Biodiversity & Economy

Management of biodiversity by stakeholders: from awareness to action

Convention on Biological Diversity

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Entreprises, territoires et environnement

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CDC Biodiversité, EDF, L'Oréal, Rhône-Alpes Region, Savin Martinet Associés, DS Avocats, Séché Environnement, SNCF, Transitions, Veolia.

Case study initiators:

Bouygues Construction, Bureau Veritas Certification, Bureau Veritas CODDE, the community of communes of the Oléron island, Crédit Coopératif, Dervenn, EDF, EIFFAGE, Gecina, Gondwana, Inddigo, Les Jardins de Gally, L'Oréal, LVMH, Maisons du Monde, Pur Projet, Saf agr'iDées, Séché Environnement, Thelema, Veolia, Voies navigables de France, Yves Rocher.

The ORÉE team (*) with special thanks to Nathalie Boyer and Cécile Couteau.

And all the amateur photographers.

PREFACE

Jacques Weber & Gilles Boeuf

What is “biodiversity"? It is nothing more than the living world, expressed scientifically; nothing more than “living diversity. Are humans living beings? If this is the case, then it is impossible or even stupid to imagine the human species on one side and the rest of living diversity on the other. So, yes, we are part of the living world. We may not be “beasts" but we are actually vertebrate mammals, in the same way as dogs, cats and whales, and we are also primates like chimpanzees, gorillas and macaques.

Not only are we a part of biodiversity, but we are also vitally dependent and interdependent on it. Everything we eat comes from the living world, in the same way as our clothes, a large part of our houses, our furniture, etc. And we only cooperate with the living! Quite recently, several articles published in the most important scientific journals showed the influence of the diversity of intestinal flora on human health, particularly where obesity, diabetes, cardiovascular diseases, auto-immune diseases, etc. are concerned.

At the beginning, some 4 billion years ago, RNA* and later the more stable DNA*, common to all life forms, viruses, bacteria, lichens, mushrooms, plants, insects and the vertebrates, to which we mammals belong, appeared in the ancestral ocean. This evolution towards ever more diversity was a process which gave rise to countless innovations which have continuously increased the adaptability of the living to the instability and variability of climates and environments.

Today, living diversity is progressively shrinking and, sadly, it is not only shrinking "rapidly" but faster and faster. On the one hand, diversity is reducing due to the accelerated disappearance of eco-systems and species, and on the other, the human species is deliberately reducing the diversity of the species on which it depends directly, sacrificing the future to the demands of a high discount* rate and a very short-term return on investment. This means that 50% of planet’s food depends currently on four plants (maize, wheat, rice and potato) and 80% on 18 plants, even though there are over 20,000 known food plants of which 5800 are locally grown in various locations. The industrialisation of agriculture is leading to the simplification and impoverishment of agro-ecosystems;

the loss of biological diversity* in the soil and cultivated areas is increasing the risk of disease and crop pests, forcing famers to use more and more fertilizers and pesticides. The production of initially useful GM* insecticide crops is now generating resistant species as was recently demonstrated in the case of maize in Africa by an IRD*[1] team.

The species responsible for this evolution is the human species: a species which dominates all the planet's eco-systems, either directly, by exploiting them for its own benefit, or indirectly through its impacts such as climate change and the plastic continents in all the oceans. We are well and truly in an "anthropocene" (expression proposed by Paul Crutzen in 2000). "The house is burning and we are looking the other way" said Jacques Chirac in Johannesburg in 2002. This world summit conference was to commit to halting the erosion of biodiversity by 2010, and we all know what came of that: erosion was accelerated. At the Rio de Janeiro summit in 2012, it was agreed that we had simply mistaken the horizon and we should have read 2020: OK, but then how do we go about it? By deforesting massively in favour of oil or by mining as happened in Ecuador where the government is sacrificing the Yasuni Park to black gold? By multiplying oil and mining permits on the seabed with total disregard for the deep sea life whose fundamental role in the way the biosphere* works has been deliberately ignored? By continuing, as at present, to believe that the biosphere* is unlimited, that the short term must absolutely predominate and that, in the long term, our children will just have to "muddle through"?

However rapid the changes, they are only perceptible to those who were alive before they occurred - otherwise, they are only statistics. Why should the disappearance of chafer beetles mean anything to someone who has never played with one, never mind actually seen one? The fact that we see almost no butterflies only worries those who are old enough to remember how many there were in the past. Not being able to drink the water in rivers or streams now seems only "natural". This absence of the experienced memory of change conjures up the illusion of inexhaustibility. The same goes for fishery where the endless increase in fishing power and the sophistication of fishing gear and fish-finding instruments, gives fishermen the illusion that there are "still as many fish whatever the scientists say" (sic!).

Our population is continuing to increase and will reach 9 billion around 2050. We claim that it is not a real problem and that, even in Africa, there is enough arable land to feed a growing population, especially if we stop diverting more and more soils from their primary vocation: food agriculture.

[1] http://en.ird.fr/ird.fr

The extension of cotton here, cocoa or coffee elsewhere, and even agrofuels is already under way and will increase even more in the future, to the expense of food requirements, as multinationals take over land. In 1982, Amartya Sen showed that, since the beginning of 19th century, there had been no famines resulting from a lack of food and that in all the cases of famine, including in Ethiopia in 1984-1985, stocks of food were provided but not made accessible to populations. More than just soil productivity, the management of access to food resources will be a condition of feeding a growing population.

The Aichi targets, adopted during the Conference on Biological Diversity Summit in Nagoya in 2010, stated that: "Between now and 2050, biological diversity* will be valorised, preserved, restored and used wisely, by ensuring the safeguarding of the services provided by ecosystems, keeping the planet in good health and procuring essential advantages to all peoples". Was this the epitome of naivety, hypocrisy or cynicism?

In 2010, the authors of this preface gave the two opening lectures at the National Conference on Biodiversity in Chamonix, in the context of World Biodiversity Year. At the time, we were both trying to trigger raised awareness on the danger of the current evolution of the biosphere*, and the living world on which it is vitally and closely dependent for the human species. We find it difficult to see what changes have really taken place since then, apart from the unceasing shuffle of environment ministers, which has actually been customary since the creation of this ministry in France. One should not forget that there have been 28 ministers or Secretaries of State since 1971, and some of them only for a few weeks: what long-term can we expect from a ministry in a constant state of flux?

For the time being, "ecological transition" has, sadly, been reduced to energy transition. Climate is complicated and those who have attended the best universities and colleges know how to solve complicated problems… But biodiversity is complex and complexity cannot be reduced to simple elements. So we deal with what we know, in other words the complicated and put the complex aside. Without developing a complex about it!

There are however easy ways of facing the problem of biodiversity erosion, an erosion which has been produced by the gratuitous attacks on ecosystems: the creation of wealth is a priori net of any externality* costs, to quote the economists. Moreover, a large part of wealth creation currently stems from the deterioration of ecosystems.

Let us imagine that we can make threats to ecosystems very costly and, in return, that we can make the cost of work cheaper. Even better, let us imagine that activities which contribute to safeguarding and improving natural potential can be made more profitable, with constant production costs and unchanged tax pressure. It would be sufficient to substantially change behaviour and improve corporate competitiveness. We proposed this approach at the Citizens of the Earth Conference held at the Elysée Palace in Paris in February, before the current crisis hit. These proposals have been repeated, and treated in depth in a series of publications (Barbault and Weber, 2010; Boeuf *et al.*, 2012) and conferences but up till now it has all been to no avail. To us, however, they seem inescapable and unavoidable if we want to counter an ever-accelerating erosion of biodiversity.

Because now is the time to take action and raise awareness and above all to set off an immediate reaction, using our intelligence and considerably less arrogance; now is the time to show a much greater desire to share and respect for this nature to which we belong.

Between those humans fascinated by technology (and of course we need them, along with the trilogy of progress, fundamental research, technology and businesses) and eager to reinvent everything and others who are watching and copying this 4-billion year old living nature, which has already endured and withstood so much, how can we find the right path? The ORÉE association plays an exemplary role in this. Launched in 2006, the "businesses and biodiversity" Working Group radically modified the way in which biodiversity is analysed and this guidebook largely explains it. Whereas biodiversity still seems to be understood by many (too many!) as preserving cute little creatures and exceptional plants, the members of ORÉE have integrated the fact that biodiversity is the great provider of their raw materials and their technologies and therefore of their profits. They understand that the preservation of biodiversity is an essential element of their own sustainability. We must go further and faster in this direction, this time from the political point of view, and the ORÉE association and its members play a key role in this dynamic of change.

EDITORIAL

What is ORÉE

As a multi-actor association, ORÉE has been developing a common thought process for 20 years on the best environmental practices, and implementing practical tools for integrated management on a territorial scale. ORÉE structures its work around three priorities: Biodiversity/ Economy; Reporting/CSR/Labeling; Circular Economy. ORÉE's network of members and partners covers a multitude of activities, territories, know-how and experience which meet, gain insight, and engage in mutual interrogation. These diversities and complementarities allow ORÉE's work and thought processes to be in line with reality, exposing the current and future issues which will best meet environmental, social and economic stakes.

ORÉE's work on biodiversity

Biodiversity has been a major theme in ORÉE's work for over ten years. In 2006, ORÉE created a pioneering Biodiversity and Economy Working Group whose work had two aims: to show the interdependence between organisations and biodiversity, and to integrate biodiversity into corporate strategy. The 2008 ORÉE guidebook entitled "Integrating Biodiversity into Business Strategies", was a landmark, and the resulting tool – the Business and Biodiversity Interdependence Indicator (BBII*) – is still an indispensable tool among the dozens which have appeared since. The BBII* enables a number of actors to identify the interdependence of their economic activities and biodiversity. This work, along with the complexity of the questions raised, proved to be fertile ground and led to the creation in 2010 of two sub-groups working on two themes: The integration of biodiversity in the accountability of organisations, and operational management by stakeholders.

Current biodiversity stakes for the economic actors…

Biodiversity is not just made up of a myriad of observable species. It is made up of the multitude of ecosystems on Earth, the genetic diversity present in a population, diversity of populations, microbial diversity, and the diversity of reproduction mechanisms from one species to another, and so on. It is into this framework that the actions of economic actors must be integrated. National and international biodiversity news items remind us of the major challenge that its future holds for businesses. The raw materials crisis, pollution, emerging diseases and even the question of waste or energy, are some of the daily and future challenges with which human societies are faced, and which question their activities as much as their relationship with biodiversity and other actors. As Jacques Weber, the former director of the French Biodiversity Institute (IFB*) recalls, the current financial and economic crisis is merely the indicator of a major ecological crisis.

... and for the territories

In France today the protection of species has been replaced by a more holistic approach to the living world, involving the protection of ecosystems and their interconnections. We now approach an understanding of an area through its functionality, in which economic valorisation does not result in the commodification of biodiversity. It is a matter of bolstering ecosystems to guarantee the services rendered by them and from which societies benefit. This means making these ecosystems more resilient, more robust and more durable. As an example, in the face of potentially invasive plants such as Japanese knotweed, the plant's development can be limited by restoring a dense and diversified plant ground cover which makes it possible to maintain the correct functioning of the riverside* ecosystem, a factor which ensures good water quality.

The new regional development plan following Grenelle 1 and 2 Laws, which has become the Regional Scheme for Ecological Coherence (RSEC*) which deals specifically with the definition of the Green and Blue Belts, gives better visibility, readability, and spatializes territorial stakes in terms of biodiversity. This tool acts as a compass, allowing us to take the biodiversity of the territory, its diversity and its connectivity's into consideration in planning policies.

This change of attitude, seen through the prism of biodiversity, allows all the actors to commit to restoring and perpetuating the functionality of ecosystems. These territorial stakes need coordination and co-construction with actors who often lack training in these issues.

The economic sectors, contribute to the future of the territories particularly by means of the surface areas they manage, but their commitment remains relative, leaving room for progress. In the future, the management and protection of ecosystems and their interactions will increasingly involve the regions which pilot European funds along with the State and potentially take centre stage under Act III of decentralisation. It is a marvellous opportunity but the condition of allocated means remains a crucial issue: encouraging the increase in funding allocated to these issues is a national responsibility. Lastly, it is important, even for land-based and metropolitan territories, to be concerned and in solidarity with the stakes of marine biodiversity, particularly overseas, as this has now reached a state of emergency.

Why should this work be published, and why now?

We forget all too often that economy is based on biodiversity. All economic activities are based on the creation of goods or services stemming from biological diversity*, either as raw materials after processing, or due to the technical knowledge or know-how inspired by biodiversity. Therefore sustainable development should not be conceived as the intersection between the spheres of economics, society and biodiversity, but rather as the reconciliation of the imperatives of these different worlds which only seem to overlap marginally and whose assets are mutually substitutable. If we take this view, biodiversity becomes the foundation of our Societies and the economy is a product of these Societies. To reconcile the conservation of biodiversity and human activity, two complementary approaches are necessary: the integration of biodiversity into actor strategy and the integration of human activities into the territory. The building of new economic and sociotechnical loops should in this way be understood in its multiple interdependences with the living world.

In these times of economic crisis, we should be asking THE central question: might the economic crisis be solely the consequence of an ecological crisis? Our societies' current model is not viable in the long term, due both to its inequality and its irrationality where the management of resources is concerned. This is the message we want to share, and that ORÉE is going to take to a national and international level, in its capacity as a member of the SOC of the Foundation for Research on Biodiversity as the French point of contact with the Secretariat of the United Nations Convention on Biological Diversity for the development in France of the Global Partnership Business Biodiversity.

We hope to see you very soon to continue working together –towards the necessary changes.

We hope that reading this Guide will make you want to share our thought processs, work and experiences, and will allow you to appropriate them and encourage you to join ORÉE's on-going and future work.

See you soon.

Best regards to all and good reading.

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Chairman of ORÉE

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Co-Chair of the Biodiversity and Economy Working Group, Operational Management subgroup - Director of sustainable development for the Yves Rocher group and Director of the Yves Rocher Foundation

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INTRODUCTION

The Working Group

In 2006, for the first time in France, businesses, territorial authorities, scientific organisations and associations got together on the question of biodiversity and, more specifically, the reintegration of economic activity into the dynamics of living systems.

The initial work was carried out by the ORÉE Working Group entitled Biodiversity and Economy, which allowed the development of thought processes and tools for reconciling economy and biodiversity.

Beyond the search for a compromise between the preservation of biodiversity and the activities of organisations, we needed to consider how to fully integrate biodiversity into stakeholder strategy in order to use biodiversity as a driving force and also to allow economic activity to be a means of preserving biodiversity - an adequate framework for a strategic thought process.

In 2008, this pioneering group produced its first publication: "Integrating Biodiversity into Business Strategies" which made it possible to establish the interdependence of actors with regards to biodiversity and give them paths to rethink their activities in this sustainable mind-set. The work and thought processes continued to grow (Houdet et al, 2010) and the Working Group chose to explore two paths: the integration of biodiversity in the accountability of organisations (Biodiversity and Economy Working Group, accounting subgroup) and the management of biodiversity by the actors (Biodiversity and Economy Working Group, operational management subgroup). It is in this framework that this publication saw the light.

Aim of the publication

ORÉE's work and other national and international initiatives have, in the last few years, enabled actors to approach their activities through the prism of biodiversity. Whatever the activities and the raised awareness to what is at stake for the actors it is possible to improve or even rethink their strategy and even their activity in a sustainable and desirable developmental framework.

Several of ORÉE's members and partners have offered to explore different approaches in order to report on the many paths for integrating biodiversity into the strategy and daily life of actors. These numerous case studies are presented in this guidebook as a practical illustration of the available alternatives, and presented as a pathway towards the reconciling of human activities and biodiversity stakes, towards a potentially future and a rich one. This reconciliation is the basis of any human future on the planet. There are various ways of reaching this goal, but many of these paths have yet to be explored and must be built together. The testimonials illustrate can take part in the collective adventure on our own terms and at our own level and we can build our own path to progress towards this reconciliation.

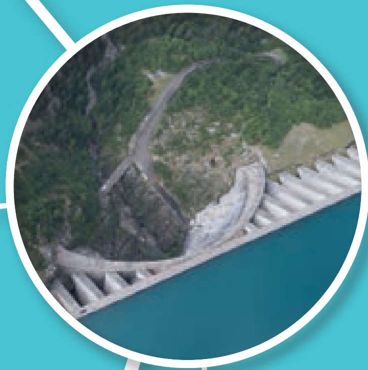
Publication construction and reading key

To read this book, you can read every page in order to follow the paths that the stakeholders have chosen to take and to build in order to reach the target of reintegrating their activities into the biosphere*. It is thus possible to work one's way towards the stakeholders' integration of biodiversity into their activities and strategies, sometimes in a roundabout way, avoiding the snares, and also to rise above it all, using their progress to tackle the next steps. The path to integrating biodiversity into the strategy and the daily lives of actors is neither simple nor unique and seeing the progression makes it possible to regularly reconsider one's targets as much as possible in one's own approach. Much in the same way as trying to climb a mountain, there are several ways to get to the top and a few detours can enable us to find other ways or shortcuts. The examples of ORÉE's partners and the inclusion of a sort of illustrated Ordnance survey map within the overview that everyone can follow according to their sensitivity, possibilities and ambitions. Due to the plethora of interactions between biodiversity and human activity, a few ideas and approaches are included in the document.

The book can therefore be read in several ways: in a linear fashion to follow the flow of the suggested approaches, in a more roundabout way by following a particular aspect of these approaches (regular references are inserted into the text), or by following some of the actors whose contributions illustrate the book.

As you turn the pages…

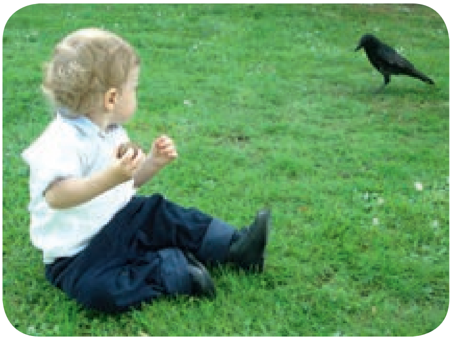
The guide leads the reader, the actor and his thought process through the different parts. In the first part, we recall the perception of biodiversity at the level of the different actors specifically as a source of costs or opportunities but showing that there is no real perception of dependence due to the absence of clearly established tools. This leads us in the second part to suggest working on the raising of awareness of the stakes around biodiversity, and specifically on the dependence on biodiversity; this awareness-raising can only be efficient if all the actors understand each other and speak a common language. For this reason we present some of the different tools which have been developed and in particular the BBII* developed by ORÉE between 2006 and 2008. In the third part we analyse these tools around products and services using case studies developed in the framework of the Working Group: these concern for example the development conditions of ecodesign approaches at both offer and demand level involving the individuals and consumers, who are the unavoidable actors when we are talking about biodiversity management. In the fourth part we take the analysis to a territorial level because territories can hide behind a product or a service, and it is through territories that we can assess the dependence of the product or service on biodiversity and ecosystem services, and also anticipate the impact of waste on the living world. We present this work starting with ecological engineering and by specifying the tools developed at territorial management level, particularly regulatory tools with the avoid-reduce-offset trio or the implementation of Blue and Green Belt types. In most cases, inserts summarizing case studies will help to illustrate and/or improve and develop these different tools. Lastly, in the fifth part and before dealing with the conclusions to this publication, we deal with prospects. We have studied the links between the different actors, and biodiversity at different levels of scale, to show the importance or the territorial scale. In order to rationalise biodiversity at a territorial level, we need to consider the interactions between actors regarding the living world. This means a more overall approach which specifically necessitates the development of new channels to consider the inherent complexity. In the tools presented, we insist on the ecology of reconciliation or multi-agent models, but also on two current Working Groups within ORÉE, one of which deals with a possible revision of accountability (a tool which is common to all the actors), and the other which is even longer-term and which offers an analysis the complexity of dynamic interactions between human systems and living systems.



ECONOMIC ACTIVITY AND BIODIVERSITY

Section 1

1.1. BIODIVERSITIES: THE PROBLEMS AND CHALLENGES FACING HUMANKIND



"Our story has its beginning in the mists of time. A man passing by notices a bush whose branches end in fluffy white flocks […] The human species has just made the acquaintance of the softness of cotton. […] If I followed the journey made by cotton, from agriculture to the textile industry via biochemistry, from Koutuiala (Mali) to Datang (China) via Lubbock (Texas), Cuiabà (Mato Grosso), Alexandria, Tachkent and the Vologne Valley (in the Vosges département of France), I would have a better understanding of my planet […] Because, if you want to understand globalisations past and present, there is nothing like examining a piece of material. This is no doubt because material consists only of threads and connections, and journeys back and forth."

(Orsenna, 2006)

1.1.1. When the living world becomes involved in society's discourse

A scientific discourse and an interdisciplinary objective

Biologists, systematists, ecologists, geneticists, palaeontologists and physiologists have long characterised living beings by their diversity. All of them had in mind that the species are not strangers from one another, but that they are connected (Barbault, 2010) and co-evolve; however the diversity of discourses and approaches has made it difficult to agree on a common theory. The Society for Biology and Conservation was created in 1985, along with the mouthpiece of this learned society, a new specialist journal called *Conservation Biology*. It was also in 1985, at the National Forum on Biodiversity, that Walter G. Rosen proposed the neologism of 'biodiversity', taken up by Edward O. Wilson and 'globalised' from 1988 onwards for the scientific community and the NGOs concerned. It was only in 1992 and the Rio Summit that the term became known worldwide (Barbault, 1994). Since then a real revolution has occurred among the various scientific fields, allowing a gradual decompartmentalisation of the different disciplines and a transdisciplinary approach to the problems faced by the planet and by our societies.

Biodiversity, the living material of the planet

Almost 4 billion years ago, living beings have flooded everywhere on the planet, in every nook and cranny – including the villosities of our intestines where – to our great benefit – some 400 types of microbes thrive. And they have brought about profound changes in the physiognomy and functioning of the Earth's surface, to the point of changing completely the chemical composition of its atmosphere: unlike planets such as Mars, Mercury and Venus where there is a predomination of carbon dioxide (95%), the Earth's atmosphere (before our industrial activities) was composed of 78% nitrogen and 21% oxygen, with only traces of carbon dioxide. But Life intervened: the photosynthesis* of cyanobacteria and later of plants helped fix the carbon dioxide and release massive quantities of oxygen, while the calcium carbonate shells made by certain algae and many animals were accumulating at the bottom of the seas, trapping most of the carbon dioxide there and thus contributing to the creation of calcareous rocks.

According to Jacques Weber, biodiversity also corresponds to the dynamics of the interactions between organisms in the changing environments which gradually, over billions of years, constructed living tissue from the building blocks of RNA* and DNA*. The amazing characteristics of these molecules have led to the appearance and adaptation of all the life forms on our planet, all of which are composed of this material and are simultaneously interdependent and in co-evolution*.

Biodiversity therefore fashions the ecosystems (see chap. 1.1.6.) of the biosphere* and can be approached more precisely through different prisms:

- diversity and genetic variability within each species,
- the diversity of species and their populations,
- the diversity of the associations of species, their communities and their interactions,
- all the ecosystem processes in which living organisms are directly or indirectly involved. They also participate in these processes which in return exert pressure on them, explaining the functioning of these ecosystems, individual selection and population adaptation (Darwin, 1859).

To live means to eat, to avoid being eaten, and to multiply. It therefore means interacting with other living beings, to feed off them, to protect oneself from them and to breed. One cannot conceive of any individual or any species which exists outside a web of relations whence they draw their roots, and which determines their present and their future. Ecologists talk of food chains and food webs*. It is the living framework of ecosystems and of the whole biosphere*. So, to use the expression 'living material' to define biodiversity is partly to foreground its ecological dimension, and by the same token partly to emphasise the importance of the interactions which are woven there (Barbault, 2010).

Attempting to understand and quantify the diversity of living things

Biodiversity is a particularly rich concept which commands humility and caution. How can we really define the criteria and signs which can allow us to realise and take into account this diversity?

The number of species can only be estimated given our current knowledge (Millennium Ecosystem Assessment, 2005):

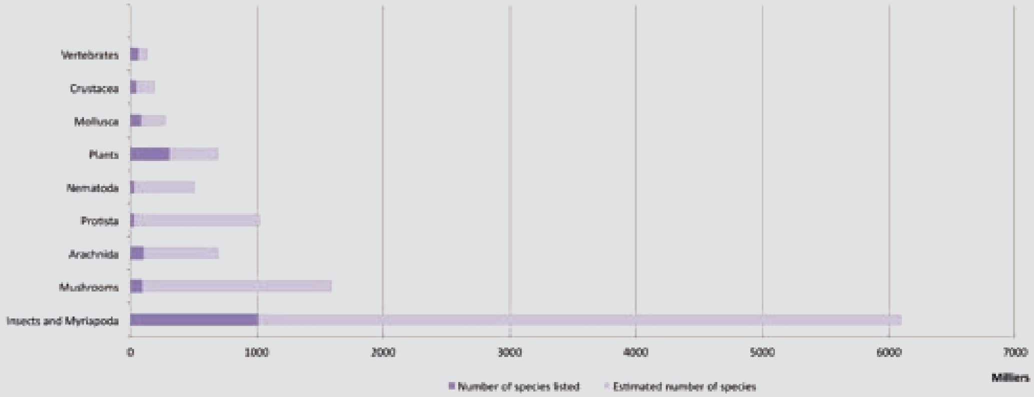


Figure 1 : Number of species on Earth (Commonwealth of Australia, 2009)

There are plenty of problems in determining the number of species contained in the biosphere*, and these may be due to the rarity of the species or the difficulties involved in observing them. So while the animal life on land or in the deep sea may be plentiful, it can be just as difficult to comprehend.

It seems that diversity of gene pools within a species presents the same virtues as gene pool diversity between species, especially in terms of the capacity of the ecosystem to sustain itself when subject to serious environmental disturbances. A good illustration is given by the experiments conducted on rice plots in China, which showed that one only needs to introduce a few rows of a variety which is less productive but resistant to a pathogenic fungus, in the middle of a very productive but less resistant crop variety, to almost totally eradicate the infestation of the culture by the parasite (Leung *et al.*, 2003).

Within the ecosystem, observations are only relative and must be taken with caution. The idea of a genetic relationship between species means one cannot compare the number of species along the lines of true measures of biodiversity: there is much more diversity in a sample of six species which includes a starfish, a dogfish, a spider monkey, a stork, a scarab beetle and a flower (rosaceous).

On the other hand the morphologic disparity and the roles and functions of each species in the ecosystems may be important; however, in the example below, if one thinks only in terms of the number of species, there are six in each of the two situations.

Situation 1

Situation 2

A discourse which goes beyond the sciences

By emphasising the importance of the diversity of life forms – to ensure successful evolution – and the challenges that that holds for our society, the concept of biodiversity forged by a handful of conservation ecologists has opened up a new field of research, thought and action (Barbault, 2010).

Biodiversity therefore outdistances scientific analysis and is conceptualised on a social level (Perrings and Gadgil, 2002), and thus a second form of the globalisation of animal life discourses prolongs and orientates the first. In this context, the Convention on Biological Diversity[1] (CBD) has considerably widened our societies' responsibilities. Since it was developed in 1992 the CBD has taken action to preserve biological diversity*, to advocate making use of it in the long term, and to oversee an equal sharing of the benefits which it can generate and could bring in the future. Taking these elements into account takes us back to the social, economic and political construction of the question of biodiversity (Aubertin *et al.*, 1998).

Definition of biological diversity according to Article 2 of the Convention on Biological Diversity

"Biological diversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems, along with the ecological complexes of which they form a part; this includes diversity within species, between species and of ecosystems." While this definition may seem mundane, even a little heavy, it is however noticeable that it is not based on genes* or species in the way classical biologists have been accustomed to do, but favours the 'ecosystem' ticket, that is to say it takes an ecological viewpoint. Given the context – a global political environment on the environment* and development – this is very pertinent. It is also new: we really are entering the era of biodiversity. The creation of this neologism lies within this split, and carries the seeds of the concept of 'ecosystemic service' which was only really brought into play with the Millennium Ecosystem Assessment* in the years 2000-2005 (Barbault, 2010).

[1] www.cbd.int/convention/convention.shtml

Global living material ...

...this image thus allows us to recall the degree to which the genetic variability of a species and the complexity of an urban or rural milieu interact. The landscape thus betrays not only its history but also the way in which the living organism adapts to it and models it at its own level.

So, if we look at it more closely, it is possible to discover to what extent the physical phenomena (such as wind, rain and the nature of rocks) influence the presence and the evolution of species, and also how these in return modify it and thus influence the existence of the species, and so on and so forth. One of the many examples of this is soil structure, which determines the possibilities for a seed which may have just landed there, and which itself modifies the soil and thus the growing conditions for other seeds, the presence of animals, the structure of the soil micro-organisms etc. In this way all the life forms on the planet are intertwined and weave together this global material which evolves over time. Human populations are caught up in this material insofar as they contribute to its development. Landscapes become human landscapes, as they are coloured by human cultures and languages, by human lifestyles and consumption, and by human land use with its consequences for the future; this can be seen when the Earth is viewed from above (Arthus-Bertrand, 2002). And the view of the anthropologist Descola reminds us that: "For several centuries in the West, Man has been characterised by his capacity to overrule all that is natural in him, ignoring all the mechanisms which we share with other organised beings. In fact this is a fiction due to the universal constraints of living beings and their established habits which, to a great extent, overlap and are mutually determined: humans need to exist as organisms in environments partly fashioned by themselves, and they have the potential capacity to give a myriad of particular meanings to their interactions with the rest of the world's beings" (Descola, 2010).

Article 8J of the CBD (see chap. 4.5.) relating to ethno-diversity stresses the importance of considering local knowledge in order to achieve the aims of the convention: "Subject to its national legislation, each party undertakes to respect, preserve and maintain the knowledge, innovations and practices of indigenous and local communities which embody traditional lifestyles relevant for the conservation and sustainable use of biological diversity, to promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices, and to encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices."

1.1.2. Biodiversity as a driver for ecosystem services

Every living being functions: it breathes, grows (makes organic matter*), reproduces, interacts with many other organisms and with its physical and chemical environment*, then dies and decomposes. Biodiversity is organised into ecosystems, which ensure the ecological processes (pollination, nitrogen fixation, water purification, carbon fixation, etc.). Because the functioning of the global living material and the associated processes contribute to the activities and wellbeing of human societies, we talk about the services provided by the ecosystems, in other words ecological services. A worldwide study conducted between 2001 and 2005 by 1360 scientists from 95 countries evaluated the importance of ecosystems for human wellbeing (Millennium Ecosystem Assessment*, 2005), developing the concept of "services provided by the ecosystems" or "ecosystem" services as a principal tool for analysis and communication.

From the functioning of ecosystems. . .

A report by the Ecological Society of America[2] suggests the following synthesising of our understanding of the effects of biodiversity on the functioning of ecosystems:

- Beyond their number, it is really the functional characteristics of species which have the greatest effect on the properties of the ecosystems and the quality of services which they can deliver. Biodiversity is a collection of specific features and doesn't just mean a random mix of cabbage, carrots and raccoons. These functional characteristics operate and are defined in a given context, which includes the effects of dominant species, keystone species (such as the great predators), engineering species (such as termites) who build the environment*, and interactions between species (such as competition, facilitation, mutualism, parasitism and predation). The importance of each species, from a functional point of view, is dependent on its numbers, although relative abundance is not in itself always a satisfactory indicator of its real influence within the system. This is because even species which are present in very low numbers or which only have a low biomass* (for example, a keystone predator or a parasite) can have a strong influence on material and energy flow paths.

- In many documented cases, changes in the composition of flora and fauna, following invasions or local extinction of species, have significantly altered

[2] http://www.esa.org/esa

the existing ecological services. These changes represent definitive systemic breakdowns because they are difficult, if not impossible, to correct – or are too costly to correct, whether it is a matter of technical or ecological interventions.

- Certain of the ecosystems' properties are initially immune to the loss of species because: (1) they contain numerous species which provide similar functions (the famous functional redundancy* which can be assessed over the long term); (2) certain species are only able to make a small contribution to the properties in question; (3) these properties are mainly dependent on and controlled by the characteristics of the non-living environment*.

- While spatial and temporal variability is on the increase (necessitated by modifications in land use and climatic changes, for example), more species are necessary in order to provide a stable supply of ecological goods and services. It is clear that that is an inevitable occurrence when one thinks about it over longer time periods and on vaster scales.

- The vulnerability to invasion by exotic species is strongly influenced by species composition, and generally decreases when the local species richness increases (Barbault, 2010).

. . . to ecosystem services:

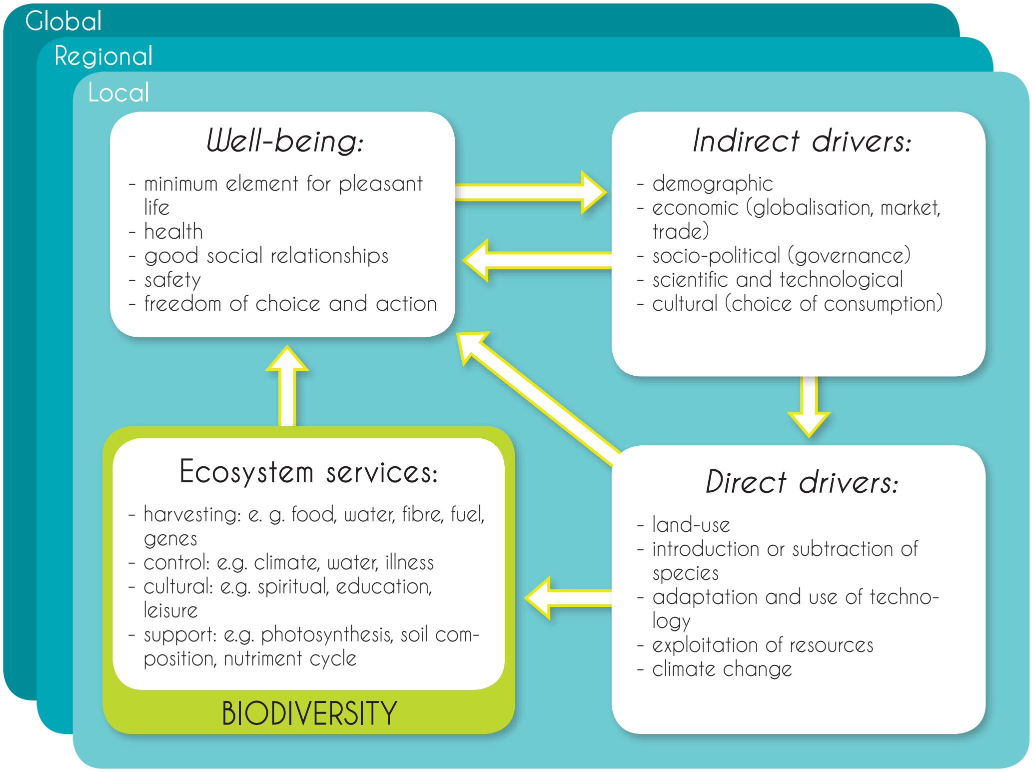


Figure 2 : Biodiversity at the heart of ecosystem services and the dynamics of interaction between socio-economic and ecological systems (MEA, 2005)*

Ecosystem services approach questions of biodiversity from an anthropogenic point of view, thus giving a reading of the living system which, rather than explaining how it functions, describes the benefits drawn from ecosystems by humans (De Groot, 2010). By categorising these under four terms we arrive at a non-exhaustive list of elements:

- supply services: these concern the products supplied by the ecosystems, in particular food products, pure water stored and recycled by natural ecosystems, raw materials such as wood, silk etc., and the genetic materials used in biotechnologies such as medicines and ornamental resources, etc.

- Regulation services: refers to the benefits obtained by the regulatory activity involved in ecosystem processes, particularly the preservation of air quality, climate regulation (such as by plant cover which participates in the evapotranspiration process, temperature etc.), water control such as erosion control, soil fertility, pollination, biological control of pathogens, etc.

- Habitat and support services: these are also referred to as maintenance services and they gather together the services necessary for the production of all the other ecosystem services, such as the production of oxygen through photosynthesis*, and water and nutrient cycles (including those of carbon, nitrogen and phosphorus) etc. It is difficult to distinguish the majority of the maintenance services provided by the functioning of the ecosystem from the underlying ecosystem structures and processes. The TEEB study limited this category to two habitat services: the preservation of the life cycles of migratory species and the preservation of genetic diversity (TEEB, 2009).

- Cultural services: these are the non-material benefits which humans draw from ecosystems. They concern spiritual enrichment, cognitive development, reflection, pleasure and aesthetic experiences. One can also consider these to include tourism, art, traditions and architecture, as well as spiritual and religious values, traditional and positive formal knowledge, educational values and a sense of belonging.

The importance of these “free services” is not limited to their effect on wellbeing, nor to their function as a means of existence: they also represent considerable added value from the economic point of view. There is more and more evidence which reveals that, due to the erosion of biodiversity, we are losing these free services, and which attempts to put a price on this (Balmford *et al.*, 2002).

Biodiversity: you can't always see it…

…and in taking 10g of soil in your palm, you will be holding a hundred thousand billion bacteria in your hand, consisting of almost a hundred thousand bacterial species. Worldwide, it is thought that there are about 5.10^{30} bacterial cells on Earth, oceans included, representing the same biomass* as that of the Earth's plant life (Le Roux, 2010). Even smaller than bacteria are the viruses, these groups of a few proteins and one or more segments of DNA* or RNA*. Bacteria and viruses were on Earth before the eukaryotes and played as big a part in the development of life as they play in its evolution today. Some of them are in the forefront of human current affairs (influenza, tuberculosis, HIV, etc.), while others remind us that, on the micro-organism level, we are animals just like any other [as is quite clear from the fact that the SARS agent was able to pass from the Malayan masked palm civet to the human species (Moutou, 2010). Others, on the other hand, are with us every day in our vital functions such as digestion [there are some 500 to 1000 different species creating a veritable ecosystem inside us (Arumugam *et al.*, 2011)]. We are therefore harbouring a microscopic biodiversity with which we interact in order to digest our food, and which is also involved in protecting our skin and its appearance. These communities of organisms (such as yeasts and bacteria) are to be found everywhere in our bodies and can pass from one carrier to another via flakes of skin.

An adult Demodex foliculorum *mite on human skin.*

Microscopic ecosystems, which are formed deep within our digestive systems, on our skin, and in the air, evolve and become part of the general functioning of biodiversity (see chap. 1.2.2.).

This approach allows us to reconsider a far too simplistic notion which only concerns the eradication of a pathogen and which has already found its limits (for example the appearance of resistance to antibiotics and the presence of nosocomial diseases). The discipline of health ecology proposes new models and tools for a more integrative and interdisciplinary approach in research on the processes at the origin of many diseases, which sometimes act on regional or global scales (Guégan and Renaud, 2004; Morand, 2010). It is essential to consider not only the pathogen but also its interactions at the heart of the ecosystem (whether that exists within the digestive system or on the level of a forest ecosystem, for example) if we are to think of controlling it both now and in the future, given the dynamics of living systems and the disturbances which they are currently undergoing (such as species displacement due to global warming).

1.1.3. Biodiversity as the foundation for our future

Among the basic needs of all species, including humans, is the need to feed themselves. Since prehistoric times we have therefore been linked to biodiversity from birth. Our interior biodiversity, that of our intestinal flora, is fundamental but unique to everyone. It is part of the way we “digest” biodiversity, the lands which have emerged from the oceans, those mutual assets around which numerous activities have developed such as harvesting, hunting, fishing and livestock farming all of which are to a greater or lesser degree industrial in nature. Seeing things through the prism of our plate thus allows us to understand and question our connection to biodiversity, its development and its implications; our link to those who work with this biodiversity; and the way in which the future of our planet and our own future can be mapped out.

Today, half of all human foodstuffs rely on four plants: wheat, maize, rice and potatoes, even though there are close to 20,000 known edible plants, and 5,800 cultivated in various places across the globe.

Farming methods based on the adaptability of living beings

From the Neolithic era up to about a century and a half ago, farmers cultivated plant varieties which they selected themselves from their own crops. By systematically choosing those which appeared to them to be the ‘finest’ seedlings in their fields, the ‘finest’ ears on the young plants and the ‘finest’ seeds in the ears, they were free to choose their own selection criteria (gustative qualities, general behaviour of the plants, resistance to potential climatic events, tolerance of pathogenic agents and insect predators, level and regularity of expected productivity, etc.). The same thing applies to animals.

In this way a number of varieties were selected, which were adapted to each ecosystem. It is therefore unnecessary to create exaggeratedly artificial agro-ecosystems and to eradicate all their competitive grasses, all the pathogenic agents and all the animal predators (Dufumier, 2010).

The artisan becomes the sorcerer's apprentice

Since 1960 and the 'green' revolution there has been a real break with the ways in which systems of agricultural production had previously been put in place. Since then, varieties have been selected in perfectly controlled conditions in experimental stations, in order to produce ever higher yields per unit of surface area and to respond to the quality standards demanded by the agro-industrial processing companies.

Whereas beforehand farmers used to select a wide range of varieties adapted to the extreme diversity of their environments*, at that point it became the opposite (Dufumier, 2010). From then on, they had to adapt these diverse environments to a very small number of species at all costs. As these varieties were cultivated some distance from the places where they were selected, the latter showed themselves to be vulnerable to competition from "weeds" and to damage incurred by insect pests. They had had to simplify the agro-ecosystems*, and this had made them more fragile, which resulted in accelerated soil erosion, a proliferation of invasive species which were resistant to pesticides, a greatly reduced cultural and spontaneous biodiversity (Poschlod P. *et al.*, 2005) and small farmers' ever-growing dependence on seed companies and agrochemical multinationals. The high returns obtained with the new varieties have therefore not only demanded a higher financial outlay from farmers but have very often translated into exaggerated ecological and health costs for society as a whole. This was the case on the island of Java in Indonesia

where the generalised use of the very first varieties of "improved" rice (IR8, IR36, etc.) very quickly led to serious infestations of the brown planthopper; the farmers immediately reacted by spraying them with increasing doses of carbamate-based pesticides, as a result of which the human population suffered from serious poisoning.

Later on, efforts were made to incorporate new resistance or tolerance genes* into the new varieties so that they could resist certain parasites and pathogenic agents. Nevertheless it is still the case that the cereal varieties which are the most cultivated in the world today remain very closely related, and that the conditions under which they are cultivated result in agro-ecosystems which are homogenous with very little diversity and are therefore fragile. It is the same for the cultivation of leguminous plants, root crops and edible tubers, not to mention the disappearance of the hardiest breeds among the main species of domestic animals.

The environmental problems posed by this agriculture result just as often in the exaggerated specialisation of systems of production (Dufumier, 2010). Farmers, unable to make a financial or a technological investment, in livestock or in cultivation, have been encouraged to position their systems, leading to the rapid disappearance of mixed systems founded on crop-livestock farming. Today the majority of the cereal farms in the Paris Basin have no livestock, while the Breton farmers produce almost no cereals. The sad thing is that because there is no livestock there is no manure either. The nitrates which result from livestock waste go straight into the water table without being fixed in the humus (organic* nitrogen). Moreover, in the absence of manure to spread on their fields, the cereal farmers use synthetic nitrogen-based fertilisers, which also contribute to the pollution of the groundwater. Soils become impoverished and, with the resulting depletion in humus content, they lose their capacity to retain water and mineral elements, see their structural stability diminish, and become more vulnerable to erosion.

This exaggerated specialisation is already causing much damage to the environment. It is possible then to implement new systems of production which mainly depend on natural renewable resources (such as light energy, atmospheric nitrogen, rainwater, and mineral elements resulting from alterations in the bedrock) and being as economical as possible in the use of non-renewable energy resources (such as fossil fuels and phosphate deposits), synthetic fertilisers and plant protection products, even if it means using a greater variety of species and cultivated varieties on farms, with cereals, leguminous plants, tubers, oleaginous plants, fibre plants etc., whether simultaneously or in succession. The point of increasing biodiversity within agro-ecosystems is that we can increase the “natural” obstacles to the proliferation of predators and pathogenic agents which are harmful to cultivated plants, thus avoiding the reckless use of pesticides (Altieri M.A. *et al.* 2004; Warner K.D. 2007).

In the face of this report arises the question of knowing whether it is really the genetic potential of the species, breeds and varieties taken individually which is today limiting farming production and income. The productivity and "sustainability" of systems of production appears in fact to be now more conditioned by the preservation of soil "fertility" and the maintenance of the production potential of the agro-ecosystems* considered as a whole.

Feeding off biodiversity and knowledge

But there are many alternatives, and multiple initiatives and ancient wisdom are available worldwide which we can use to reconcile agriculture and biodiversity, thus re-anchoring people's livelihoods within the dynamics and preservation of biodiversity. By way of an example, this can be put succinctly:

A closer association of agriculture and livestock farming can lead to stronger interactions in the joint management of water and carbon cycles, and of nitrogen and other mineral elements such as phosphorus, potassium, calcium etc. By favouring the use of organic* fertiliser we can restore a maximum of mineral elements, reactivate the microbial life associated with farming (such as bacteria and mycorrhizae*), promote interim water retention and allow terrains to resist agents of erosion.

Another future course of action is agroforestry*. The European Silvoarable Agroforestry for Europe project (SAFE) makes particular reference to the cultivation of a plot which combines walnut trees and

cereal rotation, thus allowing returns which are higher than can be obtained by cultivating each of these separately (Dupraz, 2005).

The biological war against harmful insects mostly consists of breeding and then releasing predators or rival species in order to limit the population density of the harmful pests and limit the damage they cause. Just as in the preservation of "auxiliary biodiversity", the selection of local plants also plays a part in checking the development of pathogens.

The urgency seems to be to make the functioning of these agro-ecosystems* more intelligible and to model their evolutionary dynamics. Farmers would benefit from reliable predictive models telling them what might happen even on their own farms, by showing them the possible consequences of using one or other of the alternative techniques.

Such an evaluation may be relevant not only in terms of returns from a particular variety or breed, considered separately, but would rather focus the attention on the functioning of animal and plant populations and the results of systems of production considered as a whole, including from the health and community aspects (Dufumier, 2010).

There are already in existence systems of production inspired by agro-ecology* (see chap. 4.2.) which can supply agricultural and food products while making ever more intensive use of natural renewable resources and much more sparing use of fossil energies and polluting products. These systems, which are very close to the environments and climates where they are implemented, can therefore reconnect with living beings' capacity for adaptation and the farmers' savoir-faire in order to construct systems which are more robust and capable of evolving in the face of climate change and other biodiversity risks, whether natural or man-made.

The conversion of current farming methods to systems such as these which are more respectful of the environment* and less costly in terms of fossil energy and plant protection products, requires careful and meticulous work on the part of humans. This suggests that farmers are acknowledged for their savoir-faire, their products and their environmental services (MEA*, 2005), which they provide (by participating in regulation services etc.) from the field to the plate.

This short journey through the history of our farming methods thus allows us to emphasise by example living beings' capacity for innovation and humans' capacity for working together with them. There are many other aspects of our daily life which could be visited in the same way, by starting with services as products created by biodiversity. This is because they hold a formidable reserve of the living world's answers to ecosystem – and particularly climate – changes (Abbadie and Lateltin, 2004). If this living world is too weakened by the pressure of human activities, the range of biodiversity's possible responses will be overtaken by the variability of the environment*. All we are seeing is a snapshot of the diversity of life. We could believe that the number of species and habitats is redundant or not indispensable. But the time scale is crucial if we are to understand the significance of each of the components of the biosphere* as well as that of their interactions. The roles of the species and of the groups of organisms at the heart of the ecosystems continue to develop. So the animal and plant populations have an organisation and distribution which varies according to the climatic conditions to which they have been subjected over the course of the years, centuries and millennia (Parmesan and Yohe, 2003; Pounds et. al., 1999).

This is because biodiversity, in all its variety, variability and complexity, can be thought of as an insurance policy against the unexpected in the framework of global ecosystem changes, whether they are "natural" or anthropogenic (Yachi, 1999). This diversity and its adaptive potential are also sources of many innovations, although we do not yet know which of these will prove to be necessary.

1.1.4. Humans and the erosion of biodiversity

Whether it is on the scale of a business park, a country or the planet, there are still numerous difficulties and uncertainties in defining biodiversity and understanding how ecosystems function. In dreaming of creating systems as complex as ecosystems we should take care to remain humble, especially when we recall the failures of the Biosphere 2 project* (Levrel, 2007). The current biodiversity crisis, the sixth wave of massive erosion of diversity in the history of the planet, is this time closely connected to the activities of a sole species, Homo sapiens, which has progressively come to the fore in the space of barely 2 million years (Barbault, 2010). If we, as human beings, with our genetic diversity and our diversity of lifestyle and cultures, form an integral part of biodiversity, we are also responsible, directly or indirectly, for biodiversity's current erosion and increasing standardisation.

The mechanisms responsible for the demographic collapse of animal and plant populations are those which affect their dynamic: increases in mortality and/or emigration, falling birth rates, and the absence of immigration. And the reduction in numbers sets off a true spiral of extinction (interbreeding, genetic drift, etc.). Hidden behind these phenomena, the principal active causes are the shared responsibility of all the economic players.

The different causes are listed below under four categories:

1. The destruction, alteration and pollution of natural environments. The most serious threat hanging over biodiversity is the loss of habitats – and the first means of protection is therefore logically the preservation of natural environments. Habitat fragmentation threatens the continuation of the species which live there because the dispersion capacity and species colonisation is limited by the barriers to movement of the individual (or the seed in the case of plants) such as roads and these pockets attract predators.

2. Overexploitation through hunting, fishing or cropping. The risks of extinction linked to destruction or human overexploitation are a particularly big threat to large species, of which we find vertebrates in first place. There are plenty of examples, whether these are due to hunting or to fishing (e.g. cod and red tuna) (Cury and Misery, 2008). Certain fishing techniques ravage the marine environment, whether that is by affecting non-target species (such as albatross and sea turtles) or by destroying underwater habitats (such as when the very slow-growing biocenoses of underwater peaks are scraped by trawlers) (Cury and Miserey, 2008).

3. Invasions of ecosystems by species introduced, whether deliberately or accidentally, by humans; this is a particular problem in islands with a limited surface area. In Madagascar, where the ichthyofauna* is highly endemic, with 14 of its 25 types unknown anywhere else, a recent inventory of the soft water environments found only five. In the island's aquatic environments it is the introduced fish species which dominate. A combination of the environmental degradation seems to be driving Madagascar's original ichthyofauna towards extinction.

4. The effects of climate change (which itself constitutes a large-scale environmental modification) which directly influence the development of ecosystems, particularly the distribution of the species of which they are composed (Barbault, 2010).

Furthermore, these effects do not act in isolation and can augment each other mutually. In this way, the deterioration of environments may work in favour of certain exotic species which in turn contribute to this degradation. There is a marked destabilisation of the food webs* with the well-known cascade phenomena encountered in the fishing industry. And behind this dynamic lies the unrestrained development of industrial societies – a development which is not sustainable (Barbault, 2006). It has to be said that the consequences of these changes will be anything but negligible.

Biodiversity has definitively entered into a spiral of extinction, and the force behind this acceleration is incontestably our own species. The human race is also finding itself under threat, along with much of biodiversity, but indirectly, through the pulling apart of the global material. Because this material underpins our existence and because we share it with the other species, including the rest of humanity, it is not out of the question that, if it unravels, our societies' malaise may be magnified and caught up in a deleterious spiral (Barbault, 2006).

1.1.5. From threatened species to the interactions within ecosystems

Keystone species (such as wolves), endemic species (lemurs), engineering species (termites), indicator species (corn poppies), umbrella species (capercaillie), economically useful species (bees), emblematic species (edelweiss), and every species from a bacteria to a whale can find itself taking on one of these qualifiers. These may vary according to the chosen point of view but each of them may be considered to be a bona fide part of biodiversity (CSPNB, 2008).

Whether a whale, a panda or a polar bear, biodiversity often has faces which focus the attention (such as the parrot's cousin, the superb Ara Hyacinth in the animated film "Rio") but this approach could lead to biodiversity being thought of as simply a collection of species, while forgetting about all the living systems to which these animals are attached. The relevant legislation on biodiversity, and notably the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES*), also tackles the living material of the planet. They are using an approach which could be beneficial for certain species threatened with extinction, but which influences the sampling measures and the "putting under glass" of spaces as happened with Yellowstone Park, which was instigated in 1872[3] without taking into account the ecosystems concerned and the ways in which they functioned; this included all interactions between living beings, including humans. In this way the gorilla (CITES* Appendix 1) may hide the forest in which it lives and the conflicts which threaten it and which have been doing so for years, especially the appropriation of natural resources such as diamonds, precious woods and coltan, the mineral essential to the manufacture of mobile telephones, electronic games and computers (CSPNB, 2007). It would not be realistic to consider the future of biodiversity without taking into account both the diversity of the species association in each milieu and the functioning of those systems.

The state of health of the ecosystems, illustrated by the state of their biodiversity, is a major topic both now and for the future (see chap. 6.). The Millennium Ecosystem Assessment* (2005) has emphasized the links between the ecosystems' functional dynamics and the ecological services from which our society benefits. It is therefore possible to change the way in which we look at living systems. This may be the case for low mountain ranges such as the Vercors: this massif, of which 65% is wooded, is home to an exceptional biodiversity both wild (including over 2000

[3] http ://www.nps.gov/yell/index.htm

plant species, and all the wild ungulates found in France) and domestic.

In the Vercors local breeds of cows and horses are preserved, and AOC-certified wines, cheeses and nuts are produced through agriculture. Of the jobs exercised in the Vercors[4], Regional natural Park* of the over a third are directly concerned with biodiversity: the timber industry, farming jobs, tourism, heritage conservation, etc. Another third has a direct link with the first: supply services, businesses, etc. The remaining third would not exist without the other two: public services, education, health, roads, etc. Without the existing biodiversity the economic activity of the Vercors would not exist. The biodiversity of the past is also involved because the limestone massif is the result of the accumulation of organisms which died on the sea bed in the Mesozoic era (CSPNB, 2007).

As a reflection of the European Water Framework Directive*, new legislation is to be implemented so that the natural and anthropogenic nature of ecosystem health is placed on a national and international level.

Today, biodiversity can be simultaneously a standard and an evaluation criterion. Within the Vanoise[5] national park in the French Alps, biodiversity has been designated as an aim for the management of high altitude pasture, but also as a tool for evaluating the impact of human activities, as much for the central area of the park as in the peripheral areas (Houdet, 2008). This step allows us to make better policies on biodiversity conservation with a view to including all the ecosystem's organizational scales in the management of the area. The Regional natural Parks[6], the network of Nature 2000* sites[7] and the launching of the Blue and Green Belts endorsed by the Grenelle process (see chap. 4.1.1.), are some of the initiatives through which this process is being put into practice, not just in protected areas but also in rural, marine, urban and industrial spaces.

The diversity of interactions between organisms lies at the heart of ecosystem dynamics (Barbault, 2006) and thus underpins the services we draw from them (Millennium Ecosystem Assessment*, 2005). There is a continuum of relationships between the interacting organisms, from symbiosis to parasitism, as a result of the natural selection of individuals and their capacity for adaptation (Darwin, 1859). In this way cooperation and co-evolution* became the norm over the course of the billions of years which preceded the flourishing of human activities, and the latter benefit from these interactions without always realizing it.

In any milieu, and on every scale, we can see the interactions of the living material.

[4] http ://parc-du-vercors.fr/

[5] http ://www.parcnational-vanoise.fr/

[6] http ://www.parcs-naturels-regionaux.tm.fr/fr/accueil/

[7] http ://www.espaces-naturels.fr/natura_2000

For instance, the nautilus, a deep-sea invertebrate (living at depths of 100 to 800 metres) and a cousin of the squid can only tolerate these extreme conditions with the aid of the bacteria which it houses, notably in its excretory system, and which produce gaseous nitrogen. This gas allows the nautilus to regulate its buoyancy and therefore its movements (Pernice, 2007; see CSPNB 2012 p. 136). To put it more formally, this is an example of the "contract" put in place between plants and animals over the course of evolution which ensures the survival of all of them. There are of course insects but also mammals and birds which are involved in this co-evolution* with specific plants. In the Mediterranean garrigues, nineteen bird species have been identified as active agents in the dissemination of thirty-eight plant species with fleshy fruits (Debussche and Isenmann, 1992; see CSPNB 2012 p. 131).

