ECOLE POLYTECHNIQUE

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

CHANGING BUSINESS PERCEPTIONS REGARDING BIODIVERSITY: FROM IMPACT MITIGATION TOWARDS NEW STRATEGIES AND PRACTICES

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September 2009

Cahier n° 2009-29

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Abbreviations*

Abstract: Business activities play a major role in biodiversity loss and, as a result, firms are under increasing pressures from stakeholders to reduce their negative impacts on living systems. In response, business attitudes, behaviors and strategies regarding biodiversity are progressively changing, suggesting that interactions between business and biodiversity could go beyond the search of a compromise between development and conservation. This paper proposes an analysis of business perceptions regarding biodiversity. In its first part, we discuss how biodiversity is usually perceived as an external environmental constraint on business activities, and how economic tools may be used for arbitrages in that context. Building upon our work on the Business and Biodiversity Interdependence Indicator (BBII), we then discuss how assessing a firm's interdependences with biodiversity may bring about new business strategies and practices. We propose a typology of firm behavior regarding biodiversity and ecosystem services (BES), discuss business opportunities and property rights issues pertaining to markets for ecosystem services and propose preliminary conceptual foundations of new business standards needed to reverse current biodiversity trends.

Keywords: biodiversity; business; strategy; payments for ecosystem services; impact mitigation; standards.

JEL Classification: M20, M40, Q20

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*Business and Biodiversity Interdependence Indicator (BBII); biodiversity and ecosystem services (BES); ecosystem services (ES).
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1 – Introduction

During the past few decades, firms have been under increasing pressures from stakeholders to reduce their impacts on the environment. Ecological issues have become key strategic variables for them, notably in terms of disclosures (Cho and Patten, 2006; Cormier et al., 1993) now mandatory in many countries (e.g. New Economic Regulation law for France from 2001). Bellini (2003) argues that businesses have progressively taken environmental issues into account under the impulsion of three types of arbitrage: legislative or normative, economic and technical. Within that context, biodiversity is still an emerging issue for most businesses. A real awareness of the links between business and biodiversity loss is of concern mainly to large corporations and multinationals, the businesses most visible to the general public and those directly involved with living systems such as agribusiness. These are the ones most likely to be subject to pressure from stakeholders, including non-governmental organisations, local communities and Corporate Social Responsibility (CSR) rating agencies. Since decision VIII/17 was taken in Curitiba in March 2006 at COP 8 of the Convention on Biological Diversity (CBD), the business community has been asked, through the launch of the “Business and Biodiversity” initiative, to contribute actively to the objectives of the CBD. Supported by the European Commission, this initiative calls for the adoption of best practices to reduce the impacts of businesses on biodiversity and promote its conservation.

Business attitudes, behaviors and strategies regarding biodiversity are progressively changing. Our approach to understanding interactions between businesses and biodiversity seeks to be complementary to measures and mechanisms for biodiversity conservation. In this paper, we do not discuss corporate responsibility towards nature[3] but seek to analyze how changing perceptions regarding biodiversity influence business strategies and practices. First, we study (a) how business usually perceive biodiversity, that is as an external environmental constraint on its activities (impact mitigation approach), and (b) what (and how) tools may be used for arbitrages in that context. Building upon our work on the Business and Biodiversity Interdependence Indicator (BBII), we then discuss how assessing a firm’s interdependence with biodiversity may bring about new business strategies and practices. We propose a typology of firm behavior regarding biodiversity and ecosystem services (BES), discuss business opportunities and property rights issues pertaining to BES markets and propose preliminary conceptual foundations of new business standards needed to reverse current biodiversity trends.

2- Biodiversity understood as an additional constraint on business activity

2.1 Internalizing environmental externalities

From a neoclassical perspective where the field of economics is defined as the science of allocating rare means or resources to alternative uses (Robbins 1932), our environment is seen as an exception to typical collective goods, one for which consumption by an agent may lead to the degradation of the good itself. The choice of the term ‘environment’ is not neutral: the “environment” belongs to no one in particular, while components of ecosystems, whether exhaustible or renewable, may be appropriated by individuals or firms, potentially generating externalities. Environmental problems, understood as negative market externalities, hence put into question the Pareto optimums associated with supposed perfectly competitive markets.

[3] See Bazin (2009) for a recent analysis of associated theoretical paradigms

The lack of price signals likely to be integrated into the decision-making processes of economic agents fosters the need to internalize environmental externalities. This led to the development of the field of environmental economics, with at its theoretical core the evaluation of variations in consumer surplus so as to help individuals reveal their preferences (Pearce and Markandya, 1989). As environmental externalities have materialized into predominant collective preoccupations, neoclassicists have strived towards finding the adequate allocation rules, and associated management systems, for their internalization (Vivien 1994; Panayotou 1994). On the one hand, Pigou’s approach (1920), based on the difference between private and social costs, seeks under state control to find the optimum pollution level through a taxation mechanism (polluter pays principle). This calls for the use of cost-benefit analyses (CBA) which do not necessitate a clear environmental aim. On the other hand, the Coasian tradition (1960) poses the problem in a different way as it seeks to maximize the value of collective production, by minimizing production and transactions costs. Further developments of the theory of externalities have focused on the implications of Coase’s theorem in terms of property rights, transaction costs and institutional arrangements, hence looking at the efficiency of arbitrage between economic agents (Ragni 1992; Vivien 1994). Complementary families of economic tools have been tested so far: taxes, subsidies, quotas, prohibitions, norms, licenses to operate, property rights, rights markets, tradable permits. These measures are implemented to limit actions of agents and/or to help agents find the solutions themselves.

Biodiversity, defined as the dynamics of the interactions between organisms in environments subject to change, has only recently been analyzed through the lenses of the theory of externalities. The concepts of ecosystem processes, function, services and benefits have been useful to help us understand how biodiversity contributes to economy and social welfare (MA, 2005). According to Perrings et al. (2009), “…*humans derive benefits from consumptive and non-consumptive use of ecosystem services*”. Yet, benefits from the latter may be negatively impacted by ecosystem degradation generated by the biodiversity externalities of consumptive use of ecosystem services (ES). Conflicts can arise with respect to the use of a resource or ecosystem (e.g. fisheries, livestock farming) which poses the ‘classical’ challenge of limiting free access to resources. This refers to what Hardin (1968) incorrectly named the “*tragedy of the commons*”; in reality it is the “*tragedy of free access*” (Weber and Revéret, 1993; Ostrom et al., 2002), since common property rights prohibit free access. Conflicts can also arise with respect to the same resource or ecosystem. This is due to. interactions between agents with respect to (a) interactions of different uses and (b) their impacts on other ES, both at a local level (e.g. use values for local communities and tourists) and more global one (e.g. option and existence values) (Trommetter et al., 2008). For instance, trees may be used for their wood (lumbering, collecting firewood) but also for their leaves, bark, fruits or genetic materials (cosmetics, pharmaceuticals, food products). Biodiversity externalities in ecosystem services relate to market-driven actions, whose welfare effects are ignored, that impact the well-being of either consumers or producers by altering the ecological functioning on which consumption or production depends (Crocker and Tschirhart, 1992). Perrings et al. (2009) further argue that biodiversity conservation, an undersupplied public good if left to the market, requires two problems to be solved. Firstly, the problem of local market failure associated with the local public goods and biodiversity externalities - where the loss of ecosystems services is driven by biodiversity change (MA, 2005) - and, secondly, that of international market failure linked to international biodiversity conservation efforts (genetic diversity as a global public good ; Trommetter and Weber, 2003) and the externalities of international trade. Both require economic agents to take the full costs of their actions into consideration through the development of appropriate institutional and financing mechanisms.

