WP 3.2 INTEGRAL National Case Study Reports France: Case Study Area, Pontenx

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WP 3.2

INTEGRAL National Case Study Reports

France

Case Study Area

1) Pontenx

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 282887.

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1 Introduction

Within the overall research design of the INTEGRAL project WP3.2 is dedicated to answer two questions: First, what future and forest-related developments might unfold in Europe during the next 25-30 years? Second, what consequences for integrated forest management may arise from these developments? 20 case studies in 10 European countries are being conducted to find answers to these questions. In the second phase of the INTEGRAL project, these case studies included the development of explorative and forward-looking scenarios. Each of them is supposed to integrate the individual findings of previous research steps into one big picture. The underlying notion of these scenario processes is that even in such relatively slow-changing systems as forests, the future is not determined and, hence, cannot be safely forecasted by deterministic models or projections. Of course, the scientific knowledge about causal relationsships acting in and on the living forest has to be integrated when assessments about future developments are made. Nevertheless, these developments will depend on a multitude of influential factors which are only partly known, stable or steerable. In order to reflect this uncertainty, the most important influential factors have to be identified and altered in a systematic and controlled manner, thus showing the range of future developments that exists from a present point of view.

This report presents the five scenarios and the findings that have been made throughout the scenario process in the Pontenx case study area of the INTEGRAL project. The applied research design and the individual research steps are described in detail in Milestone 31. In this report the operational proceedings are only reported insofar as they are necessary for understanding the meaning and scope of the achieved results. Other references of importance are the previous achievements of WP3.1 and the corresponding WP3.1 case study reports. Furthermore, the scenarios are based on the descriptions of the case study areas from a natural science point of view that have been made in WP2.1. Last but not least, the scenario processes integrate the assessments of Ecosystem Services (ES) that are to be expected given the settings described in the so-called driver scenarios, i.e. they are the product of interdisciplinary cooperation between WPs 2 and 3, namely between WPs 2.2 and 3.2.

2 Basic description of the case study area

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 1.5 Mha greater forest area.

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'Landes of Gascony' 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. 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:

1. A biophysical unit with podzolic sandy soils and shallow ground water levels;
2. 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 [1]). Primarily composed of maritime pine (Pinus pinaster Aiton), the forest is often described as the largest cultivated and privately owned (92%) forest in Europe;
3. 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.

Figure 1 The 'Pontenx' case study area and the relevant intersecting administrative areas

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3 Research conducted in WP3.2

Within the overall structure of the INTEGRAL project, the scenario-processes play a central role and are strongly linked with other work packages. This means that the research that has been conducted in WP3.2 for the Pontenx case study area could draw on the results of other Work Packages and, at the same time, is relevant for the research that will come later in the project. Figure 2 shows the general workflow of the INTEGRAL project focusing strongly on WP3.2.

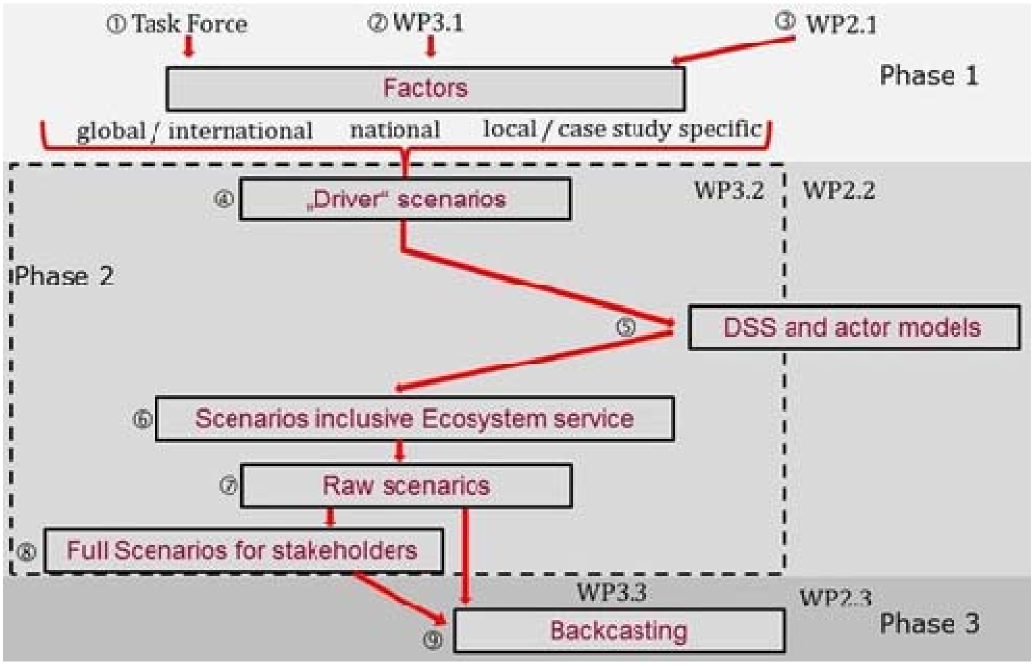

Figure 2 Workflow of the INTEGRAL project focusion on WP3.2

Phase 1

(1) A Task Force on global and international influences describes trends and developments possibly affecting the future of forest management in the European case study areas. The results are available in the form of issue-specific reports [Link]. The main factors are displayed in a STEEP-table and a corresponding glossary.

(2) The research results of WP 3.1 focus mainly on regional and national issues.

(3) In WP 2.1 the case study areas are described from a natural science point of view.

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Phase 2

(4) 'Driver' scenarios (first version) will be produced by the individual partners for their case study areas. They will be implemented into DSS.

(5) Work package 2.2 will perform an analysis of the consequences of the case study specific scenarios on forest management. The task of WP 2.2 is a scenario expression while WP 2.3 is about evaluating the policy instruments. WPs 2.2 and 2.3 will, inter alia, deal with the integration of behavioural models into the DSS. One of the results will be case study specific information on the possible future provision of ES.

(6) This information is included in the scenario process, i.e. there will be a re-run of some of the research steps to see whether the ES provided have an effect on the overall situation (represented by the scenarios).

(7) Together with the incorporated information on the provision of ES, the 'driver' scenarios constitute 'raw scenarios'. The raw scenarios and the corresponding descriptions (elements, manifestations, and glossaries) are delivered to WP 3.3 to become part of the information base for the back-casting exercises. From an operational point of view, steps 6 and 7 will take place more or less at the same time - together they aim at refining the raw scenarios through the already mentioned re-run of the coherency analysis after the integration of WP2.2 results.

(8) Additionally, the raw scenarios are elaborated into full scenarios using short stories or other useful means of communication. The full scenarios do not add new information to the raw scenarios, they rather have to be considered as a narrative reformulation. They can be seen as one of the final products of WP 3.2 which can be used for external communication in the respective countries as well. The 'language' and the means of communication should be selected according to the target group.

Phase 3

(9) Phase 3 begins with a problem-solving oriented backcasting for developing policy instruments and integrated forest management strategies.

The tasks described above as being part of WP3.2 have been realized by Irstea scientists Vincent Banos and Baptiste Hautdidier (both geographers), with the help of Arnaud Sergent (political scientist) and Philippe Deuffic (sociologist). The articulation with colleagues at EFI-Atlantic (Christophe Orazio and Rebeca Cordero-Debets) in charge of WP2.2 was sought in several meetings during 2013.

The participatory dimension of the research process was the most explicit in a one-day workshop held the 11th of July 2013 in Pontenx-les-Forges, where 10 stakeholders attended: five forest owners (some of them having responsibilities in the FWC and local terms of office), two 'managers' (regional forest cooperative, national public forest company), one industrialist (panel board), two 'planners' (NUTS3, inter-municipal grouping). The workshop was centered on the early step of phase 2 described below as 'structural analysis'. Following a presentation

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in the morning of the project and the scenario building process, the attendees were invited to perform individual ranking exercises. After an outline of the modelling offered by R. Cordero-Debets (EFI-Atlantic), the discussion was focussed in the afternoon on the aggregated results, leading to a shortlisting and a finetuning of preselected factors for drivers scenarios.

A group of 25 stakeholders had been constituted for the purpose of the workshop and kept informed by mail. Feedback is expected from this larger pool in the later steps of the project, in the form of another workshop and in direct exchanges with the research team.

4 Results

One of the outstanding features of the INTEGRAL project is its participatory character. A noticeable share of the research is based on the contributions of local stakeholders or has even been realized with their participation. As a consequence, major results of the INTEGRAL project are the learning processes that have been triggered by the discussions and debates throughout the participatory research steps. It is safe to assume that many participants have a different view on the future developments of 'their' forest, after having taken part in scenario workshops or meetings where the concept of integrated forest management has been discussed. These learning processes are 'intangible results' that are rather hard to measure, no matter how important they are for the future developments on a local level: in this regard, the insights gained from a specific remark - or the internal logic revealed by an individual ranking exercise - were as equally useful as a focus on collective agregated results and agreements. In the following tables, the results of the individual research steps of the scenario process are reported, i.e. information on the issues and influences that, from a present point of view, will drive the future forest development in the Pontenx case study area.

4.1 List of key factors by STEEP-categories

The factors, drivers and influences that are considered as most important for the future development of the Pontenx case study area are gathered in the STEEP-table below. Here, 'STEEP' is nothing but the acronym for the societal fields of ‘society’, ‘technology’, ‘economy’, ‘ecology’ and ‘politics’. The allocation of influential factors to these categories fulfills two main functions:

- It becomes possible to assess the balance of the selected factors. Just by having a look at the table, it becomes clear in an instant whether a certain area is considered as dominating the others. This would be the case, if, for example, there are 30 factors allocated in the ecological field and only 20 in the remaining four other columns.

- It is also useful to organize the factors according to their geographical origin: do they stem from the very case study area (e.g. local traditions), do they have a national background (e.g. national regulations) or are they founded on a super-national level

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(e.g. climate change)? It is important to keep in mind that the allocation to the categories micro (local level and 'neighbourhood'), meso (national) and macro (international) refers to the background of these factors, not to the level of their impact. The very reason for the factors having been included in the list is their assumed importance for the Pontenx case study area, i.e. they all are supposed to act at the micro level. So, the information on the geographical scale refers to the background of these factors.

The STEEP-table below provides an overview of 15 key factors that were presented to -and discussed with- stakeholders during the workshop held in Pontenx-les-Forges. In the following chapter (Glossary) the factors are defined and described in more detail.

Table 1 STEEP table for the Pontenx case study area

Level of Analysis	Society	Technology	Economy	Ecology	Politics
Macro / Meso	**SOC1**Evolution of social demand on forest services (*évolution de la demande sociale sur les services rendus par la forêt*)	**TEC2**Innovation in wood mechanical processing (*innovation dans le domaine de la transformation mécanique du bois*) **TEC3**Innovation in wood mechanical processing (*innovation dans le domaine de la transformation chimique du bois*)	**ECO1**Evolution of*P. pinaster*wood products prices (*évolution du prix des bois du pin maritime*)	-	**POL1**Reorganization of the political authority associated with forest stakes (*redistribution de l'autorité politique liée aux enjeux forestiers*) **POL2** Political mediation ability of sectoral interests (*capacité de médiation politique des intérêts sectoriels*) **POL3** Public action strategy associated with forest stakes (*stratégie d'action publique liée aux enjeux forestiers*)
Meso	-	**TEC1**Evolution of silvicultural models (*évolution des modèles de sylviculture*)	**ECO2**Evolution of the regional industrial fabric (*évolution du tissu industriel*) **ECO3**Regional offer on forest services (*structuration d'une offre régionale sur les services rendus par la forêt*)	**ECL2**Expected outcomes of diversification, stand- and landscape- levels (*effets attendus de la diversification à l'échelle des peuplements et des paysages*) **ECL3**Constraints associated with the management of watertable levels	-

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				(*contraintes liées à la gestion du niveau des nappes de surface*)	
Meso / Micro	**SOC2** Land-use dynamics, with regards to regional attractiveness (*dynamiques foncières en lien avec l'attractivité du territoire*) **SOC3**Evolution of forest ownership (*évolution de la propriété forestière*)	-	-	**ECL1**Vulnerability of forest stands to (a)biotic risks (*vulnérabilité des peuplements forestiers aux risques biotiques et abiotiques*)	-

4.2 Glossary of Key Factors

4.2.1 Society

Table 2 STEEP-Table – Glossary of Key Factors – Society

No.	Level	Title	Definition	Empirical information on present situation	Why relevant?	Comments
SOC1	Macro / Meso	**Evolution of social demand on forest-based services**	Evolution in industrialized countries of the representations and roles attributed to forests Legitimation and discussion at regional and local levels of these new demands	Rise of a vision of forest as a natural and recreational space, paralleling a regional attachmment to cultivated forest and a steadiness of traditional uses (hunting, NTFP picking…) Associated with important, diversified, yet potentially contradictory stakes (biodiversity, carbon, fuelwood, leasure…) forests become features of the attractiveness of rural areas	These new demands modify the relationships with forests and spark debates about diversification of uses Convergence / divergence of different uses with the 'cultivated forest' model. Forest cover is e.g. part of the attractiveness of the coastal area	…

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				Development of environmental zonings and frequentation, mostly in coastal and periurban areas Weak involvement of users in forest management stakes		
SOC2	Meso / Micro	**Land-use dynamics with regards to the attractiveness of the area**	Demographic dynamics (strong residential and tourism-related migrations) and their land-use / land-cover impacts	A low-density area confronted with urban sprawl and a strong coastal attractiveness A recent -more general- demographic growth in rural areas, with impacts on built environment Tensions for forest managers: interfaces with agricultural and urban uses, privatization and publicization of forest spaces	Demographic attractiveness and urbanization processes impact forest areas and their role in local development (land availability, fire risks, development of a residential and tourism economy…) Stakes associated with a differentiated location of social demand	…
SOC3	Meso / Micro	**Evolution of forest ownership**	Evolution of the profiles of private owners / evolution of the tenure and ownership structures (delegation, legal entities, contracts)	Forests remain a mainly family-based heritage but legal entities play an increasing role (legal status, size…) Rise of the management delegation to forest cooperatives (due to ageing, distance…) Diversity of collective involvement & mobilization logics (in fire management and productivity groups…)	Possible evolution of the type of forest management Divergence / convergence of silvicultural practices	…

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4.2.2 Technology

Table 3 STEEP-Table – Glossary of Key Factors – Technology

No.	Level	Title	Definition	Empirical information on present situation	Why relevant?	Comments
TEC1	Meso	**Evolution of silvicultural models**	Evolution of silvicultural scenarios. Aims and effects of technological innovations (mecanization, genetic selection)	Dominance in the forest area of technical choices based on plantation and mecanization Very diverse initiatives on possibles scenarios: specialization, diversification, species, regeneration mode, treatment, rotation… A genetic selection of *P. pinaster* based on productivity and adaptation criteria (drought, pests…)	Determinant for the future of the 'Landes' model in an international perspective Few alternatives to Pine (hence a work on intra-specific diversity)… …but local stakes on the introduction and the economic use of new species	…
TEC2	Macro / Meso	**Innovation in wood mechanical processing**	Development and diffusion of innovative processes amongs saw mills, panel board, pallet and packaging industrialists…	Modernization of the FWC actors (e.g. 'canter' in saw milling) but innovation strategies remaining fragile and illegible Development of a green wood finger-jointing process(ABOVE)	Stakes of the adaptation to market demand on softwood: needs to overcome structural defaults of P. pinaster wood (straightness)… …and reduced capacity to process large woods	…
TEC3	Macro / Meso	**Innovation in wood chemical processing**	Development and diffusion of innovative processes in biorefining and green chemistry	Recent reconversion of a paper mill in a world leader of specialty cellulose Emergence of green chemistry industries	Economic use of new products with high added value… Mutation of the pulpwood industry, strong growth f the green economy	…

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4.2.3 Economy

Table 4 STEEP-Table – Glossary of Key Factors - Economy

No.	Level	Title	Definition	Empirical information on present situation	Why relevant?	Comments
ECO1	Macro / Meso	**Evolution of *P. pinaster*wood products prices**	Evolution of the demand for Pine wood, declination in markets (industrial roundwood, dimensional timber, energy), public influence	Downward trend, large cyclical variations French sawmilling sector is currently losing ground Public demand for timber but weak outlets: technological quality of *P. pinaster*, weakening of processing capacities, competition with imported woods New opportunities for energetic uses: strong, public-driven, growth of fuelwood markets - but fledgling FWCs, based on mostly demand-driven incentives	Determines the competitiveness and the attractiveness of the forest area for industries, profitability of forest management	…
ECO2	Meso	**Evolution of the regional industrial fabric**	Evolution in number, location and specialization of the industrial actors in relation with the 'Landes' forest area	A regional and integrated FWC, experiencing concentration, with a decline of subsectors (pulpwood over timber) Increasing role of papermills (structural weaknesses but recent investments) Reconversion or introduction of industrial actors on 'energy' and 'green chemistry' uses, increased concurrence since	Maintenance of jobs and production of added value are increasingly linked to world-class actors Industrial evolutions have impacts on the resource type and the harvest level, on complementarity and concurrence on uses, on innovation and regional development	…

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				Klaus		
ECO3	Meso	**Regional offer on forest services**	Public-driven evolution of a formal and possibly market-based offer on the ecosystem services associated with forest areas.	A weakly developed offer but an increasing of residential and tourism economy. br /> Creation of the *Aquitaine Carbone*grouping	Diversification of the commoditization of forest areas (carbon, hunting, recreation…) More than the market, a role for zonings?	…

4.2.4 Ecology

Table 5 STEEP-Table – Glossary of Key Factors – Ecology

No.	Level	Title	Definition	Empirical information on present situation	Why relevant?	Comments
ECL1	Meso / Micro	**Vulnerability of forest stands to (a)biotic risks**	Possible effects of extreme climatic events, forest pests and fire risks	Recurring extreme events: storms (1976, 1999, 2009), droughts (1976, 2003), frosts… Phytosanitary attacks (*Ips*, processionary moth caterpillars, Fomes…) amplified by storms, regional worriness about the possible arrival of nematode Numerous fires but few damages - signalling the efficience of the collective DDFCI fire management	Strong impacts on the woody resource (the last two storms have halved the standing volumes) The context fuels uncertainties of silvicultural choices: intensification to limit the exposure of the invested capital - or product diversification? Maintenance of resilience capacities of*P. pinaster*? Stakes of the fire sensibility of forests (motorized frequentation, urban sprawl, stand structures, absentee ownership, climate change)	…
ECL2	Meso	**Expected outcomes of diversification, at stand- and**	Positive impacts of a diversification of species, in terms of	Species mix are increasingly considered (post-Klaus afforestation,	Biodiversity stakes of forest ecosystems are expressed in terms of	…

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		landscape- levels	protection and landscape attractiveness	compensations) Growing interest for ecosystem interfaces (agriculture - forest) to limit vulnerability (to diseases and storms)	resilience / vulnerability, but the debate with genetic selection is not closed	
ECL3	Meso	**Constraints associated with the management of watertable levels**	Maintenance and upkeep of a network of ditches, able to drain forest stands	Forest consensus on the importance of ditch management Recurring tensions with farmers and on European regulations (classification of river streams vs. ditches)	Equilibrium on watertable levels is key to the maintenance of the 'cultivated forest' model Consequences of an increase of agricultural land?	…

4.2.5 Politics

Table 6 STEEP-Table – Glossary of Key Factors – Politics

No.	**Level**	**Title**	**Definition**	**Empirical information on present situation**	**Why relevant?**	**Comments**
POL1	Macro / Meso	**Reorganization of the political authority associated with forest stakes**	Evolution of the vertical (institutional levels) and horizontal (between sectors) distribution of forest-related political competencies	centralized forest policy but disinvolvement from State New competencies for EU and local authorities in previously peripheric domains (energy, biodiversity). development of 'private' regulations (certification)	Coherence of the forest policy, between international dynamics, state and regions Evolution of technical and financial means targeted on forests Diversification of regulation modes	…
POL2	Macro / Meso	**Political mediation ability of sectoral interests**	Representation and organization of collective forest stakeholders	Weak national convergence of sectoral interests Instability of interbranch dynamics	Lobbying capacity of sectoral interests, by informal mediation (technical skill criteria) or	…

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				Emergence of new demands and expectations (rather diffuse) related to forest management	official participation arena Prospects for a de-partitioning of the sector towards society	
POL3	Macro / Meso	**Public action strategy associated with forest stakes**	Type of tools used for public action, assigned aims and target populations	Public help on FWC targeted on demand rather than on offer Multilevel multifunctionality rather than zoning Progressive withdrawal of direct subsidies and regulations	Identification of public incentives for the orientation of individual and collectives practices Political articulation choice, between various particular interests Questioning of multifunctionality, usually centered on production as the payer of other functions ('wake' effect)?	…

4.3 Results of Structural Analysis

In order to identify the most important (key) factors, a structural analysis according to Glenn/Gordon (2009, ch. 11) has been applied. The basic idea of the tool is to assess the relative influences of the factors under study, i.e. for every factor it is evaluated how strongly it influences the other factors included in the analysis and how strongly it is affected by the other factors. The aim of the structural analysis is to find out which factors act strongly on the system under study and which factors are acted upon strongly. The basic idea is to focus on those factors that have a high active value, i.e. that have a strong impact on other important factors and that, at the same time, can somehow be controlled – ideally by the addresses of the scenarios because that would make them relevant.

