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MAINTAINING THE INTEGRITY OF THE FRENCH TERROIR ?

Critical Natural Capital in its Cultural Context *

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ABSTRACT

This paper focuses on perceptions of threat to the integrity of France's *patrimoine naturel* as carrier of collective cultural meanings and as biophysical life support infrastructure. First we situate the *patrimoine naturel* concept with its connotations of cultural heritage or transmission, in relation to 'sustainability'. Then we give a recapitulation of results of a recent survey carried out by the French **IFEN** (*Institut Français pour l'Environnement*) exploring perceptions of what are the key categories of 'natural capital' — and their criticalness — for the French society and economy. A review is made of the availability of fundamental categories of 'natural resources' in the French economy, notably energy sources, forest assets, agricultural soils and water resources, and air quality. Finally we focus on natural capital as a life support infrastructure vulnerable to breakdown or contamination. Topical examples show environmental degradation due to pollution, accidents and the production of wastes, as being both serious and widespread. Ecosystem contamination is closely associated with defilement of food — dioxin in chickens, mistrust of GMOs in agriculture and food, and the *vache folle* — mad cow disease.

RESUME

Ce papier analyse les perceptions concernant les craintes pour l'intégrité du patrimoine naturel français, qui est considéré comme un vecteur de significations culturelles collectives et comme un support de vie biophysique. Nous définissons tout d'abord le concept de patrimoine naturel avec ses connotations d'héritage culturel ou de transmission, dans l'optique de la soutenabilité. Nous réalisons ensuite un récapitulatif des résultats d'une enquête récente menée par l'Institut Français pour l'Environnement (IFEN). Cette dernière visait à explorer les perceptions des catégories du 'capital naturel' ainsi que de leur criticité par la société française et l'économie. Un récapitulatif est également effectué concernant les catégories fondamentales de ressources naturelles disponibles dans l'économie française, notamment dans le domaine des ressources énergétiques, des ressources forestières, des sols agricoles, des ressources en eau et de la qualité de l'air. Enfin, une étude du capital naturel, considéré comme un support de vie, est effectuée afin de souligner sa vulnérabilité face aux dégradations ou aux contaminations. A travers des exemples thématiques, la dégradation de l'environnement liée aux pollutions, aux accidents et à la production des déchets, sera identifiée comme étant à la fois importante et diffuse. La dégradation des écosystèmes est très étroitement associée à la contamination de nourriture - à titre d'exemple, les problèmes de dioxine dans les poulets, le manque de confiance dans les OGM en agriculture et dans l'alimentation, et la maladie de la vache folle.

Keywords: Critical natural capital, CRITINC, Cultural heritage, Degradation, Environmental functions, Integrity, Sustainability.

Mots clés: *Capital naturel critique, Dégradation, Développement durable, Fonctions environnementales, France, Héritage culturel, Intégrité, Patrimoine naturel, Terroir.*

“... Something is rotten in the state of Denmark ...”

— Marcellus (an army officer),
Act I, Scene 5

of William Shakespeare's Hamlet, Prince of Denmark

INTRODUCTION : “LE REVERS DU PROGRÈS”

Societies in the Western tradition, having pushed to their limits the concepts of instrumental reason and productive efficiency, have found that they must nonetheless live with two sets of outcomes together — the intended and the un-intended. The first of these categories is linked, in the Western ideology, to Progress. The second is an aspect of what we might call *le revers du progrès*¹ as seen in litter, trash and chemical pollution, urban and rural habitat degradation, industrial accidents, side-effects of medicines, ozone-layer depletion, the as-yet unevaluated mad cow disease, and a great diversity of ‘environmental problems’. Man (*sic*) makes history, but it is not wholly the history that he wants.²

The Western motif of Progress, closely allied to that of purposeful control of nature for production, was forcibly articulated in the famous works of Francis Bacon, Descartes, and Leibniz.³ In contrast with many societies who saw humanity as a permanent cyclical movement of emergence, maturity and dissolution, one finds the persuasive theme of the perfectibility of man through reason, and the perfectibility of nature through the application of reason.

An epitome of this sentiment was the French Marquis de Condorcet, who in his *Sketch for a Historical Picture of the Progress of the Human Mind*, set out to show (1795, pp.4-5):

“by appeal to reason and fact that nature has set no term to the perfection of human faculties; that the perfectability of man is truly indefinite; and that the progress of this perfectability, from now onwards independent of any power that might wish to halt it, has no other limit than the duration of the globe upon which nature has cast us. This progress will doubtless vary in speed, but it will never be reversed as long as the earth occupies its present place in the system of the universe, and as long as the general laws of this system produce neither a general cataclysm nor such changes as will deprive the human race of its present faculties and its present resources.”

Malthus in the *Essay on Population* (1798 and subsequent editions) saw population increase, the natural fecundity of humankind as a biological species, as inevitably outstripping whatever increases in productivity could be obtained from improved technologies applied to a finite land base. Neo-Malthusian sentiments about energy were expressed in the 19th century (Jevons 1865), and then resurfaced strongly during the 1970s in reference to natural resource limits, particularly energy supply. Nature's exhaustion is, however, probably not the most pressing manifestation of the *revers du progrès*. More serious are disruptive environmental effects of production — the side-effects and by-productions. Along with the benefits of technological progress and mass-consumption society come the problems of massive waste production and disposal, and the associated degradation of our habitats, urban and rural. These are among the *unintended effects* of modernisation, which we see as pollution of air and water pollution, the scarring of landscapes, and the attrition of traditional social links and ways. This paper explores some aspects of this phenomenon of the *revers du progrès* as it manifests itself currently in French society.

Part One outlines the key notions of environmental functions and critical natural capital, and then presents the environmental accounting framework developed in France during the 1980s, aiming at

¹ Adapting from *Le revers de la production* (Hanak et al. 1978). See also Latouche (ed., 1977); Dupuy & Robert (1976); Baudrillard (1976); O'Connor (1994a).

² This is the kernel of the Greek notion of tragedy, as for example the Euripidean rendering of *The Bacchae* (Euripide c.400 B.C.) where the unintended effect is death and dismembering.

³ Glacken's *Traces on the Rhodian Shore* (1967, pp.471-503) gives a useful survey. On the real and imaginary march of Progress, see also writers such as Latouche (1989) and Bury (1932).

a systematic inventory of the *patrimoine naturel*. This refers to all elements of landscape, living species and ecosystems that, having been modified through human action and interaction, constitute a part of the 'patrimony' or collective wealth of a society.

Part Two gives a short recapitulation of the results of a recent survey carried out by the French **IFEN** (*Institut Français pour l'Environnement*) which made an investigation of the significance, if any, attached to the concept of critical natural capital in current French society. In this work, a questionnaire was applied to a wide sample of persons active in public administration, industry and the community, active in the environmental policy and resource management domains, exploring perceptions of 'sustainability' and perceptions of the most important categories of 'natural capital' — and their criticalness — for the French society and economy.

Part Three of the paper highlights issues associated with the availability of fundamental categories of 'natural resources' in the French economy, notably energy sources, forest assets, agricultural soils and water resources, and air quality. Though this is not an attempt at an exhaustive inventory or 'state of the nation', it allows a recurrent theme to be noted, of the fragility of natural capital as a life support infrastructure vulnerable to breakdown or contamination.

Part Four turns attention to perceptions of threat to the integrity of France's *patrimoine naturel* considered simultaneously as carrier of collective cultural meanings and as biophysical life support infrastructures. It has in recent years been recognised that environmental degradation due to the production of wastes as unavoidable (and often accidental) by-products of commodity manufacture, transport, and consumption activities, is both serious and widespread. Worse, the suspicion is arising that this distressing side of modern life, while being unsought-after and unplanned, is nonetheless inherent in the pathway chosen by France (along with all Occidental societies). We trace, as topical examples, an array of diffuse and accidental pollutions such as nitrate and pesticide contamination of sources drinking water, heavy metals in the sludge of water treatment plants, oil tanker break-up off the Bretagne coast, and so on.... This phenomenon of ecosystem contamination is closely associated with the defilement of food — dioxin in chickens — and more generally the loss of food integrity ranging from loss of flavour to visceral doubts about the use of genetic modification technologies in agriculture and food, to the public outbreak in the year 2000 of concern about the transmission of the *vache folle* (mad cow disease), to the early 2001 British and European foot-and-mouth disease crisis.

1. CRITICAL NATURAL CAPITAL AND SUSTAINABILITY

In the language of two contemporary biologists, Humberto Maturana and Francisco Varela, the life process is essentially a process of cognition (Maturana & Varela 1987). For the study of living organisms, we can represent the living 'system' in relation to its environment; and then we can apply various concepts, measurements and tools of open systems theory in order to discuss the relationship and co-evolution of this system and its environment (Morin 1977, 1980; Wilden 1980). By extension and analogy, it is possible to consider built economic structures, and ecosystems, as processes or systems that are autonomous on the one hand (with their characteristic internal functioning) and inter-dependent with the rest of the world on the other hand (Friedman 1979; Norgaard 1988; O'Connor 1994b). We realise that a system that is 'open' in this way, can evolve, change or die. An organism aware of its own being, is also aware of becoming: it may change or die. This accounts for why, most often, environmental knowledge (or lack of it) is taken for granted until there is a perceived threat of some sort.

Environmental systems and natural resource stocks provide benefit streams to society. This "natural capital" covers far more than specific minerals and fuel sources, it refers to the earth as a life-support system (Faucheux & O'Connor, eds., 1998). An appealing approach to framing policies for sustainability, is the requirement that present generations' economic activity not prejudice the welfare of generations to come by running down irreversibly the stocks of key environmental assets. Economists in this context have proposed a rule of 'non-negative change' to natural capital — that is, maintenance of the stocks of natural resources such as soil and soil

quality, ground and surface water and their quality, land biomass, water biomass, and the waste assimilation capacity of receiving environments (Pearce, Barbier, Markandya 1990).

