenon for the future of forest activities. In Aquitaine, many of the stakeholders interviewed share this view. According to Industry and Forest Cooperative representatives (S14 and S15) the concept of multifunctionality is not working because it leads to an increase of environmental regulations which remain an obstacle to the development of wood economy. Some of the stakeholders also mentioned that in the Gascony Forest the Water Act is particularly incoherent with the objective of forest management and protection against fire. The watershed management policy classifies ditches as part of the 'natural' water system whereas the forest practices provides regular maintenance operation for these forest equipments. Moreover, local stakeholders point out that policy priorities regarding environmental issues are different from one policy to another. They mention the fact environmental regulations which transform some forest plots in protected areas are not a constraint anymore when a road or rail infrastructure project comes out. NGO representative (S11) talks about politics' schizophrenia, illustrating it with the attitude of the regional council who on the one hand supports infrastructures projects which destroy large forest areas but on the other finances plantings or carbon incentive reward.

To conclude, the tension between biodiversity conservation goals and wood mobilization ones show that the forest policy, through the concept of multifunctionality, fails to integrate all the demand of the society towards the forest into a coherent policy framework. In the 1990' forest stakeholders' practices were challenged by sustainable development principles but they finally succeeded in gaining acknowledgement of the compatibility of their traditional practices with these new challenges. However, for 10 years, they are facing new challenges. On the one hand they are criticised for not being able to mobilize enough wood to respond to green market demand and they are urged to intensify and professionalize forestry practices. On the other, some representatives of

the civil society point out that forestry practices can have a negative impact on biodiversity as these areas represent a very important environmental heritage.
In the case study area many stakeholders claim that forest multifunctionality policy must be redefined and tailored to regional forest specificities in order to prevent forest-related policy from incoherency. Nevertheless, most of them still promote a sector based approach. In fact, they consider that territorial approaches pose a threat to the wood economy. In this context, most of industrialists, forest owners, forestry managers and operators in 'Landes of Gascony' require a more proactive, and less ambiguous, forest policy that takes more strongly into account the wood productive calling of this region.

3.7.2.2 Inconsistencies of the forest-related policy implementation process

Many groups of forest-related policy instruments are criticized by stakeholders for not being consistent with the goals defined by the policy framework. Public authorities are thus often addressed by them on the lack of resources (human and financial) they devote to forest measures. For example, private forest owners and municipalities always urge the State to increase (even maintain) human means devoted to the respective public bodies in charge of the management of private and public forests (CRPF and ONF). Similarly, Environmental NGOs and private forest owners ask for more financial incentives for forest biodiversity conservation and many stakeholders complain that the State never funded the support program he had committed to establish in 2008 for the wood mobilization plan. However, the criticism of the policy implementation process is not only about a mismatch between means and objectives, it is also about counterproductive effects of policy mixes. In the discourses of the stakeholders a lot of inconsistencies are regularly pointed out to legitimate their political work toward public authorities. In the next tables the most common inconsistencies of the forest-related policy mixes are presented.

Table 36: Inconsistencies of the increase of wood mobilization policies

Policy Goal	Increase of wood mobilization
Policy mix (instruments)	- Tax deductions and exemptions + Forest management documents for private forests - Regional plans for wood mobilization (Multi year regional plan for forest development – PPRDF in French)
Why this policy mix is inconsistent?	The forest tax system does not encourage private forest owners to actively manage their forest property whereas the PPRDF provides some ambitious regional mobilization goals. Tax system encourages more forest owners to capitalize than to invest and does not prevent forest area from land fragmentation. The share of the private forest affected by a management plan (which oversees forest owners' practices and encourage them to manage) is low (< 25%). The legal framework for implementation of these documents has however recently changed to increase their coverage. Moreover, this forest management system provides a monitoring of forest activities at the property scale whereas PPRDF work at the scale of the forest landscape.
Who support this argument?	Industrialists and some forestry operators Some representatives of forest administration *This inconsistency is particularly relevant for stakeholders interviewed in the case study area*

Table 37: Inconsistencies of the improvement of competitiveness of the French wood sector policies

Policy Goal	Improvement of competitiveness of the French wood sector
Policy mix (instruments)	- Incentives for biomass energy development + supports for wood use in construction + public procurement rules - Subsidies for sawmill + promotion of the French wood sector
Why this policy mix is inconsistent?	The policy mixes provided by Biomass energy policy and Wood use in construction policy support wood consumption development but they can also have a negative effect on the competitiveness of the French traditional wood sector. First, in a context of increasing competition for wood raw materials, aid granted to wood energy sector lead to a distortion in the conditions of competition in forestry and the timber market. Thus, paper and panel industries are afraid to encounter supply problems in such a situation. Second, the potential increase in the construction market may be in favour of imported wood products. Indeed, the building market regulation does not allow promoting national or local wood materials. On the contrary, on the wood materials for building markets French products are less competitive than those from Nordic and East European countries.
Who support this argument?	Industrialists *This inconsistency is particularly relevant for stakeholders interviewed in the case study area*

Table 38: Inconsistencies of the conservation of forest resources policies

Policy Goal	Conservation of forest resources
Policy mix (instruments)	- Clearing regulations - Legal framework for forest insurance (for storm damages)
Why this policy mix is inconsistent?	According to the Forest Code, private forest owners are obliged to reforest. Consequently, State used to finance the replanting of forest after a storm. In 1999 and 2009, 2 post storm restoration plans have been implemented in France. But, from 2017 no more post storm restoration plan will be financed by the State. Private forest owners are now required to sign a contract of insurance. For most of them, the cost of this insurance is considered too high given the level of forest incomes.
Who support this argument?	Private forest owners Industrialists and some forestry operators *This inconsistency is particularly relevant for stakeholders interviewed in the case study area*

Table 39: Inconsistencies of Forest biodiversity conservation policies

Policy Goal	Forest biodiversity conservation
Policy mix (instruments)	– Land planning documents (Regional Ecological Coherence Schemes) + support for more 'ecological' silvicultural practices – Regional plans for wood mobilization (Multi year regional plan for forest development – PPRDF in French) + support for intensive silvicultural practices
Why this policy mix is inconsistent?	Wood mobilization policies promote more intensive silvicultural practices and give incentives to harvesting activities whereas scientists advise foresters to take a greater account of biodiversity. For the programming period 2007-2013 of EU funds for rural development (EAFRD) devoted to the forest, a third of the amounts are devoted to the financing of forest roads and mechanization of logging (about 70 M € to 220 M € programmed). The state spends about 15% per annum of its intervention expenditure. For the period 2007-2010, 187 N2000 'forest' contracts were signed and 2.8 M€ were invested for 'ecological' forest measures. There is no coordination approach in the implementation of Regional Ecological Coherence Schemes and Multi year regional plan for forest development.
Who support this argument?	Environmental NGOs Some scientists

Table 40: Inconsistencies of Supporting local wood products and short wood supply chains policies

Policy Goal	Supporting local wood products and short wood supply chains
Policy mix (instruments)	– Support for forest local initiatives and rural development projects – Heating Fund
Why this policy mix is inconsistent?	The targeting of the aid delivered by the Heating Fund promotes more investments of industrialists and energy firms in the wood energy sector than the development of collective heating systems by municipalities and small size wood energy facilities.
Who support this argument?	Representatives of municipalities Environmental NGOs

3.7.3 Policy processes

Since 1990', French forest policy guidelines principles are defined by the 'ecologization' referential (see 3.6 Forest Policy Regime – Political ideas) which can be associated to a process of change comprising two steps: Sustainable management 'integration' step (1992 – 2007) and Green economy 'revolution' step (since 2007).

Sustainable management 'integration' step (1992-2007): a (apparent) process of replacement

First, sustainable forest management principles have been introduced formally in the legal framework of the national forest policy after a long process of translation of the general principles defined in 1992 at the United Nations Conference on Environment and Development (UNCED). The French Forest reform act (2001) stressed the need to balance the economic, ecological and social functions of forests with a focus on the implementation of sustainable forest management practices. This process of change leaded to a reformulation of forest policy goals and to a (re)definition of policy instruments in order to integrate the new forest management guiding principles established at the European and international scale. This can be interpreted as a replacement process as effort was made to take a greater account of multifunctional issues of forest areas. Nevertheless, in practice nothing really changed in the way forest sector was governed and forestry practices regulated. In fact, State forest administration and main forest stakeholders were able to contain the external pressure, mainly from civil society and international bodies, and succeed in reforming formal goals and instruments of the forest policy without undermining traditional practices and relationships.

Green economy 'revolution' step (since 2007): a process of layering

Then, French government has organized in 2007 the '*Grenelle de l'environnement*' with the aim of promoting new environmental policies. In accordance with the European framework of Climate policy, this conference has notably underlined the importance of the wood based sector development to reach climate and energy targets (reduction of greenhouse gas emissions and increased share of renewables in energy consumption). In 2007, a sector meeting (hold in the frame of the Superior Council of forest) validate this strategic orientation and put the emphasis on the need to increase critically wood mobilization. The National Forest Programme (NFP), established for the period 2006-2015, already indicated that "*France has rebuilt its forest resource and the harvest must now increase on the basis of sustainable management, not only for use now but also to prepare the forests of tomorrow and respond to global issues*". This 'harvesting turn' can be considered as a process of layering of the forest policy framework. The government has converted its European commitments in concrete wood mobilization targets and urges now the forest sector to respond to green industry needs, without giving up environmental aims and multifunctionality principles. For a very long time, forest policy focused on forest resource conservation and expansion so this 'harvesting turn' provides fundamental changes in the referential of the forest sector. But, at the moment the situation is quite ambiguous because new instruments have been added to old ones without abandoning previous ones.

4 AGENT-BASED FACTORS (MESO)

4.1Actors and their networks

In this topic, we firstly present the main factors we took into account to describe the different social networks that were present at the local level but also at the regional level.

4.1.1 Theoretical and methodological approach

We have considered social networks both as a set of social units (individuals, groups of individuals, associations, organizations…) and as a system of their relationship/interaction (Degenne and Forsé, 2004; Mercklé, 2004). The description of these networks was particularly important at a local level as action is rarely based on a strict individual decision process: if the final decision is individual, the process leading to this decision often takes into account collective opinions, norms or rules. The social actor takes his decision in interaction with others members of his social group or the organization he belongs to (Nybakk et al., 2012).

Networks may be characterized by different features (Degenne and Forsé, 2004; Ferrand and De Federico de la Rua, 2006). We have considered some of them that seem to be relevant as described in the Integral Handbook for researchers but also observed during the interviews:

- Socio-professional identity of the actor: is he a forest owner, an industrialist, a policy-maker, a NGO member…?
- Number of affiliates: what is the number of members with whom the interviewee is in contact? Are contact formal, informal, professional?
- Position of the members (central, on the margins, isolated), interconnected (reticular (one to the others) or linear (one to one)) and position of the networks (local/regional/national); level of integration (strong, weak) ;
- Type of relationship between members: are actors formally or informally involved in forest policy and forest management process? What are the characteristics of their relations cooperation, competition, conflicts, domination?
- Nature of the transactions (Lazega et al., 2012): exchange of goods, services, knowledge, information, opinions, perception. Social networks seem to be particularly important for actors to share information, and to stabilize interpretative frames, in particular when social facts are not well established (by science for example) or when new discourses emerge and contest the dominant position as with environmental stakes (Oreszczyn et al., 2010; Primmer, 2011)
- Impacts of the networks: do social networks increase or decrease sociability? Are individuals oversocialised (as they are mechanically and automatically subjected to the existing networks)? Does an individual increase his resources by belonging to more than one network (more social capital)?

4.1.2 Relevant actor networks

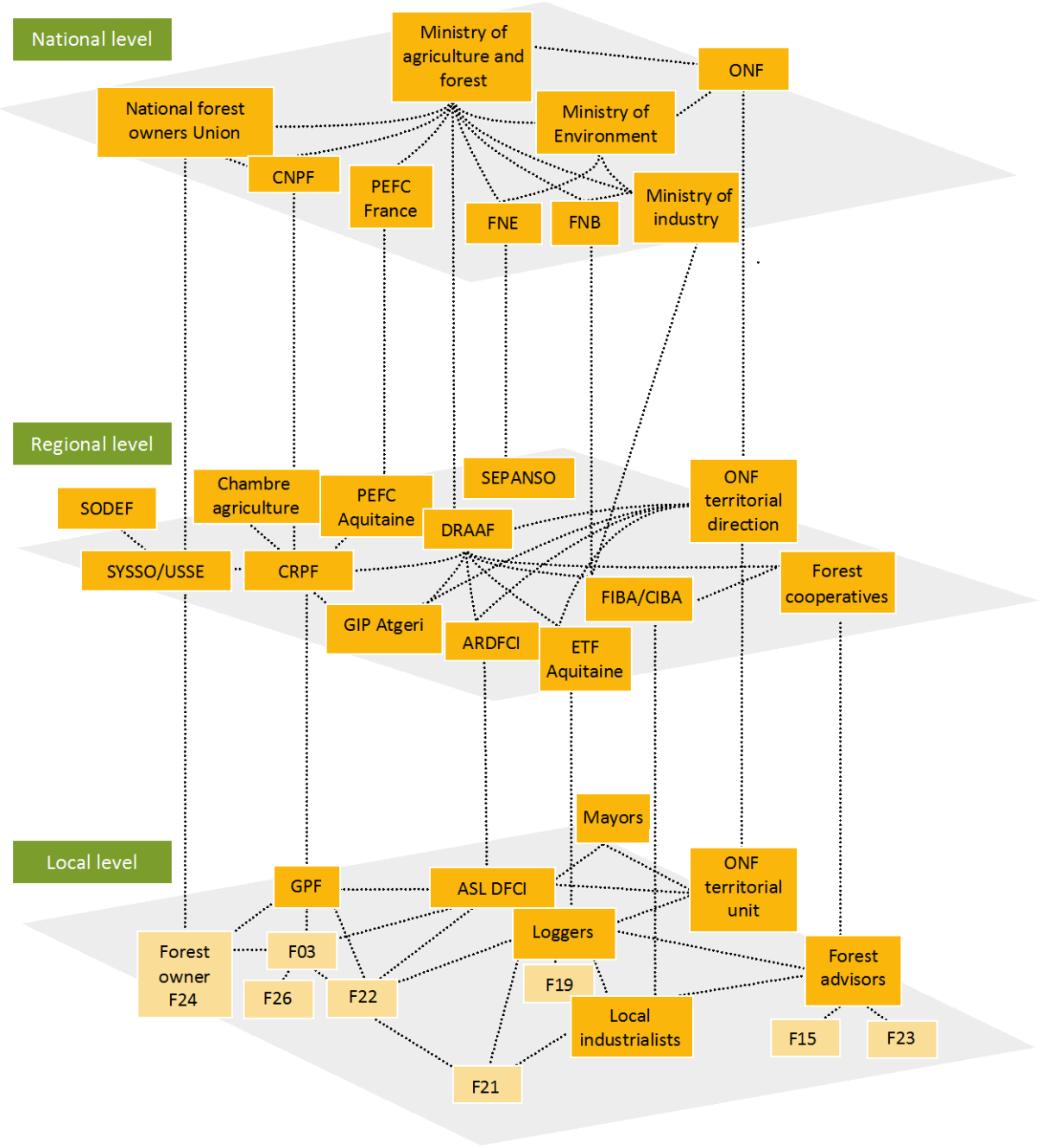
Three main scales must de distinguished when we describe the main social networks in our case-study area:

- at the local scale, there are formal and informal networks composed of forest owners, forest contractors, forest advisors local industrialist who daily deals with forestry management and timber marketing;

- at the regional level, there are structured and formal networks of professional organisations who discuss, coordinate, plan and sometimes defines forestry policies and wood sector orientations; we also find forestry schools (initial and ongoing trainings);
- at the national level, we find ministries that are (totally or partly) in charge of forest policies and inter-professional organisations (forest owners national unions, environmental NGO, industrialist Union, PEFC…).