4.3.1 Link matrices

In a nutshell, the procedure has been realized as suggested in MS31 by listing the factors from the STEEP table in a matrix of columns and rows, in both cases in the same order of succession; in this way, each factor has been juxtaposed with the others. For each pair of factors, the question has then been asked, 'How strongly does one factor influence the other?', or the other way around, 'To what extent can the development of one factor be explained by the development of the other factor'? To quantify and assess the influence, the following scale has been used:

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0 = no influence
1 = weak influence
2 = medium influence
3 = strong influence

The following matrix shows the aggregate values of the assessments made during the aforementioned workshop held in Pontenx-les-Forges the 11th of July, 2013. Eight individual matrices were built during the meeting: two of the forest owners stepped out of the exercise after having started filling the matrices, considering the task as challenging and intimidating. The matrices were captured and automatically summed in a spreadsheet. An affine transformation (division by 3) was also performed, in order to take account of software default specifications (no value above 10 for Parmenides EIDOS).

Table 7 Structural analysis matrix, Pontenx

from, to	SOC1	SOC2	SOC3	TEC1	TEC2	TEC3	ECO1	ECO2	ECO3	ECL1	ECL2	ECL3	POL1	POL2	POL3
SOC1	**X**	5	1,3	1,7	1	1	2	2	5	4	3	1	4	3	4
SOC2	4,3	**X**	3,7	3	.	.	2,7	2	2,7	3,3	2,3	3	3	2	2
SOC3	2,3	4	**X**	5,7	2,3	2,3	4,3	3	1,7	3,3	3,7	2	1	2	3
TEC1	2,3	1,7	4	**X**	7	4,3	6,3	4,3	3,7	6,3	5,3	3	1	1	1
TEC2	0,7	0,3	1	5,7	**X**	3,7	4,3	6,7	1	2	1,7	1	.	1	1
TEC3	.	0,3	1	5	2,7	**X**	4,7	6,3	0,7	2,3	1	1	.	.	1
ECO1	0,7	5	5,3	7,3	3	2,3	**X**	6,7	3	2	2,7	1	2	1	2
ECO2	2	4	3,7	4,3	4	4,3	6,3	**X**	1,3	1	1,7	.	2	2	3
ECO3	5	2,7	2,3	5,7	1,7	1,7	4	1,7	**X**	1,7	4,3	3	1	2	3
ECL1	1,3	2,7	4,7	7,3	3	3	4,3	2,7	4,3	**X**	4,3	2	3	1	3
ECL2	2,3	0,3	1,7	5	1,7	2	3,7	2,3	3,7	4,3	**X**	3	1	1	3
ECL3	0,7	1,7	2,3	4,7	0,3	1,3	1,3	0,7	3,7	5,3	4	**X**	2	2	3
POL1	2	4	3,3	3	1	1	1,7	2	2,3	0,7	2,7	3	**X**	3	5
POL2	2,7	2,3	3,7	2,7	1,3	1,3	1,7	3,3	2,7	0,3	2	2	3	**X**	4
POL3	3	2,7	3,3	4	2,7	2,3	1,7	4,3	3,7	1,7	2,3	2	3	2	**X**

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4.3.2 Active-Passive Map

The sums of the lines and columns can be considered as a measure for the degree of networked interrelationships. While the 'line sum' of any factor represents the so-called 'Active Sum' (AS) and indicates how strongly that factor affects other factors, the 'Column Sum' of a factor represents the so-called 'Passive Sum' (PS) which shows how strongly that factor is influenced by other factors. In this way, every factor has been evaluated according to the relationship between its Active and its Passive Sum. The factors can be displayed in a coordinate axes using the individual active- and passive sums as their x- and y-coordinates. The resulting distribution shows at a glance how strongly each factors acts on all other factors involved and how strongly it is affected by the others. On a general level, the following groups of factors are distinguished:

- Active or influential factors (high AS, low PS). These factors influence the system under review much more strongly than they are influenced, i.e. they are altogether very influential and have a low dependency. So, these factors are hard to steer and control, given their low PS. If one can influence these factors, they can be regarded as effective levers. Very often, they act as factors of inertia. Typical examples of these factors are climate change, demographic developments or stable institutional settings, like national laws or ownership structures. In the Active-Passive-Map, these factors are located in the upper-left corner.

- Reactive, passive, depending or result factors (high PS, low AS). These factors are influenced more strongly than they act on other factors. Since they are especially sensitive to the evolution of influential or relay factors, they represent useful indicators for the observation of a situation. A typical example of these factors is individual human behaviour. These factors are located in the lower-right quadrant.

- Critical, dynamic or relay factors (high AS, high PS). These factors are very influential and at the same time very dependent. They are linked with a network of other factors and are, by nature, factors of instability, since any action on them has consequences on the other factors under review. In this sense they are important factors for change, because they can be influenced and they are, at the same time, important for many other factors. A typical example of this group of factors would be the global timber price – it depends on a lot of variables and it has a strong influence on other factors. These factors are the most crucial ones and can be found in the top-right corner of the Active-Passive-Map.

- Buffering, excluded or lazy factors (low AS, low PS). This group of factors has a low influence and, at the same time, low dependency. This group of factors is rather isolated from the remaining factors. In the final scenarios, they might be introduced to enrich the story that is told, but not as a driver for the overall plot. Buffering factors are located in the lower-left quadrant of the two-dimensional field.

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For the Pontenx case study, the distribution of factors in the Active-Passive Map is described in figure 3:

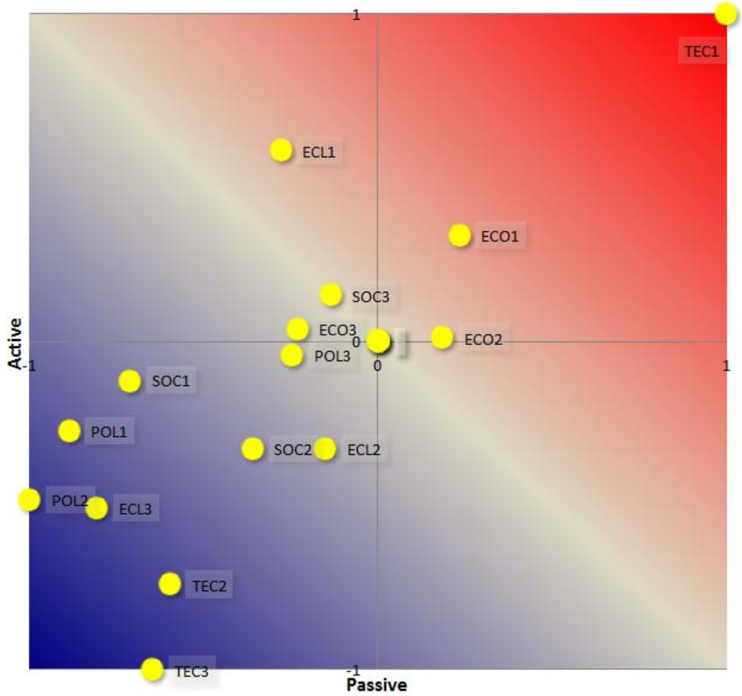

Figure 3 Active-Passive map of factors, Pontenx

The 'critical' factors should be clearly identified as TEC1, ECO1, ECO2, while the 'active' ones could be ECL1, ECO3 and SOC3. It is to be noted that no 'passive' factor was highlighted with the agregating procedure, thus the remainder could be labelled to some extent as 'buffering', with especially low scores for POL1, POL2 and TEC3. In order to get a richer understanding of the structure of relationships between those factors, it was also considered relevant during -and after- the workshop to discuss individual matrices, in order to highlight the diversity and the internal consistency of the point of views adopted by the stakholders during the exercise. See figures 4 and 5 to get the contrasted examples of two planners with an interest in forest stakes: the first sees the evolution of the regional industrial fabric as the pivotal relay factor, while the second adopts a much more bottom-up -possibly post-materialistic- perspective, assuming the diversification of forest stands to be the key for the evolution of Pontenx landscapes.

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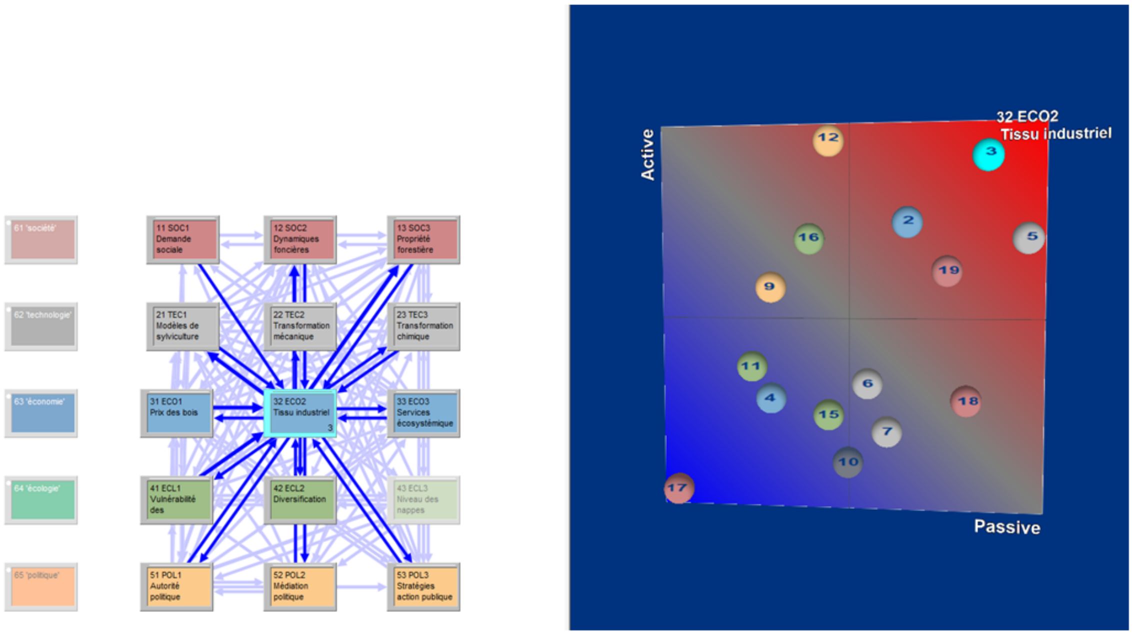

Figure 4 Example #1 of an individual Active-Passive ranking, Pontenx

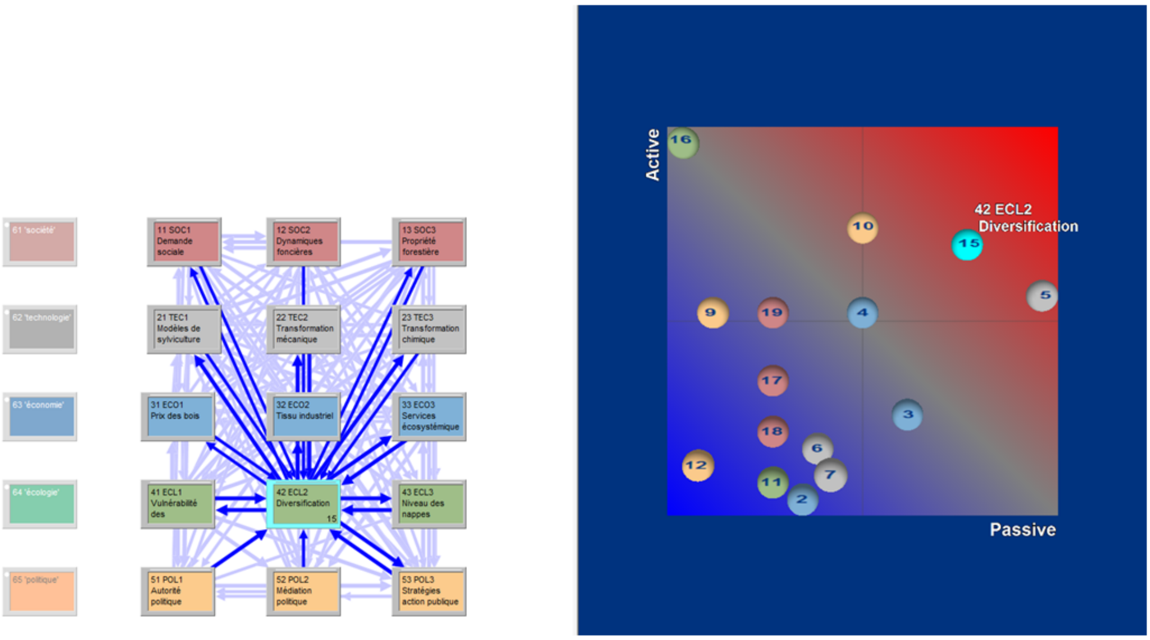

Figure 5 Example #2 of an individual Active-Passive ranking, Pontenx

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The scope of the procedure, more a tool helping to focus on the most decisive factors than a realistic model, should be reminded. One has to underline that the distribution of factors shows their influence only in relation to the other factors included in the analysis and not their influence in the real-world. This means, that the distribution might already have a slightly different aspect if only two or three more factors were to be included. Due to practical reasons, it is not possible to consider all of the factors that might be of importance in the structural analysis. One can think of the uncountable interdependencies between factors and the fact that minor changes in initial conditions and indirect influences can lead to a completely different development in the long term. In this sense, comparatively small influences can trigger big results, so it seems hard to decide which factors to include and which factors to leave out. So, even if the future developments of the forest stands in the INTEGRAL case study areas are influenced by virtually uncountable events, influences and coincidences, it is legitimate to focus on the most important ones, via tools such as the structural analysis. Those factors that are considered as most important are selected and their relationships evaluated. As with all models, there is the danger of over-interpretation, i.e the danger of taking the results of a structural analysis with 15 factors as a model of the real world situation. Obviously, this is not the case. The Active-Passive Map was an important input to the research team when it came to selecting the key factors, but it remained our own responsibility to select the 'right' factors for the Pontenx case study area.

4.3.3 Post-workshop analysis of key factors, selection of scenario elements

For some Key Factors that were the focus of a high interest from stakeholders, the explanation partly lay on their ambiguous definitional perimeter, with regards to the Integral research objectives:

- This was especially the case for TEC1, labelled with high active and passive scores. 'Evolution of silvicultural models' could indeed be interpreted as a determinant and as the explained variable. In Integral, part of these dynamics are captured in the scenario/modelling framework with the evolution of owner types, so we decided later to retain only a restricted top-down vision (i.e. innovation / institutions) of TEC1 in the elements.

- ECL1 was also identified with the highest active score. We understood that behind these conceptions of 'vulnerability of forest stands to (a)biotic risks', part of the answers were actually considering the likeliness of storms over the scenario timespan, with a rather uniform and pessimistic view on the possible positive effects of forest managers in this respect. Acknowledging the importance of these stakes as what could be a 'given' element of the evolution of the 'Pontenx' case study, we decided nevertheless to withdraw the exogenous risk from the scenario space, as it would have lead to unbalances (e.g. one scenario with a catastrophic event would be perceived as a foil compared with the others, thus losing a degree of freedom for the discussion) or levelling (e.g. pessimistic development for all the driver scenarios). We then retain the organizational side of the forest vulnerability to risks as a scenario

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element, leaving the assessment of forest stand vulnerability as a possible output of the modelling exercise.

A few interesting patterns emerged during the discussions on key factors and on the ranking exercise:

- Differentiated spatial dynamics inside the Pontenx case study area were evoked as an important feature, as a dichotomy between the coastal dune areas and the inland plateau may be further sustained or not in the future, with regards to forest management, social demands, tourism location, land pressure...

- The dynamics of public forest ownership and tenure, an acknowledged blind spot of WP3.1 work, were considered as potentially important drivers. Representing a small share of the Pontenx forest area, public forests are nevertheless subjects to specific demands and management styles, that may act or not as possible models for the private foresters.

These two features were added as 'shadow factors' in the development of elements. Various options were taken for the key factors with the lowest active/passive scores:

- Subdued: ECL3, 'Constraints associated with the management of watertable levels', was not often cited by stakeholders. It was thus only retained as an illustration of a more general element, dedicated to the relationships of forest management with agricultural and residential uses.

- Merged: TEC2/TEC3, i.e. the innovations in wood chemical and mechanical processing, were associated and inserted as parameters expressing the conditions of the maintenance and evolution of the regional industrial fabric

- Discarded: for POL1, 'reorganization of the political authority associated with forest stakes', the line of questioning contrasting authority, mediation and strategies appeared unclear and less relevant to stakeholders, and was rewritten and incorporated in a general element expressed under the moniker of 'governing arrangement'

4.4 Scenarios

Generally speaking, scenarios are supposed to depict and describe a spectrum of possible, preferable and probable future developments. One can depict the idea of scenarios with the help of the so-called scenario funnel (see Figure 6). Starting from a more or less 'known' situation in the present, the space for alternative developments opens up, the more we move into the future.

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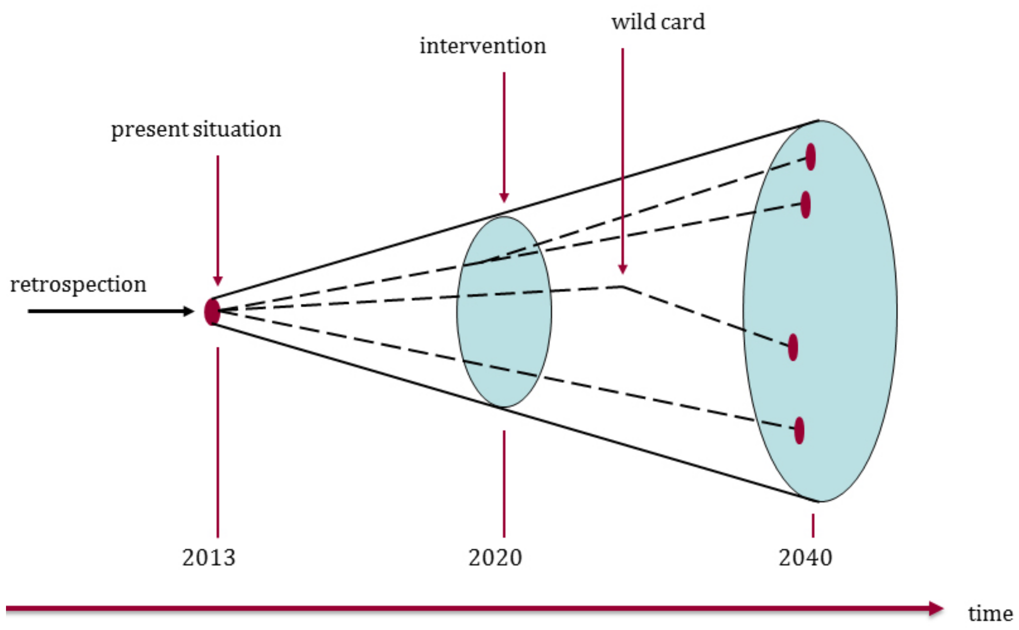

Figure 6 Scenario Funnel

When we look at the near future, the world can and will change, of course, but tomorrow and the day after tomorrow, the situation will be quite similar to today. The more we go into the future, the more uncertain we are about how things will develop. Given trends change their shape and even the factors that proved decisive until now might change their direction or lose their importance. New and unknown influences appear and change the system under examination. The further one tries to predict future development, the higher the number of unprecedented events and developments and their possible influences. This complexity and insecurity is represented in the funnel opening up to the right and into the future. If one cuts the funnel at any time (e.g., in 2020, in 2030 and so on), all of the possible future situations (scenarios) lie somewhere on the cut surface of this funnel.

To systematically think of the interplay of influencing factors in a given system is only reasonable when these factors will also be of importance for the development in the future. The research steps described above aimed at identifying these factors, i.e. factors that can be considered as decisive for the future forest development in the Pontenx case study area. Using this information as a starting point, the next steps were about the actual creation of the scenarios. A short summary of the research steps taken is necessary in order to be able to understand and assess their significance and scope – a more detailed and operational description is provided by MS31. Another useful reference can be found in Pillkahn 2008, pages 200pp.

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- Whenever possible, the previously identified key factors have been aggregated into 'elements'. For example, the factors ECO2 (Evolution of the regional industrial fabric), TEC2 (Innovation in wood mechanical processing) and TEC3 (Innovation in wood chemical processing) have been aggregated into U2 (Structure and competitiveness of the regional FWC industrial fabric). It was impossible to do this with all factors, either simply because content-related it wasn't reasonable or because the factor already had the weight and scope of other elements consisting of several 'smaller' factors. However, whenever it was possible and reasonable, it was done, first, in order to reduce the high number of factors and key factors shown in the STEEP table and the glossaries into fewer elements and, second, because most of the time the aggregaton of factors lead to an alignment of the resulting elements as far as their range and scope was concerned.

- These elements are the material the scenarios are made of. They are the issues that can be considered as crucial for the future development and which, at least partly, mark a difference between the individual scenarios. These differences were expressed by describing alternative future developments for each element. These alternative future developments are called 'manifestations' – they describe how each issue might develop in the next 25 to 30 years.

- The final scenarios were created by assessing how well each manifestation goes together with all manifestations of the other elements. This means that the complexity of assessing the plausibility of an overall future situation was broken down into a high number of smaller assessments. With software support the overall coherence of every single combination was calculated and ranked, thus identifying distinctive clusters of combinations with high internal coherence, i.e. which could be considered as plausible and internally consistent. Finally, a set of scenarios was selected – each of them can be considered as being plausible, while differing from the others in a meaningful way. By describing not only one but five scenarios, the range of possible future developments for the Pontenx case study area is highlighted.

4.4.1 Scenario Space and Driver Scenarios

The following figure gives an overview on the scenario space for the Pontenx case study area. The aforementioned 'elements' are depicted in dark boxes, while their alternative future 'manifestations' are expressed in a lighter shade. A detailed description of the elements and their manifestations can be found in the following chapter 4.4.2.