Faced with the current massive disturbances, organisms with short reproductive cycles become predominant in each environment. This is particularly true of the oceans where the very bad management of ecosystems and marine resources has resulted in the spectacular trend of the "jellyfication" of the oceans. We are in the process of passing from a world structured by fish and crustaceans to a world characterised by an overabundance of jellyfish. The "cascade" effect along the length of the food webs* affects our activities, particularly the fishing industry, and thus our very subsistence.

The diversity of interactions between organisms lies at the heart of ecosystem dynamics, and for that reason this diversity plays a part in the way the biosphere* functions. So behind the climate is hidden the biodiversity which participates in and influences fundamental cycles such as that of water, as well as elements such as carbon (through photosynthesis*). Species, including the human species, are climate dependent, and they in their turn influence it by their activities (such as use of fossil materials) and their land use (such as desertification and deforestation, etc.). In return, climate change exerts an influence on living organisms, and particularly by promoting the acceleration of plant cycles. Farmland and forests are already showing the effects (earlier grape harvests, certain plants growing at higher altitudes, fragility in the face of new parasites, etc.).

Tackling biodiversity and its challenges means being interested in the interactional dynamics between organisms in changing environments. The acceleration of the processes leading to biodiversity erosion means we are already seeing glimpses of certain consequences of irreversible changes, and the loss of interactions within ecosystems of which the disappearance of emblematic species is only the tip of the iceberg. It is therefore crucial that we ourselves consider and even reconsider how we interact with the living world.

1.1.6. Ecosystems as tools for action

A framework of living systems

The word "ecology" was forged in 1866 by the German biologist Haeckel when he became aware of the importance of the interactions between living organisms and the environment in which they lived, and that these interactions are largely responsible for the capacity of living beings to survive and reproduce in given surroundings.

Temperature, salinity, luminosity and other physiochemical state variables prove to be decisive for the establishment and maintenance of various species. In return, the presence of an organism modifies the milieu, thus determining the survival conditions of the species in question, and the establishment of the following generations, as well as those of other organisms.

The idea of the ecosystem is one of the major ecological concepts. While it often refers to a concrete object (such as a forest or a pond) it is above all a way of looking at the world through the filter of interactions between the living (biotic* elements) and non-living (abiotic* elements). An ecosystem is therefore a coherent collection of disparate elements which are mutually influential (Leriche and Abbadie, 2010).

The notion of an ecosystem is to be approached as a whole, characterised by a certain structure and a certain dynamic. This is a resolutely macroscopic view which allows us to understand the behaviour emerging from an assembly of living and non-living elements rather than the properties of each of these elements (Odum, 1971). Ecology is therefore a very conceptualised science, and this is probably due to the complexity of the questions and the study objects which remain inaccessible within a precise analytical framework (Leriche and Abbadie, 2010).

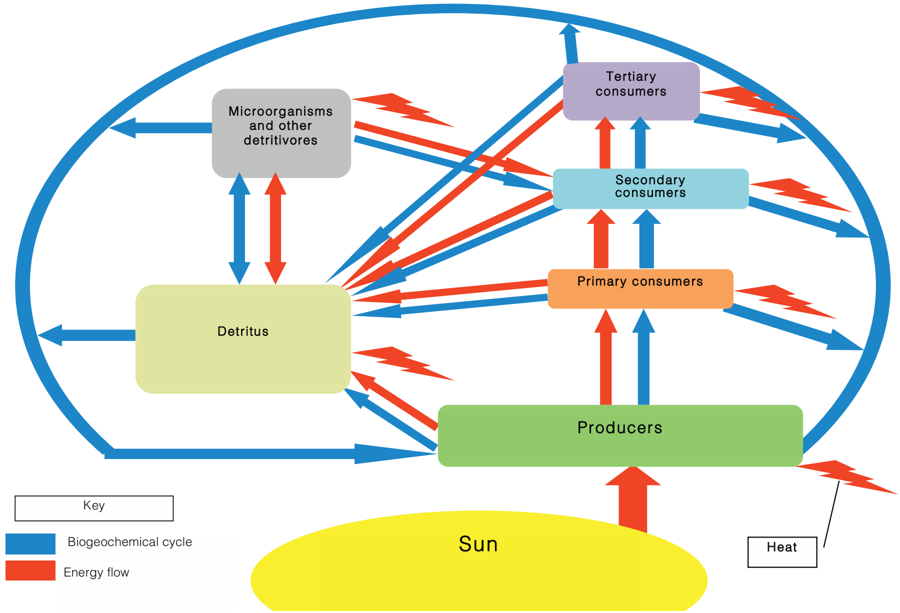


Figure 3 : Overview of the energy and nutrient dynamics of an ecosystem (Campbell, 2009)

The ecosystem can be considered to be a relatively open collection crisscrossed with material and energy flow paths. In another light, it allows us to identify the relationships which exist between the different living and non-living beings. So energy, which essential to life, passes from one compartment to the next (from plants to herbivores, and thence to carnivores and decomposers). The material flow paths also follow the food web*, but start and finish in the inert compartments, thus forming biogeochemical cycles, the great circles of life which connect the Earth's surface, organisms, water and air (Colinvaux, 1982). Let us recall that every product of a compartment becomes a resource for another: for the ecologist, there are only resources, and nothing is wasted (see chap. 4.1.2.).

This schematisation of the ecosystem must not blind us to the fact that the system is dynamic, in time as well as in space, and is therefore progressive. In order to understand its functioning, and above all its future potential, we must study not only the mechanisms and phenomena relating to the component populations and communities (such as demography, predation, and mutualism) but also the fluctuations of the energy and material flow paths by which they are constrained or fed (such as climate change, pollution, fertilisation methods, etc.) (see chap. 4.2.).

Today the problematic of the relationships between biodiversity dynamics and ecosystem function is crucial. The biodiversity crisis has forced some to wonder about the possible existence of a minimal biodiversity below which our environment would become profoundly destabilised. The first experiments on this theme were carried out on the North American prairies (Tilman, 1996), and subsequently on the European prairies (Hector, 1999). These studies have shown that an elevated number of species guarantees a better resistance by the ecosystem to variations in the physical and biological environment, for example dryness. This phenomenon can be seen as a true biological insurance policy (Loreau and Hector, 2001): the higher the number of species, the more chance there is that one or several of them will be capable of surviving the new environmental conditions, thus increasing the resilience* of the ecosystem (i.e. its capacity to dampen the effects of the disturbances).

According to the issues raised here, the level of approach to the ecosystem* can be varied: in addition to the species themselves there are the ways in which plants, for example, have a maximum photosynthetic capacity, and the capacity of certain functional groups to fix atmospheric nitrogen, to conserve water, or to resist parasites, all of which may sometimes become important. On the other hand, in a given place the species may be central to the approach, such as in the American prairie where the productivity of the plant cover as a whole is largely dependent on the presence of leguminous fixers of atmospheric nitrogen which in turn supply nitrogen to the other species.

The ecosystem concept thus corresponds to eminently complex objects, possibly the most complex after the biosphere*. These objects are the expression of an assembled multitude of biological and physiochemical components which have been made co-dependent by an even greater number of interactions, whether direct (exchanges of matter, energy or information) or indirect (the creation or modification of habitats, or the production of resources).

The ecology of the ecosystem is therefore a very complete and realistic way of reading the world around us, provided that we emphasise its dynamic nature. This intrinsic variability results in simultaneous developmental processes which continuously shape populations such as species, as well as the perpetual change in the system of constraints and climate, mineralogical and morphological disturbances etc.

In return, the ecosystem is something which can be manipulated by nature. Agriculture, forestry, water quality management, among others, are only diversions, whether conscious or not, of the ecosystems' functioning and dynamics. Numerous environmental problems could be avoided if everyone kept in mind that the ecosystems, no matter how simple, are and always will be systems! In other terms, it is not possible to maximise any particular attribute or function of the ecosystem in a sustainable and effective way – the production of maize in the field for example – while ignoring everything else (see chap. 1.1.3.).

From modelling to action

Understanding the ecosystem and its modelling, including using digital predictive models, are therefore becoming really urgent given that it is a matter of restoring thousands of damaged sites, ensuring the renewing of biological resources, adapting to climate change, etc. Managing nature these days means thinking in terms of multiple objectives, multiple stakeholders, and multiple processes, on different scales of time and space.

This reading of the logical approaches which prevail in the organisation and dynamics of ecological systems (variability, adaptability, diversity, heterogeneity, etc.) and their operational declination, ecological engineering, indisputably open innovative ways to work out new development methods (see chap. 4.2.).

The International Conference on Biodiversity, Science and Governance in Paris in 2005 saw France launching an idea for an international panel of experts on biodiversity. After seven years of consultation and negotiations, the Intergovernmental Platform on Biodiversity & Ecosystem Services (IPBES) was created: 94 countries, including France, laid down the initial basics during a meeting in Panama in April 2012[8]. The aim of IPBES is to offer a framework which is just as relevant to scientists as to decision-makers. This platform allows us to "strengthen the science-policy interface on biodiversity and ecosystem services with a view to the sustainable conservation and utilisation of biodiversity, the long-term wellbeing of humanity and sustainable development" (Resolution establishing the IPBES)[8].

The IPBES has several aims:

- To conduct evaluations on biodiversity, ecosystem services and their interactions on international, regional and subregional scales, as well as on the thematic questions and new topics identified by science (for example, the state and trends of pollination services, food security and biodiversity, the value of ecosystem services in arid zones, etc.);
- To support policy formulation and implementation by identifying policy-relevant tools and methodologies, such as models and scenarios, evaluation methods and indicators, and to enable decision makers to gain access to those tools and methodologies;
- To identify and prioritize key scientific information needed for policymakers at appropriate scales;

[8] http ://www.ipbes.net/

- To prioritize key capacity-building needs (e.g. training and dialogue) to improve the science-policy interface, notably in countries in the south;

- To facilitate a coordinated approach to the production of new knowledge

In order to facilitate the realisation of the work of the IPBES, the flagship programme of the Fondation pour la Recherche sur la Biodiversité (FRB[9]), "Modelisation et scenarios de la biodiversité," has made an initial inventory of French scientific work on the topic.

It is a major challenge to understand of the effects of global changes (climate, land use, pollution, etc.) on biodiversity, ecosystems and associated services, and to face up to them. The speed and scale of these phenomena are such that scientists are having to work hard to suggest tools which would allow us to adapt the way in which we manage biodiversity. Among these tools, scenarios play a key role because they can warn the decision-makers and managers of possible trajectories in biodiversity, ecosystems and associated services in response to environmental modifications, whether to climate or habitat. Biodiversity scenarios allow us to anticipate crises and, in reflecting the scenarios of the Intergovernmental Panel on Climate Change (IPCC[10]), they can also serve as information tools for the wider public.

[9] http ://www.fondationbiodiversite.fr/

[10] http ://www.ipcc.ch/

1.2. THE INTERDEPENDENCE OF STAKEHOLDERS AND BIODIVERSITY

In order to alter our perspective we need to take into account the issues and challenges for humans which are engendered by biodiversity. We need to produce a different reading of our activities which will then allow us to identify how much this biodiversity can give rise to opportunities, but also risks, for the stakeholders. By doing so, the stakeholder's point of view is enriched by a broader concept of the system and of the identification of those who may be directly or indirectly involved in the issues. The relationships between humans in terms of biodiversity are not binary and are rarely linear. The opportunities create new connections between stakeholders across the planet when the risks may concern several of those involved both in the here and now and in the future, rather like the somewhat fanciful image of the beating of a butterfly's wing eventually resulting in a hurricane.

1.2.1. Biodiversity as a source of opportunities

We are part of biodiversity, and all human activity is linked to it as much as humans are all linked to each other. A realisation of this interdependence opens up numerous opportunities for the economic stakeholders. These opportunities are numerous and varied, but are sometimes unsuspected due to the degree to which the prism of biodiversity helps us to reconsider its activity and its potential. It is possible, then, for the stakeholders to identify opportunities in their daily lives, on a legislative level and in the opening up of new markets.

Operational opportunities

These opportunities may be in the order of increased productivity, quality, or sustainability of stakeholder activity development, for example on the level of supply chains (TEEB, 2009). As an example, the Swiss chocolate manufacturer Halba is, as with all chocolate manufacturers, highly dependent on its cocoa supply, in terms of quality and quantity. In order to guarantee its supplies, the company has taken an interest in cocoa production methods so that it can secure them in terms of both quality and quantity. For that the activity had to be viable for the producers. The solution chosen by Halba has been to support the establishment of an agroforestry* system. In this way the producers have been able to diversify their income and minimise the risks in cocoa production. Cocoa production has therefore become attractive for the local populations. On top of that, the many different crops on each plot of land have enabled the conservation of cocoa production, because diversification of cultivated species increases the ecosystem's resistance to disturbances. The benefits of this agroforestry* are also as much ecological and social as economic. From the business' point of view, the quality of their raw materials has been maintained, and even improved, and the supply chain has been ensured (TEEB, 2009).

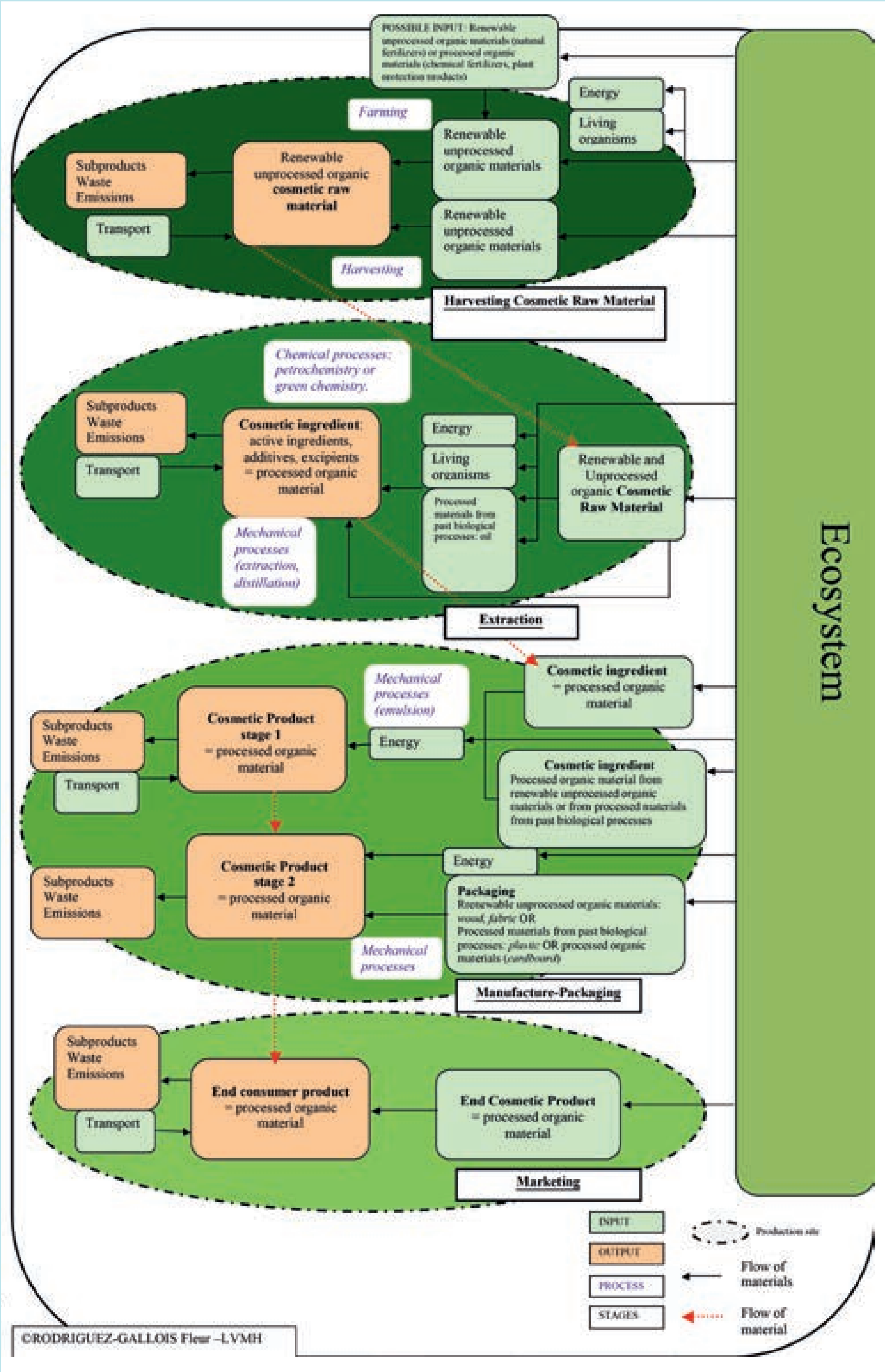
Insert 1

The study of biodiversity material flow paths in creating an LVMH cosmetic

The case study conducted by Fleur Rodriguez-Gallois for LVMH mentions the importance of using flow paths when rationalising a production site. This approach helps identify the extent to which biodiversity and services are used in a production unit, and then to integrate the cost of biodiversity in the accounting year of each production site. The outline represents the work of identifying the flow paths and reserves of biological materials used by the business in its process of creating a cosmetic.

This study allows the foregrounding of the complexity of tracking raw materials and the supply chain. The whole procedure depends on biodiversity-derived resources, which relieves the company of the problem of integrating biodiversity in the final cost of the product.

Figure 4 : Mapping of flow paths of biodiversity-derived materials for the creation of an LVMH cosmetic (© Rodriguez-Gallois – LVMH, 2009)


POSSIBLE INPUT: Renewable unprocessed organic materials (natural fertilizers) or processed organic materials (chemical fertilizers, plant protection products)
Energy
Living organisms
Farming
Renewable unprocessed organic materials
Subproducts Waste Emissions
Renewable unprocessed organic cosmetic raw material
Transport
Renewable unprocessed organic materials
Harvesting
Harvesting Cosmetic Raw Material
Chemical processes: petrochemistry or green chemistry.
Subproducts Waste Emissions
Cosmetic ingredient: active ingredients, additives, excipients = processed organic material
Energy
Living organisms
Renewable and Unprocessed organic Cosmetic Raw Material
Transport
Processed materials from past biological processes: oil
Mechanical processes (extraction, distillation)
Extraction
Ecosystem
Cosmetic ingredient = processed organic material
Mechanical processes (emulsion)
Subproducts Waste Emissions
Cosmetic Product stage 1 = processed organic material
Energy
Cosmetic ingredient
Processed organic material from renewable unprocessed organic materials or from processed materials from past biological processes
Transport
Energy
Cosmetic Product stage 2 = processed organic material
Subproducts Waste Emissions
Packaging
Renewable unprocessed organic materials: wood, fabric OR
Processed materials from past biological processes: plastic OR processed organic materials (cardboard)
Mechanical processes
Manufacture-Packaging
Subproducts Waste Emissions
End consumer product = processed organic material
End Cosmetic Product = processed organic material
Transport
Marketing
INPUT
OUTPUT
PROCESS
STAGES
Production site
Flow of materials
Flow of material
©RODRIGUEZ-GALLOIS Fleur –LVMH

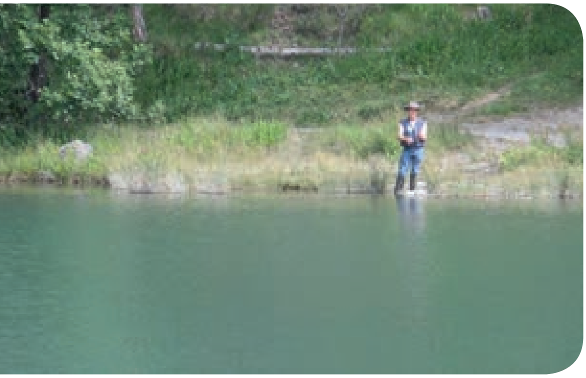
New markets

Taking biodiversity into consideration could be the opportunity for innovation or the opening of new economic markets (TEEB, 2009). A source of products as much as of services, biodiversity and the functioning of ecosystems represent a real potential for the actors. As an example, the TEEB report stated that recreational hunting and fishing are important economic activities whose market represented 37 billion dollars and over a million jobs in the US in 2007. Coastal areas, wet areas and associated biodiversity are indispensable to these activities in the same way as the durability and expansion of this market.

Even more than this, to reconsider one's activity within an ecosystem-based framework (see chap. 1.1.6.) or using tools such as the BBII* (see chap. 2.2.1.) provides an opportunity to review one's activity while identifying areas for improvement. In view of this approach, consumer behaviour is encouraging as the growing importance of biodiversity in civil society's message would seem to point towards changes in consumer behaviour; consumers are increasingly aware of these stakes, and thus the possibility of new markets[11].

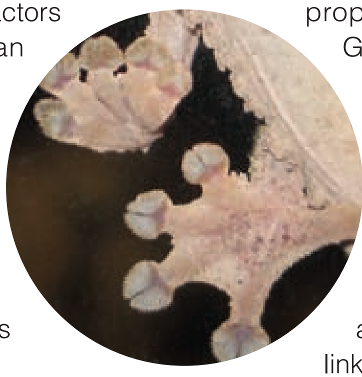
Innovations and R&D

A considerable number of products or services such as medication from living organisms, depollution processes using plants, etc. stem from biodiversity and make it possible to meet today's requirements as well as those of the future (The Madagascar periwinkle, used in traditional medicine in the form of a herbal tea, is now a basis for anti-cancer drugs thanks to the alkaloids it contains which inhibit cell division. Certain species of frog are capable of producing substances which prevent mosquito bites, and others produce particularly effective antibacterial substances.



[11] Study by Ethicity on responsible consumption. http://www.blog-ethicity.net/

Thus current biodiversity stems from close to 4 billion years of innovation and adaptation of living beings and systems. It is an enormous potential source of inspiration and innovation for actors (CSPN, 2007). All human societies have relied on and been inspired by the living world, drawing resources from it, mimicking the way in which it functions and developing innovations. Leonardo da Vinci's works are a famous example of this (Leonardo da Vinci, 1987)



And this is still currently the case, including in so-called "modern" societies whose everyday life may appear disconnected from the living world. To encourage awareness (or rediscovered awareness) of the living world as an incredible source of innovation, the appearance of biomimicry* or bio-inspiration* at the end of the 1990s aimed at valorising the processes inspired by the living world in human constructions (Benyus, 1997). This approach is inspired by the forms, behaviours, materials and interactions between species as well as the functioning of ecosystems to adapt them to human activities.

Fundamental and applied research is the activities most concerned by the living world as a source of inspiration. Animals and plants have developed astonishing properties. For example, the Gecko has sticky little hairs on the end of its fingers, and researchers have been able to reproduce this device to create an adhesive strip made of plastic polymer. This process could have infinite applications, as the market linked to adhesive technologies is enormous. In another field, an INRA* joint research unit ("Agronomics and Environment" INPL[12] (ENSAIA)) noted that certain rare plants had properties which could be used in medicine (a molecule which can be used to synthesize cancer drugs, for example). They have managed to produce via the roots of hydroponically grown plants, molecules with a high added value. This method is non-destructive for the plant and means production continuity can be ensured. This innovative process has enabled the creation of a company, Plant Advanced Technologies[13] (CSPNB, 2007). Such a potential also concerns possible innovations

[12] http://lae.univ-lorraine.fr/en/home/

[13] http://www.plantadvanced.com/home.html

in terms of practices such as industrial ecology or ecological engineering which imply changes in the actors' practices and behaviour (see chap. 4.2.).

Insert 2

The biosynthesis of plastic packaging materials supported by Séché Environnement

The BIOCOMBA© project is endorsed by the VALORIAL© cluster and funded by the Bretagne Region and the *Conseil Général du Morbihan*. Its aim is to develop a range of compostable, biodegradable, biosourced thermoplastic food packaging, with a good aptitude for food contact and barrier properties (gas and water) enabling optimal preservation of food products.

In this scope, a bioplastic based on a biopolymer obtained by bacterial synthesis (PHA) from marine bacteria on specific substrates from agrifood industry waste. PHA (polyhydroxyalkanoates) has technical properties which enable considering their use in various industrial sectors, including packaging.

A comprehensive environmental analysis will help to assess the impact on the environment of these bioplastics, from the moment of design to their end-of-life, according to the different production options and also the end-of-life possibilities considered (composting, recycling or anaerobic digestion). The results expected on the optimisation of the synthesis protocol and the extraction phase will make it possible to develop and industrialize an environmentally-friendly sustainable process.

This PHApack is a multi-actor programme and is supported by a number of industrialists in Western France, among them Séché Environnement. This PHApack collaborative programme targets the exploration of new ecodevelopment orientations, by contributing to the development of innovative green technologies, capable of meeting major environmental challenges: recycling and valorisation of materials, energy production, sustainable development and management of industrial impact.

The PHApack programme will enable the testing of an extended panel of substrates regarding the metabolic capacities of the strains available, and also, above all, transposing microbial production at laboratory level to a pilot level. This means mastering the continuous production of these PHA in 50-litre reactors, to anticipate the industrialisation phase and have, at the outcome of the project, an industrializable protocol which integrates the constraints of processes and HSE (Health, Safety and Environment) regulations. At the same time as this change in production scale, a method for ecoextracting the PHA contained in the intracellular compartment by assessing different "green" extraction techniques must also be validated. The industrial vision is all the more credible as the original bioproduction approach with marine bacteria provides guarantees of reliability. Being able to work in a saline environment also avoids risk of transverse contamination and rivalry between the microorganisms naturally present in the substrates. A second advantage is being able to run the bioreactor at room temperature (20-25°C) which represents a gain of a few degrees in comparison with a traditional bioreactor, and subsequently increased competitiveness, in addition to valorising waste and working on local supply.

The PHApack project takes into consideration in this way the whole life cycle of the material produced and the residues – residues which are essentially insoluble cellulose residues which have not been introduced into the reactor and could thus be extruded as a load in some of the polymers produced, or be managed by classical composting or anaerobic digestion channels. As for the end-of-life PHA, it can be methanized, which is one of its advantages compared with PLA, another bioplastic on the market.

Insert 3

New assets, an innovative sector for controlling Gecina's biodiversity footprint

Located in not very green urban centres, Gecina's assets are interesting due to the fact that they are close to species and habitats of ecological interest and ecological continuity i.e. Blue and Green Belts. Certain construction programmes for new buildings have already integrated this environmental dimension: these include the Velum in Lyon which is still in the course of construction, and the Vélizy Way building which is soon to be developed.

From the planning stage onwards, Gecina oversees the integration of buildings into the landscape through the development of green areas designed to respect and favour the biological balance of ecosystems, and preserve local natural resources by working on the greening-over of potentially green surfaces such as roofs and facades.

The first fundamental step is therefore to change stakeholder attitude with regards to activity and considering biodiversity.

To reconsider its link with biodiversity in this way can lead the building sector to rethink its impact in terms of exploitation, transport and processing of materials, and also of the locations and uses of the infrastructures. To accompany this thought process and a change in behaviour, ORÉE and the HQE* association have joined forces to advance the integration of biodiversity in this economic sector. Several actors in this field have already taken this path and a part of their projects is recognized by the *Stratégie Nationale Biodiversité* (EIFFAGE, Gecina-Gondwana, Bouygues Construction). For example, one of the first steps could be to reconsider the location of buildings all over the territory and thus their link with local biodiversity.

Image and credibility

The various actors, customers and users are sensitive to the brand image of a business which in turn conditions its market and therefore its activity. Biodiversity and the way in which the business reports on its management, can be an important lever in terms of improved image, leading to substantial economic impacts.

Businesses are offered tools such as labels though which they can report to stakeholders on the scope of their activities to actors. The labelling of a product or a site should help the stakeholders in their choice and also accompany the actors in improving their practices by attending to the priorities chosen by these labels. Signing a contract with a labelling body can therefore give better visibility and recognition and make it easier for actors to open or ensure markets.

However, several limits appear, firstly from the point of view of the actors for whom the specifications imposed by these labels are more or less accessible and comprehensible. It is not always easy to distinguish the demands or even the weaknesses of a label. Affixing the visible mark on a product sometimes addresses the customer's "faith" more than their critical mind.

As an example, the RSPO label (Roundtable on Sustainable Palm Oil[14]) was launched in 2003 by various partners, NGOs and industrialists to certify a "sustainable" palm oil. This certification aimed at helping to fight the deforesting of primary forests for planting oil palms and to provide local farmers and producers with social guarantees. Even though the initiative is an interesting one, it still appears insufficient. For the *Fonds Français pour l'Alimentation et la Santé* (French Food and Health Fund), RSPO certification lacks sufficient control criteria and is "not binding enough and very insufficient in its ability to protect forests". From the point of view of the consumer who is sensitive to communication on this certification, favouring these products in their purchases can give the impression of encouraging actors in supposedly sustainable practices even though they need to make more progress.

On the other hand, these tools can often be considered as an imposed constraint from "outside" the work framework of these actors, at the risk of replacing a deeper internal thought process. This could, for example, subsequently be valorised by their brand. The commitment could thus involve their know-how in a more holistic way, with a better integration of biodiversity in their general strategy and policy. The labels market currently overlaps that of actors and can be likened, from the point of view of some, to the sale of indulgences. Some actors therefore, prefer to communicate on their brand, committing to "saying what they do" as much as "doing what they say" rather than delegating the communication of their integration of biodiversity into their strategy to the obtaining of a label.

Lastly, new forms of labelling are seeing the light, and these focus more on the actors' approach than on their current activity. This is the case of the recognition of SNB* commitments at a national level (see chap. 2.1.7.) or of private labels such as Biodiversity Progress©[15].

[14] http ://www.rspo.org/

[15] http ://www.dervenn.com/wordpress/nos-prestations/strategie-et-rserso/labellisation-biodiversity-progress/

Insert 4

The labelling of an approach: the Biodiversity Progress© label by Dervenn and Bureau Veritas Certification

Biodiversity and natural resources are the basis of our well-being and our economic activities. Each organisation such as businesses and local authorities has a role to play in rethinking its socioeconomic model by integrating biodiversity into its strategy and guaranteeing the implementation of practical actions in favour of the living world. These are more than just "one-off" actions, as the interest lies in setting up a considered and adapted approach. However, these new subjects are complex and difficult to understand: the organisation needs support, a defined action framework and recognition of its commitment. With this in mind, Bureau Veritas Certification, the world leader in the field of certification, and Dervenn, a research, consultancy, design and development company specializing in biodiversity and ecological engineering, have joined forces to develop a label to certify this commitment: the Biodiversity Progress© label.

The Biodiversity Progress© labelling standard is based on a continuous improvement approach and thus measures the progress made by an organisation. It certifies the quality of the strategy and actions aiming at optimising the compatibility of its socioeconomic model with ecosystems.

Biodiversity Progress© does not endorse a product or geographic site, but rather an improvement initiative. The organisation can choose the sites and activities it wishes to submit for labelling. From this choice results its "sphere of influence" (actors, supply, flow of matter, effluents, external collaborations, etc.). The approach elaborated by the organisation must therefore take into account all the activities which enter into the site's sphere of influence. Moreover, the labelling standard is adapted to the organisation's context, organisation and functioning, which makes it possible to define a personalized and efficient plan of action. The actions will be implemented by the organisation with regards to its actors (service providers, suppliers, residents, customers, actors specializing in biodiversity, etc.)

The labelling process is made up of different stages:

- upstream, preparing labelling: developing a diagnosis of the organisation to enable the definition of a strategy and an action plan;

- year n, the certificate of commitment: the recognition of the action plan by Bureau Veritas Certification and the independent labelling committee;

- year n+1, Biodiversity Progress© labelling: achieving the labelling threshold and verification of the implementation of the action plan;

- year n+2 to n+4, follow-up: verification of the implementation of the plan of action and continuous improvement.

At each step, the employees and actors concerned take part in the development of the action plan and its implementation for a better appropriation of the subject. In this way they are practically involved, according to their means and skills, in anticipation of the linked economic, ecological and social biodiversity-related challenges.

This consensual and positive subject brings staff together through educational outings, brainstormings, awareness-raising, valorisation of personal skills, and optimizes the pooling of information.

Lastly, Bureau Veritas Certification calls on an independent labelling committee to decide on the validation or non-validation of the stages in the labelling process. This enables the organisation to valorise its commitment and actions, based on the advice of recognized experts in the field of biodiversity.

The Biodiversity Progress© label is thus a quality, systemic, adapted and federating approach which allows the organisation to act in order to rise to complex biodiversity-related challenges and to achieve compatibility with ecosystems.

1.2.2. Risks linked with actors' activity

Reputational risk: Greenwashing

Behind the word 'greenwashing' lie the false or misleading uses of the ecological argument or sustainable development in advertising for a brand, product or company. It is actually a form of manipulation of the general public or the consumer by an organisation or a brand in order to appear "greener", more concerned and environmentally-friendly than it really is. There are three cases of "greening": (1) the lack of knowledge of the principles of responsible communication and (2) the ignorance of these principles which are considered to be too stringent. The ecological argument is in this case not supported by the presence of a label for example. (3) To sum up, some actors deliberately neglect the commitments related to the use of an ecological argument, using it instead it as a simple marketing argument.

The most polluting activities have been regularly exposed for abuse of the concept of sustainable development in their business advertising messages. The consequences of this greenwashing have been so catastrophic in terms of image that today the trend has dwindled.

Economic risks

Remarkable species and landscapes (remarkable because they are noticed)

When an organisation's activities have a dependent relationship or create an impact on a rare, fragile biodiversity, or one which is considered as a cultural heritage this is a risk as much for this activity (disappearance of the species, erosion of the ecosystem) as for the actor's image. For example, the use of whale oil, elephant ivory or taking part in the destruction of coastal landscapes and natural areas can associate strong and negative economic images with this actor and his activities.

Actors' activity and strategy

The sectors which harvest or depend directly on the resources of biodiversity, such as fishery or the exploitation of building materials, are already subject to strict regulatory frameworks which can be further improved to limit the impact of these biodiversity activities (CBD*, 2010). These actors are thus encouraged to rethink their economic models and even more importantly, their strategies to take into consideration the dynamics of biodiversity as much as the current and future technical and regulatory constraints. But, more generally speaking, this covers all economic activities including those which may appear further from and less dependent on or impacting on biodiversity. A certain number of tools can help to reconsider our activity, our dependence and impacts and therefore our strategy in this context of a biodiversity crisis and the raised awareness of actors (see chap. 2.).

Increasing scarcity and disappearance of biodiversity

The disappearance of a species is a potentially very high risk for actors whether they are directly or indirectly linked with them. A multiplier effect is to increase the market value of this species which, as it becomes rarer, becomes even more attractive and leads to an increase in the rate at which it is harvested from the environment. Because of its horn, the African rhinoceros is the victim of this type of market and its current future is a sorry example of this vicious and fatal circle for the species (Biggs, 2013).

Environmental risks

Destruction, reduction and fragmentation of habitats and pollutions

Forests, wet areas and deserts are some of the many habitats threatened by human activities. The destruction of habitats implies a disappearance of the living communities which comprise it as well as the potential movement of individuals, even the creation of new interactions. Thus, the regular disappearance of primary forests deprives the fruit-eating bats which live in them of their food resources. Looking for food, they are attracted by the orchards planted near the farmed and inhabited areas which replace these forests. These wild species move nearer to the populations and their livestock, and this is probably the explanation for the epidemic of Nipah virus, which hit Malaysia and Singapore in the 1990s. At the time an unknown virus, it was hosted by flying foxes, passed to pig farms located under the lychee orchards which had replaced the cleared forest. This epidemic would never have occurred without the brutal modification of these bats' environment;

moreover the bats take part in the future of biodiversity (spreading seeds, preying on insects, etc.

Increasing urbanisation such as the development of human infrastructures: industrial, transport, development, etc. encourages the fragmentation of habitats and their reduction in terms of size. This implies the reduction of population movement which is nevertheless indispensable in the genetic mixing* which ensures the continuity of populations (see chap. 4.1.1.).

The manufacture of a product may imply the destruction of a habitat at certain levels of the production chain. In order to raise everyone's awareness as to their share of responsibility, life cycle analysis approaches are being developed. At the same time, a certain number of tools (labels and certifications) already make it possible to know if the raw materials are obtained in a manner which respects the environment* or not (see chap. 3.).

The pollution of air, water and soil is not without consequences for habitats and species. Oil spills are surely the most impressive in the public opinion, but other agents such as endocrine disruptors are just as harmful to biodiversity. Our status as a great predator should compel us to question our behaviours and activities. Dichlorodiphenyltrichloroethane, more commonly known as DDT*, offers an example of bioamplification* which shows how the "bit", the human being, can be "watered". It was DDT* which was spread by plane on crops (like the cornfield in Hitchcock's "North by Northwest") to fight invertebrates who lay waste to crops. But like all the products released into the environment, DDT* followed the rainwaters and was integrated into the food web* including the marine environment. Ingested by plankton and not degradable, it accumulated all the way up the food web* resulting in high concentrations of DDT in fish and thus in our plate as well as in the food rations of bald eagles. The falling populations of this bird, the emblem of the USA, alerted public opinion. This molecule, which is close to that of natural oestrogens, hindered the calcification of eggshell and therefore of the birds' reproduction. When the fish eaters were investigated, DDT* was found, notably, in the milk of lactating women (Brown, 1976). This perfectly illustrates the fact that human stakes are hidden behind biodiversity stakes.

The overharvesting of certain species

When a species is harvested beyond its regenerative capacities, this is the triggering for its disappearance. Even though the IUCN*[16] Red List details the levels and risks of extinction of the currently known species every year, there are examples which regularly fill publications for the general public. The most striking example is overfishing. Bluefin tuna is just one more species which may know the same dramatic fate as that of the Newfoundland cod. Behind the overharvesting of a species and its disappearance there is an imbalance of the ecosystem with consequences for many other species, human beings included. The disappearance of a species considered as a key element for an ecosystem leads to a strong imbalance. The story of the sea otter (Enhydra lutris, listed on CITES*), a cousin of the otter opposite (Loutra Aonyx Capensis), is edifying from this point of view.

A North Pacific predator, the sea otter eats sea urchins (using pebbles as tools) which limits their population, allowing the great seaweeds of the environment (sea kelp) to grow in forests under less pressure of predation from sea urchins. These submarine forests are favourite haunts for breeding fish. The system was undermined in the 1990s by the arrival of a super-predator, the killer whale, which attacked sea otters, thus reducing pressure on the population of sea urchins which exploded and invaded the environments - reducing the forest of seaweed by 90%. The reproduction possibilities of fish were drastically affected and this increasingly amplified the killer whale's interest in otters. The killer whales had actually become interested in the otters due to the decreasing populations of fish following excessive harvesting through industrial fishing. Listing the otter in the international texts will not be sufficient to preserve the species or its role in the ecosystem. Killer whales cannot read and the causes of the disappearance of the otter moreover affect regulated human activities.

[16] http ://www.uicn.fr/La-Liste-Rouge-des-especes.html

Invasion of ecosystems by introduced species

The development of large-scale transport favours the movement of species. Even if most of the transplanted species do not find the conditions needed for their development, the extremely fragile environments enable some to find conditions for growth such that their population becomes invasive from the point of view of native species. In the 1980s a jellyfish from the east coast of the United States, caught in the ballast waters of a ship, was accidentally introduced into the Black Sea. With no local predators, and in an environment already fragilized by pollution and over harvesting, it was able to proliferate unhindered and feed on small fish and zooplankton ; this led to the expansion of seaweed and the accelerated eutrophication* of the environment.

Other species are voluntarily transplanted without the consequences being measured. The water hyacinth, harvested in Latin America to decorate a South African lake, has become the scourge of the big African lakes even though it is a discreet plant on its original continent. In France, red-eared terrapin, sold for aquariums, were released into rivers by private individuals setting off important modifications of wet environments through their development.

Climate change

The drastic increase in greenhouse gases is, without a doubt, linked to industrial development and the use of fossil fuels. Human activities are also to blame for climate change which is a particularly rapid large-scale disruption with regards to the adaptability of living organisms. If microorganisms (pathogenic or not) such as invertebrates have reproduction rates which would give them the adaptability needed for their survival, this does not apply for higher organisms. In the marine world, corals are one of the fundamental ecosystems in terms of biodiversity but they are also identified as "hot-spots*" (Meyer, 2000). Their progressive bleaching, which is related to climate change, provides a warning as to their future, and that of a number of human activities which depend on them such as fishing, tourism and medical research. In the Mediterranean, temperature changes are causing the death of Gorgonian corals whose particularly slow rate of growth explains their fragility (a fifty-centimetre head is half a century old).

Participation in climate change is collective and the consequences sometimes somewhat indirect for actors. Nevertheless, Sir Nicholas Stern's report reminds that this stake and its consideration involves our societies and therefore all the actors (Stern, 2006).

1.3. WE ARE ALL ACTORS IN BIODIVERSITY

1.3.1 Reintegrating the economy into the fabric of the living world

"The Value system of a society is the way it rates the Universe, the world, things, beings and the relationships between beings and things. This grandiose typology, intrinsic to each culture, makes up the system of reference of the opinion and attitudes of individuals and groups in this society. Honesty, honour, faithfulness, country, compassion and the flag or the constitution, make up values which are not be sold, given, lent or exchanged: they are to be shared. Values thus defined cannot be interpreted as willingness to pay: values are priceless."

(Weber, 2002)

When the economy focuses on biodiversity to facilitate its integration into actors' strategies, it offers different approaches:

1. Since economy speaks of prices, why not try and "put a price on nature"? This means adding together all the willingness to pay for something "natural" by juggling with the extrapolation rate in space and time, and striving to make it the equivalent of a market between a vendor and a purchaser. This is actually what the Contingent Evaluation Method (CEM) offers. It amounts to merging the price we agree to pay in order to purchase Mona Lisa with the value of this work of art (Weber, 2002). Does a panda have more value than an anthill? And who can we ask? The answer varies considerably according to the number and sensitivities of the persons questioned.

2. It may be more efficient to consider different development scenarios and compare them using a cost-profit analysis. Between water treatment plants and safeguarding ecological systems, some municipalities have done it such as Munich, the third town in Germany, which has the cheapest drinking water in Europe, with no treatment at all. The municipality carefully monitors the good state of the forest ecosystem upstream of the village which naturally supplies pure water.

3. Following a request by the British Government, the economist Sir Nicholas Stern addressed the effect of climate change (Stern, 2006). He then proposed a new approach: putting a figure on the costs generated by climate change and, separately, those associated with the lack of action by the economic actors. A decision-maker can actually rethink a costly action or practice if it can be shown that which costs not to make or decide on.

4. The Economics of Ecosystems and Biodiversity (TEEB) group was created by the European Union and the United Nations to assess the consequences of a lack of decision on the subject of biodiversity reflecting Sir Nicholas Stern's approach to comparing the economic profits of biodiversity with the costs associated with its erosion, and those linked with inaction and, lastly, those necessary for its preservation. Here, the biodiversity object means the sum of all the ecosystem-based services and their definition by MEA* does not refer to an economic idea: "those services from which human beings benefit due to the functioning of ecosystems". Nevertheless, the group took up Costanza's (1997) perspective which presupposes that the three pillars of sustainable development are equivalent and also substitutable in terms of value. It is then possible to apply the Hartwick rule (1977), adopted by neo-classical and later economists, which takes as its optimality criterion constant human consumption per head. It also states that if the contributions taken on the natural "capital" were systematically invested to produce artificial capital which would make it possible to replace the depleted resources, human consumption would remain constant. Such a precondition raises the question in particular with economists such as Jacques Weber, who is surprised "that the constancy of human consumption should be the only criterion for judging sustainability and that artificial capital could replace living wild populations elsewhere than in production functions; all this invites one to worry about a discipline for which real facts have to report on theories and not the opposite" (Weber, 2013).

5. Another approach has been put forward on logical foundations, by the so-called "Chevassus" Commission on the Economy of Biodiversity (CAS, 2010). Putting a price on species or ecosystem-based services means relying on the goodwill of human beings who are supposed to declare a "willingness to pay" for environmental protection.

For some, like Jacques Weber, this approach results in a policy which can be summarized as: "the ugly must go!". The Commission opposed another reasoning to this approach: it is imperative to guarantee the availability of ecological services over time. Therefore any project which impacts biodiversity must be accompanied by an assessment of the maintenance or restoration costs of the availability of the services that the project may disrupt. The cost-based approach shows processes whereas the approach by prices only shows the current mood.

It is however possible to question the necessity and relevance of putting a price on living things to justify their preservation. Living systems condition human economic activities which in turn influence human activities. Shaped by our links with the biosphere*, we modify its functioning and therefore impact its future at the same time as our own. But nothing is frozen and it is all a question of balance and dynamic balance. Living systems have their own, and we condition them as long as they impose themselves on human dynamics. In their book "The Panarchy", Holling and Gunderson remind us that nature only knows variability, instability and uncertainty.

"The balance of nature is a myth that we all too often latch onto" (Holling and Gunderson, 2002). When considering the future we should ask ourselves what we should do to insure ourselves against uncertainty and preserve our future. This does not mean integrating biodiversity into the economy but finding a way to reintegrate the economy into the fabric of the living world and its dynamics (see chap. 6.). Time is of the essence and is forcing us to make up for lost time so that the future of human activities and of the diversity of living organisms is taken into consideration by the institutions* at a level which is at least equivalent to that of the climate stakes. The economic actors and first and foremost businesses must be mobilized to take part in the creation of development models of cooperation between biodiversity and human beings; i.e. "team up with Life"" (Barbault, 2006).

1.3.2 Biodiversity and its appropriation

A building or a garden can be private possessions which belong to one individual or a group of actors. They can be public, open to all in which case the use of a garden by a couple of lovers will in no way prevent other lovers from wandering around it.

The question of the ownership of biodiversity leads to another concept, that of common property. As part of the biosphere*, humans may think that they own it or conversely consider it as a public property. We mustn't forget that it is vital to all but that the use we make of it in turn conditions the use that others can make of it, currently and in the future. According to Jacques Weber, there is no "biodiversity issue" as such but rather "issues between human beings on the subject of biodiversity".

Elinor Oström, Nobel Prize winner for economics in 2010, and an eminent specialist on the forms of common property, has instilled new life into research on ownership or "methods of approtriation*" (Ostrom, 2010). Having worked with a number of communities all over the world, she was therefore able to demonstrate that these communities had been capable of, and were still capable of managing common property, in an optimal economical way through the creation of institutional arrangements. This third alternative for managing common property thus enabled the collective management of a number of ecosystems without resulting in their collapse. In this way, the development of the market development, of "free enterprise" and "laissez-faire" is associated with the dissemination of a specific method of appropriation: "private" property, but not private in the sense of individual. It can be family or collective property and defined by the characteristics which have been recognized since Roman times: usus, fructus, abusus (Weber, 2010).

Modes of ownership are therefore essential to the understanding of relationships between market and environment* and paths for innovation or rediscovering human potential exist.

Insert 5

Gecina and Gondwana: two actors committed to urban biodiversity

The partnership between Gecina and Gondwana dates back to the spring of 2011. What is it that they have in common? The will to safeguard and improve urban biodiversity. Gecina added biodiversity to its roadmap in 2011 and some of its buildings have already integrated this environmental dimension; the hanging gardens of the Tour Horizons, the green wall by Anthos in the new Trapèze area in Boulogne-Billancourt or the rezoning of green areas of certain Parisian residences to obtain the Ecojardin label.

Gondwana has led several missions on nature in towns specifically with the drafting of the white paper on biodiversity in Paris.

Gecina is aware that it can contribute to the biodiversity policy of the French capital by means of some of its key operations. This is the case of the new Beaugrenelle mall and its 7000 square metres of green roof. This project alone meets 10% of the green roofing target of the capital's biodiversity plan (7 hectares of green roofs by 2020).

Intent on making Beaugrenelle an exemplary project where the integration of biodiversity into towns is concerned, Gecina quite naturally turned to Gondwana. Following a BiodiversityAudit® of the project, Gondwana offers a programme of actions which aims at transforming the rooftop landscape to relay the ambitions of the town of Paris.

Since the beginning of 2012, Gecina and Gondwana have continued and extended their collaboration to all their land holdings. A year later this was to result in a biodiversity strategy and an action plan enabling the integration of biodiversity into existing buildings which were under renovation and being developed. This is a pioneering collaboration and approach in the property sector that the two structures present in the form of a commitment to call for the recognition of the SNB* voluntary commitments: "Integrating biodiversity into property management: the elaboration of Gecina's strategy for its assets as a reference and the Beaugrenelle mall as a practical example of innovation". This commitment was recognized by the Ministry of Ecology in 2012.

It is currently supported by both partners in the implementation of the strategy via the association of Gondwana with Gecina's internal biodiversity Working Group, which assembles all the departments working on the theme of biodiversity (business lines, Architecture and Building Department, technical departments and corporate communication).

1.3.3 A multi-actor approach

In 1963, the Parc de la Vanoise, France's first national Park, was created, in which human activities were excluded from a territory to be protected for its rich and fragile biodiversity. This was in response to the general approach of national Parks, the first being Yellowstone Park which was created in 1872. The creation of sanctuaries for "wild" biodiversity has since fuelled other types of initiative which attempt to reconcile the preservation of species and environments without "putting them under a bell jar" and integrating their future into the territory shared with human activities at different degrees. Linked in this way to the general dynamics of ecosystems, these initiatives are also an opportunity to integrate human activities into the living fabric and unite their future. To illustrate these new conceptions, we can quote the French regional natural Parks and the initiative taken by UNESCO*: the Man and Biosphere programme (MAB*).

Regional natural Parks (PNR*)

The Regional natural Parks were created in 1967 by a decree with the objective of protecting and valorising large rural inhabited areas. These areas have very high quality landscapes, natural environments and a cultural heritage but their balance is fragile. The PNR* are organised around a concerted sustainable development project, based on the valorisation and preservation of their natural and cultural heritage. The Scarpe-Escaut Regional natural Park* in the Nord-Pas-de-Calais was the first to be set up on 13 September 1968. There are currently 48 PNR* spread over 23 French regions and which cover over 7 million hectares.

The protection and sustainable development project developed for a territory is then formalized as a charter designating the territory as an PNR*. After a public enquiry, it is approved by the municipalities which make up the territory of the park, the region(s) and *département(s)* concerned, and socioprofessional partners and associations. It sets the targets to be reached, the protection orientations, enhancement and development of the park, along with the measures which will enable it to implement them.

It ensures the coherence and coordination of the actions led on park territory by the various public authorities. Valid for a period of 12 years, there is a subsequent procedure to review the charter which makes it possible, in view of the PNR's action, to redefine its new project and extend its ranking.

Developed from a diagnostic of the territory concerned by the park, the charter includes:

- The project for the protection and development of this territory for the next 12 years and the rules by which the partners will implement it;

- The Park plan which outlines the planned interventions according to the particularities of the territory;
- The statutes of the management body for the park, its financial and human means;
- The advisory bodies such as scientific committees and commissions) for the management organisation;
- a precise and priced forecast programme of actions;
- The Government project for a convention applying the charter signed by the Regional Préfet concerned, as soon as the park is created.

Since the passing of the law of 13 December 2000 on urban solidarity and renewal (Article 45), this charter is subject to public inquiry.

Man and Biosphere Programme

Launched in 1971 by UNESCO*, the Man and Biosphere* Programme encourages interdisciplinary research and demonstration and training activities for the sustainable management of natural resources. It relies on a global network of sites, the Biosphere* Reserves. These sites, designated by national and international governments and recognized by UNESCO* in the scope of its MAB* programme, are defined to promote a sustainable development based on the combined efforts of local communities and the scientific world. The idea of these reserves is to reconcile the preservation of natural and cultural diversity and economic and social development. They enable the testing and development of novel sustainable development approaches from local to international level. They are good places for experimenting and illustrating sustainable development practices at a regional level, by reconciling the social and economic development of the populations with the protection of the environment*, in the respect of cultural values. The involvement of the populations, scientific support for the environmental management and education are encouraged there.

In 2013, the global network has 621 Biosphere* Reserves in 117 countries, including 12 cross-border sites, designated according to common criteria. New sites are being added to the network every year.

In 2013, the MAB* France committee is coordinating and organising the French network of 13 Biosphere* Reserves and helping to set up new sites and ensuring liaison and cooperation with the global network.

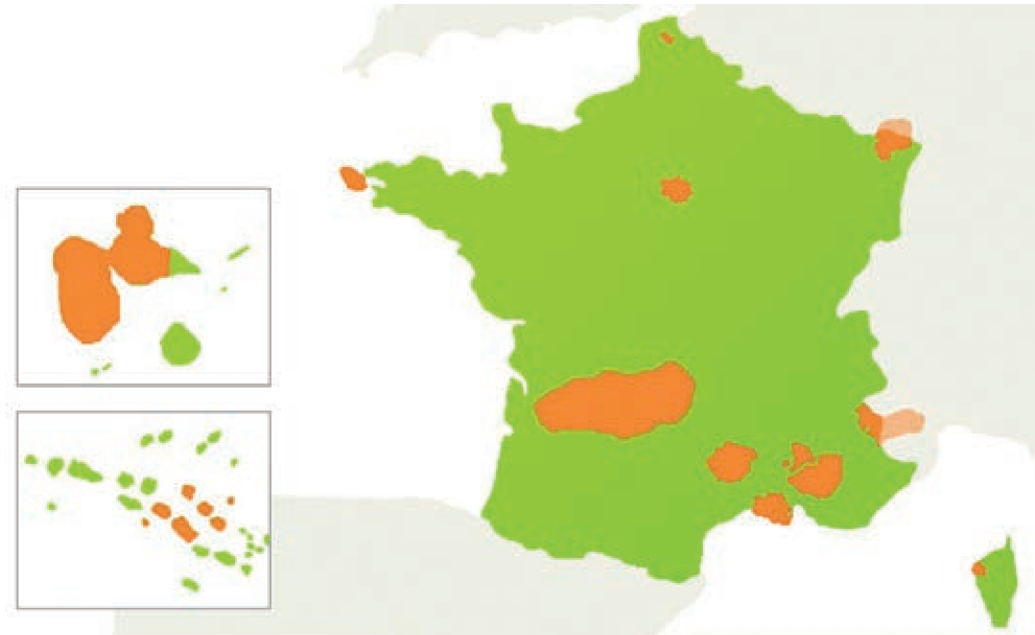


Figure 5 : Map of French Biosphere Reserves

The Biosphere* Reserves commitment charter

Several Biosphere* Reserves, in France and in the rest of the world, have been approached by businesses who wish to valorise the positive image of the designation by UNESCO* in their activities. The Biosphere* Reserves establish means of valorising the socioeconomic actors on their territory who commit to the environment* and sustainable development. In this way they establish durable partnerships with the socioeconomic fabric. Some offer those who relate to the values of

UNESCO* to make practical, verifiable and credible commitments in environmental matters and sustainable development for their activity. These voluntary decisions are subject to a public declaration and the signing of a document (commitment charter). All of them can check (signatory, inhabitant, consumer, etc.) and the commitments made and rendered public are met. Through their progressive approaches, businesses (and other actors) contribute in this way to improving the quality of their Biosphere* Reserve, of which they become the ambassadors.

Given the expectations of the Biosphere* Reserves in matters of biodiversity management, fighting climate change and, more generally speaking, of sustainability, their managers have striven to find a device which aims at:

- Developing or strengthening their relationships with the business world;
- Promoting and encouraging more sustainability, by valorising the businesses which are already mobilised and helping them and others which are less advanced to businesses to progress in the taking into consideration of biodiversity and the environment* in their activities.

Several Biosphere* Reserves have worked with voluntary businesses in different sectors. The setting up of a brand for products or services had previously been considered and finally discarded. The collective drafting of a Biosphere* Reserve commitment charter was preferred as it allows, through dialogue and exchanges between different motivated businesses and other actors (associations, national education, elected representatives and territorial managers) and building a network of « eco-actors » on a Biosphere* Reserve scale.

The process of drafting the charter leads to discussing the values borne by the Biosphere* Reserve, the various environmental, cultural and social questions relevant to the territory concerned. This is organised to favour exchanges between actors who rarely mix, with their varied sensitivities, and constraints: these may be a variety of businesses and environmental or cultural associations. The jointly built common framework, the charter, relies on both the concept of Biosphere* Reserve as it is defined by UNESCO* and on characteristics which are intrinsic to the territory and those of its actors.

The next step consists of each business defining, in the scope of this charter, the commitments to be respected for the following three years. They involve the taking into consideration of biodiversity, limiting greenhouse gases and, more generally speaking, the environment* (waste, energy, etc.), on input in terms of knowledge (funding or carrying out of studies, general public awareness-raising, etc.) or on social aspects. These commitments must be sufficiently ambitious not to destroy the credibility of the whole approach (and therefore the other actors involved) and must also be realistic. They are validated by the body concerned and made public.