2.2 A business perspective: the competitiveness – environment debate

The mandatory or negotiated implementation of tools for internalizing environmental externalities gave rise to the controversy 'competitiveness versus environment' (Boiral and Jolly, 1992; Walley and Whitehead, 1994). Within this debate, two approaches have been regularly opposed. On the one hand, a win-lose perspective (Boyd and McCelland, 1999) considers that, with increasing regulatory and societal pressures, firms cannot ignore anymore their negative environmental externalities without risking losing their legitimacy or license to operate (Boiral and Jolly, 1992). The resulting costs they incur, seen as proportional to the intensity of external pressures, cannot be easily avoided, and far outweigh the environmental benefits. Environmental issues, through notably industrial and regulatory norms, are considered as external constraints which often necessitate substantial investments with minimal or negative returns, notwithstanding the associated reductions in productivity (Walley and Whitehead, 1994).

On the other hand, a win-win approach, also known as the Porter Hypothesis, has attempted to demonstrate the advantages of environmental actions undertaken by firms, invalidating the orthodoxy of negative causality between competitiveness and the internalization of environmental concerns (Porter and Van der Linde, 1995). Advantages commonly put forward include reductions in energy and material consumption, improvement of corporate image, access to new markets, and technological innovations. Jaffe and Palmer (1997) have presented three distinct variants of the Porter Hypothesis, some studies providing further support for these (e.g. Lanoie et al., 2007): (1) environmental regulation stimulates certain kinds of environmental innovations (weak version) ; (2) flexible environmental policy regimes give firms greater incentive to innovate than prescriptive regulations, such as technology-based standards (narrow version) and (3) properly designed regulation may induce cost-saving innovation that more than compensates for the cost of compliance (strong version).

The origin of the controversy lies both in the complexity of environmental problems and the arbitrariness of cost-benefit analyses (CBAs; Boiral 2005), and / or cost-efficiency analyses (CEAs) undertaken by firms. Arbitrage between various options depends on factors which are both contingent and contextual of each situation or firm. Accordingly, various variables need to be analyzed:

(a) The role of industrial and business excellence in environmental performance: environmental initiatives are often inseparable from the normal routines, methods and organisation of the workplace designed to improve productivity and competitiveness (Sharistava 1995). For instance, measures favourable to biodiversity (e.g. specific bird species) may be intrinsically linked to specific farming practices (e.g. timing of mowing practices; McLaughlin and Mineau, 1995; Muller 2002).

(b) The distinction between preventive and corrective action (Boiral 2005; Jasch 2008): corrective action corresponds to measures undertaken after opening an industrial plant, such as process redesign to control or reduce pollution. Research supporting the "win-lose" hypothesis is typically based on comparative analysis of this type of investment (water pollution remediation systems, particulate filters), because it relies on parameters (environmental costs) which can easily be isolated. Preventive action, in contrast, refers to technical and organisational innovations integrated into production methods before the start of their life cycle, at the initial design stage. They are often indistinguishable from measures aimed at improved productivity and efficiency. While corrective action generally requires expensive investment with a minimal increase in profitability or competitiveness, preventive action can be both economically and environmentally attractive, and thus an advantageous alternative, depending on the activity or business in question.

(c) The marginal decrease in the effectiveness of environmental actions: the costs and efficiency of environmental action, whether preventive or corrective, depend directly on the level of pollution remediation projected by the business. Beyond certain thresholds, the costs can turn out to be quite prohibitive (Salamitou 1989), while the results can be uncertain.

(d) The duration / life cycle of assets: An asset is said to be specific when its use-value would be lower in uses other than that for which it is intended in the initial investment (Williamson 1981). An asset is highly specific when it cannot be converted to other uses without imposing a significant loss of productive value on its holder. Riordan and Williamson (1985) argue that there are five categories of specific assets: (1) localised assets which cannot be reused elsewhere without incurring high costs, because of the necessary proximity of production operations, (2) physical assets, such as equipment designed for a specific type of production and not reusable elsewhere, (3) intangible assets which reflect emotional attachments, such as customer loyalty, (4) human resources with specific expertise gained in the course of doing work and (5) dedicated assets which are in principle transferable but for which there is no demand apart from the transaction that led to their acquisition. According to Godard and Hommel (2001), the specificity of assets limits the options for re-deploying them. They argue there is a continuum of levels of asset engagement. At one end, the absence of sunk costs allows for an engagement that is reversible at will, in the short term, in a perfectly contestable market. At the other end, the business is engaged ‘for all time’ in markets which are not fully contestable owing to the presence of sunk costs.

(e) The dependence of CBAs / CEAs on the modes of regulation, incentives and property rights in force: if sources of pollution fall under clearly established property rights, it is socially optimal to make the polluters pay (Coase 1960). Inversely, if pollution sources are diffuse and associated with an unclear property rights regime, it will be socially optimal to make society pay. Similarly, if a premium is put on deforestation combined with the growing of export crops, it is understandable that refraining from exploiting an old-growth forest so as to convert it to a lucrative monoculture is equivalent to the incurring of an opportunity cost for the business in question.

With water, soil and air quality, and more recently climate change, at the heart of stakeholders’ concerns, most (historical and) current business environmental efforts or measures (have) target(ed) indirect drivers of ecosystem - and hence biodiversity - change, that is emissions, pollutions and waste. Within this context, biodiversity is usually understood as a new, additional form of external environmental pressure, most firms lacking the vision of “nature evolving” promoted by Holling et al. (2002). For business, biodiversity is linked essentially to regulatory frameworks overseeing where and how - though to a lesser extent - business activities can operate.