These levels are not separate. Some connections exist as forest owners and local industrialists delegate some representatives at the regional level, in particular in the Regional centre for private property forest (CRPF) of the regional trade union for wood industries (FIBA). Some of these regional representatives can also be designated to become national delegates.

Figure 33: Simplified example of social networks from the French case study area level to the national level



4.1.3 Main network at the local level (NUTS-3)

If the social interaction between two individuals is not yet a basic unit for a social network, the arrival of a third person can be considered as the first unit of a network. To study these networks in the 'Pontenx' case study area, we chose to start from the smallest and often informal unit that can exist in the field, that is to say the forest owner. We then tried to explore more complex and structured networks from this local level to the landscape and regional level.

4.1.3.1 The family network

The first unit of a social network is often observed in our case study area inside the family unit. During the interview, family network appears to be the first but also the ultimate cells of discussion between family members. Discussions start in the family unit, they continue with external advisors and the final decision is often taken between family members (as F19, see fig). Some family networks are simply structured: the eldest member of the family is the owner who finally takes the decision (as F21 in fig). He/she may discuss with his/her heirs or not but he/she often prefers to seek advice with peers of the same generation: their neighbour (F22), their forest contractor, a local network leader (F03 and F24). Some family units are complex: some forest estates are joint-held property between several family members (*e.g*. brother and sister). In this case, the forestry management decision is often delegated to the family member who lives locally and who is estimated as the most competent. If the family network formally exists, decisions are often taken by this family leader whose social networks are often more developed outside the family unit; his external network is often reticular (relation from one to the others and not only one to one). In some case, he could even have a central place in formal external networks.

4.1.3.2 The peers networks

When we look at outside the family network, the first network that is cited by interviewees is the informal network of peers: forest owners as them who live in the surroundings (5-20 km), forest contractors who work on their estate: "*I learn from the experience of a friend of the family. He's 70-75 y.o. but he was a former cooperative advisor. I always refer to him because I only have three years experience in forestry. This guy helps me since my father died. He was a very good friend of my father and without him I would be lost (…). There is also my cousin but he is not in the same forestry model as he's got much more forest than me. I also take advice from the local forest cooperative advisors even if I sometimes disagree with the current methods of the cooperative*" (F15, 42 y.o.). These forest owners have informal contacts and see each other in the field. They exchange some pieces of information and opinions about wood prices, technological innovation, seasonal pest emergence… No structured information is built inside these networks but it contributes to reinforce forest owners' opinions

4.1.3.3 The local DFCI network

This network was created at a regional scale in 1945 to prevent forest fires (whereas firemen fight active fires). If every forest owners have to financially adhere to the local DFCI association, theirs active participation to assist firemen is not compulsory. At a local scale, DFCI associations often registered many members but few of them are really active: "*In the steering board, we are ten forest owners. For the general meeting, we are 30-40 forest owners. We discuss the budget, we plan the actions for the next months: forest roads maintenance, ditch cleaning, forest fires surveillance… but 60% of the forest owners do not live in the village. Despite the compulsory adhesion for the 200-300 forest owners of the village, most of them never participate to meetings*" (F22, 65 y.o.). If the ageing

of forest owners and the migration of the youngest owners could be a problem for the survival of these local associations in the future, local DFCI associations are strategic for land use planning and forest fires prevention. The renewal of active members in many local DFCI associations is a challenge for the next decade;

4.1.3.4 The GPF network

The Forest production groups (GPF in French, see fig) have been created in the 1960's to promote modern forestry techniques and to encourage forest owners to manage more intensively their forests. GPF is the first basic and formal forestry network that exists a local level. This semi-public structure is composed of one or two forest advisors at the disposal of local forest owners and of one forest owner who is elected by peers (as F24, see fig). The forest advisors (F03) are employed by the regional centre for private property forest (CRPF) and the NUTS-3 level chamber of agriculture. They give free technical advices to voluntary forest owners but they do not market woods. They also help forest owner to elaborate their 15 years legal forest plan (PSG). If GPF seems to be very interesting for forest owners, few of them join and participate to this structure as the local forest advisor admits: "*With my colleague, our geographical zone covers 36 communes where there is a potential of 25000 forest owners. But in the GPF, we have enough time to look after only 200- 300 forest owners*" (F03, local forest advisors). Despite this low rate of participation, the GPF structures are very active in the Gascony Forest. Their actions are largely recognized and appreciated even by non GPF members who are still hungry for their advices. This very cooperative network has also strong relations with the regional centre for forest private property (CRPF) and participates locally to the implementation of forestry research;

4.1.3.5 The private forest advisors networks

Two others forestry advisors networks exist at this local scale. The first one is composed of independent and private forest experts who generally work for several large scale forest properties (500 ha and more). They often manage the whole aspects of the property (forestry planning, financial estimation, wood marketing…). The service provision to the forest owner is often contractual. Currently there are 15 forest experts working in the Gascony forest. The second forest advisors network depends on the two main forest cooperatives: *Alliance Forêt-bois* (Alliance FB) and *Gascogne*. These networks are composed of local forest advisors who propose different levels of contractual services: planting, thinning, harvesting, volume estimation, forestry planning, GIS cartography, wood purchase… many forest owners now rely on this integrated forestry services to manage their forest; 40% of the Gascony forest is now managed by these forest cooperative advisors at a different stage (from just one punctual intervention to an integrated forestry management).

4.1.4 Main network at the regional level (NUTS-2)

Some of the local bodies and networks also have representative at a regional scale. However other organisations only exist at this level as the regional services of the Ministry of the Environment of Agriculture and Forestry. Their action and relationship are much diversified and we only present the most influential in the forestry sector

4.1.4.1 The private or associative professional networks:

These organisations represent and advocate for the interest of forest owner (SYSSO/CRPF/CA/USSE), forest operators (ETF Aquitaine loggers) and cooperatives (Alliance FB, Gascogne), industrialists

(FIBA/CIBA), forest certifying organization (*PEFC Aquitaine*). Some of these organisations are located and centralized in Bordeaux in the same structure (*Maison de la forêt*/ Forest Home). They frequently meet in public and administrative arenas where forestry policies are discussed.

The first network concerns the social sphere of the forest owners and its representative at the regional level: the South-western forest owners Union (SYSSO). 6 000 forest owners are members of this union which aims at "*defending the interest of forest owners against abusive implementation of regulatory texts concerning economic, fiscal, social and more and more environmental rules*" (source: SYSSO website). Strongly attached to the independence of forest owners, they often argue against national or European regulations that infringe entrepreneurial freedom (as Natura 2000). At a national level, SYSSO also defends the specificity of the Gascony "planted" forest and its forestry model.

A second regional network is composed of an **alliance between three forest cooperatives** that merged into an unique entity called *Alliance Forêt Bois* (Alliance FB) in 2012. This network of 3 cooperatives integrate 44 000 forest owners and cover the three administrative regions (Aquitaine, Poitou-Charentes, Midi-Pyrénées) with 15 NUTS-3 level agencies and 16 local offices. With an approximate turnover of 170m€ and 500 employees, this network becomes a major key player in the regional market. It also participates to the main regional policy debates and develops intensive commercial relation with the industrialists as papers mills, sawmills, panel industries. Despite its cooperative status, the Alliance FB is sometimes criticized by some forest owners (see chapter "actors' behaviour") who think that the cooperative firstly satisfies its own interest at the expense of forest owners (these foresters often prefers to manage their forest by themselves, or to take advice with the GPF forest technicians). On the contrary, others forest owners who do not want to manage themselves their property, appreciate the turnkey services of the cooperative.

The third private important network concerns the wood industry sector. Strategic alliances are formalised between forest industrialists whose interests get served by the FIBA (Federation of Aquitaine wood industries). Created in 1947 and renewed in 2008, 120 firms belong to FIBA. Its main missions are to promote the use of local wood (in furniture, building…), to assist enterprises in their technological and economic evolution, to anticipate the emergence of new market. Fiba missions are also to participate to political debates and to make suggestions to political authorities when industrial policies are revised. They advocates for direct support for wood industries, and participate to collective definition of regional action plans for wood industries). All the members of this network have not the same strategic importance and some of them have more powers of decision as they are very influent and represent a strong economic force as the three regional papers mills, few pulp and wood-based panel industries and sawmills. Some of them are European leader in their domain and have branches in other European countries (Smurfit, Tembec, Beynel Manustock…)

Relations between these different networks are sometimes ambiguous. They sometimes cooperate to defend some commons goals as getting more support from the Ministries in charge of forest or industries (for re-afforestation plans after the storm for example), or from Europe (to get subsidies for forest fires prevention). They also wanted to create an inter-professional association to defend the maritime pine at a national level (CIPM); but this cooperation finally failed.
On other aspects, they are in competition as they discuss about what should be a fair price for wood products (roundwood, timber and wood energy) or how the future shortage of wood should be managed between the several industries for the next decades.

Others professional or associative networks also exist at the regional level at the regional association for forest fires prevention (ARDFCI). Created in 1945, this association put together 240 local DFCI associations and is very active in forest fire prevention planning. It actively collaborates with forest state services and regional centre for private forest property or Professional interest group as GIP

ATGERI. Since 2003, forest contractors have also had their own professional association (ETF Aquitaine) with 430 members. If this association give forest contractors advices about tax system, technical innovations, security and environmental rules, it also participate to the debates about the regional forestry planning and policies as the other networks.

4.1.4.2 The political authorities

The political authorities are mainly represented by the decentralized state administrative authorities and the regional political power (NUTS-2 and NUTS-3 level councils).

The state administrations implement, regulate and control national forest policies (DRAAF-SERFOB) and environmental policies (DREAL). DRAAF is particularly in charge of the regional forestry planning through regional forest orientations (*Orientations Régionales Forestières* - ORF), which are compulsory guidelines for more precise regional-level political instruments: (i) forest management regional schemes (*Schémas Régionaux de Gestion Sylvicole* – SRGS), applied to private forests (CRPF Aquitaine, 2005); (ii) regional forest planning directives (*Directives régionales d'Aménagement* – DRA), applied to state-owned forests, *eg.* (ONF, 2006a); (iii) regional forest planning schemes (*Schémas régionaux d'aménagement* – SRA), applied to the other -mostly municipal- public forests , *eg.* (ONF, 2006b). To define these regional orientations and planning instruments, DRAAF organizes and steers the public debates and the mediation with the representatives of the regional professional networks. In these arenas and participatory, forest stakeholders are not considered in the new framework of the French Forest policy (2001) as passive subjects of a national policy design, but on the contrary, are supposed to take part in the definition of a concrete agreement between parties, where prescribers are payers and each partner engaged with specific assignments and responsibilities in a common process at regional and local level (Buttoud et al., 2011). If those plans (SRGS/DRA/SRA) are mandatory, their contents are collectively defined by the regional stakeholders (with CRPF and ONF handling respectively the writing of SRGS and DRA/SRA) under the supervision of the DRAAF and with respect to the global frame of the national forest policy. As this policy aims at increasing wood harvesting, this global goal has also to be implemented at the regional scale through the SRGS/DRA/SRA. DRAAF also manages the national budget dedicated to the re-afforestation programmes (after the Hurricane Klaus in 2009) and supervises the regional forest fires protection plan (PPFCI).

The DREAL is the regional administrative service of the ministry of the environment. As the DRAAF, it implements national state policies at a regional and local level. Concerning the forest issues, the DREAL is particularly in charge of implementing biodiversity policies coming from the EU (as Natura 2000) or from the Ministry of the Environment (as the National strategy for biodiversity).

These two state services depend on different Ministries but they normally coordinate their actions. In case of conflict, the supervising regional administrative authority (the Prefect) takes the final decision. Since the implementation of decentralization in the 80s, these two regional state administrations have continuously lost their power, workforce and financial lever. However their roles have been redefined as mediators and planners even if they sometimes keep a power of coercion through the implementation of mandatory national laws or European directives (on water policy or Natura 2000 for example). Two others political authorities – the Aquitaine Regional council (CRA) and NUTS-3 level council (CG) – also influence the regional and local forestry policies. If they have no regulatory power, they have an economic and incentive influence at local level. In the French case study area, the Regional Council regularly votes credits to impulse innovations as Carbon credits, hardwood species planting, sawmill supports…

4.1.4.3 The non profit organisation networks

At regional level, an important scientific network specifically works on forest research with several public forest research centres specialized on biophysical and ecological aspects (INRA), socio-economy (Irstea), genetics and mechanization technologies (FCBA). The innovations of these public or semi-public research centres organisations are shared with private stakeholders and wood industries in a common platform for exchange and innovation, the innovative cluster Xylofutur. Finally, non market and non forest organizations are also present at regional level: environmentalists NGOs, hunter unions, and tourism boards. They are formally invited or members of the main discussion arenas about forest policies but they are a bit marginalized as their views about forestry is often opposed to the mainstream strategy of the others stakeholders(Candau and Deuffic, 2009).

4.1.5 Relations between networks

Relations between these networks are diverse and depend on issues that are in discussion. Cooperation is the most common type of relations between forest-related actors (owners, loggers, industrialist, regional policy makers) at a local and regional level. These relationship are sometimes formalized by contracts (between forest owners and industrialist or cooperatives i.e.) or inside regional schemes (ORF/DRA). When the cooperation is not sufficient to lead to genuine agreements, some of these forest organizations are lobbying at the national or EU level (advisory committee on the forest-based industries, advisory group on forest and cork).

Classic competition can be observed between industrialists for access to market or between forest owner and wood purchaser about wood prices. But since the Hurricane Klaus in 2009, competition has increased between the traditional and local network of forest industrialists (as wood panel industries, paper mills, sawmills) because of the destabilization of wood market supply. Competition has been even exacerbated since the emergence of a new market that competes for the wood resource (bioenergy). A common agreement has been more or less formalised to avoid the exportation of the local wood resource outside the Gascony forest borders. This one-off agreement can be interpreted as an alliance between insiders against outsiders stakeholders (local vs. extra-regional wood energy actors).