Yet, this is not simple. Environmental resources are not just stocks, they are dynamic systems and infrastructures that have a multiplicity of functions including life-support for human as well as non-human communities. The question may be asked, whether or not a given system — economic or ecological — is able to maintain its “integrity” in the face of changing conditions? Such a perspective was well expressed by French economist René Passet who, in *L'Economique et le Vivant* (Passet 1979), tried to reorient economics “to define the conditions which economic activity ought to respect, in order not to compromise the major adjustments of a natural milieu to whose reproduction all others are subordinate.”⁴ For any chosen sustainability problem, it is then necessary to specify the criteria by which durability and integrity will be judged.

One useful concert is that of *environmental functions*, meaning the capacities and performances of natural processes and components to provide goods and services which satisfy human needs. Analysis may proceed on the basis of the proposition that the maintenance in the long-term of economic welfare levels requires the sustaining, in a functional symbiosis, of economic and natural capital. The physical environment is considered as a complex system, and one may speak of (1) the *functioning* of natural systems — the internal regulation, cycles of renewal, evolution and transformation by which biosphere activity is maintained; and (2) the specific roles or services provided by natural systems that support economic activity and human welfare — that is, the environment's *functions* for the human economy.

Based on the work by Roefie Hueting and, more recently in the CRITiNC project by Rudolf de Groot, Sandrine Simon and others, it is now common to regroup the main types of environmental functions under broad categories.⁵ In this paper, we will refer to ‘the five **S**’s’ as articulated by Noël & O'Connor (1998):

- S**ource of biological resources, food, raw materials and energy in various forms;
- S**ink, or place of controlled and uncontrolled disposal of 'waste' products and energy of all sorts;
- S**cenery, covering all forms of scientific, aesthetic, recreational, symbolic and informational interest;
- S**ite of economic activity (including land uses and occupation of space for transportation);
- S**upport for human and non-human living communities.

Various analysts have suggested, building on concepts already existing in environmental economics from the 1950S, that sustainability policy goals or standards for each type of pressure, each type of ecosystem, and each type of environmental function, may be set on the basis of assessment of the requirements to ensure maintenance of the environmental functions in question (Ciriacy-Wantrup 1947, 1952; Bishop 1978; Crowards 1999). An operational approach is then the identification of categories of ‘critical natural capital’ whose stocks ought to be maintained at or above identified minimum levels.

Critical natural capital is defined as any set of environmental resources which, at a prescribed geographical scale performs important environmental functions and for which no substitute in terms of manufactured, human or other natural capital currently exist (see **Box**).

Yet, each country, people or region develops specific qualities of environmental information. It is necessary for diagnosis frameworks to adapt to this fact. Sustainability policy targets have social as well as functional (ecological) dimensions. For example, even if the ecological and economic

⁴ Others who have introduced systems integrity and resiliency concepts into ecological economics include Berkes & Folke (1992), and Common & Perrings (1992) taking inspiration from Holling (1973).

⁵ The pioneering argument is found in Roefie Hueting (1980); see also Hueting (1992). A detailed analysis and classification framework for environmental functions was developed by de Groot (1992). In the context of the CRITiNC project, this framework has been adapted and refined; for an overview see Paul Ekins (2000); see also Ekins & Simon (1999).

requirements of tropical forest and ocean fish stock maintenance were well-known, questions still arise about stewardship of which forests (or fish), where, for whom?

In France, the development of environmental information has been marked by the major effort, during the 1980s, at the production of systematic accounts for the nation's *patrimoine naturel* (natural heritage). The year 1986 saw the publication of a monumental tome, *Les Comptes du Patrimoine Naturel* (INSEE 1986) which laid out the conceptual framework and accounting schemas and which brought together already a large range of empirical information.

Answering the obvious question, what is meant by the generic term *patrimoine naturel*, the 1986 report's *Introduction* states that this can be given a first response in terms of the **elements** or **components**: continental and ocean waters, soil, air, primary materials and energy, animal and plant species. It is then insisted that, as a complement to the exhaustive listing and categorisation of elements, there should be a division by **geographical zones** or **territories**; and this is closely linked to the description of **ecosystems**. Finally, the fact that there is an interest in the subject at all, implies that there are human **agents** involved.

In sum, the *patrimoine naturel* is to be inventoried as a set of **elements**, associated with various categories of **ecozones** having territorial extension, and relating to the interests and usages of various human **agents** in the French society

(see **Figure 1**, on next page, from *Comptes*, p.66). Yet, this does not yet explicitly explain the specific term *patrimoine*. For this, we must situate the accounting concern within the French societal heritage. According to the *Comptes* report (p.35), a patrimony is an inheritance from the past and/or an accumulated wealth transmitted to future generations. It may be enjoyed, passed on, or dilapidated. What makes the natural patrimony particular is therefore the dual quality that it is an element or geographical zone of nature that (a) is *attributed a value by human society* and (b) is *susceptible to change*.

The definition thus excludes elements wholly produced by human hands (e.g., shoes or buildings, even if the raw materials are 'natural'); it equally excludes such elements as the sun and the stars or mountain masses, that are substantially exogenous for the span of human concerns. But it emphasises the human social process that invests an element or ecozone with value, with a value or significance (in French, *signification*) that is, at least potentially, to be transmitted into the future.

Social groups differentiated by place, time, cultural heritage, collective identity, life experience and hence preferences, will have widely divergent sustainability priorities. In the setting of norms, it is necessary to choose among the various particular economic and ecological outcomes that might be feasible within the framework of longterm sustainable activity. Hueting speaks of *competition for scarce environmental functions* for situations where the use of one environmental function is at the expense of some other function (or someone else's use of that same function). This is the case, for example, when productive uses of the environment impede its use for recreational purposes. It is equally true when choices must be made between alternative nature conservation strategies relating to habitat protection.

Identifying Critical Natural Capital

Making applicable the CNC concept requires the following considerations to be addressed:

- identifying the role and significance of different natural capital systems for supporting sustainable economic activity. This includes quantifying the effects of each economic use/user category, through determining scientifically the causes of environmental effects (depletion, contamination, congestion, etc.) and relating these causes back to the emissions, extraction or occupation patterns of particular human activities.
- defining the relevant spatial and temporal scales for which the environmental functions and, hence, the natural capital systems may be critical;
- identifying the social and cultural factors which may contribute to making critical any natural capital components; and
- the weight of the Precautionary Principle when environmental function losses in question are characterised by scientific uncertainty and irreversibilities.

Refer to Figure 1 (end of document)

"Structure du Système de Comptes du Patrimoine Naturel"

This competition implies there will have to be choices made as to the precise environmental functions, features or activities to be maintained or sustained.⁶ With the French concept of *patrimoine naturel*, the framing of sustainability is immediately seen to be a socio-cultural as well as ecological-economic affair. The notion inherent in the *Comptes* of a *social transmission of values* makes sustainable development, in the French context, not just a material business of maintaining ecosystem functions but, first and foremost, a *socially meaningful affair* — the receiving of a heritage from the past, and the passing on of this tissue of values to the generations to come. We see from this that, surely, there will be social as well as physical reasons for defining natural systems as *critical* natural capital. Non-built environments are often cherished for recreational, aesthetic and spiritual reasons, in ways that impose strong limits to their substitutability by manufactured goods and services. The conservation and enhancement of ecosystems as habitats for non-human life, and for living biological diversity, may be motivated by ethical convictions of respect and coexistence. (Sometimes this is expressed in terms of existence values or intrinsic value.)

More particularly, French communities that constitute their identity by locality, by regional appurtenance, by their territorial inheritance and their *terroir* (an untranslatable French word that connotes the local soils, spaces and symbolic relations of production), tend to identify features of their food production, cuisine, buildings and wider habitats as ‘critical’ patrimony in view of their symbolic as well as functional significance in defining group identity.⁷

This suggests that, in the French society, in order to appraise issues of sustainability or non-sustainability, we should specifically consider perceived threats to the integrity of these patrimonial values and to the collective transmission of meanings.

2. THE IFEN SURVEY OF (PERCEPTIONS OF) CRITICAL NATURAL CAPITAL IN FRANCE

During 1999 a research study was initiated by the *Institut Français pour l'Environnement* (IFEN) which aimed at obtaining insights into the perspectives of different interest groups and individuals in French society about those features of the natural environment (*milieu naturel*) considered to be of critical importance.⁸ The technique used was a mailed written questionnaire (see **Appendix One**), which was sent to a wide range of persons and/or organisations concerned with sustainable development issues in French society.

The questionnaire, carefully structured, was essentially exploratory in character. Three neighbouring terms — *capital naturel*, *ressources naturelles*, *patrimoine naturel* — were deliberately used in proximity to each other, in an effort to let respondents choose their preferred vocabulary. One of the questions indeed, was the extent to which the concept of ‘natural capital’ and, more particularly of ‘critical natural capital’, has currency in France and, to the extent that it does, what it is taken to connote. The questionnaire was structured in three parts, focussing respectively on:

⁶ The notion of ‘competition for access to scarce environmental functions’ was systematically developed in Hueting (1980). See also, on the notion of distribution of sustainability, O'Connor & Martinez-Alier (1998) and O'Connor (1997). The complexity of the norm setting process is discussed by Funtowicz, O'Connor & Ravetz (1997). A cultural dimension of systems sustainability is evoked by Berkes & Folke (1992, 1994) and by Norgaard (1988).

⁷ For a highlighting of this dimension of French economy and community, see de Montgolfier & Natali (1984) and Godard (1990). More recently, with particular regard to agricultural community, see e.g., Beuret (1998); DRAF de Bretagne (1999); DIREN Région Bretagne (1998); Landais (1998); Pujhol & Dron (1999).