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Table 8 Overview of the 'Scenario Space' of the Pontenx case study area

U1 Prices of *P. Pinaster* wood products	**U2** Structure and competitiveness of the FWC regional industrial fabric	**U3** Structure and nature of the forest tenure	**U4** Ecosystem services (& carbon) regional offer	**U5** Governing arrangements of forest activities	**U6** Relation with other land uses	**U7** General attitudes towards forest	**U8** Collective handling of risks	**U9** Technical-institutional silvicultural offer
Weak - uniform	Industrial mutation - biomass	Delegating individuals	Weak offer	Remote steering	Coastal attractiveness, inland sanctuary	Coexistence of 'nature' & 'production' visions	Strong collective fire management - incentives for insurance	Moderately diverse
Recovery - energy driven	Industrial decline - exported added value	Rise of larger legal entities	Public-led, market-based, ES offer	Coordinated, FWC-oriented, governing	Coastal attractiveness, agricultural pressure	Segregation of 'nature' & 'production' visions	Weakening of fire management institutions - no incentives for insurance	Fast
Recovery - timber driven	Industrial diversification - timber-led	Grouping owners	Public-led, zoning-based, ES offer	Differentiated governing	Diffuse urbanization	Synergies via ES reframing	…	Diverse - fast
…	Pulpwood dominance - energy	…	Private-led marketing of ES	…	…	Production 1st	…	Diverse-qualitative

Out of the multitude of possible trajectories through that scenario space the following five combinations, i.e. scenarios, have been selected.

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4.4.1.1 Driver Scenario 1: Unfinished bioenergy

(*Le tournant énergétique inachevé*)

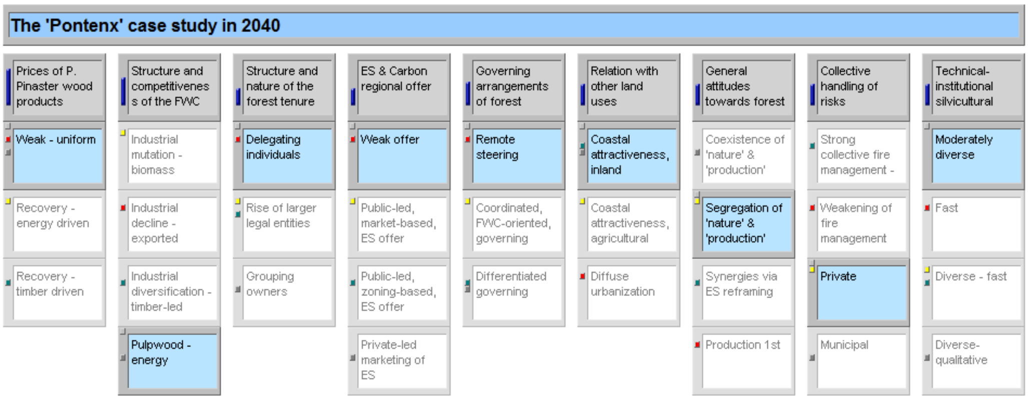

Figure 7 DS1 Scenario space

Les industries locales, en particulier de la trituration, ont pris le virage de la valorisation énergétique en s'appuyant sur un soutien de l'État à la demande (énergie-climat), une convergence locale avec des grands opérateurs forestiers et une innovation orientée vers l'amélioration génétique/raccourcissement des rotations. Mais elles n'ont pas achevé leurs mutations; les tensions sur la ressource ont affaibli leur compétitivité et leurs capacités d'investissements. Surtout nombre de propriétaires hésitent à s'engager dans cette intensification productive guidée par le tournant énergétique. Certains propriétaires continuent ainsi à privilégier une gestion patrimoniale, tandis que d'autres cherchent de nouvelles formes de valorisation dans le sillage du développement de l'économie résidentielle à proximité du littoral et des aires urbaines.

See the summary of the Full Scenario 1 below for an updated and translated version of this text.

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4.4.1.2 Driver Scenario 2: Biorefinery innovation & land-use tensions

(*Mutation, diversification, tension sur les usages du sol*)

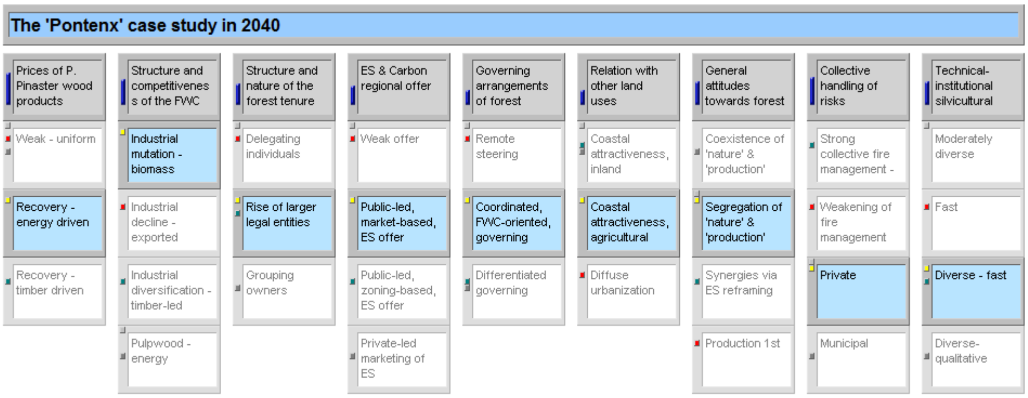

Figure 8 DS2 Scenario space

Le tissu industriel local a réussi sa mutation vers le paradigme de la bio-raffinerie et de la chimie verte. Coordination sectorielle importante, avec le soutien de l'État, autour d'une politique de l'offre et la promotion d'une sylviculture permettant de valoriser une diversité de produits (du BE aux fibres). La forêt devient un capital attractif et les services éco-systémiques sont avant tout pensés sous l'angle des « services joints » à la production. Mais les tensions avec l'agriculture, également bien positionnée sur les enjeux énergétiques, se sont également accentuées. De plus, même si les enjeux productifs sont relativement acceptés, cette convergence des logiques forestières avec l'agriculture contribue également à « déterritorialiser » la forêt et à couper les liens avec le public.

See the summary of the Full Scenario 2 below for an updated and translated version of this text.

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4.4.1.3 Driver Scenario 3: The European biomass sink

(Le terril landais)

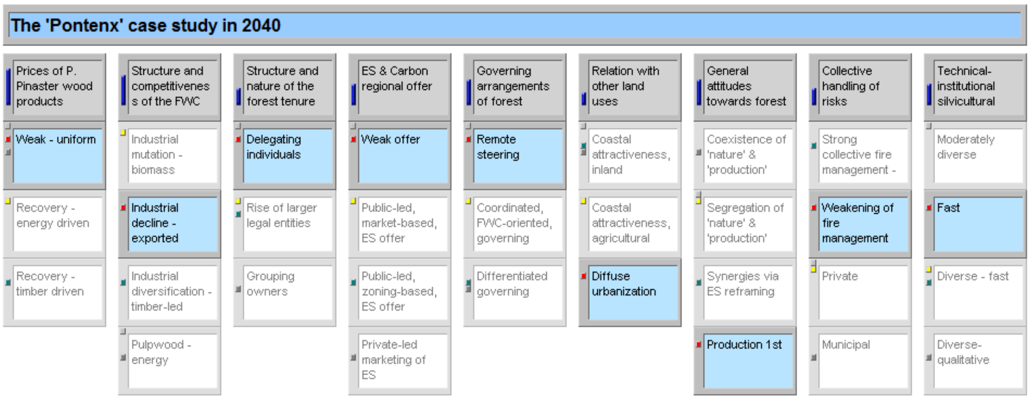

Figure 9 DS3 Scenario space

Le tissu industriel local s'est fortement amoindri. L'enjeu de la compétitivité industrielle est porté à l'échelle européenne avec des enjeux de concentrations, notamment autour des bio-raffineries. La forêt cultivée des Landes reste toutefois attractive en raison de sa capacité à s'inscrire dans une logique de « gisement ». Localement, elle peut également être valorisée en tant que réserve foncière dans un contexte d'élargissement des aires métropolitaines.

See the summary of the Full Scenario 3 below for an updated and translated version of this text.

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4.4.1.4 Driver Scenario 4: The 'Green' innovative cluster

(L'économie verte forestière)

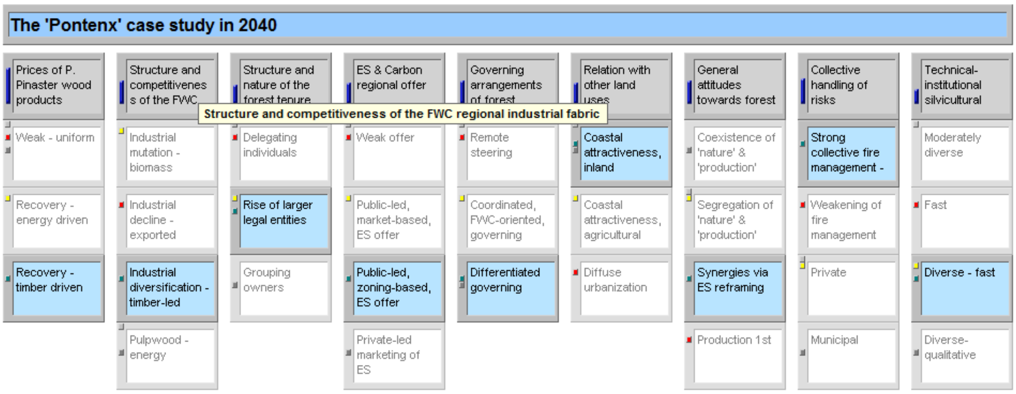

Figure 10 DS4 Scenario space

On assiste à un fort soutien institutionnel à l'éco-construction et à l'innovation autour des matériaux bois. Le renforcement de la coordination sectorielle est appuyé par les pouvoirs publics avec des contraintes fortes d'éco-conditionnalités. Des synergies autour des services éco-systémiques se développent, même si dans les faits cela se traduit par une emprise croissante, tant d'un point de vue normatif que spatial, des zonages pour la biodiversité et l'accueil du public.

See the summary of the Full Scenario 4 below for an updated and translated version of this text.

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4.4.1.5 Driver Scenario 5: The territorial partnership

(*Pacte territorial)*

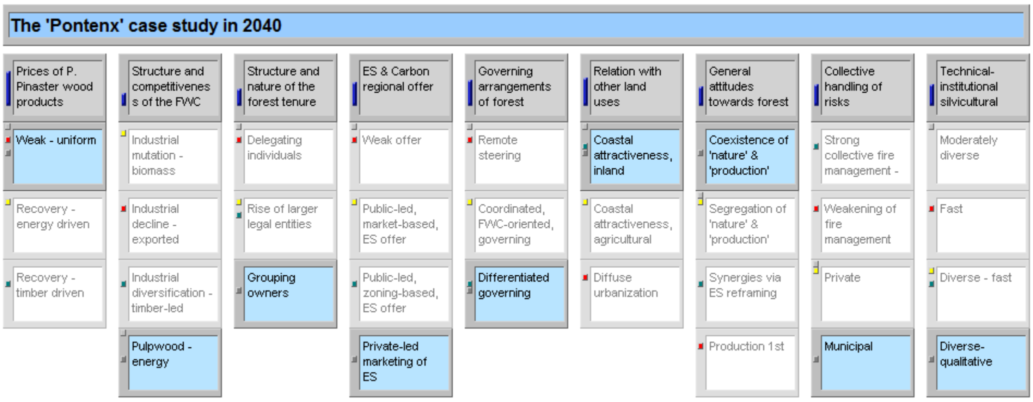

Figure 11 DS5 Scenario space

Dans un contexte de fragilisation du tissu industriel, les autorités locales et intercommunales tentent de maintenir une demande (via le bois énergie notamment) et de promouvoir une sylviculture contribuant au développement de leur territoire rural par la production de biens mais aussi de services. Cette appropriation des enjeux forestiers par les collectivités territoriales s'appuie également sur un renforcement de leurs capacités de régulations des usages du sol et des ressources en eau. En parallèle, l'amont de la filière s'est renforcé et structuré avec un développement du regroupement des propriétaires forestiers et une plus grande intégration de leurs intérêts professionnels dans les arènes de décisions infrarégionales.

See the summary of the Full Scenario 5 below for an updated and translated version of this text.

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4.4.2 Description of Elements and Manifestations (without ES Assessment)

Table 9 Descriptions of Elements and Manifestations

4.4.2.1 U1 | Prices of P. Pinaster wood products

Overview

U1	**Prices of *P. Pinaster* wood products**

Factors from Structural Analysis

- **ECO1** Evolution of *P. pinaster* wood products prices

Definition

With an income determined by interactions between volumes and prices, a large share of forest owners do take into account these possible trade-offs when making their silvicultural choices. The Klaus storm has had dramatic effects in this respect over the 2009-2013 period: the average stumpage values for *P. pinaster* pallet quality timber were divided by five, reaching an historical low in mid-2010 [2]. Prices had only partly recovered in 2013, with disappointing sales coming in stark contrast at a national level with *e.g.*Douglas fir or Norway spruce. In this dim context, the landowners of the 'Pontenx' case study do not expect miracles on regional future offers on Pine products, with regional industrial actors competing on a rarefied but low priced pulpwood. Yet, this fatalistic view may be conpensated by a possible rebund of world wood prices and a potential differential in prices with timber and energy use. The latter point may be of relevance for some owner profiles, as it would enable the profitability, even as 'niche' strategies, of quality-oriented forest managements.

Different manifestations due to ...

- Prices and markets for *P. pinaster* woods (timber, pallet, pulpwood, energy)
- Public incentives on products (subsidies, orders)

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Manifestations of U1

U1a	**Weak - uniform**

- Low prices and demand
- No effective support on timber revenue

World wood markets remain anomous on a long term basis. Due to disruptive innovations in other sectors and/or regulatory constraints, the optimistic prospects for wood energy are not met. The prices of Pine timber continues a downward trend, getting closer to pulpwood and fuelwood uses.

U1b	**Recovery - energy driven**

- Higher prices and demand
- No effective support on timber revenue

As expected by many forest experts, the peak-oil context leads to an increased demand for wood products. The associated upward trend of prices is partly buttressed on energetic uses. The prices of Pine timber slow and even stop their decline but the Δ with industrial wood gets smaller.

U1c	**Recovery - timber driven**

- Higher prices and demand
- Active support on timber revenue

The demand on wood products is also on a general increase - but the energetic uses are not overtly dominant. Due to an active role of state and regional actors, notably via orders, a market for Pine dimensional timber is favored and sustained. Large dimension sawn wood is able to maintain a noticeable Δ with industrial wood.

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4.4.2.2 U2 | Structure and competitiveness of the FWC regional industrial fabric

Overview

U2	Structure and competitiveness of the FWC regional industrial fabric

Factors from Structural Analysis

- **ECO2** Evolution of the regional industrial fabric
- **TEC2** Innovation in wood mechanical processing
- **TEC3** Innovation in wood chemical processing

Description

An important and integrated regional forestry wood chain (FWC) has been created since the 60s, alongside the development of the Gascony silvicultural model. Industrial actors are now faced with competitiveness problems: the situation is especially difficult for sawmills but even dominant actors such as paper mills (>50% of the *P. pinaster* volumes) are experiencing hard times. Above all, the coming scarcity of wood due to Klaus is set to increase an already fierce competition on industrial wood, with or without the development of biomass uses.

Different manifestations due to ...

- Concentration patterns at European scale, maintenance of paper- and sawmills in the region
- Success of timber-related innovations, emergence and integration of green chemistry actors
- Location and importance of the creation of added value

Manifestations of U2

U2a	Industrial mutation - biomass

- Regional reshuffling of the concentration pattern
- Actors and innovations from green chemistry are regionally inserted
- Strong and rather local added value

Pulpwood industries are either transformed or replaced by biorefineries or green chemistry industries. Pine uses drift to biomass and fiber (specialty cellulose), with a possible increase of the added value.

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U2b	Industrial decline - exported added value

- Concentration patterns are sustained at the European scale, with negative regional effects
- Innovations cannot be backed by regional industrial actors
- Exported added value

The region experiences a decline of its industrial fabric, in a context of industrial concentration at the European scale. With the possible closure of major industrial consumers, the added value is increasingly exported, as roundwood.

U2c	Industrial diversification - timber-led

- Concentration patterns are sustained at the European scale, with negative regional effects
- Innovations in dimensional timber are appropriated by industrial actors
- Strong and local added value

In this variant of U2b, the forest region undergoes a difficult bottleneck with the disappearance of major industrial actors. The innovation context is different though, as breakthroughs in dimensional timber technologies (such as greenwood finger-jointing), backed by public spending, are able to rejuvenate somehow the network of local saw mills.

U2d	Pulpwood dominance - energy

- Concentration patterns are sustained at the European scale, with neutral regional effects
- Innovations are driven by pulpwood uses
- Local and rather weak added value

The regional industrial fabric is maintained around world-class actors of the pulp (and panel board) industry. Wood energy uses are on the rise. The added value remains local - and rather low.

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4.4.2.3 U3 | Structure and nature of the forest tenure

Overview

U3	Structure and nature of the forest tenure

Factors from Structural Analysis

- **SOC3** Evolution of private forest ownership
- *XXX Evolution of public forest ownership*

Description

In a forest area largely dominated by private ownership, the most relevant evolution may be linked to the *de facto* tenure and management, characterised by a rising disinvolvement from owners and their increased reliance on management delegation. These distinctions are especially relevant in the frame of Integral, as the real decisions can be heavily influenced by the managers over the owners. Ownership dynamics still have an important role though: legal entities have increased their influence on the forest area - and may be joined by others. The private/public divide is not as clearcut and static as commonly expressed: public forests are a minority that is partially underestimated and contested, with several municipal forests under a private derogatory management - aside the official *régime forestier* applied by default in public forests.

Different manifestations due to ...

- Relative shares of individuals and legal entities among owners
- Importance and role of management delegation
- Degrees of collective involvement
- Role of ownership and economic groupings
- Status of *régime forestier*

Manifestations of U3

U3a	Delegating individuals

- Family ownership remains dominant
- Delegation management on the rise
- Decline of collective involvement
- Partial reform of *régime forestier*

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U3a sees a continuation of current regional trends in private ownership, where forest assets remain predominantly in the hands of individuals or families - but with an increasing reliance on external managers. We should here consider forest experts for larger estates, and the forest cooperative*Alliance Forêt-Bois* for the others. A partial reform of public forest management is considered, with an opening to private managers of some public forests (similar to a 'German' scenario).

U3b	Rise of larger legal entities

- Increase of the share of legal entities
- Management delegation on the rise
- Decline of collective involvement
- Possible questioning of the public tenure

The forest areas undergo an increase of capitalistic investment by legal entities, some of them being new to the forest sector. The public management under *régime forestier* is challenged, with a possible evolution of ONF (similar to the swedish case)

U3c	Grouping owners

- Family ownership remains dominant
- Management delegation is slown
- Stronger collective involvement of owners
- No major evolution for *régime forestier*

Collective bottom-up dynamics have a stronger role in this future manifestation, with the owners able to gain more control in the management. The action of forest cooperatives is balanced with owners' associations and independent loggers (*ETFs*)

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4.4.2.4 U4 | Ecosystem services (& carbon) regional offer

Overview

U4	Ecosystem services (& carbon) regional offer

Factors from Structural Analysis

- **ECO3** Structuration of a regional offer on ES

Description

An explicit aim in public forests (mostly the state-owned) and a largely informal practice in private forests, the structuration of the offer on ecosystem services may starkly evolve in a near-future. Payment for ecosystem services are discussed at regional and national level, but with no immediate prospects in sight.

Regarding carbon compensation, an original subsidy scheme targeted at afforestation was set up in 2011 under the impulse of the *Aquitaine*regional council, involving actors from public & private forest management(CRPF, ONF, CDC).

Different manifestations due to ...

- Marketing of a service offer (ES, carbon...)
- Influence of the public sphere
- Role of zonings

Manifestations of U4

U4a	Weak offer

- Few formal offers
- Weak public influence
- No increase of zoning

Despite several efforts and incentive schemes, the commoditization of ecosystem services remains marginal. The uptake is low on carbon markets.

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U4b	Public-led, market-based, ES offer

- Formal offers on the rise
- Strong public influence
- No increase of zoning

The commoditization of ecosystem services is gaining ground. A modest increase of carbon compensation contracts is observed. This marketing is facilitated by the rise of a residential economy and economic incentives from Europe and the region.

U4c	Public-led, zoning-based, ES offer

- Formal offers on the rise
- Strong public influence
- strong effect of zoning

The ES offer is mainly structured by institutional zoning, for public access, biodiversity… Carbon compensation contracts are *de facto* limited to the largest and the most institutional owners. The offer is concentrated on the coastal area and its immediate dune hinterland. Other market-based tools remain marginal.

U4d	Private-led marketing of ES

- Informal offers
- Weak public influence
- Weak effect of zoning

The marketing of ecosystem services is mostly structured outside the influence of public sphere, *e.g.* via the development of private hunting ranges. Carbon compensation contracts may be developed though.

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4.4.2.5 U5 | Governing arrangements of forest activities

Overview

U5	Governing arrangements of forest activities

Factors from Structural Analysis

- **POL3** Public action strategy associated with forest stakes
- **POL2** Political mediation ability of sectoral interests

Description

At the national scale, the 'forestry & wood' sector is characterized by neither a convergence of interests nor a stability of its joint-trade organization. Meanwhile, new demands and expectations are addressed in a diffuse way towards forest managers. Sofar, public support to the forest sector has privileged demand over offer, multifunctionnality over zonings, paving the way for a progressive disappearance of direct subsidies and regulations.

Different manifestations due to ...

- Types of public action tools, objectives & targeted population
- Horizontal and vertical distribution of political competencies
- Lobbying capacity of the regional FWC
- Relationships between State, region & Europe
- Dominant conceptions

Manifestations of U5

U5a	Remote steering (or Back-seat governance)

- Demand-centered actions (i.e. 'demand' policy)
- Public disinvolvement from the regulation of forest management
- Weak politicization of forest-wood stakes

An active backing of the wood demand (via climate-energy policies) but a disinvolvement from forest actions. The convergence of sectoral interests is weak, and demands from society are diffuse.