When competition increases, it sometimes ends up in conflict. This situation is illustrated when forestry paradigms promoted by stakeholders are too different or when social norms or and economic rules are not respected by all the partners. Some of these conflicts are locally delimited; they are not mediatised and stay unknown by political authorities. Others conflicts emerge in public arenas and are put on the political agendas at local and regional level. The right balance between forest and game is often a source of conflicts between forest owners and hunters at local and regional level. Those conflicts are often solved by negotiations about the fair rate of animals that should be eliminated. Common agreements about game management plans are negotiate at local and regional level. Conflicts also exists about between forest advisors networks: the private and independent forest experts say the **forest cooperative advisors takes advantage of owners' delegation** to give forest management advices while they are not supposed to do it. This situation sometimes creates a r**isk of distortions of competition**.

Another source of conflict concern the implementation of environmental plans as Natura 2000, the green and blue ecological corridor network (*trame verte et bleue*) and more generally the forestry values that sustains the Gascony forestry model. For environmentalist NGOs, forest multifunctionality is not still well and enough implemented in the Gascony forest whereas forest owners complains about environmental constraints and restrictions.

More generally, traditional forest stakeholders establish informal networks, based on common shared values and perspectives, among the supporters of traditional forest vision and among those representing other interests. In search for stability of position and status, both the local actors and the forest service adapted to each other's positions through mechanisms of resilience made of both translation (re-defining the issue and thus the solutions in order not to contradict the proper interests) and screening (blocking the flux of information and learning in order to avoid from important modifications) (Buttoud et al., 2011). This resilience of the stronger pro-productivist actors to change constitutes one of the major barriers to institutional innovations which seek to create space for new forestry practices.

4.2 Political resources

The distribution of political power and the relationships between key actors in the forest policy making and implementation process have partially been analyzed in the previous sections.
In fact, in the section 3.6 (Forest policy regime), we show that the State is still the main political authority in the forest sector. Considering that its administrative, technical and financial resources are critically decreasing, the State power relies more and more only on his legal skills. At the scale of the Gascony forest it is however important to notice that the State has funded two post-storm restoration plans in 10 years. For that reason it still remains a key stakeholder in the region. In this context, private authority, through development of PEFC certification Scheme, are gaining power in the field of control and orientation of forestry practices. Representatives of private forest owners in the Gascony forest (SYSSO) have been very involved in the implementation of PEFC certification scheme and quickly succeed in mobilizing forest owners (in 2011, around 75% of the Gascony forest is PEFC certified). In the same way, regional councils tend to be more involved in the forest policy by implementing devoted support programs. In Aquitaine, it provides funding measures for most of the actors of the forest sector and even if amounts are quite low this strategy gives it certain legitimacy among the forest sector. Moreover, regional council consolidates its power by playing a key role in the political mediation process between the stakeholders of the forest sector. Indeed, the study of the forest policy regime also reveals that the lack of consistency of the mediation arenas and practices has substantial impact on power relationships. The different groups of stakeholders fail to organize themselves and fail to lead a coherent and convergent political work. As a consequence, power distribution among the forest sector relies on a range of relationships between public, private and collective actors which can be analyzed at the local and regional scale by studying the forest networks. These networks have been described in the section §. 4.1(Actors and their networks).
In this section, we focus on the importance and influence of the actors involved in these networks as it is perceived by actors themselves.

4.2.1 Power resources

The forestry cooperative gathers a lot of private forest owners as members, manages around half of the regional forest area and participates in the commercialization of half-timber volumes. For these reasons, representatives of forest municipalities (Interview S06), regional council (S09) and State administration (S08) consider it as a very powerful actor and perhaps one of the most influential regional players on the orientation of forest management practices. A forest contractor (F09) and a forest adviser (F07) agree with them and add that this power is consolidated by the support of State administration and CRPF (public body in charge of private forests management supervision).

Nevertheless, most of them also consider that forest cooperative domination over the forest sector is widely shared with wood industrials. A forest adviser (F02) specified that Paper industry is especially powerful given the large volumes of wood it mobilizes. The NUTS-3 level council representative (S01) agrees with him and adds Paper industry has a 'monopole' on the regional wood-raw supply. Many actors interviewed (NUTS-3 level council, 'competitiveness cluster' representatives (S01, S10) and a mayor (S05) also underlines that Panel industry is powerful for the same reasons. The 'competitiveness cluster' representative (S10) added that little sawmills also has power because of their strong and old anchorage in the forest sector.

One mayor (S04) thinks paper industry is the most powerful but mentions that the whole wood industry has a dominant position in the sector. This point of view is shared by the forest municipalities' representative (S06) and one sawmill industrialist (S13), the last one considering they play a key role in the regional policy making process. The other sawmill industrialist (S12) said that 'money' leads the forest and wood industry, giving the paper industry the most power.

The latter (S12) then added forest owners are powerful because of their number. The regional council administration representative (S09) agrees on forest owners' power but a forest advisor (F02) does not, neither does one mayor (S04) thinking their lack of cohesion and coherence makes them weak. Their official syndicate, the SYSSO (South-west forest owners' syndicate), is considered by the state administration representative (S08, S09) and the NGO's as very powerful, and especially regarding its influence on forest management practices (for the NGO's representative).

Finally, according to the industry and the regional council administration representatives (S15, S09), the State and the regional council still are the most powerful because they define sector based orientations through their public incentives delivering strategy.

4.2.2 Strategies

According to a forest advisor (F02), Paper and Panel mills choose the cooperation strategy by awarding contracts with cooperatives, in order to secure their wood supply. The 'competitiveness cluster' representative (S10), one mayor (S04), one sawmill industrialist (S10), the NUTS-3 level council representative (S01), the State administration representative (S08) also say those large companies use blocking strategies against large industrials projects which could compete with them on the access to the wood resources. For example, they lobby the State administration and the regional council to limit development of wood energy mills or wood valorisation platforms projects which would increase tension on wood resource. According to the State administration representative (S08) and the regional council administration representative (S09), blocking projects' strategies are done for the forest sector's sake.

Many actors think that the forestry cooperative strategy is also based on logic of cooperation and coalition with both forest owners and wood industries. By becoming essential and omnipresent both in the field of forest management and in the field of wood market, they succeed in being highly influential in the whole sector.

In comparison with others region, private forest owners (through the SYSSO) are quite well organized and powerful in Aquitaine. They have a good legitimacy (more than 6,000 members) and are able to lead an active political work, at the regional level but also at the national or European scale. They are not part of the national private forest owners union but they often discuss/oppose to State actions and are involved in the policy making process relying on the support of local parliamentarians. At the regional scale, considering that the SYSSO is controlling the public body in charge of private forests

management (CRPF), they provide technical support to the regional council for its forest schemes, thereby helping provide legitimacy for the policy framework.

The region helps wood industry by giving them access to innovation, as stated by the regional council administration representative (S09). The State administration representative (S08) insists on the critical role of the regional gathering action, aiming at replace the absence of joint-trade organizations in the region. According to him, the main objective is to lead the actors to naturally cooperate with each other and create an efficient joint-trade dialogue. Sawmill industrialists also consider grouping as a solution, but not especially among all actors but among actors from the same sector (for example, sawmill industrialists with sawmill industrialists, forest owners with forest owners…). The forest fire prevention association representative (S07) says that its association tries to develop the cooperation among actors by grouping them and making them work on common thematic. According to him, data share and transparency is provided in those kinds of meetings, what structures the forest sector.

5 AGENT-BASED FACTORS (MICRO LEVEL)

5.1 Forest management practices

Analysing forest management practices induces to describe what is done in the field by forest owners and also by forest users. In the Gascony forest, the general objectives devoted to forest, and by consequence the forestry practices, have strongly evolved since the XIXth century. From marshes draining to the supply of ecosystem services, forest owners and users expectations are somehow contradictory today.

5.1.1 Evolution of ecosystem services between 1857 and 2000

Since its institutional extension in 1857, many different ecosystem services have been ascribed to the Gascony Forest. When the afforestation of the Gascony moorland was promulgated by the emperor Napoleon III in 1857, it was described as an "interior colonisation", a way to develop an unhealthy land (Sargos, 1997). While it certainly did not operate in the 'desert' presented by the 2nd Empire propaganda (a pre-existing 200 000 ha forest cover is for example to be attested), the afforestation was then justified with the hygienist arguments that were prevalent at the time: a way to drain and to clean up marshes and wetlands and to improve the herders' life conditions. In this respect, maritime pines have been actively sown.

After this first step of afforestation, the main service was the production of natural resin for the chemical industries till 1920. Many tenant farmers and farm workers (not really independent forest owner) were practicing pines tree tapping manually. Today, this very traditional and old fashioned activity is still profoundly imprinted in old people minds who still interpreted it as a cultural heritage even if resin harvest has totally disappeared during the 1960s. Between the two world wars, the production of pulp for paper mills developed whereas resin tapping was slowly disappearing.

The most important evolutions in terms of forest had occurred during the 1960s. During this period, regulatory texts and forest policies reforms still converged in the same direction: the Gascony forest – as other forests in France – had to participate to the mitigation of the chronic deficit of forest products at national level. The paradigm of forest modernization has radically changed the forest management practices and is still predominant today in daily forest practices of a majority of forest owners. The main changes were: (i) creation of improved varieties of maritime pines (by genetic selection and hybridization, used progressively in afforestation from 1975 on); (ii) substitution of natural regrowth by row sowing, then by plantation (with seedlings coming increasingly from genetically selected varieties); (iii) mechanization of the different management operations (from plantation –including soil tillage…- to thinning, and mechanical harvesting –generalized since the storm Martin in 1999; Cf. § 3.4.1.1).

Another kind of ecosystem services emerged during the 1960s: forest recreation in periurban and in coastal areas. On the coast, this service has been organized and policy oriented by a specific governmental institution (MIACA, Mission for the Aquitaine coast planning) between 1967 and 1992. The main objectives of the MIACA was to promote economic activities based on tourism on a large fringe of the coastal zone but rather small in surface. Tourism activities were spatially delimited to the seashore and the nearby lakes and a dense and structured network of cycle paths has been

created in the public forests. It should also be noted that a natural regional park (*Parc Naturel Régional des Landes de Gascogne*) was set up at MIACA's behest in 1970: covering 315 300 ha around the watershed of the Leyre river, it involves 41 municipalities of Gironde and Landes NUTS3 regions in a sustainable development approach, including both natural and cultural heritages. Yet, even if these moves have greatly contributed to regionally re-evaluate the social functions of forestry management against the production function, they have not led to fundamental changes in silvicultural practices.

Table 41: Evolution of the main objectives assigned to the Gascony forest

	Main objectives of FM	**Means and practices**
1857	to drain marshes and to improve life conditions of cattle breeders	• Artificial afforestation of pasture with maritime pine;
1857-1920	To produce natural resin and mining posts	• Pines tapping by former famers
1920-1960	To produce • pulp for paper mill • timber for carpentry	• Decrease of resin tapping • Increase of timber harvesting for pulp and 2nd transformation
1960-2000	To produce • pulp for paper mill • timber for panelling and carpentry To participate to tourism development on the sea-side	• Modernization of forest management practices : fertilization, mechanization, genetics selection, weed and pest control • • Land use planning for tourism on coastal zones
Since 2000	Multifunctionality • To produce timber, panelling, pulp, paper • To conserve biodiversity • to improve recreation activities	 • shortening of maritime pine rotation • implementation of Natura 2000 • land-use planning for tourism in costal, periurban and even rural remote areas

5.1.2 Evolution of ecosystem services and forest practices between 2000 and 2009

In accordance with the national forest policy promulgated in 2001 (MAPA (Ministère de l'Agriculture de la Pêche et de l'Alimentation), 2001), the regional scheme for private forest management in Aquitaine (CRPF Aquitaine, 2005) and the forest regional planning directives and schemes for the public forest (ONF, 2006a, 2006b) promote the multifunctionality of forest.

5.1.2.1 The South western maritime pine model

If the main principles of the maritime pine model had been implemented during the 1960s, many evolutions have occurred since the two windstorms in 1999 and 2009. After clear-cutting, planting has become favoured over sowing in re-afforested areas, on a rough (and now possibly underestimated) 70-80% basis (CRPF Aquitaine, 2008). The seedlings used for planted pines have been issued from a selection programme primarily based on trunk straightness and volume[11], followed in a later stage by adaptation criteria (Cf. §3.4.1.3), with an estimate of 28% of the forest region now covered by improved material (Raffin and Alazard, 2013). Phosphate-enriched fertilizers are brought with the plantation (preferentially with soil tillage or before three years) to compensate the lack of fertility of sandy soils. If the role of genetics should not be totally discarded, these are

[11] Frost tolerance was also considered as a prerequisite, with a provenance test aiming to exclude Iberian frost-riven varieties

mainly fertilization and forestry practices such as drainage, tillage, thinning[12] and vegetation control that have increased the regional average productivity from 4,8m^3/ha/yr in 1960 to an estimate of 11 m^3/ha/yr in 1998 (IFN data cited in (Trichet et al., 2008)). From the 1960s until the Hurricane Klaus in 2009, the guidelines for the dominant forestry model were mainly based on these general principles and self-reinforced the 'planted pine' model

Table 42: Schematic theoretical maritime pine forestry model (in 2000)

Forest operations	Plantation (80% of the surface)	Seedling (20% of the surface)
plantation	1250 to 1400 plants/per ha	10 000 germination/ha
Clearings		2 or 3 clearings 2 and 5 years after the seedling
Thinnings	pre commercial thinning after 12-15 years and then 3 or 4 thinnings every 10 years approximately	idem
pruning	from 3 to 6 meters high (but abandoned during the 1990 s')	Idem
final clear cutting	40-50 years	idem

This unique model could have reinforced a feeling of path dependency as a majority of key actors (large-scale forest owners, contractors, and cooperatives) have based their development on these options. However this model is a bit theoretical and forest owners do not follow it strictly. In the chapter about forest owners' behaviour (§ 5.2.3), we will see that this model is often adapted. Sowing was progressively replaced by plantation during the 1980sand 90s but since the Hurricane Klaus in 2009, some forest owners (Group G4 and G2) wish to sow a proportion of their forest instead of planting. Despite the original demand of the panelling industries, artificial pruning practices have been hardly implemented by forest owners. The most important divergence to this theoretical model is the rotation age which really increases a lot by some forest owners (as Group G2 and G3). We thus find maritime pines that are 60 or 70 years in the Gascony forest as they should have been harvested after 50 years.

[12] Until the 60s, the thinning regimes applied to *P.pinaster*, aimed to stimulate gem production, were strong enough to have a noticeable impact on productivity (Decourt, N., Lemoine, B., 1969. Le Pin maritime dans le Sud-Ouest de la France : tables de production provisoires. Ann. Sci. forest. 26, 3-44. http://dx.doi.org/10.1051/forest/19690101).

