Adaptation to Climate Change as a Challenge for Sustainability Management in the Forestry and Timber Sector

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French National Institute for Applied Sciences, École des Ponts Paristech, University of Koblenz-Landau

1. Introduction

Although climate change has been scientifically documented for a long time, it has taken time to move onto the national agenda, first through (trans-)national strategies and then in the form of regional and territorial plans. Such plans have long ignored economic actors who seemed not to be touched by this issue. However, since the publication of the Stern Review in 2007, it has become obvious that economic actors also have a role to play in addressing climate change. Slowly, economic actors have joined the fight against climate change and understood that they can also put into practice the public policies of mitigation and adaptation[1]. The issue the journal *Entreprises et Histoire* ("Companies and History") devoted to companies and climate change points both to the depth of these commitments and their ambiguities: "In just twenty years, the reduction of greenhouse gas emissions has thus become a new management objective for companies, associated with strategies, instruments and technologies. […] Companies, especially the largest ones with international capacity for action, are now being asked to be stakeholders in these international negotiations. […]. The global dimension of climate change has led companies to join forces to influence international negotiations. The history of companies facing climate change is also that of the creation of coalitions and other meta-organizations to make the voice of industry heard and to influence public debate […]" (Aggeri, Cartel, 2017: 6–20).

The involvement of economic actors depends *inter alia* on media coverage and political and economic offensives[2]. The reactions of companies to these communications may differ a lot, depending on their sector of activity and their size. Some have been at the forefront of addressing climate change through mitigation policies, in particular, for rationalization concerns. Mitigation policies are based on source reduction policies, which have already been in place for some time. A number of companies have developed ISO certifications[3], environmental and other approaches that go hand in hand with a rationalization of uses and consumption within the company. Some have been at the forefront of tackling climate change because of their vulnerability to some climate stresses and have become forerunners in the development of adaptation strategies. The distinction between insiders and non-insiders is more relevant from the perspective of adaptation, since adaptation actions are organized to deal with the effects of climate change and to counter them. In this respect, companies that have experienced unfortunate episodes have generally sought solutions and thus suggested possible actions.

This chapter focuses on what climate change means for a region like the Upper Rhine. The study focuses on the actors of the forest sector on both sides of the border of the

[1] The levers for action against climate change are roughly structured into two main categories: policies to reduce problems at their source or avoid them on the one hand, and policies to adapt to problems on the other. The latter compensate for the nuisances, discomforts associated with the deterioration of living conditions, the collapse of ecosystem services, or even their destruction.

[2] See for example the Climategate case, orchestrated around the hacking of email exchanges between IPCC experts in November 2009 (Norrand-Romand, 2012), which tried to discredit the work of the IPCC.

[3] ISO certifications define standards for products, processes or services.

Regional Natural Park of the Northern Vosges and Pfälzerwald. While climate change has been placed on the agenda of stakeholders and territories in relation to forest management and their positioning on the various wood markets, the uncertainties it introduces are the subject of differentiated social reception depending on the logic and set of specific stakeholders. Despite the great diversity of companies' positions, an increasing number of businessmen and women are realizing that climate change is a major economic challenge, both in terms of losses to be anticipated and in terms of markets to be developed.

Given the strength of economic imperatives dictated by globalised markets and the multiple sets of actors, the introduction of the climate change issue works as a factor of turbulence that does not necessarily and automatically benefit socio-ecological progress. As this study will show, an ecological cause like climate change may have perverse effects on the socio-ecosystems concerned. This observation, which can be found in the history of the environmental movement through many cases of ecological policies applied to housing, neighbourhoods and even many other sectors of society, illustrates the complexity of building environmental standards.

2. Study area and methodology

The present chapter is the result of one of several case studies conducted in the context of the project Clim'Ability. The aim of the project is *inter alia* to refine the knowledge on companies' capacities to adapt to climate change and to analyse adaptation pathways (Gobert *et al.*, 2017). Regarding the forestry and timber sector, it should be borne in mind that a large amount of added value and jobs are created in the secondary sector that transforms the raw material produced in the forest sector (e.g. sawmills, wood-based materials industry, furniture construction, etc.) (Jochum, Seegmueller, 2016). When analysing the impacts of climate change and possible adaptation pathways, it is therefore crucial to consider the secondary sector as well and not only focus on the primary sector, even if the impacts of climate change seem to be more important for the primary sector. We have therefore included both the primary sector and the secondary sector. This case study is also intended to determine how the affiliation to different territories influences awareness and action. In pursuit of this objective, this chapter is based on a concomitant field survey in France and Germany based on 27 semi-structured face-to-face interviews with persons holding key functions in the forestry or timber sector in the study region or in companies close to the study area and using timber from the study area. The guiding questions related to the impacts of climate change and climate change adaptation.

Table 1: Sectors which were interviewed

Sectors	Public organisations	Private organisations	Managers first and second transformation	Sawmills and wood product industry	Wood and construction trade	Total
Number	11	4	6	6	12	39

The study area is the Palatinate Forest-Northern Vosges transboundary biosphere reserve i.e. the Regional Nature Park (RNP) of the Northern Vosges on the French side and the Palatinate Forest on the German side. With an area of about 180,000 ha on the German side and 130,000 ha on the French side, mainly covered by forest, this is one of the largest contiguous forest areas in Central Europe. It is also the oldest transboundary biosphere reserve of the UNESCO in Europe. As such, it is an appropriate territory for a case study in order to analyse to what extent sustainability management and in particular climate change adaptation of the forestry sector are linked to the national features and organisation of the territories. Indeed, the geological and ecological characteristics are largely comparable on

either side of the border. Geologically and landscape-wise, on either side, the reserve is characterised by its striking sandstone formations and the sandy soils that emerged from them. The climatic conditions do not really differ from one side of the border to the other, but they differ depending on altitude and the west-east gradient. On the western side of the low mountain range, the annual precipitations are usually higher than on the eastern site, which is also warmer. The main tree species are beech and pine, with respectively 33% and 35% of the area on the German side and 51% and 20% on the French side. With 9% on the German and 18% on the French side, the oak is also an important species[4]. In comparison with other German or French forests, spruce do not play a major role even if economically they are still important. Regarding the ownership structures, both sides of the border are quite similar. On the German side, 57% are state-owned, 33% communal and 10% private; on the French side, 49% are communal, 24% state-owned and 27% private [5] . Thus, on both sides the forest is mainly public.