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U5b	Coordinated, FWC-oriented, governing

- Offer-centered actions (i.e. 'offer' policy)
- State involvement
- Important political weight of the FWC

Public backings are targeted on the harvest and the transformation of the forest capital. A zoning logic prevails over multifunctionality thought. The FWC is able to organize representation spaces.

U5c	Differentiated governing

- Different strategies for *sensu lato* FWCs
- Europe & regions
- 'Decompartmentalization' of forest stakes

Differentiated strategies for the coexisting sectors (wood-based -*i.e.*forestry wood chains, or not) able to value forest goods and services. Forest stakes are appropriated by representative organizations of various societal interests.

4.4.2.6 U6 | Relation with other land uses

Overview

U6	Relation with other land uses

Factors from Structural Analysis

- **SOC2** Land-use dynamics, with regards to regional attractiveness
- (**ECL3** Constraints associated with the management of watertable levels)

Description

The Pontenx case study area, known 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. Although these population growth and tourism migrations remain preferentially located on coastal areas, they are part of a major shift. Spatial interactions between residential/tourism activities and forest become an important issue. But, as noted by local stakeholders, the

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relations between agriculture and forest in the inland remain an important stake, in terms of land pressure, integration of productive activities, coordination through the upkeep of the drainage network on the levels of watertable. These East-West land-use dichotomies could be considered as a main feature of our case study.

Different manifestations due to ...

- Spatial patterns of population dynamics
- Location and size of agriculture areas

Manifestations of U6

U6a	Coastal attractiveness, inland sanctuary

- Attractiveness of coastal and sub-coastal areas as high quality spaces
- The inland remains dedicated to agriculture & forest land uses

Coastal areas and their immediate dune hinterland are strongly attractive in demographic and economic terms, featuring quality forest landscapes and products. But a large part of the inland remains relatively uninhabited. The eastern land-uses are shared between agricultural and forest activities. The latter is predominantly production-minded but may include also nature conservation goals.

U6b	Coastal attractiveness, agriculture pressure

- Tourism and residential migration increase on the coastal area and its immediate hinterland
- Competition or synergies between agriculture and forest activities in the inland

The attractiveness of coastal areas (and hinterland) strengthens the urbanization of the western part of the case study area. Meanwhile, the inland is becoming a 'resource area' to improve food and energy supplies. Relationships between agricultural and forest activities are strengthened, possibly leading to contentious competition (with a marginalization of foresters) but also to new synergies (with an hybridization of production practices).

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U6c	Diffuse sprawl

- Population scattered in small residential neighbourhoods
- A patchwork of land uses

The spatial dichotomy of the case study area is fading, with East and West appearing to be affected in increasingly similar ways. The main driver of population location is less the attractiveness of coastal areas than the extension of large urban areas in the south. Population is still growing, albeit modestly. Households need affordable homes and are more scattered. Spaces are relatively fragmented, forest activities coexist with small residential neighbourhoods, farmland, logistics facilities, and transport infrastructure.

4.4.2.7 U7 | General attitudes toward forest

Overview

U7	General attitudes toward forest

Factors from Structural Analysis

- **SOC1** Evolution of social demand on forest services

Description

Meta-discourses, understood as an set of ideas, concepts, and categorizations that are produced, reproduced, and transformed in a particular set of practices, can be assumed to influence as well forest policy decision making and forest management practices (*Cf.* cross-scale study 'opinions and discourses'). In our case study, there is a master frame derived from maritime pine forestry and its related industries, but also a cultural identity built around forest production. Many traditional inhabitants show a strong attachment to this forest and theirs trees. However, changes in public opinions on forest modify perceptions and attitudes to the 'cultivated forest'. As in many attractive areas, traditional practices are gradually being superseded by social demands for recreational functions and environmental services - and more generally for pleasant environment living and landscapes. Evolution and relations between these different, and potentially contradictory, discourses and practices are an important issue. Currently, despite few localized conflicts, they coexist but mismatches between traditional images, stakeholder's discourses and new inhabitant's practices and perceptions also increase.

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Different manifestations due to ...

- Forestry paradigm in civil society
- Traditional perceptions and uses
- Stakeholders discourses on forest

Manifestations of U7

U7a	Coexistence of 'nature' & 'production' visions

- The multiple functions of forest are well considered by public opinion
- Forest production remains a 'cultural landscape' at the regional level

In civil society, there is generally a positive opinion about using forests for recreation and the use of Non-Wood Forest Products. As the same time, stakeholders discourses about forest production as a “cultural landscape” remains a performative power. But, mismatches between these multi-functionality discourses and practice can also lead to localized conflicts.

U7b	Segregation of 'nature' & 'production' visions

- Forests are mainly perceived as an archetype of nature
- Stakeholders discourses stress the need to develop an intensive forest management

A divide is occurring in regional forest discourses between inhabitants, becoming mostly urban, and stakeholders who stress the need to develop an intensive forest management to achieve the energy and industrial objectives. Intensive forest management is thus not well perceived in areas used extensively for recreation and conservation. This basic dichotomy has a performative power on the spatial organization of activities and practices.

U7c	Synergies via 'ES' reframing

- In civil society, concerns about environmental changes are raised
- Forest stakeholders discourses are highly influenced by the institutionalization of SFM framework

In the public opinion, forest is perceived both as a threatened ecosystem to be protected and as the main way to mitigate global changes effects. Strengthened by institutionalization and diffusion of SFM standards at different political level, this

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meta-discourse is increasingly shared by forest stakeholders

U7d	Production first

- Declining forest recreation and nature conservation in public opinion on forest
- Stakeholders' discourses insist on the need to help existing industries adapt global competition

In a context of energy crisis and economic slowdown, forest amenities (recreation / nature) are no longer a priority. For people living in large urban areas, forest is mainly seen as a reserve of cheaper land. On the other hand, forest stakeholders and institutions insist on the need to help existing industries adapt to market competition and provide jobs. As a result, favourable opinions about the forest industry become more widespread in the general population.

4.4.2.8 U8 | Collective handling of risks

Overview

U8	Collective handling of risks

Factors from Structural Analysis

- (**ECO2** Vulnerability of forest stands to (a)biotic risks)

Description

As evoked in a previous paragraph, the element considered here is not so much the evolution of forest stands vulnerability *per se* than the collective actions that may be able to influence this vulnerability. In this respect, the maintenance of the DFCI fire management system is a key feature: efficient so far, it is heavily dependent on the collective involvement of owners. Another dimension was less evoked in the discussion with stakeholders, as it was considered as beyond their perimeter: the status of forest insurance. Still marginal for cost reasons, it is presented as the main alternative to the owners that are worried about the planned absence of state subsidies in case of a major, Klaus-like, storm after 2013. The public incentives associated with this stance may strongly influence the uptake of the insurances for storm damage.

Different manifestations due to ...

- Status of the DFCI collective fire management system
- Incentives for insurance

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Manifestations of U8

U8a	Strong collective fire management - incentives for insurance

- DFCI institutions keep their efficience
- Public incentives for insurance are maintained

The functioning of the fire management institutions is strong enough to keep handling forest risks and their possible evolutions. Incentives for storm damage are present over the long term, taking the form of fiscal abatement and/or direct subsidies on insurance contracts.

U8b	Weakening of fire management institutions - no incentives for insurance

- DFCI institutions lose their efficience
- Public incentives for insurance are abandoned

Due to a reduced involvement of owners and public actors, the efficiency of the DFCI system slowly wades. While the State discourse is still encouraging owners to contract insurances, it is not accompanied by economic incentives anymore.

U8c	Partial handling of risks by the regional FWC

- DFCI institutions keep their efficience
- A regional insurance fund is set up

A volontary insurance and risk management system is maintained, possibly in the frame of the PEFC regional institution. Noteworthy shares of owners are kept out of the system.

U8d	Partial handling of risks by local authorities

- DFCI institutions keep their efficience
- Local authorities are increasingly involved in the funding of risk management

Municipalities are asked to contribute increasingly to the predominantly private funding of the DFCI fire management system. Due to negative answers, parts of the area become underdesserved. Public helps may be conditional, thus also fuelling an increased publicization of forest stakes

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4.4.2.9 U9 | Technical-institutional silvicultural offer

Overview

U9	**Technical-institutional silvicultural offer**

Factors from Structural Analysis

- **TEC1** Evolution of silvicultural models
- **ECL2** Expected outcomes of diversification, at stand and landscape levels

Description

For aforementioned reasons, we restrict here our understanding of the regional evolution of silvicultural choices to the technical-institutional environment surrounding the choices of forest managers. Basically, a very common expectation from the interviewed stakeholders was the widening of the dominant 'cultivated forest' offer, under objectives such as 'reversibility' - yet the latter may act more as catchword than as a set of fully tested models. Three directions (*i.e.* speed, diversity & quality) can nevertheless be explored in this respect that we combine in the following four manifestations.

Different manifestations due to ...

- Results of genetic selection
- Other silvicultural innovations
- Success of scientific arguments for diversification
- Preferred scale for diversification

Manifestations of U9

U9a	**Moderately diverse**

- Optimistic prospects for the Pine selection programme
- Moderate uptake on disease-risks related arguments for diversification
- Moderate diversification, at stand scale

Classical Pine silvicultural scenarios remain predominant in the forest area, with no major challenge to the current post-Klaus afforestation schemes. The expected genetic gains on VF4 Pines are met. The share of broadleaved species slowly increases in dedicated diversification plots.

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U9b	Fast

- Optimistic prospects for the Pine selection programme
- Moderate uptake on disease-risks related arguments for diversification
- Weak diversification, at stand scale

The once elusive dedicated short silvicultural scenarios make a comeback, helped by good results of the genetic selection programme. These short rotations gain institutional support. The resilience of the forest area is increasingly relying on genetic-based technical innovation.

U9c	Diverse - fast

- Disappointing prospects for the Pine selection programme
- Weak uptake on disease-risks related arguments for diversification
- Noteworthy diversification, at landscape scale

New species (*e.g.* eucalypts) and silvicultural scenarios (*e.g.* short rotation coppices) are introduced in suitable sites of the Pontenx forest area. Diversification, not necessarily driven here by the percolation of scientific arguments (*e.g.* from forest entomology), is favoured at a landscape scale.

U2d	Diverse-qualitative

- Disappointing prospects for the Pine selection programme
- Strong uptake on disease-risks related arguments for diversification
- Noteworthy diversification, at stand scale

Two different arguments about quality gain ground among a noteworthy share of foresters: the relevance of switching back to longer rotation as a way to value Pine wood as dimensional timber, diversification as a way to enhance the resilience of the forest area to pests. Diversification is here associated with a rather extensive management of oak-dominated patches, possibly with the intent to build niche markets for cork oaks - and aim for a small timber production of sessile/pedunculate oaks.

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4.4.3 Estimation of Forest Owner Types, Area Distribution and applied Forest Management Programs

The scenarios that have been developed in the second phase of INTEGRAL, namely in WP3.2 and 2.2, reflect one of the outstanding features of this project: its interdisciplinarity. While the steps described above can be considered as being part of a genuine qualitative scenario process, the next steps were made possible by the quantitative modelling that has been accomplished in WP2.2.

WP2.2 was about assessing the consequences of the driver scenarios for the provision of Ecosystem Services (ES). So, from a WP2.2 perspective the driver scenarios, that have been developed in WP3.2, can be considered as descriptions of future situations or 'settings' that would serve as the starting point for the production of ES. So, the question that WP2.2 dealt with at this moment was - amongst others - 'What combination of ES would result if the setting described in this or that driver scenario would come true?'

However, the research results achieved in the scenario process and the previous workpackages did not suffice for running the calculations. Information on the forest owner types that are present in the case study area has been gathered in WP3.1. However, a common need of all models to be applied in WP2.2 was information on the actual behaviour of these forest owner types and the share of the case study area that is managed by the individual forest owner types. For that reason WP2.2 researchers developed a procedure and template to gather this information. Both aspects: forest owner behaviour (or: applied forest management program) and the share of the case study area managed by this or that forest management regime were introduced into the calculations of WP2.2. The result of these calculation runs then was introduced into the structure of the driver scenarios again, thus producing the so-called 'raw-scenarios'. In this sense, the raw scenarios are driver scenarios enhanced by information on expected forest owner behaviour and the resulting portfolio of ES.

The following tables display the information on forest owner types, area distribution and applied forest management programs by scenario. The organisation of data according to scenarios was necessary, because it is quite possible that area distribution, and the forest management programs applied by the individual forest owner types change in 25-30 year's time. The resulting combination of ES is reported in the then following chapter 4.4.4.

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4.4.3.1 Forest owner types at T_0 in Pontenx

Authors: Baptiste Hautdidier, Philippe Deuffic, Vincent Banos, Arnaud Sergent (Irstea)

Table 10 Forest Owner Types in Pontenx and share of case study area in their ownership

Name	Description	Share of case study area
G1A: The forest entrepreneur	Owners and managers of large properties (>500 ha).	30 %
G1B: The public manager	Variant of 1a, managers of the state-owned operator ONF.	12 %
G2A: The traditionalist, full-time	250-500 ha.	16 %
G2B: The traditionalist, part-time	25-250 ha.	27 %
G3: The passive outsider	Mostly 1-25 ha.	12 %
G4: The environmentalist forester	Close-to-nature forestry.	2 %
No management	Smallest patches, below 1 ha	1 %

One can refer to the Pontenx WP3.1 case study report for an in-depth description of the forest owner types. The G1B variant is introduced in order to express the specific practices of ONF public forest managers: potentially not so far from the dominant practices when working for municipalities, they maintain standards of multifunctional management in state-owned forests, be in on the coastal dune -with its very specific stakes- or in the inland plateau - with potentially original techniques, eg. favouring longer rotations, sowing, deciduous species. The G2A/G2B distinction is introduced to enrich the large G2 class. The threshold of 250 ha is related to the ability for an owner to make a living of his/her forest property, which in turn has consequences for preferences over potential forest management programs.

The figures below allows to gain an understanding of the distribution of forest properties in the Pontenx case study area, as well as of the principle of their sampling accross the typologies. By default, the aforementioned thresholds were applied. G4 estates were then sampled on 5% of properties in classes 4-25 ha, 25-250 ha et 250-500 ha. Transitions were softened on the large G2B class by attributing 20% of properties in the 100-250 ha interval to the G2A class, 20% of properties in the 25-100 ha interval to the G3 class.

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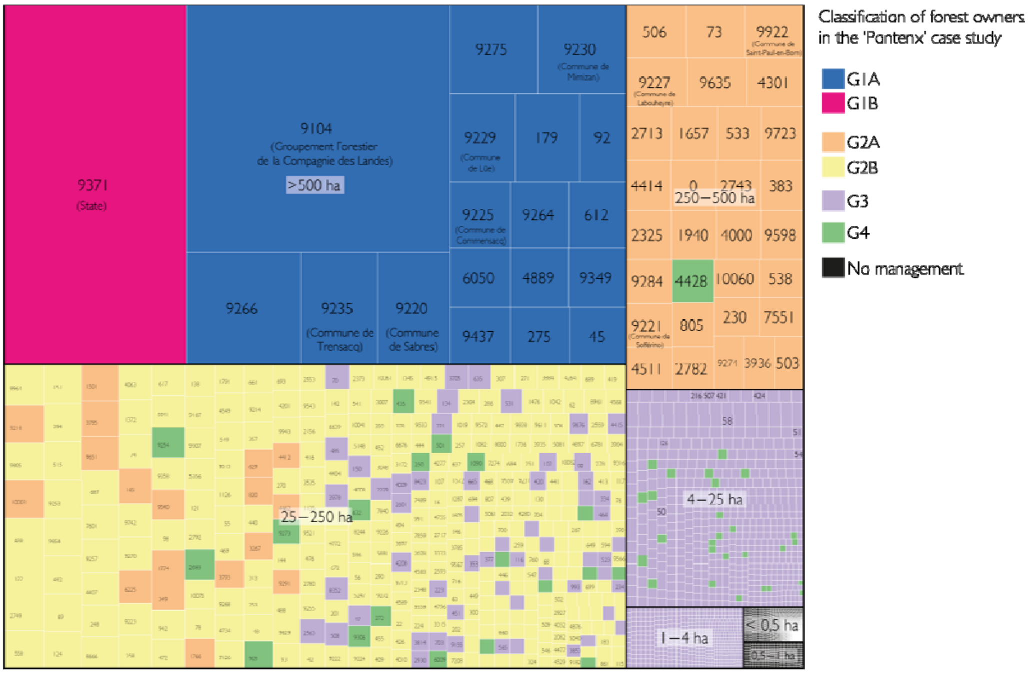

Figure 12 'Treemap' visualization of the distribution of the areas of forest properties in the Pontenx case study, with ownership typology

The largest owners are labelled with their names when owned by institutions: the *Société Forestière* holding is clearly the bigger player along with the State. But one can also note that municipalities, whether their forests are officially managed by the ONF operator or not, are amongst the largest owners, labelled as G1A or G2A.

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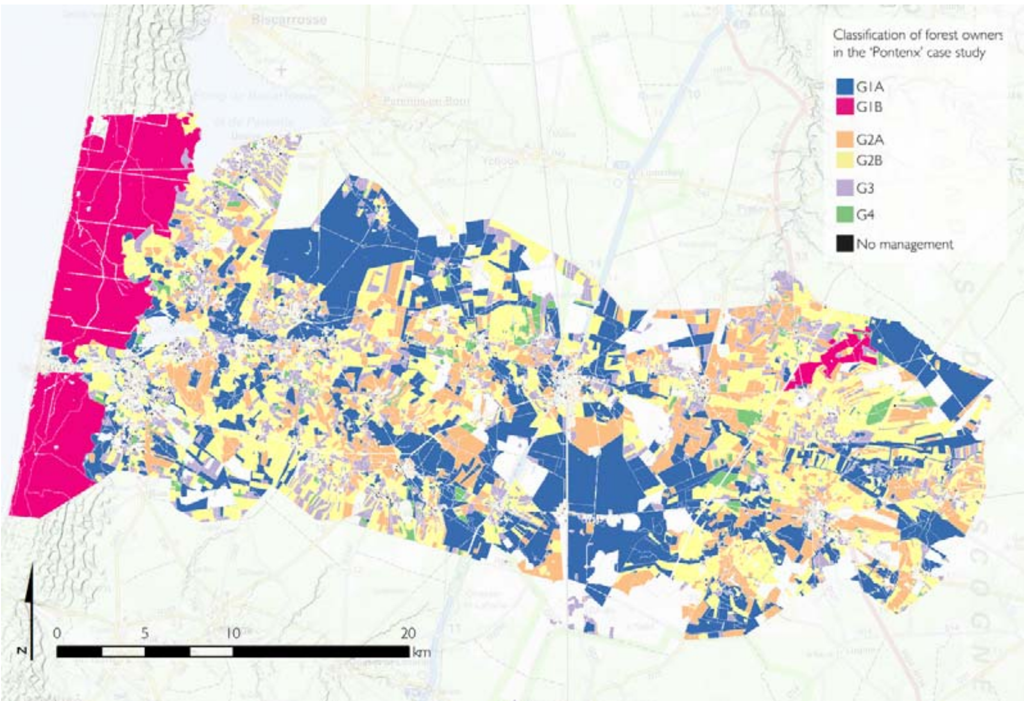

Figure 13 Mapped results of the random shuffling of the forest properties in the Pontenx case study

4.4.3.2 Current use and potential uptake of management programs in Pontenx

We describe here how the current and potential 'forest management programs' that are relevant for the Pontenx case study area relate to the behaviour of the aforementioned forest owner types. Table 10 describes the current situation, while table 11 highlight the differing appetences among forest owners for given Forest Management Programs, thus helping to define their silvicultural management practices.