⁸ The study is reported in IFEN (2000), *Le Capital Naturel Critique: Analyse Bibliographique et Consultation d'Experts*, *draft* report produced by the Institut Français pour l'Environnement, Orléans, under the French Ministry for the Environment (MATE) research contract DGAD/SRAE No.98-162, June 2000. A revised definitive report is forthcoming in the IFEN series *Etudes et Travaux*, in 2001. The report is in French. Where we consider that significant connotations are contained in the specific French terms employed, we place these (*entre parenthèses*) in italics.

1. points of view or judgements linked to the **specific activities of respondents**, e.g., their work within a firm or corporation in a public administration, environmental or community organisations (Part 1 of the questionnaire);
2. points of view or judgements concerning '**society as a whole**', that is, **the collectivity** (notably French society) and also '**future generations**' (Part 2 of the questionnaire);
3. points of view and judgements concerning '**sustainable development**' (Part 3 of the questionnaire).

In this short presentation we will not summarise all the questions and responses. We focus on those questions and analyses that bear directly on the 'inventory' of what is critical in the French natural patrimony.

Part 1 of the IFEN questionnaire asked respondents to respond on their basis of their own particular domain of activity (business, administration etc.).

Question 2 of Part 1 asked: "*What are the natural resources or the natural capitals that appear to you as potentially critical in the sense that their disappearance would seriously put in question the development, or the very existence, of your activity today or in the future?*" The format invited a list of up to five, in decreasing order of importance.

- The responses clearly placed **water** in the leading category, followed by **ecosystems** (linked to biodiversity) and **countryside** (*paysage*), then followed by **species** (also linked to biodiversity), and thereafter **air, energy resources, materials, soils** and **climate**.

Question 4 of Part 1 asked: "*What are the reasons why these natural resources or these natural capitals appear to you as potentially critical?*" Six possible reasons were listed, and respondents were asked to indicate, for each of the five 'critical' categories they had identified, whether or not each of these possible reasons was felt to apply. A table was supplied, within which respondents could place a tick (etc.).

- The reason most often affirmed was *high economic or strategic importance*; followed by *vulnerability to degradation, absence of substitutes* (or high cost of substitution) and *irreversibility*. Then followed *high social and cultural value* and, last, *scarcity*.⁹

Question 5.1 of Part 1 then asked the respondents to reconsider their listed categories of Q.2, and to answer: "*What are the natural resources or the natural capitals that appear to you as actually today critical for your activity today?*", in the sense of being at present under threat.

- The responses again placed **water** in the leading category, followed by **species, soils, countryside** and **ecosystems**. Energy is absolutely not considered as a critical problem today, whereas air and raw materials are viewed by a significant minority as under threat today.

Question 5.2 of Part 1 asked the same thing for threats "*... in the medium or long term*".

- The results differ significantly compared with the profile of immediate threat. In the medium/long term, the leading categories of preoccupation are **material resources, energy** and **species** at risk. Then follow the ubiquitous categories of **water, soils, countryside** and **ecosystems/territory**. Open space in France is listed as under serious threat by less than half the respondents.

Part 2 of the questionnaire asked respondents to address the collective point of view in the long term. Therefore some significant differences of emphasis are to be expected, since it is the future society rather than particular existing activities that is the focus of attention. The same set of questions, suitably modified, was posed. The significant differences are as follows:

Question 10 of Part 2 asked: "*What are the natural resources or the natural capitals that appear to you as potentially critical for the collectivity, in the sense that their disappearance would seriously put in question the satisfaction of the needs of future generations in France?*" The format again invited a list of up to five, in decreasing order of importance.

- The responses again placed **water** in the leading category, followed by **air** and then **biodiversity (ecosystems and species)**, then **countryside** (*paysage/territoires*) and **soils**. Remaining low on the list are energy resources, materials and climate.

⁹ The key words of the categories are here placed in *italics* and not **bold**, because they were supplied by the questionnaire and not by the respondents autonomously.

Question 11 of Part 2 asked, again: “What are the reasons why these natural resources or these natural capitals appear to you as potentially critical in the long term?” The same six possible reasons were offered and a table was supplied to be filled in.

- The leading reason is vulnerability to degradation followed by absence of substitutes (or high cost of substitution) and then, in decreasing frequency, high economic or strategic importance; irreversibility, high social and cultural value and, again last, scarcity. The criterion of vulnerability is particularly attached to ecosystems/biodiversity and to countryside/landscapes. Difficulties with substitution applies to raw materials and also species diversity, but not so strongly to energy resources.

Question 12 of Part 2 then asked the respondents to reconsider their listed categories of Q.10, and to answer: “What are the natural resources or the natural capitals that appear to you as actually today critical for the collectivity?”

- More than 90% listed biodiversity/ecosystems as critical for the collectivity, followed closely by **species, water and air quality**.

Question 14 of Part 2 asked: “What indicators should be developed in order to monitor the changes in critical natural patrimony in France over the next 30 years?”

- The responses are quite varied and wide ranging. Broadly speaking they confirm the evaluations of ‘criticalness’ suggested by the patterns of previous questions. The most frequently stated domains are **water, species/ecosystem diversity, soils, countryside/landscape**, and **air**. Much less frequently mentioned are climate, energy resources and raw materials.

Question 15 of Part 2 asked respondents to specify: “In your own region, what are the components of natural patrimony that appear to you as potentially critical for the collectivity, in the sense that their disappearance would seriously put in question the satisfaction of the needs of future generations in France?”

- The distribution of respondents between regions is uneven. Broadly speaking they confirm once again the evaluations of ‘criticalness’ suggested by the patterns of previous questions. The most frequently stated domain is **water**, followed by **ecosystem diversity, soils, countryside/landscape**, and **air**.

It is noteworthy that water, ecosystems and countryside (*paysage et territoires*), then soils and species, are persistently present in responses. Availability of ‘open space’ is not, in itself, a burning issue in France (compared with, for example, the much more dense populations of rural England or The Netherlands). Yet, there is a heightened sensibility to the vulnerability of the countryside and of the various elements that support the French wealth and way of life. High on almost every list are water, air quality, soils, and biodiversity — the components of patrimony of the productive and aesthetic countryside.

Much less frequently mentioned are climate (notwithstanding international debates) and energy resources and raw materials (notwithstanding evident economic importance). If these latter are not conceived as ‘critical’, this is not because they are ignored. Rather, the issues of ensuring adequate supply for energy and materials are not of the same sort as the perceived vulnerability of the countryside to qualitative degradation or decay.

In **Part Three** and **Part Four** of the paper, we will pick up on some of the key categories of French *patrimoine naturel*, in order to develop some interpretations which bring out the social-cultural dimension of the judgements as to what is “critical” and why.

3. THE ASSET BASE: TAKING STOCK OF THE (NATURAL) RICHES OF THE FRENCH NATION

In this Section we review some aspects of the current French situation and outlook for four broad categories of natural capital use or degradation — energy resources, forests, water, and atmosphere (or, more exactly, issues of air quality and atmospheric pollution).¹⁰ In the case of each of energy,

¹⁰ We will mention soils only in passing, in relation to water quantity and quality. The reasons that we can do this, notwithstanding the great importance of agricultural production in France, are that (a) potentially productive land area is not ‘scarce’ in France at the present time (on the contrary, in the context of EU over-production and price subsidies, there are policies to encourage ‘set aside’ and reduction of intensity of cultivation), and (b) there is no rapid change to soil quality and quantity *per se* (viz., arable land in France is not subject to major erosion or sand invasion, etc.). However, the soils in many French regions are not naturally very deep or fertile. Increases in productivity have frequently been achieved through

forests and water, we will see that the economic and strategic significance of resource stock management and supply security is plainly in view. Yet, the perceived priority issues from a sustainability point of view all relate to *vulnerability* of the *terroir* or of the countryside (*paysage et territoire*) to qualitative degradation or decay. In the case of air, which is as a 'natural resource' is not yet characterised by a 'managed' supply, the essential issues are immediately of quality degradation of various types and scales.¹¹

3.1 France's Energy Sources

France's primary energy is composed in part of transportable raw materials (coal, oil, gas, uranium) and in part of fixed exploitation sites (hydro, wind...) which can feed a grid distribution system. However, the country has relatively small domestic reserves — less than 0.1 per cent of the planet's energy stocks, and only 1.2 per cent of the world's energy production (to be compared with having 2.5 per cent of the world's consumption). So, on the face of it, energy supply is a vulnerable point for French economic sustainability. Being relatively poorly endowed with fossil fuel, France currently imports oil, coal and gas—

- Half of the coal consumed in France is imported. French coal stocks are officially estimated at about 200 million tonnes; by comparison the United Kingdom's stocks represent 5000 million tonnes compared with more than 20 000 million tonnes for former West Germany.
- The gas field of Lacq supplies 10 per cent of French needs, the rest is imported.
- Almost every oil product is imported.
- Almost all the major accessible sites for hydro energy are already exploited.
- For nuclear energy, France has large stocks of uranium, disposing of 3 per cent of 'proven' world stocks (order of 100 000 tons). It has been, over recent years, the leading producer of Western Europe (even though partly for price reasons and partly for strategic reasons France currently chooses to import from overseas much of the uranium used in its commercial reactors).

The relatively poor French fossil energy endowment is shown up by recent Eurostat compiled statistics for selected European countries. The Eurostat Task Force on subsoil assets concluded a recent round of work (in June 1999) which was focused mostly on oil and gas and included the definition of reserves and resource rent, calculation of values of reserves and ownership issues. Because the costs of proving reserves are quite high, extraction companies do not prove more than needed for maintaining their activity during a limited number of years, typically 5 to 10 years. As shown by the following tables, with few exceptions, reserves after tens of years of intensive extraction are higher than at the beginning of the recording period. However, the relative country endowments contrast greatly — notably, France's "proven" reserves are quite small.