3. Forests in the face of sustainable development and climate change

3.1. Forestry and sustainability

The first approaches to sustainable forest management are quite old. In ancient Persia, for example, forest supervisors monitored the logging of the Lebanon cedar. In the late Middle Ages, due to the increasing shortage of wood in the heavily over-exploited Central European forests, clear areas were reseeded with pine seed in order to secure the supply of wood in the long term. With this revolutionary step, foreshadowing sustainable thinking, the actors thought far beyond their time horizon and acted accordingly (Hamberger, 2013; Schmidt, 2013). Despite these initial approaches to sustainable forestry, the forest in late medieval Central Europe was heavily overused, leading to an increasing shortage of timber. Because of this wood shortage, Hanns Carl von Carlowitz called for a "sustainable use" (*nachhaltende Nutzung*) of forests in which no more wood should be harvested than regrows at the same time. With this fundamental criterion for a sustainable use of renewable resources (which today is referred to as quantitative sustainability), Carlowitz laid the foundation for the principle of sustainability. However, it took some time for the principle to be integrated into forestry on a practical and large-scale basis. Only in the 19th century, when it became possible to replace wood as an energy source with fossil fuels, was the use of wood reduced to a level that allowed forests to recover. In the 1970s, when environmental issues increasingly gained social prominence, the ambitions for sustainable forestry began to increase. Indeed, in addition to the utility function (i.e. logging), the protective function (e.g. soil, water, climate, etc.) and the recreational function of forests were enshrined in the German Federal Forest Act (§1). In practice, however, the idea prevailed that the protection and recreation functions were automatically provided by productive forests, and therefore the utility function remained largely of the main focus of interest. When the environmental movement culminated in the Rio World Summit in 1992, the new guiding concept of "sustainable development" was coined, in order to unite the three – social, economic and environmental – pillars into one target. This translated into the model of the multifunctional forest, which has to serve multiple needs of society.

Due to its long history and the decisive role that forestry has played in the emergence of the term sustainability, the concept of sustainability is very deeply rooted in the forestry sector (Hamberger, 2013, 2016). However, the understanding of sustainability is not uniform

[4] Interviews Rhineland-Palatinate and Regional Nature Park, 2018.
[5] Interviews Regional Nature Park, 2018.

in the forestry sector either (Beland Lindahl, Sandström, Sténs, 2017; MacDicken *et al*., 2015). For example, some foresters continue to focus on sustainable timber production, while others are more strongly committed to multifunctional sustainability. However, there is a broad consensus that sustainable forest management must assure intergenerational justice and that quantitative sustainability must be preserved in order to satisfy the various interests of society. On the other hand, opinions differ on the question of which social interests need to be satisfied and to what extent (Oesten, 2004). Even though this question ultimately remains open, it is clear that requirements change over time. In recent years, the most important drivers impacting the understanding of sustainable forestry have been climate change and the increasing globalisation of the sector. On the one hand, climate change greatly influences forests (see 3.2) and thus also the requirements for sustainable forest management, which need to anticipate these changes in order to create climate change resilient forests. On the other hand, forest management influences climate change because forests and durable wood products serve as carbon sinks that play an important role in mitigating climate change. The globalisation of timber markets leads to the need to evaluate the criteria for sustainable forest management against the global impact of forest management. Or as Hahn and Knoke (2013) put it, the demand side, i.e. the wood consumption of society, must also be taken into account. If, for example, less domestic wood is produced, this usually leads to wood imports or to a switch to other, generally less environmental-friendly materials. Considering the global consequences, some authors question whether it makes sense to place certain areas in Germany or France under protection and take them out of management because this may increase wood imports from other less sustainably managed forests (Schulze, Frör, Hessenmöller, 2016). In addition, the globalisation of timber markets leads to longer transport distances and thereby impedes the "climate friendliness" of wood. It is therefore crucial that the whole sector should develop in a way which allows the forests to serve the different needs of society and to optimise the forest-wood carbon sink without increasing timber importations and without increasing timber transportations.

3.2. Impacts of climate change on forests

Forestry has the particularity of having a production cycle of the order of a century. Today's planting choices commit us to a "far future" on a human scale and decisions must be made in areas of uncertainty. The forest ecosystem is subject to multiple temporalities (Alexandre, Genin, 2005). First of all, it is the result of long-term processes: the time of geology and the time of biodiversity, which both have effects on the evolution of life and the climate history. Secondly, taking into account an "intermediate" time makes it possible to consider the history of the relationships between human societies and their bio-physical environment and thus the way in which landscapes and territories have been transformed over time, as Philippe Jehin (2005) very clearly illustrates for example for the Northern Vosges from the Middle Ages to the Revolution. Short time or "anthropized time" "corresponds to natural time as modified by human interventions that disrupt its speed, rhythm and duration; this hybrid time, neither natural nor social, is, in fact, the time scale of the environment" (Barrué-Pastor, Bertrand, 2000, cited by Alexandre, Genin, 2005: 46). These specific temporalities force foresters to accept uncertainty in the choices they make today in terms of planting and exploitation, because some species may no longer be fully adapted to the future climate.

Climate change implies a multitude of climatic changes, not all of which have the same relevance for all sectors. Three climate changes are particularly relevant for the forest sector: firstly, rising temperatures resulting in heat waves in summer, shorter frost periods in winter and a longer vegetation period. Secondly, the forecasted decline in summer

precipitation for the region (Fuchs, 2010) is of great importance, especially for beech forests. The last important change concerns extreme weather events, in particular storms. All these climate changes have quite a few consequences for forestry and the timber industry, which are described below.