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Table 11 Current use of forest management programs in Pontenx

Management programs		***Relevant for owner types...***					
Name	**Description**	G1A	G1B	G2A	G2B	G3	G4
Prog 1: Pine / high-quality	High-quality timber. 60 years. Broadleaves preservation, diversified wooded undergrowth	x	x	-	x	-	x
Prog 2: Pine / standard	'Classic' silvicultural scenarios. 45 years	x	x	-	-	-	-
Prog 3: Pine / short-term	Management dedicated to pulpwood, 25 years	-	-	-	-	-	-
Prog 4: Pine / half-dedicated to biomass	Biomass at 9 years, Timber at 35 years	-	-	-	-	-	-
Prog 5a: Pine / biomass	High-density, short term silvicultural scenario aimed at biomass production. 8-12 years	-	-	-	-	-	-
Prog 5b: Broadleaves / Eucs	Short-term coppices of *Eucalyptus gundal*(gunnii x darlympleana)	-	-	-	-	-	-
Prog 6: Pine / no management	Site preparation and regeneration, followed by a minimal involvement (no thinning, erratic harvest)	x	x	x	x	x	x
Prog 7: Broadleaves / Locust	Plantation and coppices of *Robinia Pseudoacacia*	x	-	-	-	-	-
Prog 8a: Broadleaves / riparian Oaks	Even-aged management of *Q. pedunculata* (and other oaks) in riparious areas	x	x	x	x	x	x
Prog 8b: Broadleaves / lowland Oaks	Even-aged management of *Q. pedunculata* (and other oaks) on the sandy *plateau*	-	x	-	-	-	x

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Authors: Christophe Orazio, Rebeca Cordero-Debets (EFI-Atlantic) & Irstea team

Table 12 Potential uptake on available forest management programs in Pontenx

Management programs		***Relevant for owner types...***					
Name	**Description**	G1A	G1B	G2A	G2B	G3	G4
Prog 1: Pine / high-quality	High-quality timber. 60 years. Broadleaves preservation, diversified wooded undergrowth	ε	✓	ε	✓	-	✓
Prog 2: Pine / standard	Classic silvicultural scenarios. 45 years	✓	ε	✓	✓	✓	ε
Prog 3: Pine / short-term	Management dedicated to pulpwood, 25 years	✓	-	✓	ε	ε	-
Prog 4: Pine / half-dedicated to biomass	Biomass at 9 years, Timber at 35 years	✓	-	✓	✓	ε	-
Prog 5a: Pine / biomass	High-density, short term silvicultural scenario aimed at biomass production. 8-12 years	✓	-	✓	ε	-	-
Prog 5b: Broadleaves / Eucs	Short-term coppices of *Eucalyptus gundal*(gunnii x darlympleana)	✓	-	ε	ε	ε	-
Prog 6: Pine / no management	Site preparation and regeneration, followed by a minimal involvement (no thinning, erratic harvest)	ε	ε	ε	ε	✓	-
Prog 7: Broadleaves / Locust	Plantation and coppices of *Robinia Pseudoacacia*	✓	-	ε	ε	ε	-
Prog 8a: Broadleaves / riparian Oaks	Even-aged management of *Q. pedunculata* (and other oaks) in riparious areas	ε	✓	ε	ε	ε	✓
Prog 8b: Broadleaves / lowland Oaks	Even-aged management of *Q. pedunculata* (and other oaks) on the sandy *plateau*	ε	✓	ε	ε	ε	✓

Authors: Irstea & EFI-Atlantic

Legend:

- ✓ : The owner/manager may consider switching to this forest management program on large shares of his/her forest property
- ε : The owner/manager is open to this forest management program, provided it remains marginal at the scale of his/her property
- - : No interest from the owner

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4.4.3.3 T_0 management programs in Pontenx

Table 13 Behaviour matrix in Pontenx at T_0

		% of area under management programs inside types											
Owner type	**% of total area**	P1	P2	P3	P4	P5a	P5b	P6	P7	P8a	P8b	No forest	Sum
G1A	*30*	3,5	92,5	-	-	-	-	-	0,01	3,1	0,6	0,3	*100*
G1B	*13*	88,9	5,7	-	-	-	-	1,6	-	-	3,8	0	*100*
G2A	*16*	1,7	91,3	-	-	-	-	-	-	5,6	1	0,3	*100*
G2B	*27*	15,7	74	-	-	-	-	1,6	-	7,2	1,4	0,2	*100*
G3	*12*	4,6	46,5	-	-	-	-	29,5	-	15,1	3,2	1,1	*100*
G4	*2*	77,3	-	-	-	-	-	14,1	-	7,7	0,8	0,2	*100*
Sum	*100*	*19*	*68,8*	*4,4*	*0*	*0*	*0*	*0*	*0,01*	*5,8*	*1,6*	*0,3*	*100*

Steps for the building of the T_0 matrix

- Building a GIS file of 'land units', intersecting cadastral parcels (with their forest owner types) and polygons of forest cover of the national geographical survey(IGN)
- Using this forest mask to clip the 'outside forest' areas
- Crosstabulating the areas of FMPs (with dominant species age, density) derived from aerial surveys (as part of WP2 work) with the land units
- Keeping for each land unit the dominant FMP according to this crosstabulation, provided it amounts to 50% of the area of the targeted land unit
- Attributing missing FMPs to land units, by way of a clustering of long-term satellite data (MODIS EVI), using a spatial join (Cf. below)
- Updating some land units with data from the post-Klaus afforestation scheme, to identify original recent initiatives (eg. P8b oaks and P7locust plantations)
- Injecting other potentially relevant contextual GIS data such as future development areas of the municipal urban planning documents, wetlands, Natura 2000...
- Performing, for the setup of some FMPs, an additional sampling accross the forest owner typology (eg. to define among pine-dominated FMPS, where the P2 'default' should be converted to P1 and P6)

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Methods for the analysis of satellite data

The aim was here to take advantage of the hypothesis, extensively discussed in [3], that the soil fertility of the 'Landes of Gascony' forest area, classicly defined by local managers in three classes (dry, mesic and humid), can be discriminated by the analysis of long-term series of remote sensing data. We have chosen here to rely on the freely available record of the MODIS Terra sensor, with a medium 250m resolution and a subset restricted to the Pontenx case study Area. The inputs were Enhanced Vegetation Indices (EVI), computed as 16-Days composites (MOD13Q1) [4] on a period spanning from february 2000 to january 2014. A clustering, based on the K-Means algorithm, was performed on the stack of raster images. Defined with a target of 10 classes, it led to the patterns mapped below, along with our own interpretation in the legend.

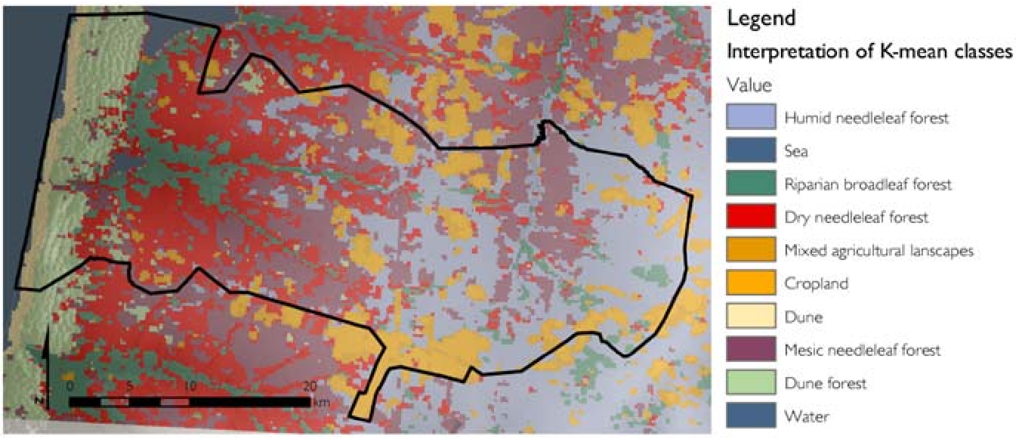

Figure 14 Map of MODIS EVI (MOD13Q1) classes over 200-2014, for the Pontenx case study

The interpretation of forest classes was made with the help of the scatterplots below, expressing the evolution of the vegetation indices over the course of the year. The fitted curves, based on average yearly values, are flattened with lower vegetation activity during the summer, partly correlated with lower fertility levels. Considering the high impacts of the Klaus storm on the vegetative covers, periods before and after the cyclone are highlighted in the plot.

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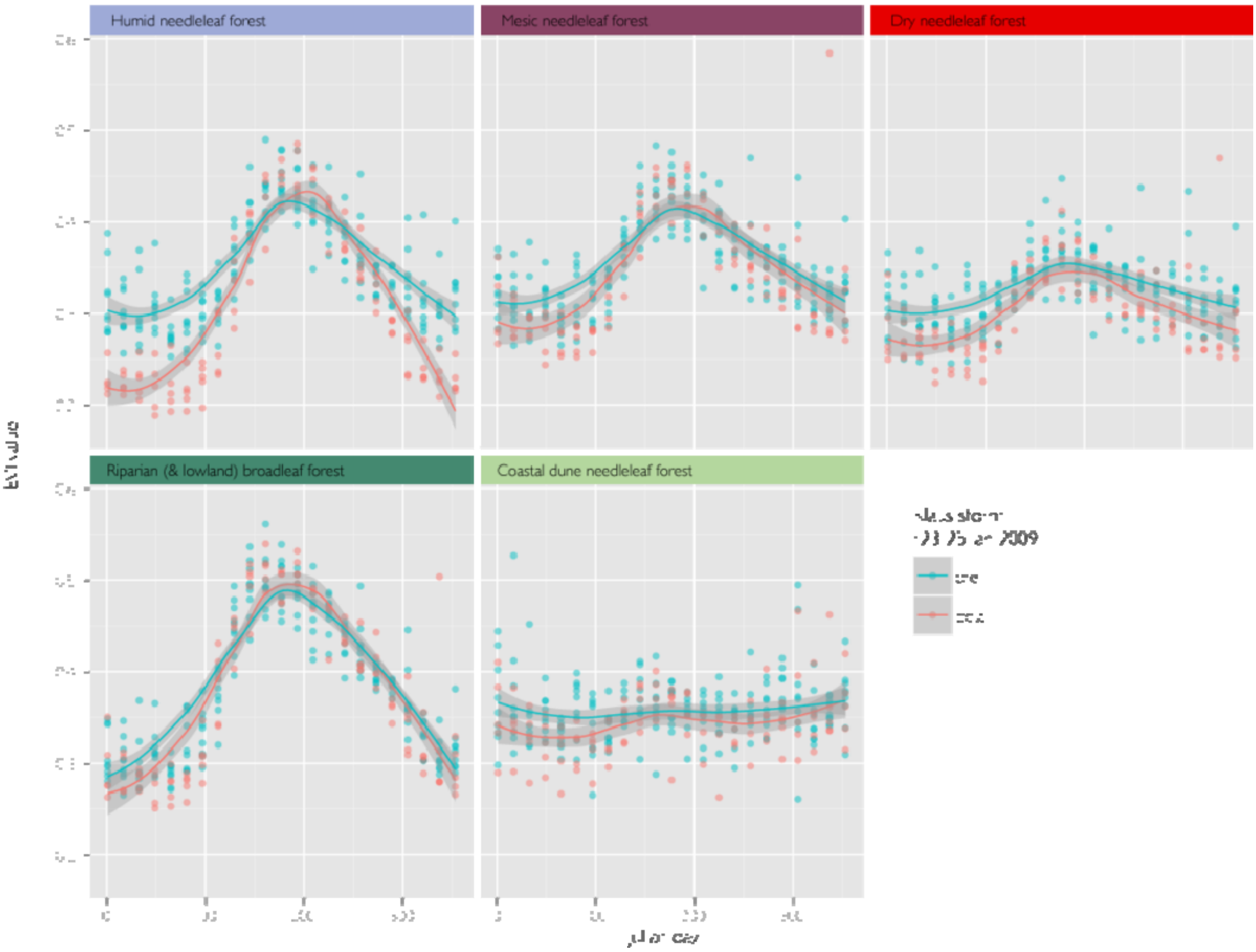

Figure 15 Intra-year trajectories of MODIS EVI values for selected classes, for the Pontenx case study

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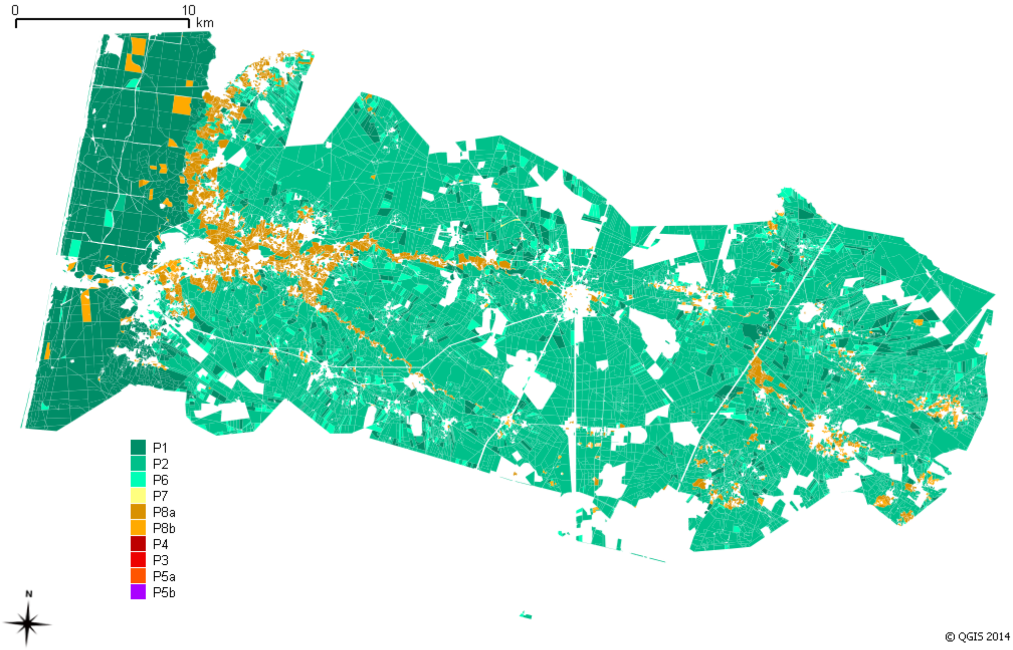

Figure 16 Map of Forest Management Programs at T0, for the Pontenx case study

Principles for the sampling of Forest Management Programs in the scenarios

The first tables in the following chapters describe the evolution of the proportions of Forest Owners Types and Forest Management Programs in the five scenarios. Two methodological points of the accompanying sampling procedure, developed as a GNU R script for this purpose on the Pontenx case study area, should be reminded here:

- As the target in the following tables are expressed in percentages of forest areas, there is a conceptual conversion to achieve within the sampling procedure, as the targeted number of sampled individuals depends on the heterogeneity of these unique land-units. The average areas of these land units differ indeed among Forest Owner Types (eg. large cadastral parcels in G1B state-owned forests VS. -rather tautologically- small areas for the G3 smallholders) AND among Forest Management Programs (typically, the P8a riparian deciduous woodlands are located in smaller parcels than in other FMPs). Weights were thus computed row- and column- wise in order to take into account these discrepancies.

- Even if the choice of Forest Management Programs remains ultimately in the hands of forest owners and managers, they do not operate in a total disconnexion with the silvicultural potentialities of the land-units in consideration. We thus considered that soil fertility was a relevant critera for the preferential location of biomass (i.e. P3, P4, P5a), Locust (P7) and Eucalypt (P5a) forest management programs. 'Suitability' maps,

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included in the three following figures, were built on the basis of the classes inferred from vegetation indices data. The sampling procedure would then take into account these maps, as probability values applied as individual filters to each land-unit potentially includable in the final sample of n land-units.

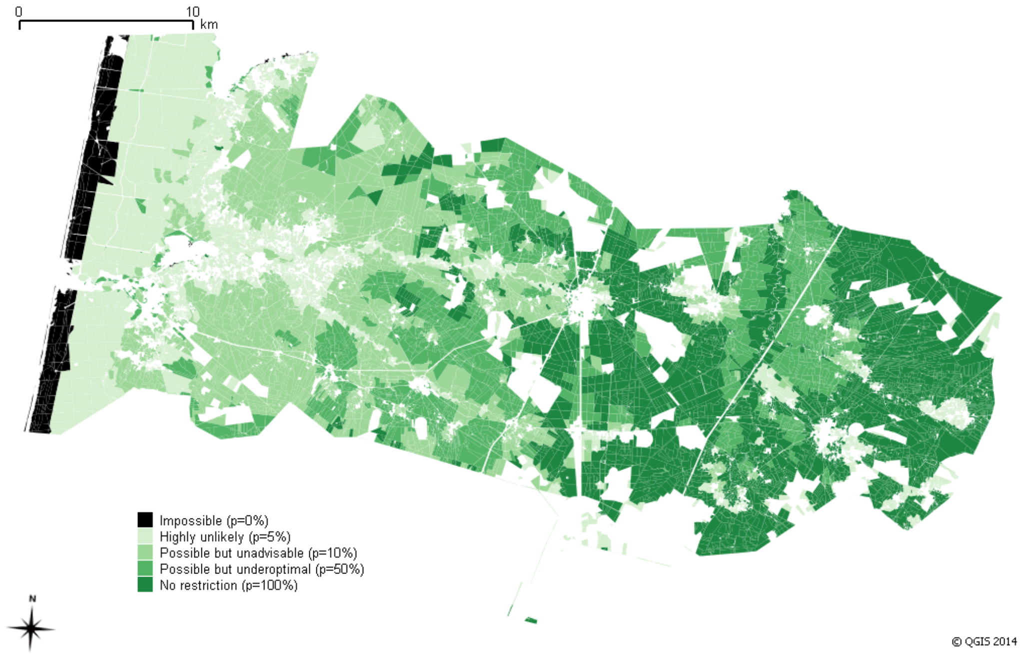

Figure 17 'Suitability' map for 'biomass' Forest Management Programs, for the Pontenx case study

The general advice from regional forest operators regarding biomass silvicultural scenarios is to implement them in the most fertile plots. The image is thus of a East-West gradient aligned with fertility.

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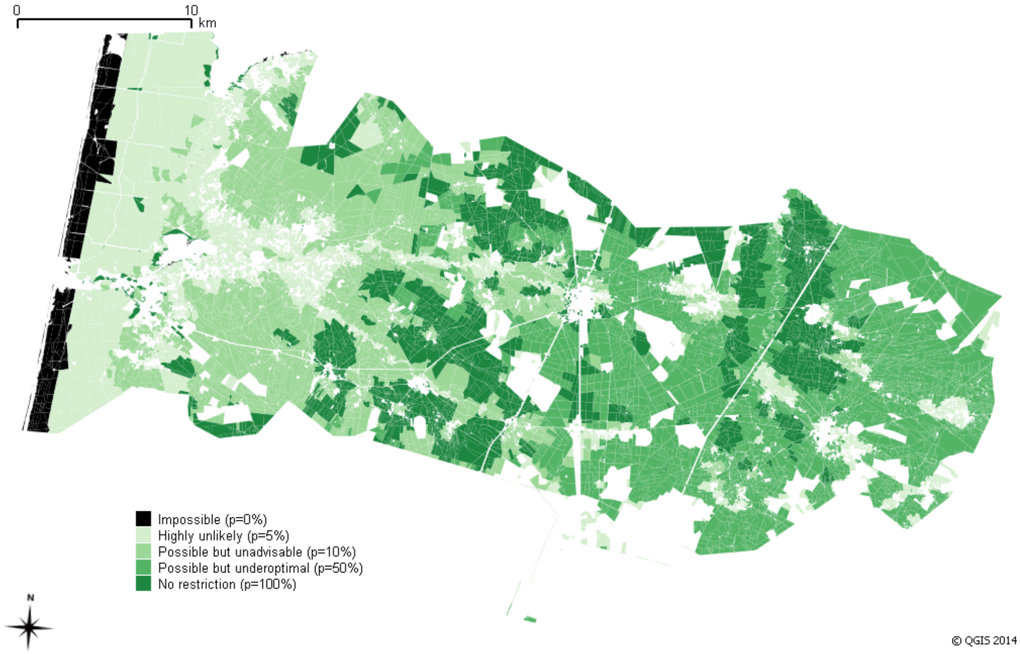

Figure 18 'Suitability' map for 'Locust' Forest Management Programs, for the Pontenx case study

Robinia Pseudacacia plantations have clearly become disregarded in the low fertility areas of the region. Watertable levels are also a concern, thus labelling the 'Humid needleleaf forest' as an underoptimal location.

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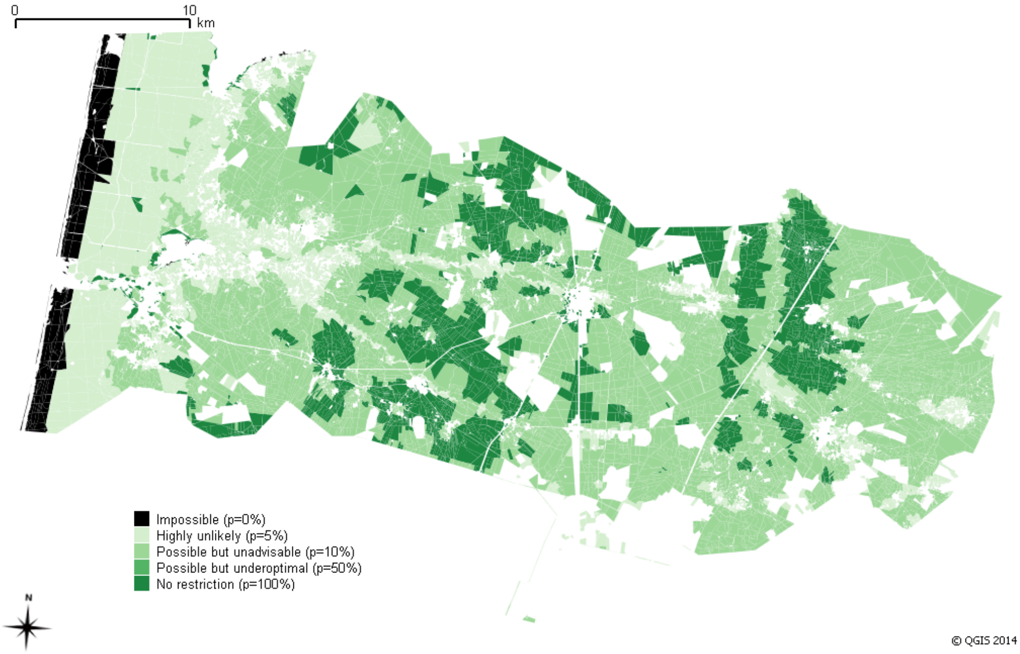

Figure 19 Figure 19: 'Suitability' map for 'Eucalypts' Forest Management Programs, for the Pontenx case study

For *Eucalyptus* plantations, the most stringent constraint in the regional context remains the frost. As a result, the eastern part of the forest area, with richer soils but also colder climates, becomes an unfavourable location for suchs FMPs.