Up until now, it has been essentially actors from tourism and agricultural production and processing sectors who have been mobilized.

The Biosphere* ecotourism programme of the Biosphere* Reserve of Fontainebleau and Gâtinais[17] conducted with the Chamber of commerce and industry of Seine et Marne, only concerns tourism service providers. At Mont Ventoux, the businesses are more diversified: cooperative wine cellars, wine-growers, farmers, gites, nougat-makers, etc. The commitment charter is being studied in Camargue, as well as in the Biosphere* Reserves of the Bassin de la Dordogne and the Fango.

Biosphere* reserve observatories

The long-term scientific monitoring of the territories, their biodiversity and human activities, is one of the fundamental missions of Biosphere* Reserves. In a changing world, the observatories provide standardized data which makes it possible to assess the dynamics at work. They enable the continuity and dissemination of global or thematic information. These data, useful to researchers, are also useful to managers and decision-makers. As an example, the Vosges du Nord - Pfälzerwald cross-border Biosphere* Reserve started using on a Geographical Information System (GIS*) tool very early on. This tool is interactive and helps in decision making for town and country planning, the management and protection of nature, the cultural heritage, tourism improvements and socio-demographic analysis. Designed first and foremost to serve the interests of the two natural arks of which it is comprised, the two GIS* are interoperable and communicate perfectly: mapping of the zoning of the Biosphere* Reserve, varied spatial statistics, digital dissemination tools for the general public or professionals. It is a good tool for analysing the evolution of the territory and very useful for its forward planning. Franco-German cooperation between the two GIS* has not only widened the spectrum of uses, but also reinforced their means and this initiative[18] has been rewarded with European funding.

[17] http ://www.biosphere-fontainebleau-gatinais.fr/participez/biosphere_ecotourisme/505

[18] http ://www.mab-france.org/fr/acquerir-des-connaissances/observatoires-des-reserves-de-biosphere/194/

THE GROWING AWARENESS OF STAKEHOLDERS TO BIODIVERSITY STAKES

Section 2

2.1. COMMUNICATING WITH STAKEHOLDERS: AN IMPORTANT LEVER

Since 1992, and in many circumstances, the word biodiversity has become increasingly familiar to stakeholders. However, the significance it conveys for each of them appears to vary considerably, as much in the received message as by the actions which claim to be in favour of biodiversity or, on the contrary, which neglect to refer to it. In the same way as Molière's Monsieur Jourdain, some are into biodiversity without even realizing, and others think they are into it even though they are taking part in its erosion. Raising the awareness of stakeholders is therefore the first indispensable step, and various tools and approaches can help to initiate and promote this.

The word 'stakeholders' refers to all of those who take part in the economic life of biodiversity, such as employees, customers, suppliers and shareholders; those who observe it such as unions, NGOs and public authorities; and those who are more or less directly influenced by it. These are therefore all the stakeholders who are mentioned when organisations are said to be socially responsible. The same organisations are also preoccupied not only with the transparency of their activities in regard to the stakeholders but also by the participation of these activities in the interests of all these stakeholders. Communicating to them is a fundamental first step to guiding the whole organisation in making and implementing its strategic choices. But it is also an indispensable tool for including, in a collective momentum, another approach to the relationships between human activities and biodiversity; it therefore represents a global change in the outlook and actions of the stakeholders.

2.1.1. A diversity of objectives and points of view

"We must save the condors not only because we need the condors but also because we need to develop the necessary human qualities to save them; because these are the qualities that we shall need to save ourselves."

MacMillan, a 19th century American ornithologist,
quoted by Nicolas Hulot in "Titanic Syndrome".

Mutual knowledge between stakeholders is all important for the good management and conservation of biodiversity, as each of them has their own perception and holds part of the know-how which is indispensable to the others. This is why it is important for an organisation to find its place in its network of negotiating partners, to identify them and to strike up fruitful communication.

Each of them has their own special features, stakes and targets, and the challenge for a business is to know them well, analyse their needs and address them in their own vocabulary, or at least with mutually comprehensible semantics (see chap. 5.3.3.).

A non-exhaustive list to show stakeholders and their centres of interest

Core functions defining the procedures, necessary authorisations and preservation methods for biodiversity

- Administrations who ensure that regulations are obeyed
- Local authorities and elected representatives who steer territorial management
- Authorities on protected areas and species, natural reservoirs
- Blue and Green Belts connected to ecological corridors

Corporate level of geographic proximity

- Residents for whom the heritage and landscape aspect will be important
- Organisations for the defence of nature
- Participative science which can make it possible to federate around projects

The business and its stakeholders

- Employees for whom the conservation of biodiversity can be a corporate cultural factor
- Markets which express expectations on working methods
- Production which has its technical requirements to channel
- Use of resources for an economic and responsible consumption

Scientific approach

- The National Museum of Natural History (MNHN*) for its procedures, expertise and data base
- The Foundation for Research on Biodiversity for its link between science and society
- Institutions such as CNRS*, IFREMER* and IRD* for their research and expertise

Management organisations for a structured use of resources

- Genetic resources
- Natural areas

The wide diversity of stakeholder preoccupations

If all human activity and even more every human being have an interdependent relationship with biodiversity, each actor has his own perception and story with this living world. Organisations which assemble a wide variety of stakeholders help to question perceptions of biodiversity and thus define the representational field. This is what was made possible by the Foundation for Research on Biodiversity (FRB)[1].

ORÉE has worked with the FRB since it was created, and has specifically co-edited the guide "Integrating biodiversity into business strategies" (Houdet, 2008). Since the FRB was created, ORÉE, along with a number of other stakeholders, has taken part in its Strategic Orientation Committee (SOC).

The FRB is the "biodiversity" meeting-point between the different scientific stakeholders and the societal stakeholders. Created in 2008 by eight public research establishments (BRGM*, CIRAD*, CNRS*, IFREMER*, INRA*, IRD*, IRSTEA* and MNHN*) its vocation is to encourage innovation, to promote scientific projects regarding society, and to develop studies, syntheses and expertise.

In order to meet the scientific challenges of biodiversity, it focuses on creating an interface between science and society and defines its work along four lines, with communication occupying an important position:

- Strengthening dialogue and mobilising biodiversity stakeholders;
- Promoting synthetic and prospective actions;
- Supporting a multi-stakeholder interdisciplinary and research approach;
- Disseminating knowledge and valorising French research.

The FRB's Strategic Orientation Committee: A mirror-image of stakeholders' preoccupations

To date, over 110 structures, associations, businesses, managers and local authorities have joined the FRB. They represent practically all the actors in the life of the nation, each one of them with their own preoccupations and priorities, and who use the vocabulary which is specific to their own environment or their activity in society (FRB and SOC, 2011).

[1] http ://www.fondationbiodiversite.fr

In order to structure debates and contributions, the FRB has set up, along with its Board of Directors and its Scientific Council which are part of the classical organisation of a research foundation, a Strategic Orientation Committee (SOC) which reflects the structure of society in forty groups, divided into five panels.

Panels	Groups
Management of areas, environments and species	1. Freshwater 3. Protected Areas 4. Forest environments 5. Agricultural environments 6. Rural environments 7. Urban environments
Management of related domestic and wild genetic resources	8. Selection of domestic fish and birds 9. Selection of domestic mammals 10. Technical institutions 11. Seed-producing establishments and farmers 12. Breeders of plant varieties 13. In-situ and ex-situ conservation associations 14. Management on the farm 15. Conservatories and territories
Protection of nature	16. National and territorial associations 17. National associations 18. Overseas associations 19. International associations 20. National federations 21. National foundations 22. International foundations 23. National conservatories
Economic and industrial activities	24. Beauty and cosmetics 25. Building and works materials 26. Health / Pharmacy 27. Environmental services 28. Linear transport and infrastructures 29. Energy and mining resources 30. Cooperatives and agrifood 31. Finance and insurance 32. Business associations 33. Multi-stakeholder associations 34. Consumption and leisure
Socio-political activities and relationships with the general public	35. Training / education 36. Dissemination of knowledge 37. Municipalities/Intercommunity structures 38. *Départements* / Regions / DROM-COM 39. Unions (1) 40. Unions (2)

The geography of words and the socio-economic contextualisation of biodiversity-related questions

SOC representatives took part in the drafting of the "Biodiversity: actors' views" (FRB, 2011), describing during interviews their perceptions of biodiversity, the pro-biodiversity actions used in their organisation, and the stakes they see for the future. This work has made it possible to shed light on the diversity of visions of the stakeholders involved, and to reveal the common ground as well as areas of disagreement in order to develop, progressively and collectively, a common vocabulary, an indispensable precondition for structuring thought processes and shared actions (FRB, 2011).

The analysis of the vocabulary used during the interviews and, more specifically, of the structuring words pinpointed the coherence [...] which exists between the discourse, and therefore the stakes, questions and visions on biodiversity, between different members of the same panel (FRB, 2011), even for the use of current words such as "biodiversity, nature, environment" and genetic" which were used in quite different ways by the members of the different SOC panels.

The preoccupations expressed by these groups ranged from the protection of nature to the management of living organisms, from a static approach for some to a dynamic approach for others, with a displacement of the stakes according to their typology of involvement in biodiversity.

To illustrate this, the economic stakeholder panel (n°4) will primarily use words linked to the impact surveys and work done by the Grenelle de l'Environnement* such as "environment, business, sustainable development*, study, action" and "project, and not specifically a vocabulary related to biodiversity. It will be quite different for the panels which are more directly in contact with nature, for example the conservatories and managers of species or environments, whose vocabulary will be based more on genetics or natural environments, and who uses word associations such as "peat land and "rehabilitation.

2.1.2. A wide awareness-raising to biodiversity: Using events

Nature, the living world, biodiversity… these words have a familiar ring for some stakeholders, perhaps less for others, and some are even frightened by them. At a global, national or regional level, it is possible to build understanding and therefore an appropriation of these words and the stakes they represent by means of awareness-raising using larger-scale operations, events or actions.

The international level: 2010

2010 Année Internationale de la Diversité Biologique

The United Nations declared 2010 International Biodiversity Year, specifying that "it is a celebration of life on Earth and the value of biodiversity for our lives. That year the world was invited to act to safeguard the diversity of life on Earth: biodiversity. It was the bare minimum that could have been done while appraising whether the "2010 target of halting the decline of biodiversity! would be reached or not.

Almost twenty years after the Rio Convention[2] this type of event, which addresses all categories of the public, was necessary to dynamize the approach. In France, the Ministry for Sustainable Development followed in the steps of the Convention and took strong initiatives to communicate to the general public by offering a platform and a label to all the structures organising events aimed at raising the awareness of the French to biodiversity.

A number of businesses joined this approach, providing an opportunity for them to assert their developments and performances, and also to raise their awareness and commitments for the future.

The national level: World Biodiversity Days and Sustainable Development* Week

In the same way as the very widely covered International Biodiversity Year, periods of high media attention on environmental issues, such as Sustainable Development* Week (beginning of April) and World Biodiversity Day (22 May) convey strong messages to a wide selection of the general public. The influence or impact of such events is often more local, but might this not be the scale on which the problem of the protection of biodiversity should be broached?

The phenomenon of coinciding events on these precise time durations makes it possible to maximise the impact of the communications by an overlapping effect which gives the phenomenon importance in the public eye. Whether it is an NGO or a business organizing an event, these highlights in the year are an excellent momentum for communication on good practices.

[2] http ://www.cbd.int

At local level

Other one-off events can also federate stakeholders on the subject of biodiversity, especially if they are participative and allow a large number of people to join in whatever their location.

This is particularly the case of the *Fête de la Nature* which has since 2007 provided a pretext for the World Biodiversity Day (22 May). Organized by the French Committee of the International Union for Conservation of Nature (IUCN*) and *Terres sauvages* magazine, this event offers five days of free events in direct contact with nature to allow all the categories of the public to discover or rediscover it. Thousands of events are organised in this way by associations for nature conservation and education, local authorities, schools, businesses, private individuals all over France, on the mainland and overseas, in towns and in the country. Today Switzerland, Portugal and the Netherlands also celebrate the *Fête de la Nature*.

Another example is the "election of the tree of the year3" whose second edition, at the beginning of 2013, was organised by *"Terres sauvages"*, and supported in particular by the French Forestry Commission known as the *Office National des Forêts* (ONF), the Yves Rocher Foundation and the Ile-de-France Region. Two hundred applications were submitted by local authorities or associations and twenty-three trees, each representing a region of France and including the overseas territories, were selected by a jury and the general public (the electronic votes exceeded 10 000 voters for some regions). The aesthetic, environmental and historical values were estimated and the result was a vast and beautiful awareness-raising operation.

[3] http://www.arbredelannee.com

2.1.3. The indispensable elements for good communication

In biodiversity, as in any other field, your message must be clear and meet the preoccupations of those you are addressing for your communication to be efficient. An important factor for success and comprehension is the widest possible use of a known vocabulary currently used by those it addresses, without devaluing the contents of the message.

We must be capable of simply and humbly putting ourselves in our counterpart's shoes. Subjects related to biodiversity generally trigger a great deal of empathy and supply easy and positive communication vectors.

To illustrate the impact of an industrial site on its natural environment, it will be easier to communicate on the counting of local species and their evolution than just by announcing concentrations of molecules in the air or in water, leaving the counterpart to have to form their own opinion on subjects whose technique they know nothing about.

Conversely, the evolution of the natural heritage will be a convincing approach for them: the right communication will then be in the choice of relevant subjects. In addition to this, an approach of this kind is a more or less long-term one as biodiversity aspects are analysed over long periods of time and often over several years due to the inventories to be carried out over a range of at least four seasons.

Insert 6

Integrating biodiversity as an essential value of Gecina's responsible approach

Gecina has organized 3 brainstorming workshops on the theme of "How can CSR* be integrated into Gecina's professions?". During these workshops, the technical managers responsible for buildings maintenance, the property rental managers, and the customer relations managers dealing with relationships with the tenants, all reacted on the topic of biodiversity. How could this topic be integrated into their profession? What tools do they need? What sort of customer relationship should be set up? All these questions guided the drafting of Gecina's biodiversity roadmap and made it possible to identify a number of future actions to be developed.

Extract of the actions proposed:

- Carry out an ecological diagnosis on the sites with a high diversity challenge;
- Raise the awareness of tenants and users on biodiversity;
- Integrate biodiversity into Gecina's responsible management system.

The choice of indicators and inventories

Biodiversity indicators are polymorphic tools adapted to hybrid questions which concern the scientific and political world and the economic stakeholders and which appear to be the best way of monitoring the impacts of human activities on biodiversity. The advantage of these indicators in comparison with other assessment tools is that they have the particularity of separating the signifer from the signified. There is actually no way of measuring biodiversity, only indicators which make it possible to respect the areas of uncertainty that a measurement would not tolerate. These indicators offer the opportunity of building bridges between the world of experts and that of the profane, between the world of science and that of politics, between the different stakeholders who find in this way a common language on the subject of this thing known as biodiversity (Levrel, 2007).

Among those most commonly used by stakeholders, there are a certain number of living kinds and species who are regularly monitored by national structures such as the *Muséum National d'Histoire Naturelle* and specifically in the scope of participative science programmes (see chap. 5.1.).

Here are a few examples:

- ***Birds, poultry: avifauna***

As a large number of them are at the top of food networks, the presence of birds shows a general state of health of the ecosystem, inventoried not only in terms of quality of habitat but also as food resources and in terms of the disruption of the environment by human activities. The *Suivi temporel des oiseaux communs* (STOC) or Common Birds Temporal Monitoring[4] programme was set up in 1989 and is currently supervised by the National Museum of Natural History (MNHN*). It relies on the voluntary participation of ornithologists with standardized monitoring of nesting populations of common birds. It has resulted in a common birds by habitat indicator which is the result of data collected by STOC network observers and which is part of the sustainable development* indicators recognized at a national and European level.

[4] http ://vigienature.mnhn.fr/page/oiseaux

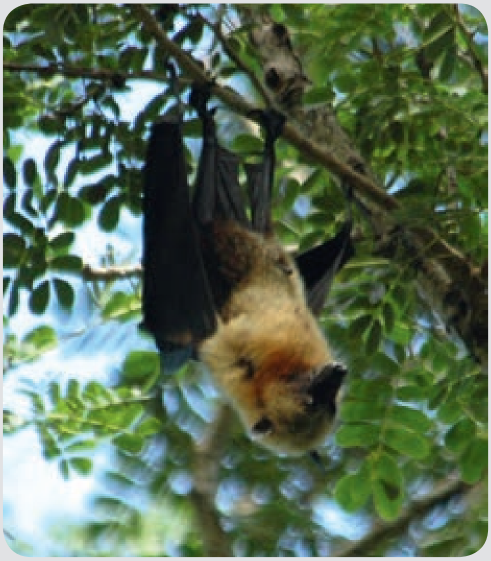
- ***Lizards, frogs: amphibians***

These animals are bio-indicators* of wet areas and hedgerow country. A number of studies have shown that chemical components resulting from human activity and which are present in water cause malformations and death. Amphibians are particularly sensitive to chemical pollution as they are very thin-skinned; their skin is not protected by scales or hairs, and is therefore permeable to these substances.

Amphibians are the focus of a national monitoring programme carried out by the *Société Herpétologique de France* (POP amphibien)[5]. The aim is to assess and understand evolutions in the state of French amphibian populations by estimating the abundance of certain species in specific environments.

- ***Pipistrelles, vespertilions: Chiroptera***

Exclusively insectivore in France, these can be found in the different farming environments, urbanised areas and forest environments. Their presence in these environments shows good environmental health as they are particularly sensitive to the plant protection products found in water and the insects they eat, to the wood treatment products in their nesting places, the closing of ponds, light pollution, the deterioration of their habitat and the disruption of their hibernation by rising temperatures. They are currently being monitored by the network of *Conservatoires d'espaces naturels* (Réseau Cen) supported in particular by the *Société Française pour l'Etude et la Protection des Mammifères*[6] - (SFEPM) - French Society for the Study and Protection of Mammals).



[5] http ://lashf.fr/suivi-amphibiens.php

[6] http ://www.sfepm.org/

- ***Damselflies, dragonflies: Odonata***

Their bio-indicator* feature stems from their ecology which covers different environments with a larval stage in water and an airborne adult stage. Their presence also shows the general quality of an environment (water, food resources, vegetation, etc.). Odonata are the subject of a monitoring programme by the *Office pour les insectes et leur environnement* (OPIE[7]– French Agency for Entomological Information). The Temporal Monitoring of Dragonflies (STELI) is part of the National Action Plan in favour of Odonata. This monitoring will enable the assessment of the yearly evolution of populations for the whole national territory, through the estimation of the probability of presence using a series of inventories. This programme specifically addresses naturalists and managers operating in mainland France whether they are individuals, associations or professionals.

We must remember that a number of plant species are only identifiable at a certain time of year whereas animal species are capable of moving according to the seasons. It is therefore important to carry out field surveys at the optimal time of year for the development of species potentially present, a period which is different for each species. Since the observation periods have a very special importance for certain groups (amphibians and nocturnal species in particular), it is crucial to specify the survey methodology retained for each type of species. The inventories must be carried out in the course of several field trips which, according to the site, should probably be spread out according to the seasons.

[7] http ://www.insectes.org

2.1.4. Transparency in Corporate Social Responsibility (CSR)

Following the actions of the civil society and the industry-based environmental catastrophes listed since the 1970s, Corporate Social Responsibility (CSR) is currently a firmly anchored concept whose objective is to develop a framework conducive to sustainable development*. The European Commission defines CSR* as the integration by the company of social and environmental preoccupations in its business and relationships with stakeholders.

The vocation of government actions initiated from the years 2000 in favour of CSR* is to set up a legal device to regulate corporate social and environmental transparency.

CSR* is encouraged within the context of a number of standards, tools and standards which are both national (NRE Law, Article 53 of the Grenelle 1 Law, Articles 224-225 of the Grenelle 2 Law, CSR* platform, etc.), European and international (United Nations Global Compact, OECD* Guiding Principles, ISO* 26000, Global Reporting Initiative, EMAS*, ISO* 14001, etc.).

Regulated communication

Corporate communication is not only located at the level of free choice, with targets and messages chosen by it, but it is also obliged by the regulations to communicate a certain amount of information, on given occasions and under imposed forms. This can contribute towards the societal acceptance of indispensable professions which sometimes come up against the NIMBY (Not in my back yard" syndrome – everyone wants electricity but not the pylons, a station but not the tracks, etc.).

This is particularly the case for those companies whose activity is classified for environmental protection (ICPE*) or for building sites on land belonging to third parties as for example in the case of linear infrastructures such as electricity or gas grids, motorways and railway tracks) in the framework of public utility declarations. This cohabitation between the different transport networks and biodiversity becomes all the more important as these activities become important actors of ecological corridors, thereby taking an active part in the Blue and Green Belts.

Armed with these imposed ICPE* obligations (due to its activity or size), the company uses them to build a message in coherence with its obligations but with the pedagogy imposed by a communication for the general public and in the framework of extended partnerships and with associations relaying areas of areas of knowledge and opinions. It is therefore indispensable to deal with all the aspects encountered, in both the construction phase and the exploitation phase, with issues as varied as the heritage-driven management of the landscape, the game* aspect or bird safety.

Many agreements have been signed by this type of business to integrate biodiversity into the industrial project, with different stakeholders, and specifically the *Fédération Nationale des Chasseurs de France* (FNC French National Hunting Federation – use of corridors with a differentiated management* and development of areas favourable to wildlife), the *Ligue de Protection pour les Oiseaux* (LPO French Bird Protection League- "green sock operation" at the foot of pylons) or *France Nature Environnement* (FNE).

The similarity of the challenges that the managers of linear infrastructures must face has even forced them to go further and group together in a *Club des Infrastructures Linéaires et de la Biodiversity* (CILB) and draft a charter. By doing this, they commit to sharing their knowledge, good practices and experience in matters of biodiversity for studies, project management and husbandry practices. All these structures have committed themselves to the National Biodiversity Strategy (SNB*). Similar initiatives exist in other fields of activity and specifically in that of aggregate production.

At an industrial level: Installations classified for environmental protection (ICPE*)

Any industrial or agricultural harvesting likely to create risks or to set off pollution or harmful effects, particularly where the safety and health of residents is concerned, is an installation classified for environmental protection. The activities falling under the legislation concerning classified installations are listed in a nomenclature which subjects them to authorisation, recording or declaration according to the importance of the risks or disadvantages which can be generated[8].

Baseline conditions - wildlife

An impact survey is included in ICPE* dossiers, with a wildlife section which analyses baseline conditions and extrapolates on the potential consequences of harvesting such as assessment of impacts, proposals for measures for removing or reducing residual impacts and proposals for compensatory measures*.

The aim of the wildlife expertise is to choose the solution which reconcile the

[8] http://www.installationsclassees.developpement-durable.gouv.fr/-Permit-system-.html

opportunity of the project with the conservation of biodiversity in the best possible way. This study is carried out prior to submitting the application for authorisation to extract.

The study will refer to an existing state of affairs, to a procedure and logic intrinsic to the installation. It integrates the local framework documents which are both constraints and guides for development: the atlas of landscapes for each region, the registers of large regional landscapes, the inventories of protected sites (protection under the law of 1930[9]) and historical monuments (protection under the law of 1913[10]) and other data for naturalist inventories (ZNIEFF*, ZICO*, ZPS*, Natura 2000*, etc.). The choice of the perimeter of this study must be justified and it is not limited simply to the location stricto sensu of the development. It involves several zones and will be the object of suitable communication:

- The potential location area which must anticipate the possible presence of environmentally sensitive animals revealed by the wildlife study;
- The area of direct influence of the work, i. e. the whole surface area disturbed during the work such as access routes, landing areas and even areas affected by noise or dust;
- The distance and induced effects area which is represented by all the ecological units which are potentially disrupted by the project. The description of habitats and ecosystems (nature of the soils, plant formations, ecology of landscapes, and the characterisation of ecological potential) can, if an ecological potential is detected, justify an inventory of the species of wildlife to be found in this extended perimeter. Therefore if the project is located inside or near a Natura 2000*[11] site, the incidence of the project on the habitat and species linked to this site should be studied.

Assessing impacts

The communication will insist on the differentiation of impacts:

According to their types

- Direct impacts: these result from the direct action of the setting up and operation of the development (for example: the deforestation of an area). Determining these impacts must take into account the development itself and the ancillary facilities such as access routes and zones of deposit;
- Indirect impacts: these are the sometimes remote consequences

[9] Law of 2 May 1930 with the object of reorganising the protection of natural monuments and artistic, historical, scientific, legendary and picturesque sites - http://www.legifrance.gouv.fr

[10] Law of 31 December 1913 on historical monuments - http://www.legifrance.gouv.fr

[11] http://www.developpement-durable.gouv.fr/-Natura-2000,2414-.html

of development such as a deposit of lime-based materials on a site whose soil has a tendency to be acid will specifically trigger a modification of the environment);

- Induced impacts: these impacts are not linked to the project itself but to developments or phenomena which can result from this project, for example: human pressure caused locally by the creation of an access route or a transport infrastructure.

○ **According to their duration**

- Permanent irreversible impacts: for example: construction on a given site will result in the total or partial destruction of one or several protected habitats or species;

- Temporary reversible impacts: linked to the work phase or starting up of the project for example noise made by the equipment during the construction or operation phase.

For each element inventoried in the study area, whether it is a habitat or a species, the impact of the project at this level will always be assessed before evaluating the overall impact of the project.

Monitoring: public inquiries and site monitoring

During the public authorisation inquiries or the site monitoring committees (formerly *Comité Locaux d'Information et de Surveillance* (CLIS*)) which will periodically assemble local stakeholders (industrialists, residents, administrations, associations, representatives of communities and elected representatives), it is important that the communication should follow a prioritization of strict challenges approved by all, in a well-defined regulatory framework to be correctly understood:

○ **Logic of areas and environments**

- Proper conservation of the Natura 2000* network;

- Proper conservation of the landscape and the ecological homogeneity of a Regional natural Park* (PNR*);

- Proper conservation of the sites detailed in the Prefectural order for the protection of the biotope* (POB*);

- Proper conservation of the habitats in the regional Red List;

- Conserving type 1 ZNIEFF* condition;

- Conserving of type 2 ZNIEFF* coherence;

- Conserving ecological corridors, conservation of landscapes and the ecological functionality of environments.

- **Logic of species**
  - Species protected by the application of Article 12 of the Habitats Directive*, refers to the list of species in Appendix IV;
  - Species protected by the application of Articles L.411-1 / L.411-2 of the Environmental Code*[12].

2.1.5. Institutional level: Article 225 of the Trade Code

Obligation to disclose biodiversity integration

The law of 12 July 2010 expressing the national commitment for the environment which is known as "Grenelle 2[13]" extends the obligation to disclose information on Corporate Social Responsibility (CSR) in the management report, to some non-listed companies who exceed the given thresholds, from 2012. Up until that time only the listed companies were subject to these disclosure obligations (Article 116 of the Trade Code, also known as "New Economic Regulations" - NER of 2001).

The number and diversity of environmental subjects to be published has increased between these two laws, particularly with the addition of "the use of soils", "adapting to the consequences of climate change" and "the measures taken to preserve or develop biodiversity".

The statutory provision does not define a specific reporting or communication methodology to be implemented by the company in this field of protection of biodiversity, but it can be put into perspective with other recognized standards:

[12] http://www.legifrance.gouv.fr/

[13] http ://www.developpement-durable.gouv.fr/IMG/pdf/Grenelle_Loi-2.pdf/

- The Global Pact[14] - the environment-related principles invite companies:
  - Applying the precautionary approach in the face of problems affecting the environment (No 7);
  - Undertaking initiatives to promote a larger responsibility where the environment is concerned (No 8);
  - Encouraging the development and dissemination of environmentally friendly technologies (No 9).
- ISO* 26000[15]:
  - Central question: Environment (6.5);
  - Feld of action 4: Protection of the environment, biodiversity and the rehabilitation of natural habitats (6.5.6).
- OECD* Guiding Principles:
  - Title VI. Environment.

Different applications according to sectors

The financial year 2012 is the first to which this exercise in communication on biodiversity applies in the management reports of large corporations or listed companies.

An analysis of the practices of CAC 40 companies was carried out by KPMG[16] which noted that these new reporting issues are not broached or only succinctly:

- adaptation to the consequences du climate change (in 15% of cases);
- integration of biodiversity (in 26% of cases);
- use of soils (in 50% of cases).

This study also highlights that these issues were dealt with differently according to the sector of activity of the companies in the panel:

- Overall, they were dealt with efficiently by the companies in the "Industry" and "Consumer goods" sectors.

[14] http ://www.pactemondial.org/

[15] http://www.afnor.org/en

[16] http ://www.kpmg.com/

- They were little discussed in the "Finance" and "Services" sectors, where they are generally considered as not relevant because their activities may appear to have no impact on biodiversity and/or not depend directly on it. It must however be pointed out that some banks now include analysis and exclusion criteria in their financing and investment.

ORÉE is now addressing the subject and has carried out a focus analysing the reporting practices of companies on the subject of biodiversity in the framework of the drafting of its Implementation-Report- of Article 22517, published at the beginning of October 2013. Developed with the support of Utopies, this analysis is based on a sample of 40 companies, including the 20 largest capitalisations of the CAC 40 and the 20 smaller capitalisations of SBF 120.

The study shows that the companies all filled in the item relative to the measures taken to preserve or develop biodiversity: 95% of the companies filled it in and only two companies left it out altogether (5%). Among the 95%, the study shows that 20% of "Not filled in/justified" relative to the companies who declared not being concerned by the item. They are made up mostly by the sample of SBF 120 (10% of CAC 40 companies against 30% of SBF 120 companies).

A large part of the answers are qualitative (58%). Two companies supply answers which are both quantitative and qualitative. Generally speaking, it lacks the precise subjects and common standards which would make it possible to assess the performance of companies on the protection of biodiversity.

The analysis shows a considerable difference between the answers of the CAC 40 companies and those of SBF 120. 75% of the CAC 40 companies give a qualitative answer against only 40% of the SBF 120 companies. Moreover, the CAC 40 answers are on the whole better developed and illustrated than those of SBF 120.

References to GRI* environmental indicators on biodiversity are made on several occasions. Four companies develop some parts or all of their Biodiversity report with the following subjects: EN11, EN12, EN13, EN14, EN15 (see chap. 2.1.6.). Subjects 11, 12 and 13 are the most recurrent and the best exploited.

[17] http ://www.developpement-durable.gouv.fr/IMG/pdf/Grenelle_Loi-2.pdf/

The answers focus quite rarely on what is a uniquely French perspective and the examples chosen are located on national territory as well as overseas. The actions led concern also the entire Group and not only France.

The reference document is not where the most information on the question of biodiversity is to be found; it is found more in specialized publications on sustainable development* (CSR* Report and websites).

What room is made for biodiversity in corporate strategy?

Even if biodiversity concerns all the companies directly or indirectly, it is included in different ways in the reports:

Do the companies identify their interrelations with biodiversity? (Impacts and dependences)

If a large majority of the companies admit their impacts, rare are those who communicate their biodiversity dependence in their report. Only two of the forty companies studied mentioned this fact.

Following the diagnosis, what commitments do they make for managing these interactions?

Seven companies, i.e. 17.5% of the sample (including six CAC 40 companies) mentioned "biodiversity policies" or "biodiversity strategies", but few of them actually make it clear. Five companies, i.e. 12.5% of the sample refers to different specifically biodiversity-oriented "programmes" set up in the company such as reforestation and the rehabilitation of species. More frequently, the companies mention the programmes they subscribe to. Among the CAC 40 companies, three present their projects accepted by the SNB*, two claim to respect CITES* and two mention their CBD* membership.

What solutions do the companies have for the impacts of their activities on biodiversity?

Few of the companies mentioned in their report what means they had implemented to measure their impacts. Two CAC 40 companies and four from the SBF 120 describe the setting up of a monitoring or an inventory of the species concerned by their activities. Four CAC 40 companies only refer to setting up a mapping of the natural areas on which they have located. Lastly, eight companies mention the protected areas on which their activities are located.

Moreover, several types of action are quoted such as supplier control, reforestation, restoring ecological continuities, help for endangered species, awareness-raising and maintenance of green spaces. Even if a large majority of the companies present their action plan by describing its general trends, others choose to detail only some of their "pilot" actions. Their report focuses on an exemplary local action, which of course has the advantage of offering a practical dimension, but which makes the sites where no action has been set up less visible.

Reading the parts devoted to biodiversity makes it possible to see the room made for regulations. Two types of regulatory requirements are particularly valorised in the reports: firstly the impact surveys, which are compulsory for any new installation, followed by the special integration of protected areas in biodiversity management (Natura 2000* sites). Two companies refer to their innovative initiatives as follows:

- L'Oreal: "Launching in 2004 of the assessment of their entire portfolio of raw materials according to the criteria of persistence, bioaccumulation* and toxicity.";
- "EDF was selected to lead an experimental ecological compensation offer operation in Rhône-Alpes."

The majority of the actions for the biodiversity protection are carried out by the companies by their own initiatives and partnerships with nature protection associations. Reference to these partnerships and sponsorships is almost systematic in the CAC 40 reports whereas it is circumstancial in those of the SBF 120.

Five CAC 40 companies (12.5%) refer in their report to their research and development activities in the field of biodiversity. These activities show the consideration for the strategic place of natural environments and species in corporate organisation.

- As an example, LVMH develops its approach as follows this: "The Perfumes and cosmetics Research & Development department has been mobilised by ethnobotany for several years. It identifies species which are of particular interest all over the planet and takes part in the conservation of these species and in local economic development."

2.1.6. Standards for commitment and progress

ISO* 14001[18]: A tool for continuous improvement

The ISO* 14001 international standard specifies the requirements relative to an environmental management system. It enables an organisation to develop and implement a policy and objectives, which take into account the legal or non-legal requirements to which it has subscribed and the information regarding the significant environmental aspects that the organisation has identified as being those that it has the means to control and which it can influence.

It does not itself establish specific criteria for environmental performance but in the scope of this standard, the environmental management system of the organisation must:

- Ensure internal communication between the different levels and functions of the organisation,
- Receive and document the relevant requests from external interested parties, and provide the corresponding answers. The organisation must decide if it communicates or not, externally, on its significant environmental aspects, and must document its decision (according to the "Comply or explain" principle).

If the organisation decides to communicate externally, it must establish and implement one or more of the methods for this external communication. The Global Reporting Initiative (GRI*)[18] is a tool which is frequently used for this purpose.

Global Reporting Initiative: GRI* - a reporting tool

The Global Reporting Initiative (GRI*) offers in its "EN - Environment chapter - Section: biodiversity" subjects which meet the expectations of the various stakeholders in the framework of regulatory communication. The definitions are universally defined which enables comparison between the organisations.

- EN11 - Location and surface area of the land owned, rented or managed in or in the vicinity of protected areas* and in areas rich in biodiversity outside these protected areas*;

[18] http ://www.iso14001.fr/

[19] https ://www.globalreporting.org

- EN12 - Description of the significant impacts of the activities, products and services on the biodiversity of the protected areas* or the areas rich in biodiversity outside these protected areas*;
- EN13 - Protected or restored habitats;
- EN14 – Current strategies, actions and future management of the impacts on biodiversity;
- EN15 – Number of threatened species on the IUCN*[20] Global Red List and on its national equivalent whose habitats are in areas affected by activities, and organised by level of risk of extinction.

2.1.7. Voluntary communication

Each organisation can inform on paper, on the internet, in the media or directly during exchanges of conversations between stakeholders and valorise its activities and thus its integration of biodiversity stakes. The palette of creativity is vast and, without falling into abusive communication (see chap. 2.2.), we can benefit from different opportunities to prove its integration of biodiversity and thus share our experience with different stakeholders.

Search for societal acceptance

Alongside these communications imposed by the regulations ("reporting"), there is a wide field of action for a more spontaneous and more beneficial message for the valorisation of those who act for biodiversity. The development of biodiversity actions strengthens the relationships with stakeholders and can also be a differentiating element with the clientele.

It is the expression of a desire to "go further" in an exemplary way, via an objective of valorisation of the natural heritage it has been trusted with, contributing to its integration in the local fabric, with associations and citizens.

The development and generalisation of such an approach is also a strong element of corporate culture, and in this case a catalyst for the integration of internal forces. It also makes it possible to involve those in charge of the site and their collaborators more by valorising their actions in favour of biodiversity on or nearby the development sites.

[20] http ://www.uicn.fr/La-Liste-Rouge-des-especes.html

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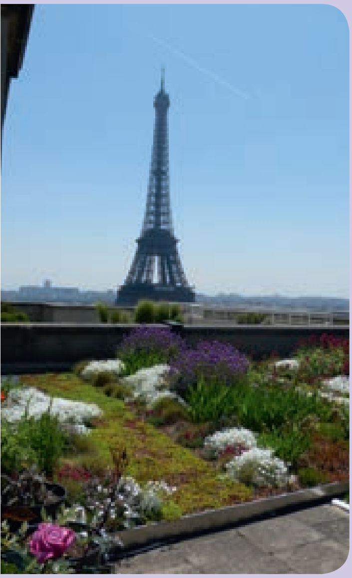
Evolution of stakeholders' perception of biodiversity – the example of the Jardins de Gally eco-contract©[20]



The existence of the eco-contract© and the valorisation of its environmental benefits by the Jardins de Gally sales teams will probably help the perception of biodiversity to evolve with its customers by strengthening their sensitivity on the subject and by demonstrating that this issue can be treated on the scale of a corporate garden in a town centre.

In the longer term, for the perception of biodiversity to be strengthened at customer level, the eco-contract© must enable them to change their outlook. Today, the customer company frequently considers development and maintenance from an aesthetic point of view. This "beauty" requirement is closely linked to ideas of cleanliness and neatness and justifies a certain profusion of plants such as horticultural varieties and sometimes exotic ones. Therefore, when they visit a customer site, the principal has very clearly indicated this request by asking the gardener to clear away the dead leaves: they looked "untidy".

It is precisely this judgment that we need to help evolve progressively through the acceptance of another more rustic form of aesthetic beauty conveyed specifically by the use of robust, local plants. Different types of mowing and pruning, the use of rustic, local plants and the occasional inclusion of spontaneous plants should not therefore be considered as aesthetic neglect but as the key elements of a living area, and valorised as such. Free from this precedence of a certain "beauty" and "cleanliness", the corporate garden will convey another image, that of a responsible company in line with the citizens' hopes of reconciliation with biodiversity. More generally speaking, the eco-contract© could be the vector of a change in the perception of biodiversity at the community level: a lever for awareness due to the associated events and communication, the eco-contract© will also be a means of reconsidering the more important role that green spaces can play in the urban matrix.

[20] http ://www.paysage.gally.com/_Eco-contrats

Insert 8

Hives on Gecina's properties to preserve and valorise biodiversity

Gecina wishes to raise the awareness of all its stakeholders and more specifically its tenants, to biodiversity. One of its first actions was to install hives on its corporate properties.

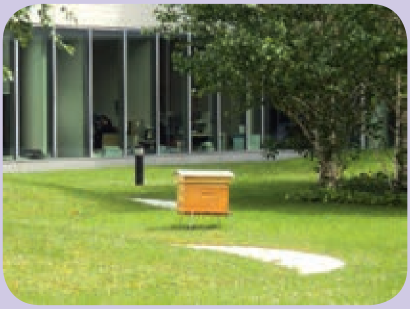
During the year, two events are organised on each site to present the products of the hives to the collaborators in order to raise their awareness on this approach and more generally speaking on the importance of conserving biodiversity.

This first step opens the dialogue for setting up other actions such as the development of green spaces or the setting up of a sustainable maintenance of the site, and these actions are part of the continuity of actions already initiated:

- The setting up of an environmentally friendly green spaces maintenance policy which takes biodiversity into consideration and creating biodiversity reserves;

- The development of the Ecojardin label on some residences (Paris 15ème) and subsequently on the tertiary sector (the Ecojardin label aims at encouraging the adoption of environmentally friendly management practices in towns. This label valorises the work of the gardeners who manage the green spaces and raises the awareness of the users to the issues of sustainable development* and ecological practices for green spaces).

To date, 17 hives have been already been installed on these sites (urban and periurban).



Public mobilisation: from the Grenelle de l'Environnement* to the Environmental Conference

Using the name and the idea of a multi-stakeholder dialogue, in the same way as it had for salaries in May 1968 (at the Labour Ministry, rue de Grenelle), the Grenelle de l'Environnement* in 2007 grouped the stakeholders of French society into panels, on challenges such as biodiversity.

"It was the nature protection associations (*Fondation Nicolas Hulot, France Nature Environnement*, WWF*, LPO, etc.) which initiated the Grenelle de l'Environnement, and this was the project they submitted to the candidates in the 2007 presidential election. After his election, Nicolas Sarkozy implemented it. We have to admit that at the time, we had little idea of where we were going.

The approach was built little by little with our initial aim being to rehabilitate biodiversity and assert its importance, at a time when messages were focusing on climate disruption. Nevertheless, it appeared to us that other questions should be broached in connection with the environment, such as employment, health or agriculture. They were divided into commissions in which the government took part, along with local communities, unions, business communities and NGOs.

Little by little, trust was established between the members. The NGOs realized that a number of companies were truly investing in it and with a conscience. The companies were reassured by the skill shown by the NGOs and by the networks of expertise they had built in the field and particularly with the National Museum of Natural History (MNHN*)."

Contribution by Allain Bougrain-Dubourg - President de la Ligue pour la Protection des Oiseaux (LPO)
Les rendez-vous des annales des mines
(31 January 2013)

The Grenelle de l'Environnement* initiated an approach which was extended in 2012 by the Environmental Conference, an event which was to be renewed every year. The aim of the Conference is to set the priorities of the government on sustainable development*. For its first edition, in 2012, it dealt mainly with questions of energy transition and the biodiversity conservation while trying to open up new projects, particularly on questions of ecological tax, of the link between health and the environment and new ecological governance. In 2013, this conference reported on the actions undertaken for the September 2012 roadmap for ecological transition and is searching to make progress on five new important orientations: circular economy; jobs in ecological transition; water policy; marine biodiversity; education on the environment and sustainable development*.

National Strategy for Biodiversity

In 2004, France met the international commitments of the Convention on Biological Diversity (CBD*) by adopting its National Biodiversity Strategy (SNB*). This was the biodiversity section of the National Sustainable Development Strategy (NDDS[21]). Structured into three transverse trends (mobilising all the stakeholders, recognizing the value of the living world, improving integration by public policies and developing scientific knowledge and observation), the SNB* is divided into ten sectorial action plans. These were reviewed in 2009 to integrate the commitments of the Grenelle* de l'Environnement. This major instrument in national mobilization is now part of the new frameworks of the so-called Aichi[22] targets of the strategic plan of the CBD* (Japan, 2010) and the scope of action proposed by the European Commission for 2020. There is therefore a new SNB* for the 2011-2020 period.

The basis and originality of this new SNB* 2011-2020 are to set up a coherent framework so that all the public and private project initiators can contribute to national ambition on a voluntary basis, by assuming their responsibilities. The SNB* aims at reinforcing the individual and collective capacity to act, at different territorial levels and in all sectors of activity such as water, soils, sea, climate, energy, agriculture, forest, town planning, infrastructures, tourism, industry, commerce, education, research and health.

SNB* membership

In June 2013, 315 organisations became members of the SNB*: 125 associations and other structures participating in the protection, knowledge or education on the environment, 111 companies and professional organisations, 46 public establishments, 31 local communities and 2 workers' unions.

Any actor can officially declare their SNB* membership.

This presupposes subscribing to SNB* vision, ambition and principles of governance (2011-2020) which can be summarized as follows:

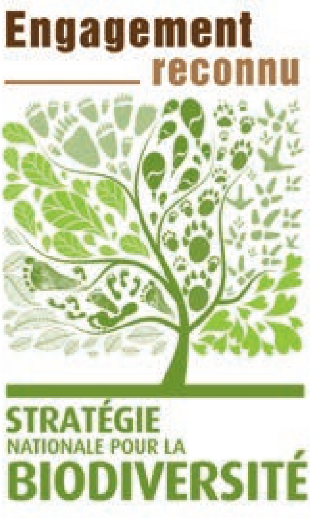
- Preserving and restoring, reinforcing and valorising biodiversity;
- Ensuring its sustainable and fair use;
- Succeeding in implicating protagonists from all sectors of activity.

It also means subscribing to the six strategic orientations and their 20 targets.

[21] http ://www.developpement-durable.gouv.fr/spip.php ?page=article&id_article=25006

[22] Set of targets set down during the COP 10 in Nagoya in 2010 to reduce impacts on biodiversity: http://www.cbd. int/2011-2020/goals/

Recognition of the voluntary commitments for the SNB*



The stakeholder's joining the SNB* has one element which is even more valorisable in terms of image, at least. This membership, which presupposes an active initiation of this strategy, also involves studying, in a maximum of 18 months, the possibility and the implementation conditions in the scope of the stakeholder's activity, of a voluntary commitment declaration, for the targets which concern them. It then becomes a potential national recognition of the stakeholder's commitment.

Joining the National Biodiversity Strategy (SNB*) and being recognized in the framework of the recognition device of voluntary commitments, is an opportunity for an organisation to publicly reveal its internal work programme on the issue of defending biodiversity.

In 2012, 33 stakolders submitted a voluntary commitment project. 22 projects were retained, initiated by 23 stakeholders, mainly from big companies, but also from associations, local communities and unions.

The voluntary commitments have highlighted the diversity of organisations and their preoccupations. Some work on managing their carbon footprint on environments or ecosystems, according to the impacting nature of their activity or their dependence on supply services, others focus more on the training, awareness-raising and communication aspects which are part of their *raison d'être* (professional or societal organisations).

The results of this first SNB* call for recognition were officially proclaimed on 17 December 2012 during a seminar held at the *Conseil Economique Social et Environnemental* (CESE) where a certificate was given to the initiators of SNB* recognized by the Ministry on this occasion, giving a wide notoriety by this act to the organisations concerned. Among the award winnners were several members of ORÉE (EIFFAGE, LVMH, Gecina-Gondwana, Humanité & Biodiversity).

2.2. SOME TOOLS FOR ANALYSIS AVAILABLE TO ACTORS

A number of works and initiatives address actors, businesses and/or local authorities to offer a panel of tools for raising awareness, reflection and support for action. They can be generic or devoted to certain activities and some are referenced in the recent work by the World Business Council for Sustainable Development (WBCSD*)[23]: Eco4Biz[24].

Using the reflections of the Biodiversity and Economy Working Group and certain members of ORÉE who offered to share their experience, we can deal with three of these tools which are well-known by those organisations who question their link with biodiversity: The BBII* (Houdet, 2008), the ESR (WRI, 2008) and the CEV (WBCSD*, 2011).

These tools are presented to actors as guides to help them, using different approaches, in their reflection on their links of interdependence with biodiversity and ecosystem services. None of them enable the assessment of corporate environmental performance, or draft a precise action plan to follow. On the other hand, they can be used to take into consideration biodiversity-linked criteria in strategic decisions and/or integrate them into an environmental management system. It is also a way of raising the awareness of the managers of the company on biodiversity and environmental issues by putting the emphasis on the need to continue to make the most of this type of service. Even if the idea of impact is reiterated recurrently throughout the regulations, the idea of the dependence of an activity on biodiversity is not yet a current one.

[23] An international coalition of around 200 companies, working on a collection of sustainable development-related topics including biodiversity and ecosystem services, and developer of several tools: Greenhouse Gas Protocol, Global Water Tool, Ecosystem Services Review, etc. http://www.wbcsd.org/

[24] http ://www.wbcsd.org/eco4biz2013.aspx

2.2.1. The Business and Biodiversity Interdependence Indicator (BBII*)

The Business and Biodiversity Interdependence Indicator (BBII) was developed in 2006 by the ORÉE - IFB* Working Group assisted by the Master Sciences and Environment Engineering of the Paris Diderot University (Alloin, *et al.*, 2006). The method developed targets simplicity for enabling a self-assessment which is accessible to actors. The indicator's field of application concerns the semi-finished, finished product[25], or the activity, which can be multiple and diversified as in the case of a group, a multinational or a local authority. The specific features linked to the company, products or activities analysed must be well-identified ex ante. The analysis grid includes 23 criteria divided into 5 categories (Houdet, 2008):

Criteria with a direct link to living systems

This criterion includes various issues: firstly the questions of the actor's dependence on raw materials via his activity such as raw materials from the current or past living systems (fossil fuels), followed by the dependence on services and technologies of the living systems, via the approach by ecosystem services such as biomimicry* (see chap. 1.2.1.). And lastly, how the management of the variability, health and complexity of ecosystems are taken into consideration.

Criteria linked to current markets

This criterion is the opportunity to question turnover and how dependent it is on biodiversity and therefore particularly to reflect on the following questions: What is the cost of the raw materials from biodiversity against the total manufacturing cost? What is the level of product range and thus the share of the company turnover which depends directly or indirectly on biodiversity compared with the overall turnover?

Criteria linked to impacts on biodiversity

This criterion questions the impacts of the activity on living systems and more specifically the question of whether or not it is possible to reverse these impacts (landscape modification by the activity, emission of pollutants, the various pressures put on wildlife). (see chap. 1.2.2.)

Criteria linked to impact mitigations

This criterion emphasizes the importance of establishing mitigations (see chap. 4.4.2.) regarding the impacts of the activity (in the case of regulations or external regulations) and monetary compensation not directly linked to the activity's impacts (action by

[25] The finished product is the item redy to be sold in stores. It covers the contents and the container.

the actor in favour of biodiversity for its conservation without the actor's activity having a direct negative impact).

Criteria linked to corporate strategies

This criterion raises the question of the strategic positioning of the company. Is biodiversity a key factor for the durability of activities? Is there pressure from public opinion in terms of biodiversity regarding the activity? Is the consideration of biodiversity a competitive source of advantages? Is the external communication on biodiversity actions highlighted in yearly reports? What are the stakes and prospects for innovation and the opening-up of new markets linked to biodiversity? Is biodiversity a way of enriching the organisation's internal corporate culture?

The assessment of each criterion is carried out using a scale which includes four

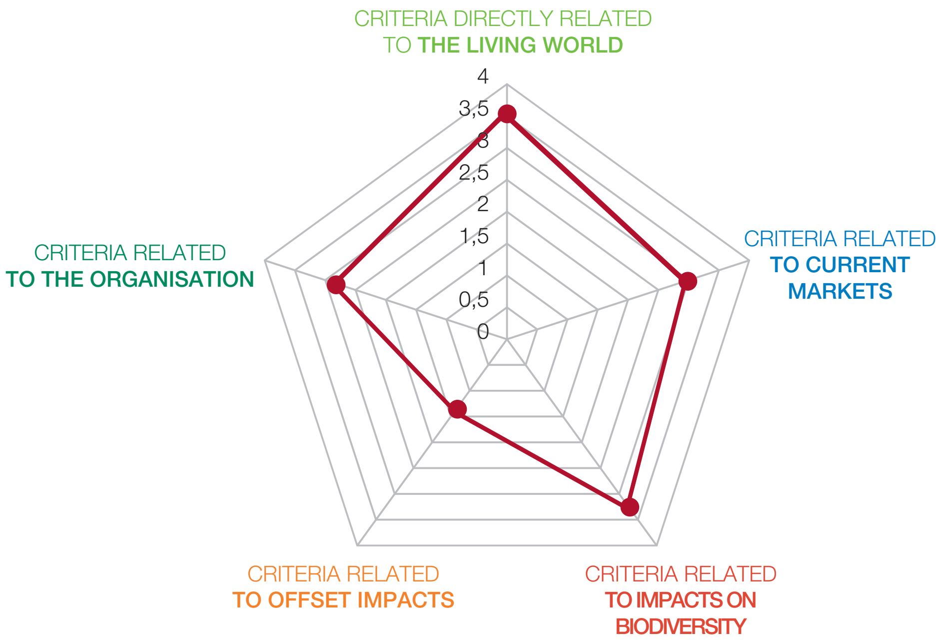


*Figure 6 : Pentagram of an actor who has used the BBII**

classes, and the actor has to position himself in one of these classes and justify his answer. In this way, it is possible to report graphically on this work by positioning the average of the criteria for each of the branches on one of the branches of the pentagram.

The BBII* is first and foremost a tool for internal concertation, awareness-raising and help in decision-making as it makes it possible to establish strategic reflection on a solid, common work basis. It allows one to position oneself with regards to an initial state and can also highlight evolution of both the awareness of the actor's interactions with biodiversity but also of the actor's strategy. The BBII* is an initial stage of reflection prior to developing an action plan or the use of other tools enabling the design, for example of an accounting system which formalises the relationships between the living systems and the activity of the organisation (see 5.4.1.). The criteria retained for building this indicator aim at presenting the widest possible vision of the interactions between actors and ecosystems. The strength of this tool is notably the highlighting of the wealth of relationships between actors and biodiversity to allow a growing awareness of the integration of human activities into the living systems.

The aim of the BBII* is to help identify the interactions between the organisation and biodiversity and to supply in this way the representation that this organisation has with biodiversity. However, the BBII* is not a tool for auditing the organisation's activities regarding biodiversity stakes. It is based on a subjective appreciation and not on a standard of quantifiable criteria and therefore depends on the knowledge of the user. It is consequently the opportunity to raise awareness and generates questions on environmental stakes and links with biodiversity, establishing thus the precondition for all reflection. The presentation of results in the form of a diagram can be used as for dialogue, explanations and sharing within the organisation.

The BBII* is a strong tool as it enables the establishment of the foundations for reflection by the organisation on its link with biodiversity and therefore the basis of future actions and strategic choices. Indeed, raising awareness on biodiversity and sharing perceptions are indispensable preconditions for any structure which wishes to go further in the actions it undertakes but the BBII* goes even further and makes it possible to rethink one's activities regarding biodiversity interdependence.

Insert 9

The BBII* for Yves Rocher

In 2008, the ORÉE Biodiversity and Economy Working Group developed their first tool, the Business and Biodiversity Interdependence Indicator (BBII) which made it possible to highlight the direct and indirect interactions between business and living systems (Houdet, 2008). Yves Rocher was able to show with this composite indicator that their activity had a strong interdependence with the plant world and therefore a stake regarding biodiversity. Based on this observation, a study of a product, in this case a shampoo, aimed at responsibly piloting this interdependence.

At the end of our study, the BBII* applied to the entire company should be an educational and useful tool, in as much as it clearly shows the company's interdependence with biodiversity. On the other hand, for a smaller perimeter such as a product, the BBII* should contain a few adjustments:

- On the criteria linked to the compensation of impacts, we wondered about the relevance of the criterion "monetary compensation not directly linked to the impacts of the activity". To us, this criterion did not seem applicable to the product portfolio's perimeter. The existing monetary compensations at Yves Rocher actually only affect part of the brand's products, and this answer has already been identified as lacking in the assessment grid and is still accounted for in the calculations of the BBII*, which amends the result downwards.
- The term "impact mitigation" appears too restrictive to us and we have extended it to "impact limitation" in order to adapt it to our perimeter.

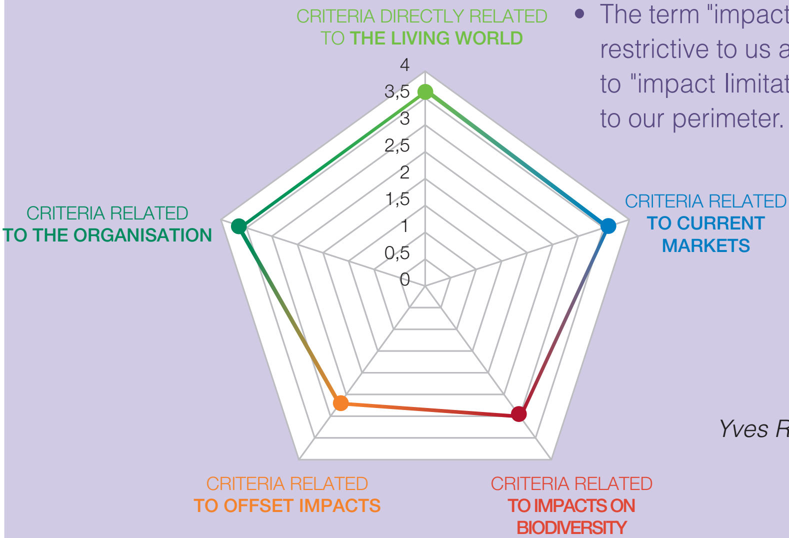


Figure 7: Pentagram of Yves Rocher's interdependence with biodiversity

Insert 10

The BBII* for Veolia on the Occitanis site

The Business and Biodiversity Interdependence Indicator (BBII*) seems useful at the level of a big firm with similar types of activity, but nevertheless raises questions when the firm wishes to use it on a local scale and for monitoring purposes. Its use then has several limits:

Firstly, it is based on subjective appreciations and not on a standard of quantifiable criteria which means that the company's perception of biodiversity interdependence can vary according to the sensitivity of the person carrying out the exercise. It is not the type of indicator generally used in a firm as the rating is difficult to reproduce and it could therefore be awkward as a tool for comparing objective data in space and time.