The central consequence of a changing climate for the forestry sector is a resulting change in the suitability of tree species. This question is of great importance due to the long production periods of forestry described above: the trees planted today or naturally rejuvenating themselves will only be ready for cutting in many decades and until then they will be dependent on a suitable climate. Especially, the temperature and the availability of water are important. If temperature is no longer optimum or if there is not enough water available, the vitality of the trees will decrease, meaning a lack of self-protection against pests and even leading to the death of the trees.

In addition to changing tree species suitability, climate change also means that problems caused by harmful organisms will be on the increase. For example, the European spruce bark beetle (also known under the Latin name of *Ips typographus*), a well-known and already very important pest, which can cause great damage especially in pure spruce stands, benefits in several ways from climate change. During hot and dry summers, resin formation is reduced and the self-protection of trees is reduced accordingly. Consequently, trees become more vulnerable to insects. The European spruce bark beetle would also benefit massively from increased storm damage, as the fallen trees offer the beetle perfect breeding grounds. In addition, the European spruce bark beetle profits from higher summer temperatures, which increase the development speed of the larvae, which can lead to an additional generation of the beetle in above-average warm summers and thus to a further damage wave. In addition to these already well known pests, climate change can also favour pests that have not yet played a relevant role to such an extent that they suddenly become a serious threat. Many examples show that it is always possible for completely new diseases to emerge as a result of climate change, especially as the increasing globalisation of timber markets supports the spread of potentially harmful organisms (Petercord, 2013). This makes it very difficult or even impossible for the relevant actors to anticipate the consequences resulting from new pests. Indeed, a tree species that is actually relatively well adapted to the predicted climate can suddenly become so massively impaired by the emergence of a new pest or disease that its use is no longer possible. The susceptibility of trees to storm events must also be taken into account when assessing tree species suitability. Windthrow is already responsible for the majority of forest damage today. If the frequency and intensity of storms increase in the wake of climate change[6], the problem will become even more important in the future. Some tree species, in particular spruce, are particularly vulnerable with respect to storms (MULEWP RLP, 2017), which in turn affects the suitability of this tree species, as does its susceptibility to harmful organisms.

For the secondary sector, i.e. wood processing companies, the effects of climate change can be divided into direct and indirect effects. Direct effects concern all corporate functions that are directly affected by weather events. For example, in very hot and dry summers, the sawmill industry has problems storing wood. Both the logs and the sawn timber must not dry too quickly in order to avoid dry cracks and loss of quality. In addition, many companies are affected by climate change because their employees suffer from increasing heat periods during which their concentration and performance capacity decrease. More important than these direct effects for most wood processing companies, however, are the

[6] Even if it has not yet been clearly proven that these extreme weather events will become more frequent or more intense in the future, there are indications that point to this (Kovats *et al*. 2014). Despite this uncertainty, due to the large impact of storms on forestry, storms are one of the most important weather events to be taken into account in the forest sector's adaptation to climate change.

indirect effects, which become noticeable through a change in the raw material and sales markets. The cascade effects or the so-called domino effects (Godard *et al.*, 2002), when one event leads to another and so on, affect the raw material markets, whereas most actors of the secondary sector do not seem to perceive anything unusual. In general, companies that are closer to the resource (e.g. the sawmill industry) see more of a problem than companies that are further away from the resource (e.g. the wood-based materials industry with a high use of waste wood).

The main problem is the decline in coniferous wood, especially due to the effects of climate change on spruce. In view of the fact that only 23% of the young forest in Rhineland Palatinate is made up of coniferous wood[7], the wood-processing companies, in particular the sawyers, see their supply of raw materials endangered. However, it must be said that this conversion towards less coniferous and more deciduous wood has been driven not only by adaptation to climate change, but also for reasons of nature conservation. Although most stakeholders, also from the secondary sector, are committed to near-natural forestry and take a critical view of pure spruce stands, they criticize the fact that the proportion of conifers is declining too much overall. The removal of forest areas from management due to the creation of process protection areas is often viewed critically as well because it reduces the overall quantity of available wood. In addition to the quantity and type of available wood, the availability of wood over time is also influenced by climate change. Since frost periods are getting shorter, there are more and more problems with timber harvesting, because the heavy machinery cannot drive into the forest without damaging the soil when soils are not frozen. For the wood processing industry, this increasingly results in logistics problems due to a lack of wood supply. On the other hand, there may also be logistical problems if there is an oversupply of timber after storms. In these situations, the sudden sharp increase in the quantity of timber can no longer be processed because the companies have reached the limits of their processing capacity.

However, due to the low carbon intensity of wood and the fact that processed wood acts as a carbon sink, climate change is seen as an opportunity for the wood-forest sector. Wood is seen as the raw material of the future, which will continue to gain importance. In contrast to the negative impacts on wood availability, this evolution is perceived as positive by the actors of the wood chain because it may boost wood markets. Then again, sales may come under pressure due to global competition. Indeed, unlike temperate forests, boreal forests in the global North are expected to benefit from climate change. Climate change could prolong the vegetation period of boreal forests, which would also increase the rate of growth and thus wood production (Keskitalo, 2008; Lindner *et al.*, 2010; Talkkari, 1998). For the same reason, high altitude forests may also benefit from climate change, but to a lesser extent. From the point of view of the local timber industry, this is likely to further intensify competition with the cheap wood from boreal forests.

3.3. The difficult stabilization of environmental and climatic standards

The territorial and sectoral environmental consequences of an altered regime sometimes remain difficult to identify, quantify and evaluate. Fundamental and applied research associated with climate change is focused on clarifying these aspects and is regularly synthesized in the IPCC reports. These updates remain partly unknown to the main stakeholders. The responses to an EU survey (EEA, 2017) show that data harmonisation remains a tangible climate policy issue. The lack of data harmonisation hinders the objective assessment of efforts made in other countries, but also the objective assessment of the

[7] Interviews Rhineland-Palatinate, 2017.

transnational constraints that may affect different sectors. On the scale of the Upper Rhine, the Clim'Ability project (Interreg V) attempts to address these weaknesses by relaying and territorializing the various advances resulting from scientific activity and assessments carried out by the IPCC. The comparative study of the forest-wood sector between Germany and France led in the context of the Clim'Ability project is exemplary in this respect. The controversies that animate these territories reflect the difficulty of distinguishing between preconceived and well-founded ideas. We will come back to this later in the chapter.