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4.4.3.4 Scenario 1: Unfinished bioenergy

Table 14 Behaviour matrix in Pontenx for driver scenario 1

		% of area under management programs inside types											
Owner type	**% of total area**	P1	P2	P3	P4	P5a	P5b	P6	P7	P8a	P8b	No forest	Sum
G1A	*30*	3,1	53,1	-	39,7	-	-	-	0,01	3,1	0,6	0,3	*100*
G1B	*13*	88,9	5,7	-	-	-	-	1,6	-	-	3,8	-	*100*
G2A	**21**	3,7	47,8	-	41	-	-	0,5	-	5,7	1	0,3	*100*
G2B	**17**	15,7	48,6	-	25,5	-	-	1,6	-	7,2	1,3	0,2	*100*
G3	**17**	7,8	40,7	-	-	-	-	34,9	-	13	2,8	0,8	*100*
G4	*2*	77,3	-	-	-	-	-	14,1	-	7,7	0,8	0,2	*100*
Sum	*100*	*18,6*	*42*	*0*	*24,9*	*0*	*0*	*6,9*	*0,01*	*5,8*	*1,6*	*0,3*	

Rationale for the building of the behaviour matrix

- A marked decline of the share of traditionalist, part-time owners (G2B), whose land parcels are equally dispatched between more (G2B) and less active managers (G3).
- Few evolutions of the forest management programs, dominated by Pine: the only change is a noticeable uptake on a half-dedicated program, at the expense of the current standard.

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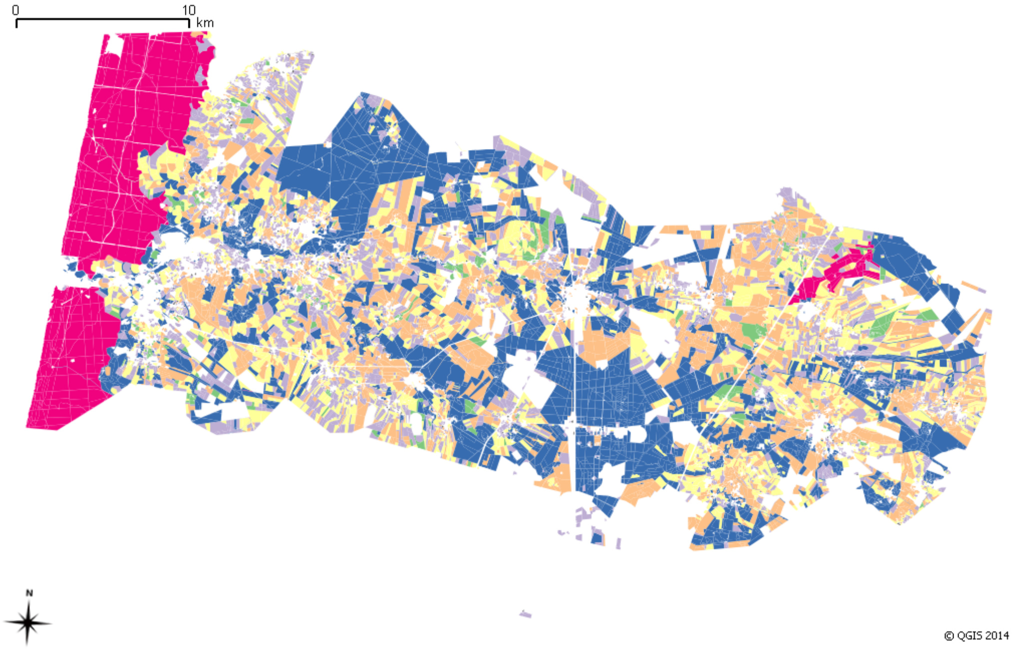

Figure 20 Map of the reshuffling of the forest owner types in scenario 1

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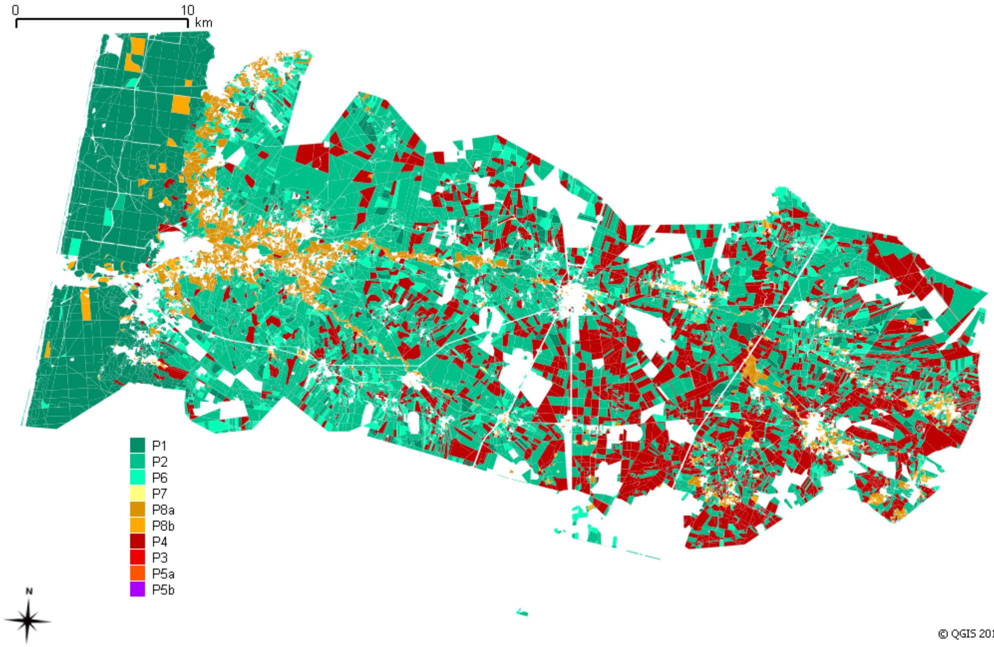

Figure 21 Map of the reshuffling of the Forest Management Programs in scenario 1, for the Pontenx case study

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4.4.3.5 Scenario 2: Biorefinery innovation & land-use tensions

Table 15 Behaviour matrix in Pontenx for driver scenario 2

		% of area under management programs inside types											
Owner type	**% of total area**	P1	P2	P3	P4	P5a	P5b	P6	P7	P8a	P8b	No forest	Sum
G1A	**36**	-	-	34,4	38,5	16,3	6,7	-	0,01	3,1	0,6	0,3	*100*
G1B	**11**	86,1	-	2,8	1,5	0,6	0,4	1,5	-	-	3,8	-	*100*
G2A	*16*	0,3	3,4	21,9	48,4	11,1	7,9	-	-	5,6	1	0,3	*100*
G2B	*27*	14,8	-	21,4	35,4	10,3	7,9	1,4	-	7,2	1,4	0,2	*100*
G3	**6**	-	-	12,1	33	3,1	2,5	29,9	-	15,1	3,2	1,1	*100*
G4	*2*	45,2	-	-	24,9	-	-	21,2	-	7,7	0,8	0,2	*100*
Sum	*100*	*16,2*	*0,6*	*23,3*	*33,5*	*10,1*	*6,7*	*2,7*	*0,01*	*5*	*1,4*	*0,3*	*100*

Rationale for the building of the behaviour matrix

- A strong increase of the industrialist owners (G1A), at the expense of G1B (the management of state-owned forests in the plateau become de facto fully identical with their large private neighbours) and G3 (small properties are preferentially bought by the largest landowners).

- The current standard is exploded into four biomass-inclined programs: with a dominance of the socalled half-dedicated program, followed by short-term and full biomass for Pine, with a share of Eucalypt plantations.

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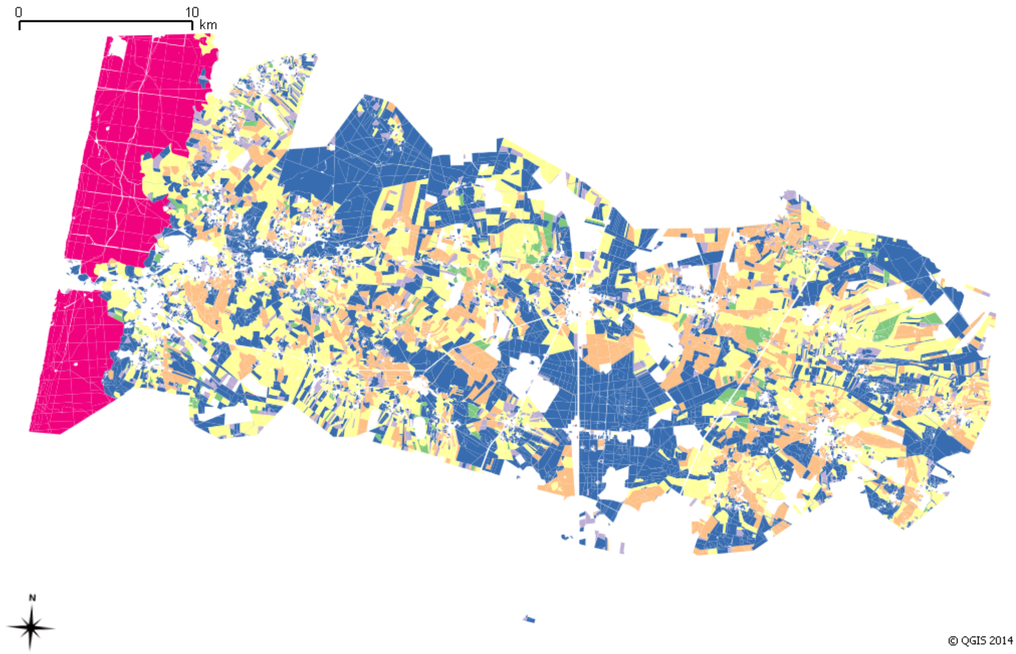

Figure 22 Map of the reshuffling of the forest owner types in scenario 2

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 282887.

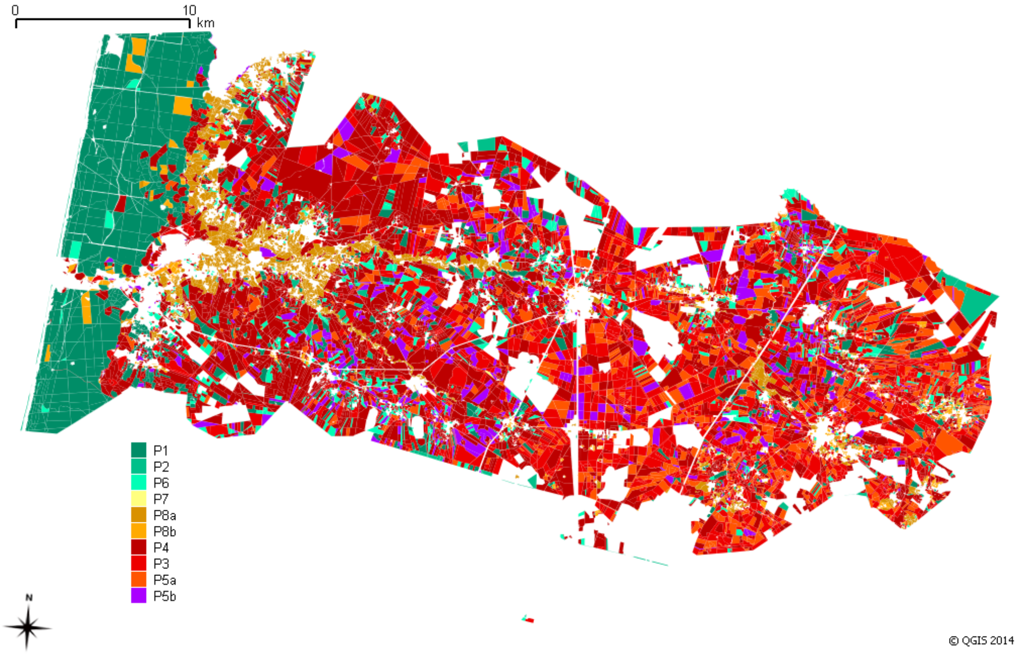

Figure 23 Map of the reshuffling of the Forest Management Programs in scenario 2, for the Pontenx case study

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4.4.3.6 Scenario 3: The European biomass sink

Table 16 Behaviour matrix in Pontenx for driver scenario 3

		% of area under management programs inside types											
Owner type	**% of total area**	P1	P2	P3	P4	P5a	P5b	P6	P7	P8a	P8b	No forest	Sum
G1A	*30*	2,1	36,1	25,4	-	15,1	7	10.3	0,01	3,1	0,6	0,3	*100*
G1B	*13*	88,9	5,7	-	-	-	-	1,6	-	-	3,8	-	*100*
G2A	**14**	-	41	24,9	-	9,1	7,7	9,5	0,1	5,5	1	0,2	*100*
G2B	**21**	6,3	29,5	26,9	-	11,9	6,7	10	-	7,1	1,4	0,2	*100*
G3	**20**	4,5	14,5	12,7	-	-	-	53,3	-	11,8	2,4	0,8	*100*
G4	*2*	70,7	-	-	-	-	-	7,9	-	7,7	13,5	0,2	*100*
Sum	*100*	*15,8*	*26,3*	*19,4*	*0*	*8,3*	*4,6*	*17,6*	*0*	*5,8*	*1,9*	*0,3*	*100*

Rationale for the building of the behaviour matrix

- Relative disinvolvement from forest owners, partly sliding from G2A to G2B and G2B to G3.
- The rotations are generally shortened, with a strong presence of 'opportunistic' programs (short-term, biomass and eucalypts)

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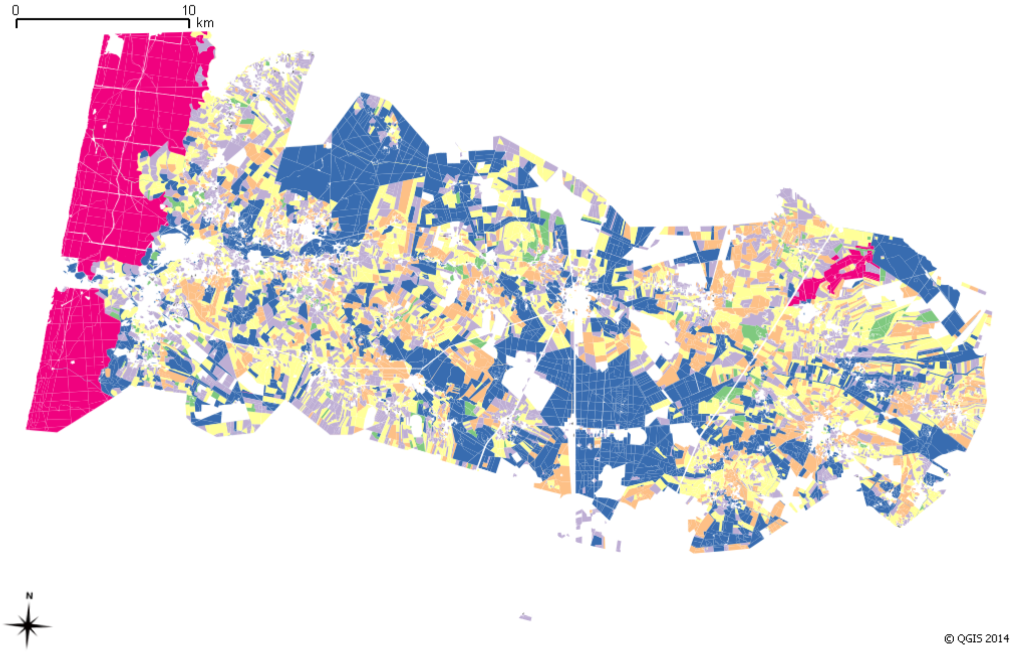

Figure 24 Map of the reshuffling of the forest owner types in scenario 3

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 282887.

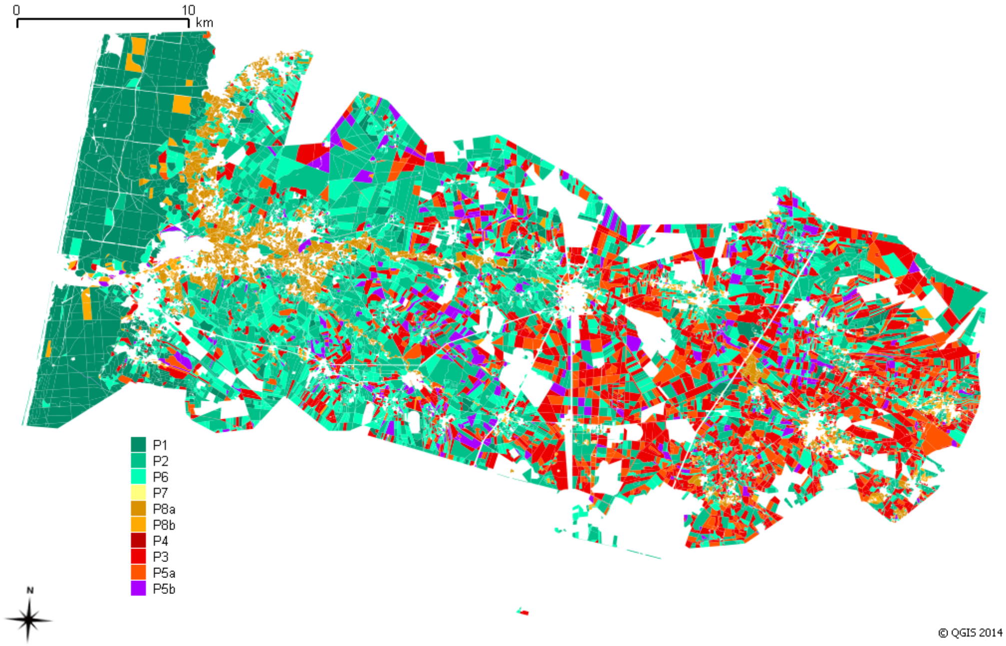

Figure 25 Map of the reshuffling of the Forest Management Programs in scenario 3, for the Pontenx case study

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4.4.3.7 Scenario 4: The 'Green' innovative cluster

Table 17 Behaviour matrix in Pontenx for driver scenario 4

		% of area under management programs inside types											
Owner type	**% of total area**	P1	P2	P3	P4	P5a	P5b	P6	P7	P8a	P8b	No forest	Sum
G1A	33	7,4	34,8	-	48,2	-	-	-	5,4	3,2	0,6	0,3	*100*
G1B	*12*	88,9	2,9	-	2,8	-	-	1,6	-	-	3,8	-	*100*
G2A	13	1,1	29,2	-	50,5	-	-	-	12	5,7	1,1	0,4	*100*
G2B	29	14,8	15	-	50,1	-	-	4,6	5,7	8	1,7	0,2	*100*
G3	8	4,6	47,2	-	-	-	-	18,1	10,7	15	3,1	1,3	*100*
G4	6	65,8	-	-	7,3	-	-	2,7	-	8,7	15,2	0,3	*100*
Sum	*100*	*22,2*	*23,4*	*0*	*37*	*0*	*0*	*3,1*	*5,7*	*5,8*	*2,4*	*0,3*	*100*

Rationale for the building of the behaviour matrix

- Increase of G1A, at the expense of G2A
- Mild increase of G4 owners, 'convinced' among G2 and G3 owners
- A greater involvement of the most passive owners leads to a rise of G2B at the expense of G3
- For Pines, the half-dedicated program gains momentum over the standard. Noticeable introductions of locust plantations.

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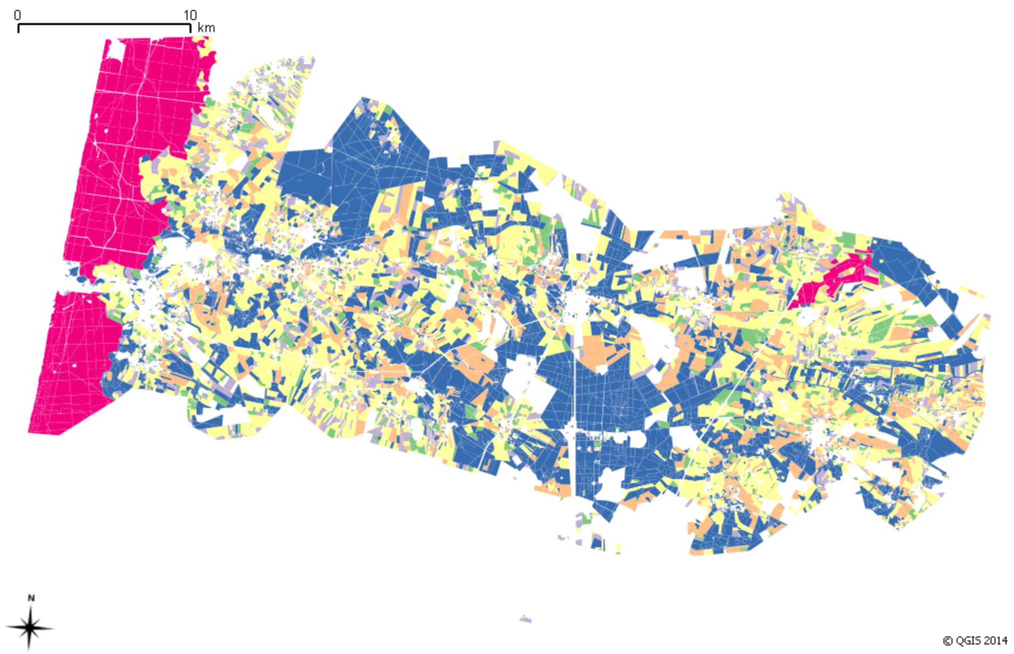

Figure 26 Map of the reshuffling of the forest owner types in scenario 4

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 282887.