Gas reserves (billion m³ — Source: Eurostat)

	Initial year	Initial Reserves	Final year	Final reserves	Total extraction
Norway	1984	2910	1997	4820	338
United Kingdom	1977	773	1997	1271	1091
France	1980	65	1995	21	57
Austria	1975	14	1997	32	24

mechanisation of farming and intensive use of inputs from the outside (fossil energy and, more especially, chemical fertilisers and herbicides) and irrigation practices. This has resulted in the now characteristic profile of chemical contamination of groundwater and surface water, and (as will be discussed in Section 4) of foodstuffs themselves.

¹¹ Biodiversity and living genetic variety within French ecosystems deserves a fuller treatment than if afforded in this paper. In a very incomplete way, we will indicate some of the considerations in relation to forest resources, food and agriculture, and controversies surrounding GMOs (genetically modified organisms) in food and agriculture (Section 4). Another major category that we do not discuss is fisheries resources and marine ecosystems.

Oil reserves (million tonnes; source: Eurostat)

	Initial year	Initial Reserves	Final year	Final reserves	Total extraction
Norway	1984	1677	1997	4113	1282
United Kingdom	1977	1915	1997	1134	2159
France	1980	14	1995	16	41
Austria	1975	23	1997	15	25

The ambitious French energy policy pursued in the wake of the 1973 oil crisis was composed of three main aspects: developing the domestic energy production, mainly provided by the electro-nuclear programme which needs great investments; the diversification of the energy balance and foreign supplies; a policy for energy savings and research into new energy sources. By the early 1990s a new profile of energy supply had been stabilised, based around nuclear electricity. Generation of nuclear electricity increased from 2 per cent in 1973 to 34 per cent of total energy production in 1992 (which is about 70% of French electricity production),¹² while hydroelectricity remained stable at 7 per cent. The share of coal greatly diminished, whereas use of natural gas has increased.

Yet, the “downstream” issues associated with energy use energy production and use — that is, the localised and dispersed impacts relating to the environment’s roles as site and ‘sink’ — look, currently, to be more problematical than the source/supply constraints in themselves. French policymakers will need to make decisions about replacement of the first reactors built in the 1970s, their dismantling (after 2015), and possible world tensions concerning uranium stocks. The big looming issue is what to do with radioactive reactor wastes. Another set of questions concern the international agreements to limit greenhouse gas emissions, as framed at Kyoto in late 1997. Under the terms of pre-Kyoto agreements within the European Community (see *Council Conclusions on Climate Change* of 3 March 1997), the Community as a whole had stated a commitment to achieving 15 per cent reduction compared with 1990 levels of a weighted basket of greenhouse gas emissions, including notably CO₂, CH₄ and N₂O. For France, taking account of its high nuclear-electric capacity, the provisionally indicated agreed target for 2010 was to not exceed the 1990 emissions level. Given the high dependence in France on oil products for car and truck mobility, achievement of GHG emissions stability will not be an easy target.

3.2 France’s Forest Assets

The French are proud of their *patrimoine naturel*, and of the beauty of their “natural” spaces — which are large by comparison with several European neighbours (notably England and The Netherlands, and on a per capita comparison with Germany) which are major sources of tourists (along with others from overseas) who spend extensive summer holidays and other *randonnées* there.

Woodlands and forests are a major component of the countryside (*paysage*) and are associated with much of the species and ecozone diversity — the biodiversity as well as landscape qualities — featuring in the responses to the IFEN survey. The “naturalness” of most of the forests would, of course, be disputed by environmentalist purists; these forests have been exploited, modified, managed, replanted and reconstructed over long periods of time. This is hardly a “wilderness” concept of nature. The very concept of *patrimoine naturel* carries the presumption of a human influence within the ecosystems being transformed and transmitted through time.

France’s woodlands and forest resources are relatively important on a European scale, partly because the temperate climate and regular rainfall means that regeneration is quicker than in more

¹² The electricity generation capacity now outreaches domestic demand, and exports of electricity to neighbouring European countries have become a significant item, increasing from 25 TWh in 1986 to 45 TWh in 1990 and remaining high since. For an overview of these trends, see P. Meral, P. Schembri & E. Zyla (1994).

northern or arid climates. The wood resource is significant as a productive input, including both construction and specialised uses (e.g., oak for wine barrels). Wood resources can be transported and much wood is, indeed, imported into France. However the forest as a scenic/recreational resource and as a biodiversity is not transportable. Woodland degradation through pollution is, at present, a relatively minor concern. In the wake of the December 1999 tempests that massacred millions of trees in wide swathes across western and central France, questions have, however, been posed about the 'health' of the forest patrimony.

We can furnish a quantitative profile of the French forest resources through retaking some results of the application in France of the European Framework for Integrated Environmental and Economic Accounting for Forests (IEEAF).¹³ As a part of Eurostat's work on Environmental Accounting the IEEAF framework was developed, tested and refined by a Eurostat Task Force which started in 1995. The objective of the IEEAF is to link forest balance sheets and flow accounts for land and timber, forest-related economic activities and the supply and use of wood within the economy, in a consistent way in both physical and monetary terms and, in a next step, to also integrate monetary and physical data on non-market environmental and protective functions of forests, on biodiversity, the health status of forests, etc.

In order to implement the IEEAF a first set of 10 main tables was developed covering monetary and physical balance sheets for land and standing timber, economic accounts of forestry and monetary and physical supply-use tables.¹⁴ The four Member States covered by the first set of pilot applications (Germany, France, Finland and Sweden) represent 60% of wooded land area in the European Union (and 70% of forest land area). Based on the results of the pilot applications the following overview of the forests of the four reporting countries can be given:

- Nearly 85% of the forests are reported to be 'available for wood supply', ranging from 78% (Sweden) to 94% (Germany).
- Almost all forest 'available for wood supply' is more or less regularly managed. As could be expected, in European Union countries natural forests constitute very small areas and are normally situated in areas designated for protection reasons, i.e. 'not available for wood supply'.
- Between 4 and 11% of the total forest area has some form of protection status. The proportion of protected areas increased significantly over the reporting periods (5 years). The absolute increase is about 760 000 ha for all reporting countries.
- The stock of standing timber is about 10 billion m³ over bark.
- The annual growth of standing timber (after deduction of natural losses) is about 360 million m³ over bark — i.e. about 3.5 % of the stock of standing timber.
- The annual fellings are about 220 million m³ — i.e. about 2.2% of the stock of standing timber.
- The annual growth exceeds fellings by about 140 million m³, which represents a net increase of about 1.4 % of the stock of standing timber per year.

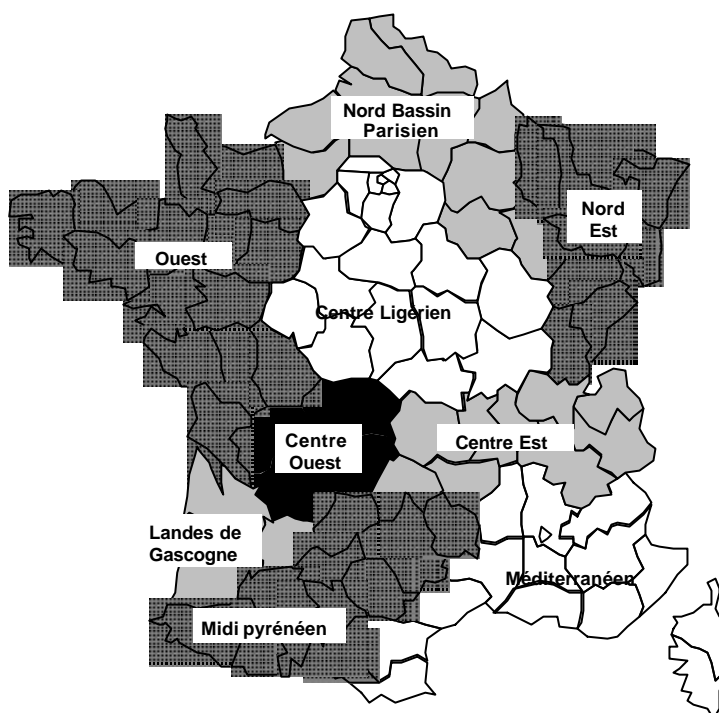
The reported value of forests (land and standing timber) is on average 5000 ECU/ha. The total value of forest assets is 280 billion ECU or 8.6% in relation to annual GDP at market prices in these four countries.

A pilot exercise to set up regional forest accounts is under way in France. Under a contract with Eurostat B1, France (ENGREF, in co-operation with IFEN) has experimented with the application of the IEEAF at a regional level. The main objective so far was to identify homogeneous forest regions on the basis of their characteristics as regards the wood supply function. French forests have been divided into nine regions (see map below). Changes in land use and characteristics according to some exploitation parameters have been calculated.

¹³ We are grateful to Anton Steurer from Eurostat for having made available these results from current reports produced at Eurostat (see also Steurer 2000).

¹⁴ The results of the first set of pilot applications of the IEEAF have been published as 'The European Framework for Integrated Environmental and Economic Accounting for Forests: Results of pilot applications' (European Commission 1999, Series 2D, Eurostat catalogue number CA-22-99-329-EN-C). The handbook 'The European Framework for Integrated Environmental and Economic Accounting for Forests' has also been published in 1999. Publication of the second set of pilot applications is under way.

Changes in land use from and to forest have been established for the nine regions (see **Table (a)** on next page) on the basis of the Teruti survey for the 1986 to 1996 period. Results are preliminary but show the different dynamics of the forests in the nine regions, e.g. due to agricultural land abandonment, urbanisation, etc. Some regions show a very high increase in forest area (West and Mediterranean forests), while for other regions (North East and Alps) the increase is very slow; for the 'Landes' region (one of the most productive forest areas) there is a decrease due to the pressure of agriculture and urbanisation.