Beyond this crucial question of the scientific, administrative and political construction of data, the identification of the sensitivity of ecosystems to different hazards on the one hand, and the factors determining the vulnerability of these ecosystems on the other hand, constitute the major points of the discussions devoted to the sustainability of the forest-wood sector. Indeed, assessing the general state of the forest is a prerequisite for any serious foresight work about the sustainability of the forest-wood sector. This assessment rests on an iterative process between different actors. The production of knowledge goes back and forth and follows time frames that do not align with those of ecologists, scientists, managers, entrepreneurs, etc. There are numerous obstacles to an alignment of interests between scientists and entrepreneurs, due to the fact that like most social actors, they are often caught up in routines that can be described as "business as usual". Entrepreneurs may argue that they do not possess sufficient knowledge to direct their action. However, the economic actors may simply not be willing to be confronted with the ecological impacts of their business.

However, it cannot be overlooked that this blindness is maintained by the dominant economic culture, which is opposed to any intrusion into its reasoning system, its own logics, etc., in short, into its normative system. One of the most significant achievements of the dominant economic culture is that it has achieved almost total closure of its system (Polanyi, 1944). The economic system remains the absolute reference for many institutional actors. This is evidenced by the limited space given to scientists in business clubs and economic forums. The main question at stake, then, is: how can complex knowledge be taken into account by economic and social actors? It seems necessary to conciliate highly sophisticated knowledge and the complexity of socio-economic life in order to tackle climate change and enable a genuine ecological transition.

4. Integrating climate change into the forest-based sector: different realities along the value chain

This section discusses how stakeholders act in view of the challenges of climate change and sustainability discussed in the first section. The 1st sub-section is descriptive and displays the results obtained thanks to the interviews, while the 2nd and the 3rd are more conceptual and seek to answer the research questions.

4.1. Differentiated sensitivity and adaptation to climate change within the value chain

The comparison that we conducted between the French and the German part of the Palatinate Forest-Northern Vosges transboundary biosphere reserve is based on field logics that are not exactly the same on the two sides of the border. In field sciences, the data are influenced by the context in which the researchers' investigation took place. On the French side, the survey took place in the context of the renewal of the Park's charter and the development of sustainable policies by the Eurometropolis of Strasbourg (EMS). This resulted in an intense mobilization of the actors and a high willingness to respond to the researchers' requests. The interviews conducted on the French side, compared to the investigation conducted on the German side, oriented our reflection towards the following

hypothesis: a collective action can emerge in favour of a territorial strategy and in response to global issues like globalization and climate change. On the German side, the study was influenced by the fact that the sector is more fragmented due to a higher degree of industrialization, even though the French actors often consider the German side as more resilient. This contrast is interesting to consider from the point of view of the representations that persist on both sides of the border. It is quite common for players who are hesitant about or in favour of the industrialisation of the forestry sector, or the introduction of new species such as Douglas fir, for example, to underline the success story of the German neighbour, even though it is not as resplendent as it may seem.

The forest-wood sector is not really more coherent in France than in Germany, in particular due to the lack of continuity of the sector and the multiple conflicting interests of the different actors. Nevertheless, it appears that in France, the Regional Nature Park acts as a coordinator, working to mobilize different actors, including communities of municipalities, to ensure the existence of a territorial logic. These efforts are motivated by the need to preserve the naturalness of the forest against an increasingly monofunctional approach, i.e. oriented towards the economic profitability and productivity of forest areas. In response to a loss of agricultural land, which has gradually been replaced by tree fields, the Regional Nature Park has determined to design a new charter, based on a multifunctional conception of the forest. Beyond this this mediation position, objective, the Regional Nature Park promotes the principle of capturing local value, in advantage of a circular economy. This circular economy should protect the naturalness of the Northern Vosges and to its different species.

The Regional Park has embraced two main strategies to pursue its goals. On the one hand, the Regional Natural Park is trying to mitigate the industrialisation of the sector, which has already taken place in Germany; on the other hand, it favours the economic model of a circular economy. The actors involved in the establishment of the Regional Nature Park Charter[8] are trying to fight against the increase of forests' vulnerability on the one hand, and against the loss of locally added value caused by globalization on the other hand. This territorial project takes into account both the ecological aspect (preservation of mixed deciduous and coniferous forests, soil and biodiversity preservation) and the economic and social aspect (development of local skills and markets, safeguarding the recreational nature of forests, etc.), in order to enrol as many actors as possible and to settle or put on hold certain conflicts (introduction of the Douglas fir, game problems, etc.) rather than to set up would-be "defenders of the forest" against those who produce and exploit it.

In this territorial rhetoric, the topic of climate change – which initially held little or marginal importance –, is gradually gaining importance. This new challenge, due to the emergence of climate change, complicates the game of actors grappling with socio-economic logics that are not always in tune with each other. Paradoxically, taking climate issues into account does not always serve the ecological interests of the forest and of the sustainability of territorial development. Some actors use the argument of climate change to call for a massive use of exotic species such as Douglas fir. The carbon storage argument is another commonly used argument to address ecological issues, which do not promote the naturalness of forests. Contrary to what is commonly advanced, the forestry sector does not necessarily and systematically contribute to carbon storage. Indeed, forest management can cause massive destocking, to answer the needs of the sector[9]. Renewable energy production and the preservation of forest habitats do not always go hand in hand. The trend to increase the production of wood to contribute to energy transition and to feed the wood markets does not always serve the ecological interests of the forest. Even if the topic of renewable energy is not a central topic in the narrative of interviewees, the energy transition option is willingly

[8] Forest owners, elected officials, first and second transformation actors, etc.
[9] Interview with a Park maintenance professional, 2017.

mobilized when it comes to arguing for investments in the forest sector that do not necessarily and systematically serve the ecological interests of the forest as an ecosystem and habitat. In particular, low market prices for beech wood, bolstered by path dependencies (in terms of markets, know-how and equipment), hampers an effective combination of ecologic and economic forests producing the raw material for the local timber industry. In any case, the discussion about climate change and the transformation of the energy system has given rise to a controversy about the sustainability and naturalness of forests, which can become more or less heated, depending on the stakeholder configuration.