Another distinct forestry model is applied in sand-dunes public forest on the seashore. Along this coastal zone the production function of forest is integrated in the ONF multifunctional management with the aim of answering the following main stakes: protection of men and assets against marine and wind erosion, biologic protection (conserving dune and wetland habitats, favoring a mix with broadleaved species, delimiting old-growth stands), access for the general public (ensuring a secure and qualitative –from landscape and tourism perspectives- recreational use), *Cf.* pp. 65-66 in (ONF, 2006a).
To meet these objectives of sustainable forest management (identified and precised as Helsinki criteria), the coastal maritime pine model is mostly based on natural regeneration (natural regrowth, with sowing only as a complement). In areas where the stakes of dune protection and/or public access dominate, two adaptations prevail: (i) the size of management stands can be considerably smaller, with silvicultural treatments qualified as 'parquet high forest' (*futaie en parquets*) or irregular; (ii) the rotation age, ranging from a recommended optimal of 50 years in good soils to 65 years in the poorest soils, can reach a *de facto* maximum of 120-130 years, *Cf.* p. 91 in (ONF, 2006a).

If multifunctionality of forest has been promoted in 2001 at national level by the ministry in charge of forest (MAPA (Ministère de l'Agriculture de la Pêche et de l'Alimentation), 2001), the production of goods and woody products has been reintegrated as an important goal of the national forest policies by the Sarkozy government in 2008. The slogan of the forest policy goal of what have been called the '*Grenelle de l'environnement*' was: "more production for better protection". As the 2001 forest policy orientations were not denied, these two ambiguous – and sometimes contradictory – messages could be applied. If ecosystems services were equally promoted according the 2001 law about multifunctionality, production could also remain a priority now. Consequently, these three functions (production of goods, environment protection and recreation) have been diversely applied and prioritized according to stakeholders groups that have been interviewed (see topics "actors' behaviour).

Thanks to the tables of the guidelines proposed in the Handbook, we have tried to synthesize the dominant opinion among the interviewees:

Table 43: Overview on ecosystem services provision in Gascony forest

Ecosystem Services	**Provision through active FM?**		**Assigned importance**			**Economic relevance**		
	Yes	No	Primary	Second-ary	Involun-tary/ Implicit	Yes	No	Indirect
Timber	**X**		**X**			**X**		
Wood Fuel	**X**			**X**		**X**		**X**
NWFPs - Food		**X**		**X**				**X**
Clean water		**X**		**X**	**X**		**X**	**X**
Biodiversity	**X**			**X**	**X**		**X**	
(Eco)tourism	**X**			**X**		**X**		**X**
Hunting/mushroom		**X**			**X**		**X**	**X**
Aesthetic Services		**X**			**X**		**X**	
Climate regulation		**X**			**X**			**X**
Air regulation		**X**		**X**	**X**		**X**	
Water regulation	**X**		**X**					**X**
Disease regulation	**X**			**X**		**X**		
Fire prevention	**X**		**X**			**X**		
Waste detoxification		**X**		**X**			**X**	
Recreation	**X**			**X**		**X**		**X**
Supporting services		**X**	**X**			**X**		**X**

5.1.2.2 Some sources of tension

This overview hides conflicts about what kind of ecosystem services forest provide. If the prevailing multifunctionality model assumes that wood production pays for joint services (*eg.* mushrooms, hiking...), the possibility that in a near-future such ecosystem services would become marketable is highly conflictual. The main ones concern:

- Biodiversity : during the 1990s', the implementation of the Natura 2000 network, based firstly on compiling a list of habitats and species that could be recognized as being of Community importance, generated considerable conflict in France and in particular in the Gascony forest, to the extent that the directive was suspended in July 1996 (Alphandéry and Fortier, 2001). Finally, the changes in the procedures of the Habitats directive and the role given to negotiations succeed to calm things down. In the middle of the 2000s', debates were pacified as Natura 2000 zones were restricted to riverbanks, marshes and sand dunes forest and rarely integrated forest production areas;
- Water management: another source of conflict between farmers and foresters concerns land and water resource management. Forest stakeholders accuse farmers to dry up the water table to irrigate farmland surroundings forest stands. These claims were particularly vigorous during the drought that occurred in 2003. Ten years after, conflicts are still latent and no clear negotiated solutions arise for the moment - although this problem will probably become more important with climate change;
- Hunting: hunters and forest owners frequently disagree about the fair rate of game (roe deers and wild boars) that forests may support without damages. To solve this problem, annual hunt plans are negotiated between forest stakeholders to define the harvest rate. If hunters do not kill enough game and if animals make lot of damages to trees, a system of financial compensation exists but it does not entirely satisfy forest owners in case of game overpopulation; the hunting issue may get worse with the ageing and the decrease of hunters population and, on the opposite, the explosion of game population in the future (Cf. § 3.3.1.4) ;
- Recreation: Whereas the original objective of the Gascony forest was to produce resin and then timber, recreation activities have been ignored until the 1960s'. If the MIACA promoted tourism on the coastal zone (and its hinterland, through the setting up of the natural regional park), nothing was really organized to structure outdoors activities in periurban forests. Today, if public access to forest is free, conflicts for small touristic infrastructure (bicycle trails, pedestrian paths) promoted by municipalities creates conflicts with private forest owners: "*in a decade, the population has increased by 30% (S02) and when we build a trail for pedestrian near private forest, some forest owners are fed up; they prefer seeing nobody in their forest*" (S02, mayor). Forest owners fear forest fires risks, litter, and mushroom over-picking. A local public authority (*Conseil Général des Landes*) has proposed a insurance contract with forest owners to hedge risks in exchange for free access (only on the paths not inside forest) but few forest owners contract this insurance;

5.1.3 The hurricane Klaus in 2009: a turning point or a status quo?

In 1999, the northern part of the Gascony forest was damaged by the Hurricane Martin which windthrew 23 million cubic metres. Despite this first warning, most of the forest owners considered this storm was exceptional and based not on a decadal but a century scale cycle.

Ten years after, in January 2009, the hurricane Klaus severely damaged the central and southern part of the Gascony Forest. Around 40 million cubic metres (223 000 ha) were windthrown, equalling 5 years normal regional annual felling. For individual forest owners, the economic effects of the storm were disastrous. The prices of the marketable timber collapsed from 30€/m^3 before the storm to 5-10 €/m^3 and sometimes even less during the following months after the storm. If the cleaning

programme did not really succeed to the save the maximum value for forest owners, the sawmilling and panelling sector succeeded to preserve the most valuable wood by building water storage areas next to their firms and thanks to public grants.

To avoid distortion of the market on a medium-term, an 8 years restoration programme (2009-2017) has been implemented by the national and regional public authorities. The ministry of Agriculture in charge of forest voted:

- 600 million Euros of subsidies loans ;
- 475 million Euros of tax reduction or postponement on forest incomes, land taxes on non-built properties, and grants to clean and re-afforest forest properties before 2017;
- 100 million Euros of grants or credits to buy, to store or to transport wood in the next months following the storm.

Despite the protestation of the forest owners union, no collective/public system of insurance similar to what exists in agriculture, has been applied. The ministry of agriculture decided to delegate the insurance system to the private sector as from 2017.
The Regional Council also voted a special budget or 22 million Euros to help the forestry sector to recover from the storm by supporting investment in mechanization for forest contractors and loggers, by participating to the budget for the creation of wood storage platform, etc. Finally, 110 million Euros came from the European Union Solidarity Fund to clean the forest during the first year after the storm.

This major event has not deeply changed the opinion of forest stakeholders about ecosystem services that forest could provide but it strongly questioned them about the traditional forestry model that was applied until 2009 and despite the 1999 first alert. Two different assessments have been request by the ministries of Agriculture (Laffite and Lerat, 2009) and the Ministry of environment (Gip ECOFOR, 2009). Both of them argue for the integral restoration of the forest but not on the same forestry principles at all. Whereas the ministry of the Environment wished for more environmental concerns, the ministry of Agriculture insists on the economic support of the forestry sector. At regional level, many debates also occurred among forest stakeholders. Some forest owners and forest contractors identified tillage and plantation as determinants of storm vulnerabilities. Others also accused the strength of the gust wind (172 km/h at Biscarosse, 20 km northern from the case study area). A collective assessment has been organized under the supervision of the GIP Ecofor. Many aspects were analysed, assessed and deliverables were produced. One document deals with the forestry models that could be implemented after the Hurricane Klaus (Lesgourgues and Chantre, 2009). Some propositions have been introduced into guidelines for forest owners who wanted to re-afforest their property. Six different models to re-establish or regenerate the storm affected forests have been proposed (see The traditional forestry model that prevailed before the storm was the model n°1 (high quality timber). After the storm, most of the forestry organisations firstly recommend forest owners to shorten the maritime pine rotation to 40 years at most. During cleaning operations, stump harvesting practices has been also largely implemented despite some forest contractors proposed this technique few years before the storm. On this particular aspect, the post-hurricane period really constituted a turning point. During the interviews, forest owners gave us explanations that were clearly profit-oriented: "*From an economic point of view, stump harvesting is really interesting for forest owner. Tillage operations are really cheaper after the harvest as ploughing can be realized non-stop. And I can prove it: normally, 4.5 ha a day can be afforested; without stump, it's 7 ha a day! It is then also easier to clean the soil and to cut the understoreys; there are also less mechanical damages on tractors and you could afford to work with a less powerful engine!"* (F18, forest manager, 59 y.o.). But other forest owners from group G4 (see chapter "actors' behaviours), stump and slash harvesting can severely affect soil fertility and should be restricted to the more fertile forest areas.

Table 44).

The traditional forestry model that prevailed before the storm was the model n°1 (high quality timber). After the storm, most of the forestry organisations firstly recommend forest owners to shorten the maritime pine rotation to 40 years at most. During cleaning operations, stump harvesting practices has been also largely implemented despite some forest contractors proposed this technique few years before the storm. On this particular aspect, the post-hurricane period really constituted a turning point. During the interviews, forest owners gave us explanations that were clearly profit-oriented: "*From an economic point of view, stump harvesting is really interesting for forest owner. Tillage operations are really cheaper after the harvest as ploughing can be realized non-stop. And I can prove it: normally, 4.5 ha a day can be afforested; without stump, it's 7 ha a day! It is then also easier to clean the soil and to cut the understoreys; there are also less mechanical damages on tractors and you could afford to work with a less powerful engine!*" (F18, forest manager, 59 y.o.). But other forest owners from group G4 (see chapter "actors' behaviours), stump and slash harvesting can severely affect soil fertility and should be restricted to the more fertile forest areas.

Table 44: Comparative approach of six forestry model for *Pinus sp.* in the Gascony Forest. Source: (Lesgourgues and Chantre, 2009)

Model	M1	M2	M3	M4	M5	M6
Name	High quality	Standard	Short rotation V1	Short rotation V2	Semi-dedicated (timber and biomass)	Biomass
Species	*P. pinaster*	*P. pinaster* *P. taeda*	*P. pinaster* *P. taeda*	*P. pinaster* *P. taeda*	*P. pinaster* *P. taeda*	*P.pinaster* *P. taeda* *Eucalyptus*
Regeneration	Seedling or planting	Seedling or planting	Planting	Planting	Planting	Planting (seedling ?)
Rotation	45- 60 years	35-45 years	30-35 years	25 years	9 years for biomass 35 or more for timber	8-12 years
Objective	High timber quality	timber	round wood	round wood	Biomass and timber	Biomass
Volume (/tree) or total biomass (/ha)	>1.5 m^3	1-1.2 m3	0.6-0.8 m3	0.3-0.4 m3	30 t/ha or 1 m3	70t/ha
Initial density (trees/ha)	1250	1250	1250	1250	2500	1500- 3000
Final density (trees/ha)	250	300	500	700	300	
Number of thinnings	4-5	3-4	2-3	0-1	1 for biomass and 3-4	0
Impact on soil fertility	Very low	low	medium	Medium	strong	Very strong

The success of stump harvesting during the cleaning period (2009-2012) can be explained not only by individual based factors but also – and even mainly – by structural factors: the demand for stump really have really increased since 2008 with the emergence of large-scale bioenergy industries based on cogeneration and bio-refineries... one of this industrial units is able to burn more than 200 000 tons of stumps per year. And during the next decade, demand will probably exceed supply.

If these heating and power plants will receive an abundance of industrial by-products in the coming 2-3 years, it will probably be followed by a period of expected shortage of woody biomass for energy production. To avoid this troublesome situation, pulp and paper industries promote short rotation model (M3-4) and even biomass dedicated model (M5 and M6).

5.1.4 From theoretical forestry model to practices in the field in 2012

Three years after, when we interviewed forest owners and forest stakeholders, reactions suggesting a total transformation of the forestry model are not so obvious and not shared by a large majority of the interviewees. If the hurricane engendered a large disappointment in forest owners' mind, who decided for a part of them to reduce their financial and management personal investment, a vast majority of forest owners decided to re-afforest their land.

After the hurricane damages cleanings, many forest owners re-afforest the same way, in order to have as many choices as possible in the future. If the structure of subsidies may act as a 'windfall profit' on post-storm harvest, cleaning and re-afforestation practices –as they *e.g.* promote plantation- it remains that most owners are dubious about models that would end up into a single

product as the biomass model. They do not want to restrict themselves to a plantation that will only fit pulp or energy markets, partly because they do not know what those markets will be like in 20 years. According to a forest expert (F07) and a regional forest administration representative (S08), the absence of forestry change in post-hurricane plantations comes from the fact that all the economic, scientific, political institutions claimed for ages that the maritime pine model is the only one that could suit regional growing conditions. This opinion is largely spread among every group of forest owners we interviewed. If their faith in progress has been strongly shaken by the consequences of the hurricane, the local interpretative master frame of the maritime pine as "the" pillar of the regional forest economy still dominates.

As noticed by a majority of the forest stakeholders, most of the forest owners follow the same forestry model (M1 and M2) as before the hurricane (to produce 40-45 years timber for sawmills, harvest the cleanings for paper mills, everything with maritime pine species planting, same densities and management). For a forest expert (F07) and a sawmill industrialist S12), this attitude can be explained by as forest owners have still considered early-clearcuttings as an "*impecunious practice*", a "*harvest before benefits*". For an industrialist (S15), this lack of confidence in innovative models (M4-M5-M6) also proves that some forest owners do not calculate properly their return on investment and also their lack of professionalism. But others stakeholders are more optimistic and think forest owners and managers will do their final clearcuts sooner than before because of the risks threatening the forest and the market demand trend (more wood for industry and energy and less high quality timber). Many forest owners of group G1/G2 (see the typology in chapter "actor behaviour") do not want to restrict themselves to a single forestry model that only fit to pulp or energy markets, partly because they do not know what those markets will be like in 20 years. The balance between different forestry model on the same property is not easy to find and even not realistic for small and medium property. For a forest advisor (F02), a cautious approach consists in keeping a timber wood objective on some forest stands even if more dynamic forestry models are more profitable on a short-term and could decrease fires risks (S07). For environment-oriented forest managers (S06) and NGO' representatives (S11), forest owners' interests in new species and new forestry management models are not really motivated by the mitigation of climate change or pest controls but by profit, even if those models may affect soil fertility soils.