2.3 Valuing biodiversity and ecosystem services for CBAs

At the heart of the ‘competitiveness – environment’ debate lies the use of cost-benefit analysis (CBA), notably for land-use decisions relative to the appraisal of industrial projects by public authorities. Businesses perform them in order to calculate optimal pollution or damage levels, using cost-efficiency criteria contingent to norms defined by public authorities (Vivien 1994; Boiral 2005). Expanding CBAs to take account of biodiversity and ecosystem services (BES) requires the pricing of their economic value and, more precisely, capturing their marginal economic value for trade-offs purposes (Braat and ten Brick, 2008). As argued by Ruhl et al. (2007), “*failure to refine our understanding of their value, and the consequent inability to account for those values in regulatory and market settings and, more important, in* *the public mind, is unlikely to promote their conservation*". The total economic value of biodiversity is traditionally divided into its use values (direct use value, indirect use value, option value) and non-use values (existence value and bequest value), with a gradient of decreasing tangibility as one moves from direct use values to existence values (Barbier 1989; Freeman 1993; Pearce and Turner, 1989). According to Perrings et al. (2009), "*maximizing societal welfare calls for understanding the tradeoffs between the net benefits from consumptive and non-consumptive use of ecosystem services, and the costs that these uses create in the form of biodiversity externalities that can diminish future ecosystem services*." Valuation techniques for BES may be grouped into four types (de Groot et al., 2002): (a) direct market valuation, (b) indirect market valuation (avoided cost, replacement cost, factor income, travel cost, hedonic pricing), (c) contingent valuation and (d) group valuation. Their use can be helpful towards assessing the full cost of proposed projects (Turner and Daily, 2007). CBA analyses coupled to BES valuation may allow businesses and stakeholders to account for BES loss, especially for indirect ones such as that caused by raw material suppliers or by the indirect impacts of a proposed project (e.g. new town needed to be built so as to supply the labour force of a new mine).

Yet, despite numerous efforts to capture their economic value (e.g. Azqueta and Sotelsek, 2007; Costanza et al., 2007; Curtis 2004; Howart and Farber, 2002; Turner et al., 2003; Wilson and Hoehn, 2006), BES may not easily be priced, that is translated into a monetary proxy for market internalization and put into boxes such as "goods", "services" and "capital" (Dasgupta 2001; Farber, et al., 2002; Heal 1998; Wallace 2007). Major components of BES do not give rise to market transactions, which means relying on non-market valuation techniques for CBAs. Each tool has its methodological limitations, notably in terms of underlying assumptions. For instance, concerns with contingent valuation relate to the reproduction of protocols and the comparative analysis of results across time and space (Bonnieux 1998; Kumar and Kumar, 2008; Weber 2002a). Biases are also associated with benefit transfer techniques applied to the results of studies based on one or more valuation techniques (e.g. Costanza et al., 1997; Troy and Wilson, 2006; Turner et al., 2007; Wilson and Hoehn, 2006). As argued by Nelson et al. (2009), they incorrectly assume that "*every hectare of a given habitat type is of equal value – regardless of its quality, rarity, spatial configuration, size, proximity to population centres, or the prevailing social practices and values*". Moreover, economic valuation of BES is an anthropocentric approach grounded on 'weak sustainability', that is the substitutability between different forms of capital (Pearce et al., 1990; Godard 1995). Depending on the aims and context of the study (e.g. questions asked to interviewees) and the methodological assumptions of the model used (e.g. chosen discount rate), the marginal value of an additional BES unit would vary considerably, and in some circumstance be particularly low (e.g. Simpson et al., 1996; though this approach is controversial as it supposes a high substitutability between genetic resources - Sarr et al., 2008). This would even truer within the context of most CBAs of highly lucrative industrial projects, hence some stakeholders arguing that the total economic value of biodiversity (inclusive of that of ecosystem services), though useful, is not sufficient for arbitrage (especially for 'remarkable biodiversity'; Chevassus-au-Louis et al., 2009).

2.4 The business – biodiversity interface from a regulatory perspective

For most firms, internalizing biodiversity externalities is an issue pertaining to regulations and is thus essentially associated with emissions, resource and land use restrictions, such as water pollution levels, harvesting quotas (fisheries) and areas set aside to protect biodiversity. From a legal and land-use perspective, biodiversity may be divided into

(a) 'remarkable biodiversity'[4], to which existence values are attached and / or for which some sort of protection status exists, and (b) 'ordinary biodiversity', which contributes to varying degrees to ecosystem functioning and ecosystem services and for which no direct protection is offered (Chevassus-au-Louis et al., 2009). Furthermore, three types of situations may be proposed for the business – biodiversity interface:

1. No or extremely limited business opportunity or activity allowed within or close to areas harboring 'remarkable biodiversity' so as to protect biodiversity from its negative impacts (e.g. national parks, species protected from trade, exploitation and / or destruction).
2. Areas containing both ordinary and remarkable biodiversity, where business opportunities, development models and choices, as well as the use of and access to renewable and exhaustible resources, are negotiated with stakeholders so as not to compromise the viability of biodiversity (e.g. Natura 2000 sites in Europe, UNESCO's biosphere reserves network), including its components key to local communities from a cultural perspective.
3. Other areas which do not have any protection status and where impacts on ordinary biodiversity are addressed - often indirectly - through complementary regulations such as mandatory Environmental Impact Assessments, statutory norms for waste, emissions and pollutions, and legislative frameworks with regard to the prevention and remedying of environmental damage (e.g. EU's Directive 2004/35 on environmental liability).

In other words, different decision-making processes would apply whether the (proposed) business activity threatens ordinary biodiversity or biodiversity elements which are protected by law and / or are important to local community groups. Its social acceptability or legitimacy may not necessarily be linked to values which can be priced and put in aggregate formats (Chevassus-au-Louis et al., 2009; Gobert 2008). It would be contingent to stakeholders' perceptions of the interactions between the (proposed) business activity and specific BES components, in reference to other value systems and social needs (e.g. empowerment strategies - Bacqué 2005; environmental justice - Schlosberg 2005).

Within this context, conventional business strategy amounts essentially at identifying, assessing, monitoring and mitigating the impacts of business activities, projects or ventures on biodiversity (Tucker 2006), especially on its components protected by law or those important to legitimate stakeholders. As argued by Stigler (1971), when it comes to regulations, firms, often through business lobbies or associations of firms (Viardot 1993; Roy and Whelan, 1992), seek to optimize their behaviour given the rules which are imposed on their business operations, and may attempt to manipulate them to their own advantage (strategic lobbying; Regulatory Capture Theory). The goal is to legitimize the activity under stakeholder scrutiny, often using (1) CBAs of project alternatives for arbitrages (see its limitations previously underlined), and (2) impact mitigation procedures at the lowest possible financial and social cost.