In addition to this, the criteria which make up this indicator are very distinct. Consequently, the radar chart representation would appear questionable and we can ask ourselves the following questions: Can one make an average per branch given the heterogeneity of the criteria? Is there any point in linking the branches together? The shape of the pentagram depends entirely on the mutual positioning of the branches. But how can this positioning be justified? In one branch, if we choose to allocate the grade of 4 to one criteria and if we give grades of 1 to 2 to the remaining criteria, the sole grade 4 meaning nevertheless a strong link for the business with this criterion will be smoothed in the total average. This result would therefore tend to describe a weak link between the company and the branch considered even though the activity is strongly linked to one of these criteria. In our case study, this limit is intensified for the "directly linked to living systems" branch. The use of ecosystem services only corresponds to one criterion of this branch. The Occitanis site depends only slightly on the other criteria considered in this branch even though it is strongly dependent on ecological services (freshwater supply service, erosion and pollination regulation services specifically). Despite this, the overall result only gives a grade of 2.5 for the branch "directly linked to living systems". It would perhaps have been a good idea to think about developing weighting factors which would have given more weight to certain criteria which contain very vague ideas such as the "use of ecological services".

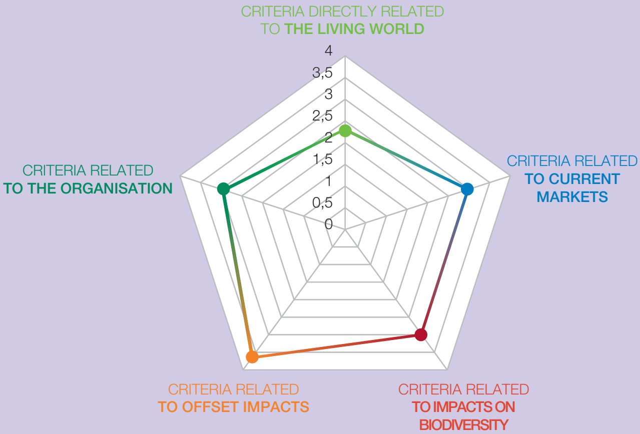


Figure 8 : Pentagram of Veolia's Occitanis site's interdependence with biodiversity

2.2.2. Corporate Ecosystem Service Review (ESR)

The assessment of services rendered to businesses by ecosystyems (ESR) is a methodology designed to help decision-makers to organize strategies for taking account of the risks and opportunities linked to their impacts on ecosystems. It stems from collaboration between the World Business Council for Sustainable Development (WBCSD*), the World Resource Institute (WRI[26]) and the Meridian Institute[27].

This tool is based on the list of in the report by the Millennium Ecosystem Assessment* (MEA*, 2005). The reflection is carried out in 5 stages:

- The first stage is devoted to the choice of the perimeter of development for the study. This is a crucial step and therefore it considerably conditions in return the results of the study.

- The identification and prioritization of the services according to the company's dependence and impact using a series of closed questions (for example: is the service a direct resource or does it condition the performance of the company? no=> "low" dependence if yes, are there cost-effective substitutes for this service? yes => "moderate" dependence. no=> "strong" dependence). The prioritization of services is also a strong working hypothesis which conditions its results.

- The understanding of the state of the services identified as a priority and the deterioration or improvement factors. For this stage, we strongly recommend calling on experts. Keys are offered to help in the analysis of development factors.

- Exploration by means a brainstorming session of the risks and opportunities which may result from the evolution of the services identified as priorities. To structure the reflection, we suggest distinguishing between the operational, regulatory and legal, financial, image, and market risks and opportunities.

- The development of a strategy to minimize the risks and maximize the opportunities. Three types of measure are proposed: in–house changes such as rethinking the process, products and purchases, the involvement of the sector or stakeholders (collaboration with local activities, etc.) or even involving political decision-makers to improve regulations.

[26] http ://www.wri.org/

[27] http ://www.merid.org/

This method aims at allowing the actor to focus from the start on the most significant stakes from his point of view at the time when he takes up this examination. The ESR is an accessible tool which uses scientifically validated nomenclature and offers a clearly structured approach. It can be used by any actor including those who are little aware of the stakes of biodiversity.

This tool integrates biodiversity-related stakes to reflect upstream of a strategy. It is a potential awareness-raising tool as it is relatively easy to set up in an organization and the first results can be communicated quite rapidly which encourages actors' implication. Its results also make it possible to integrate biodiversity criteria into environmental management systems. It must be noted that it does not impose any search for accurate priced data.

An important bias in the ESR method stems from the fact that it uses the ecosystem services approach proposed as a framework for reading and reflection (specific approach by MEA*, 2005). Therefore ecosystems are considered to serve the actors without taking the relationships of interdependence between human activities and the biosphere into account. Such a claim can lead us to question the results of the approach. It must also be noted that this identification of impacts takes place upstream of expert consultation and implies a prioritization and a choice which are not without consequence on the shared vision of the exercise and its conclusions.

As a communication tool, ESR can help to focus on the most significant stakes for the company. In addition to this, the results are easily shared including with those who are not highly aware of the stakes of biodiversity. The ESR offers to guide reflection up to the defining of a strategy to manage the risks and seize the opportunities resulting from the stakes highlighted during the study.

Insert 11

ESR for Veolia on the Occitanis site

ESR is first and foremost a descriptive analysis enabling the identification of the ecosystem services to be taken into consideration in corporate strategy.

The assessment of dependences and impacts stops at the descriptive threshold on a scale which reiterates the criteria: low, moderate and strong. This makes it possible to define the priority services for the company. However if we only take into consideration the tools deployed by the ESR, it is not possible to mutually prioritize the services. The quantification of interdependence is not carried out at a very detailed level. It must also be noted that the definition of impacts can only be partial, the level of expertise of the user of the method being variable, and his capacity to identify relevantly all the impacts of the company on ecosystems is potentially partial and imperfect. The repeatability of the method lies essentially on the choice of the person commissioned to apply the method.

2.2.3. Corporate Ecosystem Valuation (CEV)

Designed to become one of the flagship tools of the World Business Council for Sustainable Development (WBCSD*), the CEV must allow the business "to clarify, using a practical approach, the way in which it assesses, valorises, manages and reports on its impacts on ecosystems and on biodiversity" (WBCSD*, 2011). The "Corporate Ecosystem Valuation Guide" was developed by the WBCSD* in 2011, in partnership with the *Union Internationale pour la Conservation de la Nature* (IUCN*[28]) and the consultants Environmental Resources Management (ERM[29]) and PricewaterhouseCoopers (PwC[30])

The CEV is intended to accompany actors and firstly those in charge of environmental issues in the allocation of values (specifically monetary) to the damage they cause to ecosystems, and to the profits they would reap via ecosystem services (ES). These values, costs and profits associated with ecosystems and identified by the actor as priorities, can then be integrated into the classical internal decision-making processes. Therefore, the CEV makes it possible to meet four main categories of expectations:

- The analysis of compromises: comparing the value of ecosystem services for different scenarios in a project: building the infrastructure, locating a site, investment programme, etc.
- The calculation of the total economic value: evaluate in monetary terms the profits generated by ecosystem on a geographical area (production site, land ownership, natural asset, etc.).
- The distributive analysis: estimate the distribution and degree of impact and dependence on ES between the different stakeholders.
- The analysis of mitigation and sustainable financing systems: assessing the compensation or income potentially attributable to certain stakeholders, according to the negative impacts they incur or the positive impacts from which they benefit.

The proposed methodology is carried out in five stages and thus accompanies the actor in his reflection on his particular requirements and on the relevance of adopting the CEV approach to meet them. The aims of the method are clarified in detail in the guide along with the different corporate situations where implementing the process can be useful.

[28] http ://www.uicn.fr/

[29] Consultant in the environmental management of natural resources. http://www.erm.com/en/

[30] http ://www.pwc.fr/

Insert 12

Veolia's application of the CEV to the Crépieux-Charmy site

Veolia's study on the Crépieux-Charmy site was carried out by Veolia their Social and Environmental Responsibility Department and Ecowhat[31] consultants according to the recommendations of the "Corporate Ecosystem Valuation" guide (CEV). It took around forty days of work over a period of six months.

A preliminary study had made it possible to identify the selection criteria for a relevant Veolia site for the assessment of ecosystem services. It was from these criteria that the Crépieux-Charmy site was chosen. The ecosystem services associated with the site were identified and then monetized using the best-adapted techniques. The data collection necessary for the assessment exercise was carried out by means of on-site interviews, telephone conversations and emails with the site managers and representatives from associations for the protection of nature.

In this case, the facility does not actually produce ecosystem services per se; it is the production method chosen, through the conservative management of the catchment area, which uses and maintains ecosystem services:

- The ecosystem service of water purification whose production of drinking water profits directly;
- the ecosystem services linked to the carbon sequestration, the heritage value of the site, or the recreational uses such as hunting, fishing, bird-watching, etc. which are indirectly maintained by the method of producing drinking water.

The profits assessed here are those of current ecological management relative to a scenario which would not conserve the Crépieux-Charmy ecosystems. The quantification of the ecosystem services produced on the site lies therefore on the estimation of the cost and advantage differentials between the current situation and the situation which would prevail if Crépieux-Charmy had not been protected for the quality of its water resources and its biodiversity. For example, the location of the site in an urbanized area would seem to suggest that, without conservation, the site would be urbanized.

The economic valorisation exercise was carried out following the recommendations of the CEV guide which enables the assessment of the relevance of such a study and its sequence of events. The guide also accompanies the clear structuring of the presentation which can be compared with other studies of the same type.

[31] http ://www.ecowhat.fr/

The CEV involves a qualitative analysis to identify the priority ecosystem from the actor's point of view. Implementing an ESR is therefore an indispensable precondition. Quantitative values are then allocated to the ecosystem services which are identified as priorities, followed by monetary values where it is deemed relevant. This monetary information allows the comparison and aggregation of data. It is specified that the non-monetary information must be taken into consideration and integrated adequately into the analysis in order to maintain an appropriate weight in decision-making. The approach to follow for this is however not specified.

The results of the approach are adapted to the costs-profits analysis and can enable the comparison between different scenarios in a project, provide criteria of choice or arguments for stakeholders as to the validity of a particular project. This tool also makes it possible to assess the risks of damage to biodiversity and ecosystem services such as the estimation of the compensation level, with the subjacent target of minimizing risks and the provision the estimated amounts).

Despite the approximations of the approach, the CEV can lead to the integration of the positive or negative externalities* linked to the management of the site such as the compensation of affected stakeholders and requests for compensation for impacts incurred, which could strengthen the relationships with some stakeholders. This approach can also lead the actor to target cost-efficient investments in natural capital (ecological management of ecosystems as a substitute for technological solutions, specifically in the case of flood prevention and water treatment), or anticipating his participation in new markets linked to ecosystem services (carbon compensation, paying for ecosystem services, etc.).

Lastly, the development of a CEV approach by an actor can allow him to raise the awareness of his stakeholders and convey a proactive and responsible image regarding environmental stakes.

The CEV guide is proving to be an educational tool for the monetizing of ecosystem services, and for planning the valorisation approach.

Nevertheless, even if the CEV offers an approach in stages, it cannot accompany the actor in the calculation of the monetary values associated with ecosystem services, or even supply detailed information on the different valorisation techniques. Although the guide gives an overview of the possible methods (revealed preferences, declared preferences, methods based on costs, value transfer methods, etc.), it subsequently recommends that the actors call on specialists to fill in these economic calculation stages (in-house environmental economists, consultants, research teams, NGOs, etc.). The CEV does not actually accompany the actor in the calculation of the monetary value of interesting ecosystem services, and calling on experts in environmental economy for these calculation stages, he leaves the choice of methodology to these experts.

This assistance appears indispensable and therefore influences the cost and trends of the study.

Applying the results of the CEV also raises questions. The only processes mentioned are those which are compatible with the values produced, but the integration of these values is not prescribed.

The CEV can guide decision-making at a given time for a particular project. It also accompanies an investor's approach, making it possible to endorse the choice by a cost and profit diagnosis of but it is in no case a tool for monitoring and managing biodiversity and ecosystem services over time.

Insert 13

Results of the application of the CEV by Veolia on the Crépieux-Charmy site

The Veolia study on the Crépieux-Charmy site highlights the low cost of ecological management compared with the amount of associated economic profits. The major part of the value of the ecosystem services assessed here depends on this ecological management. The first profit associated with ecosystem services would appear to be the heritage value of the islands of Crépieux-Charmy. However, it must be noted that the estimation of the islands' heritage value is relatively less robust than the other values of the study, since it is based on willingness to pay, which contains a certain degree of subjectivity linked to the individuals questioned. Furthermore, the overall result of the economic assessment confirms the positive impact of Veolia's activities in preserving the supply of these ecosystem services. It is Veolia's activity on the Crépieux-Charmy site, associated with le Grand Lyon, the CREN and the ONF, which makes the existence of these profits possible.

The results of this study offer different

prospects and difficulties:

- They are an assistance in decision-making for the future management of the site (or other equivalent sites) which provide the elements which make it possible to move towards management scenarios which are the best technical, economic and environmental compromise and which, by favouring ecosystem services, generate more internal and external profit.

- The results of this study could be used by le Grand Lyon in communication approaches for the general public to give added value to the local community's natural heritage and justify the protection of the site and prevent access. This study's approach is good for the territory's image, and possibly even for its attractiveness.

- The main difficulty encountered was relative to data collection. Dealing with the externalities* of the activities requires collecting data which are not part of the traditional reporting process set up in the company from a certain number of stakeholders. The capacity of identifying the right counterparts, who have the information needed and their desire to collaborate is crucial. If we add to this the fact that the data finding process is necessarily iterative, the analysis of the first information received often resulting in a demand for secondary information, this data collection phase extends over time without making it possible to carry out the economic assessment as completely as we would have wished! Therefore in Crépieux-Charmy, recreational activities or flood protection linked to the sites have not been quantitatively valorised.

- In this context, it is important to emphasize that the more means the project initiator puts into the development of the study; more the results will be complete and robust.

BBII*, ESR and CEV, are therefore three tools to help actors to take the living system in which their activities are developed into consideration. As any other tool, they each have their own non-exhaustive functionalities which imposes using them according to the chosen situation and stakes. The BBII* is intended to help rethink the interdependences between the living systems and economic actors to establish strategic reflections, but the ESR and the CEV choose to consider these interdependences solely through the prism of ecosystem services. Therefore the three tools provide different and complementary reading keys according to the expectations of the actor and can often underpin an educational exercise and a sharing of the strategy. Nevertheless we must go further towards tools which make it possible to reconcile the languages and perceptions of economic actors with biodiversity stakes.

Section 3

INTEGRATING BIODIVERSITY INTO THE DESIGN OF PRODUCTS OR SERVICES

3.1. THE ROLE OF THE PRODUCT IN BIODIVERSITY STRATEGIES

Even when their awareness is raised on biodiversity stakes and the interdependent relationship of their activities with the living world, actors are often at a loss as to what action to take. There is a vast range of possibilities from stakeholder awareness-raising operations to improving their management practices - for those who have a website. But the first step could quite simply be to think about their product and structure their strategy by organising their biodiversity improvement approach.

3.1.1. From curative strategies to a preventive strategy

The various initiatives developed by organisations today target setting up measures to minimize the impacts of their activities on biodiversity, specifically through local actions for preserving environments.

A typology for corporate biodiversity strategies (Bellini, 2013) gives a classification following two approaches:

- A curative approach to biodiversity with three levels of process: awareness raising, training and intra-/extra-site management;
- A preventive approach to the impacts on biodiversity with measures focusing on an intervention at the product or service level of the organisation.

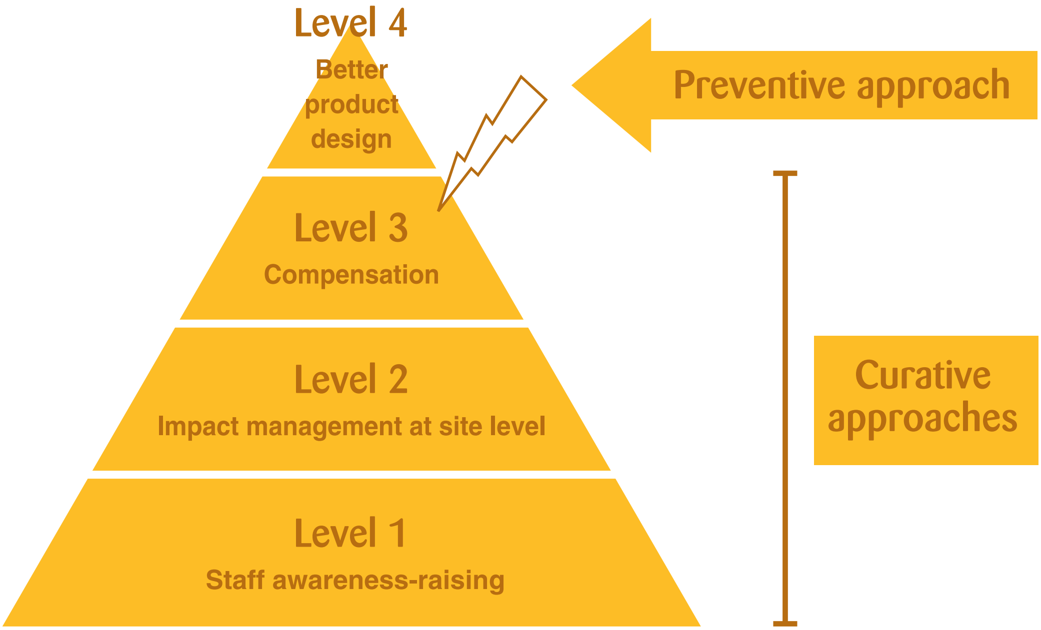


Figure 9: Strategies in terms of integration into biodiversity (Bellini, 2103)

A curative approach is required to minimize the impacts generated by human activities. However, today it seems that there is a need to direct organisations towards preventive approaches and this viewpoint is developed moreover in the four environmental principles via the "The Prevention Principle* and curative action, as a priority at source [...]" (Article L110-1 of the French Environmental Code*[1]). It is important to try to avoid damage to biodiversity. Nevertheless, actors all have their own very different ideas of this preventive approach and some of them will see the development of preventive actions in the creation of Blue and Green Belts (see chap. 4.1.1.) even though they are only actually a protective action regarding the pressure related to the development of human activities. The integration of biodiversity into the very design of the activities is perceived here as the ideal preventive action. The ecodesign approach for products and services is indicative of this type of approach, and impacts on biodiversity must thus be integrated into the design phase of products or services at all the phases of their life cycles, from procurement to end-of-life (Bellini *et al.* 2011).

[1] http://www.legifrance.gouv.fr/affichCodeArticle.do?idArticle=LEGIARTI000022494168&cidTexte=LEGITEXT000006074220

3.1.2. The product as the focal point in biodiversity strategies

Some companies are now aware of the challenge of preserving biodiversity but it is however obvious that they are waiting for tools to enable them to structure their approaches better.

The link between biodiversity and their activities is still sometimes a little vague as to the conception of their activity and is mostly limited to raising awareness on a site and the local measures to be taken. In this way, an organisation can choose endemic* plants for its interior garden or set up a hive or an insect hotel, but in so doing have they considered the prevailing impact of this organisation's activity in relation to biodiversity? To do this, it is essential to consider the biodiversity impacts related to their activity, products and services throughout their whole life cycle, from procurement to end-of-life. This then raises important questions which mostly involve the procurement phase. For example, is the harvesting of the materials used in manufacturing my product potentially impacting for biodiversity? Most of the time, we discover that the answer to these questions requires a traceability which cannot necessarily be accessed directly by the organisation, even though these data are essential to a relevant assessment of these impacts.

The product or service can also prove to be a key point for a company in search of a strategic biodiversity perspective.

3.1.3. Barriers impeding the setting up of a preventive biodiversity strategy

Although the product or service approach may seem clear, very few actions using this approach have currently been identified and the following two major barriers can be quoted

Linking different scientific cultures

One of the identified reasons is to be found in the cultural disruption which exists between the product design engineering approach and that of environmental science. These can almost be considered as two parallel worlds which rarely converge and whose interpretations diverge. It is therefore important today to compare the vision of these two disciplines for an optimal preservation of biodiversity. For example, in the field of design, although some corporate ecodesign engineers grasp the stakes related to integrating biodiversity into their approach, it is not currently included in their remit of responsibility. Likewise, those in charge of biodiversity studies have no contact with the product design services of the organisation and would sometimes be surprised if a joint discussion were to be suggested.

A lack of adapted tools

A second reason for implementing a "biodiversity product strategy" is linked to the tools currently available in the field of product or service ecodesign. The method widely used today: Life Cycle Assessment (LCA) is a standardized approach at an international level (ISO*14040, 2006) which was developed in the 1990s. Nevertheless, the application programmes have not been formatted to integrate the local data which are indispensable for integrating biodiversity and the profession does not appear to be highly aware of this. However, in 2013 a professional association, SCORELCA[2], launched a call for tender on "Using data flows and existing LCA methods to address the impact on biodiversity" which shows that LCA professionals are aware of their tool's limitations.

[2] http://www.scorelca.org

3.2. TOWARDS INTEGRATING BIODIVERSITY INTO ECODESIGN PRACTICES

The ecodesign approach, by its name alone, could attract actors who are concerned about their impacts on the biosphere. However, biodiversity is currently largely overlooked in this framework which falls short of meeting actors' expectations even though there are a certain number of avenues to explore in order to bring the product closer to the different ecosystems it impacts and on which it is dependent.

3.2.1. The principles of the ecodesign approach

The regulatory and prescriptive contexts, along with market pressure, are leading more and more companies to explore an approach characterized by the integration of the environment* from the product design phase. Ecodesign is defined in the ISO*/TR 14062 technical report as being "the integration of environmental aspects from the design and development phase of products". This integration of the environment* from the design stage of the product (the product being considered a product, service or system) is seen more and more as a competitive challenge and a source of innovation.

By acting at product design level, environmental performances have every chance of being optimal. Throughout the life cycle of a product, up to 80% of its pollution is determined from the design phase (De Winter *et al.*, 1994) and it is therefore important to reflect on the integration of environmental data at this stage.

ORÉE and its members are aware of the strategic, regulatory and economic stakes of such an approach, and in 2009 they designed the first product and service ecodesign platform, namely: ecoconception.oree.org. Free of charge and completed by feedback, this tool is intended more specifically for SMEs and, on a wider scale, all organisations, whatever their size and vocation, who wish to commit to an ecodesign approach or simply discover the subject.

Ecodesign is a multi-criteria, multi-stage and multi-actor approach:

- A multi-criteria approach which is designed to tackle all types of product-related environmental impacts;
- A multi-stage approach where the assessment must deal with all the phases of the life cycle of the product, with no pollution shifts from one stage to another:
    - Supply (e.g. less consumption of materials);
    - Manufacture (e.g. less energy-intensive processes);
    - Distribution (e.g. decreasing weight of packaging);
    - Use (e.g. increasing shelf life);
    - End-of-life phase (e.g. assisting disassembly).
- A multi-actor approach because the information needed to develop it is owned by all the actors in the product's value chain.

One of the difficulties encountered in setting up the approach stems from a profusion of ecodesign tools which are difficult to understand. The dynamics of the Grenelle de l'Environnement*, and specifically the project on environmental product information for everyday consumer products, has led to an increase in the tools proposed. A mapping of ecodesign tools has been developed in which the tools available are presented according to their levels of assessment and recommendation in order to help companies choose the tool best suited to their needs (Bellini and Janin, 2011). It makes a distinction between the level of assessment of the tool and the level of ecodesign recommendation.

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Maisons du Monde's ecodesign approach

With a first range of ecodesigned products, Maisons du Monde wanted to use an exemplary approach which would serve as a model and activate progress on other products in their catalogue. In order to implement an ecodesign approach, customer perception and choice on purchase were analysed and assessed, showing the areas for improvement and future focus. A questionnaire with the aim of quantifying customer preference between the classical model and the ecodesigned one was published, in order to define the level of customer maturity with regards to responsible products and to rank purchasing criteria. After a year, the survey showed that 70% of those answering prefer the ecodesigned model at the same price and quality, and that it was first and foremost the low environmental impact, price and organic cotton cover of the product which influenced their choice of purchase. Moreover, 51% of those surveyed considered that the approach added value to the product whereas 27% never buy "ecological" products as they are on the whole insensitive to this feature.

This survey was critical as it enabled Maisons du Monde to understand consumer expectations better and reinforce their wish to extend ecodesign to other products. The customers therefore shared their desire to see more information such as provenance and manufacturing conditions on the products.

Generally speaking, the customer is in favour of a transparent and fair transmission of information and some customers say that they are still wary of companies' ecological commitment.

A positive economic balance-sheet can be added to this marketing point of view and, after one year on the market, the ecodesigned ROMA sofa created a new market share: sales of the classical version remained stable while those of the ecodesigned version generated 32% extra turnover. This is therefore a new clientele who are attracted by a distinctive, responsible offer.

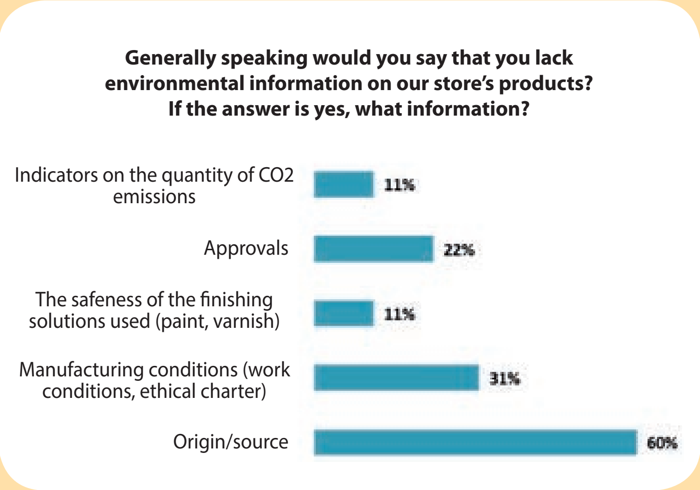

Figure 10 : Survey of the type of environmental information lacking on Maisons du Monde products

This result shows a real demand for this typology of product but it would benefit from better support to enable the ecodesigned model to gradually replace the classical one.

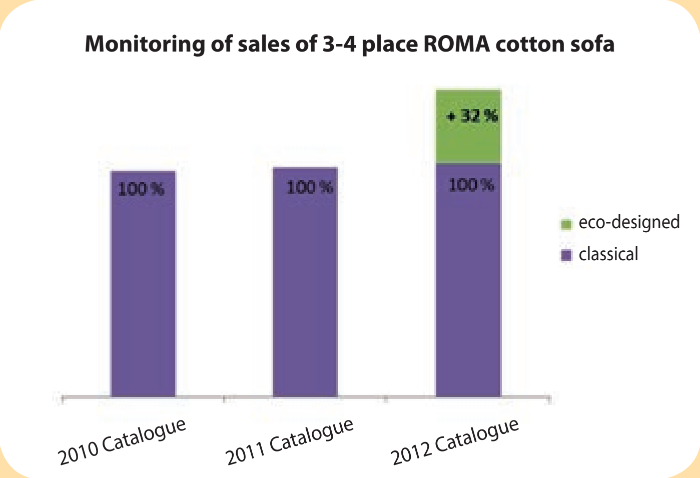

Figure 11 : Monitoring of the sales of Maisons du monde's ROMA sofa

Ecodesign generated a very positive internal and external image of the possibility of offering an alternative to the existing market, and offered measured and credible guarantees through the award of the *Prix Entreprise et Environment du Ministère de l'Écologie et du Développement Durable de l'ADEME** (2011). 17% of the customers questioned between March 2012 and March 2013 would not have bought the product without the ecological guarantee that it displayed, and 63% considered that the ecological argument gave added value to the product and that this was even a distinguishing element in comparison with other stores.

Thus strong customer interest can be noted for transparency on the provenance and the environmental impacts of the products which, even if they do not determine the act of purchase, are part of the store's brand image and the trust in the products offered.

3.2.2. Completing the range of ecodesign tools

The most used and recognized tool is Life Cycle Assessment (LCA). This approach assesses the environmental impacts of a product from primary data (i.e. real data from the organisation) and secondary data (for example data averaged on the activity sector). The majority of data however are not localized, apart from the data linked to production and calculated according to the energy models of each country. The link with biodiversity is all the more difficult to achieve due to the fact that the current methods of assessment of the environmental impacts of products and services do not integrate this factor conspicuously. We can therefore find impacts such as global warming, eutrophication* and acidification which moreover contribute more or less directly to biodiversity loss.

This situation therefore raises questions on the integration of specific local characteristics. When accounting for impacts on water, it seems to us essential that the water stress values linked to the production area be integrated in order to give a clearer view of a product's impact, especially if water is used to manufacture it.

These aspects are also important for the preservation of biodiversity. For example, some ores used in the manufacture of a product may be harvested in a manner involving primary forest deforestation practices (see chap. 1.2.2.) without the manufacturer being aware of the link with his product if several commercial intermediaries prevent him from having easy traceability of the data.

Developing assessment tools to supplement the LCA and databases which cover the localized elements to gain a better understanding of the real impacts of the consumptions seems crucial to us. It would also be interesting to have the formats of these databases standardized at an international level in order to make it easier to access information. Relationships could thus be developed with the Global Biodiversity Information Facility (GBIF*) created in 2001[3].

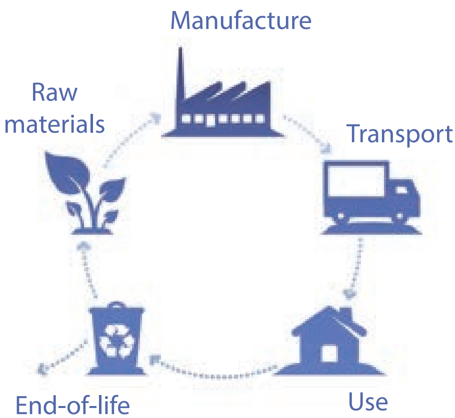

Figure 12: Diagram of the phases in the life cycle of a product

[3] http ://www.gbif.fr/

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The limits of Life Cycle Assessment observed by Maisons du Monde

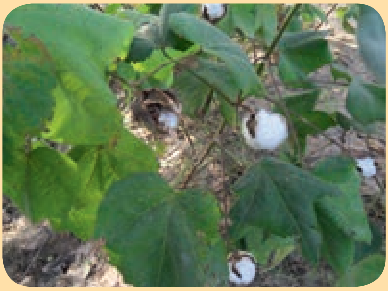
Life Cycle Assessment has made it possible to assess the reduced environmental impact of the ecodesigned sofa using various indicators and reinforced our approach. In addition to the noble practices imposed by organic farming and the sustainable management of forests, we can now quantify the carbon footprint generated by these alternative choices.

Nevertheless there are some limitations to this calculation tool. Firstly, the data used are semi-specific which means that these results must be understood in the context of a certain degree of uncertainty. It is actually extremely difficult for Maisons du Monde to collect specific data on how its cotton is grown, or on its milling or weaving, due to the fact that these processing stages are not accurately localised.

Next, Life Cycle Assessment does not take into consideration the aspects which are intrinsic to the living world of wildlife or human beings. Indicators such as dependence on the raw materials, services and technologies of the living world are difficult to quantify and cannot in fact appear in a calculation tool. They must be the subject of a parallel study which requires observation of the ecosystems involved over quite a long period of time to reach exploitable and realistic results; these may include the positive or negative impacts on biodiversity in the vicinity of the sites where the raw materials are extracted or processed and where the products are manufactured.

The presence of social and societal dimensions is not covered by Life Cycle Assessment specifications, which only involve the impact on the environment* in its broadest meaning for the time being. Maisons du Monde would like to see the state of health of ecoystems as an additional indicator. Let us remember that the interest of ecodesign is not in transferring pollution from one indicator to another, and that a choice deemed better for the environment* and made at the expense of human beings would be harmful.

LCA is therefore a piece of the puzzle which helps us not to get entangled in the choice of alternatives but which remains insufficient with regards to the vital stake represented by the good health of the ecosystems surrounding each stage in the product's life cycle.



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Integrating biodiversity at product or service level by Bureau Veritas CODDE and Dervenn

Raised awareness on corporate responsibility in the consideration of environmental stakes has already encouraged a number of manufacturers to identify and reduce the environmental impacts of their products through ecodesign approaches and, more specifically, using Life Cycle Assessment (LCA) methodology. Currently, the categories of impacts most regularly taken into account involve global issues such as climate change and the destruction of the ozone layer using so-called "mid-point" methods whose mechanisms are relatively simple and well-known.

Nevertheless, natural environments are extremely diversified with complex biotopes*. It is difficult to define the consequences related to human actions which affect an environment, or the levers to be used to limit or even reduce them. This is particularly so in the case of the manufacturing processes of products consumed by our Western societies, which are generally complex, globalised and multi-site, meaning that industrial actors do not have a comprehensive overview of the whole manufacturing process of the product they design, produce and market. In addition to this, during the product's life cycle, the other phases such as distribution, use and end-of-life also generate impacts on the environment* that the designer cannot necessarily control.

Work has been carried out using Life Cycle Assessment methodology to determine the consequences on biodiversity. These experiments have led to the creation of new categories of impacts known as "end-point", among which can be quoted the ReCiPe series of data (ReCiPe 2008 - a life cycle impact assessment method which comprises harmonised category indicators at the midpoint and endpoint level, 2013). However, as the work of the European Platform on LCA (ILCD4) has shown, these tools lead to uncertain results. Consequently, ILCD has implemented a classification of these methods at an "interim" level (not recommended).

[4] International Reference Life Cycle Data System

They ignore the local approach which is often crucial as it involves microcosms. In addition to this, they do not deal with biodiversity as a whole, i.e. the whole living world (diversity of species, environments, etc.) and often concentrate on only a few aspects such as changing land use and disappearing species.

There is currently therefore a mismatch between the actors' wish to make progress on biodiversity-related issues and the tools and methods which are available to them. This leads to information which is partial and/or difficult for the end customers and decision-makers to understand, meaning they are unable to differentiate the products on the criterion of biodiversity.

Consequently we must go further in defining tools which make it possible to determine the consequences on biodiversity of the life cycles of products and services and the levers to control and reduce them. Communication tools must be strengthened on the basis of solid results and also on the ergonomics adapted to the products, customers and categories of potential impacts on biodiversity. The ultimate aim is foreveryone, from intermediate customers to end customers, to be able to make an informed choice.

3.2.3. Integrating biodiversity into product information

The Grenelle 1 Law (Article 54) established better consumer information through the mandatory ecological labelling of products. Article 85 of Grenelle 2 Law in 2010 modified the regulatory deadlines, and experiments were launched in France in 2011 whose feedback aimed at helping the government to determine the final labelling status. A BPX30-323 good practices guide (AFNOR, 2009) was drafted during work by the ADEME*/AFNOR platform in charge of the dossier. Sectorial groups were set up in order to determine the environmental criteria on which it would be most relevant to communicate by type of activity. Biodiversity was often quoted as being relevant but the recognized lack of methodology did not make it possible to integrate this criterion in the sectorial guides.

However, labelling attempted to assess a biodiversity impact with different methods, most frequently using surface indexes such as an equivalent in m^2 of affected biodiversity. However, the significance of these figures is limited and even challenged. The hypothesis which is most often used is that a concentration of the activity on a lesser surface area is favourable to biodiversity; using this, would a pig bred in intensive livestock farming be likely to be considered as having less impact on biodiversity than a lamb occupying a much larger area in the mountains?

In addition to this, the calculation of these indices does not refer to local impacts but to averages, a point which also limits their relevance in the field of biodiversity.

3.3. IMPLEMENTING THE APPROACH IMPLIES RAISING AWARENESS

The integration of biodiversity at product level could be a major approach for piloting actors' activities and strategies. The dissemination of the approach and tools available to actors implies optimising them within the company and with stakeholders.

3.3.1. Raising actors' awareness on product design stakes

The integration of biodiversity into the design of the product can only be developed if organisations are made aware of it.

The fact that the French Ministry for Ecology, Sustainable Development and Energy retained a question on this topic among the six proposed by France at the IPBES5 in 2013 is a sure sign of awareness in progress. The work of selection had been carried out jointly with the FRB and, as a member of the *Conseil d'Orientation Scientifique* of this organisation, ORÉE rose to this important challenge.

At the same time, in a study (European Commission, 2013) on the impact of the European Union on deforestation which was published in 2013, one of the first proposals for action involves the setting up of labelling on products' forest footprint. The relationship between impact and product seems to be a topic to be developed, as information on this relationship displayed on the product reinforces the customer-awareness approach. A study on this topic was actually carried out in 2013 in the framework of an educational project in partnership with the Envol Vert NGO (Delli Zotti *et al.*, 2013).

[5] Scientific and political intergovernmental platform on biodiversity and ecosystem services. http://www.ipbes.net/

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Pooling of skills by Bureau Veritas CODDE and Dervenn

It is in the context of the non-integration of biodiversity in LCA that Bureau Veritas CODDE (a pioneer of LCA and ecodesign, developer of LCA data and software (EIME)) and Dervenn (a specialist in the field of ecological engineering and biodiversity) have chosen to work together. Their aim is to develop a tool which will enable the integration of biodiversity at product level. This on-going project will make it possible to provide an additional level of knowledge on the impacts of products in terms of biodiversity, and to communicate reliably and transparently to customers and decision-makers.

Initially, this entails carrying out a state-of-the-art review of the available methods, whether they are applied or not, by focusing on their relevance and their feasibility with regards to industrial constraints such as economic cost and implementation time. Each of these methods will be analysed and put in perspective in their entirety using a criteria grid. This assessment aims at achieving a level of relevance for each method which will be discarded or selected with a "combinatory" objective.

The results of the first stage will make it possible to develop a new method which can be linked to the Life Cycle Assessment of products and services approach. The methodology will make it possible to determine the categories of impact on biodiversity generated by the life cycle of products and services, on a local and global scale. It will also mean qualifying these impacts simply and providing coherent results. It must enable communication to specific customers and decision-makers in all sectors and its use by industrialists. To guarantee its feasibility, this tool will be developed in partnership with industrialists from different sectors in the course of pilot projects.

This project will help to promote the integration of biodiversity at product and service level and also increase environmental protection.

3.3.2. Raising the awareness of consumers to the stakes of their choices

It is currently difficult for consumers to make the connection between the products they purchase and their impacts in terms of biodiversity (see chap. 2.2.2.). Experiments carried out in the framework of the more general approach on environmental impacts known as "Life Cycle Perception" (Bascoul *et al.*, 2009) show that when the consumer assesses the product, the production and end-of-life phases are deemed the most impacting. The end-of-life phase is regularly the first raised as it is the most familiar to citizens as they are used to sorting their waste on a daily basis. The procurement phase is rarely mentioned, even though it is often criticized, specifically in terms of biodiversity impacts.

The aim is therefore to highlight the consumer cum actor's role: "responsible consumerism is the idea that the consumer not only has rights but also duties" (Debuisson-Quellier, 2009).

Initial approaches are being developed at this level, specifically by highlighting manufacturers who commit to a more responsible approach such as the non-GMO* soya sector with the Round Table on Responsible Soy Association (RTRS[6]).

[6] http ://www.responsiblesoy.org/

MANAGING BIODIVERSITY ON A TERRITORIAL SCALE

Section 4

4.1. THE INTEGRATED MANAGEMENT OF TERRITORIES

A territory can be read differently depending on the viewpoint and the scales considered by the players. As an example, a scarab beetle, a weasel and a sparrow hawk would not have the same experience of the territory. As protagonists in the functioning of ecosystems, they may even play a fundamental role from the point of view of certain stakeholders such as farmers. Allowing biodiversity to keep the landscape alive presupposes the restoration of the living material which has now become moth-eaten due to human activities. The restoration of the ecological network may now depend on tools such as the Blue and Green Belts.

But it is also possible to reconsider the territorial functionalities from an anthropogenic point of view. This means looking at our organisation, activities and relationships with other stakeholders as a system, being inspired by the long experience and ingeniousness of the ecosystems to rethink our activities and strategies: it is the opportunity offered by industrial ecology, and more particularly by a territorialised industrial ecology.

4.1.1. Blue and Green Belts: incorporating an integrated territorial management system into our activities

Since 1970, certain countries such as the Netherlands, Lithuania and Estonia have begun to work on the implementation of such a network on their own territory. Following the 1992 Rio Conference, and the drawing up of the Convention on Biological Diversity (CBD*), in 1995 the members of the EC[1] signed the Pan-European Biological and Landscape Diversity Strategy, in particular to create an ecological network on a European territorial scale.

[1] International organisation based in Strasbourg which brings together 47 European states – http://hub.coc.int/

The *Trame verte et bleue* (TVB), or Green and Blue Belt, forms part of this idea of a pan-European ecological network and France is thus the nineteenth European country to commit to setting up its own territorial ecological network.

It was after the work of the Grenelle de l'Environnement* (2007), which brought stakeholders together to discuss questions of the environment and sustainable development, that the TVB was valorised as a pro-biodiversity tool in the management and use of territory. The aim of this initiative was to maintain and reconstitute an exchange network on the national territory in order to allow biodiversity to benefit from ecological corridors.

The TVB is connected with the existing tools already implemented on French territory, such as the protected areas*[2], national parks[3], regional natural Parks[4] (PNR*), nature reserves[5], etc. The innovation represented by TVB is that it allows us to take our biodiversity management to a higher level because it is no longer only a question of notable species but now takes into account the ecological functioning of spaces and species in the management of land destined particularly for what we call "ordinary biodiversity"*.

TVB is a network formed of land- and water-based ecological continuities identified by the Regional Schemes of Ecological Coherence (RSEC*) and by the TCS* and LTP* town planning documents. This ecological network comprises reservoirs of biodiversity, in other words 'green' pockets connected by a grid of ecological corridors.

[2] Territories benefitting from a conservation status and to which the government authorities afford special protection.

[3] http://www.parcsnationaux.fr/

[4] http://www.parcs-naturels-regionaux.tm.fr/fr/accueil/

[5] http://www.reserves-naturelles.org/

TVB also acts as a land management tool because on a local level it must be brought into line with the aforementioned town planning documents (TCS* and LTP*). This allows the integration of ecological continuities in land use programmes; however, this is not without constraints, and the incorporation of TVB into these projects must be strongly anticipated at a very early stage.

A certain number of actions are realised at different levels of governance:

National level
A national work framework fixed by the State which provides coherence over the entire territory;

Regional level
A range of regional framing and support for local initiatives, guaranteeing the coherence of the system and the consideration of services provided by biodiversity;

Departmental level
All policies regarding sensitive natural spaces, management of departmental road infrastructures, agricultural land use, biodiversity knowledge and implementation;

Project area level
Implementation of TVB as an integral part of the territorial project, complementarity and coherence between the different public policies. Implementation of contractual experimentation and tools such as PNR*, intercommunalities, SAGE* etc.;

TCS* level
Implementation of TVB as an integral part of the territorial project, complementarity and coherence between the different public policies;

Community level
Operational implementation and third party effectiveness through town planning documentation;

Individual level
The effect of businesses managing their own sites and reducing their environmental impact.
Positive role of farmers and foresters in maintaining ecological continuities.
The actions of citizens in their own gardens, in associations etc.

Figure 13: Schema representing the actions of different actors at the different levels of TVB governance

Regional Schemes of Ecological Coherence (RSEC*)

The Regional Schemes of Ecological Coherence (RSEC*) are fundamental to the construction of TVB. These schemes are the responsibility of the Regions and answer to Grenelle Law 2 and to Article L.371-3 of the Environmental Code*. They are constructed according to the issues of spatialisation, hierarchisation and a framework of intervention comprising action plans, tools for action and monitoring methods. The RSEC* also include the spaces identified by existing tools, the *Schema Directeur d'Amenagement et de Gestion d'Eaux* (SDAGE*) or Land Use and Water Management Plan (LUWMP*), and protected zones and integral nature reserves.

The implementation of TVB following the development of the RSEC* has strong implications for the actors and their economic activities. In fact, the economic activities connected with the territory, the implantation of infrastructures, of factories and quarries, are all sources of territorial modifications and must conform to the RSEC* as well as the other planning documents such as LTP* and TCS*. This therefore involves taking into account TVB and RSEC* at the pre-planning stage in the development of future projects, in addition to current considerations.

Taking TVB into account in planning documents

Local Town Plan (LTP*)

The Local Town Plan (LTP*) is a town planning document which, on the level of a community or group of communities, establishes a general town planning and land management policy and as a consequence lays down general regulations for land use on the territory in question.

The LTP has as its aim the sustainable development of the relevant territory, while seeking a balance between urban development and the preservation of natural spaces. Since the Grenelle Law came into being, this entails a consideration of TVB and RSEC*.

Territorial Coherence Scheme (TCS*)

The Territorial Coherence Schemes are the result of the Solidarity and Urban Renewal (SUR) law of 2000. They aim to bring consistency to all the sector-based policies from the perspective of the preservation and valorisation of the environment. The Grenelle laws reinforced the attributes of the TCS*, in particular in the fight against urban sprawl. TCSs must include conservation, restoration and the creation of ecological continuities, and thus impact on the different actors in the territory.

The TVB are therefore opportunities for innovation in the fight to improve the reduction and avoidance of possible impacts during large-scale projects. In this way, could linear infrastructures such as roads be designed in such a way that they incorporate the relocation capacity of biodiversity?

4.1.2. Industrial ecology as a mode of integrated management

If most of the human story can be read as a battle for survival in a badly controlled environment, the balance between human societies and nature seems to have reversed over the course of the last two centuries. Hans Jonas points out that "we have reached an unprecedented level of technical powers: our technical actions have global consequences, in space and in time" (Larrère, 2003). The balance has swung, and we have become a global force with the capacity to destroy the planet (Hiroshima, 1945) but we must not allow ourselves to forget that we cannot live without the biodiversity of which we humans are stakeholders. It is in the face of this acknowledgement that, over the course of the last two centuries, moves have been emerging which aim to reconcile humans and biodiversity. One of the trails followed rests on one of the simplest ideas: to use the example of natural ecosystems and their capacity for resilience* and adaptation. Within this circle of influence, industrial and territorial ecology (following the example of ecological engineering) is one of the most promising areas to consider (Buclet, 2010).

Industrial and territorial ecology

Industrial and territorial ecology (ITE) is positioned as one of the different approaches of the circular economy which seeks to remedy the rarification of raw materials as well as the deterioration of our environment. Taking as its inspiration the way in which ecosystems function, it is also a question of optimising the materials and energy flow of a system, whether this is on a product or a territorial level. Operationally, industrial and territorial ecology thus allows us to find a territorial response for the support of the dynamics of local ecosystem development (collectivities, economic actors, etc.). In this context, ITE may lead to the anchoring of territorial activities while promoting their potential for innovation.

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Yves Rocher and managing the biodiversity

Starting with the lines traced by the strategy, a company's life is regulated by project management. Such management includes methods, tools and guidelines, for example the guidelines controlling the choice of plant ingredients.

The company's life is also enriched by regular or occasional contributions connected with certain specific commercial operations and grants contributing to the work of the Yves Rocher Foundation, and this occurs at the most detailed level of management.

It is by the overlapping of these different layers of management that we progress in the integration of biodiversity management in a 'circular' perspective. Does this mean that the purchase of a product sets off a contribution to biodiversity at the level of the plant source of our products? And, how are the consumers and stakeholders invested and concerned in this circular perspective?

The analogy of ecosystems and industrial ecosystems: industrial ecosystems

From the onset, the industrial revolution was heavily reliant on the emergence of coal-hungry motive power, as well as new production techniques, sometimes coupled with access to new fossil or mineral resources; this led to a radical swing from an economy based on the scarcity of resources towards an economy living on the myth of abundance. Over the course of the nineteenth century this movement, which subsequently determined the economic development of industrial countries, gradually replaced the previous model of industrial development based on the maximisation of the use of any and all exploitable resources. All sectors of production are affected by this movement (Bouclet, 2010).

These days, however, this classical linear industrial system, which uses raw materials and supplies products and services while producing waste, is led to evolve and to be replaced by a "more integrated model" called an "industrial ecosystem".

According to Robert Frosch and Nicholas Gallopoulos, this is a matter of passing from a linear economy in which the resources are extracted from the ecosystem, exploited by human activities and returned to the system in a degraded (and even non-degradable) form, to a circular economy. This is a dematerialised economy because it only draws marginally on natural resources, in order to produce and respond to human needs. It is therefore a systemic approach, based on the existence of multiple positive and negative retroactions between human activities (Joël de Rosnay, 1975), such as one can identify within an ecosystem (Buclet, 2010).

Industrial and territorial ecology is an operational approach which tries to produce the sustainable economic development of a territory in order to limit the impact of human activities on the ecosystem.

The concept of industrial ecology is quite recent, and emerged from the United States in the 1990s under the term "industrial ecology", from "ecology" (scientific ecology and the study of ecosystems) and "industrial" (all the economic activities of a territory) (Erkman, 2004). The juxtaposition of the word "territorial" appeared at the beginning of the twenty-first century, notably to promote a comprehensible language which could be used by the territorial actors. This term "industrial and territorial ecology" (ITE) also allows for the integration of a spatial dimension and the territorial factors of the approach. ITE includes all the energy and material flows of the economic activities at territorial level and targets the cooperation of all the actors who interact in a defined ecosystem: the territory.

The current industrial system rests on a functioning which consists of extracting resources (which are frequently non-renewable) and producing waste. But, the ultimate ideal of industrial ecology is rather to arrive at the opposite, an integral closed cycle of material and energy flows, a Utopia founded on the rather simple analogy of the functioning of an ecosystem. In this way, all industrial systems should function entirely cyclically, with solar energy able to make up for the few inevitable losses. This is the dominant vision among the international community concerned by industrial ecology, and is thus being applied to the systemic optimisation of industrial society, but the fact is that this vision is based on two presuppositions which are not neutral in terms of deciding on the directions to take: enrolling industrial society into a dominant market economy, and the rapid growth of a society founded on the development of environmental technologies.

Brad R. Allenby and Deanna J. Richards (1994) present different scenarios of the functioning of industrial ecosystems. The current linear system is "the Type I ecosystem" (Figure 14, Current situation), and they go on to identify the "Type II ecosystem" (Figure 14, Transition path) in which the inflows and outflows are limited by the availability of resources and by the limits of the environment to accommodate waste. Finally, in the "Type III ecosystem" (Figure 14, ideal situation), only renewable resources are integrated into the system. The internal components form interconnected synergies which encourage the maximum valorisation of material and energy flow paths.

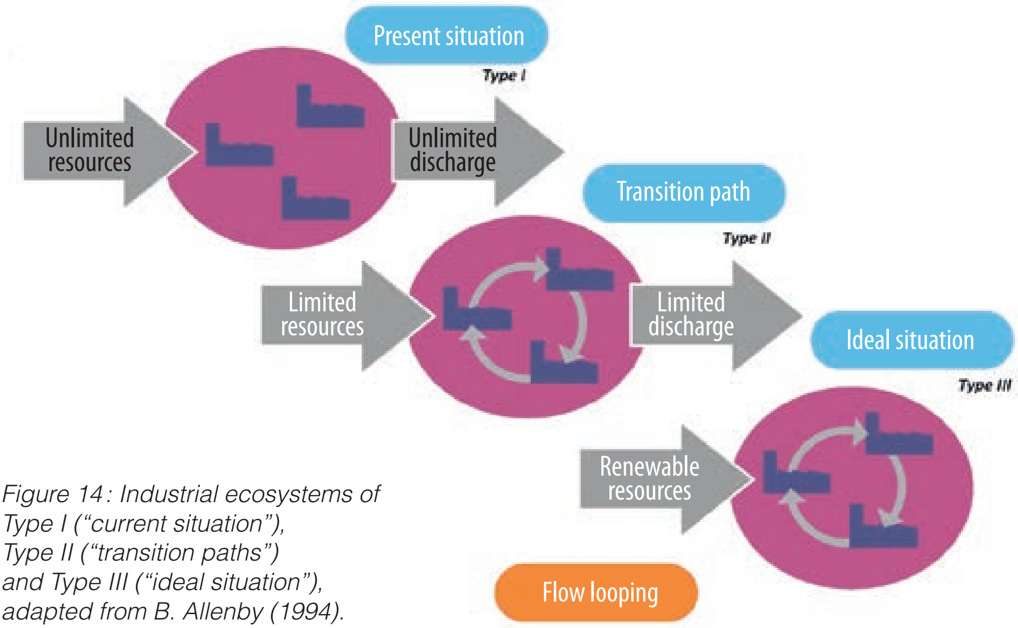

Figure 14: Industrial ecosystems of Type I ("current situation"), Type II ("transition paths") and Type III ("ideal situation"), adapted from B. Allenby (1994).

Thus, in order to improve the sustainability of the current industrial system, industrial ecology seeks to limit the removal of resources and the production of waste, thanks to different principles. One of these, directly inspired by the functioning of eco-systems, consists of looping the energy and material flows as far as possible by developing symbioses known as industrial symbioses. These industrial symbioses allow an economic actor's waste products, co-products and energy losses to become a potentially valuable resource for other actors in other activity sectors. These may be similar or different, such as in the example of synergies between industrial and agricultural activities given below.

Insert 19

From producing renewable energy to producing foodstuffs and biodiversity preservation with Séché Environnement

In Mayenne, a French region of agricultural activity (mainly dairy cattle farming) the organic* portion of household waste has added value when it is transformed into electricity and heat (cogeneration). The biogas methane is converted into electricity (which is sold on the distribution grid) and heat in the form of steam. This production takes place in the countryside and cannot be put to uses such as supplying an urban heating supply system: only localised use can allow the optimal use of the energy value of waste (cogeneration) in the context of industrial ecology. A fodder crop dehydration unit has just been installed next to the energy valorisation unit, allowing a convergence of the interests of local resident stakeholders. A cooperative of about 700 members has just dehydrated its fodder crops (particularly alfalfa, which represents 90% of the feed crop), allowing them to conserve their yields with perfect traceability, and to feed their animals independently of the mowing schedule, thus ensuring the animals' subsistence throughout the year. The dehydration process avoids the possibility of fermentation of the crop and at the same time conserves their nutritional value, thus creating a virtuous circle. This collaboration has resulted in the agricultural cooperative (CODEMA), supplied by the energy from Séché Environnement, receiving the Sustainable Agriculture Trophy from the Minister of Agriculture himself in 2009.

Unusually, compared to most of the French *départements*, there has therefore been a development in the sown crops of alfalfa. CODEMA being authorised to treat organic agricultural products, this development is accompanied by a local reduction in the use of plant protection products. This integration of alfalfa into the crop cycle has led to the reaping of the benefits of its many properties. Its nitrogen-fixing capacity actually limits the spread of nitrates and thus pollution, enriches the soil to the benefit of the other rotation crops, thus diminishing the recourse to fertilisers. Its presence in the fields also reduces water and wind erosion. Due to this, the alfalfa contributes to the protection of the subterranean water resource and to the runoff which is also one of the preoccupations for Séché Environnement's waste storage site from which the biogas is extracted. This environmental and animal feed plant benefits those associated with the territory and busy with this crop, and particularly with Séché Environnement, which considers the plant to be a positive contribution to the company's ecological footprint.

Alfalfa is a bee-forage plant and thus an important element in the local beekeeping industry because, unlike rape or maize, it provides a continuous pollination service. The field within the Mayenne bocage is a refuge for numerous animal species, and so participates in the integrated crop pest control. The fields adjoining the Séché Environnement site create true ecological corridors (within a radius of 25 to 30 km), both around and under the shadow of the waste treatment facility. The differentiated management* structure set up on the site of the treatment facility, with designated areas reserved for the conservation of biodiversity, ensures the perfect integration into nature and the territory of an industrial activity. This is partly due to its by-product, the heat energy used for fodder conservation, that this biodiversity-rich environment is developing and creating a symbiosis between the inhabitants' daily lives (and the production of the correlating waste), the energy-producing industrial activity, and the good management of agricultural spaces.