Characteristics as concerns the wood supply function have also been appraised. The nine regions present very different characteristics as concerns the wood supply function — see **Table (b)** on next page. The volume of standing timber per hectare ranges from 221 m³/ha (North East region) to 85 (Mediterranean). Total removals represent 85% of the increment in the Paris basin and 39% in the Mediterranean region. However, in most regions (except the south west 'Landes' region) the commercial part of the removals is much lower than total removals.

Table (a): Changes in land use by forest region (in hectare)

	North East				Mediterranean			
	Wooded land	Agricultural land	Other land	Land under structures	Wooded land	Agricultural land	Other land	Land under structures
Gross flows	133 200 7,0%				848 000 33,1%			
Net flows	54 200 2,8%	-100 300	-13 900	60 000	506 000 19,7%	-238 300	-308 500	40 900
Afforestation	93 700 4,9%	-44 800	-38 600	-10 400	677 000 26,4%	-232 100	-421 600	-23 300
Deforestation	-39 500 -2,1%	24 900	6 700	7 900	-171 000 -6,7%	46 200	100 500	24 200
Other flows		-80 400	18 000	62 500		-52 400	12 500	40 000
Final area	1 965 800	2 354 800	131 400	378 800	3 069 800	2 221 400	1 712 600	519 400

	Centre East (Alps ...)			West (Brittany)		
	Wooded land	Agricultural land	Other land	Wooded land	Agricultural land	Other land
Gross flows	428 900 26,9%			189 600 17,5%		
Net flows	45 300 2,8%	-78 400	-13 500	92 200 8,5%	-352 800	94 900
Afforestation	237 100 14,9%	-80 300	-143 700	140 900 13,0%	-84 300	-48 600
Deforestation	-191 800 -12,0%	98 900	54 300	-48 700 -4,5%	26 800	14 400
Other flows		-97 000	75 800		-295 300	129 100
Final area	1 637 300	2 462 200	645 600	1 178 000	7 169 600	436 900

	Centre West					Centre				
Gross flows	139 200	13,0%				241 700	10,5%			
Net flows	51 900	4,9%	-94 400	15 200	27 200	83 800	3,7%	-164 500	-11 400	92 000
Afforestation	95 600	8,9%	-46 900	-43 100	-5 500	162 800	7,1%	-64 100	-78 800	-19 800
Deforestation	-43 600	-4,1%	25 500	10 600	7 600	-78 900	-3,4%	32 400	24 500	22 000
Other flows			-72 900	47 700	25 200			-132 800	43 000	89 700
Final area	1 121 300		1 731 900	151 400	221 200	2 377 500		5 574 100	328 200	793 900

	Landes					Paris Basin (North)				
Gross flows	118 000	9,5%				138 200	10,3%			
Net flows	-5 600	-0,4%	-15 500	-10 200	31 300	100 700	7,5%	-184 700	2 900	81 100
Afforestation	56 200	4,5%	-17 500	-32 700	-6 000	119 500	8,9%	-76 300	-33 800	-9 400
Deforestation	-61 800	-5,0%	29 900	19 700	12 200	-18 800	-1,4%	11 100	3 900	3 800
Other flows			-27 800	2 900	25 100			-119 400	32 800	86 700
Final area	1 240 800		882 700	120 100	249 800	1 438 600		4 720 800	181 500	661 400

	Pyrenean				
Gross flows	169 500	10,5%			
Net flows	74 500	4,6%	-201 700	55 200	72 000
Afforestation	122 000	7,5%	-61 400	-58 400	-2 200
Deforestation	-47 500	-2,9%	29 500	11 900	6 100
Other flows			-169 700	101 700	68 100
Final area	1 692 700		3 253 200	527 900	371 200

Table (b): Standing volume, increment and removals

Region	Standing volume m ³ /ha	Increment m ³ /ha/yr	Commercial harvest in % of increment	Total removals in % of increment
Paris Basin	168,4	7,5	48,1%	86,6%
West	136,3	7,0	46,4%	68,2%
Centre	144,9	6,7	34,5%	58,0%
North East	221,2	8,8	48,2%	79,4%
Landes	164,9	8,5	68,0%	74,8%
Centre West	146,7	7,3	46,8%	58,6%
Centre East	201,8	8,6	27,7%	57,2%
Pyrenean	127,9	5,2	29,9%	55,6%
Mediterranean	85,5	3,4	22,4%	39,2%
France	154,0	7,0	41,4%	65,4%

These figures give an overview of the quantitative extent of French forests. It is remarkable that, at the present time, their quantity does not seem to be under any immediate threat. Indeed, the quantity of wooded or forested area in France is slightly increasing year by year.

The apparent lack of pressure on national wood resources is partly due to imports of wood and timber, e.g., from the Cameroon and other African sources.¹⁵ In this respect, France may be « importing » its sustainability at the expense of some other regions of the world.

There are also some concerns expressed locally about the sustaining of the French forest patrimony. Immediately after the Christmas 1999 freak tempests that brought down trees in wide swathes across France and stretching into Switzerland and Germany, comments were made in numerous quarters that the damage was more serious than it might have been because of “neglect” of the forests. This judgement was offered as much towards woodlands managed as non-commercial patrimony (private domains as well as regional parks, etc., under state management) as towards forests oriented to commercial production. In effect, the question was posed of a possible ‘loss of integrity’ of the social-cultural-territorial space.

It is not easy to make an ‘objective’ appraisal of the basis (or not) of this perception.¹⁶ Forest scientist Jean de Montgolfier (2000) offered an interesting commentary on the losses occasioned by

¹⁵ For example, as documented by Lescuyer (2000), there is a significant presence of large forestry exploitation companies with major French ownership, in several African countries including the Cameroon. Much of the cut logs are destined for export, including to Europe. This is one way for France to reduce pressure on its own forest reserves...

¹⁶ A good spectrum of ‘opinion’ and information is to be found on website: <http://ac-grenoble.fr/CARMI-Pedagogieitindex.htm>

the tempests. He noted that, in quantity terms, around 120 million m³ of standing timber was uprooted or broken, which can be compared to the total volume of some 2000 million m³, the annual regeneration of about 70 million m³, and the average harvest of slightly over 50 million m³. The damage was often more severe in plantations established and managed with a preoccupation for low costs and high 'productivity' reasons — namely, areas of trees having all the same age, and plantations of certain fast-growing or high value tree species in conditions far removed from their 'natural' conditions.

3.3 (Soils and) Water Resources — Quantity and Quality

Ecosystems and the countryside are highly rated in the IFEN survey as critical categories of natural capital. Analysis by the IFEN on a canton basis (a canton is a grouping of adjacent communes) establishes a breakdown of about 22% of cantons in large-scale agricultural production, 10% in forest cover, 10% with dominant urban cover, and 'complex' or mixed landscapes with fragments of agriculture, fragments of woodland, fragments of prairie for most of the rest. The 'patchwork' landscape that integrates productive land use with villages and then forested and unexploited spaces, is indeed the landscape so dear to the heart of the French people (and, in many cases, of the tourists too). A quantitative breakdown on the basis of area (rather than administrative unit) is available using the CORINE Land Cover geographical information system (GIS) data.¹⁷

In a first rough approximation, France's productive soils may be considered as an unchanging 'catalyst' of land cover (including agricultural production).¹⁸ Water, on the other hand, is the mobile agent (it falls, flows, trickles, floods, infiltrates, percolates, resides and so on) that, on the one hand, may be polluted in itself and, on the other hand, and given the non-arid character of most French regions, is the medium that 'holds' and transports many pollutants that, from another point of view, are contributing to soil contamination.

Water resources, we have seen, are at the top of the heap in terms of perceived 'criticalness' of French natural patrimony needing to be husbanded. An enormous quantity and variety of statistics are available in France on water use and water resources. These cover, notably:

- The volume of water extractions from surface and underground sources, classified by sector of use (agriculture, industry, town supply), region by region;
- The volume of water extractions by user category and by resource type at the national level;
- The volume of water consumption by user type at national level;
- An estimation of the renewable fresh water resources within continental France
- The holding capacity of major dams in relation to principal water uses.

France is one of the pioneers in Europe for the testing of concepts and empirical procedures for systematic accounting for water. For some years the Eurostat Task Force on Water Satellite Accounting has worked on consolidating a framework and sets of tables for Water Satellite Accounting, taking into account results from pilot studies by Member States. The Task Force has, in 1999, investigated the use of monetary data from the national accounts and discussed outstanding issues such as the concept of 'scarcity of water' and the linking of data on water flows between the economy and nature to a description of water in nature, building on French experience with water quality and quantity accounts. An example of accounting results for water

¹⁷ CORINE stands for Co-ordination of Information on the Environment, and refers to a unified GIS data system operated by the European Environmental Agency in co-operation with the individual EU member states. In France, much of the responsibility for maintaining and for facilitating the exploitation of CORINE data falls to the IFEN. We are grateful to François Levarlet for his information on the IFEN's work with CORINE land cover data. See also the website presentation: <http://www.ifen.fr/pages/3clature.htm>.

¹⁸ It may seem excessive and naive to present the soil resources as 'static' in this way. An index of the relative stability of French rural land use is the durability of walkways traversing farmland and forests, often dating back centuries.

quality at a fairly aggregated level, is given in the **Table** below, as compiled by IFEN researchers and translated into English at Eurostat.

Accounts of the Quality of Watercourses in France

organised by quality class (organic matter) and by size class of watercourses, in standard kilometre-river (1km stretch with a flow of 1 m³/s)

Size class	1992 state					Differences by quality class					1994 state				
	1A	1B	2	3	HC	D1A	D1B	D2	D3	DHC	1A	1B	2	3	HC
(Big) Rivers	5	1253	891	510	177	3	336	9	- 183	- 165	8	1583	893	358	12
Large rivers	309	1228	1194	336	50	16	464	- 275	- 182	- 22	325	1691	919	154	28
Rivers	260	615	451	128	47	44	130	- 129	- 17	- 28	306	749	322	110	18
Brooks	860	1464	690	243	95	- 44	- 176	228	15	- 23	810	1295	917	258	72
Total	1434	4560	3226	1217	369	19	754	- 167	- 367	- 238	1448	5318	3051	881	131

Note: the difference between the 1994 and 1992 states is not always identical to the difference as shown in the columns 'Differences by quality class'.