For preexisting business activities, this would involve at best a cost-effectiveness approach with respect to new negotiated or mandatory ecological goals linked to changes in practices, for instance compensation payments for costs incurred due to compulsory conservation constraints (e.g. Hackl et al., 2007). For new business projects, a "no net loss" five-stage approach is being promoted, notably by the Business and Biodiversity Offset Program (2009) and the International Association for Impact Assessment (IAIA 2005). It involves (a) avoiding irreversible losses of biodiversity (prevention), (b) seeking alternative solutions to minimize losses, (c) using mitigation to restore biodiversity, (d) compensating for

[4] One might question whether this is the appropriate terminology. Given the contingent nature of 'remarkable biodiversity', we would argue that it might be nothing more than biodiversity elements *noticed* by law, human communities and / or specific professional groups.

residual, unavoidable loss by providing substitutes of at least similar biodiversity value, and (e) seeking opportunities for enhancement. This approach, focused on business impacts on biodiversity, has lead to the development of mitigation mechanisms, hybrid tools involving both markets and state regulation.

2.5 The role played by mitigation mechanisms

Trommetter et al. (2008) argue that there are three alternatives for mitigating of BES loss: avoided or minimized mitigation, self-realized mitigation and externalized mitigation. Though this would depend on the country and its regulatory framework, any business could theoretically be subject to mitigation measures when it proposes a new development project, hence its need to arbitrate between the three options aforementioned, most likely according to the risks and costs contingent to each situation.

(a) Avoided mitigation relates to operations carried out with no impact on biodiversity and ecosystem services benefiting other economic agents; which includes the option of project withdrawal. Minimized compensation relates to projects with impacts as minimal as possible on BES.

(b) In the case of self-realized mitigation, either the firm buys land assets ecologically equivalent to what has been lost in its newly developed areas (additional costs relate to the price of land assets bought), or it needs to restore acquired land assets so as to meet ecological equivalency criteria.

(c) Lastly, externalized mitigation relates to the demand for restored land assets. The company may acquire ecologically equivalent areas restored by other organizations, or it can purchase BES units from a ‘mitigation company’ (business specialized in selling BES units) according the number of units required for mitigating its BES loss.

This third option is without doubt the most uncertain for both suppliers and demanders of BES units, as it is subject to the laws of the market. The latter can be less attractive than expected, for instance because firms (perceive) find it less costly to either perform avoided or minimized mitigation or self-realized mitigation (Trommetter et al., 2008).

Various mitigation mechanisms have been implemented worldwide, notably Wetland Mitigation Banks in the USA (Clean Water Act of 1972) and the Bush Broker Program in Australia. Provided criteria of ecological efficacy are at their core, these may be very effective at integrating conservation objectives within regional planning. First, they put a price on BES destruction. This sends very important signals to businesses and may encourage them to maximize avoided or minimized mitigation at the project design stage (preventive approach), for instance via the systematization of tunnels and viaducts to secure ecological continuities. Secondly, land areas with high ecological value may become much more attractive than under ‘normal’ circumstances. Thirdly, economies of scale push businesses to restore habitats over large areas and sell BES units associated with these lands. Mitigation markets thus allow the private sector to complement the public sector’s efforts for biodiversity conservation.

Combining ecosystem services to mitigation mechanisms may become a standard for environmental policy throughout the European Union. This will not be without legal problems, notably with respect to the management and ownership of mitigation sites, as well as the associated liabilities and market regulation mechanisms. Roach (2006) stresses the importance of ecological equivalencies because of the difficulties and limitations of the economic evaluation of ecological damages. According to Perrings et al. (2009), the construction of the ratio of restored areas to degraded ones is relatively empirical in reality. From 1993 to 2000, some 95 km^2 of wetlands have been cleared in the USA in exchanged for 165 km^2 of restored ones (ratio largely superior to 1). Though public authorities usually decide the equivalence between hectares developed and hectares restored, this might reflect the need to ensure its acceptability from the perspective of key stakeholders.

Mitigating business impacts on BES is not without its controversies (Trommetter, et al., 2008). Ideally, the question should be "*what are the most optimal combinations of options, from an economic, a social and an ecological standpoint, to mitigate development projects within an ecosystem?*" For firms however, the aim is, most likely, to find the best option(s) to minimize costs given ecological objectives defined by the state or other relevant authority (cost-efficiency approach). Several authors further highlight the limitations and difficulties relating to the implementation of mitigation contracts between businesses (e.g. Hallwood, 2006): (a) lack of clarity with regards to the methods and indicators used to measure ecological performance may prevent the rigorous assessment of net BES loss or gain (Fennessy et al., 2007); (b) mitigation costs can be prohibitive for the mitigation business when compared to the price of BES units on the market; (c) unexpected or unimplemented penalties or fines; and (d) very high transactions costs can have negative influence on social wellbeing (Goldman 2007), hence the need to simplify administrative processes.

Though they are more than necessary for the internalization of certain biodiversity externalities, impact mitigation mechanisms fall short of the goal of fully integrating biodiversity into business strategies and practices. Their key, underlying shortcoming lies in the conceptual framework within which they tend to restrict business perceptions of its interactions with living systems. As argued by Raffini and Robertson (2005), "*the commodity in wetland banking is not healthy wetlands or clean water. Rather, it is the less concrete service of regulatory relief. Developers and polluters have no utility in clean water or healthy wetlands; what they want is a rapid permit process and the avoidance of liability for mitigation site failure*". Besides, the additional costs resulting from mitigation measures may not necessarily be integrated into core business routines and processes so as to foster collective innovation.

3 – The interdependence between business and biodiversity: Rethinking business strategies and practices

3.1 Introducing the Orée – IFB Working Group

Various organizations have attempted to help companies address biodiversity issues through risk analysis and stakeholder management, so as to gain competitive advantage and / or avoid costs as the underlying rationale (Houdet 2008; MA 2005; Tucker 2006). Risk analysis, the assessment of the uncertainty, frequency or probability of an event and its severity, is central to social controversy and economic activity. While one of its elements is fairly objective, that is to say the probability and the severity of damage, it also contains a subjective, cultural element, that is to say the perception and acceptability of risk (Chevassus-au-Louis 2007). Several studies have classified biodiversity risks (ISIS 2004; Mulder 2007; Tucker 2006; Waager et al., 2008), essentially in terms of regulations (liability, taxation), industrial standards and norms, stakeholders' pressures and expectations, corporate image or reputation, evolution of customers' needs and wants (market risk), operations management (accidents, availability and costs of resources) and cost of capital (financing, insurance and investment risks; UNEP FI 2008). A step-by-step, procedural methodology for identifying business risks and opportunities with respect to ecosystem change has been recently developed by the WBCSD, the Meridian Institute and the WRI (Hanson et al., 2008). It can be used by any company and focuses on assessing business's dependence and impacts on priority ecosystem services so as to develop strategies.