If there is a general consensus amongst forest stakeholders about the central role of the maritime pine for the future afforestation plans, some pro-environmentalist and NGOs also approve the possible diversification that is also offered in the plans, in specific areas and with alternative tree species. According to the forest state administration representative (S08) the sum of risks acts as a driver for diversification of maritime pine plantation diversification. The development of *Robinia* is promoted in the northern part of the Gascony forest (Médoc sub-region) for outdoor furniture and *Quercus suber* in the southern part (Maransin) as its cork could be used as a heat insulator for high environmental performance building. But these tree species will probably represent less than 5-10% of the future afforested area. In the 80,000 ha of re-afforested areas since the storm Klaus, only 1% have been planted with hardwood species (491 ha of *Robinia pseudoacacia*, 124 ha of *Quercus pedunculata*, 115 ha of *Quercus sp*., etc.). Moreover, 50% of these broadleaved species have been used to maintain or to improve existing plantations; only 30% are new (Source Gip Atgeri Cartogip, 2012). Another practice is slowly spreading by forest owners: the natural afforestation of maritime pine plantation with broadleaved hedgerows. Those hedges have a landscape impact as they introduce a source of visual diversity even if their first purpose is to limit pest attacks. Some of these hedgerows are also implemented near roads with high traffic in order to create a visual barrier to harvest operations. For a forest municipalities' representative (S06), more pragmatic reason may explain these practices: tractors drivers cannot access the borders and then let natural species grow, what permits a kind of greenwashing. Finally, if broadleaved should remain on the fringe of ordinary forest management practices, they could become irreplaceable in areas infested by fomès (*Heterobasidium sp*) that slowly but continuously spreads in the Gascony forest. A short-term

invasion of pine nematode (*Bursaphelenchus xylophilus*) in the next 5 years could have the same effect as no efficient treatments exist at the moment.

Concerning wood energy market, few forest owners re-afforest with the model dedicated to biomass (M5 or M6). As now, they prefer to market harvest residues (stump and slashes) because "*prices are not well enough to consider such actions*" (F20, forest owner). However, according to all the stakeholders, the wood energy demand will be so high from 2015 that it could be satisfied only if more energy dedicated plantations are implemented locally. One cooperative representative (S14) says that his cooperative already deals with some of those short rotations on some plantations. According to one out of the two sawmill industrialists (S12), these energy-dedicated plantations could lead to a real diversification and would let some specialized forest areas for timber (see the chapter about forest behaviours).

Whatever the forestry models will be implemented, this re-afforestation movement is important for forestry stakeholders and in particular for the industrialists. According to the forest adviser (F02) and a major industrialist (S15), a future competition for wood stock will threaten the wood industries from 2016. Some industrialists anticipate this situation by contracting with forest owners (who are sure to sell their wood at a good price, even if a major hazard occurs) in order to secure their wood supply when the competition situation will come. The cluster representative (S10) describes another possibility to overcome this source of tension: to think about reconversions in order to make transformed products with more added value and/or to import wood from others regions or countries even if "*industrial actors still prefer proximate resource to remote one*" (S15)

If forest stakeholders and forest owners are mainly concerned by the sustainability of forest management practices towards wood production, they also have to take into account specific consequences of these practices toward the provision of ecosystem practices. Some interviewed stakeholders as a mayor (S02) and forest advisor (F02) notice conflicts exist between hikers or tourists and forest owners because first ones are considered as disrespectful toward forest, but also threatening against forest's health. The forest adviser (F02) also mentions the opposition existing between forest owners and ecologists, each other fighting for the forest. The cluster representative (S10) says he does not understand both parts do not find a compromise because all stakeholders have the same superior interest: to maintain forest sustainability, to keep a social link between different users of the forest as "*forest can exist without the timber sector and no timber sector could exist without forest*". Despite this interdependency, the distribution of social uses between forest decision makers is considered as a political stake. The forestry paradigm that prevails during the 1960s is slowly losing its predominance as the social structure of the Aquitaine population is changing. Recreation, outdoor activities, landscape, and scenery are progressively expected by urban and periurban inhabitants but also by new incomers in rural areas. This new expectations are sometimes sources of local conflicts between forest owners, local authorities and tourism stakeholders. The latter regret the lack of cooperation of forest owners in the implementation or pedestrian or cycling paths as forest owners denounce municipalities which take economically advantage of tourism without economically rewarding forest landowners.

5.2Actors' behaviour

After having described what is done on the field, we will analyse why actors behave as they do and how they make their decisions and, on the aggregate level, what drives their forest management practices. In this chapter we will consider the responsiveness of different actors to structural factors and the role of relations and social networks and resources.

5.2.1 Theoretical frame

Since the sociology has emerged at the end of the 19th, a classic differentiation is done between an individualistic approach (Weber) and a more structuralist (Durkheim) perspective about actor's behaviour.

The first suggests that what happens in a society can mainly be explained by the individuals and their choices. This perspective has been developed in the rational choice theory and the bounded rationality (Simon, 1957). Some theorists refers to it as the logic of calculation or consequentialism in which individual essentially proceeds by picking the alternative with the highest pay-off (*homo oeconomicus*).

The second suggests an explanation of actor's behaviour by the social structures (incarnated in institutions). This Durkheimian perspective holds that actors behave for their social conformity, which means respect (or refusal) of tradition and of social/ technical rules and adherence (or opposition) to policies and collective norms (*homo sociologicus*). For March and Olsen (2006), the appropriateness of rules includes both cognitive and normative components. In the logic of appropriateness, rules provide behavioural guidance by defining appropriate course of action. Rules are followed because they are seen as natural, rightful, expected, and legitimate. Actors seek to fulfill the obligations encapsulated in a role, an identity, a membership in a political community or group, and the practices and expectations of its institutions. It does not mean that actors are slaves of social norms but that they are reasonable people adapting to the rules of institutions (Searing, 1991). Embedded in a social group, they do what they see as appropriate for themselves in a specific type of situation.

A third way has been developed by psychologist and constructivist sociologist as Berger and Luckmann (1996 [1966]) and interactionnists as Snow (2001) and Benford (2000). These theorists insist on the overriding roles of ideas and knowledge in the process of decision. Most of the time, actors' behaviours are stabilized by beliefs systems, mental frames and story lines. Actors behave according to a level and a stock of common-sense knowledge they acquired during primary and secondary socialisation. The more this knowledge is embedded (as with primary socialisation), the less the actor is ready to change his habits and routines. In this case, major changes only occur through external and often traumatic events (socioeconomic crises, natural hazards as a windstorm or forest fires). These events may induce the replacement of one ideology by another , what Berger and Luckmann call an "alternation" (1996 [1966]).

These three logics (consequentialism, appropriateness and cognition) are generally segregated but they can also be combined: action is often utility-oriented but rarely infringes socials norms and is often based on knowledge (we act because we want to reach an objective but in respect of rules and thanks to informed decisions). Action is also based on routines which are mode of action that have been informed, evaluated and transmitted by our predecessors and/or by our own experience and which are collectively accepted in our social surroundings. The individual often compromise between his interests (utility, profit, power), his values (autonomy, solidarity, success, universalism, welfare…) and his social obligation (the respect of norms, of tradition). For Lahire (1998), the social actor's identity is often plural and loaded with contradictions. For him, "action is the meeting point of past individualist experiences that have been incorporated in perceptive and evaluative routine schemes and of current social situation". If social determinations and structures are important to explain actor's behaviour, they are not so univocal. On the opposite, bounded rationality or methodological individualism give too much importance to immediate choice and do not take enough into account factors as memories, routine and incorporated past.

To thoroughly understand the behaviours of forest owners towards forest management, we have adopted the theoretical framework of knowledge sociology proposed by Berger and Luckmann (1996 [1966]), which they developed from the phenomenological perspective of Alfred Schütz (1987 [1962]). These authors argue that knowledge is socially constructed and oriented towards particular practical problems so that facts can never be considered as neutral but reflective of why they are required. In other words, what we know about environmental issues does not simply spring up out of reality itself, since our knowledge – whether it concerns the natural or the social world – does not derive from a simple and neutral recognition of reality (Lidskog, 2001). In this constructivist perspective, individuals are dominantly seen as socially created, meaning that they carry norms, values and expectations that originate in the institutions of a society (Vatn, 2005).

A methodological consequence of this theoretical perspective is the importance of the discourse as a means to understand the interviewees' universe of sense and thoughts This analysis of the "world built by the actors" can be done by studying what individuals say about their social practices, by monitoring specific vocabulary, with the interiorization of routine and social norms, in short, with the acquisition of legitimate knowledge that allows the development of practical strategies and the assertion of a recognized identity at the same time (Dubar, 1996). In this perspective, we also consider the influence of what Goffman (1991 [1974]) called "frame" which can be seen as cognitive and normative matrix, a set of concepts and theoretical perspectives on how individuals, groups, and societies organize, perceive, and communicate about reality at a global level. Some of these frames are called "master frames" as they are interpretative discourses that dominate at a worldwide scale and at the interface of media communication and public policies. Two of these master frames are potentially important in the forest actors' community:

- The master frame of the market: this frame is based on the primacy of economic exchanges to increase richness and economic development and on private property and without any (of few) state intervention and control. Despite the weight and the potential adherence of forest owners to this frame, we may also have doubts about its relevance. In the Gascony Forest, few forest owners really make profit: 1% of forest owners (n=150) can live only from forest products (>500 ha); 5% (1500) sometimes earn money (100-500ha), 30% rarely earn money (10-100 ha), 65% loose money (1-10 ha) ;

- The master frame of the environment: this frame gives the primacy to an eco-centered relationship to nature, with the wish that forestry participates to local development and that recreational activities are and not only the pursuit or satisfaction of individual profit. But the cost and the benefits of these non market services are discussed among forest owners who do not adhere spontaneously to this frame.

Following this general framework, our research aims at understanding foresters' behaviours, concerns, and beliefs that they legitimize and construct about forest management practices. We also consider that the relevance, the meanings and the attitudes towards forest management models schemes are built collectively. Action is rarely based on a strict individual decision process but is often under the influence of social networks. If the final decision is individual, the process leading to this decision often takes into account collective opinions, norms or rules. The social actor takes his decision in interaction with others members of his social group or the organization he belongs to. As has been shown for farmers (Darré, 1993; Lémery, 2003; Schoon and Te Grotenhuis, 2000) and for foresters (Bieling, 2004), we make the assumption that foresters discuss their ways of going about things with neighbouring foresters and within a local network of relations (local professional network, family and peers network, local advisors from GPF or Cooperatives). However, they also participate in more external networks (forest owners' associations as SYSSO, forestry cooperatives, etc.) where they discuss the evolution of their activity as well. We therefore make the assumption that foresters develop the sense of their activity in various places of social integration by discussing

with selected peers or interlocutors, such as other foresters, forestry consultants and local advisors. Depending on these places of social integration, the meanings conferred on forestry can differ from one group of foresters to another.

5.2.2 Methodology for content analysis

Unlike quantitative survey, the methodological principles that sustain a qualitative survey is not to ensure a demographically-balanced and representative sample of the forest owners' population but its diversity. It is the reason why our qualitative survey consists of semi-structured, tape-recorded and face-to-face interviews conducted with 26 forest owners and forest managers.

To achieve the typology of forest owner, we mobilized the answers to the different questions that were proposed in the interview guide for forest managers (as described in the handbook for researchers in november 2012). We tested their responsiveness to structural factors (demography, public opinion and discourses, economic development, technological development, ownership structure and tenure arrangements, forest policy regime) and the impact of agent-based factors (social networks, political resources).

Using cross analysis, we divided the interviewees into four groups. Usual social variables such as age, gender, job and the portion of income from forest products were not really discriminating. More complex variables actually seemed to distinguish the foresters' attitudes toward the integration or rejection of environmental practices:

- The paradigm of forest management models. As Pregernig (2001) did with Austrian forestry professionals or Uliczka et al. (2004) with Swedish private forest owners, we also differentiated sub-groups by their values with regard to forest management. Despite the hegemony of the maritime pine intensive model in the Landes Forest, different paradigms of forest management are discussed and applied within each social network. Forest management practices range from soft-management forestry to the close-to-nature forestry model, with intermediary situations, depending on the network;

- Their relation to nature and technological progress. In the scientific community, the idea of the complete control of nature has therefore largely been abandoned and the rarely controllable risks involved in the appropriation of nature are taken into account (Görg, 2004). However, in the forester community, faith in science and technology to prevent and eliminate risk is still very prevalent, even if some foresters count more and more on nature to restore ecosystem balance ;

- Social discussion networks (see chapter "social network). Three main networks are important for distinguishing foresters. The first one is the official professional and corporative network of the regional centre for private forest property (CRPF/GPF) and the forest cooperatives network (Alliance FB, Gascogne) which are both very influential at the regional and local level. A large majority of forest owners are members of these networks but few are very active. The second network is a loose conglomeration of owners who are members or sympathizers of a pro-environmental association of close-to-nature foresters (Pro Silva). The third one is the neighbourhood network, which is often very local, not official and essentially composed of members of the family or neighbouring foresters and forest users (hunters, hikers). This network is very important since official advice from the first two networks is often discussed and sometimes refuted within this local sphere;

We performed a two-stage content analysis of their discourse (structural and theme analyses). The first part was the structural analysis which consisted of coding, clustering, and labelling individual extracts from interviews into differently themed categories (structural analysis). The second part was the thematic analysis, which involved studying the different opinions expressed by all of the interviewees on the same topic (a category or a concept labelled in a thematic item). The aim was to reveal the arguments and the system of values used to accept or reject a specific item (opinions on forest policies, on factors influencing forest management…). In the final stage, we combined and synthesized these answers into a set of key factors or synthetic variables that help us to build the typology:

- First key factor (K1) deal with forest management objectives and models and the main changes that forest owners decided to impulse on their property. This factor aggregates data about the type of goods and services produced on the forest property (WFP or NWFP, goods and services), the forest owners' level of involvement (active/passive) and commitment (personal or delegated) in forest management, the portion of income (coming from WFP or NWFP), the main changes in FM practices on their property…

- The second key factors (K2) concerns environmental beliefs and attitudes: these factors have been tested in former interviews and are also dispatched through items as biodiversity and water/soil protection ecological factors;

- The third key factor (K3) includes the different opinions about the incoherencies and inconsistencies in the policy mix and the political and institutional factors that could influence the future of forest;

- The fourth key factor (K4) is mainly descriptive and is related to the social profile and the social integration of the forest managers. They were based on the answers related to the set of question dealing with the social features of the forest owners (age, gender, job, general education level, forestry education background, integration in social networks (isolated or collective, leader or follower, scale of integration), imitation or differentiation in forest management with their peers...

A fifth set of variables (K5) could have been created by combining the factors that influence forest management decisions as social norms (public opinion, medias, new scientific insights…), political tools (EU policies, national/local policies,), economic factors (market prices, cost of FM,…) technical factors (available technologies,) relationship to nature and environment (anthropocentric, eco-centric, interest for biodiversity conservation..). But this set of variables combines factors of very different nature. We decided to dispatch them into the three previous factors (K1/2/3/4) according to their thematic proximities: technical and economic factors into K1, ecological factors into K2, political tools into K3, social norms into K4, etc.