With the spread of large scale irrigation practices, industrial uses and generally rising per capita domestic consumption, quantitative limits to France's God-given water assets are now a major object of management concern. To date, however, it is undoubtedly the degradation of water quality rather than quantitative scarcity that is the dominant preoccupation. Although 'progress' is often cited in the mastery of specified categories or regions of water pollution, there are new announcements almost weekly of contamination thresholds being transgressed — notably for drinking water supplies, implying the closure of extraction points and/or the need to take urgent remedial action.¹⁹

3.4 Atmosphere and Air Quality

The atmosphere that we breath is undoubtedly a critical natural capital. And, the menaces to air quality and to the services that the atmosphere provides are as many and diverse as the atmosphere services themselves.

Due to historically lower intensity of heavy industry in urban areas and also climatic factors, French society has been relatively less afflicted by urban atmospheric pollution than, by comparison, Germany and England. At present, however, it is admitted that there are significant health costs of current urban pollution and, in the context of European norms and directives, a higher profile is gradually being given to the problem.²⁰

Many emissions from combustion processes are sources not only of local air quality degradation but also of long-range pollution. This is notably the case for acid rain precursors (principally sulphur dioxide and nitrogen oxides) and for emissions of greenhouse gases (carbon dioxide and, in the case of natural gas leaks, also methane). The third major category of long-range atmospheric pollutants is CFCs (cloro-fluoro-carbons) and other molecules that contribute to the degradation of the stratospheric ozone layer. All of these pollution categories have been the object of international agreements and negotiations. So they have a clear profile in French environmental and technology policy. In effect, the key questions being posed in each case are: (1) how urgent is the reduction of the pollutants world wide? (2) what is the appropriate contribution of France to this reduction? (3) what will be the cost and/or inconvenience to the French economy and to specific sectoral interests within the economy?

¹⁹ The C3ED's case study in the CRiTiNC project, focussing on water pollution due to agricultural production in the Bretagne region, included a detailed appreciation of the water-soil matrix (Douguet & Schembri 2000; Douguet, Noël & O'Connor 2000). See also Commissariat au Plan (1997), Conseil Economique et Social de Bretagne (1988), Bretagne Eau Pure (1998); IFEN (1998), Giovanni (1998), Sebillotte (1999), Amorsi (2001).

²⁰ Useful information sources in this regard are: <http://www.airparif> and <http://www.ademe.fr>. An example of the state of the art, which more constitutes monitoring and diagnosis than, as yet, concerted action for change, was the conference PRIMEQUAL-PREDIT held at Toulouse on 29-30 November 2000, sponsored by the French Ministry for the environment and the ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie); see <http://www.predit.prd.fr>.

- Concerning acid rain, there is little current discussion in France. The air is a "vector" of damaging forces rather than a sink; and it is the water/soil that would be the "critical" natural capital potentially at risk. By comparison with more northern European neighbours, the French nation (policymakers and public) do not feel themselves or their territory as being significantly menaced. Nuclear energy and the phasing out of coal some years back, mean that acid deposition loads are "sub-critical" on most of the French territory. So, despite being embroiled in some technology controversies (notably concerning the *pot catalytique*) the French are essentially "followers" rather than initiators of international policies.²¹
- The attitude concerning CFCs and the upper atmosphere ozone layer somewhat parallels that of acid rain precursors. France is not exposed to the immediately noticeable effects of the thinning of the ozone layer (for instance, there is nothing like the rise in sunburn and skin cancer incidence in France, as is seen in fair skinned populations in some southern hemisphere countries such as Australia and New Zealand). The main preoccupation in France with negotiations to phase out the production and use of CFCs has therefore been at the level of industrial strategy: several major French companies had important stakes in CFC manufacturing and in the wake of international protocols in the 1980s were forced to adjust (Faucheux & Noël 1990; Theys, Faucheux & Noël 1988 ; Megie 1989).
- Concerning greenhouse gas emissions and climate change, the problem is defined as global rather than national in scale. Since the 1980s it has been widely asserted that, through its choice to invest heavily in nuclear electric capacity, France has already contributed substantially to reduction in GHG emissions (and acid rain precursors). Be that as it may, within the Kyoto agreements dating from 1997 and whose application is currently uncertain, France's part is to assure a 0% increase in GHG emission for 2010 (that is, the window 2008–2012) compared with the 1990 baseline levels. Prospects for respecting this target are highly uncertain.²² At the popular level, since 1998 there have been periodic flurries of debate within French society, as to whether "unseasonally" warm winters or wet summers, or freak tempests (notably in December 1999) can be attributed to *changement climatique*...

4. THE DIS-INTEGRATION OF THE TERROIR ?

The science of thermodynamics tells us that purposeful production will always be accompanied by unwanted wastes and disruptive environmental effects. This becomes a global social problem. As development theorist Gourlay (1992) writes:

The more we consider the industrialised world of today, and the Third World of tomorrow, the more we realise that we live in a world dominated by waste, a World of Waste, most of it undesirable, and that unless we do something about it, humanity may disappear under its own detritus, and the world we know with it.

The Paris *métro* (underground inner city railway) from the turn of the 20th Century helped reduce the volume of horse manure and stench in the city. Later still the flush toilet transported highly diluted human wastes to an elaborate under-the-street sewerage system... Today, a regular frustration of city traffic is to be stuck behind a *camion-poubelle* (rubbish collection truck) which is picking up domestic and commercial premises' refuse in a narrow Paris street. Another distinctive feature of the city life is the army of small trucks and workers, carrying bright green logos "*Paris Propre*" (Paris Clean!) engaged in the sweeping and washing of the streets.

It has become possible to imagine that mass-consumption is a pure good. Not only does the market deliver the enjoyable "goods and services," but by the combined efforts of technological

²¹ For some discussions of the acid rain politics at the European level see: H. Wüster (1992); and Castells & Funtowicz (1997). Concerning the French internal politics of 'what to do' around the acid rain emissions question, see Roqueplo (1988), Faucheux & Noël (1990) and Hourcade, Salles & Théry (1992).

²² As examples of the abundant literature at the European level, see van den Hove (ed., 1998), O'Connor, Faucheux & van den Hove (1998); O'Riordan & Jäger (eds., 1996). Simulation modelling addressing the feasibility of the French Kyoto targets is presented by Schembri (1999a, 1999b).

ingenuity and a benevolent social authority (the state, along with municipal powers, etc.), the "bads" and dirt are suppressed and tucked away out of sight. Cleanliness is close to Go[od]liness.²³ Yet, the novelty and incessant innovation that is the mark of the technological society, is matched by the novelty of *uncontrolled ecological change* due to pollution and habitat disruption. Equally dramatic is *uncontrolled social change*. Trans-nationalisation of investment, the routine transportation of commodities and manufacturing inputs between continents, and increased consumer affluence and mobility, all contribute to social fragmentation, placing stress on "traditional" community structures and solidarity as well as on ecosystems. French social scientist Serge Latouche (1989), has observed:

The individualist worldview is like a yeast for the decomposition of social ties. It eats away at the tissue of traditional solidarities like a cancer. The thing that renders individualism irresistible, is that to each individual it appears as a liberation. It emancipates, in effect, from constraints and opens up unlimited possibilities — but at the expense of the solidarities which constitute the fabric of social collectivity.

In the context of concern for *natural capital*, one is tempted to transpose the argument onto the "biophysical" solidarities that, in the Strong sustainability perspective, are the necessary underpinning for durable economic and social well-being.

It is illustrative to consider the history of marine supertanker disasters. The first big supertanker disaster was that of the *Torrey Canyon* in 1967, liberating 117000 tonnes of crude in the English channel (north of France) in a black tide that made headlines world-wide. In 1978 *the Amoco Cadiz* foundered on the Brittany coast, pouring more than 200000 tonnes of light crude into the sea, the worst disaster of this kind in volume terms. No lives were lost, but direct clean-up costs exceeded 600 million French francs (about US\$100m), with additional uncompensated adverse impacts on the regional tourist industry, and difficult-to-quantify damage to marine and coastal ecosystems. In 1989, the wreck of the *Exxon-Valdez* on the coast of Alaska liberated 38000 tonnes of crude. The *Amoco Cadiz* and *Exxon-Valdez* spills have been decisive events in the evolution of compensation law and also in the applications of economic valuation methods in litigation and jurisprudence. However, the accumulated experience does not seem to have led to decisive improvements in tanker maintenance or safety. In December 1999, again off the coast of Brittany, the *Erika* foundered and broke in two parts, releasing a large part of its more than 30 000 tonnes of heavy fuel oils.

In the case of the *Amoco Cadiz*, the question of "compensation" payments for damages, and for costs incurred in the clean-up period after the oil-spill, was resolved only after protracted court hearings in the United States. But, the payments made were decided within the frame of legal liability and "proof" of damages having taken place. Several claims against the tanker owners were dismissed wholly or in part by the judges.²⁴

After the foundering in December 1999 of the *Erika*, there was an outcry about the absence of adequate regulations in the European Union zone providing for legal liability in the case of accidental oil spills.²⁵ It was revealed that the tanker was in a lamentable state of non-maintenance, and that the crew members seemed to have little relevant expertise, and so the whole process of ship licensing (flags of convenience and so on) became once again a talking point. Questions were posed about the true character of the cargo, notably the suggestion that it contained, at least in part, not just heavy fuels but also waste by-products of refinery processes having a highly toxic (carcinogenic) nature. A legal judgement during in late 2000 asserted that

²³ A scattered but extensive literature exposes these links between preoccupations with cleanliness as a moral dimension, and the technical and economic dimensions of public health and waste disposal services. For example, Boyer (1969); Douglas (1966, 1971, 1973, 1984); Illich (1972); Jouarre (1899); Laporte (1978). As-yet unpublished work by Patrick Jolivet at the C3ED (Université de Versailles St-Quentin-en-Yvelines) explores the notions of a "partnership" that should exist between the Technical Universe (represented by, e.g., municipal authorities) and the members of a Household, to ensure the efficient and pain-free disappearance of packaging, sanitary waste and other overflows of modern household life.