The survey carried out on the German side shows that the industrial logic of the secondary sector resulted in the shutdown of most of the small sawmills. This restructuring, which the French compare to the fate of agriculture in the 1960s, has enabled significant progress to be made in the secondary transformation sector, which now plays on international markets. If the logs go abroad they often return to supply specialized wood companies that meet standardized construction markets. This restructuring of the sector has been achieved to the detriment of weak players, like small sawmills or resource extractors, which have not made their conversion. The success story of the German forest sector, i.e. the preservation of an efficient timber sector in the Rhineland Palatinate, has only been achieved at the expense of some small players, which have disappeared or been replaced by machines. Behind this story of modernization, there are arrangements that are not as virtuous and exemplary as they appear when considering the concepts and models that support them.

Many locally sustainable projects are not as blameless as they claim. Behind the exemplary wooden constructions and facades of eco-neighbourhoods are processes that are crucial to the regional economy, starting with products that rest on ecologic forest management and avoid transportation. This is one of the issues tackled by the Regional Natural Park in association with the EMS and actors such as Fibois (the federation of the wood industry). This association of actors works to ensure that urban markets do not go against the *Hinterlands* of metropolitan areas (Brenner, Schmid, 2014). The aim is to interest urban dwellers in territorial logics, i.e. by drawing their attention to the perverse effects of certain standardised products, which do not support local multi-functional forestry. It is also a question of re-connecting producer and consumer territories, and cauterizing the "metabolic rift" somewhat.

Despite the differences on both sides of the border, which have been revealed by the survey, a certain consensus nevertheless seems to be emerging around the first transformation (as to the fate promised to the weak, who are regarded as outdated actors in this sector). The positioning of the actors regarding different wood species and forest management doctrines is not simple. The situation differs from one area to the other and from one individual to the other. The abandonment of species such as beech for example raises controversies. These controversies are not exclusively motivated by ecological and scientific arguments, but are also influenced by technological changes as well as by the personal interests of the different stakeholders.

In this regard, path dependencies due to investments in machines specialized in cutting and processing certain types of wood exclusively are very important. Such investments are binding in the strongest sense of the term. Actors who have not carried out early restructuring and therefore have no machines that have to be paid off may be more inclined to engage in new business models. Indeed, some actors see the switch from coniferous wood to deciduous wood as theoretically possible, but point out that coniferous wood cannot be replaced by deciduous wood in terms of quantity. Indeed, the 3rd Federal Forest Inventory shows that in Rhineland-Palatinate, apart from pine, all coniferous species have higher growth rates per hectare than deciduous species. If, for example, one hectare of spruce forest with an average

growth rate of 16.7m³/a is replaced by beech forest with an increase of 11.2m³/a, the industry will lack 5.5m³ of wood per year in quantitative terms.

These different perspectives, which cannot summarize the complexity of the forest-based sector, show that when it comes to standards dedicated to forest sustainability, there are multiple motives and interests at stake. Given the number of actors in the forest sector – foresters, handlers, sawyers, various wood-based materials producers, architects, craftsmen, etc. not to mention scientists and civil society (hikers, naturalists, hunters, etc.) – the construction of forest sustainability depends on many social issues. The formation of compromises that could regulate the sector is far from assured. In the vast majority of cases, innovation efforts are always suspended to social arrangements (coalitions of actors, subsidies and various forms of public aid, qualifying schemes, etc.), which do not always come into being. In order to promote such arrangements, local governments sometimes support what they call demonstrators. These are exemplary cases whose objective is to encourage imitation and spreading.

4.1. Structuration of adaptive responses

In line with the findings of our survey, it can be argued that the adaptation of the forest-based sector to climate change goes far beyond the issue of building resilient forests. Nevertheless, and although this may seem contradictory, the challenges of the forest-based sector are largely constrained by climate change. The pressure of climate change on the forest-based sector is due to objective vulnerabilities compounded by numerous uncertainties about the ecosystem's responses to the consequences of climate change, which are exacerbated by the socio-economic pressures on forests.

To summarize the situation, we argue that climate change makes the various actors in the sector act indirectly and sometimes directly. The type of reaction usually depends on the sensitivity of the company, which is often determined by proximity to the resource. Companies close to the resource are often more aware of the impact of climate.

"Low noise" forms of adaptation can occur without companies becoming aware of it. These cases of adaptation are often only revealed through interviews, which raise the interviewees' awareness of the transformations that have taken place without having been noticed. This is the case for certain practices linked to seasonal factors that are increasingly being lengthened or, on the contrary, shortened. Examples include: the gradual introduction or extension of log watering; the reorganization of forest harvesting schedules, with some parcels becoming less accessible in winter due to soil moisture, etc.

These forms of adaptation, known as "low noise", are sometimes relayed by more conscious responses resulting from a process of reflexivity. The latter, which can proceed in many ways and take the form of questions about forest management or wood production methods, is rarely the work of isolated companies. Questions relating to the resilience of forests take place in hybrid forums (Callon *et al.*, 2001) where representatives of the first and second transformation of the wood sector, but also public authorities, associations and independents, sit. Issues[10] of interest to actors closest to the forest - such as forest managers, operators and or sawyers, for example -, are of little interest to downstream actors in the sector, who are more concerned with timber markets (orders) and the accessibility of timber lots, quickly and at competitive prices. If triggers for such reflections are often extreme events like the 1999 storm, which forced an organisational leap and led to the implementation of an emergency plan to cope with similar events and avoid massive

10 "Which species are most resistant to water stress?"; " Should these species be actively introduced?"; "Should exotic species be used although their properties are still partly unknown?"; "Should we change the way we manage the forest", etc.

wood losses, significant actions rarely operate at the company level only. Relevant innovations are often dependent on forms of cooperation or on simultaneous actions, which can be encouraged by regulation or by a dominant company. While the inter-professional sector can sometimes approach the subject indirectly, there is in fact no structural exchange between the upstream and downstream of the forest-wood sector to build adaptation strategies and no territorial logic strictly speaking. However, some collective structures are emerging around common reflections and actions that may in part relate to climate change.