5.2.3 Four main different logics of behaviour

If actors behaviour analyses are often divided into two main theoretical models – *homo economicus* versus *homo sociologicus* – , the qualitative analysis shows that behaviour models are more complex. Forest owners never strictly belong to one of these two models. They often have predominant preferences for economic arguments but they also take into consideration ethical, social and environmental stakes. To paraphrase Norton (2012), no descriptive disciplinary model or expert system can embody all of the variables and data necessary to understand, predict, and control the functioning of the dynamic system within which forest owners struggle with complex problems. But

we can propose an exploratory typology based on a selection of variables as forest owners' forestry models, their attitude towards environmental stakes, forest policies and social networks.

5.2.3.1 Group G1: forest entrepreneurs

The first group of 'forest entrepreneurs' (Group G1) consist of forest managers (or owners) of very large properties (from 500 to 15,000 ha). They are often full-time forester and they generally have some own equipments (as tractors, skidders) and they sometimes employed permanent workforces (from 1 to more than 10 employees).

They are often involved in forest policy process and in the management of important forest owners' organization and networks. Most of them are leaders or very active members of these local organizations (as GPF, DFCI,) and they often elected as representatives at a regional scale (in CRPF, SySSO,). They can also be members of different steering committees (regional banks, forest cooperatives, PEFC Aquitaine …) and are often invited to discuss about policy orientations at a regional level by forest authorities. Most of these forest owners are also collectively organized at a local level inside formal organization. They collect and sell larger volume of timber coming from diverse forest estates to obtain better prices from buyers (as pulp mills or forest entrepreneurs).

During the interviews, these foresters have explained that they use some of the latest innovations in forest technology such as genetically-selected plants, fertilization, systematic thinning, mechanized harvesting, GIS plot inventory, etc. This cutting edge approach had led to substantial profits, since timber represents a large portion of their income. Non forest wood products as mushroom are sometimes marketed through professional networks even if it finally does not count for an appreciable amount. If most of them have inherited their parents' property, they have decided to keep and not to sell their inheritance as they consider forest as a financial investment like any other banking product: "*I am born in 'Landes of Gascony' and my mother is a forest owner. For the moment, I haven't inherited her forest but I have bought 95 ha because I like forests. For the same price, I could have bought a flat in Toulouse. However I have chosen to invest here, in forests, because I know what it means to be a forest owner. And the economic interest is essential, it's a financial investment, that's clear; I haven't invested only for pleasure* » (n°L23, forest owner, 36 y.o.).

For stakeholders in the G1 group, the key barometer of performance in the forestry sector is profit. This group tends to use the success of their business relationship with the industrial sector as proof of their legitimacy. Their watchword is not "*to produce wood to accumulate standing timber capital*" but "*to produce wood to sell it*". Even if most of them are private forest owners, they have a similar socio-economic profile to industrial foresters. They assume strong connections with the forest industrialists with whom they regularly sign wood supply contracts. They also share the same language and rhetoric arguments as notion of "*profitability*", "*productivity gains*", "*costs rationalization*", etc: "*we have improved the time we spent on the field, from 22 hours per hectare 20 years ago to 4 or 5 hours per hectare today. Tractor could run 7 or 8 times on the same plot; now it only runs three times. (...). We purchase the best and most capable machines at the best value; we also improve work organization to avoid slack period. We continuously improved the whole process of production*" (L05, forest manager in a cooperative).

Due to the primacy of commercial exchange, members of this group tend to limit their consideration of biodiversity to the types of trees that are the most commercially profitable, such as *Pinus pinaster* and *Pinus taeda* in the Landes Forest. For the defenders of this intensive productive model, biodiversity conservation policies (as Natura 2000) or local incentives to protect hardwood species or wetlands infringe upon profitability as they increase operating costs. Many biodiversity measures (as deadwood and old-trees conservation e.g.) interfere with mechanized forest operations and increases the cost of thinning and clear felling. It is the reason why they prefer spatial segregation of

functions with, on one hand, very intensive forest stands (as even-aged, intensively managed, and single-species plantation, short rotation coppices) and, on the other hands, forest specifically dedicated to nature conservation programmes

In order to avoid appearing obsessed with productivity alone, G1 stakeholders sometimes introduce hardwood species into peripheral forest stands. But they are dubious about the real efficiency of these "ecological broadleaved hedges" and their functional benefit in terms of resilience or resistance against pests (as promoted by scientists). Until now, they could achieve their economic performance without taking into consideration these environmental aspects: "*forest owners have implemented a very intensive forestry model for almost five decades. They have turned over the soil with farming plough, they used almost the same pesticides and herbicides as in intensive farming, and they have doubled the forest yield per hectare without taking into account – and even sometimes by eradicating – biodiversity. How to convince them today that biodiversity is important*?" (L01, forestry advisor, 35 y.o.). Environmental "constraints" are tolerable if they are located in specific places without any economic value (river banks, marshes, deep incised valley) and if they do not imply major changes in forestry practices. G1 forest owners sometimes transform these environmental constraints into a commercial argument to show to the public, the local NGOs and DIY central purchasing agencies that they are taking environmental stakes into consideration. To demonstrate their environmental commitment, they adhere to eco-standards as PEFC.

The prevailing belief in this group G1 is that forestry in 'Landes of Gascony' is largely determined by the natural condition: low level of soil fertility, very fluctuant water supply (too wet in winter, too dry in summer), restricted range of tree species suitable for forestry. Other plant species are often seen as competitors for access to water and nutrient. Moreover, as only maritime pines have been marketable for decades, other tree species are considered as useless in the framework of intensive forestry. The environmentalists' claims for biodiversity conservation even seem absurd for G1 group in such an artificial and anthropocentric forest. They think biodiversity conservation cannot be an objective in itself but just a consequence of forest management practices. Their relationship with ecologists is rather conflicting due to the lack of mutual knowledge about the constraints and preferences of each other: "*During my Master in forestry at the University, some environmentalists told me I shouldn't grow maritime pine in the Gascony forest. After many discussions, they admitted maritime pine what the best adapted species in the region. They then call into the utility of drainage ditch questions… I may discuss about the size of ditches and the period of ditch cleaning but we cannot ignore their vital importance in terms of drainage. Claiming for alternative tree species as hardwood species instead of maritime pine or neglecting ditches mean less productive forests, wood industries closures, less employment, etc*. *But environmentalists don't care about these arguments!*". (L11, forest owner, 39 y.o.)

Concerning others structural factors, G1 forest owners are careful and a bit afraid of demographic trends that leads to more urbanization and more infrastructures (one new high-speed railway, a new motorway, high voltage lines) at the expense of forest surface homogeneity. They also fear an increase of forest fires near urbanization zones. As the main demographic change is a significant increase of net migration with population coming from others regions than Aquitaine, forest owners are afraid of a cultural gap between traditional inhabitants, new incomers and forest owners. Whereas traditional inhabitants in rural zones usually support intensive forestry models, forest owners are afraid that new incomers do not understand and do not accept this forestry model. Some examples of conflicts are given by forest owners as the claim-making of urban population near the Arcachon forest or Capbreton forest, who refuse clear-cutting and who impose landscape mitigation of forest operations. For Group 1 forest owners, new incomers will complicate forestry management in the future. And for the moment, recreation activities are not structured enough to provide forest owners a direct or indirect income. Some of these forest owners try to make money with other ecosystem services as private hunting. But the hunting system is traditionally collective and

privatization of hunting activities is generally not well perceived neither accepted by local hunters. In the study-case area, only two private hunting estates exist. They belong to the largest private forest owner who dedicated 400 and 1500 ha to private hunting.

5.2.3.2 Group G2: "traditionalist" foresters

In contrast to group G1, most of the members of the second group (Group G2 or "traditionalist" foresters) are part-time forest managers with smaller properties (25-100 ha). They have often inherited the property from their parents. As they live locally, they manage their own forest but also the property of the others members of the family (e.g. their brothers, sisters, nephews who do not live in 'Landes of Gascony').

As is the case for Group 1, they are members of forest organizations (e.g. producer cooperatives, forest owners' unions) but without assuming elective responsibilities on any of their governing boards. They are more oriented towards local neighbouring networks or family networks with whom they develop informal agreements. They are very sensitive to the opinion of their peers, their neighbours and we can see the strength of social norms that partly dictate their attitude towards forest management and biodiversity conservation. Most of them claim to adhere to the traditional and technical know-how they acquired with their predecessors (parents and grandparents) during their childhood and in which they still trust.: "*I didn't learn forest at school, I learned forestry on the job, with my father and my grand-mother when I was seven (…) My father died when I was 17 and since I have been managing the forest for my grand-mother and with the help of my neighbour*" (L43, forest owner, 35 y.o.) The structural influence of primary socialization is often determining in this group as it still strongly frame their interpretation of present forest management practices.

They try to follow the technical advice offered by professional organizations and are not opposed to the adoption of technological innovations that they feel capable to understand and to implement (planting instead of seedlings, systematic thinning, conservation of hardwood species to limit pest invasion). But they often fail to apply all of them due to a lack of financial resources. They rarely take time to calculate the return on investments, and profits are therefore lower in this group than in Group G1, with some foresters even recording losses. Within this second group, profitability is rarely the main concern. They are not obsessed by marketing their wood and they just want wood to be paid at a fair price. If they do not succeed to obtain what they consider as a fair price, they prefer to postpone the sale and to wait five or ten years to market their wood. This mentality explains why some of them are keeping their trees a long time (50, 60, 80 years) far beyond the optimal economic level (35-45 years). They manage their forest carefully on a long-term basis for themselves or their descendants, without however neglecting the rules of good management applicable to any forest property For them, performance is not synonymous with economic maximization, but with technical quality (timber quality, annual average increase of diameter, straightness of the trunk…). Some of them have been hit hard in the past by natural disasters – severe frost, drought storms, or the use of inappropriate techniques (introduction of eucalyptus, etc.). Often ambiguous with regard to the progress of forest science and technologies, they have doubts about innovations and their consequences in terms of forestry and environmental impacts. They adopt innovation if its innocuousness and its technical interest as been tested for many years in their neighbourhood.

Their approach to environmental stakes is to introduce hardwood species such as alder (*Alnus sp*.) or locust trees (*Robinia pseudoacacia*) in and around forest stands. However, this knowledge of biodiversity is limited to the most profitable types of trees While Group G2 stakeholders know the names of some insects; they hardly recognize them in the field. Except for bees and butterflies, they regard the majority of insects as pests and not as auxiliaries. However, some foresters in this group wonder about the specific causes of tree decay and are able to distinguish two sources of tree

mortality: climatic accidents and “primary pests” that directly cause the death of the tree, and “secondary pests” that reveal tree weakness and act as forest “cleaners”.

Just as with the first group, they are not entirely convinced of the benefits of environmental practices as deadwood or hardwood species conservation. They do not analyze it as an economic problem or a risk for visitors, but they fear pest invasion and do not imagine or understand the environmental role of deadwood and hardwood species as a habitat for fauna and flora. If they are aware of environmental stakes, they prefer to wait for more tangible proofs before changing their traditional practices. They do not expect these proofs necessarily coming from scientists but from more familiar advisors (their traditional social network). And when some of them modify the traditional forestry model in “test zones” and in marginal areas, they do it with the advisory of forest consultants they used to work with. They do it in order to see the technical feasibility (more than the economic profitability) of best management practices for biodiversity as introduction of mixed-species stands of broad-leaved trees around maritime pines, wetlands restoration, and deadwood conservation. Suspicious towards environmentalists’ discourses, they make a distinction between “remarkable biodiversity” that is seen as a major concern for NGOs but not for forest owners and “ordinary biodiversity” that is maintain thanks to their daily forest management practices. The rhetoric use of a notion as “ordinary biodiversity” could be seen as a way to legitimate the traditional forest management model. In this new interpretative frame of what should be the notion of biodiversity, they integrate more tree species than group G1: *Pinus pinaster* but also understorey species as *Quercus* sp., *Betula* sp., *Robinia pseudoacacia*, *Alnus* sp*. etc.* Not to strictly focus on tree species, they also evoke the different structure in age and density that characterized the forests stands of ‘Landes of Gascony’: coppice, coppice with standards, high forest, planted forest, natural forest… More than an even-aged and monospecific forest, they insist on the forest stands diversity existing at a landscape level and that finally create a mosaic of heterogeneous stands. If they admit species biodiversity is rather low, they legitimate this low level by the natural conditions (poor sandy soil, rainfall regime) that do not allow a high level of biodiversity. For them, forestry management cannot mitigate nor really significantly improve biodiversity as it is economically counterproductive: “*we have lot of forest stands with dry and poor soil, with heather [Erica sp] as well (…) and as a forester, I am fighting against heather and I have to choose: either I let pine grow, either I let heather dominate but as far as now, we make more money with pines than heather*” (L21, forest owner, 45 y.o.). In this group G2, most of the forest owners do not understand why coercive environmental policies are imposed in the name of biodiversity protection as they considered themselves as the main defenders of forest biodiversity: “*we don’t have to wait for environmentalists to protect the environment (…) we don’t need hundreds of hectares being strictly protected. It would be better if special areas of conservation were located in non productive areas*” (L24, forest owner, 44 y.o.)

Concerning their responsiveness to others structural factors, they generally follow the opinion of G1 group leaders about the influence of public opinion or new incomers relationship to forest. They are less afraid than group G1 about a potential splitting of the Gascony forest into several sub-forests as they consider they are less exposed to this phenomenon than larger forest estates. They also less troubled by seeing visitors into their forest as they considered that forest has been still opened to the public. But in the most urbanized zones, they also fear – as G1 forest owners – a cultural gap with urban population and forestry limitations (as no clear-cutting, natural regeneration instead of planted forest…). However, some of them see the net migration as an opportunity to increase the financial value of their forest if these new incomers are ready to buy forest as future building plots.

5.2.3.3 Group G3: “passive outsiders”

Group G3 foresters (passive outsiders) consider themselves no longer interested in forestry. They are often more interested by non wood products (as game, mushroom, scenery) than timber. Often

older members of the forest community, these owners generally have smaller properties than the other groups (4-25 ha) and are often absent. They tend to be less active than in their youth. Despite they have more time than in their youth as they are retired, they do not have enough financial and physical capacities to manage intensively their forest. As they are not member of any professional forestry network, they are a bit isolated and often ignore innovations or are dubious about them. Disappointed by low profits and a series of natural hazards, they do not strive for technical excellence, nor do they aim for maximum profit. They also considered that the current predominant forestry model in the Gascony forest is not adapted to their economic capacities: "*I would like to play with the big boys but I can't afford it. I would want to do prunings and thinnings in time, to fertilize young trees as big forest owners do, but I can't. It is too expensive and too exhausting*" (L26, forest owner, 66 y.o.). They do not consider themselves as "*forest manager*" but only as "*woodland owner*" who even do not succeed to make the bare minimum as clearing out shrubs to avoid forest fires propagation: "*I only have small scattered forest stands and a small tractor to manage 14 ha. If the tractor had been more robust and powerful, it would have been easier to manage my property. If I would own 300 ha, I would have appreciated to be a real forest owner. But I only have 14 ha*" (L26). They often postpone main forestry management decisions. They wait for their heirs to choose what the destiny of the forest estate will be after their death (to keep the forest or to sell it).