²⁴ A definitive French source on these matters is Bonnieux & Rainelli (1991).

²⁵ A European directive is "in the making" but not yet in force; and in any case the current facilities for surveillance and enforcement of envisaged rules are inadequate in most European countries (including France: see for example Canard Enchaîné, 8 November 2000).

the cargo transported in the *Erika* was within the specifications for heavy fuel. But, this legal decision has not much reduced the widespread attitude that the whole affair has come about due to an excessive preoccupation with commercial advantage and low costs at the expense of public interest, ship maintenance and environmental security...²⁶ Nor were matters helped when, within a few months, other major oil spills in high seas took place, including one just off the Galapagos Islands which is one of the ecological treasures of the world...

The rusty *Erika* and its oil slick arrives as a symbol of the deepening sentiment on the part of many members of the French public that they are witnesses to a *marée noire* — a generalised black tide — of degradation of their physical environment and quality of life.

Take another, slightly whimsical example. In 1999 it was discovered that some chickens and also eggs produced in certain Belgian poultry farms (which are really factories) contained easily measurable traces of dioxins, a family of highly toxic chemicals that are by-products of various manufacturing and combustion processes. The subsequent inspections revealed that, to varying degrees, dirty waste water and sump oil were “inputs” into the poultry production processes... The dioxin component was unintended, but the ‘recycling’ of dirty water (etc.) was intentional. Belgian chickens (and eggs) became highly suspect — another reason for the French to make jokes about the Belgians. In the ensuing months, a great part of egg production in France and in Belgium miraculously became ‘organic’ (*les œufs biologiques, en français*). Several major cases of fraud concerning supposedly ‘organic’ poultry feeds or supposedly eggs labelled ‘organic’ that were not, were subsequently brought to light. The French satirical newspaper, in July 2000, introduced its thematic *Dossier du Canard No.76*, with the following declamation:²⁷

En matière d'alimentation, aucun risque de manquer d'imagination! Des poulets à l'huile de vidange aux camemberts à l'eau oxygénée, l'actualité nous démontre chaque semaine que l'inimaginable peut devenir réalité...

(Translation: When it comes to food, there is no risk of lack of imagination. From chickens with sump oil to camembert cheese made with oxygenated water, current events show us each week that the inconceivable can become reality...)

The dioxin in the Belgian chickens is another metaphor. It stands for many similar “scandals” that are intruding like a kind of pestilence into the images (some would now say the illusions) that producers, retailers and, on the other side of the counter, most French people as consumers, had sought to maintain concerning the quality and ‘integrity’ of French food with its rural economy and countryside connotations. Three grave issues now combine with the many ‘minor’ stories of food fraud and farce, to plunge the whole agro-alimentation industry (and the consuming public) into a deep state of unease. These are:

- (1) chemical contamination of drinking water, notably with nitrates from fertilisers and animal wastes, with pesticides from farm and other uses, but also with many other items including — an old unintended effect — lead (Pb) contamination due to the use, up until 1995, of lead metal in the piping of water distribution networks...
- (2) The confirmed presence of ‘mad cow disease’ — in French *la vache folle* — in herds of several European countries including France (and fears of possibly widespread presence in countries where screening has not yet taken place)²⁸

²⁶ A variety of websites permit an appreciation of the debates, including: <http://www.ac-grenoble.fr/CARMI-Pedagogie/itindex.htm>; <http://www.defense.gouv.fr/marine/actu/erika>; <http://www.marenoire.com>; <http://www.marenoire.org>; <http://belle-ile-en-mer.org>. Not everybody was reassured when it was learned that the French government had made an agreement with TotalFinaElf (the shippers of the *Erika*'s cargo) that put the latter in charge of communications concerning the operations of attempted salvage of the thousands of tonnes of heavy oil still within the hold of the sunken ship (see <http://www.totalfinaelf.com/erika/index.htm>).

²⁷ Canard Enchaîné (2000), *Qu'est-ce qu'on Mange Encore? Nouvelle enquête au fond de nos assiettes*, Les Dossiers du Canard Enchaîné No.76 (July 2000), p.5. In fact, the Canard Enchaîné had published a similar Dossier two years previously (Canard Enchaîné (1998), *Qu'est-ce qu'on Mange? Les Dossiers du Canard Enchaîné No.68*, Paris, July 1998). The catalogue of bizarre contaminations, suspect food processing and doubtful marketing practices is, sadly, based carefully on established facts.

²⁸ At the time of revising this article (March 2001), there is also a major outbreak of the more classical “foot-and-mouth disease” amongst sheep in the United Kingdom, with risks of spread to other parts of Europe.

- (3) Controversy over the introduction of genetically modified organisms (GMOs, in French *organismes génétiquement modifiés, les OGM*) into agriculture and, more generally, into processes of food production.

The *vache folle* — Mad Cow disease — crisis is, at the end of 2000, taking on major economic and political proportions across the European Union. Revelations of infection, and of possible pathways of infection via transports — more or less illicit — of cattle feed made with suspect animal inputs (etc.) and non-observation or non-quarantining of infected animals (etc.), are likely to persist through at least 2001. The financial and societal repercussions for the farming sector (in France and elsewhere in Europe) are very far-reaching. All of this deserves a separate discussion. However we confine attention to just a few basic points.

- First, the economic repercussions are already very heavy, even while knowledge of the extent of infections and of the transmissibility of the disease remains very incomplete.
- Second, it is agreed that, whatever the other factors playing their part, a major cause of the fiasco (in Great Britain first of all and then, once the U.K. situation became publicised in the mid-1990s, in France and other European countries since) has been the tendency, despite risks, to seek low costs for beef production and low disruption of the sector — the perverse result being very high costs and very high disruption (not confined only to the beef producing sector).
- Third, an illustration is given of the complexity of biological processes and ecological systems — including the pathways of infection and of transmission from one species to another of a cause of sickness — and of the irreversibility of the “unintended” innovations introduced by human agency.
- Fourth, a striking sensation is conveyed of the loss of integrity of basic foods and, beyond and beneath that, of our biological and environmental life-support conditions.

This is the context in which debates about the introduction of genetically modified organisms (GMOs) into food and agriculture in Europe are now taking place.²⁹ At the end of 1996, a controversy about GMOs emerged in the media and in the wider public sphere. New and diverse actors became involved, including not only environmental and consumer NGOs, but also farmers, food retailers, and scientists. During 1997-1998, government policy on agricultural GMOs began to oscillate in response to demands for a more precautionary approach to environmental and health risks and for more transparent and participative decision-making procedures. The controversy was further fomented in December 1998 when the French high court (*Conseil d'Etat*) repealed the authorisation for cultivation given for the transgenic maize at the centre of the debate, arguing that the government had not taken sufficient account of the precautionary principle. By the end of 1998, transgenic crops had become a focal point for broader controversies about science, technology, and environmental risks in France. In June 1999, demonstrating a reversal of its 1996 position, the French government called for (and in effect obtained) a moratorium, at the level of the European Union (EU), on any further authorisations for the commercialisation of GMOs.³⁰

In June 1996 France was, within the EU, the Member State with the most supportive policy toward the introduction of GM crops and food onto the market. By June 1999, the situation was reversed and France had become one of the most obstructive EU Member States.³¹ In the intervening period, the Centre-Left-Green coalition government (led by Prime Minister Jospin) that came to power in late 1997, had oscillated its position concerning permits for GMO cultivation, and had

²⁹ This is also the context in which, now, discussions about stockage and disposal of nuclear reactor wastes are taking place, a point to which we return shortly.

³⁰ This summary is based on the documentation by Claire Marris (2000), “Swings and Roundabouts: French Public Policy on Agricultural GMOs 1996-1999”, *Cahiers du C3ED No.00-02*, Université de Versailles St-Quentin-en-Yvelines, Guyancourt. This paper is part of the work carried out in the project Public Perceptions of Agricultural Biotechnologies in Europe (PABE), funded by the European Commission (contract FAIR-CT98-3844) during 1998-2000, co-ordinated by the CSEC (Centre for the Study of Environmental Change), Lancaster University, U.K.