Another principle of this hyper-industrialised vision of a society founded on industrial ecology is the consideration of the neeed to pass from the current industrial systems, considered to be "juvenile" systems, to "mature" industrial systems which are the only ones capable of following natural ecosystems in creating circular energy and material flow paths. The four major directions in achieving "mature" industrial ecosystems are the following:

- To use waste as a resource whose value can be increased;
- To seal material flow paths and minimise wasteful emissions;
- To dematerialise economic products and activities;
- To reduce CO2 emissions during energy production.

(Buclet, 2010)

To return to the previous analogy, it is a matter of creating "industrial food chains" (Erkmann, 2004) within the "industrial ecosystem" concerned (Figure 15).

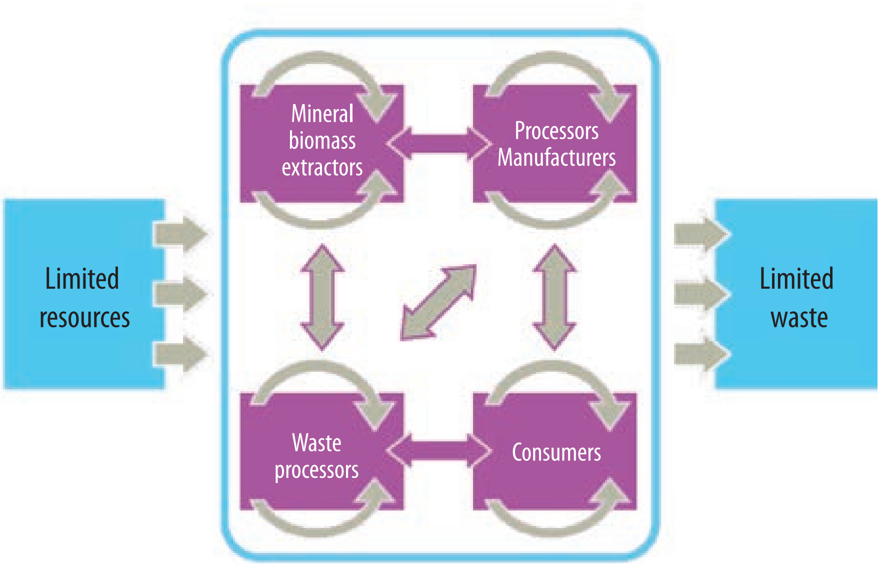

Figure 15 : Schema of an ideal industrial ecosystem (adapted from B. Allenby, 1994).

Industrial and territorial ecology also depends on another principle, called mutualisation synergy, allowing the mutualisation of the supply or treatment of certain waste materials. Such a mutualisation aims to reduce companies' supply costs, the rationalisation of transport and the massification of flow paths which result in a communal management system. Service mutualisations such as caretaking, child care facilities, food outlets and the maintenance of green spaces etc. are also integrated into the industrial ecology, and this often allows for the initiation of a collaboration between the different actors and the development of sustainable development* clauses in certain services, such as a ban on pesticide use in green spaces, organic food in catering outlets, and so on. Detecting the implementation of these synergies requires a precise analysis of the material and energy flow paths (Houdet, 2008).

There are numerous instances of the operational implementation of industrial and territorial ecology at a national level. One could mention examples such as:

- The symbiosis of the famous Kalundborg industrial and territorial ecology project in Denmark. The symbioses were created between the local businesses in a spontaneous manner for economic reasons around several domains: water management, energy savings and reusing waste.
- In Geneva, a law on public action on sustainable development was passed in 2001, and this sets out the legal bases to achieve a cantonal Agenda 21*. Article 12 of this law, entitled "Ecosite", is directly inspired by the notion of industrial ecology. Within the framework of its Article 21*, the canton of Geneva has therefore achieved a metabolism of its economic activities, subsequently formulating a number of hypotheses for integrating the principle of industrial ecology with the management of the canton.

In France, the discipline has been applied for the last ten years or so, and France can now count around forty initiatives which have started up around the territory.

- The first experiment was conducted in the Grande-Synthe industrial estate, six kilometers west of Dunkirk. This initiative is steered by the Ecopal network which was created in 2001 and now has over 400 members: big companies, small and medium businesses, associations and individuals. With numerous mutualisation and substitution synergies Ecopa has become a point of reference for French industrial ecology projects.
- Another reference is the Aube Industrial Ecology Club (AIEC), initiated as a result of several operational synergies. To take one example, the implementation of a procedure for recovering the sand produced during the washing of beetroot by a building and public works company, rather than using quarry materials, and the utilisation of recycled materials for the construction of the motorway bypass which has saved the use of 12,000 tonnes of new materials and a financial saving of 12%.

The COMETHE project (*Conception d'Outils Méthodologiques et d'Evaluation pour l'Ecologie Industrielle*) has been one of the major programmes in France allowing the structuring of the methodology. This programme, financed by the National Research Agency (NRA) and coordinated by OREE between 2008 and 2011, has regrouped a dozen partners from the scientific and economic worlds. Their aim was to succeed in putting in place a methodology and tools to facilitate the implementation of industrial symbioses on a technical rather than an organisational level. To do this, the project was dependent on five French experimental territories: the territory around the Aube, that around Dunkirk, the Metropole Savoie economic area, and the port industry site and business sector in Lagny-sur-Marne. One of the project's deliverables was the creation of an internet platform (www.comethe.org). It consists of an integrated evaluation and decision-making tool for commercial sectors.

Analysis of material and energy flow paths

The analysis of flows necessary for industrial and territorial ecology also respond to a precise objective: the optimisation of material and energy flow paths and the integrated management of resources in a territory. This idea brings us back to the concept of metabolism, and considers that metabolism in human activities must be linked to the metabolisms of living beings.

In a systemic approach, the interactions of the economy with the environment must be considered as multiple positive and negative retroactions between human activities (Joël de Rosnay, 1975).

Territorial metabolism is a diagnostic tool which allows us to identify a territory's problems (dependence, resources, supply, etc.) and to "prioritise actions". The aim is to retranscribe the circulation of material and energy flow involved in human activities, in order to promote resource management between stakeholders on a territorial level.

As Suren Erkmann mentions in his book, "the metabolism approach seeks to provide a quantitative and qualitative reflection of the truly physical dimension of these economic activities, such as the flow paths and reserves which form the substratum of all industrial activity". (Erkman, 1998). It also allows us to systematically characterise the relationships between society and nature, and to analyse territorial pressure on the environment.

Suren Erkman suggests a methodological analysis, to be applied over a geographic perimeter which consists of (Erkman, 1998):

- Establishing an account of the general material and energy flow paths on the territory;
- Identifying the flow of material reserves (resources);
- Retracing the itinerary and the complex dynamics of flow paths (spatial diffusion);
- Specifying their physical and chemical state (pollutants, heavy metals, etc.)

Metabolism studies may be carried out on the scale of an industrial estate (in which case one can talk of industrial metabolism), a town, region or country, but also a business, product, service or procedure. In general terms, the metabolism approach remains identical whether the territory be urban, industrial or territorial. It offers an overall comprehension of the way in which the system studied functions, and brings into view the different interconnections which exist between the entities. It also allows us to locate the great majority of flow paths on which it will be possible to act (Houdet, 2008).

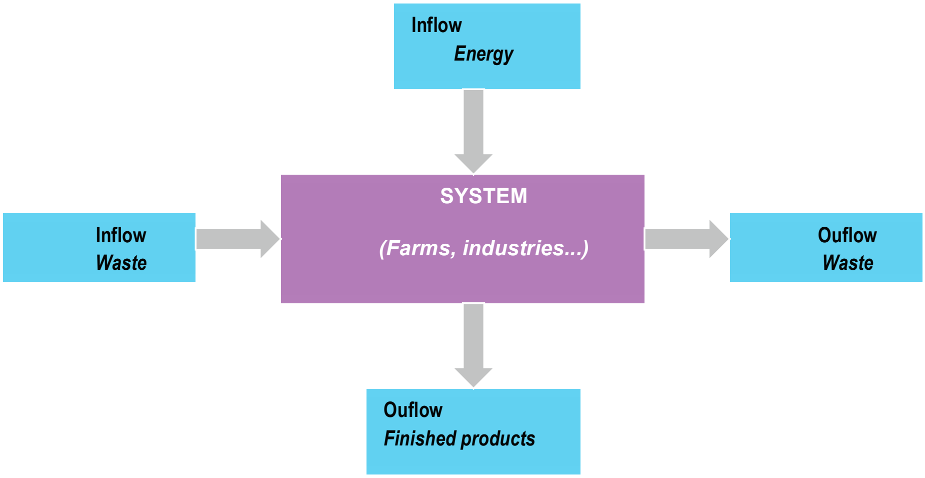

Figure 16 : Simplified diagram of industrial metabolism (Erkman, 2000)

The study of territorial metabolism is thus a decision-making tool for the territorial management of resources. It gives decision makers a better understanding of a territory's potential and the existing interactions between the actors and also the identification of resources and potential risks, such as overdependence in the case of a flow path or the risk of a reserve being depleted.

The implementation of an industrial and territorial ecology approach and the use of various linked tools promotes the sustainable management of resources and thus, on a territorial scale, considerably limits the impact on the environment and on biodiversity.

The ITE approach does not only consist of reproducing natural cycles in an industrial environment but also encourages reflection on the interactions between the system of industrial production and a territory's ecosystem. In fact, the willingness to reproduce natural cycles should not stop at the ultimate capacity for the absolute looping of material and energy flow paths, but a priori respond to needs while favouring the resilience and development of the ecosystems (Buclet, 2010).

On the other hand, it is convenient to analyse a territory's capacity for responding to needs without compromising the access to resources and without endangering the environmental dynamics of other territories. That is to say, putting in place a local management structure which would be adapted to the milieu without causing negative effects on a global scale and allowing other territories to be developed. The territorial authorities therefore have a duty of responsibility to be less and less dependent on external resources, whether on their own territory, the neighbouring ones or those further afield.

Insert 20

Crédit Coopératif: what are the links between monetary flow paths and the circulation of cash in the ecosystems?

The banking sector exercises an essential function in modern economics by supporting, serving and financing economic and social development. If we observe the economic and environmental difficulties with which society is currently confronted, it is opportune to analyse the banking models to determine those which are best conceived to respond to these difficulties. The last five years have known a series of significant challenges to the financial system in general, and to the banks in particular.

At the same time one can see a growing awareness on the part of French banks of their environmental impacts. If their approach remains still broadly centred on institutional promotion, and even on "product" promotion, it has already been translated into concrete actions and sure progress, as emphasized in the Friends of the Earth report of March 2007, "French banks, Fossil banks?". Good practice develops with, for example, the consideration of their direct impacts such as efforts to reduce their paper, water and energy consumption as well as the development of recycling, but also a deepening of their policies of transparence and reporting.

The banks are also gradually developing an approach which integrates their indirect environmental impacts through the "products" they offer. In this way, over and above the offers of "responsible" products such as SRI (Socially Responsible Investments), savings and charitable loyalty programmes, French banks have also developed "green" loan packages, in other words enabling the favouring of responsible behaviour as regards environmental matters. Through their ability, as investors or as credit providers, to finance industrial projects, infrastructures, property and development, the banks have a relatively unique power to influence the choices made in almost all sectors, promoting environmental criteria, and encouraging the emergence of “cleaner” activities which are more protective of biodiversity.

An example of interaction at Crédit Coopératif with their *Agir* account:

Crédit Coopératif is defined as a bank which has long acted in the public interest within the real economy. Sustainable development figures among their strategic priorities. The Bank supports initiatives which aim to preserve biodiversity. It has supported and participated in the structuring of financing the Geotexia methanisation unit at St Gilles du Méné (22).

At the end of the 1990s, a group of farmers became aware of the fragility of the farming model. In questioning themselves on the viability of farming concerns and their environmental impact, they created an association, Mené Rural Initiatives (MRI), which united farmers and non-farmers to think about the problems of slurry treatment. This launched the territorial dynamic and resulted in the Geotexia methanisation project.

It is thanks to the dynamism, investment and doggedness of all those involved in the project, surrounded by experts from the French environment and energy management agency ADEME*, waste treatment industrialists and financiers, but also elected representatives and local organisations which worked collectively, constructively and positively to complete this project, and to make it the pioneering example of territorial community which it is today.

Making use of both the waste materials produced by the food-processing industry and farming waste, this unit allows the co-production of electricity and heat which is immediately reused on site in the exporting of digestate.

The environmental problem comes back to the question of energy, and the unit provides the means to simultaneously:

- Respond to the regulations regarding treatment of farm waste and making best use of the territory’s organic materials;
- Find a solution which is compatible with the farm economy;
- Contribute to Brittany’s energy independence;
- Reduce greenhouse gas emissions.

The methanisation unit is part of the energy plan of the agglomeration of communities which has as its aim “100% renewable energies”. The production of electricity contributes to the Brittany Electricity Pact, and wood chips from short rotation willow coppice spread with pretreated water will be reused in the boilers installed in the nearby communes.

The process of 100% renewable, independent and innovative optimum valorisation is an exemplary collective adventure emplifying industrial ecology at the service of biodiversity.

Operational implementation

There are many motivational factors in the implementation of ITE initiatives: responding to environmental and health risks, thinking globally about the environmental and economic preoccupations of the territory, promoting the creation of new activities and jobs. In a general sense, action develops from the willingness of the actors to be engaged in a collaborative partnership approach (ETD *et al.*, 2013). On the other hand, there are numerous advantages, as much for businesses (reduction of costs, creation of new income streams, improvement of brand image) as for the territory (attractivity, creation of new local non-relocatable jobs, economic development, etc.).

The implementation initiatives of the ITE approaches may be supported by actors from different structures such as business associations, chambers of commerce and industry (CCI), local authorities, economic development agencies, etc.

The implication of territorial collectivities is primordial in the implementation of an industrial and territorial ecology approach. By virtue of a deep knowledge of the territory, local authorities can supply a good amount of information and finance aimed at developing a strategy for looping flow paths.

On the level of implementation strategies, the approaches may vary according to the area and the stakeholder territorial authorities. There are three distinctly different approaches (ETD, 2013):

- **"Strategist" role** (Region, *Département*): the local authority may encourage the implementation of an ITE dynamic on its territory.
  - In June 2013 the Rhone-Alpes Region invited tenders for the recruitment and accompaniment of two territories in an ITE initiative, financing a research consultancy and a dedicated person to run it.
  - On the scale of the Nord-Pas de Calais Region, a global dynamic has been initiated on the territory by integrating the issues of resource preservation, economic potential and innovation.
- **"Organiser" role** (intercommunalities): the local authority may launch and sustainably maintain the ITE dynamic on their territory. This also applies to the 2008 Seine Estuary initiative which involves 26 intercommunalities
- **"Implementation Stakeholder" role** (intercommunalities, communes): as emitters and receptors of raw materials, energy and waste, the collectivities are the potential stakeholders in ITE initiatives.

Within this strategy we can also mention SYDEME, a transport and waste management syndicate in East Moselle, which has implemented selective waste collection, methanisation of organic waste, the valorisation of biogas in the form of electricity, heat and biomethane injected into the natural gas network.

Progression of the operational implementation of an ITE initiative thus goes through several stages (Figure 17).

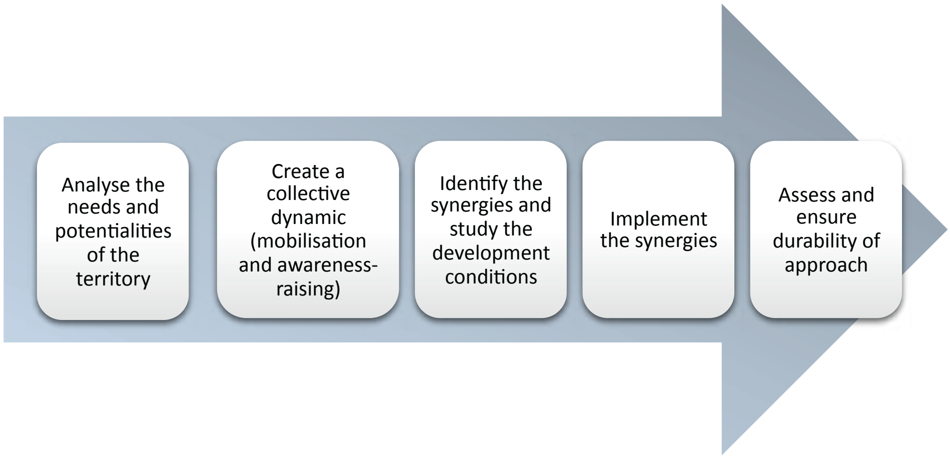

Figure 17 : The different stages in the operational implementation of an ITE initiative (adapted from COMETHE)

The vitality of the territory, the raising of awareness and the imparting of information on the project to businesses, are essential steps which may determine the success or failure of an initiative. It is essential to identify the stakeholders and territorial resources to be integrated into the project, and to mobilise business at the earliest possible stage, so that the majority of them are familiar with the principle of ITE and their interest when the flow study is launched (Brullot, 2009).

The territorial metabolism study is often carried out by a service provider, but may also be done by the main contractor with the help of methodological tools such as COMETHE. Once the territorial diagnostic has been carried out, the report of businesses' inward and outward flow paths must be compared in order to give the most exhaustive view possible of the realisable substitutions and mutualisations; there are IT tools which can be used to facilitate this comparison. The potential synergies which have been detected must then be analysed using different filters in order to understand their geographical, qualitative and technical, quantitative and economic, regulatory and environmental feasibility. An implementation scenario is thus created so that the actions to be put in place over the short, medium and long terms can be understood.

To ensure the long-term nature of the project, mechanisms for follow-up and continuous improvement of the initiative are recommended.

At the present time, one of the principal brakes to ITE development is the lack of communication between the economic actors, who are often ill-informed about their immediate economic environment. Their relationships are more often marked by a culture of competition than of cooperation, and many data remain confidential. That is why the raised awareness and motivation of local actors is a decisive stage. Another widespread brake is the lack of human resources (local organisation) to ensure that the dynamic implemented after the initial research lasts; it is therefore important to anticipate such organisation over the long term. And finally, there are still regulatory curbs which delay and prevent the implementation of synergies which are otherwise beneficial from an economic and environmental viewpoint.

4.2. ECOLOGICAL ENGINEERING

The Ecology Ministry's Terminology Commission[6] defines ecological engineering as "all the scientific and practical knowledge founded on ecological mechanisms and usable for the adaptive management of resources, the design, development and monitoring of projects and equipment". Ecological engineering concerns "the design and monitoring activities, project management and studies promoting the resilience* of ecosystems and relying on the principles of ecological engineering". This section will focus on the discipline of ecological engineering and its advantages, a true philosophy of action.

[6] Created by the ministerial decree of 20 April 2000, this commission is responsible for areas where there are issues with the terminology on the themes of water and biodiversity, pollution and risk prevention, public participation and environmental evaluation. http://www.developpement-durable.gouv.fr/Des-commissions-au-service-de-la.html

4.2.1. A reconciliation between stakeholders and biodiversity

Undertaking an ecological engineering approach means recognising that living systems are self-organising and know how to maintain themselves generally on a sustainable trajectory, even if they are in continually unstable states towards their end. An ecological engineering approach means aiming for an overall stability for the ecosystem, and also having a profound systemic view.

Ecological engineering is also a way of intervening in harnessing the uncertainty of the trajectories and turning it into a biological emergent force. Emergence can be the source of the innovation of which we have such need. To be capable of moving forward within the context of such uncertainty means the ecological engineering knows how to adapt.

Ecological engineering is a philosophy of action which accepts the ecosystem and its own capacities in order to move toward restorations, rehabilitations and other successes. It means a reasoned guidance leading to an optimisation of the sustainability of ecological systems “there where man no longer knows what to do”. The professionals of this discipline are seeking this self-organisation which will ensure the success of their interventions. They have learnt that this success is also a matter of accepting that this means management in the long term. Time is needed for an ecosystem to recover its powers and to self-manage; the ecological engineer knows how to work within this temporality.

Ecological systems are complex systems (Gallagher and Appenzeller, 1999) and wanting to work on their management demands a better comprehension and apprehension of this complexity by the engineer to optimise their efficiency. In reality, the ecological engineer must be able to manage ecosystems in a regime of uncertainties.

4.2.2. Definitions of ecological engineering

The identification of those ecoystems which are most adapted to human needs, and the understanding of their functioning and functions is to be found at the heart of ecological engineering (Gosselin, 2004). The aim is to better use the multiple possibilities offered by the mechanisms and processes developed by the living being, while also respecting it. In contrast to traditional biological engineering, which rests on installations and artificial constructs to eliminate, process and limit pollutants without any contribution from the ecosystem, here the driving force is an ecosystem. Ecological engineering is “a man-made environmental manipulation which uses a small quantity of extra energy to control the systems in which the principal energy forces still come from natural sources" (Odum, 1962).

One could also write that the ecological engineer's strategic goal is "to maintain, and even to promote natural processes with a minimum of human intervention by minimising the collateral effects".

In a more general sense, ecological engineering can be interpreted as being on two levels of intervention: strictly speaking, it consists of the in situ manipulation and steering of ecological systems (which may

be individuals, populations, communities or ecosystems) within an explicit ecosystemic context (such as other organisms or physical and chemical dimensions). In this way, when a watercourse undergoes accelerated eutrophication* due to the accumulation of chemical elements such as phosphates, the quantity of plant plankton explodes, setting off a deoxygenation of the water and a gradual death of the aquatic environment. By introducing fish which themselves feed off other fish, it is possible to re-balance the aquatic food web* and halt the eutrophication* (Hulot *et al.*, 2000).

In a broader sense, ecological engineering designates environmental management and the development of adaptive, multifunctional sustainable developments inspired by (or based on) the mechanisms which govern the ecological systems (self-organisation, increased diversity, heterogeneous structures, the effective use of energy and materials, etc.) (CNRS*, Cargèse Seminar, 2007). A good example of this is the Bergerie de Villarceaux agroforestry* project in the French Vexin Regional natural Park*. This project is the result of a consultation process initiated in 2004, and forms part of two ongoing strands of agronomic research: one on organic cereal systems with no imported animal fertility, the other on old varieties of wheat. In this project, trees are planted between the cultivated plots, and the agroforestry is subject to a long eight-year crop rotation cycle (4 years of cultivation and 4 years of grassland). The originality of this project lies in the fact that the trees are included in the rotation, with 4 years of cultivation followed by 4 years of stock farming, and not on the plots specifically dedicated to stock or crops. The main objective is to study the ways in which agroforestry* can contribute to improving the sustainability of an agrosystem*, through the trees' impact on the fertility of the environment and on its functional biodiversity*.

The definition of the Cargèse Seminar (2007) could extend to the management of socio-ecosystems and the development of territories. The mechanisms which govern ecological systems are then transferred into a broader societal framework and used as such for the sustainable management of the territories.

Ecological engineering thus allows us to respond to many objectives such as the rehabilitation of damaged ecosystems, the restoration of animal and plant communities, the conservation of sustainable ecosystems which are valuable to societies and the biosphere, and the perfecting of biological tools to resolve pollution problems, and to re-establish or maximise an ecological service (CNRS*, Cargèse, 2007).

According to the sociologist André Micoud (CNRS*, Cargèse, 2007), the terms “engineer” and “ecological” form an oxymoron. The word “engineering” is seen through the prism of design, the overall study of a project, in the approach directed towards action and engineering methods, and thus in an action organised in a planned way and constructed on scientific principles. With the word “ecology”, the objective is the sustainable management of natural environments, while respecting or helping ecological processes, and a global acknowledgement of ecosystems. There is therefore a juxtaposition of two paradigms, the one advocating optimisation, anticipation, simplification and decision making (engineering), the other considering that chance plays a part in the issue and is not conceived as a problem (ecology). One analyses the technical problem in a social context, while in the other the stakes and skills for solving it are the domain of ecology and the suggested solutions respect the natural processes or rely on them. Ecological engineering thus differs from other branches of classical engineering in two ways: (1) it is based on an adjacent ethic, in which the preservation of the ecosystem is recognized as having prime significance, and (2) it will be completely based on ecological science.

The originality of this approach lies in the fact that the steering of ecosystems is conceived at the lowest cost from the anthropocentric point of view, and above all as an alternative to those technical approaches whose implementation has more serious consequences. For example, it is more sensible to plant a multifunctional forest which will act as a water filter than to build a water filtration station; in addition, mixing different plant species can optimise this service in places where a water filtration/purification system can no longer do so (such as in the case of emerging pollutants). Zhang *et al.* (2009) have also shown that plant diversity can have a positive influence on the microbial biomass* in terms of water purification.

Since 2004 the National Biodiversity Strategy (SNB*) and its “natural heritage” action plan have aimed to contribute to the maintenance of species and habitat diversity and to the good functioning of ecosystems. The 2010 national wetlands action plan is part of this framework and, in recognising that, along with their commercial, cultural, scientific and recreational value, the ecological function of wetlands is fundamental, the plan emphasizes the importance of halting the degradation of these habitats. There are already solutions to this problem, based on the promotion of effective tools for the restoration* and management of wetlands. Some devices call on ecological engineering, developing the project management and making best use of the biological diversity which is subservient to these spaces and their functions. This is the case with floating islands. These creations are born out of existing natural formations such as floating marshes. Through the diversity of the species and organisms that live there, they will help optimise water purification (Headley and Tanner, 2006). Although not very common, these ecosystems can already be seen over hundreds of hectares worlwide, in countries such as the USA, France, Australia and Romania.

Insert 21

Pur Projet, the management of biodiversity stakes and ecological engineering

Businesses depend on their ecosystems if they are to develop in a sustainable way. This awareness is growing, especially among those businesses which use natural ingredients. If the business does not preserve its resource, it puts its sourcing, image and sales at risk in the relatively long term.

Before even participating in resource regeneration projects, the business' approach consists of evaluating its footprint on the ecosystem (carbon and climate footprint and the use of biodiversity and water in its products and activities), reducing them and then compensating the effects as far as possible via the progressive integration of ecosystemic projects.

Clarins, for example, which sources a number of natural ingredients for the manufacture of its cosmetic products, is fully aware of the necessity of regenerating resources and the ecosystems of their processes. Clarins therefore participates in a number of biodiversity regeneration and preservation projects worldwide.

In the world of luxury goods, the lives of the leading firms' brands are often intimately linked with an agricultural, natural, and often exceptional patrimony, and with its ecosystem, which forms a part of the DNA* of these brands.

Even if preserving the resource and its ecosystem is part of all brands' DNA* it is only done out of necessity. Pur Projet accompanies businesses who are engaged in this movement.

Pur Projet helps its partners in the integration of their ecosystemic projects in line with their processes and their mission, and connects them with their marketing and commercial development issues, for example in product launches, promotions, and developing customer loyalty. The projects they finance are as likely to be reforestation projects, conservation of primary forests and botanical gardens as crop plantations, agroforestries*, or plants for medical or cosmetic use. There are projects in more than 20 countries, in tropical environments as well as in Europe.

The projects are integrative and holistic. They are intended to serve as a model for a world which is richer in biodiversity, which has more interhuman solidarity, and in which there is a more harmonious rapport between Man and Nature.

4.2.3. A new vision for the management of ecological systems

The stakeholders can therefore understand the viewpoint of the ecological engineer who works on the land with the double purpose of improving the ecosystems to ensure human wellbeing, while also protecting them. The engineer has to develop a new set of principles and practices which take account of the variability and unpredictability of these living systems. The principles and practices must be clearly defined and will be applied with the same degree of rigour as any other branch of classical engineering would do.

First of all, what is a complex system? It is a system whose properties can not be entirely explained by a simple understanding of its components (Gallagher and Appenzeller, 1999). A complex system is an ensemble of a great number of entities and mutual interactions which prevent the observer from predicting their retroactions, behaviour or evolution by traditional calculation methods (Parrot, 2002).

Several key concepts are associated with complex systems:

- **Emergence**, which can be defined as "a process in which a collection of interactions will acquire new qualitative properties which would never have seen the day simply through the individual contribution of each of the parties". Emergence has given birth to very interesting dynamics in complex systems such as social order in bee colonies and the development of consciousness in the human brain (Solé and Goodwin, 2000).

- **The self-organisation** of ecological systems, which is connected to a process in which the internal organism of a system, usually an unbalanced system, would automatically increase without being directed by an external source. It is thus the capacity of ecological systems to organise themselves. Emergence is a product of this auto-organization.

- **The different interpretations** of this system. A complex system is often dissimilar at different levels: for each level, given the resolution at which one observes the system, a different model can be conceived to describe the characterisitcs which are to be seen at this particular level (Meyer, 1997) (see chap. 5.4.2.). It is a key concept which has notably given us a better understanding of the many problems connected to the analysis of remote sensing data (Marceau, 1999). It is essential to understand the functioning of an ecosystem. On a detailed scale the ecosystem may have unbalanced structures (the arrival and loss of species at each time-step on a local scale, for example) but which on a broader scale allow an overall residence of this ecosystem thanks to functional redundancy* (Walker, 1992). In an ecosystem there are always several species whose ecological niches are very close, and which can be substituted for one another.

- **The unpredictability** of complex systems on small scales. Complex systems evolve from one metastable state to another. The tendency of ecosystems is to remain generally stable in spite of adjacent changes (Varela, 1974). It is precisely this type of dynamic which allows the prediction of natural ecosystems' long term trends, but which makes it difficult to make precise predictions at more detailed levels.

As Parrot (2012) has written, complexity research has shown that many complex systems share common dynamic and structural properties such as the existence of scaling laws, the appearance of self-organised synchronisation between the system's components, and the emergence of stable energy-dissipating structures.

4.2.4. A new philosophy of action

One of the principal aims of research on ecological complexity is to improve understanding of the dynamics and structure of ecosystems by exploring the similarities between the properties of ecosystems and those of other complex systems[7].

Some of them, such as the notion of scale (Odum, 1996) and a system's capacity for self-design (Mitsch, 1998) are already significant concepts in ecological engineering. Others, such as the instability inherent at various scales and the global stability as well as the lack of predictability of ecological systems, continue to challenge some ecological engineering projects.

In an ecological engineering approach, it is essential to accept the idea of change and, in so doing, to recognise the idea that ecosystems are dynamic systems in a perpetual state of flux. It is an idea which is emphasized in many texts on ecosystemic management and which has led to theories on adaptive management in order to compensate for the associated uncertainty (Walters, 1986).

In an ecological engineering project, one must accept the idea of constant change, always with the possibility of a new type of management on the horizon. In ecosystem management, the challenge for the ecological engineer is therefore to notice whether an unexpected event indicates the eventual disappearance of the ecosystem, or whether it simply corresponds to the continuing evolution of the system. In the case of ecosystems with complex dynamics, it is probable that the best prediction is that which will delimit a set of probable future states and thus provide a working framework.

As a result, in ecosystem management an ecosystem's long-term behaviour cannot be accurately predicted. For example, in restoration projects it is often very difficult to guarantee the success of a reintroduced species (Clewell and Aronson, 2010). The dynamics of the current

[7] Institute of Complex Systems. http://www.iscpif.fr/

species communities may be governed by low-level interactions which give rise to unforeseeable (emergent) results, leading to another exotic species placing this reintroduced species in difficulty (Levin, 1999). Due to the complexity of the interactions between species which occur at local level, it is often almost impossible to predict the structure of the final community of the restored system with any degree of certainty.

So the ecological engineer will instead need to try to understand the system's adjacent forces of self-organisation and work to guide them, allowing the management system itself to evolve in a realistic time frame. It is the aforementioned notion of self-design: the idea of imagining an array of small-scale components which allow the optimisation of the clean organisation of the system in selecting the species which are best mutually adapted, especially to the environmental conditions of the site.

The strategy of ecological engineering is thus becoming the idea of putting together the best conditions for encouraging the system's capacity for self-design. This strategy has been successfully applied within numerous projects, particularly in the notion of "living machines" (Todd and Todd, 1994).

It also presupposes a minimal understanding of ecological concepts.

An ecosystem may have several stable states and these states may play an important role in the maintenance of diversity by giving the ecosystem a flexible structure (Levin, 1999; Holling, 1996).

The management policies which apply fixed repeated rules in the same way in all intervention spaces in order to ensure a sustained yield inevitably lead to an increase in the fragility of the system's structure (Gunderson *et al.*, 1995; Holling, 1996; Schneider and Kay, 1994).

In this way, using ecological engineering inevitably corresponds to a philosophy of action which requires an understanding and an acceptance of the constraints imposed during the ecosystems' constant evolution through natural dynamics. In contrast to the majority of engineering systems, a resilient ecosystem will be able to naturally adapt itself to the development of external factors. A good design will be able to incorporate this elasticity, while at the same time it will be necessary to introduce elements which guide the system in such a way that its global dynamic level continues to respond to the required functional demands. As Holling (1996) stresses, ecological engineering makes it necessary to maintain an "ecological resilience*", in other words a level of disturbance which can be tolerated by the ecosystem before a marked change in its structure. That necessitates, at the very least, the maintenance of a specific diversity (species diversity) and a functional redundancy* on various scales. It is therefore a matter of maintaining a set of species which are different but which share the same function, for example, all the corpus of species which act on soil decomposition: if one species disappears, it is replaced by another which performs the same role within the ecosystem. Peterson *et al.* (1998) suggested that ecological resilience* was generated by several overlapping functions within the same system scale and that this comes about through species redundancy, which in turn acts on several scales. In that case it is a matter of letting species create their own self-organisation on various scales. This means that the role played in ecological dynamics by spatial heterogeneity and ecological diversity cannot be ignored; every ecological engineering project should aim to introduce heterogeneity and to put in place the appropriate mechanisms to maintain this heterogeneity.

4.2.5. Ecological engineering and engineering the future

Ecological engineering is a conceptual framework for envisaging the future:

"The inherent central idea in the long term is that the future is not inevitable, but that it is constructed step by step, that it is not so much a matter of discovering it but of inventing it. In order to construct the future, we must be proactive. Without anticipation, we are left only with emergencies which give virtually no room for manoeuvre. In an exploratory phase, long-term planning attempts to reduce uncertainty in terms of the future, to decode and speculate collectively about possible futures. Then, in a more normative phase, it allows a vision of a desirable future to emerge, as well as the trajectory necessary to turn it into reality, in providing the necessary room for manoeuvre, even if the latter are reduced, little by little, in view of the growing importance of external variables which weigh more and more heavily on the territories' future" (Durance *et al.*, 2007).

4.2.6. Source of inspiration for new business strategies

In the new partnership between humans and biodiversity, the latter becomes an essential actor in all acts of restoration, but for business it also becomes a source of inspiration and innovation. Research into emergence in the dynamics of these community cooperatives may be a fruitful source of solutions to the difficulties encountered in achieving sustainable means of ecosystem management.

In this way the assemblage of particular plant species which lead to the action of specific bacteria seem to be the route to follow for resolving the issue of emergent pollutants (such as copper, zinc and fine particles) in the drinking water (Headley, 2006).

In conclusion, could one consider the self-organisation of living systems to be favoured in all actions as a guarantee of success and of the general endurance of ecosystems? Ecological engineering is the least expensive and the most commonsense way of making savings while resulting in sustainable living systems which will in the end follow their own trajectories.

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Voies navigables de France and managing the Vosges canal

For several years ecological monitoring within the ISO* 14001 certification framework has been realised on the Vosges canal at Crèvechamps, where a hydraulic installation has led to the creation of a mini fish spawning ground*, demonstrating the good functioning of this little spawning ground which is characterised by both its productivity and the diversity of its fish stocks. Among these is the pike, a patrimonial species which is quite rare in such an artificial environment. As this species feeds primarily on fish larvae*, this confirms that the spawning ground is working well. Several loach, another protected species, have also been caught by fishermen. After seven years of feedback to date, the results of this planning demonstrate that it is possible to recreate natural ecological spaces in a canal. In this case, the waterway is simultaneously considered to be a transport infrastructure and also a complete ecosystem which can generate life. This confirms the advantages of developing an ecological approach when designing waterways.

To do this, it seems important to determine during the design stage the state and pressure indicators which allow us to better understand the stress which the operator wishes to remedy in planning the context of the installation. These clues will stem from the response indicators which will allow the evaluation of the performance of the device put in place to respond to the initial context.

In summary, the prevalent idea is no longer to recognise the interest of ecological engineering as such, but rather to better claim it for ourselves by making full use of it in our actions and future relations with the living world.

4.3. MANAGEMENT ON SITE LEVEL: DEALING WITH BIODIVERSITY ISSUES

4.3.1. Why deal with biodiversity issues?

"What a business life is" write Robert Barbault and Jaques Weber (2010).

This link of the living world to entrepreneurial organisation is bijective: businesses are also living organisms and they evolve within diverse and varied ecosystems which are as much economic – which is the first thing to come to mind when thinking of businesses – as human, social and natural. These contexts are not independent from each other but are continually interacting, giving a degree of complexity to the action due to the multifactorial causal links.

To ensure a link between business and biodiversity, certain companies develop exemplary practices with regard to respect for biodiversity and even integrate biodiversity into their strategy. Their initiatives generally stem from a same commitment, but may respond to plural motivations, of which the "communication" component is an integral part (see chap. 2.1.).

The manner in which businesses understand biodiversity stakes varies according to their size, the nature of their activity and the place where they exercise it. A linear infrastructure administrator will have different preoccupations from a hydraulic engineer working for a water supplier, for example. Do they each act on a site on which they are the land managers – and where they therefore have the freedom to act – or are they in the public domain? Do the impacts of the activity remain limited to an agricultural plot or are they broader and more diffuse?

For certain businesses, whose field of expertise has an immediate effect on the environment – in particular those which are CEPF[8] – it concerns their operating licence. They must negotiate with the local residents on the real or perceived impacts of their actions. For others, the major stake resides in the access to raw material resources. They are confronted with the issue of sharing the advantages (see chap. 4.5.). Still others are sensitive to the functioning of the ecosystems which are fundamental to their activity, such as water for example. In this case, their resource is dependent, above other things, on the way in which nature is surface managed, notably in the potential use of pesticides by themselves or others. What they all have in common is an approach which is principally devoted to risk management (see chap. 1.2.2.).

For certain actors, the dependence and impacts of their activity in terms of biodiversity may seem less obvious than for others who extract resources, manage the territory and dispose of waste, etc. They can then tackle the biodiversity stakes by using an aesthetic approach and the preservation of the natural heritage. It is therefore often the ecosystems' cultural services which are foregrounded.

How do the biodiversity stakes permeate the economic models of these diverse businesses? Is it the economy which is instilled in biodiversity, or the other way round? In many cases, the problem consists of "internalising the externalities", in other words to make the businesses assume the financial cost of the consequences of their actions, which until now have been absorbed by the community. With this in mind, 1975 saw the instigation of the principle of "the polluter pays". Since then there has been huge progress in the regulation, and nowadays the logic consists of avoiding, reducing or compensating, the latter only coming into play if the former two have proved insufficient (see chap. 4.4.).

In order to implement this establishment of a hierarchy in favour of biodiversity, businesses draw up their action plans in conjunction with their activities on a given territory. This management is defined in line with local and regional policies and blueprints (such as the Blue and Green Belts) and the classification of zones (protected areas etc.) and species which are currently or potentially protected.

[8] Classified environmental protection facilities – (see chap. 3.1.)

4.3.2. How to implement an action plan?

The 1992 Rio conference: the main points

From global to local

The condition of any plan of action is the mobilisation of knowledge and analyses made in preparation for the initial phases, through the implemention of the various available data acquisition tools (ESR, BBII*, (see chap. 2.2.)). But which conceptual framework should be given to this analysis? And to which purpose should this be attributed? How and with whom can we define the objective to which the ecological transition must lead?

Twenty years ago, in 1992, during the Rio Earth Summit, this subject was discussed on a planetary level, accompanied by recommendations to the States involved to give the measures that the different actors in society would take to local level. The recommendations announced in the “action 21” report are on international and national levels; it is therefore for each actor to put them into effect at their level in identifying actions which could be managed locally.

In proceeding thus one avoids the risk of only taking into consideration the large areas such as those listed in the framework of Natura 2000*, or only to protect emblematic species or those in danger of extinction. It means opening the discussion about nature In its entirety, in daily life, to a biodiversity which is often qualified as “ordinary”.

Invitations to action

Among the measures advocated in chapter fifteen paragraph five of the Rio “Actions 21” report of 1992, some are easily transposable at business level:

- **To preserve** (15-5-G) “to take the measures which may be necessary to ensure the preservation of biological diversity…”;
- **To draw up an inventory** (15-5-L) “the reinforcement of inventory systems…”;
- **To sustainably manage spaces** (15-5-D) “the measures of encouragement which suit the management of pasture and wildlife zones, which exploit, maintain and increase biological diversity…”;
- **To rehabilitate** (15-5-H) “promote the rehabilitation or reconstitution of damaged ecosystems…”;
- **To promote** (15-5-J) “to promote development in the sectors adjacent to protected zones without endangering the environment which can be included in the duration, in order to better protect these zones…”;

- **To encourage** (15-5-M) "to encourage a better comprehension and appreciation of the value of biological diversity…".

Nearly twenty years later, these means of considering biodiversity, its management, its promotion and ways of monetising it are underpinning the aims of the National Biodiversity Strategy launched in France and of which a certain number of businesses, collectivities and societies have already become members.

Their action plans are gradually being subject to labelling by the Minister for Ecology, before becoming realities in the field (see chap. 3.1.).

Application on the ground

Defining the aims and the project

The biodiversity preserved by the business is that which surrounds it every day, and which often passes unnoticed, because it is thought of as common or ordinary by some people, but this biodiversity is the wealth of the territories of tomorrow.

The business integrates a biodiversity section in its strategy, either just as a minimum to respect regulations oror at best because they are convinced of their importance and its contribution as it applies to their own enterprise and/or their image (see chap. 3.1.).

The management of the impact of their activity means paying close attention to biodiversity. This starts with limiting extraction of resources (such as specific consumption of water, consumption of raw materials produced when using waste), a monitoring of disposal of waste into the natural environment (flow surveillance systems, analyses of developments in the biosphere by lichenic bio-monitoring) and great respect for biodiversity (differentiated management* of spaces, integration of industrial premises).

These bio-indicators* among which are lichen analyses which are simultaneously witnesses to air quality and biodiversity, analyses of water for an understanding of aquatic environments, and counting fauna and flora, in species and in number, are the diagnostic tools applied to the evolution of ecosystems, and thus the evaluation of environmental policies led by the business in its natural milieu (see chap. 3.1.).

To summarise this kind of policy approach for the actor in a few main points:

- Preservation of sectors with patrimonial value from the design stage of the project while respecting and maintaining the existing ecological corridors.

- Implementation of monitoring measures to support biodiversity;

- Not dissociating landscapes and biodiversity, in other words integrating landscapes and renaturation into management programmes, elements which unite in enriching biodiversity, by paying particular attention to choices of vegetables, bushes, trees and seeds. Priority will be given to local species;

- Finally the implementation of an adapted management structure for natural sectors notably through differentiated management*, a tool which determines the means and the timing for the maintenance of protected natural zones and the nearby zone.

Forward planning and long term commitment are the keys necessary for having a sustainable positive impact on a natural environment. The coordination of this can be entrusted to an ecologist.

The aims will obviously be according to the specific context of each business or farming enterprise. The projects will often share a particular regard to the actions which will allow them to fight against the erosion of biodiversity of which they may be the perpetrators, in general terms (see chap. 1.1.4.):

- Artificialisation of surfaces;

- Overexploitation of natural resources;

- The fight against invasive species;

- Actions against environmental pollution;

- The fight against climate change.

The balancing of these criteria will vary according to the sectors of activity, but generally they will be minimally present or entirely absent. Some of them, such as the fight against climate change, are sometimes the object of specific policies through regulation on greenhouse gas emissions. In this way, Article 75 of Grenelle law 2 insists that over certain thresholds businesses and local authorities achieve and publish a Balance of Greenhouse Gas Emissions (BGGE) accompanied by a three-year plan of action to reduce their emissions. It is similarly the case for actions to prevent pollution of environments with which a framework of specific legislation is concerned.

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Maintaining spaces for humans and biodiversity: the land use plans of Séché Environnement

In the spirit of sustainable development* of the environmental policy of Séché Environnement, there is no alternative to choosing a differentiated spatial management structure. Thus the natural zones are maintained with a light touch so as not to disturb the current biodiversity. The maintenance is adapted with regard to the type of environment and preserves the natural zones daily and in the long term.

During the establishment of the landscape blueprint of each storage site of the Group, natural zones typical of the local landscape have been preserved. These voluntary natural reserves have been qualified as being within the sensitive ecological zones (SEZ of 15% of the total site surface on average). They allow the maintenance of a "pool" of endemic* biodiversity thus guaranteeing that the local landscape identity is safeguarded.

In order to attain this objective of differentiated management*, among the actions implemented in favour of biodiversity, one must mention:

- The creation of wildflower meadows on the slopes and visitor sectors through an appropriate choice of seeds, thus making these zones visually attractive while developing environments which are friendly to pollinating insects;
- The choice of bushes and berries in planting programmes, to feed fruit eating birds;
- The conservation of meadows and pastures to maintain varied biotopes*;
- The conservation of wood and dead trees during maintenance, because these provide a supply of trees and food for insects, microfauna, and certain tree-dwelling bats and birds nesting in this type of habitat;
- Maintaining grassed areas by mulching, in order to fertilise the lawn with grass clippings, which avoids drying out of the soil;
- No plant protection products.

This space management, which is respectful of biodiversity, is translated into a conservation of the biological patrimony already present in these areas, and may eventually allow an increase in the diversity of flora and fauna in the protected or rehabilitated zones.

To judge the effects of this management, phytosociological monitoring (studying the evolution of plants in an environmental context) is specifically carried out with a readability of the results in the long term.

The sensitive ecological zones as well as the natural zones are afforded a late mowing, the resulting organic matter* later being exported; this practice guarantees that the wildlife is not disturbed during its reproductive cycle and favours the maintenance of biodiversity. There are fewer mowings and certain areas are left as pasture and wetlands are used as biodiversity.

In order to re-establish an exchange of material beween species, these protected zones are connected with the other rehabilitated sectors and the neighbouring territories. In this way true ecological corridors are created. These continuities allow the animals to cross the site and encourages population exchanges (genetic mixing* which favours the maintenance of biodiversity).

Drawing up an inventory of what is in place and creating preservation tools

Identifying the ecosystems present on the site and the species which populate them

Every initiative starts with an inspection of the place, an inventory of the flora and fauna present on the site. It generally takes over a year to get to know the natural richness over the course of the seasons, and to be as exhaustive as possible. This approach which is made by animal species (amphibians, Odonata, Chiroptera, mammals, etc.) and plant species corresponds to the administrative demands in the framework of impact studies (see chap. 3.1.).

These inventories correspond to a study of sensitive points in the environment and notably:

- local bird life at the end of the food chain is an indicator of the availability of food resources and habitat quality;
- amphibians are bio-indicators* of chemical pollution;
- Chiroptera are sensitive to chemical pollution (such as pesticides and household products) and light pollution;
- Odonata are witness to the general quality of an environment (habitat, food, vegetation, etc.) (see chap. 2.1.3.).

In order to construct a “biodiversity” policy limiting oneself to one species-based entry is nevertheless too restrictive, and the analysis must be extended by taking a census of the ecosystems present on the site, their functioning and their connections between themselves and with the world outside the site (the idea of the ecological corridor) (see chap. 4.1.1.).

It is interesting in this context to position the site in its host territory to be able to compare its own biological richness to that of the region of location. Carrying out inventories according to recognized scientific protocols will allow this confrontation in space and time to measure its evolution relevant to external reference points which are if possible not subject to or very little affected by the conversion of open spaces, landscapes and natural environments by human action such as natural parks. Such is the case for the local birdlife with the TMGB (Temporal Monitoring of Garden Birds) programme of the National Museum of Natural History (NMNH*) (see chap. 2.1.).

Analysing the state of ecosystems and the way in which they risk being impacted

Once these ecosystems have been identified, it is useful to conduct a study on their initial state, and then to use simulation to superimpose the impacts of the considered industrial or commercial activity to calculate their potential effects. Is it necessary to cut down a forest, and what are the consequences of this? What services are provided by this forest? Is it necessary to fill in a pond to provide access routes? There are so many questions to ask.

In the case of artificialisation, one will always have to ask about the management of water and this must be considered in conjunction with the different erosion mechanisms (see chap. 1.1.): for instance, once the rain water of a proposed supermarket building has been collected, is it returned to the environment or reused in order to reduce the “water footprint” of the project? In the case of heavy rainfall is there a potential risk of flooding or, conversely, the drying out of wetlands due to overly rapid drainage? The answers may stem from such analyses, and lead to a reassessment of certain aspects of the project, as in the case of grassing over the roof which will not only affect the regulation of stored/released rainwater but will also have insulation properties as well as a visual impact which allows the building to be integrated into the landscape.

There are also very diverse aspects to study of which some are sometimes little known: it is more usual to think about preserving habitats for the birdlife of the region or Chiroptera than to ensure the absence of light pollution. But a sight which is always too brightly lit will disturb the diurnal cycle of the latter (which are a protected species), and therefore their development. For the same reason birds may be led to move because the insects on which they feed are attracted by light spots where they burn themselves. In the absence of a food supply the birds will go to nest elsewhere.

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Identification and valorisation of the interdependence links to biodiversity on the Occitanis site of Veolia

In order to enrich the thought processes on the different methodologies, to identify its directions of action and to dispose of duplications in practical cases, Veolia evaluates the effective deployment of these methods through the realisation of case studies in the different environmental services which the Group proposes to its customers. In this way the Group carried out a case study in 2012 on its Occitanis centre for the storing and treatment of dangerous waste located in Graulhet, in the Tarn region of France. The objective was firstly to identify the principle ecosystem services with which the site enters into interaction and then to evaluate the associated costs and benefits.

To identify the links of interdependence of the site to biodiversity, three complementary methods have been used: firstly, all the inward and outward flow paths of the site throughout its four phases of life (construction, exploitation, urban redevelopment and post exploitation) have been identified. Then it was decided to bring together two more global methods, the Business Biodiversity Interdependence Index (BBII*) and the Ecosystem Services Review (ESR). These tools have allowed the identification in broad terms of the principle ecosystem services linked to Occitanis:

- Fresh water supply service: two types of water (excluding use of the water tables) are available on a storage site: this comes from leaching and rainwater which is collected in basins. This water has all come directly or indirectly from precipitation, and (rather than extracting drinking water from the network) it is used for running the stabilisation unit which treats certain waste before it is stored; this represents the highest level of water consumption on the site.
- Erosion regulation and pollination services: these are essential to the good maintenance of the storage infrastructures: the perennity of the plant cover of the cells of managed waste plays an important role in the maintenance of the watertight unit.

- Cultural leisure services and ethical values: the harmonious integration of the site into its territory depends in part on the local societal acceptance of which the image conveyed by the site is a strong component.

Next, all the actions realised since the opening of the site in 2002 and connected more or less strongly to biodiversity have been evaluated and classified under six broad categories. For each of them, one or several functional microsystems synthesising all the site's interactions with its environment, and notably the ecosystems, have been developed. Then, the totals associated with each of these evaluated actions have been considered in order to be able to evaluate their costs and benefits. Since many actions were carried out by the site employees, the costs of staff dedicated to these actions have been integrated into the analysis.

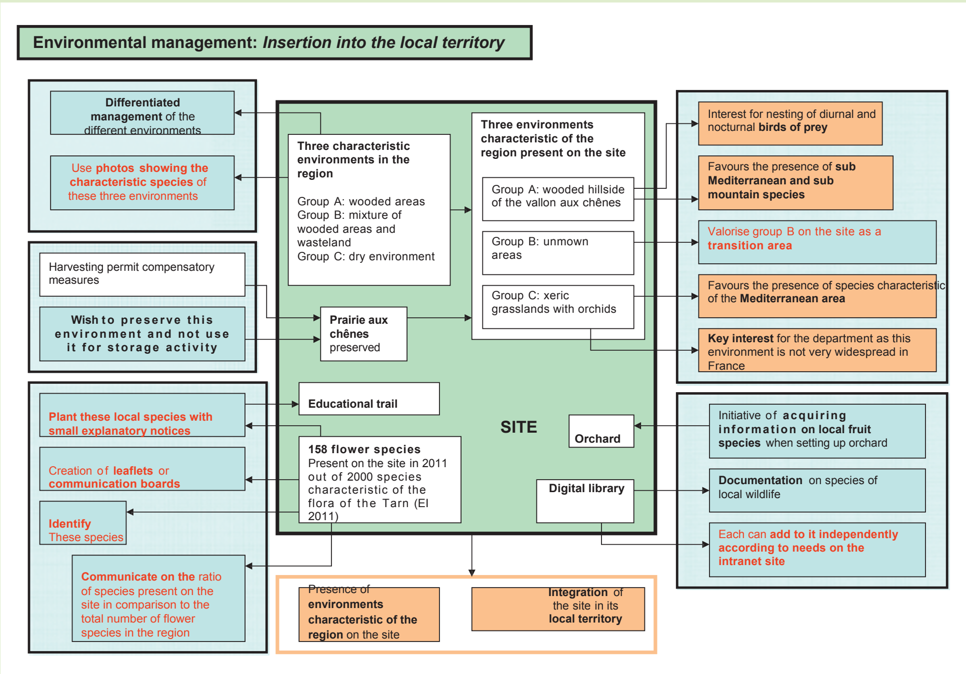

Figure 18: Example of schematisation in microsystems of the insertion of the Occitanis site into its environment: Interdependence with biodiversity and the actions envisaged

The results of this study show that:

- Most of the expenses allocated to biodiversity management are the actions which are directly connected to the treatment and storage of the site waste. This observation may notably serve as an encouragement for the administrators of similar sites in giving them paths for improving their biodiversity management. It may also show external stakeholders that an activity which in fact is not intended for biodiversity management leads despite everything the actions which are connected to it.

- The voluntary actions directly identified as “biodiversity” (e.g. nest boxes, pastures, differentiated management* of green spaces) represents a minimal part of the expenditure linked to biodiversity.

- The measurable benefits drawn from the ecosystems are linked to the site activity: it is in particular a matter of avoiding costs thanks to good water management, and thanks to the on site reutilisation of water to support the vegetation of depolluted land by the centre’s depollution unit.

On the other hand, the non-monetisable benefits remain difficult to identify and even more difficult to valorise. They have only been treated here through a qualitative analysis and their quantification with the aim of integrating them more systematically within the decision making processes and the businesses’ strategies remains the main risk.

The method developed is intended to be transferable onto the Group's other sites which practice the same activities. The fact of having conducted this study on a particular site implies that the analysis integrates limited actions in this precise place. One must also ask questions about the nature of the actions implemented on other sites. Will these implement the same actions as Occitanis? Or rather might we find similarities in the organisation of actions conducted in favour of biodiversity on one site so as to bring together the six themes identified in this study?

So two points remain to be followed: to evaluate the transferability conditions of the method and results, and to improve the quantification of non-monetarisable benefits.

Analysing the business's degree of dependence vis-à-vis the good functioning of these ecosystems

In return this poses the question of the dependence of the project regarding biodiversity. (see chap. 2.2.1.).

The necessary preservation of the well-fields of drinking water is a good illustration of this, as is the contribution to the treatment of used water of technologies implementing "green purification stations" in which plants ensure a capture phase of residual pollutants (see chap. 4.2.6.).

This aspect will be particularly important for projects which draw a significant part of their supply resources from ecosystems such as the cosmetic and pharmaceutical industries, the food processing industry, etc.

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Identifying and quantifying interactions between the Écopole of the community of communes of the Oléron island and biodiversity.

During the course of the Oléron/Inddigo study, the material flow paths coming from biodiversity were compiled as follows:

- A list of all the material flow paths linked to the activity (inward/stored – immobilised/outward) during the construction and functioning phases of the Ecopôle.
    - A List of materials used for construction, necessary machinery, and waste produced;
    - An Analysis of input materials needed for the activity (raw material and energy) as well as outward flows (products and waste) starting with the balance sheet.
- A selection of material flows from biodiversity and categorisation of inflows and outflows.
- Links with a potential financial transaction.

In order to identify all the ecosystem services in regard to the activity, the following elements have been used:

- The material flows concerned by one or several ecosystem services, in terms of dependence or impact;
- A list of the ecosystem services of the Ecosystem Services Review (ESR) and classification of ecosystem services according to their categorisation as a supply, regulation or cultural service.