The members of this group showed two different approaches to biodiversity conservation. In one case, interviewees completely ignored forestry issues and environmental concerns, and admitted letting natural afforestation invade forest stands, referring to these areas as "*wasteland*" or "*wild boar refuges*". The second biodiversity approach observed for this group was somewhat different. Some of these foresters no longer feel constrained to comply with forestry standards, and have begun to use a variety of environmental practices. These include diversifying plantations by introducing hardwood species, as was observed with group G2, or "*leaving deadwood for birds, fungi, and insects*" (L26, non profit private forest owner, 66 y.o).

Concerning their responsiveness to others structural factors, these G3 forest owners show few concern about demographic trends. However some of them considered that migration is a good opportunity to reactivate remote areas, and to maintain or even develop public services. For them economic development can come from every kind of economic activities: forestry but also tourism, non wood industries… As they personally do not have lot of economic capital and interest in forestry, they do not really fight tooth and nail for the development of the forestry sector.

5.2.3.4 Group G4: "environmentalist foresters"

The members of the fourth group (G4 or "environmentalist foresters") cannot be clearly distinguished by the size of their property which ranges from 10 to 500 ha (more or less the same as groups G2 and G3). However, they actively participate in and sympathize with alternative forestry networks such as Pro Silva and with regional environmentalist NGOs. The leaders of this group also follow the scientific advances of the INRA local research unit that is specialized in ecosystem functioning and they often participate to the national meetings of the ProSilva association. Thanks to this interconnected and diverse networks, their collect information that they disseminate largely in their own regional and local networks. Belonging to more than one group allow them to increase their source of information as this forest owner who do not trust only his local forest advisor "*a cousin of my wife is a forest advisor in the northern part of the forest of Gascony. When I have a doubt on timber volume estimation for example, I ask him to come here and to help me to estimate it. I also ask to a friend and a neighbour to come. It's more pleasant and reassuring to do it together*" (L12, forest owner, 70 y.o.). But as environmentalist network and forestry network are often in opposition on many topics concerning forestry models, group G4 forest owner often distance themselves with the management of their union (which is often under the control of G1

stakeholders). And leaders of the group G4 have even broken off relations with the G1 group network.

While G4 foresters are just as profit-orientated as G1, they do not adopt the intensive forestry model, choosing instead to use technologies with a lesser impact on the environment (avoiding ploughing, mechanical mowing instead of herbicides, selective thinning, no stump and residues harvesting for biofuels). True to their principles of 'close-to-nature forestry', members of the G4 group optimize their production by maintaining a natural balance between all parts of the forest ecosystem. To achieve this; they favour elements of biodiversity such as hardwood species and even deadwood - not only to catalyze forest productivity but also to preserve the natural ecological functioning of forests. With the 'close-to-nature' model, biodiversity is not seen as a constraint or a barrier to forestry management, but as an important element in the sustainability of the ecosystem in terms of habitats, and for the recycling of nutrients and soil fertility: *"Why should I cut down deadwood? (…) Some neighbours tell me: 'yes, but it's full of insects'. Of course it's full of insects, but there are insects everywhere, not only in deadwood but also in the soil, on bark, and, in the air. We can't control them!"* (L04, forest owner, Landes). Although they have the same fear of the risks of pest invasion as the two others groups, they rely on the presence and the antagonism of the different insects (pine pests eaten by carnivorous predators) to restore a natural balance. However, they would appreciate having some form of scientific verification of this phenomenon.

To achieve this 'close-to-nature' forestry model, group G4 forest owners often realize forest operations themselves as these ones are more complex and required a high level of technical competencies. Group G4 forest owners who cannot manage their forest themselves may request assistance of forest operators. As these forest owners have enough economic and social capital, they can impose their views to these external operators (what owners from group G2 and G3 cannot do).
If this group G4 is very interested in ecological forestry models, they are suspicious of political ecology and particularly of deep ecologists: "*To be really convincing, close-to-nature forestry models have to prove that they are ecologically sustainable but also economically profitable but deep ecologists ignore this aspect of the problem*" (L28, large-scale forest manager, 50 y.o). To reinforce the economic dimension which is seen as a key factor for close-to-nature forestry credibility, G4 forest owners suggest limiting the most expensive forest operation as ploughing, artificial regeneration, pruning… For them, searching for natural balance between forest components (as pests and pests' predators) could save more money on a long term than trying to control artificially every pest emergence.

Concerning their responsiveness to others factors, they also fear the consequences of a splitting of the Gascony forest but not for the same reason as the group G1. If G1 forest owners mostly fear the economic consequences, Group G4 forest owners are basically disappointed by the ecological impact of infrastructures as motorways and railway on fauna and flora. It is the reason why they protest against these projects with G1 group but not exactly for the same reasons. Concerning public opinion, they feel supported by the lay public as their ideas are well perceived by the urban fringe of the new incomers. But they do not know if these new actors will really accept all forest operations as tree harvesting, natural regeneration, deadwood conservation…

5.2.4 Summary of the prevalent logics of behaviour

The analysis and the structure of the four group lead to a schematic overview on forest owners' behaviour we met during the qualitative survey

Table 45: Prevalent logics of behaviour among Gascony forest owners

Forest owner group	*"Homo economicus"*	*"Homo sociologicus"*	"*Homo interpreter*"	Short comments
Group G1 "Forest entrepreneur"	Strong	Weak	medium	• Economic and profit-oriented performance, • Found of technological innovation • Few interest for multifunctionality (or only if segregate)
Group G2 "Traditionalist forest owner"	Medium	Strong	Strong	• Strong family tradition • Medium profit oriented, • respect of social norms • not opposed to environment but only if does not radically change forestry model
Group G3 "Passive outsider"	Weak	Medium	Weak	• Non interested in timber and wood production but by scenery/hunting/non wood products • Wait and see attitudes
Group G4 "Environmentalist Forest owner"	Weak	Medium	Strong	• Profit-oriented but with respect to ecological functioning • Ready to diverge to forestry norms

5.2.5 Change in future logics of behaviour

Change in behaviours can be the consequence of many events and structural factors. Concerning events, these transformative moments happen when the individual observes divergences between reality and interpretative frames, when facts does not fit the matrix of explanation, when perturbations (natural hazards or disasters, economic crisis, political change) implies a socio-technical evolution. Some of these events are softly introduced in the forest owner's mind (e.g. new practices seen during a field trip with peers) whereas others events are totally unforeseen and are sometimes traumatic (Hurricane in 2009). The speed and the impact of those events are also very diverse. Some events induce progressive adjustments, limited to some aspects of the forest management practices. Minor adjustments are done and do not affect the whole coherence of the FM system (planting instead of sowing, introduction of few hardwood species, from 5 to 3 thinnings per rotation. Other events are so tragic that they call into question the whole system (big forest fires in 1949 in the Gascony forest, severe frost in 1962, Hurricane in 2009). Following these events, so many changes are done that they require a new coherence of the whole forest management system (from intensive forestry to close-to-nature forestry, from high quality timber to short rotation coppice). Structural factors are not the unique source of change, agent-based factors are also important for forest owners. These "change-makers" are often local or regional leaders who will impulse technical change since the implementation of a innovation is generally negotiated inside a professional group. To adopt an innovation, the forest owner will often seek for the agreement of the social network he belongs to. Change makers can also be embodied in institutions (governmental authorities, market agents) which have the power to change the rule and to impose them to forest owners.

These examples show that isolating one factor from the others is not obvious. But locally and considering the period we interviewed forest owner we can assume that the Hurricane Klaus (2009) has strongly impacted forest stands and forest owners' state of mind. Forest owners have been thrown into confusion the year following the second storm. Some of them wanted to give up forestry and to sell their property; others wanted to introduce any tree species but not maritime pine. And a majority of them claims for national solidarity and ask the French ministry in charge of forest policies to plan a reforestation programme and to implement an insurance system as it exists for agricultural disasters. If the question of insurance has been postponed in 2017 and delegated to the private sector, the programme of subsidies for "forest cleaning and reforestation" has been implemented 4-6 months after the storm. Today, if forest owners complain about the backlog of subsidies files, the moral consequences of Hurricane Klaus seem to be partially attenuated in collective memories The

national programme of restoration and the collective mobilization of the regional forest institutions help forest owners to support this catastrophe by bringing subsidies, technical advices, policies adaptations, additional workforce… What is the situation today? Do forest owners consider they will have to adopt new forestry models to face up to climate change, natural hazards and forest policy changes? Will they sell their forest? Will they change tree species? Or will they carry their business as usual?

A good barometer of the forest owners' behaviour three years after the hurricane Klaus (2009) is given by the observatory that have been created by the regional direction of agriculture and forest (depending on the Ministry of agriculture), the regional Council and the GIP Cartogip. The observatory shows that a majority of forest owners have finally decided to join the restoration programme. 65 % of the forest area that was blown down (223 000 ha) has been cleaned (181 457). After a sanitary waiting period of two years, 20% of the area (50 000) is currently re-afforested. The regional direction of agriculture and forestry receives so many grant application demands that most of them will have to be postponed between 2014 and 2017 for payments. The observatory also shows that 95% of the re-afforestation areas are planted with maritime pine (*Pinus pinaster*). Although some forest owners considered introducing a large amount of new tree species, these only cover 5 % of the area.

Table 46: Distribution by trees species of the re-afforestation areas of the restoration programme 2009-2017. Source: *Observatoire Cartogip*, Figures for the 15th of November 2012

Species	percentage
Pinus pinaster	95.71 %
Pinus taeda	1.54 %
Populus sp.	0.94 %
Robinia pseudoacacia	0.61 %
Quercus pedunculata	0.15 %
Quercus petraea	0.12 %
Quercus rubra	0.12 %
Undefined *Quercus* sp.	0.14 %
Other species	0.67 %

Were there any effects of the hurricane Klaus on forest owners' behaviour? Will they really change anything in their future forestry models? Our interviews allow us to make the assumption of less dependency to a unique model of forestry management. According to the forest owners we interviewed, main major changes could occurs in the next ten years:

- **A trend for intensification and hyper intensification**: G1 forest owners bet on more forestry intensification in order to shorten drastically the maritime pine production cycle from 45-50 years to 25-35 years. To reach this objective, they already adopt forestry model 2 and 3, to introduce the 3rd generation of new genetically selected clones of Pinus pinaster, to decrease the number of thinning per cycle, to choose clones with a better root system: "*We are on sandy soil. If we don't plant maritime pines, we don't know what else can be done. So, the global system is not called into question. Nevertheless we must adjust our model. We'll shorten the rotations, we'll decrease the tree density, we'll look at and preserve the root system*" (F16, 33 y.o.). For this group, a mass production system may be profitable only if forest rotations are harshly reduced. Some of them also wish to experiment on small surfaces very short-rotation systems with maritime pine (model 4-5) and even biomass model (model 6) with pines, eucalyptus or Robinia. But the economic profitability of these hyper-intensive models is not established enough to convince them to adopt these models at a larger scale. Their large-scale implementation model will greatly depends on the regional and national policies orientations in the future; if G1 forest owners feels this new market is stable and profitable and publically supported, these hyper-intensive models could be widespread adopted it in the next 5 years;

- **Indecision and postponement**: For G2 and G4 Forest owners, it is a really a dilemma to adopt these intensive forestry models. As they have smaller properties, mass production could generate lower incomes. Culturally, they also give more importance to timber quality rather than timber volume. For the moment, they re-afforest with the same density, the same techniques as the models (1-2-3) that existed before the storm. If they can postpone their decision today, they will have to make real choices after the first pre-commercial thinning in 10 or 12 years. Some o them will trust to the model 1 (high quality timber on long term production cycle); others will follow the G1 group and will probably adopt model 2 or 3 (forest rotation between 35-45 years or 30-35 years)

- **A trend for extensive forestry**: G3 and G4 Forest group express their interest for more extensive models which are not really promoted by forestry institutions. G4 forest owners would gathered environmentalist foresters still bet on the high quality model (model 1) with long rotation (45-60 years) and less traumatic forestry operations as no ploughing, less regular thinning, more seedling (instead of clones plantations). In group G3, extensive model is seen as a good opportunity to re-afforest with the lowest investment as possible, a perspective that is corroborated to their low financial capital. As they are less interest in profitability, they just want to re-afforest to be in conformity with the law but with no expectations concerning future profits. This lack of investment from G3 forest owners could lead to more neglected state of small forest estates with major risks of forest fires;

- **A higher diversification in production models**: if a large majority of the forest owners intend to choose one predominant model of forestry management among the 6 existing ones, most of them also imagine combining one, two or three models on their property as “they don’t want to put their eggs in one basket”. Lot of the interviewed forest owners are interested by the potential reversibility of models 3-4 and 5 that allow them to take final and irreversible decision – to shorten or to increase forest rotation – only in 15 or 20 years;

- **A higher diversification in the sources of incomes**: if a majority of forest owners are engaged in the reforestation of their estate, we can assume that some of them (mainly from group G3) will reorient their future investments into other sources of income (real estate business, agri-tourism, classic bank saving, etc.). Instead of investing money in the most expensive forestry models (models 4-5-6), they will choose extensive and cheapest models;

- **Development of woody biomass**: biomass development really started after 2005 under the effect of European and national energy policies but, in our case study area, few forest owners adhere to these policies. The Hurricane in 2009 gave an impetus to this sector as biofuel industrialists bought stumps and slashes coming from windthrows. This new opportunity temporarily seduced forest owners who did not know how to value these residues. Four years after, the stump stock has to be renewed. G1 forest owners are still interested in slashes and stump harvesting under the condition of fair prices and stable demand. If they are a bit dubious about middle-term supply contracts (8 to 20 years), some of them are ready to supply local biofuel industries. For G2 forest owners, the profitability is not so obvious and they fear loss of soil fertility. As G1, G4 forest owners are not opposed to the development of the biofuel sector but only is environmental stakes are taken into account: partial slash harvesting (70% of the slash but not 100%), preservation of deadwood for biodiversity… the big unknown is the implementation of

the biomass forestry model (model 5 and 6) specially dedicated to wood energy. Few forest owners we interviewed wish to implement these models for the moment. Only one forest manager (F16) have experimented short rotation coppices of eucalyptus but he could not draw firm conclusions.

- **Forest management delegation:** Another major change in the future could concern the profile of the real forest manager. For the moment, technical advisors from the traditional structure as GPF/CRPF or private forestry experts still have a considerable influence among forest owners at a local scale. But advisors from the forest cooperatives now cover the whole Gascony forest and proposed integrated services (from plantation to harvesting, forestry planning and supervision…). With the ageing of forest owners population, their progressive disinvolvement with business, the physical distance of the youngest forest owners, this kind of services are more and more appreciated. For many forest experts as the industries leader (S15), the cooperative member (S14) and the NGO representative (S11), more and more forest owners will delegate forest management to forest advisors (private expert or cooperative councillors). One consequence can be a more financial relation to forestry, at the expense of amenities as landscape preservation, and biodiversity conservation.