The *Orée* – Institut Français de la Biodiversité Working Group (WG) belongs within the scope of the aforementioned Business & Biodiversity Initiative and seeks to be complementary to these approaches. It ambition is that its work will go beyond the search for a compromise between conservation and the economy to incorporate biodiversity fully into business strategies, using the language of business itself, that of costs and revenues (Houdet, 2008). Ways must be found through which biodiversity can drive development while economic activity can be a means to conserving or increasing biodiversity. This may seem utopian, but we posit that it is an appropriate framework for strategic thinking. To make the WG's approach clear to its business members, we first worked on the assessment of the dependence of the economy on biodiversity, in a 'rough and ready' way, across the various industries as defined by the French national accounting system. Selected groups of criteria comprised technology, raw materials, impacts and sales, with results showing that living systems considerably shape business activity, directly or / and indirectly, irrespective of the industry.

Business members were then asked to engage in the same exercise themselves, using the Business and Biodiversity Interdependence Indicator (BBII) which was developed in 2006 by the WG[5]. With its cross-sector approach, the BBII can be applied to any semi-finished or finished goods or to any company's operations, which may be multiple and diversified, as in the case of a large multinational. The analysis chart includes twenty-three criteria (Houdet 2008; 2008b): those linked to business strategies, those linked to impacts and impact mitigation, those linked to current markets and those directly linked to biodiversity (ecosystem services, biotechnologies, renewable and non-renewable resources, management of ecosystem health, variability and complexity). For each criterion the analysis offers four options. The business has to select one of these options by checking a box: (1) not concerned by this criterion, (2) slightly concerned by this criterion, (3) moderately concerned by this criterion, (4) strongly concerned by this criterion. Asking for an explanation of the choice for each criterion was meant to give a qualitative sense of each company's understanding of its interdependence with biodiversity.

The outcome of this work is compiled within a book and presented in the form of self-assessments in which 24 organizations of various industries (retailers, water utilities and mining companies among others) convey their own perception of their interactions with living systems (Houdet 2008). This concluded Phase 1 of *Orée* - IFB WG: it gave us legitimacy and support for further work with respect to the full integration of biodiversity into business strategies.

3.2 A typology of business perception and behavior with respect to biodiversity

Numerous articles bearing on businesses' attitude to environmental issues have been published. They focus on typologies of business behavior (Hart 1995; Martinet and Reynaud, 2000; Persais 1998; Capron and Quairel-Lanoizelée, 2007). For instance, Jolly (1993), on the basis of the works of Carroll (1979), has proposed a typology of environmental strategies by highlighting different types of business behavior: (a) eco-defensive behaviors, which focus on immediate economic returns and consider environmental investments exclusively as costs ; (b) eco-compliance behaviors, which seek to do no more than satisfying regulatory norms; and (c) eco-sensible behaviors, which seek to go beyond legal requirements, environmental concerns considered as key to the viability of the firm. Bellini (2003) further argues that

[5] The BBII is a composite indicator. For a complete list of criteria, please refer to Houdet (2008).

business behavior regarding environmental issues is shaped by two types of decision-making logic within the firm : (1) an additive logic, where the firm does not question its decision-making process (eco-defensive and eco-compliance behaviors) which is opposed to (2) a systemic logic, for which taking into account environmental dimensions of a business activity deeply modifies the structure and dynamics of the decision-making process ("eco-sensible" behaviors).

Business perceptions, attitudes, behaviors and strategies regarding biodiversity are progressively changing, as illustrated by the European Platform Biodiversity Research Strategy (EPBRS) meeting and e-conference on 'Biodiversity and Industry' in October - November 2008 (Grant et al., 2008). Building upon the results of Phase 1 of *Orée* – IFB WG, biodiversity can no longer be exclusively associated with an external constraint on business activity (impact mitigation approach). The interactions between living systems give rise to diverse sets of ecosystem functions, services and benefits, such as raw materials and biotechnologies used directly by firms. Therefore, biodiversity is also a source of revenues and expenses. Using the matrix of the dynamics of compromise adapted from Métrot (2005) and the business self-assessments of their interdependence with biodiversity published in Houdet (2008), we propose four types of business perception and behavior with respect to biodiversity issues:

- *Stonewalling policy* (status quo): most firms do not consider themselves concerned by biodiversity loss, even they though readily acknowledge their use of raw materials and technologies derived from BES. Taking biodiversity into account from this perspective would involve, at best, the use of charters or codes of conduct without training or audit system. At best, they might sponsor projects dedicated to biodiversity conservation, as a form of biodiversity offset not linked to the business activity.
- *Reactive policy*: biodiversity is acknowledged as a potential risk and is considered as an external constraint. Stakeholder management is focused on justifying current business practices, including "business-as-usual" projects or ventures, as well as on avoiding damages to corporate or brand image. The focus is on procedural measures, certification (e.g. a few, often relatively indirect or imprecise, biodiversity "performance" indicators included in environmental management systems and reporting) and public relations (greenwashing). Firms seek to avoid mitigation measures (or minimize their costs if unavoidable) by justifying the social and economic benefits of their project. At best, unavoidable mitigation measures have elusive or intangible BES targets and are hence mostly ecologically ineffective: a release from legal responsibility is what is actively sought.
- *Pro-active policy:* biodiversity is identified as a tangible business risk which necessitates specific policies and / or action plans. It may lead to changes in business perception, for instance considering that costs linked to taking biodiversity into account are normal, recurring costs to be incorporated within the standard decision-making framework of the firm. The focus is on compliance with norms or regulations (e.g. mitigation measures duly performed), sometimes going beyond requirements but without questioning the business plan.
- *Win – win policy*: firms see biodiversity as a whole, not only some of its readily valuable or used components, as true business opportunities and are ready to rethink and / or redesign their production, organizational and decision-making processes. This is akin to Jolly's systemic logic approach mentioned previously. For instance, some businesses may use biological and / or ecosystem heterogeneity and / or diversity as a standard for technological and organizational innovation: e.g. treating polluted water through diversified artificial wetlands rich in indigenous biodiversity (Houdet 2008). This means choosing to make use of the diversity of living systems so as to produce goods and services, including ES benefiting other economic agents (e.g. the multi-functionality of European agriculture may lead farmers to 'produce' ES, or, more precisely, be paid for specific (in)actions linked to specified BES

outcomes). This form of business behavior necessitates public support policies (institutional innovation) for the diffusion of the required technological and organizational innovation, as well as new accounting and reporting information systems with respect to the interactions between firms and BES (Houdet 2008).

This last component of our proposed typology of business perception and behavior with respect to biodiversity sets the scene for the analysis of new business strategies with respect to living systems, first at the level of business practices linked to payments for ecosystem services (sub-sections 3.4 and 3.5) and, secondly, at that of standards of production, management, corporate performance assessment and / or innovation (sub-section 3.6).