In order to quantify the interactions between the activity and biodiversity, these have been divided according to their influence, their sensitivity and the type of management to which they are subjected. The different ecosystem services have therefore been integrated into a table:

	Ecosystemic service impacting the activity	Ecosystemic service sensitive to the activity
Managed service	Managed impacting service	Managed impacted service
Non-managed service	Non-managed impacting service	Non-managed impacted service

To analyse the interactions between biodiversity and the economic system of the business, the different ecosystem services identified have been classified following the revenues generated or the costs incurred. This has been done using the balance sheets of the business.

To summarise, to identify and establish a hierarchy of the different stakes involved in the relations between living beings and the business, so as to allow the selection of the most pertinent actions, different departments were questioned:

- Among the managed services:
  - Do they have a positive or negative impact?
  - What are the possibilities for improvement?
- Among the non-managed services:
  - Which ones could they be?
  - Why aren't they?
  - Is it possible to modify the contractual model for those services which are not concerned with the financial transaction?

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The question of biodiversity management by Saf agr'iDées on a farm site

In order to remain as operational as possible, Saf agr'iDées adopted a bottom-up aproach: it is possible to generalise by sector using the particular case of one farming enterprise. This farming enterprise is the Agricultural Civil Farming Society (ACFS) of the Hermitage, a farm of 420 hectares in the Picardy basin. The business is composed of a farming unit, where equipment and products are maintained and stored. Its products are: common wheat, beetroot, malted barley, winter barley, onions, industrial potatoes and potato flour, green beans, broad beans and rape. The ACFS Hermitage enterprise employs on average 3 HWU (human work units), the activity is seasonal and most of the work takes place in the summer.

An analysis of material flows has been realised around the farm. By material flow we understand this to mean all materials, whether resulting from biodiversity or not, which enter and leave the farming enterprise. However, we are more particularly interested in the biodiversity flows and we will include in these the products resulting from organic* chemistry, such as pesticides, oils, fats and certain fertilisation products. The consumption of these material flows occurs on the farm unit (for the product used in the maintenance of the machines) and on the plots of land (for the products used in the maintenance of crops and earth). There is therefore always a two way process between the farm unit (storage facility) and the plots (sites of production).

The material flows resulting from biodiversity may be classified in five types: bought input, revalorise input, natural input, output products and residues.

The management of services may be represented in four categories with the migration of services according to their degree of management (self-assessment according to the measures taken within the farming enterprise studied and the optimal operational management). The arrows represent a possible future of some of these services (e.g. openness to the carbon market, commercialisation of alternative means of control, remuneration of the reduction of flooding risks, etc.). It is therefore a dynamic graph which can subsequently be rescaled according to the financial transactions and the degree of management of each of these services (Figure 19).

Management of services

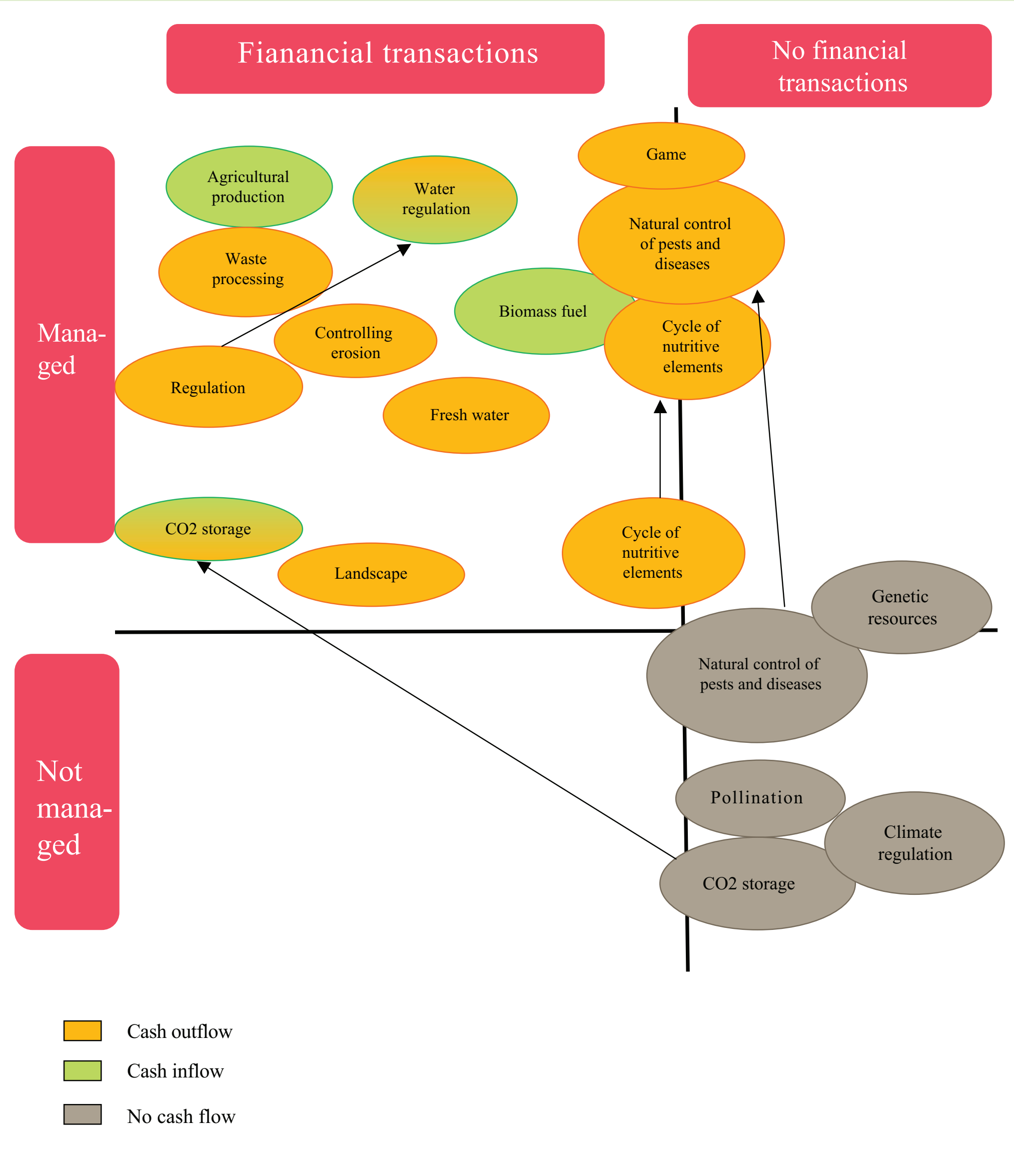

Figure 19: Representation of ecosystem services according to their degree of management

Considering the resilience* aspects over and above the simple activity of the business

All of these analyses and simulations allow us to produce a fairly comprehensive overview of the impacts of biodiversity activity of a project's location site. These facts will make it possible to review the initial project in order to minimise the impacts and preserve the biodiversity.

This type of approach is a long term one because the site evolves with a natural rhythm. The landscape plan must integrate all the envisaged future developments of the industrial activity in order to integrate it from the earliest stages of the overall plan.

The superposition of industrial installations and their infrastructures onto the existing ecosystems allows the best positioning of the constructions on the site. The understanding of endemic* species of fauna and flora, in the light of the surrounding land, allows the drafrint of a "landscape blueprint" which will guarantee the long term integration of the site into the local landscape.

In a bocage landscape, we take care to follow the curve of the peripheral hedges in order to avoid a visual break where the property ends. Quite apart from the simple phenomenon of visual perception, this continuity will also ensure the continuation of an ecological corridor allowing animals to move freely and under cover (see chap. 4.1.1.).

Creating "nature reserves" of preserved zones

To allow biodiversity to re-conquer development sites, it is essential to preserve the zones which are particularly rich in biodiversity – the wetlands in particular – which will be the reservoirs of endemic* species.

These zones which the industry protects are not a result of protection legislation but are freely made into a sanctuary for the preservation in the first instance, rehabilitation with local resources in the second instance, after the works have taken place.

The identification of these zones, and the acceptance of their protection which anchors the industrial activity there by freezing its use, are serious general policy actions which are decided at the highest level of the site hierarchy. In order to be fully effective, these actions and their purpose must be shared with the farmers working on the land to ensure that they subscribe to the project, which is an indispensable condition of its success.

These zones mean that a "breeding ground" of endemic biodiversity* can be maintained, thus guaranteeing a safeguarding of the local landscape identity.

In order to "restore" an exchange of material between species, these protected zones are connected with the other rehabilitated sectors and neighbouring territories. In this way true ecological corridors are created. These continuities allow the animals to cross the site and promote population exchanges (genetic mixing* favourable to the maintenance of biodiversity) (see chap. 4.1.1.).

This approach includes a strong pedagogical element in terms of biodiversity knowledge and it comprises an important element in a federated business culture built around common values (see chap. 2.1.1.).

Managing the different stages of the work

Understanding the temporary nature of certain impacts

The periods during which the work takes place have a serious impact on biodiversity because they occur over a vast area which is greater than that of the final project in its strictest sense. This is the phase during which habitats are modified. There are also certain environmental hasards which are specific to heavy construction, such as earth moving and the dust which results from it, as well as the noise of traffic and heavy plant movement.

It is important to minimise the impact of this activity; by providing skills support (either internally or using external experts) and by putting strict limits on the areas on which the work takes place:

- By anticipating certain animal movements (by taking plant samples and growing seedlings in nurseries; moving nests and supplying nest boxes; fishing and re-implanting fish into a nearby aquatic environment; and even preserving species by installing hatcheries, as was possible im the case of crayfish on a planned motorway in the Jura);
- By using palliative measures (watering to avoid dust being blown away, broad protection of trees, etc.);
- By scheduling the work according to the reproduction cycle of certain species which nest on the site.

Bringing together the stakeholders

Understanding the temporary nature of certain impacts

This phase of the work triggers a fundamental modification of the landscape: its original state is transformed by the presence of activities and the changes are in general very visible and may create a certain anxiety among residents. It is therefore essential to have engaged in a dialogue beforehand.

The fact of having brought together the stakeholders in creating the inventory means they can be involved in the project as it is realised. In this way, Séché

Environnement, for example has strong collaborations with associations such as the *Ligue pour la Protection des Oiseaux* (LPO[9] – French Society for the Protection of Birds) and *France Nature Environnement* (FNE)[10]. These associations will then be independent observers overseeing the monitoring of the compensatory measures* implemented to limit the impacts of the construction work. By means of the available feedback from similar construction projects, they will also be able to analyse the transitory aspect of potential damage during the construction phase, and the duration necessary for resilience*. The tools for counting species, such as TMGB for the local birdlife, have allowed a very logical observation of a reduction of richness during construction work followed by an eventual recolonisation, with the help of support measures and thanks to the gradual rehabilitation of the progress of the work.

The tools for measuring the impact on the landscape (as a percentage perceived from a point outside the construction area site, in rehabilitation, laid to grass, being replanted, etc.) are also very useful for managing the visual impact of the project and in explaining its development to residents. But other methods also exist which are based on the willingness to pay (see chap. 1.3.1.).

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An economic evaluation of a complex environmental asset on an EDF site: the improvement of the richness of the Rhine fish stocks

In order to reinforce its competence in the monetary valorisation of the environmental costs and benefits, EDF has commissioned a study from ACTeon[11], in partnership with the National School of Water and Environmental Engineering in Strasbourg[12], on the economic evaluation of an improvement of the piscicultural richness in the Franco-German upper Rhine basin. This methodological study is included in a series of applications conducted by EDF for testing different methods. In this particular case, it is not a matter of developing a particular activity linked to water or to a particular species, but rather to make a general assessment of the value which the study area population accords to a complex environmental asset: an improvement of the richness of fish stocks (a mixture of all species).

[9] http://www.lpo.fr

[10] http://www.fne.asso.fr

[11] ACTeon is an advice and research consultancy specialising in developmental support - http://www.acteon-environment.eu/

[12] beatrice.hutlet@gmail.com

This value integrates the usage values (given to the improvement of usage conditions influenced by the piscicultural richness such as fishing and public rights of way) and non-usage values (given, outside all present activity, to future uses or to the sole existence of the piscicultural richness). The field of study takes into account the whole of the Franco-German upper Rhine basin because it includes all of the principal course of the Rhine, its main tributaries, and the abandoned river courses, polders and flood expansion zones. The consideration of a hydrographic network such as this (rather than of a particular water course, stretch of river or body of water) is one of the features of this study which affects each of its phases.

For this study the Contingent Valuation Method (CVM) (Hanemann, 1994)[13] has been chosen in order to understand the value given by the population to the improvement of the piscicultural richness (combining all species and habitats) over the whole of the cross-border hydrographic network (see chap. 1.3.1.).

In the face of the difficulties linked to the particularly complex application of the CVM the challenge was to test the means of minimising the methodological biases inherent in the method, and this was done in order to improve the robustness and coherence of the results. That is why the protocol phases of application of the CVM have been proposed and tested (through mobilising technical experts, targeting work on the development of the questionnaire and supporting documents, and the organisation of specific tests to ensure greater public understanding).

In terms of results, the study gives us a detailed view of the perception of people who were asked for their views on the state of the Rhine and its fish stocks. Among the environmental issues raised, the deterioration of water resources and the disappearance of species are not the most important issues for the people surveyed. Concerning the Rhine in particular, 12% of those surveyed consider the river to be "in bad health" (The criteria being defined by those surveyed as including the presence of fish, the diversity of animal species, the degree of plant cover and the appearance of the banks). The survey reveals a rather pessimistic view of the state of fish stocks in the Rhine and its tributaries: 53% judge their state to be middling to bad and only 25% consider it to be good or very good. This state is essentially attributed to chemical pollution of the water. On the other hand, concerning the willingness to pay (WTP), nearly 60% of those surveyed say they would accept financial responsibility. The average WTP of the Franco-German

[13] Hanemann, W.M., 1994. Valuing the Environment through Contingent Valuation. *Journal of Economic Perspectives*, Vol. 8, No.4. p19-43 (see chap. 1)

sample falls within a bracket of 30 to 37 Euros per household and per year over ten years. According to the approaches tested, there is a significant risk of over- or under- estimation of the WTP (approximately +/- 30%).

The main benefit of this study is to show that a rigorous implementation of the CVM allows us to improve the reliability of the results in a complex context. The essential point is the maximum development of the preparatory phases in order to take into account potential bias right from the design phase of the study. The challenge has been to construct and optimise a questionnaire based on the scientific knowledge of a panel of experts which would be comprehensible and acceptable to the public. It has been a matter of identifying the necessary elements of knowledge and formulating them in such a way that the people surveyed would be involved in the contingent valuation, and could construct a WTP which best reflected their preferences. Another important aspect has been to design the questionnaire in such a way that it allows us to better understand the perceptions, knowledge and behaviours of the people surveyed, and above all the influence of these factors on the expressed willingness to pay. This preparatory work leads to an improvement in the trustworthiness of the results. The main study limits are found at the level of the econometric analysis of the results, and in effect, the predictive capacity of the different models tested remains weak. This is relatively disappointing given the level of preparatory work but is similar to what we observe in general in the literature.

The analysis of the study results in a cross-border context is also enlightening as regards the practice of value transfer method. That is in a context in which this CVM is being used ever more frequently to support the decision making in the field of environmental economic evaluation. In fact the study confirms the reservations on the robustness of the transfer methods.

Séché Environnement© and their tool for landscape impacts

The monitoring of the landscape is intended to transcribe the subjective notion of the activity's visual impact. A self-monitoring of practices is integrated into the methodology, and the results obtained allow the reprioritising of the possible courses of action.

The evaluation is made through a biennial photographic record which gives an understanding of the different "visibility windows" between winter and summer. As the notion of visual aestheticism is very subjective, the analysis is based on the visible proportion compared to the total aspect of a site from a given point, using five criteria relative to the activity on the sites[14].

- Visibility of the waste;
- Visibility of the harvesting zone;
- Visibility of the earthworks and site materials;
- Absence of final landscaping such as grassing over or planting trees and shrubs;
- Lack of maintenance: "weeds", unused materials, environmental scarring, etc.

In order to be representative, monitoring must allow the evaluation of every facet of the storage sites but must also be representative of the view which someone would have passing the site on foot or in a car.

Anticipating and supporting nature's reclamation of the site

Implementing a differentiated management* structure

Once the sites are being farmed, it is useful to manage them in terms of the shareholders' expectations throughout their lifetime. While carefully tended gardens such as lawns and rosebushes are still often welcome on staff reception areas around offices, and inspire a certain form of trust by the care which is afforded to them (see chap. 2.1.7.), it is possible to think about the areas surrounding industrial spaces and ecological preservation zones in different terms.

Starting with an initial assessment of the area, with a detailed description of the fauna and flora, the landscape blueprint specifies the tools, methods and schedules for the interventions on a given sector, as well as the long-term monitoring by which the results can be measured in terms of biodiversity. It is addressed in particular to the ordinary biodiversity* of the sites.

The natural zones are lightly maintained so as not to disturb the biodiversity present. Maintenance is adapted according to the type of environment, and preserves the natural zones both on a day-to-day basis and in the long term.

[14] Example drawn from the good practice guidelines of Séché Environnement

The sensitive ecological zones as well as the natural zones undergo a late cut and the organic matter* is later exported, thus guaranteeing that the wildlife is not disturbed during the reproduction cycle and favouring maintenance of the biodiversity. The mowing periods are reduced, certain areas are put to pasture, and wetlands are used as resources.

Differentiated management*

The implementation of differentiated management* is an important aim, particularly for larger areas. These maintenance techniques and the programming of green and natural space management are respectful of site biodiversity, and focus on three objectives:

- To optimise the management of green and natural spaces;
- To keep a good visual aspect of the sites;
- To limit the use of plant protection products.

These techniques bring into play the restoration* of wetlands, late cuts, non-traumatic means of intervention, and conserve certain elements of the landscape such as a dead tree which may be a nesting place or shelter for certain animals such as rodents, and which will eventually become food for other animals such as insects when it decomposes.

Integrated biological control

The framework of biological control means using, for example, lacewing larvae for the biological protection of certain plantings. Lacewing larvae naturally devour most garden pests: such as aphids, thrips, acarids, whitefly, soft cochineals and Colorado beetle larvae. This practice provides:

- Health protection for employees and the public;
- Respect for the environment by limiting phytotoxicity;
- Efficiency against certain recalcitrant parasites (e.g. cochineal);

Biological control of insect pests most often consists of breeding and then releasing predators or species which will compete with these pests in order to limit their population density and their damaging effects. This technique has sometimes shown itself to be very effective, as is illustrated by the release of Trichogrammae intended to neutralise the incidence of the corn borer without attempting to eliminate it through pesticides or genetically modified cultivars*. Certain pests can also be attracted and trapped by pheromones, thus preventing them from laying eggs on their usual host plants. However certain technical difficulties still make the general use of such practices problematic today (Wäckers F. L. *et al.*, 2007). “Integrated” control against pests should not be considered to be the only juxtaposition of biological control with the diverse forms of chemical control, but should rather form an integral part of all the techniques intended to regulate the environment of these pests in order to limit their numbers and their potential damaging effects. Such a systemic approach, which is destined to ensure the best crop protection by conserving the maximum biodiversity, still often comes up against our deficient understanding of the functioning of agro-ecosystems* (Deguine, J-Ph. *et al.*, 2008).

Finally and most importantly, we note that the presence of a rich biodiversity limits the recourse to biological control because birds, natural predators of the insects, and competition between insects limits the development of parasites.

Pastoralism

Pastoralism limits human intervention, avoids the enclosing of environments and therefore avoids the loss of diversity particularly linked to the lack of light. This extensive grazing responds to both the aim of sustainable development* and economic management.

It is also useful to conserve, safeguard and promote threatened farmyard breeds (goats, sheep, chickens, etc), to develop the utilisation of these breeds, to maintain open natural environments and to sensibilise the public to the need to safeguard this living heritage.

Recourse to a heritage pastoral system on a Séché Environnement site

On the Changé site, maintenance through the grazing of hardy domestic breeds such as Highland cattle and the *“chevres des fossés”* (goats from Brittany and Normandy) completes the system of biodiversity preservation and conservation on the Séché Environnement sites. This extensive grazing responds to the two aims of sustainable development* and economic management.

The Charnie Conservatory is a French association which is an exclusive partner and indispensible to this experiment.

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This experiment has an exclusive and indispensible partner, the Charnie Conservatory, a French association whose aim is to conserve, safeguard and promote threatened farmyard breeds (goats, sheep, chickens, etc.), to develop the use of these breeds to maintain open natural environments and to raise public awareness to the need to safeguard this living heritage. It has graciously put at the disposition of the Changé site groups of *chevres des fossés*, a hardy and (ordinary) breed of

goats which were previously very common and which, due to lack of the spaces and the resources they need, are now becoming scarce. In order to participate in the preservation of the breed, Séché Environnement introduces males and females in alternate years, leaving the genetic management to the association concerned. In return, the presence of these animals helps the company to achieve three of the objectives of sustainable development*.

Means Economy implemented by the management of the site and nature preservation.

An industrial site, even in a differentiated management* context as in the present case, needs maintaining. Intervening in wetlands to conserve their richness necessitates a minimum of grass mowing. As it is a matter of sensitive ecological zones being preserved for their biological richness, the intervention of farming machinery is not appropriate given the inherent risks in these techniques (such as the bogging down of machinery and the correlative destruction of environments, and hasards associated with heat engines such as greenhouse gas emissions and the consumption of fossil fuel resources. It is perfectly appropriate to turn to a pastoralism of hardy species which are adapted to these environments.

Heritage and affective value

In addition to its usefulness in the maintenance of spaces, the return of patrimonial domestic animals in the everyday landscape of all the stakeholders gives a pastoral dimension which improves perception of the site. In return, familiarisation with these forgotten species helps their reintroduction. In this way the Charnie Conservatory raises public awareness of this type of goat and benefits from its particularly gentle nature to accompany children with learning difficulties.

This affective and cultural dimension is one of the bases of the differentiated management* approach which is intended to reconcile human intervention and the preservation of nature, in other words our common heritage. This type of management is also called “sustainable gardening”, i.e. harmony with Man and the rhythm of nature.

Anticipating the post-agricultural phase

In a certain number of licences for agricultural use the rehabilitation of the site is compulsory, but very often this is only required at the end of the period of exploitation and therefore rehabilitation sometimes only takes place after many years. However, if the rehabilitation is not implemented during the course of the work, diversity and the landscape are impacted during the years of the exploitation.

The easiest rehabilitations to put in place are those which are based on the concerted preservation of nature and of ecosystems* from the beginning of the project, including the role devolved to preserve “sensitive ecological spaces” such as wetlands. The entire implementation of the landscape blueprint is conducted with this aim in mind.

Anticipating this rehabilitation phase presents many advantages:

- a better popular acceptance of the site because the impact of the activity on the site is minimised from the outset, and good practices also allow the immediate benefit of positive effects (such as preservation in sensitive zones, improvement of ecological corridors, improved species richness through the care taken in the choice of plants and the preservation of habitats);

- a better economic management of the ecology: this work include the rehabilitation aspects, which leads to a deep understanding of the organisation of the work.

Whether it is a matter of running a quarry or a waste storage facility, there is a significant amount of excavation. The regulations make it necessary to re-landscape the site, so a merlon (hillock) is then built at the end of the exploitation or maybe created from the excavation work. Good management will favour the virtually immediate reuse of the resulting earth by keeping in mind the building of the merlon. The first stage in the beginning of the reconstitution of the landscape, or storing it on site for future use in covering the zone after the period of exploitation has ended.

In this first case, adequate plant cover of the merlon will improve visual perception from the edges of the site, and this plant cover will act in partially retaining the dust generated by the work; these are two advantages which are of no small importance to the residents.

In the two cases the non-exportation of earth will limit the transport (and thus transport costs and greenhouse gas emissions) and the cost of storage on another site. On the other hand, at the moment when the site is covered at the end of the work the stock will already be in place, thus avoiding recourse to other external natural resources (with the same savings in costs and greenhouse gas emissions).

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An illustration of landscape integration during a depollution process at Séché Environnement

In Aveyron, the residues of the different zones of a former mining site have to be treated so as to render them permanently inert. They are then stored in a dedicated pit, in sealed areas made up of clay and geo membranes which avoid the leaching of pollutants. In order to transport them to the treatment facility and thence to the pit, an innovative procedure has been put in place by Séché Environnement. Rather than create a route from the mining site to the facility, convoying installations have been put in place. The transport is therefore ensured by means of a conveyor belt which is insulated from the external air by a cover and put on piles to limit contact with the ground and therefore the impact on biodiversity. This transport system will be dismantled at the end of the operations, restoring the harmony of the surrounding countryside. At the end of operations a five year landscape rehabilitation phase of the site will create a natural framework favouring biodiversity.

Ensuring a long-term economic balance

Optimising costs in terms of amount and duration

The management of diversity on a site has a cost which is broken down into its own direct expenses for actions on the terrain, and that part which represents for the local authority the externalities* engendered by the exploitation. On the other side of the coin one has to consider the products, the services which come from the ecosystems and from which the enterprise benefits which include the patrimonial and cultural value which is important for the acceptance of its activity by the residents.

Despite there being great difficulty costing and making a monetary evaluation, thinking of this by means of a "corporate ecosystem valuation" (CEV) (see chap. 2.2.3.) allows us to approach this problematic. Normal business accounting practices are not sufficient in this domain, in which the classification criteria are to do with expenditure and type of supplier but do not connect the expenditure to a particular aspect of biodiversity management.

An excellent accounting method which breaks down the expenses of a given period according to the elements of biodiversity gives a more precise idea. It consists of evaluating everything connected with water management, greenhouse gas emissions, ecological engineering expenses, purchase of plants and seeds, and analyses and metering. In the light of some examples, it appears that within the framework of good biodiversity management, which, as has been mentioned earlier, should be anticipatory, the extra costs specifically connected to biodiversity remain very reasonable. Most of the expense remains within the industrial operations. It is therefore only a matter of conducting the latter throughout the project within a dynamic of biodiversity preservation. The same intervention of construction work may be destructive of biodiversity, or may be conducive to its preservation depending on how it is conducted.

Insert 30

An economic evaluation of the ecosystem services on a Veolia site

Following a study carried out on the Crépieux-Charmy site by Veolia, the economic benefits of the ecosystem services associated with the conservation management of this site have been evaluated:

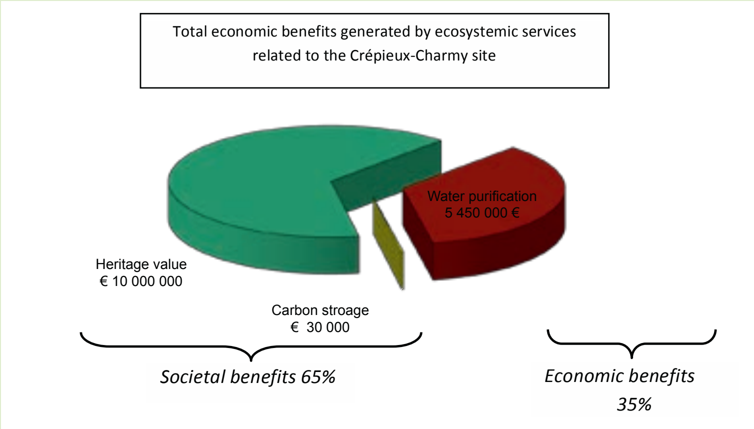

Figure 20: Total economic benefits generated by the ecosystemic services associated with the Crépieux-Charmy site

- The financial benefits (internal), corresponding to the avoided costs of treatment, representing 80% of the total annual cost of the production of drinking water, and up to 16 times the cost of the ecological management of the site. It is thanks to the latter that most of the evaluated benefits are generated.
- If one adds to this the other societal benefits (external) linked to the heritage value of the site and to the carbon sequestration, all the economic benefits associated with Crépieux-Charmy represent an annual sum equivalent to double the total cost of the production of drinking water and up to 45 times the cost of the ecological management.

The advantages of the conservation management of Crépieux-Charmy also represent a hidden benefit of 12 Euros per year and per inhabitant of the Grand Lyon, of 56 Euros per member for drinking water and of more than 40 000 Euros per hectare of preserved nature.

Finally, the ecosystem services generated through the method of drinking water production represent a sum equivalent to 29% of the drinking water portion of the water bill (excluding taxes and licence fees) paid to Veolia (agent) and to the Grand Lyon (owner) in order to have permanent access to drinking water from the tap (and the benefit of these ecosystem services).

Insert 31

Optimising incomes from the activity while having a minimum impact on biodiversity on the Écopole of the community of communes of the Oléron island

The identification and quantification of the ecosystem services around the site of the Écopole of the community of communes of the Oléron island has allowed the definition of the different function modifications which would allow optimisation of the income from the activity while having a minimum impact on biodiversity, and may even be beneficial.

Interactions between the enterprise and biodiversity

Two main paths for work have appeared to improve the interactions:

- Better management of incoming green waste. The management of incoming green waste (primary production) actually affects a significant part of the activity: quality of the site management of flow, income, and quality of compost. The management of the service could be improved: at present everything which arrives is treated no matter what the quality. The paths of action are, for

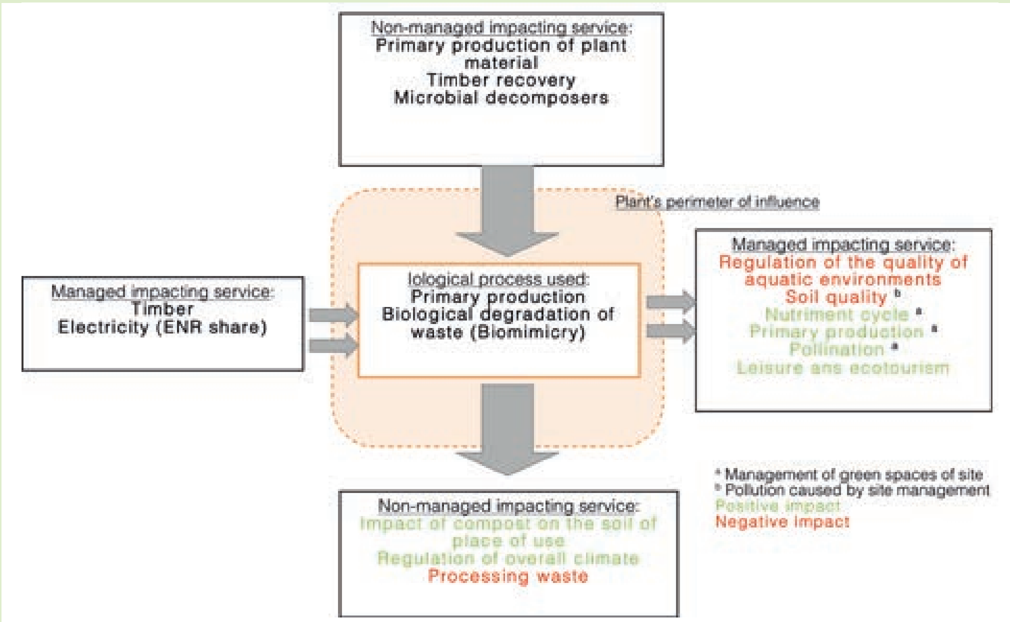

Figure 21 : Flow chart of interactions between the Écopole of the community of communes of the Oléron island and biodiversity

example, a better link with producers of green waste (through information and raised awareness), and a change in the way the entry tariffs, which could be indexed on the quality and stronger monitoring of arrivals. That would allow a dynamic of improvement with, as an added bonus, an additional income.

- Increased levels of information on the good use of compost. Compost is the platform's outgoing product which is the most likely to have a positive impact on ecosystem services. This service is in part managed (commercial sales) and partly non-managed (the way in which the clients use the compost). One plan of action could consist, for example, in better communication on the different uses of the compost (related to its quality, granulometry, soil requirements, etc.) by the users. It could be accompanied by a system of evaluation (such as through a simple questionnaire at the point of sale) in order to understand its range and efficacy.

Developing closely related opportunities based on the ecosystem services

The biodiversity element of business strategies is in general strongly influenced by policies of impact avoidance and therefore the minimisation of the associated costs (see chap. 2.1.).

Another approach which creates resources and jobs is developing in parallel as a response to these mechanisms: ecological engineering and new urban planning policies are examples of this response to the urbanisation of the land. All the policies which have elsewhere been used in the battle against greenhouse gas emissions serve to counter climate change and have a beneficial impact on biodiversity. The battle against pollution and the over-exploitation of resources drives research and innovation policies to favour substitution products and techniques which have less impact on the planet.

4.4. MANAGEMENT ON A TERRITORIAL SCALE: THE "AVOID, REDUCE, OFFSET" PLAN AND BIODIVERSITY MANAGEMENT

The legal obligation to offset has existed in France in theory since 1976 but has rarely been implemented. It came back into fashion with Grenelle laws 1 and 2 and has led to the drafting of a decree in 2011[15]. This decree foregrounds the triptych avoid, reduce, and offset. Stipulated in point 7 of the decree are the measures expected by the petitioner or the developer to:

- "avoid the notable negative effects of the project on the environment and human health";
- "reduce the effects which cannot be avoided";
- "offset when possible the notable negative effects of the project on the environment and human health which cannot be avoided or sufficiently reduced. If it is not possible to offset these effects, the petitioner or the developer needs to justify this impossibility".

Offsetting is therefore effected on the residual part of the impact. According to Trommetter *et al.* (2009), this is the case when the impact on the environment is situated in the perimeter of "the regulation of installations classified for the protection of the environment (ICPE*) where the "superior" interest of industrial and agricultural activities authorises the irreversible effects on an environment considered everyday or ordinary and subject to offsetting measures*, this was also applied to large-scale projects and town planning since the law of 10 July 1976 (L121-1 C.Env.)" (see chap. 2.1.4.).

[15] Decree No. 2011-2019 of 29 December 2011 which was responsible for the reform of impact studies for work and planning projects.

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Biodiversity management on territorial and site scale by Voies navigables de France

For an infrastructure manager, the question of biodiversity rests on the triptych avoid-reduce-offset, which is found in the principles of ISO* 14001 certification, and which has guided the North-Eastern territorial management of Voies navigables de France for their repairs of dykes and banks since 2005. It consists of realising, ahead of any restoration, an initial appraisal which provides an extremely accurate inventory of the environmental characteristics of the sector concerned, including an assessment of the numbers of species and habitats present.

Whatever the technique used, it is then a matter of minimising the impact of the work on the environmental biodiversity (particularly fish species). The last step is the feedback from the greening of the banks and this allows subsequent selection of the plant species which, over and above their good mechanical properties (in terms of their ability to put down roots in particular) improves the floral diversity of the bank. To do this, work has been carried out on seed mixes by the specialists of the North-Eastern territorial management since 2011. To sum up, the question of biodiversity involves measuring the ecological performance of the restored bank through annual campaigns of ecological monitoring, these include the evaluation of water quality, productivity and fish diversity as well as the presence of juveniles near the restored sections.

The general aim is to verify how a "well thought out" ecological development can, in addition to its favourable carbon footprint, modify and improve the physio-chemical and biological characteristics of canal water, which is a unique transport infrastructure because it also constitutes a living environment. The results are interesting in the context of implementation by the Water Framework Directive (certain canals are considered as bodies of water) and the Blue and Green Belts.

The technical purpose is to improve the ecological procedures of restoration of the banks. The scientific and ecological purpose is to verify the environmental added value of these techniques on the "canal ecosystem". In effect, the results tend to demonstrate that, in general, a canal bank restored using plant techniques reproduces the characteristics of a natural bank.

4.4.1. What to avoid and what to reduce

According to the doctrine suggested by the Ministry of Ecology, Sustainable Development and Energy in March 2012: "the effects on the major stakes must in the first place be avoided" (MESDE, 2012). That principally concerns remarkable biodiversity*, the principal ecological continuities and the "key" ecosystem services at territorial level.

The developer is therefore required to "justify" the reasons for which the project has been retained, given the alternatives, and to use the best available techniques at reasonable cost. The alternatives must respond to the same need, and it is up to the developer to suggest the option which minimises the impacts at a reasonable cost. To suggest a low-impact project does not guarantee that the project will be accepted by the relevant authorities. In this way, in the case of a development project impacting on a Natura 2000* site or an ecosystem sheltering a protected species, acceptance of the project will be made on condition that the project is a "major public interest", even if the alternatives all have a greater ecological impact. The project may therefore be refused.

The notion of avoidance is therefore principally based on the justification of the "choice of site" and of the "best technologies" available (e.g. motorways on embankments versus motorways on piles, as neither the avoidances nor the costs will be the same).

If it is not possible to realise the avoidance, the second phase is the reduction of impacts. It is therefore principally a matter of mobilising technical solutions at a reasonable cost. One can cite the example of a motorway constructed on embankments, which is more impactful than a motorway on piles but, even if this does not avoid the impact, the implementation of passages for game species can allow its reduction by facilitating the animals' passage from one side of the motorway to the other. Here, the idea of economically acceptable means cost becomes truly significant. Because whatever the avoidance and reduction activity, they must be made at economically acceptable cost, as this will "justify" the choice of a project which could turn out to be more ecologically impactful, knowing that the choice of one of the alternatives would lead to costs which were not economically acceptable.

To our knowledge, very few academic studies are concerned with these questions of avoidance and reduction while the major stakes are present in terms for example of interactions between the economic, the social and the environmental. That will be even more true if the impact on the ecosystem services drawn by humans from biodiversity is taken into account in the question of the avoidance and reduction of impacts.

4.4.2. The offsetting of residual impacts, a particular form of biodiversity management

The legal obligation of offsetting and its implementation

The legal obligation of ecological offsetting allows businesses to invest in the restoration of semi-natural habitats*. This offsetting mechanism is reasonably well developed, in particular in the United States where Mitigation Banks* were created within the framework of the Clean Water Act* of 1972 for the protection of wetlands. These offsetting banks bring together all the "credit offers" in order to sell them for future development projects. On an organisational level, these businesses buy plots of land, which are either in danger or sufficiently preserved each of which represent one offsetting unit. They may also carry out a restoration activity (an extra expense over and above the purchase price of the land), of, for example, wetlands, permanent grasslands, hedges, etc. They then sell the offsetting units to businesses who develop habitats elsewhere. The price of the offsetting unit is fixed by market legislation following official validation of the equivalence between the number of hectares which are developed and the number of hectares which are offset (the number of offset hectares being generally greater than the number of hectares destroyed). In the USA it is not the mitigation companies which fix the level of offsetting when the avoidance and reduction activities have been realised. This is also the case in France, where an independent body, for example the National Council for Nature Conservation (NCNC), will suggest a level of "ecological equivalence" between the hectares to be offset and the offsetting. hectares. On this last point, Roach (2006) poses the question of equivalence in terms of habitat, stating that it is all the more important to think in terms of equivalence when it is difficult to make an economic evaluation of the damage. A question is therefore raised by Perrings (2007) on the construction of the ratio between developed hectares and restored hectares which remains, as it stands today, relatively "empiric".

Offsetting also presents certain limitations. Hallwood (2006) outlines the limits and difficulties to be found in the implementation of offsetting contracts between deprived parties. He emphasises:

- restoration costs which may be prohibitive for the offsetting business compared to the market price of the biodiversity unit;
- unforeseen or unimplemented penalties;
- very high transaction costs which can have negative effects on social wellbeing, a point reinforced by Goldman (2007). According to Hallwood it is therefore necessary to simplify the approaches so as to reduce the transaction costs, thus rendering offsetting more effective.

There is no collectively accepted standard on "the" procedures for identifying, attenuating and offsetting all the changes instigated by a project or an activity, the tools currently mobilised being concerned essentially, even exclusively, with patrimonial species and habitats. There are therefore difficulties linked to the choice and construction of appropriate indicators (Levrel, 2007; Tucker, 2006). With the obligation for offsetting, that will be even more complex if the authorities take into account certain ecosystemic functions (and services): fluid functions – retention and depollution; CO_2 ; and habitats for protected or useful species (Willamette Partnership, 2009).

Avoidance is dependent on the fact that the development is realised in such a way that it affects neither the ecosystem nor the services which are drawn from it by the other actors (extra development cost and nil offsetting), that would be by means of a certification, even a standard, such as an HQEEB (High Quality Environmental Energy and Biodiversity Standard) which guarantee "no net loss" (Figure 22).

The hierarchy of "no net loss" biodiversity

The reduction of the impacts is associated principally with the technologies mobilised, and the offsetting of the residual impacts on diversity may be realised in two ways: either the company realises it for itself, which means it falls to the company developing the site to realise the acts of restoration demanded by the authorities (the extra costs of restoration and offsetting itself), or the offsetting is linked to the purchase of the biodiversity unit (the supplementary cost is calculated as the market price of a biodiversity unit multiplied by the number of units necessary to realise the offsetting). Before developing a site the company must compare the costs of the alternatives, including the costs of developing elsewhere. It will then choose the option which is least costly to itself.

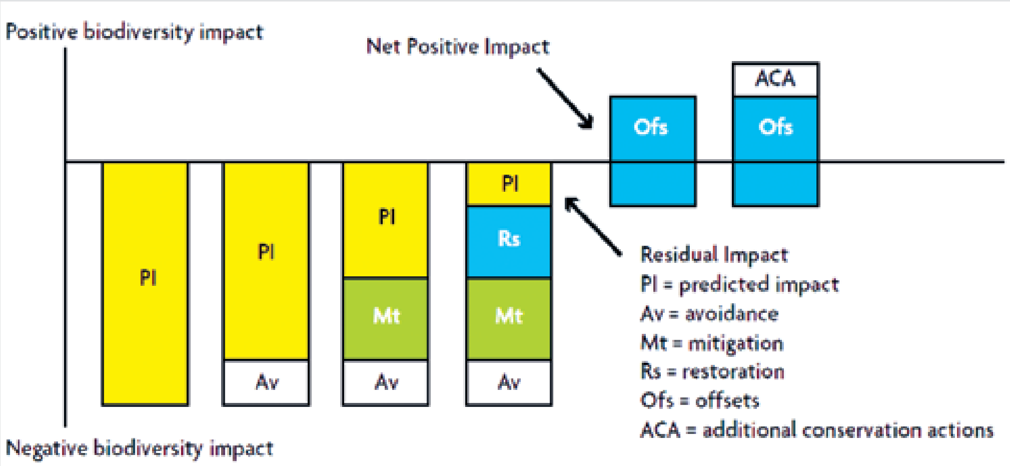


Figure 22: The hierarchy of "no net loss" biodiversity

Houdet (2010) emphasises that "in this context, many organisations worldwide, notably the Business and Biodiversity Offset Program (BBOP, 2009) and the International Association for Impact Assessment (IAIA, 2005) promote a 'no net loss' approach to biodiversity, which will comprise five stages (Figure 22): (Av) avoidance of irreversible biodiversity losses (prevention); (Mt) seeking alternative technical solutions to minimise the damage; (Rs) the implementation of measures to restore biodiversity; (Ofs) the offsetting of inevitable residual losses by the realisation of substitutes of (at least) similar ecological values; and (ACA) seeking opportunities for improving the state of the biodiversity ("net positive impacts', which implies that the gains outweigh the losses)".

The example of businesses selling offsetting

The CDC Biodiversité (Registration and Deposit Office; RDO) (Piermont, 2005 and 2006) was the first business in France to create a subsidiary, RDO Biodiversity, whose aim is the ecological management of terrains which generate "biodiversity units" destined to be sold to public or private bodies, whose projects have an effect on the environment. CDC Biodiversité is committed to being a service enterprise whose objective is to help businesses to limit their impacts themselves (using the notions of avoidance and reduction). When it started, CDC Biodiversité was provided with a capital of 15 million Euros, its mission being to organise the long-term financing and realisation of offsetting operations and to maintain them over several decades. For example:

- One project is to restore, the natural habitat of the European Mink, a protected mammal, on the banks of rivers. It is necessary to convince the forest owners not to destroy the burrows, and therefore to enter into a contract with them; to recreate a passage for the animals; to buy the most significant parcels of land, etc. The financing for the realisation of this project comes mainly from the offsettings due from a motorway construction business.

- In Provence, CDC Biodiversité has realised a project of purchasing more than 300 hectares in the Crau plain for restoration, with the aim of reconstituting one of the last steppe-like plains in France (the Cossoul) which are home to a population of little bustards. On this particular project, the mechanism is expected to be close to that of carbon credits: the Office buys plots, obtains a validation from the state as to the conformity of its preservation action, then resells its biodiversity credits to the developer (e.g. constructors of ring roads, or harbour, industrial or wholesale zones). CDC Biodiversité remains the owner of the land and commits itself to maintaining it over several decades. We are within the framework of a bidding-based approach.

Other businesses are following in the steps of RDO in the offsetting sector, notably BIOSITIV – a subsidiary of Bouygues – and the FIPAN© initiative of EIFFAGE and Dervenn. For the businesses which are involved in restoration operations the question is: should one respond to a demand or should one realise a offsetting bid? The advantage of the "bid-based approach" is to have ecological continuity and eventually to participate in the Blue and Green Belts. However, for that to be possible, one would need to revisit the ecological equivalence conditions to allow the substitution of certain zones by others; however, this point remains a matter for political as well as scientific discussion. Offsetting on demand guarantees, in theory, offsetting by equivalent pieces of land but with the risk of granting permission for projects which have not shown great concern on an ecological level, as was the case for years with agro-environmental measures. This may be due to areas being too small and/or the irreversible breaking up of spaces which do not allow for good ecological continuity.

The existence of competition in the bidding for offsetting will create a market situation. But, if the number of bidders is too large, there is a risk of a reduction of prices for offsetting plots and biodiversity units. If the reduction is effective, that will be to the detriment of the businesses making a offsetting bid based on restoration (which is more costly than the simple purchase of land). The market is therefore shown to be less attractive than expected, whether because the businesses increase their activities of avoidance and/or reduction of the impacts, or because the number of bidding businesses selling offsetting units is too high. On the other hand, if demand is too high this may increase the price of offsetting and biodiversity units, and this could encourage certain firms to implement the impact avoidance or reduction activities after the event; these can then prove to be prohibitive in the light of the expected benefits of the project. That poses the question of the definition of a biodiversity unit: does a hectare bought to avoid its future destruction represent as great a biodiversity unit as a hectare which is bought and rehabilitated and of which the overall cost is much higher? That is all the more significant as these credits form part of the assets of the business, although there is a problem of evaluation of the asset (whether the "value" be equated to the market price of a unit, the amount invested by the business for a biodiversity unit which includes the cost of restoration) given that a price lower than the value of the biodiversity units on the balance sheet assets would be damaging for the business for the same reasons as depreciation of financial assets. This means that the question of the valuing of "shares" in the businesses' balance sheet comes back to accounting: should they be rated at purchase value, at market value, or at another value entirely?

Insert 33

BIOSITIV, Bouygues Construction's bid for infrastructure projects

BIOSITIV is a structure specialising in construction and biodiversity, and is the fruit of a partnership between DTP Excavation Bouygues Construction and the association Noah Conservation. BIOSITIV supports project teams in the regulatory sequence "avoid, reduce, offset" and for any action which affects flora, fauna and natural environments. As BIOSITIV Director Brice Quenouille states: "it is a matter of seeking technical and ecological innovations which promote the insertion of the project into its natural environment. These techniques concern the influence, works and, if the residual impacts persist, the actions on the ground intended to offset them". This search for innovation is supported by active R&D.

In the proposal stage, BIOSITIV facilitates the:

- Acheiving of the "biodiversity accounts" of projects and identification of the stakes;
- An understanding of the local context and knowledge of the actors;
- Anticipation of the actions (avoid, reduce, offset), risks and costs;
- The raising of a distinctive and competitive bid.

In the project phase, it:

- Steers the development of the regulatory dossiers such as the National Council for Nature Conservation (NCNC), the public enquiry on Law on Water, and Natura 2000*;
- Seeks innovative solutions for impact avoidance, reduction and offsetting;
- Guides the implementation of compensatory measures* (researching and securing of plots, ecological restoration work, etc.);
- Manages in the long term natural spaces, whether restored or developed;
- Develops a network of partnerships with the territorial stakeholders.

BIOSITIV and the commitment of its partners have been recognised by the Ministry of Ecology, Sustainable Development and Energy under the National Biodiversity Strategy (SNB*).

Examples of application: the Nimes-Montpellier bypass (France)

Almost 150 protected species are present in the territory of this new rail project.

With BIOSITIV, Bouygues Construction has worked since the tender process on solutions for minimising impacts: modification of the proposed line, adaptation of the work schedule, structures to give transparency to the project, etc. One innovative method, founded on the scientific idea of ecological equivalence, has moreover been applied to define these compensatory measures* and to restore conditions which are favourable to the species and to the ecosystems. Guided by BIOSITIV the initiative is conducted in partnership with the associations, farmers, land operators, design offices and ecology research laboratories.

Going further than the legal obligation to offset

Businesses may go further than the legal obligation to offset, whether out of concern for their image or for reasons linked to the ecosystem services that the business itself draws from the ecosystems and which it wishes to develop. In the latter case the development and its offsetting are directly integrated into the business strategy, which takes into account in its overall assessment the fact that the destruction of an ecosystem, and the associated services drawn from it by humans, may be harmful for the future of the business itself. There is therefore a better consideration of the dynamic interactions between business and "nature", which is also the aim of the accounting section of the ORÉE Biodiversity and Economy Working Group.

The offsetting of services is an even more complex issue than the offsetting of sites. Does the business really only have to offset the current identified services, or does it have to take into account the potential services which humans could draw in the future (a hypothetical value in the sense of limiting the irreversibilities)? To give a theoretical example: a forest of 10 hectares can offer the natural purification of the water consumed in a village of 100 inhabitants. If a business develops in the region of this forest, reducing it by 5 hectares, the service may be altered. If the service is no longer guaranteed, it must be offset. On the other hand, if the service is still guaranteed the question of offsetting is posed. Dispensing with offsetting for the business signifies that one does not consider the fact that the village, which now has 5 fewer hectares of forest, sees its capacities for development (as much in demographic as in economic terms) reduced because they are constrained by the new natural water purification capacity of the forest.

It is therefore justifiable that offsetting is considered from the first destruction of a unit of forest, including for services not currently drawn. It is thus a matter of making provision for charges or repayment of natural capital.

Insert 34

FIPAN©: Dervenn's Natural Heritage Intervention Fund and EIFFAGE

The maintenance of ecosystem services necessitates concrete actions on an ecosystemic scale and calls on two complementary approaches: the limitation of negative impacts on the one hand, and the maintenance, restoration and rehabilitation of natural environments on the other. In a context where 92% of the mainland territory is in private hands, these actions depend on the involvement of the owners and managers of the land, who are for the most part represented by farmers, foresters, and private owners. The maintenance of a territory's ecosystem services also requires increased skills regarding economic models and customs, technical support, education and lastly agri-ecological engineering interventions.

These actions should not however be the exclusive responsibility of the managers, farmers and owners because it concerns the management of a common asset which benefits the whole community. It is with each user, each inhabitant of a territory and each consumer of nature that the responsibility and the long term advantage of the ecosystems lies. Also, the global cost of the maintenance of ecosystem services must find its support among the beneficiaries. It is the principle of "payment for the maintenance of ecosystem services" (PMES). The aim of this system is the pooling of the financial flows necessary for the maintenance of ecological services, by permitting each territorial actor, beneficiary of ecosystem services, to participate in this global action in whatever way they are able, in terms of their means, their responsibility and their ecological debt.

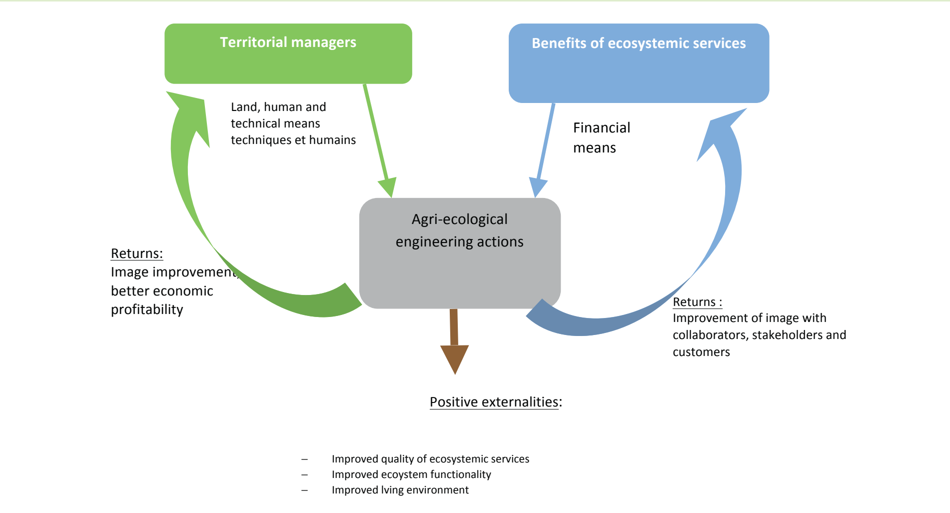


Figure 23: Functionality diagram of the FIPAN© tool

It is therefore indispensible today to create new tools to manage these financial flows and the actions which flow from them.

It is within this framework that the specialist ecological engineering company Dervenn has created an innovative measure, the Natural Heritage Intervention Fund (*Fonds d'Intervention pour le Patrimoine Naturel*: FIPAN). FIPAN© is a tool for the pooling of technical and financial means for the management of ecosystems and the maintenance of ecological services. It is managed at national level by a non-profit association whose role is to coordinate and guarantee the local initiatives which have been implemented.

FIPAN© allows the creation of a model of innovative territorial governance which involves all the territorial actors (beneficiaries, consumers and ecosystemic service administrators) for the preservation of biodiversity and natural resources, and allows the development of a dialogue and cooperation between the actors in the matter of biodiversity.

The operational implementation of FIPAN© uses agri-ecology, which is an innovative operational tool for territorial management which allies economic value, ecological functions, customs and the human dimension. This approach relies on an actor dynamic closely involving the main territorial managers which comprise the agricultural or forestry enterprises; these are therefore recognised as much for their economic production as their ecological production.

The economic model is amalgamated with the natural dynamics guaranteeing the perennity of the activities. This approach leads to a positive and optimistic view of the territory and of its actors.

The EIFFAGE company wishes to act as a responsible actor for the natural capital by developing, with Dervenn, a FIPAN© project along the Brittany – Pays-de-Loire high speed train line that the Group is currently constructing between Le Mans and Rennes. This project constitutes the first large-scale application of the FIPAN© initiative. Its principal objectives are the following:

- To reconcile the expectations and habits of the territorial actors with the functioning of the ecosystems;
- To take into consideration the common biodiversity, and not just that which benefits from protected status;
- To participate in the financing of the conservation, restoration and renaturation of a milieu consisting of ordinary or patrimonial nature and contribute to the realisation of Blue and Green Belts;
- To experiment with remuneration for the maintenance of ecological services;
- To establish an involved approach on the part of each actor;
- To make the best use of the territory and its actors.

4.5. RIGHTS AND DUTIES: ACCESS AND BENEFIT-SHARING (ABS*)

The availability of genetic and/or biological resources is one of the services provided by ecosystems to humans. These resources are used principally in pharmacy, cosmetics, agriculture and the food processing industry. But "this service of access" to genetic resources is ruled by at least three international conventions: the CBD*[16] of the United Nations Convention on Biological Diversity CBD, the International Treaty on Plant Genetic Resources for Food and Agriculture : ITPGRFA[17] of the Food and Agriculture Organisation FAO*[18] and the Trade Related Aspects of Intellectual Property Rights TRIPS[19] regulated by the World Trade Organisation WTO*[20] and its national legislations. The Nagoya Protocol* proposes 27 types of monetary and non-monetary advantages such as the right of access, the financing of research, eco-business, participation in product development, knowledge transfer, the reinforcement of capacity as regards technology, and social recognition.

[16] http ://www.cbd.int/

[17] International Treaty on Phytogenetic Resources for Food and Agriculture. http://www.planttreaty.org/

[18] http ://www.fao.org/home/en/

[19] Aspects of Intellectual Property Rights Affecting Commerce. http://www.wto.org/english/tratop_e/trips_e/trips_e.htm

[20] World Trade Organisation. http://www.wto.org/index.htm

What is the Nagoya Protocol* and what is its aim?