In general, the survey conducted on the Regional Nature Park of the Northern Vosges and the Pfälzerwald enabled us to identify four types of actions that reflect contrasting adaptation careers depending on whether or not the positions are oriented towards new development models. They depend not only on the organizations (firms) but also on the context (forest/wood supply chain or territory):

- Remedial actions, which are organized in response to a specific problem encountered when a hazard occurs. Hazards can for example damage buildings, disrupt production, or hinder the delivery of supplies or products. These discomforts usually materialize on a site and are resolved on the site. Depending on whether or not such a remedial action is the subject of an ex post reflection, it is likely to evolve towards the second type of action.
- The second type of action is characterized by the inclusion of a specific hazard in the company's organization. Following a problem, lessons are learned and some reorganization takes place at different scales (from simple repair tactics to more strategic action).
- The third type of action is based on a more proactive approach, anticipating the consequences of climate change.
- The fourth type, finally, can be described as a transformative action. It is beyond the scope of adaptation since it uses the foreseeable impacts of climate change to propose new rules of the game. These transformations can result from one very climate-sensitive individual, who has an influence on an organization or from regular feedbacks within the organization, inciting the organization to go beyond simple and targeted actions and incremental adjustments (Gillard *et al.*, 2016).

The following diagram, based on Challinor, Stafford Smith, Thornton (2013), illustrates different actions that can be implemented. They distinguish tactical actions from transformative actions by integrating direct proximity to the resource. Indeed, resource proximity is an important factor determining the level of sensitivity to climate change. This result obtained through analysis of the interviews is confirmed by academic literature (Wise *et al.*, 2014).

Figure 1: Actions to fight climate change (source: author generated)

<FIGURE 15.1 HERE>

4.2. Modalities of action in an uncertain world: building standards to regulate timber markets

The multiplicity of positions of the actors identified in the survey testifies to the dynamic nature of this sector. This dynamism is partly due to the economic challenges of the forest-based sector, but also to the increasing ecological and social challenges caused by the state of the planet. Decade after decade, the widespread collapse predicted by Diamond and others (Diamond, 2006; Servigne, Stevens, 2015) is becoming more and more likely without any concrete options emerging. Unless there is widespread denial of climate risks, why is there such inertia? Why do we feel trapped in a vicious cycle? What postures should we adopt in the face of this impending collapse?

Given that this is a longstanding problem, there is no shortage of theoretical references, and yet very poor policy responses (Rudolf, 2018). Beyond the difficulty of reaching a consensus of values and action, it may be useful to point out that the absence of a common reference framework in plural and globalized societies is largely responsible for this inertia.

In *Les économies de la grandeur* (1987) and the essay *De la Justification* (1991), Boltanski and Thévenot suggest the model of a plural social actor, backed by multiple social logics or limited rationalities. This reminds us that each of us and, consequently, the actors we meet, position themselves according to the contexts in which they interact with others. The multiplicity of values produces breaks in rationalization with which the actors manage as best they can. This results in a relative inconsistency of the actors, which is socially constrained. Thus, in differentiated societies as in modern and post-modern ones, adjustments will be more difficult than in more "integrated" ones (Duclos, 1987; Douglas, Wildavsky, 1983; Douglas, 1999). Some actors may appear more reliable than others because of their ability to negotiate, hence the importance of negotiation contexts such as the park charter. Beyond the moral aspect of reliability, the ability to adjust between different rationalities may be the main social skill needed in our time in response to climate change.

The ability to move from one situation to another calls to mind Habermas's discussion about the complexity of modern society and the unfinished process of democratization pursuing by the modern project (Habermas, 1988). The environmental question has only redoubled the impossible quest of modern society for some rational and consensual arrangement. As shown by Godard's reading of Boltanski and Thevenot's essay *De la Justification* (Godard, 1989), the project of a rational environmental policy is hampered by the multiplication of values that have found legitimacy in the history of modernity. According to the authors, the social world is constructed along different orders of worth, which they refer to as "cities", organized around a specific logic and coherence. They distinguish six different cities: the inspired city, the domestic city, the city of opinion, the civic city, the merchant city and the industrial city. These cities are defined by specific modes of understanding and solving conflicts, and so constitute so many different frameworks in which nature policies may be designed. In this social organization, building coherence is near impossible. As a pragmatic example, it is sufficient to ask the question of the harmonization between cities as far apart in their logic and values as the inspired city and the industrial or commercial city or even between the commercial city and the civic city. More broadly, it is also a question of reconciling the quest for universality without denying the irreducible singularity of a territory or a place. This type of impossible equation is at heart of Boltanski and Thevenot's essay, which reveals to us the condition of the modern.

To these considerations, it is necessary to add the uncertainties that weigh on the beings and entities participating in the process of constructing the social world, or at least collaborating in a shared enterprise. The challenges that the actors in the sector have to face involve the ability to associate distinct quantities. They must ensure continuity where it does not exist. From this point of view, building a pacific and rational society isn't as easy as it could seem. This also makes it clear that it is impossible to design a social project on one's own. That a project can sprout in a context of relative isolation is one thing, but that it should remain so while pretending to be universal is more difficult to conceive. What matters, ultimately, is that the stakeholders of the forest-wood branch toned to master of the art of connecting different types of social and technical skills (Stengers, 2007 ; Rudolf, 2015) and of combining different norms in order to achieve social and climate innovation goals.