3.3 Payments for Ecosystem Services: business opportunities

As previously argued, mitigation measures may lead to positive changes in ecosystem services which could be remunerated. This may be correlated to relatively recent research and schemes with respect to remunerating economic agents for specific practices linked to the delivery of specific ecosystem services, including those that contribute directly to another business activity (Barbault 2006; Perrot-Maître 2006) and those which are linked to the provision of public goods (biodiversity conservation, CO_2 sequestration). Provided ecosystem services are identified and their benefits to economic agents evaluated, the focus would be on measuring their maintenance costs and the associated financing mechanisms; the latter including at least three (potentially complementary) options: (a) payments by public authorities, (b) payments by beneficiaries of BES and (c) payments by consumers of final goods and services produced in a “biodiversity-friendly” way (Trommetter et al., 2008).

Direct compensation payments have been proposed with respect to *in-situ* agro-biodiversity conservation (Boody et al., 2005; Hackl 2007; Pascual and Perrings, 2007; Perrings et al., 2009). When a farmer shifts to non-productive land uses which are favorable to biodiversity, several options do exist for financing there changes:

1. State intervention, through subsidies, is justified on the ground that BES are undersupplied public goods. This is particularly relevant within the context of the multi-functionality of European agriculture and the reform of the Common Agricultural Policy and somewhat akin to conservation easements in the USA where the focus is on preventing economic agents from *doing something* (e.g. change in land use) through contractual agreements (Gustanski and Squires, 2000; Merenlender et al., 2004).

2. A complementary mechanism may see consumers paying a premium for goods and services which are produced according to practices or standards which ‘protect or restore BES’, as (supposedly) in the case of organic farming and eco-tourism. In such a context, BES ‘maintenance’ (supply) costs are internalized into the prices of goods and services, though it remains unclear under which institutional conditions business practices favourable to biodiversity may or may not be more costly than practices homogenizing it (including labelling and certification schemes; Hodge 2007; Angeon and Caron 2008)[6].

3. Similarly, certain business transactions between firms can be understood as payments for ecosystem services: firms may undertake practices (action or inaction) which deliver specific (levels of) ecosystem services and be paid by beneficiaries. In the case of Vittel (a mineral water firm in France; Déprés et al., 2008; Perrot-Maître 2006), the company pays farmers for practices which go beyond legal requirements in terms of water quality, as

[6] When comparing the evolution of labor costs with input costs, organic farming could be economically more efficient under certain conditions (Roger-Estrade et al., 2008).

excessive nitrate concentrations due to fertilizer use could lead to the (temporal) closure of its water bottling plant. This approach is allegedly valid up to the point it becomes more expensive for the firm than an 'artificial' alternative which would substitute the ecosystem service in question (e.g. water treatment plant in the case of Vittel to capture nitrate particles) and, most likely, homogenize biodiversity simultaneously (e.g. intensification of farming practices within watersheds, notably the increased use of fertilizers and / or the shift to monocultures).

The generalization of Payments for Ecosystem Services (PES) seems highly appealing. While research into systems (Odum 1983; 1996) and industrial ecology (Erkman 1997; Shrivastava 1994) has shown that the development of firms is intrinsically linked to the evolution of the ecosystems to which they belong, its analysis of interactions between firms and ecosystems has almost exclusively focused on resource and energy consumption (and their related impacts on ecosystems), thus leaving most business – biodiversity interactions out of the picture. Combining[7] strategies for mitigating BES loss (Polluter or Impacter Pays Principle - OCDE 1975; SLWRMC 1999) and remunerating BES supply (Beneficiary Pays Principle - Aretino et al., 2001; Hackl et al., 2007; Pascual and Perrings, 2007; linked to some extent to the Victim Pays Principle - Siebert 1992) opens the door to new forms of arbitrage with respect to land use and development, as well as core business processes and practices. This approach sees BES provision becoming an integral part of the business plan of the firm, first as a strategic core variable among others for decision-making and management (beyond impact mitigation) and, perhaps more importantly, as a source of (a) new assets and liabilities (BES trading rights and / or contractual agreements), (b) new skills or competencies (e.g. biodiversity skills in the Finnish forest industry; Wolf and Primmer, 2006), as well as (c) technological (e.g. using living systems as ecosystem engineers; Byers et al., 2006; Hastings et al., 2006) and organizational innovations. The development of markets for BES may hence lead to major changes in business methods, routines, practices, intra-organizational norms and organization of the workplace.

Yet, managing ecosystems for specific ecosystem services, especially those which generate higher returns on investment, may lead to unforeseen ecosystem change, degradation or even collapse. For instance, managing biomass and productivity of tree plantations to maximize CO_2 sequestration leads to diminished stream flows, increased soil salinization and acidification (Jackson et al., 2002). In a *Calluna vulgaris*-dominated moorland invaded by bracken (*Pteridium aquilinum*), a species which sequestrates nutrients, Marrs et al. (2006) showed a potential dilemma between controlling a mid-successional invasive species for conservation policy objectives, and the negative effect of increasing environmental costs in terms of carbon accounting required, the potential input of nutrients to aquatic systems, and long-term nutrient loss. Though recent efforts have focused on designing institutional mechanisms targeting various ES (CO_2 storage essentially) while conserving biodiversity (REDD proposals; Gibbs et al., 2007; Miles and Kapos, 2008; Mollicone et al., 2007; Swingland 2002), one may argue that such situations (i.e. relatively unexploited tropical forests) are more an exception than the rule. The key challenge lies in developing markets for BES in areas where business activities are diverse and intensive.

3.4 Payments for Ecosystem Services: delineating and enforcing property rights

[7] Iftikhar et al. (2007) provide some preliminary thoughts on inter-linkages among and between Compensation and Rewards for Ecosystem Services (CRES) and human well-being, with a special focus on its implications for poor communities.

Perrings et al. (2009) discuss various requirements for an efficient sharing of BES advantages: "*(1) to clarify the level of excludability and rivalry of such ES by beneficiaries and providers; (2) a sufficient demand or willingness to pay for such services by the beneficiaries; (3) to delineate and enforce property rights surrounding land use and ecosystem services; (4) investment in social capital to foster collective action and cohesion between the providers and beneficiaries of ecosystem services.*" To those may be added policy challenges relating to defining ecosystem boundaries as well as to ES spatial and temporal relationships across different scales (though cross-scale evaluations may be unreliable over time given the propensity of ecosystems to behave like complex adaptive systems; Holling and Gunderson, 2002). Several ecosystems may exist within a larger one and their boundaries may expand and contract over time in response to ecosystem changes, including anthropogenic influences. Nevertheless, the precise tracing - *if ever possible* - of ES from their source(s), which may be discrete, ambient or variable, to their ultimate user(s) (point, diffuse, or spotty) is likely to be required, and may further necessitate identifying service provision timing, delivery channels, distance delivery, and delivery timing (Ruhl et al., 2007).