6 'STEEP' ANALYSIS

(First draft, later edited and translated by the team, and enriched in the 1st scenario workshop)

	Society	Technology	Economy	Ecology	Politics
Macro	* Forestry paradigms in civil society	* Development of biorefinery technology	* Growth of market for wood in construction sector * Growth of wood energy market * Organization of the market for environmental services	* Climate change effects	* Changes in the distribution of political authority in the forest sector * Evolution of public support for wood markets (wood energy and wood for construction) * Forest use and management regulatory framework
Meso	* Demographic changes * Evolution of social demand related to ecosystem services	* Mechanization development and degree of intensity in forest practices * Modalities of species selection for reforestation (Maritime Pine) * Development of solid wood technologies	* Evolution of the wood prices * Sustainability of Paper industry investments	* Phytosanitary issues * Stand and landscape ecological heterogeneity * Drainage and water table level	* Evolution of political mediation structures
Micro	* Changes in the forest owners profile				

Society

No	Level	Title	Definition	Empirical information on present situation	Why relevant?	Comments
	Macro	**Forestry paradigms in civil society**		- Forest as an archetype of nature - Forest seen as threatened - New roles for forest (biodiversity, carbon storage, wood energy)	-	
1.	Meso	**Demographic changes**		- Coastal and urban polarization - Demographic growth of selected rural areas	- Land pressure on forests areas - Fire risk prevention - Location of social demand on forest services	
2.	Meso	**Evolution of social demand related to ecosystem services**		- Inhabitants and tourists are not concerned with forest issues - Zoning of social pressure on forest areas (coastal appeal and suburban attractiveness)	- Increase or decrease of the tourism value of the forest area	
3.	Micro	**Changes in the forest owners profiles**		- High commitment to family heritage conservation - Many forest owners delegate the forest management activities to a third party - A minority number of forest owners involved in the definition of forest standards	– Convergence or divergence of forestry practices	

Technology

No	Level	Title	Definition	Empirical information on present situation	Why relevant?	Comments
1.	Meso	**Mechanization development and degree of intensity in forest practices**		- Reproduction of forest is mainly artificial (by planting tree seedlings) - Use of mechanization is important and widespread - More intensive silvicultural treatments are promoted for wood energy production	- Define the cost and the type of forest management practices - What is the future of the old-fashioned ''Landes of Gascony' model' of planted forest?	
2.	meso	**Modalities of species selection for reforestation (Maritime Pine)**		- Selection based on wood quality criteria (rectitude…) and on adaptability criteria (drought, disease…) - Development of methods of genetic selection	- Low possibility of introduction of new species (for wood production) so strong challenge to work on selected plants of Maritime Pine	
3.	Macro/ meso	**Development of dimensional timber technologies**		- Development of a green wood finger-jointing process (ABOVE research project)	- Adaptation to the market demand for softwood products - Need to overcome the structural defects in the maritime pine	
4.	Macro/ meso	**Development of biorefinery technology**		- Tembec mill, located in Tartas, is one of the world leaders in specialty cellulose	– Increase in value added products – Mutation of the paper industry and growth of the green economy	

Economy

No	Level	Title	Definition	Empirical information on present situation	Why relevant?	Comments
1.	Macro/ meso	**Evolution of wood price**		- Downward trend in prices for forest owners - Cyclical fluctuations (post storm crisis)	– Competitiveness and attractiveness of forest region for industrial investment	
2.	Macro	**Market opportunities for wood in the construction sector**		- Fall in the building market but slight increase in the share of wood - Competition with imported wood based materials for building market - Decrease of the sawmilling capacities in Aquitaine	– Valuation of timber and sawmilling industry sustainability	
3.	Macro	**Growth of the wood energy market**		– Tremendous growth opportunity in that market	- Competition / complementarity with the panel and paper industries - Development of local wood sector	
4.	Meso	**Sustainability of paper industry investments**		- Structural changes relatively unfavourable in the paper industry - Large mills have recently made significant investment in the region (Smurfit & Tembec)	- Strong dependence of the sector towards papermakers - Employment and value added in the territory - Strong symbolic issue	
5.	Macro/ meso	**Organization of the market for environmental services**		- Not developed yet - Regional council has created 'Aquitaine Carbone' association devoted to forest carbon credit valuation	- New opportunities for forest resources development	

Ecology

No	Level	Title	Definition	Empirical information on present situation	Why relevant?	Comments
1.	Macro	**Climate change effects**		No significant changes before 2040		
2.	Meso	**Phytosanitary issues**		Current pest-related concerns (bark beetles, processionary caterpillars, Armilaria, Fomes…) may be strengthened by the emergence of nematode	Wood product capacity and Maritime Pine development	
3.	Meso	**Stand and landscape ecological heterogeneity**		Broadleaved species are increasingly taken into account (hedges, post-Klaus plantation scheme), Interest for the spatial patterns of agriculture / forest interfaces (storm & pest vulnerabilities)	Biodiversity and resilience	
4.	Meso	**Drainage and water table level**		Management and maintenance of an extensive network of ditches	Sustainability of the planted forest model	

Politics/Polity/Policy

No	Level	Title	Definition	Empirical information on present situation	Why relevant?	Comments
1.	Macro	**Changes in the distribution of political authority in the forest sector**		- Centralized policy but decrease of the involvement of the State - Development of EU and local authority competences in forest related policy - Development of "private" authorities (Certification schemes)	- Consistency of sector based policy - Development of technical and financial resources devoted to public forest - Diversification of the policy instruments	
2.	Macro/ meso	**Evolution of political mediation structures**		- Weak convergence of sector based interests at the national scale - Development of new joint-trade dynamics at the national scale - Weakening of the joint-trade organization in Aquitaine	- Ability to lobbying for sector based interests representatives - Capacity of the sector to open up to the society	
3.	Macro	**Evolution of public support for wood markets (wood energy and wood for construction)**		- Strong political support for emerging sectors - Public support devoted more to the demand (wood and energy industries) than to the supply (forest sector) - Competition for wood raw material from forests	- Growth of the wood market	
4.	Macro	**Forest use and management regulatory framework**		- Multifunctionality and sustainable management - Few conservation areas - Management "mandatory" for properties over 25 hectares	- Priority given to the increase of wood mobilization - Low interest in environmental issues in forest areas	

7 INTERPLAYS

A careful reading of the present report led to the matrix of Figure 34, depicting the existence / absence of semantic interactions between the subchapters of the text – and thus providing a first rough proxy for the potential interplays identified between the factors in the French case study. Two situations were encountered: (i) citations from one paragraph to another, as made explicit by the authors; (ii) implicit relationship, due to an overlap of the contents of the paragraphs.

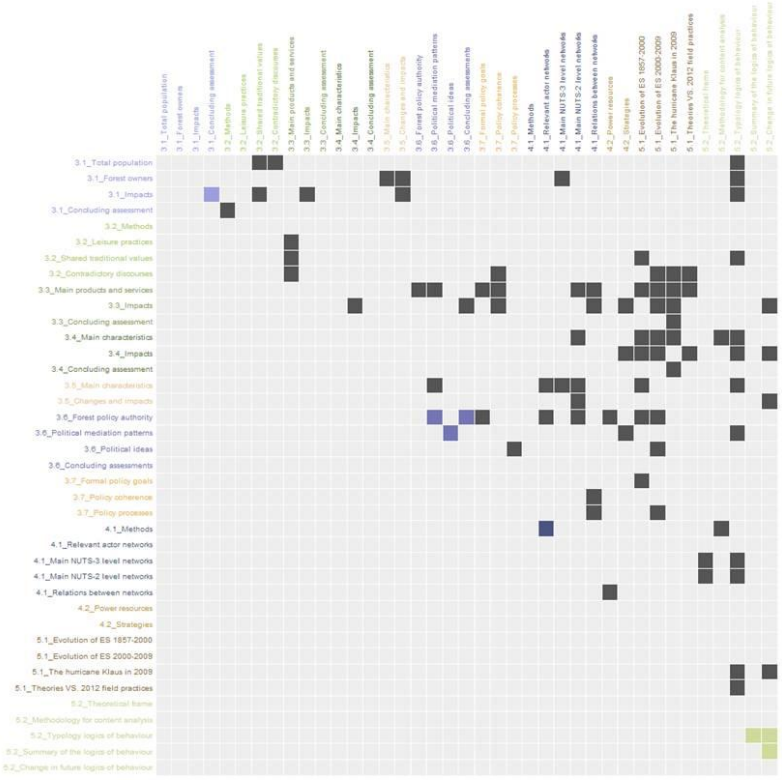


Figure 34: Overlaps between topics in the paragraphs of the current report

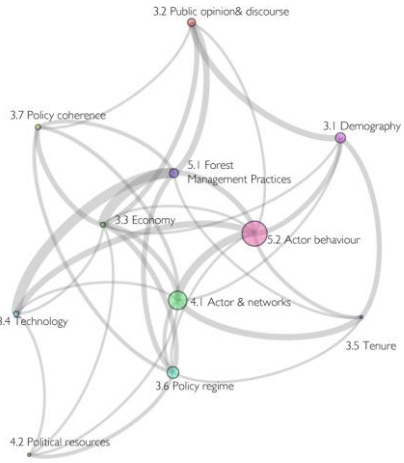


Figure 35: Network visualization of the number of overlaps between subchapters

A general emerging picture is that these overlaps between subchapters are numerous, yet with uneven contributions. A 'hairball' visualization of the same dataset (with overlaps summed at the level of subchapters, depicting the width of links, Cf. Figure 35) allows getting a more explicit (if not clearer) view of the structure of the relationships. In this respect, the most central factors (*i.e.* the most connected nodes) may be 'Actors' behaviour' (5.2), 'Forest management practices' (5.1), 'Economy' (3.3), 'Actors and networks' (4.1).

Even with a limited objective (no causality is for example implied in the aforementioned non-directed graph), one should remain cautious of an over-interpretation of the identified patterns: they can indeed as well be derived from important underlying processes as from a general economy of the writing:

(i) Chapters were written in parallel by several collaborating authors, thus the timing of the writing tasks is not 100% neutral in the final structure of the text;

(ii) An interplay between two factors, when made explicit in the text, can be expressed by only a few of the interviewed experts. Potential imbalances could thus result from the non-systematic nature of such preliminary outputs;

(iii) The interplays could also result from a more general disciplinary bias of the writer. As a political scientist, a sociologist and two geographers, the writers of this report were well

aware of the Janus-like nature of most concepts and processes of a social/economic nature.

8 SHORT CONCLUSIVE COMMENTS

With these limitations in mind, we provide with the matrix of Figure 36 a summary of the processes - and their interplays- that we consider as the most relevant in their influence on the evolution of forest management in the 'Pontenx' case study area.

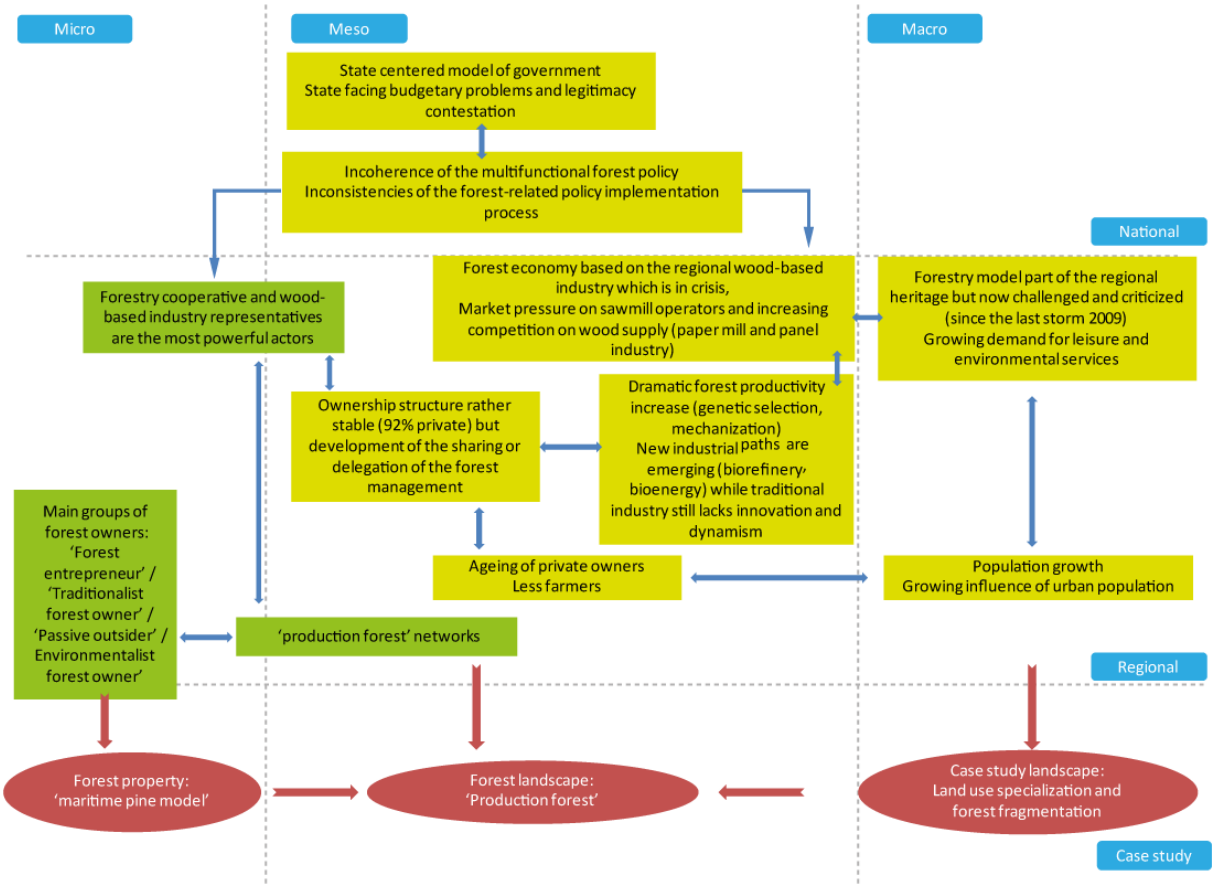


Figure 36: Main processes identified for the 'Pontenx' case study

Probably more than in any of the other INTEGRAL case studies, the Klaus storm and its aftermath are central to the joint understanding of: (i) the dynamics of the forest management at the landscape level; (ii) the prospects for the evolution of the regional forest-sector. It is also for this reason that the current report owes much to recent and ongoing regional researches and debates. In terms of future-oriented thinking, the impact of the storm is ambiguous, as the ongoing afforestation efforts suggest very few changes of the dominant forestry models, while the remaining uncertainties on the regional forest sector and the evolution of the overall resource tend *a contrario* to widen the scope.

Located in France, the case study is able to bring in a very specific vision of multifunctionality in silviculture and forest policy. Yet the specificities of the 'Landes of Gascony' forest – planted, cultivated, 'culturally appropriated'- were also made clear. In this respect, the insertion of the 'Pontenx' landscape in its regional context (*i.e.* the relative autonomy of the 'Landes of Gascony' forest area and the Aquitaine NUTS-2 region vs. the national level) is a key feature of the case study area, and a potential enrichment of INTEGRAL's comparative analysis.

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