³¹ At the European Council of Ministers on 25 June 1996, France was the only government to support the application by Novartis for the authorisation to commercialise a GM maize (Bt176), whereas at the meeting of this same Council on 25 June 1999, the French government, (with Greece) led a call for the suspension of all further authorisations for the commercial release of GMOs.

announced various measures aimed to improve transparency for the public, notably the intention to launch a broad public debate on GMOs (notably, in 1998, via a Consensus Conference).³² Questions of food security and GMOs had become the object of numerous discussions involving scientists, agricultural sector organisations and individuals, public authorities, NGOs and the general public.³³ On the 5 June 1999 a group of more than 50 persons including leaders of the *Confédération paysanne* (notably José Bové and René Riesel) and several dozen Indian farmers, forced entry into a CIRAD research establishment at Montpellier and destroyed several thousand plants of a genetically modified rice.³⁴ Shortly after this, at a French cabinet meeting on 23 June 1999 the Jospin Government decided that it would call for an EU level suspension of further authorisations for the commercial release of GMOs at the European Council of Ministers to take place on 24-25 June 1999. Four countries supported the French position, sufficient to create a de facto moratorium. Seven other countries signed a separate declaration which also urged for caution with regard to the commercialisation of GMOs. This meant that no more authorisations for the commercial release of GM crops and foods would be issued in the EU.³⁵

Putting the GMO concerns in a wider sociological context, shows a compatibility of doubts over possible risks associated with genetically modified organisms in agriculture and food technologies, with wider but typical French concerns with the integrity of their *terroir* (products of the land) and *patrimoine* (both cultural and physical environment heritage). One can thus discern deep socio-cultural reasons for the emergence of suspicion about the GMOs and, more widely, for the economic and technological forces that they have come to represent. The same reasons are at work in the French society's reactions to the *vache folle* and other food quality and health security scandals, as we have seen.³⁶

5. CONCLUDING REMARKS

Once the 'reverse side of progress' is admitted as an inherent by-product of the historical choice of modernity, what can we say about the ways that different socio-cultural frameworks either enhance or inhibit capacities for response? French society, along with many others, is entering the phase of a general *paradox*, which involves the invention of policies and governance practices that seek self-consciously to manage these 'unintended' (and so often negative) dimensions of social, technological and environmental change. What is the influence of particular socio-cultural

³² The French 1998 Citizen's Conference was organised following the model of Danish Consensus Conferences. After 2 days of debate, the panel retired for 24 hours to produce a report. The main recommendations addressed issues of better information (including separation of risk evaluation from commercial interests), prudence in the face of uncertainty. A full report is available at <http://www.senat.fr/opicst>.

³³ An example is the Forum-Débat on "Sécurité Alimentaire et Santé du Consommateur" held on 17 May 2000 at the Ecole Normale Supérieure Sciences in Lyon; see AGRO PROJETS ETUDES (2000).

³⁴ The CIRAD is the Centre de Coopération Internationale en Recherche Agronomique pour le Développement. Its work in the GMOs field has become controversial partly because of accusations of a heavy influence of GMO companies on the research orientations (meaning that, rather than the companies subsidising public good research, the public purse is allegedly financing private commercially oriented research...). The persons arrested on charges of wilful damage (etc.) are — as of early 2001 — yet to be tried.

³⁵ In May 2000 it was reported on the front pages of major French papers that fields had nonetheless been planted in several EU countries (including France, the UK and Sweden) of an insecticide resistant genetically modified colza (destined for oil production). The seeds of the genetically modified variety had supposedly been mixed "by error" with those of non-modified varieties. More generally, the controversy surrounding environmental release and marketing of GMOs has become a stimulus for a wide-ranging debate in French and European policy circles about the need for new types of regulatory procedures to deal with a great range of policy challenges related to new technologies, food quality, health security and environmental risk.

³⁶ Cf. Benoit Browaeys (1999), Apoteker (1999), Ecoropa (1997), Marris & Joly (1999). Further examples could be cited that reinforce the thrust of this diagnosis. The revelation that there are significant concentrations of a variety of toxic "heavy metals" in the "sludge" that is extracted from sewage treatment plants and that has, "traditionally", been spread onto farmland as a source of nutrients, is a case in point. Once again, there was a long interval between some knowledge that this contamination was probably the case, and a public admission of the problem. Some plots of farmland were taken out of production (more or less definitively) after the extent of the "unintended" contamination was revealed...

frameworks on the ways that people — individually and in groups — perceive, adapt to and cope with these unintended effects?

Georges Bataille in *La Part Maudite* (1967) suggests that driving forces of a cultural group can be understood by investigating what it does with its produced surpluses and wastes. In the French context, the “agricultural surpluses” currently posing problems are not just the subsidised and unsold foodstuffs but, more particularly, the nitrates and pesticide residues that stray into the air, soil and water. The “energy surpluses” that currently are causing the most concern are not the nuclear-electric kWh sold by Electricité de France across the border to European neighbours, they are the still overly (radio)active nuclear reactor wastes in need of eventual disposal.³⁷

At the beginning of the 1970s French nuclear programme, waste disposal was not an urgent problem. By the mid-1980s, there was an increasing amount of radioactive waste to be stored, and environmental organisations were becoming more vociferous about the long term consequences associated with the waste management options. Among international experts, a convergence was taking place towards geological disposal as the reference solution. In the late 1980s the French National Agency for Radioactive Waste Management (ANDRA) began design studies for underground laboratories. This awoke some violent expressions of opposition from local populations as well as from concerned environmental groups. This was the context for the French *Loi Bataille* (1991) which established a *Commission Nationale d'Evaluation* and sought a new process for evaluating options for high-level radioactive waste involving all stakeholders. This work is still going on, and is envisaged to draw conclusions by about 2006. A policy decision has been made that the stockage/disposal should be within the metropolitan French territory — that is, in “the Hexagon”. This makes the national territory into a critical natural capital, where the question is to establish the territory’s capacity to receive and to store various qualities and quantities of radioactive wastes that will be active for tens, hundreds or thousands of years! So far, there is no sign yet of an “agreed” solution. Despite careful technical and geological work on underground rock storage concepts, the ANDRA and other organisations has not yet found a clear willingness on the part of any local community in France to accept to “host” the wastes.

The question arises, why are the reservations or uneasiness so strong, whereas the French public has relatively readily accepted the nuclear production choice over the past 30 years? There is not yet a clear explanation. Maybe it is related to a diffuse sense of potential “violation” of the integrity of the French space, once again the *terroir*? This is a hypothesis that might be explored in sociological work that remains to be done.

It is noteworthy that the ways that doubts and mistrust are expressed over the *marée noire* of eventual environmental defilement and decay, are visibly moulded by a specific “political culture”. French society is characterised by a strong polarity between, on the one hand, the managing elites who affirm for themselves (and are ascribed by the public to be supposed to have) a technical and managerial competency and, on the other hand, the public themselves who affirm a somewhat fatalistic “irresponsibility” and who readily admit that they will live (or die) with the outcomes of whatever decisions that might be taken — or, in the case of breakdowns in competent regulation, not taken — by the powers-that-be.

This polarity is visible, for example, in the way that the French public has accorded responsibility on nuclear safety issues in the past. It is also visible, at another level, in the ways that members of middle class households conceive of the “partnership” that should exist between the *Technical Universe* (represented by, e.g., municipal authorities) and the members of a *Household*, in matters of domestic waste collection and disposal. In a recent empirical study of householders’ attitudes concerning waste and rubbish disposal carried out in suburban Paris, the householders perceive very clearly that it is a responsibility of the public authorities to ensure putting in place an efficient and pain-free waste-disappearance system. Their own duty or responsibility is also affirmed; but this is strictly delimited to the appropriate transporting of the rubbish-filled plastic bags (often being precisely the supermarket sacs which come in filled to overflowing with useless packaging...) out the door and into the storage room or bin in the street. Notions of sorting (*tri*) and recycling

³⁷ For some interpretative analyses, see for example, reports from the CEC project RISKPERCOM, on <http://www.move.to/riskpercom>. Also Barthe (1998), Hériard Dubreuil (1998), Hériard Dubreuil, Schieber & Schneider (1998); Poireau & Zurita (eds., 1999).

manifest the same dichotomy: if the system is made easy, household members say, they will sort their waste; but (they ask) is there really a process of recycling going on out there?³⁸

A comparable polarity is visible in ways that many French people make observations on breakdowns of regulatory competency or effectiveness (e.g., the current *vache folle*, but also past and ongoing scandals including *use of asbestos* in schools and other public buildings, distribution of *blood known to be at risk of AIDS contamination...*). These are perceived as unfortunate and outrageous, and they are the sorts of events that justify the ordinary French public to adopt a cynical view of the silliness and myopic self-interest of many members of the governing classes and the Technical Elites. But, this outrage is largely fatalistic — for the great majority of French people it is not strongly converted into any social or political commitment towards reform.

Such a fatalistic outlook has been equally noted in the case of opinions expressed by a variety of French people concerning risks that may be associated with genetic engineering. In a diffuse sort of way, people are quite aware of possibilities of wide-ranging ecological ramifications and, more particularly, modifications to “human nature” itself.³⁹ But again, although this is disquieting, the unease does not spontaneously flow over into a notion of political or regulatory reform.

We may say, using Wittgenstein's (1978) language, that “awareness” is not just a matter of “opinions,” but rather a matter of people displaying, individually and collectively, *different forms of life*. This study has put sought to give an interpretative analysis of priorities and preoccupations in French society, with the maintenance of ‘critical natural capital’. It has been shown that French people express, in a variety of ways, a strong preoccupation with maintaining integrity of their environmental space and ecosystems, where this is to be understood in the sense of the *terroir*, as the quality of food, as the identity and integrity of an organism, or the relation of oneself to one’s origins and symbolic space. Hence, in the French culture, sustainability has much to do with ‘holding’, renewing, maintaining unbroken an (umbilical cord?) that is signalled by the *patrimoine* — a ‘tradition’. In this respect, French society as a whole is not strongly ‘Progress’ oriented; rather (despite a certain fascination with technological sophistication) it is deeply change-resistant. Whether or not this ‘conservative’ tendency can be a positive force for sustainability as a creative *projet de société*, is deeply uncertain and remains to be seen.

³⁸ This interpretation is supported by unpublished work being undertaken as part of a doctoral programme of studies by Patrick Jolivet at the C3ED (Université de Versailles St-Quentin-en-Yvelines). On French contexts of domestic waste and refuse, see also ADEMA (1996), Maresca & Poquet (1994).

³⁹ This is highlighted in interviews and discussion groups that took place within the European Commission funded project *Public Perceptions of Agricultural Biotechnologies in Europe* (see Marris 2000). In one group the question was asked, “What does a sheep become when you put human genes into it?” — and conversely, when does a human become no longer human? The ontological categories become blurred.

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Figure 1 : "Structure du Système de Comptes du Patrimoine Naturel"