For businesses to fully embrace markets for BES, the aforementioned uncertainties will need to be resolved, especially with respect to defining clear regimes of property rights over BES, as the basis for contractual agreements between sellers and buyers. Property rights cannot be reduced to private property or state property. In effect, private property itself cannot guarantee the viability of renewable resources (Ostrom et al., 2002). It is liable to lead to their wanton destruction, especially if financial capital is mobile (Weber 2002). Besides, to address the management of BES in terms of land rights can lead to confusion between ownership of the land itself and of the rights to BES their users derive from it. A variety of property rights exist, from the traditional (private and public property rights) to the more complex (rights of access and use). We may hence speak of modes of appropriation, of which land ownership is only one form and private property a very special case. Insofar as rights of access and use are independent of property rights on goods (resources), using markets for trading property rights may be highly flexible and adaptable, transaction costs being reduced by trading certain elements of property without laying a hand on property itself. As argued by Weber (2002), "*patents, which are temporary monopolies on access and use, do not constitute 'ownership rights'. You cannot own genes, but only acquire a monopoly on the access and use of them. Living systems thus cannot be 'appropriated', but markets can be developed for the trading of rights of access and use.*"

As the previous arguments suggest, the scientific issues around BES are in fact also economic, social and political issues. As argued by Weber (1996), "*managing biodiversity means focusing primarily on the management of interactions among humans with respect to nature, first at the level of regulation and control of access to resources, then at the level of the decision-making process, whether imposed from elsewhere or negotiated and contractual*". For instance, according to Freyfogle (2006), "*private property is a form of power over people not land*". This leads to equity concerns with respect to the emergence of markets for BES. Weber (2002) further argues that the growth of markets of property rights is not a reason to be optimistic about opportunities for the poor to regain control of their lives. If markets of property rights were to expand to cover the management of BES, on the current model of intellectual property rights, this would have a major impact in so-called 'developing' countries. Depending on how they would be regulated, these markets could either strengthen local communities or, much more probably, marginalize them further through the hoarding of rights by those in power, whether politicians, customary chiefs or private organisations. Recognising that very varied regimes of appropriation do exist, by guaranteeing rights to temporary or permanent access and use, is one of the surest ways to fight poverty (Weber

2002). It is a prerequisite for socially equitable local governance models, by giving local communities the opportunity to regain possession of their present and engage themselves in the future.

Despite these challenges and risks, approaches attempting to internalize BES externalities - both positive and negative - through market mechanisms provide a new framework for the framing of business strategy regarding living systems. While these present opportunities to be sized (or 'created') by *proactive* and *win-win* members of the business community (see aforementioned typology of business behaviour), public authorities and stakeholders should help ensure that the underlying objective clearly remains to combine economic, ecological and social efficacy. From this perspective, we would argue that compensating, subsidizing or paying for specific BES delivery is unlikely to cover the complete spectrum of interactions between businesses and the diversity of living systems, hence the need for complementary tools and approaches ensuring dynamics of co-viability between them. As aforementioned, the last subsection of the paper discusses the need to revisit business standards.

3.5 Production, management, corporate performance assessment and innovation standards promoting the diversity, heterogeneity and variability of living systems

According to Arthur (1989), the word 'standard' has two meanings: that of conventions or code of practice and that of the technology or method or code that comes to dominate. Various taxonomies exist to classify standards, for instance by distinguishing them on the basis (a) that they pertain to 'thresholds', 'compatibility issues' or 'definitions / methodologies' (David 1987) or (b) that they apply to 'things' (e.g. metric system), 'things one does' (e.g. quality improvement) or 'things one has' (e.g. carrier plans) (Brunsson and Jacobson, 2000). By further discussing the nature of interactions between businesses and biodiversity, the last part of this article will attempt to propose preliminary conceptual foundations of new business standards needed to reverse current biodiversity trends.

First, it is crucial to assess the nature of interaction dynamics between businesses and living systems. Norgaard (1985) argues that we are both witnesses and participants in the co-evolution of ecosystems and socio-economic systems. One example of this coevolution is the reciprocal influences between agricultural pests, pesticides, the regulation of pesticide use and the cultural assessment of their use: knowledge, values, types of organisation, technology and ecosystems are all in continuous interaction (Norgaard 1984; 1994). Businesses are not intrinsically hostile to living systems, in fact far from it. Some species, which provide direct monetary or cultural benefits, have been selected by humans for millennia, and thus can be said to have co-evolved with them: we need only mention the growing of crops or the breeding of farm animals[8]. Concerned organisms have adapted to business selective pressures and in turn affect their strategies and modes of production. The overt or unconscious motivation for these selective dynamics of coevolution - which has led to the competitive exclusion of other living systems over increasingly wide areas - seems to be the 'necessary' control over uncertainties associated with ecosystems in order to produce goods and services at minimal private costs and meet consumers' demands. Businesses and all their stakeholders, including consumers and governments, are thus responsible for globalizing the homogenisation of living systems. Contemporary technological, organisational and institutional innovation is elevating uniformity to the status of a universal model, thus inexorably reducing the variability, diversity and complexity of living systems (Barbault

[8] Notwithstanding recent massive business investments linked to biotechnologies.

1994; Weber 1996). As a result, randomness-generating mechanisms ('Biological roulettes' according to Pavé 2007), which operate at all levels - from biological systems to ecological ones, are rejected, over-simplified and even obliterated outright by businesses: this is a key driver of ongoing biodiversity loss.

If diversity, variability and adaptive change are the true insurance policies for the success of life on Earth (Barbault 2006; Pavé 2007) and for the (free of charge) ecosystem services which underpin our economies (Braat and ten Brick, 2008; MA 2005) and, hence, business activities (perceptions of businesses which used the BBII; Houdet 2008), what are the risks associated with such business choices and practices? Pavé (2007) underlines the importance of 'chance' in the functioning and evolution of living systems. 'Biological roulettes' guarantee the diversity of living systems and their evolutionary capacity in uncertain, changing environments. In other words, randomness-generating mechanisms are necessary for the survival and evolution of living systems, including that of humans in all our cultural, linguistic and organisational diversity, as well as for our policy and development choices, economic models and industrial systems. From this perspective, business models based on biological uniformity can have major consequences on business themselves. This may involve ecosystem collapse after certain (possibly interacting) thresholds are crossed (e.g. impacts of irrigation practices on dryland salinity and farming activities in Australia, bankruptcies linked to collapsed fisheries due to single-stock approach to fishery management, water bottlers forced to relocate their operations because of pollution – Déprés et al., 2008); hence past and current research undertaken with respect to the resilience of socio-ecological systems (Abel et al., 2006; Carpenter et al., 2002; Walker and Meyers, 2004). Accordingly, can we rethink the nature of interactions between businesses and the diversity of living systems? What co-evolutionary logic could be chosen to develop mutualistic evolutionary dynamics between biodiversity and networks of firms? This amounts to asking simultaneously how can profits be used to diversify living systems, and how can biodiversity become a source of increased profits.