The norms that guide the actors in the wood-forest sector emanate from different justification logics. The configurations of actors involved include forest scientists, engineers and technicians, representatives of the various professions in the timber-construction sector and customers (real estate companies, public procurement, architects, individual customers,

etc.). While scientists, engineers and technicians belong to professions organized according to explicit norms and rules – derived from the scientific system or public service –, the other actors are less so. Let's say that their system of justification seems to be more inspired by the economic vulgate. Hence, it does not appear reasonable to assume that actors can easily create horizons of shared meaning. The organization of arenas in which meaningful content can be formulated, tested, discussed and shared is of great relevance and importance in a context in which associations of ideas, fashionable trends, etc. have more influence than the logic of proofs.

5. Conclusion

This chapter has attempted to illustrate through a particular economic supply chain - the forest-wood sector - how climate change is integrated in the firms' strategy and whether adaptation pathways or careers can be defined. Proximity to resources seems to determine sensitivity to climate change and the resort to transforming adaptive actions, while the professions using wood like sawyers, carpenters plug the gaps to cope with the difficulties they meet (reactive adaptations). The different stakeholders act according to their interests and their views of nature and the future; that is why it seems particularly relevant to analyze their position and their individual or collective way of acting through Boltanski and Thevenot's conceptual frame.

Besides, the French/German comparison gives insights to analyse the role of particular socio-ecosystems, which develop particular norms, even if they are submitted to similar external injunctions (from economic globalism, wood prices…). The prevailing collective action logics are not the same. While in the Northern Vosges a circular and territorial economic model is emerging at different scales, Germany is based on an economic model which designs products with high added value, even if the wood travels many kilometres.

The connection between sector-based and territorial approaches provides fruitful material and data in order to further study the modalities of action in an "uncertain world" and in reaction to the uncertain consequences of climate change. All the stakeholders face climate change difficulties and opportunities and are aware of the limits of their individual action; sometimes they use this as an excuse for not changing their business, sometimes as a lever for working with others.

However, non-human beings suffer from this absence of global coordination. It can be asked whether the different actions taken to tackle climate change are really sustainable in this uncertain context if the protection of resources (water, soil trees) is not considered. Sustainability and climate change are main concerns for forest preservation, but they do not lead to the same actions and considerations, depending on the interests and the positions of the players of the social game. The concern for preserving forest multi-functionality allows for the free play of the multiple interests of the stakeholders and makes it more difficult to create consistency. It should be noted that putting climate change on the agenda is not enough to provide some consistency. Exclusive emphasis on climate change may lead to undesirable effects: for example, privileging wood as an interesting material, because it stores CO_2, may result in the overuse of forests. Climate change can coexist with many different options, even likely to contradict and neutralize each other. Undesirable effects are always possible. Climate policies should avoid unduly privileging the need to find new sources of energy over the « habitat » functionality.

References

AGGERI Franck, CARTEL Mélodie (eds.), 2017, "Le changement climatique et les entreprises: enjeux, espaces d'action, régulations internationales", *Entreprises et Histoire*, 86: 6–20.
ALEXANDRE Frédéric, GENIN Alain, 2005, "Temporalités dans la biosphère: les trois temps de la végétation", *L'Information géographique*, 69 (3): 45–65.
BARRUE-PASTOR Monique, BERTRAND Georges, 2000, *Les temps de l'environnement, Actes des journées du PIREVS (1997)*, Toulouse, Presses universitaires du Mirail.
BELAND LINDAHL Karin, SANDSTRÖM Camilla, STÉNS Anna, 2017, "Alternative Pathways to Sustainability? Comparing Forest Governance Models", *Forest Policy and Economics* [online], 77: 69–78, available at: 10.1016/j.forpol.2016.10.008.
BOLTANSKI Luc, THEVENOT Laurent, 1987, *Les économies de la grandeur*, Paris, Cahiers du Centre d'études de l'emploi, Presses universitaires de France.
BOLTANSKI Luc, THEVENOT Laurent, 1991, *De la Justification*, Paris, Gallimard.
BRENNER Neil, SCHMID Christian, 2014, "The 'Urban Age' in Question", *International Journal of Urban and Regional Research*, 38 (3): 731–755.
CALLON Michel *et al*., 2001, *Agir dans un monde incertain. Essai sur la démocratie technique*, Paris, Seuil.
CHALLINOR Andy, STAFFORD SMITH Mark, THORNTON Philip, 2013, "Agro-Climate Ensembles: Emerging Tools for Quantifying Uncertainty and Informing Adaptation", *Agricultural and Forest Meteorology*, 170: 2–7.
DIAMOND Jared, 2006, *Effondrement. Comment les sociétés décident de leur disparition ou de leur survie*, Paris, Gallimard.
DOUGLAS Mary, 1999, "Les risques du fonctionnaire du risque. La diversité et la répartition des risques", *Alliage*, 40: 61–74.
DOUGLAS Mary, WILDAVSKY Aaron, 1983, *Risk and Culture. An Essay on the Selection of Technological and Environmental Dangers*, Berkeley, University of California Press.
DUCLOS Denis, 1987, "Douglas Mary, Wildavsky Aaron – Risk and culture. An Essay on the Selection of Technical and Environmental Dangers" (Review), *Revue française de sociologie*, 28 (1): 178–181.
EEA (European Environment Agency), 2017, *Trends and Projections in Europe 2017. Tracking Progress towards Europe's Climate and Energy Targets*, Report no.17 [online], available at: https://www.eea.europa.eu/publications/trends-and-projections-in-europe-2017.
FUCHS Hans-Joachim, 2010, "Analyse und Prognose des Klimawandels in Rheinland-Pfalz", *in* Der Präsident des Landtags Rheinland-Pfalz (ed.), *Die Folgen des Klimawandels für Rheinland-Pfalz*, 44, Schriftenreihe des Landtags Rheinland-Pfalz: 19–28.
GILLARD Ross, GOULDSON Andrew, PAAVOLA Jouni, VAN ALSTINE James, 2016, "Transformational Responses to Climate Change: Beyond a Systems Perspective of Social Change in Mitigation and Adaptation", *WIREs Clim Change*, 7: 251–265.
GOBERT Julie, RUDOLF Florence, KUDRIAVTSEV Alexandre, AVERBECK Paul, 2017, "L'adaptation des entreprises au changement climatique. Questionnements théoriques et opérationnels", *Revue d'Allemagne et des pays de langue allemande* [online], 49 (2): 491–504, available at: DOI : 10.4000/allemagne.606.
GODARD Olivier, 1989, "Jeux de natures: quand le débat sur l'efficacité des politiques publiques contient la question de leur légitimité", *in* MATHIEU Nicole, JOLLIVET Marcel (eds.), *Du rural à l'environnement. La question de la nature aujourd'hui*, Paris, ARF Éditions, L'Harmattan: 303–342.
GODARD Olivier, HENRI Claude, LAGADEC Patrick, MICHEL-KERJAN Erwann, 2002, *Traité des nouveaux risques. Précaution, crise, assurance*, Paris, Gallimard.
GREIVING Stefan, UBAURA Michio, TESLIAR Jaroslav, 2018, *Spatial Planning and Resilience Following Disasters. International and Comparative Perspectives*, Bristol, Policy Press.