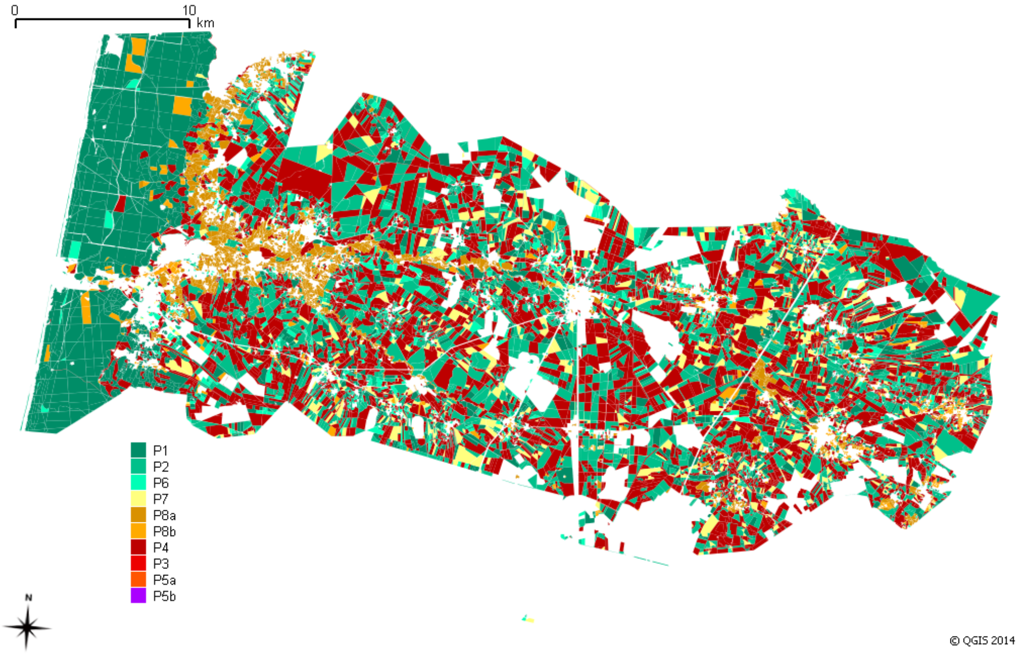

Figure 27 Map of the reshuffling of the Forest Management Programs in scenario 4, for the Pontenx case study

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4.4.3.8 Scenario 5: The territorial partnership

Table 18 Behaviour matrix in Pontenx for driver scenario 5

		% of area under management programs inside types											
Owner type	**% of total area**	P1	P2	P3	P4	P5a	P5b	P6	P7	P8a	P8b	No forest	Sum
G1A	**25**	21,2	64,9	-	-	-	-	-	-	3,5	10,1	0,3	*100*
G1B	**15**	70,5	18,9	-	-	-	-	1	0,1	1,3	8,1	0,1	*100*
G2A	**20**	24,1	54	-	-	-	-	3,1	-	7	11,5	0,4	*100*
G2B	**20**	25,6	53,3	-	-	-	-	1,8	-	7,2	11,9	0,2	*100*
G3	*12*	14,6	27,3	-	-	-	-	30,1	-	14,4	12,6	1,1	*100*
G4	**8**	9,2	55,8	-	-	-	-	5,4	-	7,1	22,3	*100*	
Sum	*100*	*31,4*	*46,7*	*0*	*0*	*0*	*0*	*4,3*	*0*	*5,8*	*11,5*	*0,3*	*100*

Rationale for the building of the behaviour matrix

- Mild decrease of G1A, as the management of the forests of municipalities is aligned with the state-owned properties (G1B), with a few sales to smaller owners
- G4 owners are on the rise, 'convinced' among G2 and G3 owners
- A voluntary policy favouring the grouping of owners leads de facto to a rise of G2A owners at the expense of G2B and G3
- The standard program remains dominant, with noticeable introductions for most owner types of oaks (P8b) and 'traditional' longer rotations for Pines (P1)

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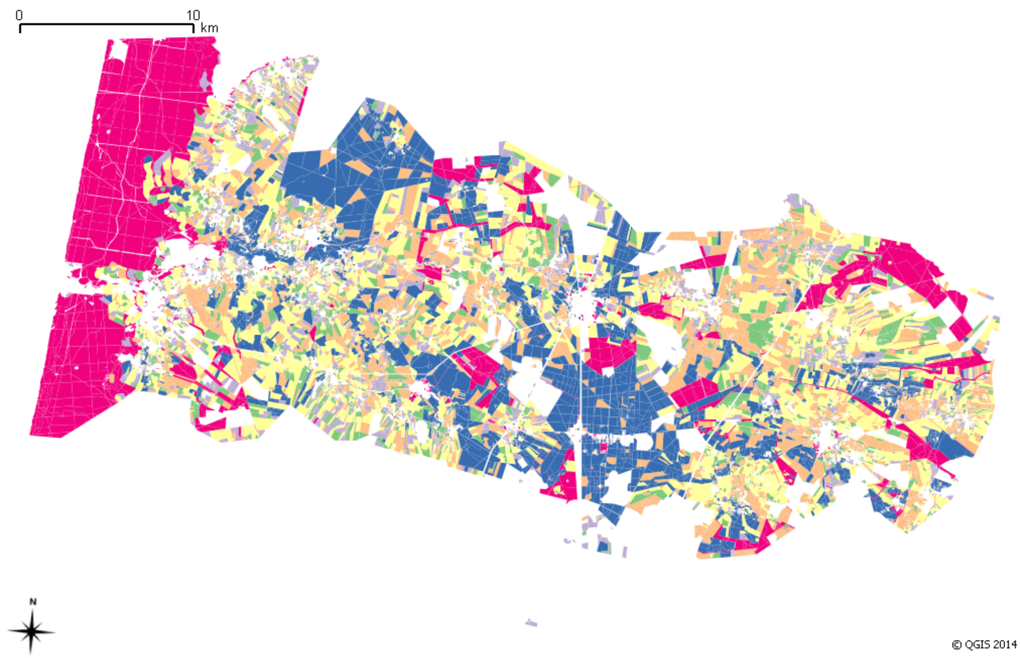

Figure 28 Map of the reshuffling of the forest owner types in scenario 5

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 282887.

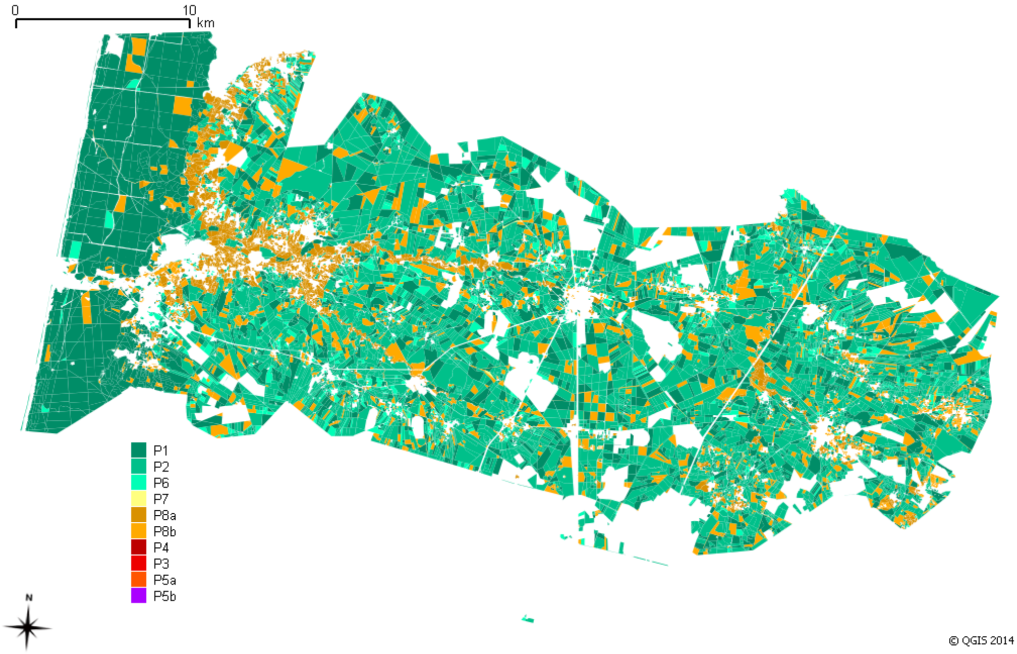

Figure 29 Map of the reshuffling of the Forest Management Programs in scenario 5, for the Pontenx case study

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4.4.4 Results of WP2.2 Calculation (ES Assessment)

A very central parameter of WP2.2 is the average age of the modelled stands. Not included here, it is closely related to other indicators, that we interpret here in terms of ecosystem services:

ES1	Standing timber volume
TEEB potential interpretation ▪ **Provisioning**, as (potential) source of timber (raw materials) ▪ **Supporting**, as related to primary production	
Description Total volume, in m^3. See WP2.2 results for more details. Based on Lemoine & Fagacées models for pines and oaks. For oaks, the volume of branches can also be computed.	
Different manifestations due to ... ▪ Age of the stand ▪ Vg at tree, stand levels ▪ ...	

ES2	Standing carbon
TEEB potential interpretation ▪ **Regulating**, as carbon sequestration and storage ▪ **Provisioning**, as closely correlated to timber volume	
Description Total carbon content in above ground biomass, in T. See WP2.2 resultsfor more details.	
Different manifestations due to ... ▪ Age of the stand ▪ Vg at tree, stand levels ▪ ...	

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ES3	Standing timber values
TEEB potential interpretation ▪ **Provisioning**, as derived from the (potential) source of timber	
Description Total timber value, in current €. See WP2.2 results for more details.	
Different manifestations due to ... ▪ Age of the stand ▪ Vg at tree, stand levels ▪ ...	

ES4	Harvest
TEEB potential interpretation ▪ **Provisioning**, as derived from the (realized) source of timber	
Description Total yearly harvest, in m^3/yr. See WP2.2 results for more details.	
Different manifestations due to ... ▪ Age of the stand ▪ RDI ▪ ...	

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ES5	Wind vulnerability

TEEB potential interpretation

- **Regulating**, as moderation of extreme events, with different ecological reactions to possible storm damage

Description

Dedicated index describing an average susceptibility to wind damage (without dimension). See WP2.2 results for more details.

Different manifestations due to ...

- Dominant height
- Years after latest thinning (with a peak at 2-3 yrs)

ES6	Fire vulnerability

TEEB potential interpretation

- **Regulating**, as moderation of extreme events, with different ecological reactions to possible fire damage and human safety implications

Description

Dedicated index describing an average susceptibility to fire damage (without dimension). See WP2.2 results for more details. The understorey is NOT modelled yet in the CAPSIS/SIMMEM framework implemented for Pontenx.

Different manifestations due to ...

- Density
- Age (with a peak at 6-7 yrs)

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ES6	Biodiversity

TEEB potential interpretation

- **Habitat & supporting**, as habitats for species & maintenance of genetic diversity
- **Cultural**, as eg. source for aesthetic appreciation and inspiration
- **Regulation**, as helps for biological control

Description

Dedicated index describing the average biodiversity associated with forest stands (without dimension). See WP2.2 results for more details.

Different manifestations due to ...

- Age
- Amount of deadwood (linked to thinnings)

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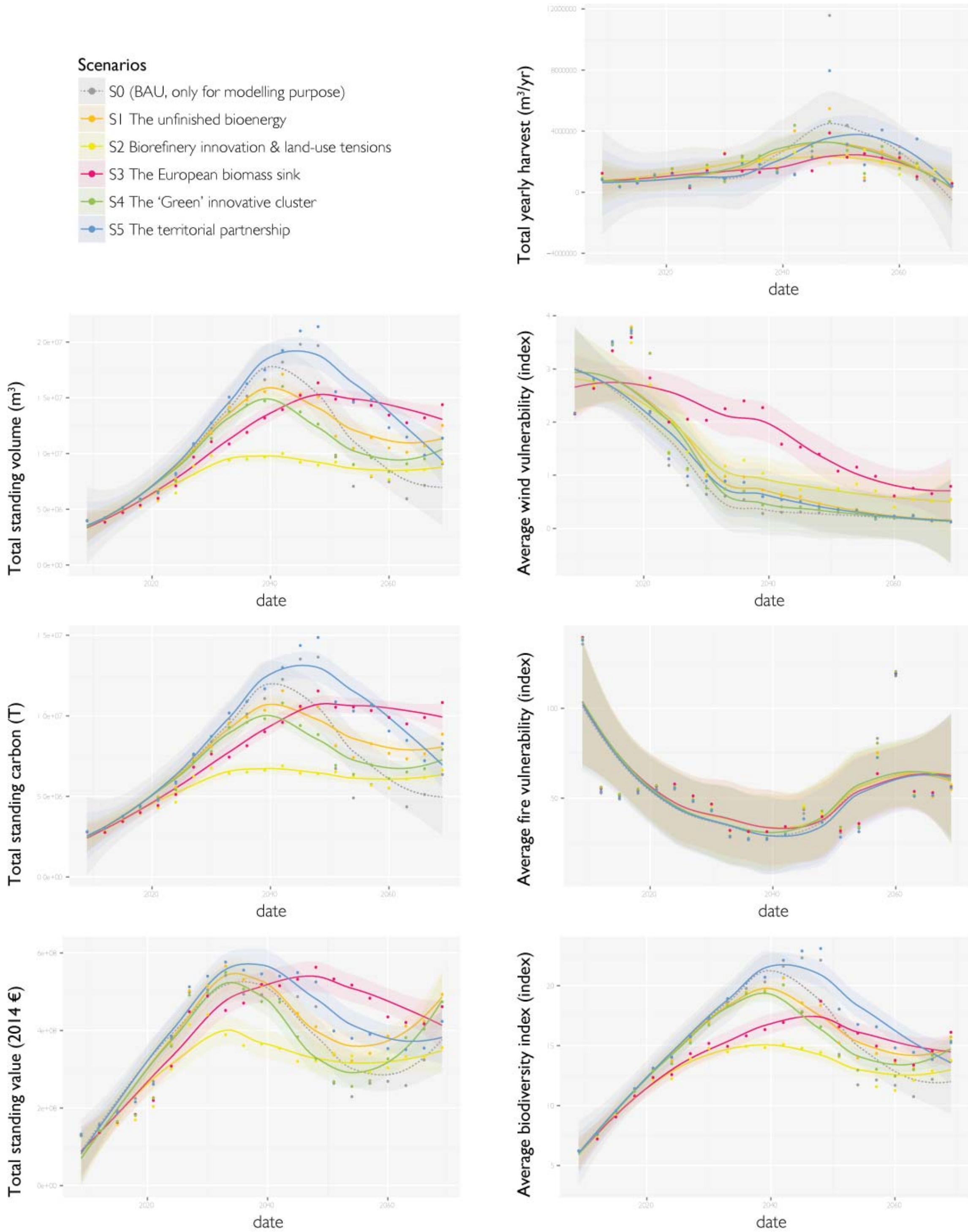

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Figure 30 Scatterplots of the evolution of seven indicators for the Pontenx case on a 2009-2069 timespan, compared between the five scenarios and an hypothetical silvicultural BAU.

While not a scenario in itself, we include a S0 which can be considered as the silvicultural BAU.

To be implemented for the last round of workshops: a recreational index based on public preferences, inferred in Cross-European Delphi workshops [5] (adapted from Iberic values).

4.4.5 Raw Scenarios (Including ES Assessment for each Scenario)

Rather than presenting updated (but autoreferential) screenshots from the EIDOS software (with FMPs & ES combination columns), we restrict here ourselves to a short discussion of the results presented in the last figure. The focus is on the consistency of the indicator values, as well as on the relevance of the contrasts between the scenarios.

Table 19 Commentary of ES attributes in scenarios

Scenario name	Comment
S0	Based on the unrealistic assumption of totally unchanged management practices, this silvicutural 'BAU' is characterized by a small set of FMPS. This results in a strong peak in timber volume and carbon sequestration in 2040, followed by a strong decline.
S1	The closest to the BAU, this scenario yields lower diversity levels at 2040, but with more buffered harvest levels and standing volumes over the timespan.
S2	The most intensive scenario, S2 is characterized by very low standing volumes and the lowest biodiversity levels
S3	The differentiated silvicultural practices described in this scenario (i.e. pressure for short rotations AND a rising share of disinvolved owners) lead to a slower recovery of standing timber volumes than in the other scenarios. After 2045 though, volume, carbon, value, and biodiversity are steady and high. Vulnerability to wind damage is a concern in this scenario.
S4	The ES values of this scenario remain close to those of S1, even if the computation at the scale of the CSA tends to mask relevant landscape level dynamics. Defined by a more dynamic (yet timber-oriented) management, S4 has lower standing volumes
S5	The longer rotations of this scenario lead to a stark increase in volume and biodiversity. The harvest levels are the lowest until 2035, then rise above the other scenarios

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A few remarks could be made with regards to the contrast of ES scores in scenarios:

- Some ES indices -such as ES1, ES2 & ES3- are very correlated, but most remain responsive to the differing scenarios
- This is not the case for the fire vulnerability index, with few differences between scenarios
- S1 & S4 remain close in terms of ES assessment. Considering that the rationale of the S1 full scenario is somehow a non-overtly optimistic middleground, this has consequences for the backcasting: S1 could be dropped out in this step without compromising the range of ES values assessed in WP2.2.

4.4.6 Analysis of Coherence

We provide here some information on the assessment of the coherence between manifestations, consisting of a matrix ranking the individual intersections This step was performed as a desk research by the scientists of the Irstea team (i.e. Banos, Deuffic, Hautdidier & Sergent). The matrixes were filled individually in parallel, followed by a small collective workshop, where the discrepancies between individual matrixes were discussed, leading to the building of a unique consensus table filled in the dedicated 'Option Development tool' of the Parmenides Eidos Software Package, displayed in the figure below.

Figure 31 Screenshot of the Option Development tool of the Parmenides Eidos Software Package used for the consistency analysis.

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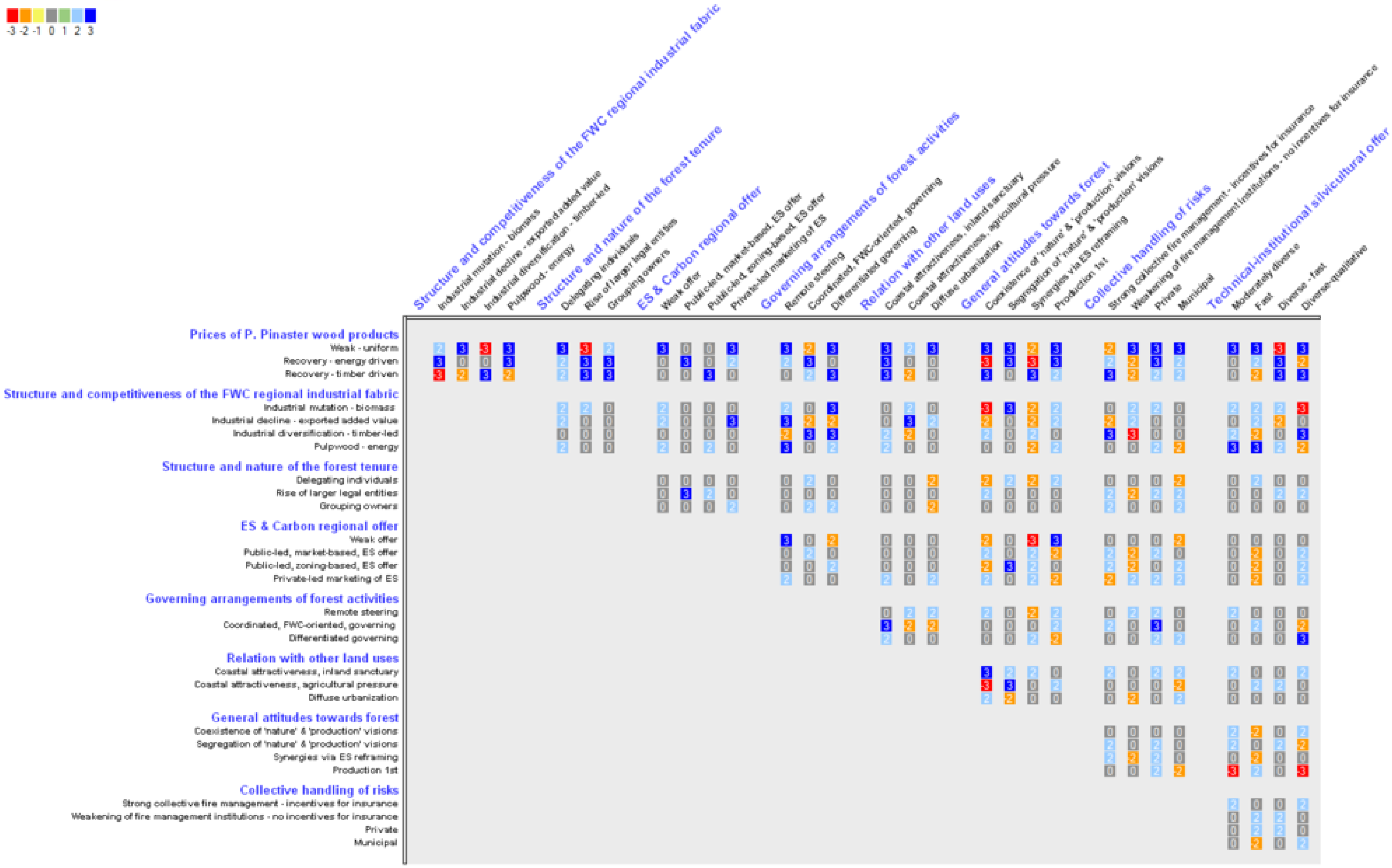

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The figure below gives an overview of a visualization on a 2D plane of the selected scenarios in the Parmenides EIDOS software.