The Nagoya Protocol* on access and benefit-sharing is a new international treaty adopted under the auspices of the Convention on Biological Diversity (CBD*), at Nagoya, Japan on 29 October 2010. Its aim is to ensure the fair and equal sharing of the advantages gained from the use of genetic resources, thus contributing to the conservation and sustainable use of biological diversity, and to the realisation of the three aims of the CBD. The Nagoya Protocol* will come into force when 50 countries have ratified it.

Why is the Nagoya Protocol* important?

The Nagoya Protocol* provides an assurance of the greatest legal certainty and transparency, as much for the suppliers as for the users of genetic resources, in:

- Creating more predicable conditions for access to genetic resources;
- Contributing to the assurance of benefit-sharing, when a contracting party supplying genetic resources no longer has access to those genetic resources.

In contributing to an assurance of benefit-sharing, the Nagoya Protocol* creates encouragements in favour of conservation and sustainable use of genetic resources, and as a consequence reinforces the contribution of biological diversity to human development and wellbeing.

What is the application field of the Nagoya Protocol*?

The Nagoya Protocol* is applied to genetic resources and to traditional knowledge, both of which enter into the application field of the CBD and to the advantages generated by their use.

What are the fundamental obligations expected under the Nagoya Protocol* regarding genetic resources?

The Nagoya Protocol* foresees several fundamental obligations for the contracting parties, in terms of the measures to be taken with regard to access to genetic resources, benefit-sharing and respect for obligations.

Obligations regarding access

The measures adopted at national level as regards access to genetic resources must be:

- To ensure legal certainty, clarity and transparency;
- To put in place rules and procedures which are fair and non-arbitrary;
- To establish clear rules and procedures regarding prior informed consent and conditions suitable for a common agreement;
- To deliver a licence or its equivalent, once access has been agreed;
- To create suitable conditions for promoting and encouraging research contributing to the conservation and sustainable use of biological diversity;
- To take due consideration regarding current or imminent emergency situations which threaten human, animal or plant health;
- To take into account the importance of genetic resources linked to food and agriculture for food safety.

Obligations regarding benefit-sharing

The measures adopted at national level regarding benefit-sharing ensure a fair and balanced benefit-sharing flowing from the use of genetic resources as well as the advantages produced by future applications and commercialisation, with the contracting party supplying the resources. The term "utilisation" covers activities of research and development on the genetic and/or biochemical composition of genetic resources. The distribution is subject to the conditions agreed in a common contract. The advantages may be monetary or non-monetary such as charges or a sharing of the results of research.

Obligations regarding respect of obligations

The specific obligations destined to encourage respect for the legislation and national regulatory demands of the contracting party supplying the genetic resources, and the contractual obligations contained in the conditions agreed in a common contract, constitute a significant innovation of the Nagoya Protocol*. The contracting parties must:

- take measures to ensure that the genetic resources used under their jurisdiction have been obtained following prior informed consent, and that the conditions agreed in a common contract have been established, such as those required by another contracting party;

- Cooperate in the case of alleged violation of the demands prescribed by another contracting party;

- Encourage contractual measures for the settling of disputes within the agreed conditions of a common contract;

- Be careful to allow recourse within their legal systems, in the case of disputes over the conditions agreed in a common contract;

- Take measures concerning access to justice;

- Take measures to monitor the use of genetic resources, notably by designating effective monitoring points at any stage in the value chain: research, development, innovation, pre-marketing and marketing.

How does the Nagoya Protocol* manage the traditional knowledge associated with genetic resources and the genetic resources held by indigenous and local communities?

The Nagoya Protocol* deals with traditional knowledge associated with genetic resources within the framework of its measures on access, benefit-sharing and the respect of obligations. It also deals with the genetic resources for which the local and indigenous communities benefit from an accepted right of access. The contracting parties must take measures to ensure the prior informed consent and the fair and equal benefit-sharing, by keeping the spirit of the laws and community procedures, as well as the habitual utilisation and exchange.

Tools and mechanisms supporting the implementation

The success of the Nagoya Protocol* will depend on its effective implementation at national level. Several tools and mechanisms allowed for within the framework of the Nagoya Protocol* will help the contracting parties in this regard, notably:

- The designation of national correspondents and competent national authorities, serving as points of contact to supply information, agree access and cooperate on questions relating to the respect of obligations;

- A centre of exchange on access and benefit-sharing for disseminating information on issues such as national regulatory demands relating to access and benefit-sharing, and on national correspondents and competent national authorities;

- A reinforcement of capacities for supporting the basic elements of the implementation. Based on the countries' self assessment of their national needs and priorities, this may include the capacity to:

- Develop a national legislation on access and benefit-sharing in order to apply the Nagoya Protocol*;

- Negotiate the conditions agreed in a common contract;

- Develop research capacity and institutions* within each country.

- Awareness-raising;

- Transfer of technology;

- Targeted financial support, to support the reinforcement of capacity and the development of initiatives using the finance mechanism of the Nagoya Protocol*, namely the World Environment Fund (WEF).

For the plants dealt with by the CBD (in other words those not treated by the FAO), the various states will define the providers of genetic resources as rights beneficiaries. These rights beneficiaries will be either at institutional level (ministry, environmental agency, NGOs, etc.) or at the level of local populations (collective property rights), or the conferring of rights at an individual level, which may go as far as a private ownership of genetic resources. Access and benefit-sharing are realised with prior informed consent. The contracts define the conditions of access and use (everyone's rights and duties) of genetic resources which generally include measures on:

- Rights of entry and prospecting (cost of access to material and later to information including the knowledge of indigenous populations);

- The royalties on innovations according to the duration of the protection (or the commercialisation). These depend on the nature of the effects of the local resource in the innovation (material and information);

- Automatic licensing processes and technology transfer, whether free or at a reduced cost (based on a macroeconomic indicator, for example) for the country where the prospected material has originated. Technology transfer is a key element within the measures regarding access and benefit-sharing;

- The implementation of research activities with, in particular, cooperative projects;

- All other activities which could be interpreted as being relevant to benefit-sharing.

The question of knowledge held by indigenous people is dealt with within the Protocol but with the usual caveats ("conforming to its internal law, each party takes, at its convenience the appropriate measures to facilitate access to traditional knowledge associated with genetic resources…"). This approach therefore presents the difficulty of accessing the knowledge of indigenous populations regarding "their" genetic resources, whether this is about specific characteristics (pharmacological properties, good adaptability to soil salinity, resistance to pathogens, etc.) and their geographic origins (agricultural seed exchanges). To defend their traditional knowledge and understanding, there are rights on management activities and their knowledge which relate to genetic resources (their functions). That poses the question of the value of the information (see the idea of an innovation) and the adequate type of protection (Swanson-Göschl, 2000). Different rights apply therefore according to the material concerned and refer to two international conventions:

- In the case of materials used for farming, the rights of farmers[21] (negotiated within the treaty of the FAO) intended to recognise the work of improvement and conservation of local genetic resources by farmers as well as their knowledge including their knowledge of the particular characteristics of the material. The implementation of this right is the responsibility of the national states. One can therefore confirm that within the treaty the farmers' right is only an "encouragement to do something".

- In the other industrial developments linked to biodiversity and genetic resources, a right of indigenous communities is currently being negotiated in Article 8J of the CBD (see chap. 1.1.1.). It is directed at recognising a right for local populations in relation to their management actions and their knowledge about biodiversity. As with the farmers' right, the implementation of this right will be, in the first instance, the responsibility of each state, even if the negotiations are ongoing at the level of the CBD to implement the protocol on the ABS presented in 2010 at Nagoya, and therefore to try and harmonise the rights of indigenous populations.

[21] Resolutions 5/89 and 3/91 of the FAO - http://www.fao.org/focus/f/96/06/07-f.htm

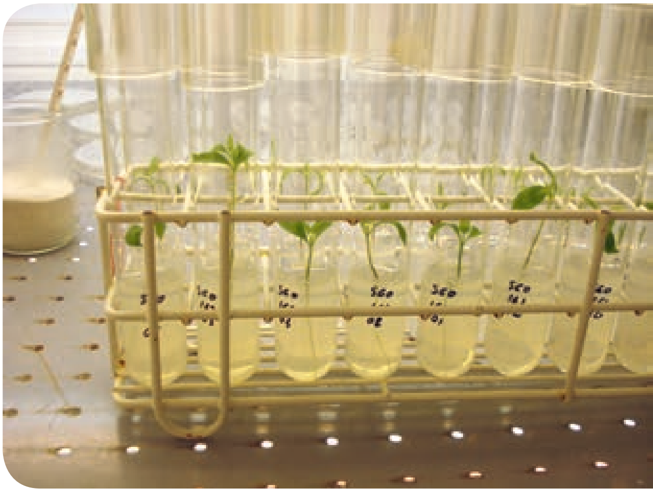
The adoption of the Nagoya Protocol*, even though it is not yet in force, therefore offers a constraining legal framework. The Protocols' objective is to enable maximum coordination of the contracts of access to limit the transaction costs and, for the southern countries, to reduce the risks of abuse by multinational businesses thanks to the need for prior informed consent. The protocol indicates that this information may come from a "certificate of conformity recognised on a international scale" which would provide confirmatory evidence that:

- there has been prior informed consent regarding access to genetic resources;
- the conditions of benefit-sharing have been agreed in a common contract, and that it is detailed in the internal legislation and regulation relating to access and benefit-sharing.

The contract is not as harmonised as it is within the framework of the FAO treaty, but it limits the risks of abuse even if the balance of power is not favourable in southern countries and particularly in less developed countries. Two Articles are particularly significant, even if their current wording remains particularly vague: Article 10 is applied when sovereignty is difficult to identify so a multilateral system is suggested; Article 12 concerns the genetic resources for which countries could find themselves in competition in terms of granting access (this concerns cross-border resources); coordination between the countries concerned is therefore recommended.

Implementation of an ABS*

With the ratification of the Nagoya Protocol*, "involuntary" biopiracy should disappear, because it is the responsibility of the local signatory which could be brought into play in the case of non-respect of the local law (interpretation of Article 6). One would avoid finding oneself in situations such as that which occurred in September 2012 when 35 companies were ordered to pay a fine in Brazil for non-respect of the 2001 law on benefit-sharing within the supply of natural substances, while even lawyers



agree that the 2001 law does not allow an actual return for indigenous populations.

Another challenge is knowing whether the contract of access and usage covers all the stakes. We realise in effect that the extra constraints may be implemented at country level. More and more countries are going beyond the CBD, integrating into their laws conditions on the management of biological resources which is becoming evermore widespread. In effect, according to the definition of the CBD: biological resources are all genetic resources, their organisms and elements, populations and any other biotic elements of the ecosystems having a use or an effective value for humanity.

On the other hand, there is no one model for using biological or genetic resources.

Insert 35

A close up on L'Oréal's "Sustainable Argan" programme

For some years now, certain cosmetic ingredients have been sourced from Morocco, including several ingredients which come from the argan tree and which can be found in many L'Oréal group's products. These are marketed on an international scale, and include the Garnier, L'Oréal Paris-Elsève, Kiehl's, Lancôme and Matrix brands, in all categories of cosmetic products: skincare, cleansing, hair products and make up.

In 2008, in full dialogue with its supplier – the Serobiological Laboratories, a division of Cognis France (BASF) – L'Oréal called on the NGO Yamana, as a development expert, in order to optimise the technico-economic, social and governance dimensions of the network of cooperatives of the GIE Targanine. They had to pay particular attention to the expectations of the local stakeholders (communities, cooperative operators, etc.) in connection with the socioeconomic context and the cultural specificities.

This programme is set out around the following principal aims:

- To determine the level of fair return to women working in the cooperatives;
- to reinforce the traceability of the product;
- To guarantee the respect for traditional knowledge and absence of biopiracy;
- To allow a progressive economic autonomy of local cooperatives.

Three years after the initiation of this project, several advances have been accomplished: the acceptance and appropriation* of the initiative have clearly been appreciated as guarantees of perennity and reliability; the traceability and quality of the ingredients marketed have been significantly improved facilitating certifications such as

Ecocert Bio, Equitable and the Protected Geographical Indication (PGI) for the six cooperatives of the Targanine network; the remuneration of the 250 women working in the cooperatives has clearly progressed, notably thanks to the equitable valorisation of the oil and of several co-products such as oil-cake and argan nuts providing new sources of income for the women without any extra work and in the best conditions.

In the last few years, the use of cosmetic ingredients emanating from the argan tree has continued to grow within the L'Oréal group. This trend is likely to increase given the professionalism and commitment shown by the members of the Targanine network in maintaining a high level of traceability and quality of production, as well as animating all the initiatives and tools developed with the support of the NGO Yamana. Furthermore the Targanine network has now attained a level of technical and economic maturity which makes it a reliable and autonomous supply partner. In relying on a strong tripartite partnership, this initiative has constituted a real promotion opportunity on the international cosmetic market, of the responsible valorisation of the argan tree in a spirit of respect for the culture, work and traditional knowledge of the Berber in South West Morocco.

The use of biological resources, for example in the cosmetic industry, may be likened to the repeated purchase of raw materials needed for production.

- Is there a risk that the purchase by third parties is made to the detriment of utilisation by the local populations? This question is posed by example for the neem or margousier, which is a plant originating from India and known for its insecticide properties. During the 1990s, the use of margousier in the fields as an insecticide by local populations was observed and patents were filed and sold on to an agrochemical giant, without the involvement of the local populations.

- Is there a risk that the local production is made to the detriment of biodiversity and especially by the expansion of cultivated areas?

- Is there a risk that the production might be delocalised once the plants have been recovered as is the case today for Quinoa, a marginal plant of poor Andean populations which is now cultivated in a significant number of countries? This is all the more important if the indigenous knowledge has been associated with the first utilisation of the resource, access to the knowledge not being necessary for each subsequent purchase.

In the case of genetic resources, for the pharmaceutical industry for example, what is sought is an active ingredient or a genetic diversity. *A priori* there is no pressure on the resource: on the contrary, once the active ingredient has been identified, there is no real "interest" in keeping the plant as a genetic resource. For genetic diversity, it can be noted that, at an international level, implementation by ex-situ conservatories has been preferred rather than maintaining these varieties *in-situ*. These resources will in general be associated with traditional knowledge whether used in pharmacopeia or on the specific characteristics relating to food or farming.

It can be seen therefore that the cases of demands for access and for types of usage can vary greatly. In the same way, the consequences for the local populations may be equally diverse and not contained within the ABS* framework. This means countries must be vigilant in the construction of their policies of access and of benefit-sharing associated with biological and genetic resources.

Businesses themselves can also impose extra constraints in terms of the Nagoya Protocol. In the ORÉE Biodiversity and Economy Working Group, many businesses in the cosmetics industry have integrated the question of benefit-sharing in their strategy. In the particular case of primary materials, they find it difficult to imagine a reliable supply on the world market without worrying about modes of production as much on an environmental as on a social level. At the same time, these enterprises are in general as interested in what passes for the production of primary materials in the country in which the enterprise is based as for the production of primary materials in other countries.

Whatever the place, it is a matter of securing the inward channel, while ensuring a sustainable development for the people.

ABS is not only a monetary sharing, it is also an investment which must not question the short term competitivity of the business, but which allows it to commit in the long term. This means that the constraints for the enterprise will be due to the purchase cost of the primary material and the contribution of the primary material in the added value of the final product.

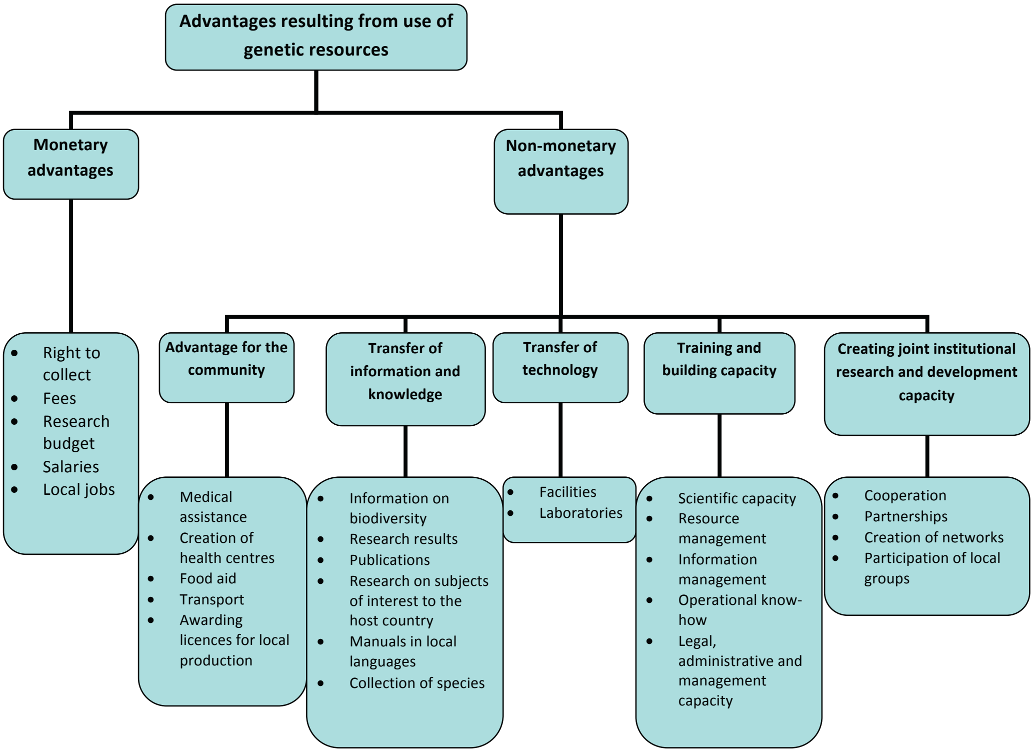


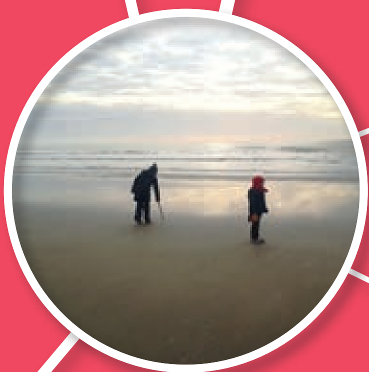
Figure 24 : Flow chart of the advantages resulting from the utilisation of the genetic resources from biodiversity

The creation of values shared by all the stakeholders, while respecting biodiversity and different cultures, allows us to anticipate the generation of promising new micro-economies. Even before the application of the Nagoya Protocol, certain cosmetics companies of the ORÉE Working Group have engaged forms of benefit-sharing such as: the implementation of distillers, supporting the development of small and medium-sized businesses, supporting education and preventative health care, local agronomic research, forestry management, and the sharing of toxicology research findings through micro-projects which are closer to the local populations.

At international level, ABS is not only summarised in terms of financial offsetting and the creation of shop windows; in the internationalisation of ABS lies a real opportunity to balance respect for cultures and biodiversities while allowing the development of the planet's economies.

Section 5

ACTORS' PROSPECTS: BIODIVERSITY AND ECONOMY



ORÉE and the *Institut Français de la Biodiversité* (IFB*), aware that biodiversity interacts with society, initiated the Biodiversity and Economy Working Group in 2006 in which ORÉE and its partners carried out exploratory work to develop reflection and tools for reconciling economy and biodiversity. It was the first time that companies, local authorities, scientific organisations and associations in France had collaborated on the issue of biodiversity and, more specifically, on the reintegration of economic activity into the dynamics of living systems.

Currently, there are other projects which can help to advance the analysis of the relationships between organisations and biodiversity and, in particular, reconciliation ecology, the "capability" approach, multi-agent modelling and ORÉE's new projects.

5.1. RECONCILIATION ECOLOGY

5.1.1. A first step with participative science

We need scientific knowledge of ecology in order to attempt to reconcile human activity and biodiversity. In clear-cut language this is known as "reconciliation ecology".

The idea here is to rethink and understand biodiversity as an "ordinary biodiversity"* concept (Chevassus-au-Louis, 2009) to which we humans belong, and not to think of ourselves and position ourselves as if we were disconnected from this biodiversity. The emblematic or even extraordinary heritage species, this remarked-on and therefore so-called remarkable biodiversity* (Chevassus-au-Louis, 2009) is only the tip of the biodiversity iceberg, and often not highly representative of a more day-to-day, less noticed but just as essential "ordinary biodiversity*" for actors or citizens. This biodiversity is a part of the ecosystems. It models them, is inherent in their functioning and thus comprises the foundation of the ecosystem services provided to human activities by biodiversity (such as pollination, soil preservation and water purification (MEA*, 2005)) (see chap. 1.1.).

The aim of reconciliation ecology is to help bring human activities and this "ordinary biodiversity*" closer together. "Ordinary biodiversity"* is fragile and all the more difficult to preserve and manage because it is generally spread over wide areas and/or areas which are for the most part highly anthropized*. The economic actors who benefit from these services and also the territorial management actors impacting this biodiversity are the key partners for this reconciliation.

Reconciliation ecology is based on participative science. Participative science initiatives and other biodiversity research institutes were set up over twenty years ago and rely on the participation of non-scientists for the development of knowledge. The Vigie-Nature1 programme was set up by the National Museum of Natural History (MNHN*) to group together several research campaigns, in cooperation with partner associations and open to the general public (STOC programme, *sauvages de ma rue*[1], etc.) (see chap. 2.1.). The Vigie-Nature[2] programme has a double aim:

- The extensive collection of observations which will make it possible to support scientific work (with the specific constraint created by the diversity of observers);
- The participation in the reconciling of the stakes of biodiversity and those of human activities. These programmes provide an opportunity for raising awareness and teaching in terms of biodiversity and scientific approaches. Another more specific French example of a type of environment is led by the *Centre de Recherche sur les Ecosystèmes d'Altitude* (CREA - Alpine Ecosystems Research Centre) with a focus on scientific and teaching programmes inviting citizens to measure the impact of climate change in the mountains, on vegetation (PhenoClim[3]) and on bird migration (PhenoPiaf[4]) at home and abroad (PhenoAlp[5]).

Economic actors also have the opportunity of taking part in these participative science initiatives and in observatories via the monitoring of their different sites which involve at the same time their collaborators and sometimes even residents (see chap. 4.3.). Preliminary studies or monitoring have often already been carried out on the actors' sites and this approach makes it possible to bring together and support knowledge of biodiversity and consolidate actors' ability to understand their relationship with biodiversity.

[1] http ://sauvagesdemarue.mnhn.fr/
[2] www.vigienature.mnhn.fr
[3] http://www.creamontblanc.org/en/phenoclim-2/introduction/
[4] http://www.creamontblanc.org/en/phenopiaf-en/introduction-phenopiaf/
[5] http://www.creamontblanc.org/en/phenoalp-en/presentation-phenoalp/

5.1.2. From reconciliation to metamorphosis

This practical involvement of actors is a possible first step towards a more fundamental approach based on the mutual reintegration of human activities and biodiversity.

“We need to share our world with all the other species that live in it and develop human habitats to host as many species as possible, and also for the benefit of local societies. In other words, ‘reconcile mankind with nature.’ ” (M. L. Rosenzweig, 2003). This was how Gilles Boeuf, President of MNHN* recalled the global and especially the historical landscape of the stakes in question (Boeuf, 2010). If at first, like all omnivorous mammals, Homo sapiens impacted his environment, in view of his size, and the impact became more apparent from the moment he tamed fire. Homo sapiens rapidly became more technical, intelligent, ingenious and aggressive, and began to have a disturbing influence on environments and cause the deterioration of its surroundings, often irreversibly for ecosystems and biodiversity (Lévêque and Mounolou, 2001). The modern human being is actually only extending and amplifying, with the means currently at his disposal, a process of destruction of environments and the erosion of specific diversity begun a very long time ago (Martin, 1984). The situation is serious, but it affects an Earth on which our undeniable influence is also a source of hope and solutions. It is up to us, each at our own level and means of participation, like the humming-bird in a vast forest devoured by flames (Amerindian and African legend): "The dismayed and powerless animals watched the disaster unfold. Only the humming-bird picked up water in its beak and let the drops of water fall one by one onto the fire. Faced with the scepticism of the other animals who considered it pitiful, the humming-bird’s gesture is a reminder to us that if everyone had done the same, the fire would already have been put out".

Edgar Morin challenges us when he speaks of an unavoidable metamorphosis to be invented: "we have entered a time of beginnings, an era interlaced with both despair and great expectations" (Morin, 2010).

But how can this be done practically? Ecosystem services (MEA*, 2005) could be a key to understanding the stakes of this reconciliation, and therefore of potential action. This approach insists on the vital dependence of human beings on biodiversity while the activities and the development of human societies are endangering this same biodiversity.

When one of these services disappears, there are two somewhat antagonistic actions available to the actors who benefited from them:

- To attempt to substitute the biodiversity and ecosystem services lost by trying themselves to extract even more from "nature" and to replace this or these services by infrastructures which reproduce the lost ecosystemic service, such as water purification, air-handling and maintaining good soil structure. This approach may recall the utopia of transhumanism applied to ecosystems. The transhumanism put forward by Julian Huxley for human beings (Huxley, 1957), highlighted the idea that it was possible to improve human beings physically and mentally using science and techniques. The limits and risks of such a philosophy of the technological improvement of living beings as applied to humans had been outlined very early on by his own brother, Aldous Huxley, in his futuristic novel "Brave New World" (Huxley, 1931). The limits and risks of substituting ecosystem services are also numerous and the attempts of Biosphere 2* specifically call for a dose of humility (see chap. 1.1.4.).
- To restore the functionalities of the disrupted ecosystem and adapt human activities to take part in the perpetuation of the endangered ecosystem. This second solution appears to us to be the most sustainable both for the ecosystem and biodiversity and also for the actors (Teyssèdre, 2005) who in a strategic approach can also ensure their future in terms of dependence on ecosystems. The town of Munich has the cheapest drinking water in Europe, without any form of treatment, thanks to the care taken by the municipality to keep the forest ecosystem upstream of the river in good condition so that it naturally supplies pure water (see chap. 1.3.1.).

All human activities, including those of companies, local authorities, NGOs and associations, etc. therefore have a major role to play regarding their environment, whether in terms of dependence or impacts (see chap. 2.2.1). The activities of all are concerned but the role of all the stakeholders and other actors as a driving force and awareness-raiser must not be neglected (see chap. 2.1.).

Reconciling human activities and biodiversity in one's activity is a first important step, but this new point of view can and must make it possible to rethink the activity, the design of products and services and therefore of its strategy in this living setting shared by all (see chap. 4.1.2.).

On a more global scale, we can also consider that the economic and financial crisis of 2008 was in fact the first major ecological crisis that humanity has been faced with. The symptoms are economic and financial, as Jacques Weber reminded us, but the real disease underlying all this is an ecological crisis (CDC Biodiversity, 2013). If we agree to change our perspective and understand the current situation, we can also reconsider the economic tools and build a bearable and desired future.

The market which is so destructive for the environment in the current situation also contains instruments which can help to preserve this same environment. The example is shown by the fisheries for which several countries have developed instruments known as "individual transferable quotas" (Weber, 2010). New Zealand, Iceland, Canada and the United States have the same process (Scott, 2008): a total allowable catch rate of each species of fish is determined on a yearly basis by scientists, and each company is allocated a fixed percentage. With the obligation of these quotas, companies can rent out or sell these quotas to each other. The Government can intervene in this market as an economic agent, buy back quotas to lessen their numbers, and sell or give quotas if the size of population of a species justifies it. A system of this kind freezes fishing rights below the total allowable catch rate and supports the viable harvesting of fish stocks.

From the first steps of "reconciling" human activities with biodiversity with the "metamorphosis" of our world, actors are the ones who can lead all our societies towards a desirable, bearable and sustainable development.

Raised awareness is the first step in initiating a virtuous circle of the reintegration of human beings into their environment (Prevot-Julliard and Fleury, 2012), but there are already a number of avenues for promising actions, experiments and work which show the possibility of a future for humans on the planet. This book aims at taking part, modestly but practically, in this impulse by addressing those who determine the present and shape the future, the actors. Human beings are the victims of the biodiversity crisis as well as being the catalyst of a future other than that promised by current catastrophes. Responsibility in the environmental crisis implies a responsibility in the solutions to be applied. The human being thus returns to his position and his wealth and importance, including in economy, is highlighted by Amartya Sen's "capability" approach.

5.2. ENCOURAGING THE CONSERVATION OF BIODIVERSITY: AMARTYA SEN'S "CAPABILITY" APPROACH

Development stakes are frequently perceived exclusively as economic stakes, and moral values are not considered to be relevant in judging market efficiency. However, more and more national and international development programmes focus on the importance of considering a certain number of very different values from those which are of a monetary order, and specifically that of fairness.

In 1998, the Nobel Memorial Prize in Economic Science was awarded to the Indian Amartya Sen for his work in welfare economics which offers a "capability" approach to better ascertain the welfare of individuals. The individuals, "I", "we", "you", are all everyday actors, and the consideration of parameters other than just economic indicators appears fundamental when considering avenues for action which are rich in possibilities.

Originally, Sen (1987a) wanted to understand why ethical consideration had disappeared from contemporary economic science to be replaced by other "mechanistic" considerations, and to show by his work the interest of reintroducing this approach. In his work (Sen, 1993), he highlighted the fact that to consider Pareto efficiency (Jacquemin and Tulkens, 1996) as a criterion of social optimality in judging the market has led us to neglect all other criteria including personal freedom. Pareto efficiency defines a situation in which it is not possible to improve the situation of an individual without degrading that of at least one other individual; several solutions are possible and, for each of them, there is a distribution of resources which is more or less egalitarian between individuals.

In order to redisseminate the notion of ethics in economic reflexion, Sen develops the idea of "capability". Amartya Sen integrates the idea of freedom into this "potentiality", i.e. the freedom of an individual to choose between different possible lifestyles (Sen, 1992). "What real opportunities do you have with regards to the life that you can lead?" (Sen, 1987b).

The value given by an individual to property or the possession of property will only be considered in as much as this property enables him to achieve something which he considers to be important, i.e. his "capability". So, owning a bicycle is conditioned by the importance of the mobility that it gives to the individual; it can therefore contribute more or less to increasing his quality of life according to situations. Known as a "conversion rate", this potential increase in quality of life is relative to both the intrinsic and social characteristics of the individual.

It therefore becomes possible to approach the world of actors and that of the markets with a fresh and more creative outlook which allows us to open up possibilities.

Sen's idea of "capability" can therefore be included in a biodiversity management strategy. An integrated assessment enables the simultaneous consideration of questions of human development and the conservation of biodiversity, as illustrated by the setting up of the Niokolo Koba Biosphere Reserve in Senegal (Levrel, 2008). This participative method can help solve the problem of the use of natural resources and the existence of several booming banana plantations in the reserve's buffer zone. Their presence causes a deep disruption of the ecosystem such as the conversion of natural habitats to cropland, the use of input and the increasing scarcity of water.

A companion approach (see chap. 5.3.) enables all the actors to share and communicate in order to build solutions found collectively and which are beneficial for all the stakeholders, including biodiversity. In this process, the focus is on how the level of individuals' "capability" largely conditions their use of ecosystem services. This means that a situation of extreme poverty does not allow a person to adopt a viable use of biodiversity, even if they are the uses it valorises most (Duraiappah, 1998). Observation of the strategies adopted by the actors, and the discussions, confirms how much the increase of "capabilities" is constrained by the existing possibilities of diversification of uses (banana and groundnut crops, livestock breeding). In the Senegal example, the assessment and dialogue processes have made it possible to stress the possible synergy between the reinforcing of actors' "capability" and the preservation of biodiversity, benefitting from the diversification of uses (Levrel, 2008).

The idea of "capability" thus offers actors an alternative for analysing the impacts of their decisions by studying the allocation of those decisions on the range of choices, and then on how the different stakeholders use this choice. "Capability" policies make it possible to better understand the interactions between the different stakeholders. The challenge is therefore to keep as many wide choices as possible.

5.3. MULTI-AGENT MODELLING FOR ACTORS AND BIODIVERSITY: INTEGRATING THE HUMAN ASPECT

In order to gain a better understanding of the interactions between social and ecological dynamics, researchers from CIRAD*[6] have developed modelling activities, and in 1993 the anthropologist and economist Jacques Weber created the GREEN[7] research team. The team has since developed and takes part in a great deal of work, and specifically the ComMod[8] project.

5.3.1. A different understanding of the stakes

One of the fundamental principles of GREEN's work is to tackle questions raised by going beyond disciplinary approaches and the particular angle they take when they broach any question. Therefore, for a given environmental question, some will see "an ecological system which is subject to anthropic disruptions" where others will understand a "social system subject to natural constraints". In the first case, researchers use the dynamics of the evolution of resources and consider the management of these resources in terms of human activity-induced modifications and their long-term effects on the ecosystem. The social dynamics are then represented according to the type of harvesting of the resource generated (Amblard *et al.*, 2006). In the second case, researchers generally focus on the problems of how the resource is used on the principle that isolated economic actors will try to maximise the profits obtained from the harvesting of a limited resource. The collective use of a common resource is therefore placed under the sign of competition (Amblard *et al.*, 2006). But this bipolarity of

[6] http://www.cirad.fr/en/home-page

[7] http ://www.cirad.fr/ur/green

[8] http://cormas.cirad.fr/ComMod/en/index.htm

the perception of the interactions between social and ecological dynamics is not everything. One can and should tackle the issues with a less differentiated approach where human beings would not be outside the ecosystem but well integrated within it. In that case they will be neither subject to natural constraints nor a threat to its environment.

Being able to integrate the human being into the reflexions on the interaction of social and ecological dynamics means putting actors' words, and therefore their representations, back at the centre of decision-making. By actors we mean both decision-makers, scientists, local actors and economic actors, i.e. "the citizens", and this is where the companion modelling approach comes into the picture (Bousquet *et al.*, 1996).

An important issue broached using this companion modelling is that of the participation of lay people with institutional actors and experts in the development of local policies.

Multi-agent modelling and role-play, developed in the 1990s and aimed at strengthening actors' reappropriation or ability to intervene in the procedures for managing their environment (Aquino *et al.*, 2002; Daré, 2005). This method allows the different forms of know-how (scientific, technical and local) and different actors (researchers, managers and users) to live together and express themselves, lessening the implicit balance of power. The end result is the building of a common modelling of the interactions between natural and social dynamics (Chlous-Ducharme, 2008).

The understanding of the dynamics of a research topic requires a broad and complex vision of social and ecological systems. The relevant social environments and groups must be defined and actors' perceptions clarified. This consideration of each actor's own perception is what makes this such a powerful tool. The aim of multi-agent modelling is to understand how the different processes interacting in a given environment are coordinated. It is therefore important to consider the ecological and social processes at stake.

5.3.2. A constructive method: ComMod

The ComMod[9] approach tool offers the possibility of developing simulation models which integrate the different points of views of actors, and of using them in the context of collective training platforms. This is a modelling approach in which actors take full part in the construction of models in order to improve their relevance and increase their use for the collective assessment of scenarios. The main objectives of ComMod consist of facilitating dialogue, shared training and collective decision-making in an interdisciplinary and implicated research-action which aims at reinforcing local communities' capacity for adaptive management. Likewise, at the centre of the approach lies the issue of appropriation. The actors are directly involved in decision-making and consequently are responsible for it. It then becomes more justified to set up decisions taken collectively during a process where all the actors are on the same level. Using such an approach would appear to make it easier to tackle the growing complexity of the issues related to the management of natural resources, their changing characteristics and the increasingly rapid organisational modifications (Amblard *et al.*, 2006).

As in the case of any other form of representation of a potentially manageable system, multi-agent models make it possible to increase knowledge of the ecological and social processes at stake. In this way the collective creation of a common artificial world serves to develop a shared representation which is required for simulating various scenarios identified by the actors and with the help of scientists. Within this framework, all decisions, and particularly those which are collective, depend on the context and must be considered as a special stage in the continuous management process of a complex challenge. In the words of Roling (1996): "on the basis of their intentions and experience, people build reality creatively with their language, work and technology. These same people change their reality over time in order to adjust to changing circumstances". This approach also makes it possible to collectively mobilize these representations and, during the joint construction of a model or when taking part in role-play, there can also be an increased wealth of overall perceptions from the points of view put forward by the other actors (Chlous-Ducharme *et al.*, 2009).

[9] http://cormas.cirad.fr/ComMod/en/index.htm

5.3.3. A tool to be shared with stakeholders

Multi-agent systems (MAS*) provide a simulation process which is rich in potential because they make it possible to model interaction processes between actors and between social and natural dynamics. They actually make it possible to deal with human and non-human agents which have their own perceptions, methods of communication and control, using the same structure and the same procedures. They also make it possible to represent individual, collective, real or symbolic agents, in an interactional dynamic which is not predefined. In this, they are one of the first adequate social science modelling processes which does not involve an exaggerated reduction of real complexity. They are an interdisciplinary tool for dialogue and enable the building of models which can be socially validated or invalidated, without claiming that they are "true" or "false". Multi-agent systems, whose history is recent, open new prospects for exploring social and natural interactions in the long-term (Bousquet *et al.*, 1996).

As an illustration, the companion approach was proposed to encourage the coordinated management of the very special environments in the geographical region of Le Causse Méjan. This outstanding region has been shaped by human activities (livestock breeding, grain farming and wood production) which have generated steppe-like areas with a high biological diversity. Changes in livestock breeding systems and reforestation programmes in the 1970s encouraged the spread of Scots pine and black pine and both these trees have invaded the territory of livestock breeders and decreased forage production. The simulation and role-play tools used in the companion approach have resulted in the raised awareness of the dominance of conifers on the territory and encouraged mediation as a real support for decision-making. This approach made consultation between actors subject to the same ecological dynamics easier. The appearance of innovative behaviours was favoured by the plethora of opinions and actors. Lastly the approach made it possible to offer the administrations concerned agri-environmental measures aiming at re-establishing areas with heritage stakes. These local plans set up in a coordinated way between companies, users and elected representatives, reflect the aims of all and are consequently better accepted (Etienne *et al.*, 2010).

5.4. THE WORK DONE BY THE ORÉE WORKING GROUP

The work done by the ORÉE Working Group was carried out in stages. A first stage (2006-2008) showed that economic activities not only generate impacts but also largely depend on biodiversity and ecosystem services (BES). This stage resulted in the creation of the Business and Biodiversity Interdependence Indicator (BBII*) (see chap. 2.2.1). and the publication of ORÉE's "Integrating biodiversity into Business strategies" guide book (Houdet, 2008).

Since 2009, within the framework of the Management subgroup of this Working Group, case studies bearing specifically on the incoming and outgoing movements of biodiversity in organisations were developed, and served as a basis for the drafting of this book. At the same time, the work carried out in the framework of the Working Group's Accountancy subgroup addresses the development of a Biodiversity Accountability Framework approach, i.e. an approach which will result in the design of practical tools for taking into consideration this interdependence between economic actors and biodiversity.

In 2013, the Working Group drafting this book chose to explore the interfacing of human system dynamics and biodiversity dynamics, and to tackle the complexity of these closely linked systems in order to better reconcile them.

5.4.1. Work carried out by the Accountancy subgroup of the ORÉE Biodiversity and Economy Working Group

Context

Since the end of the first decade of this century a number of tools dedicated to the analysis and management of the interactions between actors and biodiversity and/or ecosystem services have seen the light of day, and these have greatly increased over the last few years: from around ten in 2010 (Houdet, 2010) there are now around forty, some of which have been mentioned in this book (see chap. 2.2.). Two recent books make it possible to reference a large number of them: *Eco4biz* (WBCSD*, 2013) and *Measuring and Managing Corporate Performance in an Era of Expanded Disclosure* (Waage *et al.*, 2013). The second book offers a coordination framework for the categories of tools, and illustrates it with those considered to be the most relevant.

These various tools, which are interesting from a conceptual point of view, do however have a certain number of limitations:

- Mainly focused on the issues related to production sites, they leave out part of the interaction interfaces between actors and biodiversity, and specifically those related to overall corporate strategy and its economic model.

- Their approach does not include other tools which would make it possible to restore corporate performance in terms of biodiversity and ecosystem services, or those which enable the assessment of this performance.

- Lastly, none of them offer a subsequent integration of biodiversity- and/or ecosystem service-linked assessments in ad hoc decision-making. These assessments cannot therefore intervene in the continuous steering of activities and do not allow the monitoring of the evolutionary dynamics of ecosystems and the organisation concerned.

Since 2009, ORÉE's Biodiversity and Economy Working Group's Accountancy subgroup has chosen to take a different path to reach its objective; the integration of biodiversity and ecosystem services in corporate accounting data systems. The inclusion of environmental information in accountancy has a number of advantages, specifically in the raised awareness of managements, improved decision-making, and even inspiration for developing actors' management or coordination processes relative to biodiversity and/or ecosystem services.

Methodology

The use of accountancy can be justified by the dual aim of:

- As a first step, building a tool which will enable the taking into consideration of interactions between multiple actors: companies, local authorities, inhabitants,[...] and biodiversity (Houdet, 2008 and this book);

- In the long run, developing tools which will make it possible to consider the interactions "between" actors on the subject of biodiversity.

The accountancy tool is used by all the actors involved in biodiversity issues and is more or less sophisticated in terms of assets and liabilities. Moreover, accountancy makes it possible to extend the analysis to all the stakeholders including those who are not on a given territory but who will have an influence on corporate strategy, e.g. the shareholders, apart from speculators, who will be interested in the fact that the erosion of biodiversity is a medium-term threat in terms of corporate activity (see chap. 1.2.2.).

The approach proposed by the Working Group's Accountancy subgroup is intended to complement the work developed at the Paris Dauphine University by Professor Jacques Richard's team who proposes a new organisation of accounting known as the CARE model (Richard, 2012).

This model exclusively addresses the consumption of natural capital and therefore the company's impacts on its environment. It insists on the notion of "natural resource use thresholds" in the same way that a company has "machine use thresholds" which are then associated with the machine's depreciation period. In the case of the machine, this means avoiding irreversibility due to insufficient depreciation costs.

According to the same principle, the CARE model offers an approach by "depreciation of natural capital consumption". The notion of depreciation in accountancy is interesting as it takes into consideration the notion of uncertainty on the reality of the effect. There are therefore depreciation costs, extraordinary depreciation costs and provisions. In the case of provisions for future costs, there may be drawings on provision if the final cost is lower than forecast.

In 2012, Jacques Richard specified that:

- "if the depreciation of the environmental function is safe and systematic, it is an ordinary depreciation cost", e.g. soil sealing will disturb the functioning of the site over the long term);
- "If it is safe but episodic, this is an extraordinary depreciation cost", e.g. the impact of the choice of soil working uses can be the lack of nutriments in a soil;
- "If the depreciation of the environmental function is only possible, this is a provision", e.g. the possible spill of pollutants by an actor upstream of the activity site.

The CARE model does not however consider the fact that biodiversity can be useful for creating value in organisations, for example the added value of the company. The BBII* approach developed by ORÉE (see chap. 2.2.1.) made it possible to raise the different actors' awareness of their dependence on biodiversity. Certain case studies in this book have shown that it is possible to benefit from services free of charge and/or to destroy services with no compensation and that this can be harmful for the company itself (if it is deprived of the service) and for other actors if the company destroys services without compensation. With the accountancy approach of the monetary and accounting flows of biodiversity, the aim is to have a better consideration of the evolution of natural capital and therefore of ecosystem services in corporate strategy, whether in terms of depreciation or provisions, etc. The aim is to show that a depreciation of the natural capital (represented here by a depreciation of ecosystem services) can be a cost factor in the same way as a depreciation of the financial capital. To avoid "stowaway" behaviours this approach must be "universally" accepted.

The accountancy approach obliges financial managers and, more generally speaking, managers of companies (including SMEs) and local authorities, to integrate the issue of biodiversity. If this is only one of many environmental issues, financiers will help to reach an objective at a lower cost. If biodiversity is both a factor of costs and profits, then the whole production chain of the company may find itself questioned and thus implicated. This will be all the more true for the actor's Research and Development and innovation strategy if it is through a change in practices, processes and products marketed which should integrate these new constraints for the company. Until now, natural capital has been perceived as free of charge and available in unlimited quantities. The cost for companies to use it was either nil or based on the price of extracting the resource. The paid price was never associated to the scarcity of the resource or the risk of disappearance of a service.

With our approach, the aim is to show that biodiversity has an effect on costs and the creation of "added value".

5.4.2. The future-oriented studies of the Operational Management subgroup of the ORÉE Biodiversity and Economy Working Group

In light of the experience of its participants over nearly ten years, the Biodiversity and Economy Working Group is proposing to extend its collective work in the Operational Management subgroup to an issue which to us seems fundamental for the future of human activities: that of the interfacing between the dynamics of human systems and the dynamics of biodiversity.

Basic premise and aims

The state and evolution of biodiversity are often broached by regular surveys of the endangering of specific species (e.g. species monitoring and Red List) but these "snapshots" might detract from the underlying dynamic which is that of a living system. This dynamic however exists on the local level of a site or an ecosystem as much as at a global level. The evolution of biodiversity in space and time determines its future in an anthropized* landscape of the planet and also conditions human activities, specifically for the future of ecosystem services (see chap. 1.1.).

In the same way, actors observe the state and evolution of their own activities using appraisals such as balance sheets or LCA (see chap. 4). Even though these tools can be used to support strategic reflexions, they cannot be the only reading guide for the activity and are not sufficient to reflect on a time and space dynamic of an actor's or a group of actors' activities (of a sector or a territory) and its future.

Today these two entities of biodiversity and human activities are two systems which are attempting to live and change, more or less consciously and voluntarily together, each with their own dynamics for the observation of which monitoring tools exist (Boeuf, 2012). But these two systems are in fact interwoven in terms of their functioning as well as their future. There can be no human activities without biodiversity; as Einstein is supposed to have said: "the day bees disappear, humanity will only have four years left".

This need to think in terms which resonate with both human development and that of the rest of the living world is surely not a new idea for a number of populations or individuals on this planet. But for our modern and often urban societies, which are "disconnected" from biodiversity on a daily basis, this is an approach which needs to be clarified. René Passet symbolized it by three concentric circles, the economy being included in society which itself was placed inside the biosphere. He was thus the founder of environmental economics (Passet, 1979). Taking up once again his idea of interwoven systems, Jacques Weber recalled more recently the fact that ecosystems and their biodiversity support economy and society (Weber, 2013) (see Introduction).

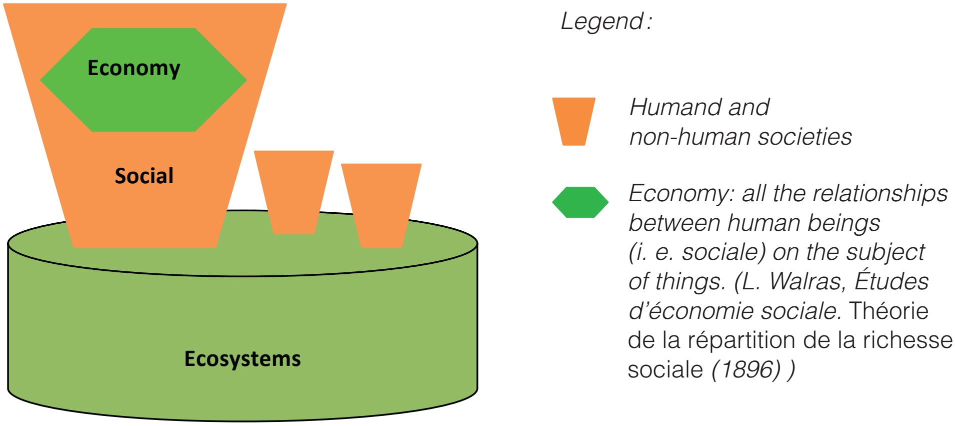


Figure 25: An end to the "three pillars of sustainable development": The role of ecosystems in supporting societies and their economy

As early as 1972, and twenty years before Rio, Ignacy Sachs had conceptualised ecodevelopment as follows: "a development in harmony with nature", the word harmony being used in the physical sense of "vibrating with" (Sachs, 1993). In 1992, we talked more restrictively of sustainable development. This idea of "vibrating" together, in terms of human activities and biodiversity, is the subject that the Working Group proposes to explore.

Through exchanges and collaboration, the Group therefore proposes to use the variety and complementary nature of its participants (local authorities, companies, associations and experts) to prepare the ground for a reflexion on the way in which these dynamics of space and time can fit together to preserve a human future for our planet. The challenge is considerable and the aim ambitious, but there are already knowledge transfer paths and tools in the field of ecology, that together with businesses, local authorities and human science make it possible to help build a promising collective reflexion of a pluridisciplinary and multi-actor approach which can define the optimum procedures to be followed.

Thinking in this way of the interface between actors and biodiversity, or more precisely "between actors in terms of biodiversity", for building their future and that of the biosphere, questions first and foremost the perception and language and therefore the ideas of the actors; these aspects have already been mentioned in various places in this book. From the entrance of the term biodiversity in scientific and later political and public language, to tools for coordinating actors and communication, we have highlighted how much the actors' perceptions are fundamental and have to be considered, as much in asking the questions as in finding the answers.

Method and first steps

For the design of any project, at the actor or collective level, and before even looking for or building tools enabling the (re)conciliation of living and anthropized* systems, just as in industrial ecology and ecological engineering, the importance of the human aspect must be raised.

The Working Group and the diversity of its participants is therefore an ideal laboratory for ideas and experiments.

Before finding any kind of answer, the question must be well-defined and relevant, and this will make it possible to share the challenge, followed by the answer and its implementation as well as managing the consequences of choices. Working on this pre-condition means focusing on the actors and tools available to develop this question.

As a large quantity of the work mentioned in this book has already highlighted, the perception of the systems studied is a fundamental pre-condition.

The various approaches presented in this book show that the future of the planet, and thus Humanity, depend on the manner in which the complex dynamic interactions between human beings are going to be managed with regard to biodiversity and ecosystem services. Reconciliation ecology, metamorphosis, potentialities, multi-agent modelling, accountancy, etc. are all tools which are not rivals but complementary for managing this complexity. Our future research and collaborations are already part of this analytical framework.

The system, one of many representation tools (E. Lateltin, 2013)

A "system" is first and foremost no more than a representation tool. This conditions its comprehension and reappropriation by actors.

The systemic approach is based on the representation of the contextualized relationships between the entities of a bounded set. The study bears both on the entities and the network by which they interact. This means we have to suppose that these entities are interdependent, and that by modifying one of them we will therefore modify the whole set. This set is represented by a system, and a number of trials have made it possible to formalise its characteristics (Lemoigne, 1977).

A system is structured and separated from its environment by a boundary. Its entities are linked together by a communication network. But the system is continuously in communication with its environment and its network ensures its functions of conservation, regulation, reproduction and adaptation to this environment via feedback loops.

This definition of a system supposes that we have identified a part of the world, separated the system from its environment (in order to simplify the study as far as possible), composed the system from certain entities, focused our point of view on certain functions, and chosen to observe certain properties of its functioning.

The system is therefore really a tool for generating a representation chosen by a subject to solve a problem. Consequently, any word relative to the term "system" or "ecosystem" precludes certain representations and certain problems which cannot be broken down into simply the properties of the systems.

The example of the forest requiring sustainable management can illustrate the representations and consequences of a forest system approach for some actors; here forest sustainability (access and use) is reinterpreted by them in terms of standards of procedure and performance (certification) of a good management of the forest's structural elements (ecosystem). The ecosystemic representation is used to the exclusion of all other representations, specifically those that the actors who live in and off the forest may have. The representation of this forest system is presented as a universal representation which is valid whatever the problem and, on the basis of scientific objectivity, is the only legitimate one. There is no alternative or iterative dialogue between contributors or even the actors of the territory. This is an ill-adapted simplification of the complexity of a forest, and contributes to a mystification of the method (Brédif, 2008).

CONCLUSION

> *“Let us start by helping economists solve their problems through ecological approaches and not the opposite.”*
>
> (J. Weber)

This book is the result of the reflections and discussions led by the Biodiversity and Economy Working Group over the last few years. A first book in 2008 served as the foundation for a common and fruitful reflection, and its analysis of the perception of dependence on biodiversity has enabled the partners to go further in analysing dependence and, above all, actor-biodiversity interdependence. Real case studies were required to perform this analysis and they were carried out within the scope of the "Operational Management" sub-group on various scales, for example at both organisational and spatial levels. Having used these experiments, the current work of the Working Group can be illustrated by special focuses on stakes such as the conciliation between economic activities and biodiversity and the raised awareness of actors to biodiversity stakes. Eyewitness accounts also accompany the question of integrating biodiversity at product and service level as well as the management of biodiversity around the territory. The various itineraries described may help to share an illustrated reflection with readers to inspire them in their own activities.

The content is rich and constructive and filled with ideas and experiments, but it also highlights the current pitfalls and weaknesses and helps to identify avenues for work.

- It is important to mention the difficulty of controlling the whole sector and even the product's life cycle. It is indeed difficult to identify all the actors right through the production chain and to define and collect data. It is therefore important to reflect on tools which enable a good traceability at production chain level both in the management of input and the management of output and waste.

- Actors generally study the services which are directly connected with their activities and on which they depend directly. This then raises the question of identifying those that they manage or do not manage and those which may or may not lead to monetary transactions. Today the exercise is a hard one when it comes to analysing the options open to actors who are faced with services they do not manage and which are not subject to a monetary transaction. Another avenue for work is developing with the study of services which are not directly linked to production (carbon footprint, recreational heritage, etc.), services that actors will generally manage alone or with other actors at territorial level and which do not lead to monetary transactions. To date, however, those services which are not directly linked to production can produce costs for the company which have no real monetary consideration. In this last case, and in the case of a crisis within the organisation, it is to be feared that budgetary restrictions will be focused initially on this type of non-core activity which is ancillary to the productive activity of companies and which is nevertheless significant in terms of biodiversity and economic consequences.

- Certain experiments and reflections mentioned in this book have focused on the interactions between stakeholders on the subject of biodiversity. Through this prism, the actor can on the one hand analyse the services (whether he manages them or not) which will have an influence on his activity, and on the other consider services (whether or not he manages them) which will have an influence on the activities of others. The cases presented have been diverse and, where some concentrate on securing input, others focus on the consequences of their activities on others (i.e. positive or negative impacts), and lastly others study both upstream and downstream dependence.

Whatever the level of analysis, the question that remains for the actor is that of how to measure, in terms of physical and monetary flows, the interdependence of his activity with biodiversity. If the option chosen is the measurement of monetary flows, then other issues arise, such as measurement in terms of costs, avoided costs, opportunity costs and the costs of inaction, profits and payment for maintaining ecosystem services. The wide variety of case studies presented shows the wealth of the work accomplished and the scope of what has yet to be done. An essential question for the years to come is that of how to take these inflows and outflows, and thus the interactions between actors relative to the living system, into consideration.

Work is in progress which aims at taking account of the fact that human activities are increasingly integrated and that the actors themselves are interacting more and more. The work presented here is complementary and deals with industrial ecology, circular economy, potentialities, etc. ORÉE contributes to reflection on these subjects with the Biodiversity and Economy Working Group Accountancy and Management sub-groups.
The Working Group Accountancy subgroup is a necessity for raising the awareness of all the actors to the fact that biodiversity is not just an environmental issue. It is also essential that all the companies including SMEs should integrate biodiversity into their strategy without jeopardising their competitiveness. The Operational Management sub-group proposes to approach the problem of the upstream interdependence of human activities and biodiversity by studying the possible functioning, evolution and coevolution* of human systems and natural

systems. To think in terms of dynamics by considering the trajectories of ecosystems and those of actors or groups of actors on a territory will make it possible to support the actors' long-term reflection. ORÉE is therefore positioned in the national and international context, as a driving force for reflections, actions and proposals.

Using its wide panel of members and its daily work on the topic of biodiversity, ORÉE and its partners propose to analyse and try to understand the inherent complexity, in order to identify avenues for action for all the stakeholders.

> "*Biodiversity, as it is known, is still too often thought of as a nomenclature or a list of possessions, i.e. hardly thought about at all. Consequently it should be considered as the support of a grammar which can generate gestures and relationships, intermingling and escape, as a gigantic parade of behaviours and openings.*"
>
> (Bailly, 2013)

THE CONVENTION ON BIOLOGICAL DIVERSITY

Convention on
Biological Diversity

The Convention on Biological Diversity

The Convention on Biological Diversity which was opened to signature at the time of the Rio de Janeiro Earth Summit Conference in 1992 and which entered into force in December 1993, is an international treaty for the preservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from the use of genetic resources. With 193 Parties, the Convention has participants in practically every country in the world. The Convention seeks to take account of all the threats affecting biodiversity and ecosystem services, including the threats resulting from climate change, with the use of scientific evaluations; the development of tools, incentives and action; the transfer of technologies and good practices; and the active and full implication of the most appropriate stakeholders including indigenous and local communities, young people, associations, women and the business community. The Cartagena protocol on biosafety is a supplementary agreement to the Convention. It seeks to protect biological diversity from the potential risks posed by modified living organisms resulting from modern biotechnology. To date, 166 countries plus the European Union have ratified the Cartagena Protocol. The Secretariat of the Convention and its Cartagena Protocol is located in Montreal.