We thus propose to overturn the uniformity model and build a new model of development based on the growth and globalisation of the diversity and heterogeneity of living systems. This amounts to enhancing, at the heart of technological, organisational and institutional innovation, the biological roulettes which underpin the evolutionary dynamics of human beings and the living systems which they depend on and form part of within the biosphere. In other words, the challenge is to develop standards relating to business activities which promote or reward the use of the variability and diversity of living systems so as to maintain or restore the widest possible range of ecosystem services (inclusive of biodiversity itself) used at different time and spatial scales; as insurance policies for the viable management of marine and terrestrial ecosystems, whether urban, agricultural, rural or wild. This opens the door to significant research and development with respect to both pre-existing and new standards involving a considerable array of business issues, notably from plant and product design, technologies (e.g. modes of agricultural production and pollution treatment), information systems (e.g. product labelling, management accounting systems) to ecological thresholds linked to ecosystem use and management.

From the perspective of production processes for instance, the recommended approach would seek to understand ecosystem functioning, maintain or increase its potential and draw upon its features to provide goods and services to consumers. This means 'playing with' natural variability, not suppressing it, and developing adaptive strategies for both natural and economic variability, instead of pursuing optimal solutions (Weber 1996; 2009). For instance, recent experiments in China (Zhu et al., 2000) show that mixtures of rice varieties resistant to the most threatening pathogens did form a barrier to the spread of destructive fungus, with a resulting harvest 89% more successful than rice monoculture. Similarly, investing in multicropping models, common place in so-called developing countries, is gaining ground in western ones (e.g. agro-forestry and silvo-pastoralism; Dupraz and Liagre, 2008; Mosquera-Losada et al., 2005). This provides some insights of the kind of technological innovation needed as an underling scheme for markets for BES: firms in all economic sectors could develop ecological engineering expertise for the restoration of ecosystems on a hitherto unparalleled scale. Moreover, from the perspective of corporate performance assessment, this calls for a new corporate accounting and reporting standards institutionalizing an enlarged business responsibility towards biodiversity and ecosystem services useful to stakeholders. This means adopting an ecosystem-based interpretation of value-added creation through industrial processes and economic dynamics, going beyond national and jurisdictional boundaries to focus directly on the access, use and modes of appropriation of BES.

To that end, means must be found so that costs of change are bearable for firms. Costs and benefits of reducing negative externalities with respect to BES are often modelled for unchanged technology or modes of production (link with aforementioned asset specificity issues)[9]. We argue that the institutional (both incentives and disincentives) frameworks 'governing' markets of BES and associated business standards should be based on a co-viability logic between businesses and the diversity of living systems, the latter including human communities (Houdet 2008). A growing number of studies are proposing viability or co-viability models (Viability Theory; Aubin 1992), especially for fisheries (Béné et al., 2001; Doyen et al., 2008; Martinet et al., 2007), agro-systems (Tichit et al., 2007) and water bodies (Martin 2004). They reveal a profound shift towards a dynamic, viable approach to ecosystem management, and suggest possible pathways for modelling co-viability dynamics between businesses and biodiversity.

4- Conclusion

Biodiversity is usually understood as a new, additional form of external environmental constraint on business activity within the context of the environment – competitiveness debate. It is linked essentially to regulatory frameworks overseeing where and how businesses can operate, chiefly through the appraisal of new industrial projects. Businesses make use of cost-benefit analyses so as to capture the marginal economic value of biodiversity and ecosystem services for trade-offs purposes: this allows them and their stakeholders to account for BES loss or gain from an economic perspective. Yet, despite numerous efforts, BES may not easily be translated into a monetary proxy for market internalization, hence some stakeholders arguing that the total economic value of biodiversity, though useful, is not sufficient for arbitrage. Accordingly, conventional business strategy amounts essentially at identifying, assessing, monitoring and mitigating the impacts of business activities on biodiversity, especially on its components protected by law or those important to legitimate stakeholders. For preexisting business activities on the one hand, this would involve at best a cost-effectiveness approach with respect to negotiated or mandatory ecological goals linked to changes in business practices. For new business projects on the other hand, mitigation mechanisms based on a "no net loss" five-stage approach are actively being promoted worldwide, studies highlighting the importance of ecological equivalencies given the difficulties associated with the economic valuation of damages.

Though they are more than necessary for the internalization of certain biodiversity externalities, impact mitigation mechanisms fall short of the goal of fully integrating biodiversity into business strategies and practices: they restrict business perceptions of its

[9] With the exception of GHG emissions for which research is undertaken so as to both reduce them and help businesses adapt to ecosystem change.

interactions with living systems to the management of their negative impacts on BES. Nonetheless, business attitudes, behaviors and strategies regarding biodiversity are progressively changing. Previous work on the Business and Biodiversity Interdependence Indicator (BBII) have shown that firms' perceptions of their interdependences with biodiversity are highly diverse, referring to technologies, sales and the management of supply chains among other issues. This suggests the emergence of business strategies and practices which could go beyond impact mitigation and the search of a compromise between development and conservation. Combining strategies for mitigating BES loss (Polluter Pays Principle) and remunerating BES supply (Beneficiary Pays Principle) opens the door to new forms of arbitrage with respect to land use and development, as well as core business processes. This approach may see BES maintenance or provision becoming an integral part of the business plan of the firm, as a core variable among others for decision-making and management and as a source of new assets, liabilities, skills, technological and organizational innovations. Provided that property rights regarding BES are clearly delineated and enforced, the development of markets for BES may lead to major changes in business methods, routines, intra-organizational norms and organization of the workplace. Yet, compensating, subsidizing or paying for specific BES delivery is unlikely to cover the complete spectrum of interactions between businesses and the diversity of living systems. Ecological and social risks associated with managing ecosystems exclusively for a single ecosystem service need to be taken systematically into account when designing markets for BES. This calls for complementary approaches and tools ensuring dynamics of co-viability between firms and biodiversity. We thus underline the need for management, production, innovation and corporate performance assessment standards designed to promote or reward the use of the diversity, heterogeneity and variability of living systems by firms, so as to maintain or restore the widest possible range of ecosystem services - inclusive of biodiversity itself - used by all stakeholders at variable time and spatial scales.

5- ACKNOWLEDGEMENTS

The authors would like to thank the members of the *Orée* - IFB Working Group "*Integrating biodiversity into business strategies*" and especially CREED - Veolia Environnement for funding the research project (CIFRE fellowship – PhD thesis).

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