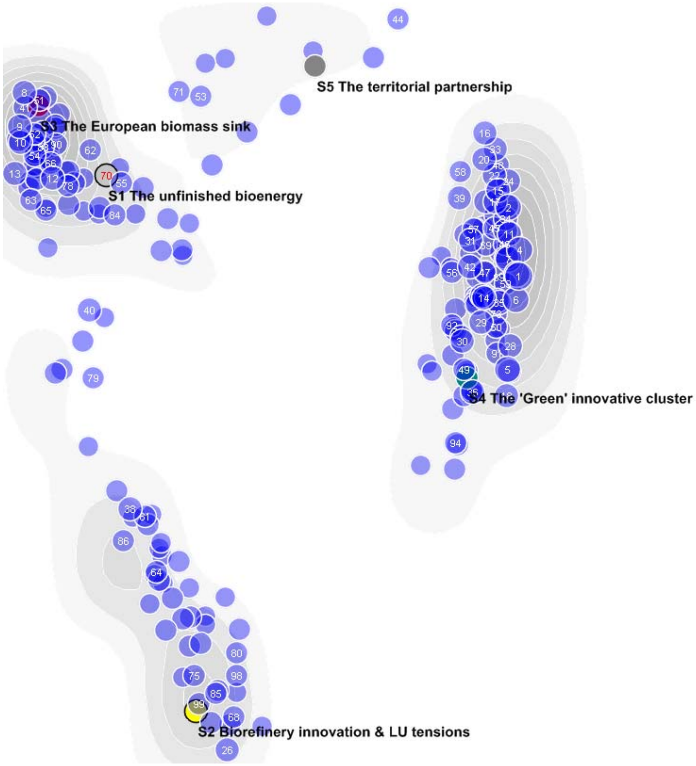

Figure 32 Cluster Map of the scenario space, including the selected scenarios for consistency analysis.

The scenarios were selected among the 82000+ computed combinations with the following criteria:

- High consistency
- Contrast and relevance

The range of the rankings described in the table below show that we chose scenarios in the top percentile, but not necessarily with an absolute naive confidence on the consistency score.

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Table 20 Attributes of scenarios in the EIDOS 'option development' tool

Scenario name	Ranking	Consistency score
S1	70	1,58
S2	144	1,53
S3	131	1,53
S4	74	1,57
S5	138	1,53

4.4.7 Full Scenarios

From a scientific point of view the raw scenarios and the underlying documents already encompass all research results that have been gathered throughout the scenario process of WP3.2, e.g. the description of elements and their manifestations, the glossary of factors, the combination of ES that was calculated for each driver scenario and the information on the assumptions on forest owners' behaviour. In this sense the individual scientific pieces the scenarios are made of have been reported in the previous chapters. However, scenarios are about integrating individual pieces of information into a comprehensive and coherent picture. The following chapters show the final scenarios that - in their synopsis - emphasize how open the future of The Pontenx case study area really is. Each of them illustrates the relevancy of the previously gained research results by making them part of a true-to-life narration.

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Scenarios	1 The unfinished bioenergy	2 Biorefinery innovation and land use tensions	3 The European Biomass sink	4 The Green innovative cluster	5 The territorial partnership
Prices of P. Pinaster wood products	Weak uniform	Recovery energy driven	Weak uniform	Recovery - timber driven	Weak uniform
The FWC regional industrial fabric	Pulpwood-energy	Industrial mutation biomass	Industrial decline - exported added value	Industrial diversification - timber-led	Pulpwood-energy
Technical - institutional silvicultural offer	Moderately diverse	Diverse-Fast	Fast	Diverse Fast	Diverse qualitative
Structure and nature of the forest tenure	Delegating individuals	Rise of larger legal entities	Delegating individuals	Rise of larger legal entities	Grouping owners
Ecosystem services regional offer	Weak offer	Public-led, market-based, ES offer	Weak offer	Public-led, zoning-based, ES offe	Private-led marketing of ES
Governing arrangements of forest activities	Remote governing	Coordinated, FWC-oriented, governing	Remote steering	Differentiated governing	Differentiated governing
Relation with other land uses	Coastal attractiveness, inland sanctuary	Coastal attractiveness, agricultural pressure	Diffuse Urbanisation	Coastal attractiveness, inland sanctuary	Coastal attractiveness, inland sanctuary
General attitudes towards forest	Segregation of 'nature' & 'production' visions	Segregation of 'nature' & 'production' visions	Production Ist	Synergies via ES reframing	Coexistence of 'nature' & 'production' visions
Collective handling of risks	Private	Private	Weakening of fire management institutions	Strong collective fire management institutions	Municipal

Figure 33 Summary table of the 5 scenarios for the Pontenx case study area.

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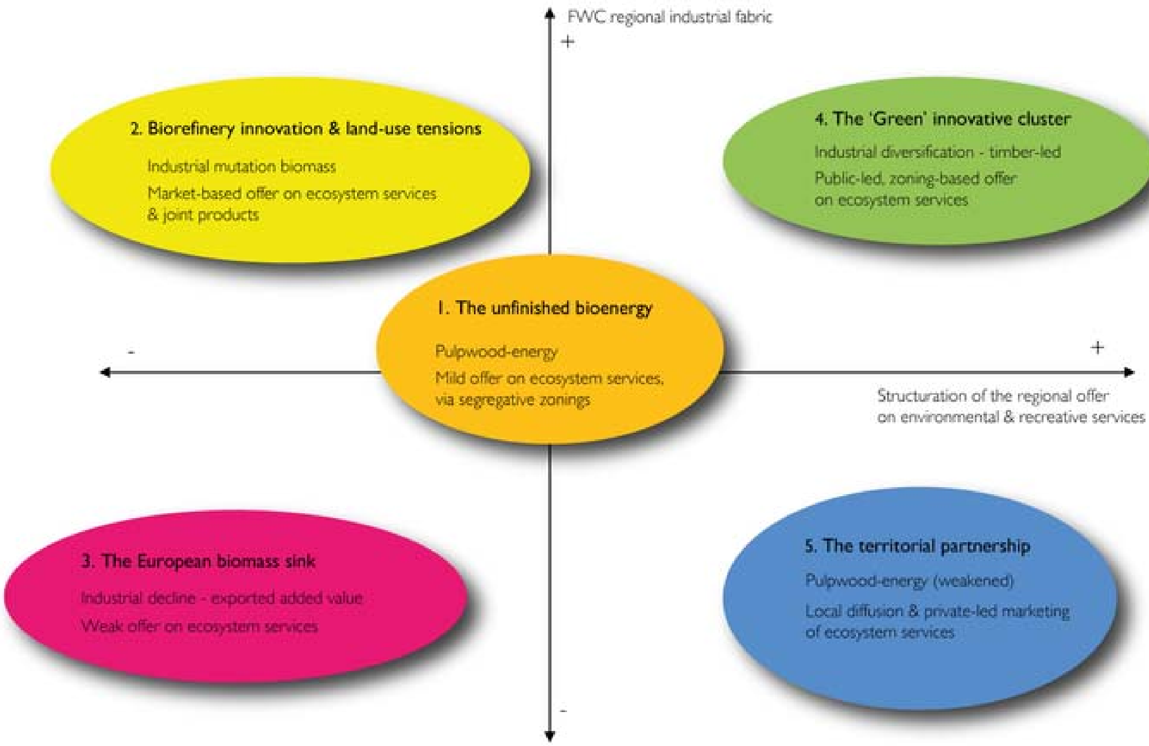

Figure 34 Dominant logics for the 5 scenarios for the Pontenx case study area.

4.4.7.1 Scenario 1: Unfinished bioenergy

Overview

The pulpwood industry has also become involved in generating energy, taking advantage of a variety of demand-side measures (energy and climate). There is also greater cooperation with large forest operators. This is accompanied by a more innovative approach to silviculture, using genetic selection and shorter rotation times for maritime pine trees. However, these changes are not entirely complete. Friction surrounding the question of wood resources has adversely affected the industry's competitiveness and reduced its investment capacity. Many forest owners have been reluctant to sign up to this new intensive production strategy, which is driven by a growing need for fuel wood.

In effect, there has been a two-tier development in silviculture. On one side, there is the growing need for biomass, while on the other; more traditional styles of forest management remain in place. Ecosystem services have not been extensively developed, except in coastal and suburban areas.

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Explanation

By 2045, the pulpwood industry has maintained its influence at regional level, but competitiveness and investment capacity have decreased. This paradox comes from the fact that the energy turnaround first instigated 40 years ago (in the wake of new energy and climate policy) is incomplete. At that time, the pulpwood industry invested heavily in energy recovery strategies for forest biomass. This action was supported by regional stakeholders and large forest operators, who favoured the adoption of a more dynamic approach to silviculture. Some notable consequences of this were management delegation, an increased reliance on the maritime pine breeding program, and the implementation of short-term silvicultural scenarios.

However, in the decades following these events, a number of tough obstacles began to appear. The “back seat” style of governance adopted by the State, through demand support and new innovations, turned out to have few advantages for the forest sector. If anything, it proved detrimental. In the midst of wood shortages following the Klaus Storm, an increase in demand for energy in the 2020s pushed up industrial and energy wood prices. These changes had an adverse impact on the competitiveness of the regional wood and paper industries. This did little to benefit forest owners, because timber prices continued to drop at the same time, reaching the same level as pulpwood.

As a result of this reduced cost-effectivenes and increased influence exerted by forest operators, there was ultimately very little take-up of proposed new approaches to silviculture. Many forest owners were simply reluctant to become involved. There has essentially been a two-tier development of silviculture, combining biomass-oriented strategies with more traditional asset management approaches.

Despite occasional, limited attempts to formalise the provision of ecosystem services, such initiatives are still not recognised as a major issue. Other authorities are unwilling to become involved in forest issues, and are reluctant to fill the gap left by the withdrawal of the State. Ecosystem services have not been developed to any great extent, except in the case of larger towns and coastal zones, which lobby the authorities to ensure that forests in their vicinity are classed as green belt areas. As a result of the development of the residential economy, some forest owners have developed other ways of generating revenue, such as selling land, creating private hunting estates, selling firewood, etc.

This diversification is reflected in regional land-use patterns, where there is stark contrast between the traditional approach to forestry that is still found inland, and the more “modern” developments that are beginning to appear along the coast.

Even fire management institutions are affected by this two-tier development. This is because wood producing areas are being managed privately (due to reduced state funding) while the subsidies provided by municipalities reflect their priority of protecting forests around built-up areas.

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4.4.7.2 Scenario 2: Biorefinery innovation & land-use tensions

Overview

The fabric of local industry has been transformed by the growth of biorefineries and green chemistry. This industrial restructuring is based on increased sectoral coordination, which in turn is a product of supply-side policies and a more intensive approach to silviculture. Ecosystem services are developed as joint products of wood-based activities.

In many areas, farmers and forest owners are producing the same kinds of products, meaning that they are competing to gain ownership of land. In addition to this, increasingly intensive forest management practices lead to trees essentially being treated as crops. This causes a "deterritorialisation" of the forestry wood chain, and serves to alienate the general public.

Explanation

By 2045, stakeholders in the wood energy sector are specialised in producing energy, chemicals, and specific materials. Following a similar path to the biorefinery model, this transformation has led to the advent of multi-product industries, able to quickly change from producing one kind of product to another in order to keep up with changing opportunities on the world market.

These changes have resulted in part from a sharp increase in worldwide demand for energy, and in part from a wish to produce high added-value products, which help to balance out the increasing price of raw materials (pulpwood, but also timber, as a result of growing demand for long fibre processing), as well as greater competition on the generic product market.

These changes are also due in part to sectoral coordination. Forest owners have been encouraged to invest more in their forests and cut down more trees. The authorities helped move this initiative along by applying supply-side policies until the early 2020s. In the wake of this strategy, regional forest management has become more focused on the operation of "peripheral forests", privatisation of the DFCI system, and the promotion of a more intensive approach to silviculture. These changes, founded on shorter rotations of maritime pine trees, and involving the occasional introduction of new species (such as eucalyptus and even miscanthus in agricultural areas) is less a question of adapting to climate change and more one of trying to satisfy the changing needs of local businesses.

The aim of these initiatives is to reduce tension surrounding wood resources, and preserve the comparative advantage of the different industries in the Landes region. Growing institutionalisation of ecosystem services, which first began in the 2010s, is also part of this sectoral perspective. With the support of both national and European policies, it is essentially based around the development of carbon compensation, and the labelling of products as part of a system of contracts and "joint products", much the same as that implemented in the farming sector. The Landes forest area has thus become an attractive kind of capital, especially for corporate forest owners, who can diversify their investment. On the flipside, these industrial changes, and the resulting intensification of silvicultural practices, are also

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accompanied by a conflict of interests. In inland areas, particularly to the East of the Potenx case study site, friction between forest owners and farmers on the subject of energy is particularly strong. At the same time, as more trees are cut down to satisfy a need for biomass, the public accuse the main protagonists of turning their forests into farms. The links between industry and territory begin to come undone. This “deterritorialisation” leads to inland forest areas being seen as less attractive than those situated closer to the coast.

4.4.7.3 Scenario 3: The European biomass sink

Overview

Activity in the region’s wood industry has plummeted. A number of “breakthrough” innovations have utterly transformed the energy sector. New industrial strategies have led to huge biorefineries being constructed close to major European transport hubs. These initiatives are supported by the EU, through new competition policies focused on energy transition and industrial transformation. Thanks to its size and dynamic management practices, the Landes forest area has managed to adapt to these changes, and remains an attractive source of wood.

As more and more wood is “mined” across Europe and shipped through major supply networks, the resulting empty land can be considered as new space on which to build housing, leading to diffuse urban sprawl.

Explanation

By 2045, industry in the Landes region is dominated by methanisation and biomass pretreatment facilities (pyrolysis and torrefaction). These sites are at the centre of a supply network providing material to biorefineries close to ports in northern Europe, as well as supplying cities along the Atlantic coast. Roundwood is also exported, albeit in smaller quantities, to Eastern Europe and the Iberian Peninsula.

This radical transformation is the result of a dual process, whose origins can be traced back to a long financial crisis that first began to affect Europe in the 2010s. Already weakened by growing competition on international markets, the wood and paper industry was unable to counter the introduction of breakthrough innovations in energy production in the latter half of the 2020s. The sector was also affected by industrial concentration, with biorefineries being constructed close to major transport hubs. At the same time, following continued recessions and poor economic growth, the EU has gained more influence. Competition rules have been tightened, with the aim of promoting extensive investment in energy transition, and driving industrial change, through better technology, regional specialisation, and supply networks. The Aquitaine “Euro Region” now focuses predominantly on pioneering industries such as aerospace and laser production.

While the regional forestry wood chain has been considerably weakened in both economic and political terms, the Landes forest remains an attractive asset, because of its size and the

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dynamic way in which it is managed. Seen as a "wood mine", it is now centrally controlled by forest and energy operators, with a particular focus on biomass. This strategy, which favours short tree rotations (8 to 12 years), takes advantage of a number of technical improvements, achieved through breeding programs.

Supply contracts are signed with forest owners, who are required to implement different forestry practices, and must satisfy certain levels of production. These contracts generally exclude less active smallholders. They also marginalise styles of forestry based on traditional values asset management and environmental considerations. Publically-owned forests continue to be managed in an entirely different way, and serve as "examples of biodiversity", especially in coastal areas.

Forest areas can also be desirable at local level, not so much for their environmental quality and potential for leisure activities, but more for the potential additional building space they offer (diffuse urban sprawl).

The delocalisation of the local wood industry has led to a loss of added value, meaning that the protection of forests has become less of a priority for local authorities, who are more concerned with issues of housing and urban planning in metropolitan areas. The importance attached to these issues means that there is less focus on land use conflicts between forest owners and local residents. This is further exacerbated by the fact that production and economic competitiveness has come to be seen as more important than other social considerations.

Some fire management institutions now rely partly on agricultural stakeholders to help them in their efforts, notably through the designation of certain croplands as fire breaks.

4.4.7.4 Scenario 4: The 'Green' innovative cluster

Overview

The forestry wood chain is centered on innovative industries and small businesses, especially in terms of green chemistry, green building, and wood-derived materials. Advances in silviculture have focused on the potential of maritime pine for use as timber, and increased use of hardwood timber.

Increased sectoral coordination is guaranteed through regulation and market-based instruments that call for a certain level of "eco-friendliness". Despite the development of designated areas open to the public and special biodiversity zones, there is still an element of segregation between different types of forest management.

Explanation

By 2045, the local forestry wood chain is mainly focused on green chemistry and a number of innovative small-scale sawmills and green building contractors. These changes are

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accompanied by a strengthening of sectoral coordination, and the institutionalisation of "eco-friendliness" requirements, supported by both regulation and market-based instruments. Support from European and local authorities is also focused on promoting sustainable silviculture, the use of wood materials in construction, protecting biodiversity, and communicating with the general public. In Aquitaine, these changes were monitored particularly closely by the authorities, because of the corresponding drop in demand for pulpwood and increase in revenue generated by the residential economy. As the Landes forest region has become more and more of an attractive place to live, maintaining its landscape attributes and environmental quality has become a priority for the regional authorities.

The growing influence of eco-labelling has increased production costs, and there is greater regulation of forest management. Looking at this situation from a sociological perspective, there have been clear changes: forest owners, attracted by fairly lucrative contracts awarded to them as part of new energy and climate policies, have seen their influence grow. In addition to this, those who have signed up to particular environmental charters can now access carbon and wood markets that are subject to ecological certification.

The effects of these changes are accentuated by the arrival of younger, more urban entrepreneurs looking to earn money by developing new ecosystem services. The maritime pine remains the tree of choice, with most development work aimed at improving its reliability as timber for use in both green building and green chemistry (particularly in terms of its long fibers, used to produce specialty pulp). There is also growing emphasis on hardwood timber, which has resulted in greater numbers of broadleaf species being planted, especially black locust.

The forest is now one of the main reasons why the Landes region is so attractive, mainly due to its contribution to mitigation strategies, its role in making ecosystems more resilient, and the general quality of life it brings to local residents. While this represents a certain synergy between users and stakeholders in terms of ecosystem services, it does not represent full-scale multifunctionality.

While there are more and more specific zones dedicated to biodiversity and recreational use, they generally tend to be located in coastal areas or around lakes and rivers. The inland part of the Landes region is still seen as a sanctuary for traditional forestry activities, with its own set of production targets. The "cultivated forest" in the region continues to play a role in maintaining the territorial equilibrium, helping to preserve natural resources, and protecting a variety of ecosystems. This is achieved through contracts between forest owners and various local authorities in coastal areas.

The continued efficiency of risk management strategies (fire, storms, etc), is also a result of a new kind of governance, based on coordination between market-based and regulatory instruments. These can be both direct and indirect in nature, such as making forest insurance policies tax deductible, or by creating a dedicated investment fund paid for by taxes levied on both producers and consumers.

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4.4.7.5 Scenario 5: The territorial partnership

Overview

As the industrial fabric of the Landes region has become more fragile, local authorities are attempting to maintain demand, notably by supporting energy wood projects. They are also trying to promote an approach to silviculture that will contribute to the development of their respective territories through the provision of goods and services. This pro-active initiative undertaken by local authorities has been spurred on by their becoming responsible for a wider range of issues, as well as increased regulatory powers given to them as a result of decentralisation.

The supervision of forestry activities differs depending on the objectives laid down by local authorities, working in cooperation with newly-created groups of forest owners and operators. In many cases, these objectives are defined based on what would most benefit forest owners and managers. Ecosystem services are recognised by public bodies, but their main support comes in the form of private initiatives, with varying degrees of success from one territory to another.

Explanation

By 2045, forests in the Landes region have expanded into a wider range of uses, depending on their ability to contribute goods and services to the territories in which they are situated.

The forest has become a focal point for a number of issues, such as employment, energy, climate, the environment, and town planning. These questions are the subject of growing scrutiny from stakeholders and interest groups, leading to a greater territorialisation of forest activities. After a number of regulatory changes, further decentralisation reforms have served to validate the reshaping of public action in forestry.

Under the guise of subsidiarity and participation, local authorities (French regions, departments, cities, national parks, etc.), have been given the means to influence the implementation of forestry action programs. These regulatory powers cover a number of domains. Firstly, in economic terms, there is greater use of contracts (fire protection, etc.). From an urban planning point of view, forestry-related issues receive much greater consideration. These new powers also extend to the field of water resource management.

The way in which forestry action is overseen depends on predefined objectives. These objectives are defined in cooperation with those further up the forestry wood chain, i.e. forest owners and operators. Because of this, territorialisation tends to be of the greatest benefit to these kinds of stakeholders. These advantages can come in many forms, including the creation of forest owner collectives (allowing them to supply large volumes of wood to companies and organisations under long-term contracts). There are also political advantages, namely the ability to make their wishes heard to local policy makers

After some initial criticism and reluctance, sectoral stakeholders eventually decided to go along with this change in direction, acting with something of a resigned attitude. The last few

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decades have been characterised by a reduction in local industrial demand. In an attempt to counter this stagnation, local authorities have worked together to launch a range of new energy wood projects, aimed at supplying local collective boilers and surrounding metropolitan areas. They also support the creation of wood pellet factories. At the same time, a number of new privately-led initiatives are springing up, looking at ways to derive profit from forests on the back of a growing residential economy (private hunting estates, firewood, theme parks, etc.). The local demography continues to grow, helped by the attractiveness of the coastline and a general desire to enjoy the tranquillity of rural living.

However, urban growth is stringently controlled through restrictions on the expansion of residential zones in favour of further developing existing medium-sized settlements. Ecosystem services are becoming more commonplace, as well as enjoying the support of the regional and European authorities, who are keen to encourage multifunctionality and rural development. Despite this, these projects are not universally successful, with some failing to cultivate sufficient local support. In silviculture, in the absence of any viable alternative, the maritime pine remains the species of choice, selected based on their ability to adapt to varying conditions (drought and pathogens). Selecting trees in this way leads to an inevitable trade-off in terms of volume.

Deciduous woods and forest edges are on the rise, mainly dominated by oak trees. Experiments involving the planting of black locusts and eucalypts remain an occasional activity. Fire prevention institutions have varying levels of success, depending on the level of support received from local authorities.

5 List of Figures

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6 List of Tables

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This project has received funding from the European Union’s Seventh Programme for research, technological development and demonstration under grant agreement No 282887.