More information on: www.cbd.int

The strategic plan for biological diversity and the Aichi targets

At the tenth meeting of the Conference of the Parties (COP 10) held in October 2010 in Nagoya, Japan, the Parties adopted a revised and updated Strategic Plan for biological diversity for the period covering 2011 to 2050. This new plan represents the general framework of work on biodiversity for the whole United Nations system. The 20 Aichi biodiversity targets are the key elements of the new strategic plan and are organised into five strategic goals. These strategic targets and goals represent hope for success on a global level and a flexible work plan for establishing national or regional targets. The Parties are encouraged to develop their own objectives in the scope of this work plan, taking into account the national needs and priorities and bearing in mind the country's contributions to reaching global targets.

See all the Aichi biodiversity targets: http://www.cbd.int/sp/targets/

Access and benefits-sharing

The Nagoya Protocol **on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity*, which was adopted at the third meeting of the Convention on Biological Diversity, is an international agreement which aims at sharing the benefits arising from the utilization of genetic resources in a fair and equitable way. This includes affording appropriate access to genetic resources and the appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies and, by appropriate funding, thereby contributing to the conservation of biological diversity and the sustainable use of its components. It was adopted by the Conference of the Parties to the Convention on Biological Diversity at its tenth meeting on 29 October 2010 in Nagoya, Japan. The Nagoya Protocol* will enter into force 90 days after the date of deposit of the fiftieth instrument of ratification.

For background information on the Convention's work programme on access and benefit-sharing prior to the adoption of the Nagoya Protocol, for information on the negotiations of the Nagoya Protocol*, and for information on the negotiations relative to the Nagoya Protocol*, please see the following pages: http://www.cbd.int/abs/

The Global Partnership for Economy and Biodiversity

The Global Partnership for Business and Biodiversity was developed from the commitments of the Convention on Biological Diversity (CBD*) with the economic sector. The CBD* secretariat and various partners have undertaken "to encourage the development of initiatives for business and biodiversity on a national and regional level by setting up a forum for dialogue between the Parties and the other governments, the economic sphere and the other stakeholders, with specific focus on the global level". The general mandate of these national initiatives is to "encourage dialogue between stakeholders […] and to help raise awareness on biodiversity and the sustainability stakes within the economic community". These national initiatives should also support companies in identifying and understanding the Convention's objectives and the Aichi targets". This means that, ideally, a large majority of enterprises could become sustainable from an ecological point of view by strongly reducing their negative impact on biodiversity, and may even have a positive impact. In order to attain this goal, it will be important to focus efforts where they will be the most effective and, at the same time, to raise and create synergies with the work of the other corporate components. Such initiatives currently exist in a number of countries such as Canada, Germany, France, the Netherlands, Japan, Brazil and South Africa. Many other countries have also committed to developing such initiatives.

For more information see: http://www. cbd.int/en/business/global-partnership

Through its mandate for the commitment of economic actors, the CBD* also works at global, regional and national levels with a number of partner organisations all over the world. The Secretariat is in charge of compiling, analysing and disseminating a variety of tools and methods, case studies and good practices. Work is also carried out with the partner organisations to integrate biodiversity into public sustainable development policies. Lastly, the CBD* works with the other international treaties on biodiversity and sustainable development, including the other Rio conventions (UNFCCC and UNCCD), and is also involved in post-2015 agenda discussions concerning sustainable development stakes.

CASE STUDIES AND THEIR INITIATORS

8.1. Case study initiators

Aware of the increasing pressure that human activities have on natural resources and equilibriums, we consider that it is our responsibility as a builder and operator to understand and limit the carbon footprint of our developments and services.

Our target is to take all forms of biodiversity into consideration, from the remarkable to the ordinary – along with the ecosystem services it provides us with throughout the life cycle of our projects from design to operation.

Our approach consists of adapting to the context, i.e. to climates, territorial geography, the expectations of communities and of our user clients... We believe that it is safe to bet on the possibility of associating the restoration of nature, sustainable construction and a search for well-being.

We have chosen to focus our action by working on two perimeters: urban blocks i.e. buildings, eco-quarters, green spaces and public lighting, and infrastructures.

To meet our commitments, we have adopted an action plan, structured around three targets:

1. TO INNOVATE and strengthen the Group's technical expertise:

- Continue the R&D programmes devoted to biodiversity in each profession.
- Integrate biodiversity into the environmental management system of projects and develop tools to monitor the efficiency of the actions implemented over time.
- Strengthen the Group's expertise with the help of expert ecologists, by developing the skills of our collaborators and encouraging in-house sharing of knowledge.

2. TO PROVIDE new offers of products and services relative to biodiversity by:

- Meeting the expectations of the civil society on the services rendered by nature in urban, periurban and rural environments.
- Offering our clients innovative offers and services for protecting and enriching biodiversity according to the project's potential.

3. TO BECOME INVOLVED in collective dynamics with all our stakeholders by:

- Taking part in collective discussions with the scientific community, environmental protection associations and all our partners to share our experience and move forward together.
- Raising our collaborators' awareness on the preservation of biodiversity and encouraging initiatives.

To pilot this strategy, a specific governance method was set up which brings together representatives from different professions, ecologists, and a network of external partners.

Applied by all the professions within the Group, this strategy is initiated by our collaborators to make **Bouygues Construction** a relay for the preservation of the natural heritage and a partner of local communities, economic actors and the civil society to build a sustainable living environment together.

CODDE is a centre of expertise in ecodesign and Life Cycle Assessment for the Bureau Veritas Group and has over 15 years of experience in the field. Our company is a partner of a number of firms in industry, large-scale distribution and services in the sectors of consumer products ranging from electrical and electronic, to textile, furnishing, toys, agrifood, construction and transport.

Bureau Veritas CODDE thus accompanies and supports companies at all levels of their environmental product or service policy: assessment of environmental impacts (ACV), accompanying the defining of a relevant ecodesign strategy and the integration of ecodesign in organisations, certification of their ecodesigned products or services, environmental declarations in PEP, FDES and EPD format, environmental labelling of consumer goods, transfer of skills through training and the availability of the LCA and ecodesign tool we develop: EIME.

This Life Cycle Assessment and ecodesign tool was created in 1997 with financial backing from ADEME* and is the basis of specifications of an industrial group. The majority of environmental assessments carried out by Bureau Veritas CODDE use EIME (Environmental Improvement Made Easy) methodology.

ISO* 14040 and ISO* 14044 requirements describe the method to implement for carrying out Life Cycle Assessments for both products and services. Using the EIME software and its database allows CODDE to comply with the principles of LCA standards. The new version of the software (version 5) was developed according to the requirements of the ILCD[1] platform and integrates both the European ELCD database and the CODDE database.

The most important feature of EIME is its accessibility. The EIME user-friendly interface and ready-to-use database allow designers to draw up the environmental profile of any type of product or service.

Its research and development activities enable CODDE to develop its skills and expand its knowledge of the methodological problems specific to LCA including the integration of biodiversity into the Life Cycle Assessment of products or services.

Bureau Veritas CODDE is also developing on an international scale in order to offer you tools and services which are best suited to your requirements and which are consistent with changes in regulations and standards.

[1] International Reference Life Cycle Data System *(ILCD)*

The **Écopole of the community of communes of the Oléron island** has committed to upgrading its channel of plant waste processing by composting and the production of a fuel for its wood-fired heating plant.

A platform for composting green waste was developed on the Matha site (municipality of Dolus d'Oléron) in former quarries. The target of this project was the development of a complete facility, controlling nuisance and producing compost which meets standards.

The project is part of the framework of a global redevelopment plan for the Matha site. In the long term, the site will have other functions such as the management of scrap wood, fuelwood energy and inert materials. These activities must preserve the site's lanscape and ecological qualities.

Due to its climate and geographical location, the Oléron island offers a wide variety of plant species and is also well-known for its very special species of mushrooms. The island also has a very rich animal life with over 250 species of birds and 34 species of mammals. In 2007 the island was listed for the preservation of heritage and landscapes.

With over 90% of its surface area reworked, the overall view of the site was one of an area with a low ecological potential. Apart from the artificial lakes, whose characterisitcs seem ill-suited to wildlife (very steep banks, a great deal of floating and immersed waste), the habitats were represented above all by areas of grassy wasteland.

The Oléron/INDDIGO case study targets establishing a link between the flow of materials necessary to the activity of the site and the ecosystem services concerned, either directly or indirectly, with the aim of optimizing both economy and biodiversity.

The method retained consisted in analysing how, right through the project (construction and operation), biodiversity could have been or could be better integrated. This critical assessment must give us insight and serve as a basis for recommendations in the framework of INDDIGO's future engineering operations.

The site presented in the study, of which **INDDIGO** is the designer and prime contractor, is now called the "Écopole of the Oléron island". This Eco-cluster is committed to an approach which should result in the methodological standardization of the way in which it manages its relationship with biodiversity with the INDDIGO design office.

Up until 1990, the site was occupied by a limestone quarry which was subsequently impounded and partly and temporarily operated for waste processing. In 2009, the site was developed for four activities:

- Composting of green waste (8000 t/year)
- Manufacture of wood chips and fuelwood (1 000 t/year)
- Inert waste storage (30 000 t/year)
- As an educational area

Crédit Coopératif has been a member of ORÉE since 2006 and is the banking partner of a large number of companies and general interest associations. It is strongly committed to the development of renewable energy and environmental protection.

Crédit Coopératif has a nation-wide presence. Its sustainable economic model is one where priority is given to people rather than capital. As a co-operative, its capital is provided by its clients who are also members who make up the Board and take part in the decisions made by the bank.

Crédit Coopératif is the banking partner of environmental actors including a number of co-operatives, industrial groups, SMEs, general interest bodies, and companies in the eco-industrial sector of waste processing and recycling and the production of renewable energy.

Its clients also include environmental protection associations working on renewable energies in France or in developing countries, on the protection of wildlife and energy management.

Its actions:

It finances their added-value environmental projects related to ecohabitat, eco-industries and energy management, and accompanies its clients - companies, associations, general interest bodies and also private individuals – who want to act for the environment, by offering solutions which take the ecological criteria of their project into consideration.

It has developed a range of products and services to meet the requirements of companies:

- Carbon Assessment, in partnership with Indiggo (sustainable development consultancy and engineering)
- *1.2.3 Environnement* or *Envol* Environmental Certification
- Social Accountability Certification
- Financing of green investment solutions
- Leasing
- Strengthening of equity

It also offers all the day-to-day banking services such as remote banking, means of payment and international services along with a range of investments which provide resources for partners investing in sustainable development*, in particular Undertakings for Collective Investment in Transferable Securities (UCITS) managed by Ecofi Investissements, Crédit Coopératif Group's management company, which has developed a strong expertise in matters of ethical management.

Some of Crédit Coopératif's commitments:

Crédit Coopératif is a partner of Comité 21, L'Observatoire de la responsabilité sociale des entreprises (ORSE), Observ'ER, PEXE, le Syndicat des énergies renouvelables (SER), France Energie Eolienne (FEE), AMORCE, the SCIC Enercoop (supplier of green energy).

Dervenn accompanies public and private actors in the implementation of actions for the living world, with a positive vision of the relationships between societies and ecosystems. Founded in 2002 by Patrice Valantin, Dervenn was specialized at the time in work on natural areas. It rapidly developed to intervene in a number of environments in the Northwest of France. By recruiting technicians specializing in biodiversity, using specific equipment and innovating in practices which respect ecosystems, it has become one of the top ecological engineering companies in the western part of France.

In 2004, Dervenn set up a design office in order to provide an expert answer to the specific requirements of project managers. In 2010, it created a consultancy cluster to give a global strategic view and accompany companies and communities for the ecological integration of activities and territories, a strong lever for development.

Alongside the services developed for its customers on a daily basis, Dervenn's in-house research and development cluster, in collaboration with the wide network of partners, imagines and develops innovative solutions, for example the Biodiversity Progress© labelling standard was developed by Dervenn in partnership with Bureau VERITAS, on the basis of work carried out by Dervenn since 2008 on the interactions of organisations with ecosystems. Dervenn is also the instigator of the *Fonds d'Intervention pour le Patrimoine Naturel* approach (FIPAN© - Natural Heritage Intervention Fund), supported today by a dedicated association: FIPAN©.

Dervenn is currently the only French group to offer overall interventions (studies, work, consultancy and Research and Development) in the fields of ecological engineering and ecosystems.

The **EDF Group** is an integrated energy company and a leader on the European energy market and present in all professions such as the production, transport, distribution, trading and sale of energy. The leading European producer of electricity, in France the Group's means of production are essentially nuclear and hydraulic and provide 95.9 % of an electricity with no CO2 emissions.

In France, its electricity transport and distribution subsidiaries operate 1 285 000 km of medium and low voltage overhead and undergound electrical lines and around 100 000 km of high and very high voltage networks. The Group contributes to supplying energy and services to close to 28.6 million customers in France. The Group acheived a consolidated turnover of 72.7 trillion euros in 2012 of which 46.2 % were outside France.

The EDF Group is commited to the protection of the living world: As a user of natural land and water areas, EDF is strongly concerned by biodiversity stakes. Due to its activities (production, transport, energy distribution), EDF is highly dependent on resources such as water, air and soil. The majority of production sites are under 500 metres from Natura 2000* sites. Aware of its responsibility and the role it has with regards to these stakes, the company is committed well beyond the imposed regulatory framework. In order to limit the impacts of its activities on ecosystems, it is developing its knowledge of natural environments. EDF also strives to preserve and protect wildlife, to inform and train residents and engage in dialogue with experts and particularly NGOs.

All the professions are concerned by biodiversity and today, they must must take biodiversity into consideration, either for big industrial projects such as the building of new means of production, the acceptability of existing projects,or smaller-scale development work such as building car parks and storage areas. Biodiversity must be integrated as far upstream as possible from project design.

EDF has chosen to use ESR on one of its production sites. ESR is a tool for diagnosing the environmental stakes at the level of a site and developing an integrated management of these stakes. A certain number of advantages and limits have appeared that EDF is sharing in order to enable actors to use its experience through this tool and use ESR in the best possible way.

Aware of the impacts that its activities can generate on biodiversity, the **EIFFAGE** Public Works and concessions Group is an actor recognized for its commitment to biodiversity. The Company signed the 2011-2020 National Biodiversity Strategy and its voluntary commitments in this area make up a programme for piloting change within the Public works professions to consider integrating biodiversity stakes. The two higher goals of this programme are firstly to anticipate ecological transition and contribute towards stemming biodiversity erosion. The programme of actions resulting from this is both ambitious and pragmatic with the perpetuation and expansion of the internal dynamics initiated several years ago, raising the awareness of the social fabric, training and changes in practices intrinsic to professions, anticipation via long-term or innovative actions and specifically those relative to fundamental and applied research and to ecological services.

EIFFAGE has been in charge of the development of the future high speed line[2] between Le Mans and Rennes, known as LGV BPL[2] since 2011. As early as 2010, when the call for tender by Réseau Ferré de France was issued, EIFFAGE had approached Dervenn – an ecological engineering SME from Rennes - and FIPAN© to assess the feasibility of the FIPAN© approach with the aim of building an "agro-ecological infrastructure" on the railway infrastructure, independently from the environmental regulatory obligations linked to the development of the structure, and specifically regarding ecological offset. In its role as a developer and actor on the territory (200 km of track crossing three departments) exercising its responsibility towards natural capital, EIFFAGE wanted to act correctly and sustainably using the FIPAN© experiment. In the framework of this partnership the "FIPAN© BPL" project was thus initiated in 2011. It was also the first large-scale application of the FIPAN© approach.

The first two years of work made it possible to specify the methodology of action, the protocols and initial financial needs. Agri-ecological engineering action areas were targeted from a multicriteria analysis of the territory in a radius of 10 km around the future LGV. The issue areas are identified on the basis of existing ecological, hydraulic, and economic and landscape information and data. The project is now entering its operational phase and a test was first conducted with several volunteer farms to initiate the approach and launch a process on a territory selected in Ille-et-Vilaine. This test was continued at the end of 2013 with the development in the field of the first agro-ecology interventions on a farm, creating a "pilot experiment" which demonstrated in a practical and visible way what a FIPAN© approach represents.

[2] It will be commissioned in 2017, and EIFFAGE will ensure its maintenance and servicing until 2036

Aware of the essential role of the real estate sector in the fight against climate change, the optimisation of renewable resources and the limiting of the consumption of raw materials, **Gecina** integrated sustainable development* into its strategy and functioning in 2007 and resolutely committed to a continuous improvement policy. Its CSR* policy is structured around 4 pillars: Heritage, Planet, Collaborators and Society, and each of them is accompanied by commitments, action plans and key indicators. The ecodesign of buildings, integrating the reduction of their carbon footprint right through the life cycle of buildings, is therefore a priority. This continuous progress creates value and benefits all the stakeholders (communities, tenants, etc.).

Since biodiversity is a real and growing challenge for its professions, its heritage (design, building, operation and renovation) and its image, Gecina has made this a strong point of its CSR* policy at the heart of the responsible building. It is for this reason that Gecina has adopted an ambitious strategy with regards to biodiversity which was recognized by the government in 2012 with the award of the SNB* (National Biodiversity Strategy) label.

A strategy defined in 3 orientations and 10 commitments.

Gondwana was set up in 2005 by five business specialists who wanted to use their skills for the protection of biodiversity.

They all share the same belief: the company can only develop sustainably if it takes the living world into consideration in its functioning. They share this philosophy and their enthusiasm with a network of experts made up of scientists, sustainable development* specialists, design offices and even professionals from the field of ethical communication.

Gondwana is the first and only firm of consultants exclusively dedicated to the integration of biodiversity into the strategies of private and public actors. Thanks to its team made up of biodiversity specialists and strategic and operational consultancy and the development of innovative tools, Gondwana accompanies companies and local authorities in defining biodiversity policies and action plans.

LESJARDINS DEGALLY

Les Jardins de Gally is a company belonging to the family Group of Les Fermes de Gally. Located in Ile-de-France since 1746, the LAUREAU family has been running Les Fermes de Gally et de Vauluceau for four generations, just outside the Versailles Park. The fruit of several decades of diversification, the Group currently has 500 collaborators, distributed around three big activity clusters:

- Agriculture,
- The general public with a shop dedicated to a country life style: garden centre, decoration and regional products, and two educational farms,
- Services to companies: design, development, maintenance of indoor and outdoor gardens, a service of fruit provided for offices, decoration and flower subscription and plant decoration for event-staging.

In a context of global warming and erosion of biodiversity, **Thelema** (co-operative consultancy firm) was set up to contribute towards the restoring the balance of flows between economic and natural capital. Because it considers that a redistribution of natural capital is only possible if organisations consider the environment at a strategic level, Thelema's mission is to accompany them in the strategic integration of the environment. This specifically involves case studies, the assessment of their impacts and dependence regarding natural capital, and the mobilisation of tools such as the Carbon Assessment® or ESR (Ecosystem Services Review). In the framework of this study, the ORÉE methodology and the ESR tool were very much in demand.

The case study is the fruit of a close collaboration between les Jardins de Gally and Thelema. It was conducted in three major phases from March to June 2012: firstly, a perimeter was defined, followed by a phase of interviews and bibliographic research and lastly, the creation of indicators.

The work methodology is based on the four following elements:

- The analysis of internal documents relative to the management of the gardens and the development of a 2011 outdoor garden customers database which subsequently made it possible to define the main families of gardens maintained by Les Jardins de Gally according to the type of customer (companies, municipalities, private individuals, etc.), the surface area and the geographic location (town centre, residential area, industrial or rural park) of the garden,
- The flow analysis of on a garden scale and the study of the ecosystem services required and rendered by the garden in the town centre. This study was carried out using the ESR tool,
- Interviews and field visits,
- Bibliography and meetings with experts.

THELEMA
BIODIVERSITÉ ET GAZ À EFFET DE SERRE

L'ORÉAL

The world leader in the field of beauty, **L'Oréal** has served world beauties for over 100 years with a unique portfolio of 27 international, varied and complementary brands. In 2012, L'Oréal achieved a consolidated turnover of 22.5 billion euros and numbers 72 600 collaborators all over the world. In 2013, the Institut Ethisphere, a leading international think-tank on corporate ethics, corporate social responsibility and sustainable development named L'Oréal one of the most ethical companies in the world. It was the fourth time that L'Oréal had received this award.

For L'Oréal, who celebrated its one hundredth anniversary in 2009, the idea of sustainability is a permanent challenge. Using raw materials from plants, the Group started a reflection on the protection of biodiversity in 2002 which is an important source of innovation for the development of active cosmetic ingredients.

The preservation of complex ecosystems and their valorisation are essential for maintaining this potential for innovation. Moreover, the access to resources from biodiversity, under these fair and equitable conditions, is also decisive in the framework of an international responsible development. L'Oréal therefore works with its suppliers to make these supply channels real vectors of local development in the respect of natural resources. It committed as early as 2005 to the valuation of biodiversity according to the targets of the Biological Diversity Convention by:

- Identifying biodiversity stakes on procurement areas and defining suitable action plans, specifically on the richest and/or the most sensitive territories from the ecological point of view,
- Taking part in the creation of tools for understanding, managing and monitoring biodiversity,
- Encouraging the use of renewable raw materials sourced in a manner which respects biodiversity in the best possible way,
- Implementing action plans for the species valorised by L'Oréal and whose ecological status can be weakened, with the aim of minimising the negative impact, and even creating a positive impact.

The «Sustainable Argan» programme launched in 2008 demonstrates this approach.

The story of the **LVMH** Group began in 1987 when Moët Hennessy and Louis Vuitton decided to work together. The Group chaired by Bernard Arnault is the world leader in the field of luxury and is the fruit of successive alliances between companies, which, from one generation to the next, have successfully combined traditions of excellence, creative passion, opening onto the world and in some cases, since XVIth century.

Made up of over 70 distinct "Houses", the Group has close to 110 000 collaborators, 79 % of whom are based outside France, and is present in more than 3 000 shops in 90 countries. Due to its visibility and the aspirational nature of luxury, LVMH considers that it has a duty to be exemplary.

The different professions in the Group operate for the most part in the manufacture and distribution of consumer goods with a long lifespan or with a strong brand image. The main fields of activity are: wines and spirits, fashion and leather goods, perfumes and cosmetics, watches and jewellery and selective distribution.

Each branch of activity is made up of Houses of all sizes, and each brand has its own soul and an exceptional which it controls. Together they make up a Group of global dimension where the oldest Houses provide their expertise to the younger brands. Environmental subjects are dealt with by each House and also by the holding, which, since 1992, has offered the skills of its Environment Management to all the Houses. The Houses are obliged to respect the Group's Environmental Charter signed by Bernard Arnault in 2001. This charter materializes the vision of the Group on the way to integrate environmental protection into its activities and encourages each House Chairman to become involved in the approach by means of practical actions. Finally, the Group subscribed in 2003 to the United Nations Global Compact programme.

With the aim of controlling the impact of the different Houses with regards to the environment and biodiversity, the Group developed new skills for its professions. Biodiversity is recognized as a major stake due to the strong dependence of the LVMH group on the raw materials and processes of the living world, for wines or spirits (vines and wine making), perfumes and cosmetics (plants and oil-derived products), fashion and leather goods (wools, cotton, linen, silk, leathers and other natural materials), and for the shops, packaging and promotional items (wood, paper, cardboard and plastics).

The Group Managing Director, M. Antonio Belloni, subscribed to the 2011-2020 National Biodiversity Strategy (SNB*) and the Group's voluntary commitment programme was recognized by a panel of experts for the period 2012-2015.

Maisons du Monde was created in 1996 by Xavier Marie, for the distribution of items of decoration based on the valorisation of craftsmanship of countries all over the world. In 2006, the retailer offered its first catalogue of furniture made from tropical wood such as Mahogany from Indonesia, Sheesham, Mango tree and Acacia from India) and also wood from more temperate climates such as Pine, Oak, Elm and Birch.

Due to the lack of availability of certified tropical woods on the markets, and the increasing number of references in the Maisons du Monde catalogue and a number of sales points in Europe, it soon became essential for its founder to look, along with local actors, for solutions for a sustainable management of natural resources. Maisons du Monde thus instigated a dialogue with its suppliers to raise their awareness and accompany them in a forest certification approach. In 2010, at the time of the creation of sustainable development* management, the first partnerships with NGOs in the field such as TFT (The Forest Trust) were signed in order to act directly on the supply chains and forest resource.

At the same time, the shop developed its first carbon assessment and a simplified life cycle assessment on a sofa.

The study showed a real interest for ecodesign with results generating a significant reduction of environmental impacts, without leading to loss of quality or an increase in the cost of the product.

A first range of ecodesigned sofas saw the light of day, received the eco-product award from the Ministry of Ecology and ADEME* (Agency for the Environment and Energy Management) and created a precedent for the brand.

In the scope of this study, the materials from biodiversity such as the wood and the cotton were analysed. More than just being natural, these are materials which play an important role in the composition, quality, cost and environmental impacts of the product.

Lastly, the processing stages were determined by following the channel upstream to identify the n-2, n-3, etc. ranges and locate them, up to the producer ecosystem.

Pur Projet is a group of social entrepreneurs whose aim is to accompany companies in preserving the ecosystems on which their activity depends by an integrated approach for the management of natural resources. By integrating the socio-environmental stakes at the heart of channels and professions, Pur Projet builds bridges between the preservation/regeneration of ecosystems and corporate management with the added advantage of a number of benefits which range from safe procurement to innovation and increasing notoriety.

Because of the number of services it provides, the tree is an ally for ecosystem regeneration. Planting and looking after trees in agricultural channels makes it possible to replenish living and fertile soils and create virtuous circles for water, air, biodiversity and climate.

Maximizing the ecosystem services offered by the tree offers multiple benefits to farmers, local populations, industries and the planet.

"Trees provide unparalleled free ecosytemic services and there is no other investment which offers as much in terms of returns for all the stakeholders. As for agroforestry*, it is the compromise between the preservation of the forest and agricultural development and the basis of a circular economy." Tristan Lecomte, co-founder of Pur Projet.

Pur Projet calls this transition of companies towards a novel economic model "Insetting". As opposed to "offsetting" (carbon compensation), where the offsetting actions take place in a distinct place and using processes detached from the activity, "Insetting" integrates the socio-environmental commitments of companies from all sectors in their channels, professions and values.

Beyond this reconnection of the company with its ecosystem, Pur Projet is an invitation to reconnect with universal conscience and the values that the group intends to defend within organisations. Solidarity has a central role in their projects which are designed and developed by organisations of small agricultural producers. The purpose of these co-operatives or participative village associations is the general interest of local communities through social aid, environmental regeneration or development education.

Pur Projet currently has over 30 projects in 20 countries such as Peru, Brazil, Ghana, Morocco, India, China, Thailand, the Philippines, Japan, France, Spain and England.

These projects are supported by various brands and companies: Accor, Clarins, Vittel, Ben & Jerry's, Melvita, Chanel, LVMH, Etat Pur, Dumas Literie, Altarea Cogedim... and these companies all contribute towards the creation of positive growth, shared value and renewed ideals and are also helping to change the World.

An independent agricultural think-tank with a national and European vocation, **Saf agr'iDées** is a recognized association under the French law of 1901. Over the years, and thanks to the concepts and ideas it develops, Saf agr'iDées contributes towards bringing progress to farming and imagining and shaping tomorrow's European agriculture. Its work addresses firstly farm managers and decision makers, followed by those in charge of agri-supply and agri-food and lastly all the citizens.

After the collaboration with ORÉE which led in 2008 to the Guide "Integrating biodiversity into corporate strategy", Saf agr'iDées conducted a case study on the interdependence between farms and biodiversity.

The farm which is the subject of this study carried out by Laurent Capelle, is the SCEA de L'Hermitage which is located on a 420 hectares in the Picardy basin near Laon in the Aisne department.

Made up of a farm unit, the company is currently in the process of obtaining ISO* 14 001 GlobalGap certification, and is launching an HEV certification approach (High environmental value: a level 3 environmental certification approach laid down by the Grenelle de l'Environnement).

The starting point for the work was to determine the physical flows in the perimeter of the company. This means all the materials, from biodiversity or not, which enter or leave the farm. We will be looking more specifically into biodiversity flows and will integrate those produced by organic chemistry*, such as plant protection products, oils, grease, certain fertilisation products… The consumption of this flow of materials takes place in the farmhouse (for the products used for the maintenance of the machines…) or on the parcels (for the products used for the maintenance of the crops and earth…). Therefore there is always a flow between the farm (storage area) and the parcels (production area). In order to see the interactions between the company and biodiversity, we carried out an identification of the existing ecosystem services in the perimeter of the farm.

A specialist in recovery (a generic term covering waste reuse, regeneration, recycling, organic recovery* or energy recovery) and processing (the physical, thermal, chemical or biological processes, including sorting, which modify waste in order to reduce its volume or dangerous nature), **Séché Environnement** provides solutions which help to reconcile economic activity, industrial development, and the preservation of resources and biodiversity. The Group is also strongly positioned on renewable energy professions, either by the use of biogas recovery (gas produced spontaneously during the decomposing of the fermentable fraction of waste in an anaerobic environment and produced by the storage of household waste) or incineration, in compliance with the national targets set by the Grenelle de l'Environnement*. The Group is also strongly involved in the development of eco-innovative green technologies. With its professions built and deployed around two strategic points which are the extraction of resources from waste, secondary raw materials and/or energy production and the securing and control of potential hazards from final residues, it meets the large-scale environmental stakes such as recycling and recovery of materials, energy production, sustainable development*, management of industrial impacts.

Through its profession, Séché Environnement works on a daily basis for the environment, and is highly aware of the value of ecosystems. Its profession puts the Group in permanent contact with nature – a silent stakeholder – on its sites and also externally through its societal involvement on the territories. The challenge for Séché Environnement is to enable a harmonious life in a healthy living environment, using its know-how of environmental matters in general and more specifically of waste processing. Séché Environnement is a link in the circular economy in its industrial ecology and waste valorisation phases. The story of Séché Environnement is one of the continuing expansion of its professions and know-how. The range of solutions offered to its clientele has extended over time, but their efforts are still focused on waste. From being a generator of disruptions, waste is now considered as a resource pending use.

The approach led by **Voies navigables de France** in favour of the ecological restoration of the banks of the waterways is part of a long-term approach.

With over 6700 km of inland waterways, the French waterway network managed by VNF is operated in a strong dynamic of development of waterway transport. Relaunched in the 1990s and by the Grenelle de l'Environnement*, it represents over 55 million tonnes in France in 2011 i.e. over 8 billion tonnes per kilometre.

It is in this context which is favourable to waterways that Voies navigables de France wanted to include the operation, renovation and the development of waterways in an approach which is more and more respectful of the environment.

A canal is not strictly speaking a natural environment. According to Wasson *et al.* (1982), its biotope* is artificial and made up of non-living elements: the water mass, channel, substrate and banks. This assertion could lead us to consider that the canal is an environment not highly suitable for living beings and the development of pollution-sensitive faunal groups would appear difficult under these conditions. The result is a trivialisation of the fish fauna and a decreased hydrobiological heritage.

Despite this, waterways make up the main water resource on French territory. They are concerned by the quality objectives set by the Directive Cadre sur l'Eau (DCE - Water Framework Directive) and enter into the field of application of the Blue and Green Belts prescribed by the Grenelle de l'Environnement*. From a regulatory point of view, the canal is not therefore considered only as a transport infrastructure, as opposed to roads or railway lines. The canal is also a potential ecosystem and therefore an environment likely to support life.

Aware of its role in the preservation of the environment and ecosystems, VNF launched an environmental plan in 1997. The use of ecological engineering for the protection and restoration of the banks is one of the pillars of this plan and the use of plant techniques aims at reproducing the ecological functionalities of a natural river bank in an artificial environment, specifically by re-establishing land-water continuities and creating habitats suitable for the development of wildlife. Thanks to this approach, canals are considered both as waterways and ecosystems. Beside their transport-related functions, they supply ecological services which benefit a wide panel of users (communities, residents, fishermen, hikers, scientists, etc.). Navigable waterways are becoming multifunctional waterways. In a context which encourages the development of alternative methods such as river transport, ecological engineering makes it possible to reconcile the economic interests of waterways with the requirements of environmental renewal.

The vocation of **Veolia**, a world reference in services to the environment is to provide solutions for industrialists and communities in three complementary activities: management of the water cycle, management and valorisation of waste and energy management. Present on all five continents, the group operates a number of facilities where it is in charge of good land management and associated green spaces.

Alongside ORÉE, the company launched into the identification and assessment of its interdependence with ecosystem services and the possibility of valorising them economically. After a first report drafted using BBII* at Group level and a case study carried out on the waters of Berlin (BWB) in 2010, two new case studies were conducted in 2012, the first on a facility for storing and processing dangerous waste (Hygiene), and the second on a wellfield (Water).

1. An initial study was carried out on the Graulhet (81) facility operated by Occitanis for storing and processing dangerous waste. The site which has a surface area of around thirty hectares is surrounded by a type 1 ZNIEFF*. Since it was opened in 2002, the site managers, conscious of the biodiversity-related issues, have striven to integrate biodiversity management in their environmental management plan. The objective of the study was first to pinpoint the existing interactions between the facility and the ecosystem services and then to assess biodiversity-related costs and benefits from an economic point of view by listing around 10 years of integrated operational biodiversity management actions.

2. The other study was conducted on Crépieux-Charmy, the biggest wellfield in Europe (375 ha) located to the North East of Lyon. With its 114 collection wells, it supplies drinking water for 90% of the population of Le Grand Lyon (urban community of Lyon). In association with Le Grand Lyon, the *Conservatoire régional des espaces naturels* (CREN) and local nature protection associations, the site carries out ecological monitoring actions which contribute to preserving the naturally excellent quality of the water resource, partly thanks to the filtering and purification performance of the ecosystem associated with the alluvial groundwater.

The target of the study was therefore to identify the hidden benefits of the conservative management of the Crépieux-Charmy site for the production of drinking water, by means of the economic assessment of the associated ecosystem services.

Thus, by giving value to the actions led in favour of biodiversity on its facilities, Veolia structures and improves the visibility of its biodiversity strategy, valorises its operational know-how and can differentiate itself in its offers and contracts.

YVES ROCHER

Yves Rocher, who was born in La Gacilly in Bretagne, is the founder of the cosmetics company of the same name. Faithful to his roots, Yves Rocher made La Gacilly the cradle of the brand and the headquarters of its activities. As a botanist, harvester, manufacturer and distributor, Yves Rocher is the only brand of beauty products in the world to have chosen to control all the professions of its activity.

At Yves Rocher, plants are at the heart of all the formulas and they are a source of inspiration and innovation, with over thirty new active ingredients created and developed every year by Yves Rocher research. Plants are also the object of a significant mobilisation, including the creation of the Yves Rocher Foundation, in charge of raising awareness on environmental protection, and the strict plant charter. This charter, to which the brand is subjected and in turn subjects its suppliers, is specifically oriented on its refusal to use GMO* plant ingredients or threatened plants and on the priority given to Organic Farming.

Lastly, as early as 1995, Yves Rocher was the first brand of cosmetics in the world to commit to an environmental certification approach.

Having identified its interdependence with biodiversity using BBII* and other work carried out in 2010 with Institut INSPIRE and the Dervenn design office, Yves Rocher wished to develop indicators to initiate a piloting of its dependence on natural capital.

With these values and its biodiversity strategy in mind, Yves Rocher is conducting this study, with the aim of integrating biodiversity and ecosystem services into its decision-making and operational processes through the creation of eco-efficiency indicators.

The aim of this study is to lay the foundations of a methodology for creating so-called “eco-efficiency” indicators, by adopting an approach which is both environmental and socio-economic.

In the scope of this study, two projects were managed simultaneously:

- An in-house data collection aiming at collecting all the existing monitoring indicators, whether they are indicators linked to taking sustainable development into consideration or management control.
- An analysis of the ecosystem services used during the life cycle of a product such as the mallow volumizing shampoo, in order to build indicators on the services identified as priorities. This analysis was carried out by **Thelema** (co-operative consultancy firm).

Moreover, all the work was an opportunity to identify other capitals which are equally essential to the smooth running of the company: intangible capital or «brand value » and the social capital specifically related to the historical siting of the brand in la Gacilly.

T H E L E M A
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8.2. Table of inserts

APPENDICES

9.1. Bibliography

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9.2. List of figures

9.3. Acronyms

ADEME: Agency of the environment and the control of the energy

ABS: Access and benefit-sharing

BBII: Business and Biodiversity Interdependence Indicator

BRGM: French geological survey

CBD: Convention on Biological Diversity

CIRAD: French research centre working on international agricultural and development issues

CITES: Convention on International Trade in Endangered Species

CLIS: Local committee for information and survey

CNRS: French national centre for scientific research

CSR: Corporate Social Responsibility

DDT: Dichlorodiphenyltrichloroethane

DNA: Desoxyribonucleic acid

EMAS: Eco-Management and Audit Scheme

FAO: The Food and Agriculture Organisation

GBIF: Global Biodiversity Information Facility

GIS: Geographical Information System

GM: Genetically modified

GMO: Genetically modified organisms

GRI: Global Reporting Initiative

HQE: High environmental quality

ICPE: Installations Classified for the Protection of the Environment

IFB: French institute of the biodiversity

IFREMER: French research institute for exploitation of the sea

INRA: French national institute for agricultural research

IRD: French research organization on development research

IRSTEA: National research Institute of science and technology for environment and agriculture

ISO: International standardization organization

IUCN: International Union for Conservation of Nature

LTP: Local Town Plan

MAB: Man and Biosphere

MAS: Multi-agent systems

MEA: Millennium Ecosystem Assessment

MNHN: National Museum of Natural History

OECD: Organisation for Economic Co-operation and Development

POB: Prefectural order for the protection of the biotope

PNR: Regional natural Parks

RNA: Ribonucleic acid

RSEC: Regional Scheme for Ecological Coherence

SAGE: Scheme of planning and management of waters

SDAGE: Master plans of planning and management of waters

SNB: National Biodiversity Strategy

TCS: Territorial Coherence Scheme

UNESCO: United Nations Educational Scientific and Cultural

WBCSD: World Business Council for Sustainable Development

WTO: World Trade Organisation

WWF: World Wildlife Fund

ZICO: Major zone for preservation of birds

ZNIEFF: French Natural Zone of Ecological, Faunal, and Floristic Interest

ZPS: Zone of special protection

9.4. Glossary

Abiotic: refers to a non-living element, system or process. It describes an environment where life can no longer develop. Abiotic factors are temperature, pressure, etc.

Agenda 21: action plan for the 21st Century that was adopted by 173 Heads of States during the 1992 Rio Earth Summit. The action plan's 40 chapters describe sectors where sustainable development must be covered within the framework of local authorities.

Agro-ecology: this term was used for the first time by Basil Bensin, a Russian-American agrologist, in 1928. Agro-ecology is a scientific term standing for the application of ecology to agriculture.

Agroforestry: refers to the association of trees and crops or animals on the same plot, at the edge or in the middle of fields. There is a wide diversity of agroforestry development: inter-plot cropping, hedges, pruned trees, isolated trees, streamsides (riparian*)… These practices include agroforestry but also sylvopastoral, agrosylvopastoral or mixed orchards (animals grazing under fruit orchards) systems.

Agro-system, agro-ecosystem: an ecosystem dominated by continuous human intervention for the production of animal or plant species for food production, industrial and energy purposes.

Anthropization: processing of natural areas, landscapes, ecosystems or semi-natural environments through human action.

Appropriation (methods of): the act of appropriating something. In the case of biodiversity, we cannot own genes* but only the rights (or even exclusive rights) of access to and the use of genes for a predetermined period (usually 25 years). There is no "ownership of living entities", only the development of markets for trading such rights. Patents, which are exclusive temporary rights of access to and use, do not constitute "ownership rights". Indeed, property rights include rights of use, rights of benefiting from and rights of "abusing" the item or object owned (*"usus, fructus, abusus"*).

Autopoietique: produced by autopoiesis which is the capacity of a system to permanently produce itself by interacting with its environment and thus, maintain its structure despite changes in its components.

Autotrophic: form of nutrition found in organisms, especially plants, bacteria and protists, that are able to produce food from inorganic molecules or from photosynthesis.

Auxiliary biodiversity: biodiversity elements involved in agricultural activities that promote these one. They include insects, birds and worms.

Bioaccumulation, bioamplification: a process whereby tissue concentration of toxins increases from one tropic level to the next within the food chain*. Therefore, the concentration of water pollutant increases in the tissue of living organisms as they are at the top of the food chain*; this concentration is low among plankton and very high among large predators including humans.

Biocoenosis: all the interacting organisms living together in a specific habitat (or biotope*).

Biodiversity hotspots: geographical places on Earth containing at least 1500 endemic plant species but that have also lost at least 70% of the species that were present in their original state. At present, 34 hotspots are recognized, and their total combined area represents only 2.3% of the Earth's surface. However, more than 50% of plant species and 42% of terrestrial vertebrates live in these 34 hotspots. France, with its overseas territories and departments, is one of the countries most concerned by these hotspots; it is ranked as the fourth richest country in terms of its biodiversity. Places on Earth that are both biologically rich - and deeply threatened. For our own sake, we must work to protect them.

Bio-indicator or biological indicator: an element of the living system (bacteria, mushroom, fauna, flora, etc.) whose condition indicates the general state of the ecosystem or local biodiversity. Lichen is a relevant bio-indicator* for the monitoring of some air pollutions.

Biological diversity (Biodiversity): the variability among living organisms from all sources, including, 'inter alia', terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems, and also the interactions between organisms.

Biomimicry, bio-inspiration: the biomimicry*, defined by Janine Benyus in 1997, is a drive for innovation through the transfer and adaptation of the principles and strategies implemented by living organisms and ecosystems in order to produce eco-friendly goods and services and to make human societies compatible with the biosphere*. It details three levels of inspiration with a growing demand in terms of sustainability: forms adopted by living creatures; materials and production processes operating by living creatures; interactions that species develop among themselves and the overall functioning of natural ecosystems.

Biomass: the total quantity of organic matter* (mass) of all living species present in a population, a habitat or a given ecosystem. In the energy field, the term includes all organic material* with the potential to become a source of energy (wood, methanisable material).

Biosphere: the global, self-sustaining ecosystem which includes all living things and their relationships, both to one another and with the hydrosphere (water), the atmosphere (air) and the lithosphere (rock), in a metabolism which continuously affects these three spheres by modifying, storing or recycling them.

Biosphere 2 project: an experimental site built between 1987 and 1991 in the Arizona desert, intended to reproduce a closed and viable ecosystem in a huge dome. It was supposed to assess the feasibility of such installations in the framework of space conquest, Biosphere* 1 being planet Earth.

Biotic: characterizes an environment in which life can develop, a living environment.

Biotope: all elements inherent of given physico-chemical environment with specific flora and fauna ("biocoenosis*").

Clean Water Act: an American Federal law on protection of waters and limiting of pollutants, adopted in 1972.

Coevolution: a phenomenon occurring between two or more species which influence each other. The evolutionary changes of the first species lead to a selective pressure on the second, which evolves in turn. Pollination, for example, is the result of thousands of years of coevolution between plants and their pollinators (insects, birds, and mammals). By extension, and on different time scales, one can consider a coevolution between companies and the biosphere*, because companies impact the ecosystems' evolution, which in turn influences the companies' evolution.

Compensatory measures: in French environmental law, operations, management practices or intangible procedures (training and awareness-raising of a site's users or managers) designed to compensate for the loss of an ecologically important area or element. They are imposed when measures for eliminating or mitigating the negative ecological impacts of a project have failed.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES*): also known as The Convention of Washington, this is an international agreement between governments that aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The text of the Convention was adopted during a meeting in Washington on the 3rd March 1973. The Convention came into force on 1st July 1975.

Corporate Social Responsibility (CSR): CSR is the contribution businesses make to sustainable development issues. For a company, this approach seeks to take into account the social and environmental impacts of their activity, in order to adopt the best available practices and thus contribute to the improvement of society and environmental protection. CSR* makes it possible to associate economic reasoning, and social and environmental responsibility.

Cultivar: a plant variety (including trees) obtained by planting, generally by selection, for its characteristics which are “deemed to be unique”. These can be aesthetic or technical qualities, growth speed, adaptation to biotope* or resistance to disease.

Desoxyribonucleic acid (DNA): a macro-molecule that is made up of two winded helicoids. Provides directions for its own replication and for the structure of the NRA and cellular proteins. Contained in all nuclear cells, DNA is the bearer of genetic information and is transmitted during reproduction.

Differentiated management: a way of managing green spaces in anthropized environments without applying the same intensity and nature of treatments on all areas (mowing, pruning, etc.).

Discounting: the calculation of the present value of a given future value: for example, today, how much would 1 000 € from the year 2050 be worth today? The discount rate is the opposite of the interest rate. Sir Nicholas Stern’s report uses a discount rate of 1.4% to estimate the total cost related to climate change in 2050 without any decision.

Ecological niche: the overall use that a species makes of its environment’s biotic* and abiotic* resources. Thus, each species is able to define its needs of habitat, food resources, etc.

Ecological restauration: “assisting the regeneration of degraded, damaged or destroyed ecosystems”. This activity initiates or accelerates the recovery of a past state of an ecosystem, with regard to its specific composition, its community structure, ecological functioning, capacity to support living organisms and its connectivity with the local landscape. This requires a good knowledge of the targeted ecosystems’ functional and evolutionary ecology, its history of anthropogenic degradation, and, finally, the choice of a reference ecosystem in order to carry out the planning, the completion, monitoring, and assessment of the restauration project.

Ecosystem: the complex of living organisms and the abiotic* environment with which they interact at a specified location, ranging in size from a single site to the entire biosphere.

Endemic: refers to an animal or plant species which exists in only one relatively small specific geographic area.

Environment: all components (biotic* and abiotic*) where an individual or a species lives.

Environmental Code: the French Environmental Code covers legal texts relating to environmental Law.

Environmental liability: a charge (expenditure) assigned as a liability on a business's financial accounts when it is probable that the settlement of a present obligation, environmental in nature and resulting from past events, will produce an outflow of resources without at least an equivalent inflow, and that the amount of this charge can be reliably estimated.

European Water Framework Directive: on the 23rd October 2000 the European Council and the Parliament defined a framework for the management and protection of waters in terms of river basins at a European level. The Framework Directive gives priority to the protection of the environment and requests that care is taken for to ensure that water quality is not degraded and that an overall good state of surface (including coastal waters) and ground waters is reached by the year 2015.

Eutrophication: a process by which the concentration of nutrients, particularly Phosphorus and Nitrogen, rises considerably in a watercourse, leading a greater growth of organisms like algae. Eutrophication is a natural and slow phenomenon, but can be increased and accelerated by human activities (industrial and domestic sewage, leaching of fertilizers, etc.), subsequently resulting in the suffocation of the ecosystem.

Externality: an impact on any party not directly involved in an economic decision. An act of consumption or production has a positive or negative impact on another entity not involved in the act, without the latter entity being fully compensated for the damage or required to pay for the benefit which results.

Fish larvae: young fish that still depend on the yolk sac to be fed.

Food web (or **food cycle**) is term describing the feeding connections in an ecological community, i.e. predators, herbivores, etc. This permits the transfer of energy throughout the system it also serves as a control mechanism on population sizes.

Functional group: a set of organisms, grouped with reference to the ecosystem function and structure in which they develop, and not by similarity. They share one or several responses to one or several environmental factors, or affect the ecosystem in the same way.

Functional redundancy: in an ecosystem, several species may have very close ecological niches, and appear to be substitutable.

Game, game management: refers to the management of wildlife, in the framework of hunting. The purpose of this form of management's is to optimize game production on a territory, in order to guarantee the sustainable exploitation of game without disturbing the balance of ecosystems.

Genetic mixing: with sexual reproduction, each generation of individuals contains new layouts of the genetic material inherited from its parents. The development of new reproductive cells (gametes) and the association of these two cells from two different organisms during fertilization leads to the genes mixing*.

Gbif: as a Gbif member since its creation in 2001, France commits to promote free and open access to data on biodiversity on the Internet. Thanks to a global network made up of different countries and organizations, Gbif promotes and facilitates the mobilization, access, discovery, and use of primary data about organisms, over time and all around the world.

Gene: a genetic information unit located on chromosomes and made of a particular sequence of nucleotides in the DNA*(or RNA for some virus).

Grenelle de l'Environnement: takes up the name and the idea of a multi-stakeholders consultation, as was organized on the subjecty of salaries in May 1968 (at the Ministry of Labour rue de Grenelle). The Grenelle de l'Environnement brought together French entities involved in environmental issues such as biodiversity, by category, in 2007.

Habitats Directive: this is the 92/43/CEE Directive on the conservation of natural habitats, and wildlife. The European Union is seeking in this way to promote the protection and management of natural areas and wildlife species as heritage value of the member States, in accordance with the economic, social and cultural requirements.

Heterotrophic: a heterotrophic organism consumes organic compounds* from animal or vegetable sources (herbivores, carnivores, decomposers) to obtain carbon essential for growth and development.

Ichtyofauna: all fish living in a geographic area or a given habitat.

Institution: any arrangement between at least two individuals or groups which is recognized beyond these individuals or groups. For example, marriage is an arrangement between two persons which is recognized by all.

Invasive (invading) species: species which settle outside their native range, and which are usually introduced, deliberately or not, by humans. It may become a damaging perturbation factor for the native biodiversity of ecosystems where it has settled.

Millennium Ecosystem Assessment (MEA*): UN-sponsored international scientific program which in 2005 provided the first overview of the environmental state of the planet. The consequences of the ecosystem degradations were evaluated in relation to human well-being, and possible future scenarios were proposed to face these changes.

Mitigation banks: financial systems that are intended to replace and compensate for the functions and bio-chemical, physical and ecosystemic resources of a site by quantifying these functions in the form of "credits". These credits can be purchased.

Mycorrhizae: these are fungi that live in symbiosis with plants (in the roots area).

Nagoya Protocol: the Nagoya Protocol (also called ABS* for “Access and Benefit Sharing”) is one of the major commitment texts adopted during the 10th Conference of the Parties (COP10) of the Convention on Biological Diversity* held in Nagoya (Japan) in October 2010.

Natura 2000: a European nature conservation program with the dual goal of preserving biological diversity* and improving the attractiveness of the landscape. A network of sites is spread across Europe in a systematic continent-wide initiative. In France, the Natura 2000* network covers 6.8 million hectares, or 12.4% of the total land area and includes more than 1,700 sites.

Ordinary biodiversity: this is often little-noticed biological diversity* (like grass), with no identified intrinsic value, but which, by its abundance and by the interactions of its multiple entities, contributes at different levels to the functioning of the ecosystem and the supply of services from which human societies benefit.

Organic: see organic matter*.

Organic matter: any matter that has once been alive.

Photosynthesis: conversion of solar radiation into chemical energy which is stored in carbohydrates and other organic* molecules. Occurs in plants, algae and some bacteria. Consumes water and carbon dioxide and produces oxygen.

Polluter pays principle: a principle set out in article L110-1 of the French Environmental Code*, stating that the costs resulting from prevention, reduction, and the fight against pollution must be borne by the polluter.

Precautionary principle: “In case of proven environmental risk, it is not sufficient to state an absence of scientific certainty and not decide”. The precautionary principle is an action principle which promotes knowledge development with regards to uncertainty.

Prefectural order for protection of the biotope: the prefectural order for protection of the biotope, sometimes inappropriately referred as “order for protection of the biotope” or “order for the biotope” is an order issued by the Prefect in France, to protect a natural habitat or biotope with one or more wild and protected animal and/or plant species.

Prevention principle: allows action to be taken to protect the environment at an early stage from risks whose existence is proven or known empirically, sometimes so fully that we can estimate the likelihood of their occurrence (nuclear accidents, asbestos, smoking, etc.). The uncertainty does not relate to the risk itself, but to the likelihood of its occurrence.

Protected areas: these are territories benefiting from a conservation status and special protection from government authorities.

Regional natural Parks of France (PNR): in France, PNRs* are created by adjacent local authorities in order to implement a natural and cultural heritage conservation project, on a consistent territory (sometimes outside the formal administrative boundaries).

Remarkable biodiversity: biological diversity noticed by human societies and considered as having an intrinsic value (like the Giant Panda), founded on values other than economic ones. This term can cover genes*, species, habitats, and landscapes alike.

Resilience: C. S. Holling was the first to introduce this term into ecology in 1973. Others have since defined it as the time required for a system to return to a stable equilibrium after a period of stress or exogenous disruption. For Holling, resilience is "the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a different set of processes. A resilient ecosystem can withstand shocks and rebuild itself when necessary.” On this view, there is no steady state for a single system, whatever its nature. Resilience is defined as the system's adaptive capacity to resist disturbance, rather than change its state and thus modify the variables and processes that govern its own evolution.

Riparian forest: forest formations that form along water courses.

Ribonucleic acid (RNA): a macromolecule acting as intermediary between DNA* and synthesized proteins. It makes up the single genome of some viruses (no DNA*).

Regional Scheme for Ecological Coherence (RSEC) is a new planning mechanism in France that is designed to protect certain species and natural resources by favouring water quality in watercourses and ground water.

Semantic: the study of a language from the meaning point of view. This theory aims at reporting the signification structures and phenomenon in a language.

Semi-natural habitat: a specific environment constituted of site conditions (climate, soil, relief) and a particular biocoenosis* of animals and plants.

Spawning ground: the place where fish and some amphibians meet for reproduction, the place where females lay their eggs so that males can cover them with semen (external reproduction for most of these animals).

Sustainable development: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs", in the words of the Brundtland Report (1987). This definition relies on a concept of intergenerational equilibrium and sustained yield. It is based on a view of nature as an inventory or stock, to be managed optimally, a concept which inevitably leads to hair-splitting distinctions between "strong" and "weak" sustainability, depending on the discount* rate adopted. Weak sustainability upholds the perfect substitutability of different forms of capital (human, social, manufacturing, natural), with the implication that it would be rational to destroy biodiversity to sustain indefinitely economic development.

Type 1 French Natural Zone of Ecological, Faunal, and Floristic Interest (Type 1 ZNIEFF*): small surface areas welcoming at least one patrimonial species or ecological habitat. They can also have an important functional interest for local ecology.

Type 2 French Natural Zone of Ecological, Faunal, and Floristic Interest (Type 2 ZNIEFF*): areas wider than Type 1 ZNIEFF*, which have an ecological and landscape coherence, and are ecologically rich or minimally affected, with some high ecological potential.

Zone of Special Protection (ZPS): the special protection zones have been created by application of European Directive 79/409/CEE1 ("bird directive"), governing wild bird conservation. SPZs* are integrated into Natura 2000* measures.

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Notes

Layout :
Impribeau (Sainte-Ode, Belgique)
www.impribeau.be

Printed of October 2014

Printed on paper from forest sustainably managed

"Yes, we are part of the living world! This means being aware of the danger of the current evolution of the biosphere on which the human species is vitally and closely dependent. Now is the time to take action, raise awareness and above all to set off a reaction, using our intelligence, a desire to share and a respect for this biodiversity to which we belong".

The ORÉE association plays an exemplary role in this. The "businesses and biodiversity" Working Group launched in 2006 radically modified the way in which biodiversity is analysed and this guidebook largely explains it.

The members of ORÉE have integrated the fact that biodiversity is the great provider of their raw materials and technologies and therefore of their profits. They understand that the preservation of biodiversity is an essential element of their own sustainability. Whatever the activities and the raised awareness to what is at stake for the actors, it is possible to improve or even rethink their strategy and even their activity in a sustainable and desirable developmental framework. In this guidebook, different approaches are explored by several actors who report on the many avenues for integrating biodiversity into their strategy and daily life in order to build a pathway towards the reconciling of human activities and biodiversity stakes. Due to the plethora of interactions between biodiversity and human activities, the general subject, several fundamental ideas and the examples of ORÉE's partners will enable everyone to build their own strategy according to their own sensitivity, possibilities and ambitions.

ISBN 978-2-9533188-3-8