HABERMAS Jürgen, 1988 [1985], *Le discours philosophique de la modernité. Douze conférences*, Paris, Gallimard.

HAHN Andreas, KNOKE Thomas, 2013, "Angebot, Nachfrage und Nachhaltigkeit im Wald", *LWF Wissen* (Landesanstalt für Wald und Forstwirtschaft), 72: 123–127.

HAMBERGER Joachim, 2013, "Von der Sylvicultura zur Waldkultur", *LWF Wissen*, 72: 15–23.

HAMBERGER Joachim, 2016, *Aus dem Wald in den Wald. Von der nachhaltigen Nutzung zur Nachhaltigen Entwicklung: Die Geschichte der Nachhaltigkeit*, Bayern, LWF.

JEHIN Philippe, 2005, *Les forêts des Vosges du Nord du Moyen Âge à la Révolution. Milieux, usages, exploitations*, Strasbourg, Presses Universitaires de Strasbourg.

JOCHUM Michael, SEEGMUELLER Steffan, 2016, *Die Forst-, Holz- und Papierwirtschaft in Rheinland-Pfalz. Aktuelle Erkenntnisse*, Rheinland-Pfalz, Forschungsanstalt für Waldökologie und Forstwirtschaft.

KESKITALO E. Carina H., 2008, "Vulnerability and Adaptative Capacity in Forestry Northern Europe. A Swedish Case Study", *Climatic Change*, 87 (1–2): 219–234.

KOVATS R. Sari *et al*., 2014, "Europe", *in* BARROS Vicente R. *et al*. (eds.), *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge, Cambridge University Press: 1267–1326.

LATOUR Bruno, 1999, *Politiques de la nature. Comment faire entrer les sciences en démocratie*, Paris, La Découverte.

LATOUR Bruno, 2015, *Face à Gaïa. Huit conférences sur le Nouveau Régime Climatique*, Paris, La Découverte, Les Empêcheurs de penser en rond.

LINDNER Marcus *et al*., 2010, "Climate Change Impacts, Adaptive Capacity, and Vulnerability of European Forest Ecosystems", *Forest Ecology and Management*, 259: 698–709.

MACDICKEN Kenneth G. *et al*., 2015, "Global Progress toward Sustainable Forest Management", *Forest Ecology and Management*, 352: 47–56.

MULEWF RLP (Ministerium für Umwelt, Landwirtschaft, Ernährung, Weinbau und Forsten und Landesforsten Rheinland-Pfalz), Landesforsten RLP (n.d.), *Der Wald in Rheinland-Pfalz. Ergebnisse der Bundeswaldinventur*, 3.

NORRAND-ROMAND Caroline, 2012, "Éditorial", *Territoire en mouvement* [online], 14–15: 1–2, available at: http://journals.openedition.org/tem/1706.

OESTEN Gerhard, 2004, "Nachhaltige Waldwirtschaft – Ein Modell für nachhaltige Entwicklung?", Consultation of the Council for Sustainable Development, *200 Jahre danach – Wald und Nachhaltigkeit* [online], 11 February, Berlin, available at: https://www.ife.uni-freiburg.de.

PETERCORD Ralf, 2013, "Ohne Waldschutz keine forstliche Nachhaltigkeit", *LWF Wissen*, 72: 34–38.

POLANYI Karl, 1983 [1944], *La grande transformation*, Paris, Gallimard.

RUDOLF Florence, 2015, "Les enjeux de la territorialisation des changements climatiques: les épreuves de la montée en compétence des entreprises à travers l'exemple alsacien", *Pollution atmosphérique* [online], 225, available at: http://lodel.irevues.inist.fr/pollution-atmospherique/index.php?id=4842.

RUDOLF Florence, 2018, "L'injonction à agir vite: une fausse bonne idée", *Temporalités* [online], 28, available at: http://journals.openedition.org/temporalites/5441.

SCHMIDT Olaf, 2013, "Die Wurzeln der Nachhaltigkeit liegen im Wald", *LWF Wissen*, 72: 11–14.

SCHULZE Detlef E., FRÖR Oliver, HESSENMÖLLER Dominik, 2016, "Externe ökologische Folgen von Flächenstilllegungen im Wald", *AFZ- Der Wald*, 15: 24–26.

SERVIGNE Pablo, STEVENS Raphaël, 2015, *Comment tout peut s'effondrer. Petit manuel de collapsologie à l'usage des générations présentes*, Paris, Seuil.

STENGERS Isabelle, 2007, « La proposition cosmopolitique », LOLIVE Jacques, SOUBEYRAN Olivier (ed.), L'émergence des cosmopolitiques, Paris, La Découverte: 45-68.

TALKKARI Ari, 1998, "The Development of Forest Resources and Potential Wood Yield in Finland Under Changing Climatic Conditions", *Forest Ecology and Management*, 106 (2–3): 97–106.

WISE Russel *et al.*, 2014, "Reconceptualising Adaptation to Climate Change as Part of Pathways of Change and Response", *Global Environmental Change*, 28: 325–336.