DEVELOPING A COMMON KEY PERFORMANCE INDICATORS FRAMEWORK FOR BIODIVERSITY MANAGEMENT IN GYPSUM QUARRIES THROUGHOUT EUROPE FOR EUROGYPSUM

CARLINE PITZ

TRAVAIL DE FIN D'ETUDES PRESENTE EN VUE DE L'OBTENTION DU DIPLOME DE MASTER BIOINGENIEUR EN GESTION DES FORETS ET DES ESPACES NATURELS

ANNÉE ACADÉMIQUE 2012-2013

(CO)-PROMOTEUR(S): GREGORY MAHY, CHRISTINE MARLET

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ACKNOWLEDGMENTS

First of all, I would like to express my deep gratitude to my supervisor, Pr Gregory Mahy, for his multiple advises and discussions which were essential during the work preparation, and for the multiple and attentive readings and corrections brought during the redaction of this document. I am particularly grateful to him for enlightening me in times of doubt and for guiding me when everything became blurred. I thank him for his availability and the time he has given to follow my work week after week and refer me throughout the process.

Moreover, I also gratefully acknowledge the whole personnel of Eurogypsum for their support and for the opportunity they gave me to lead this study. More particularly, I would like to thank my co-supervisor, Christine Marlet, who introduced me to the world of lobbyists, business and European issues. I also thank the members of the Quarry WG, Philippe Chevalier, Dave Kent, Dr Matthias Reimann, Hans-Jörg Kersten and Christine Marlet, who were proactive in this project. I thank them for the multiple constructive discussions and exchanges we had.

Additionally, I would like to thank all the contributors of this study: the people who answered to the survey and the people who welcome me in France, Spain and Germany. More particularly, I thank Mr Thauront and Mr Trankle for their constructive advice and the time I spent with them.

Then, I would focus a special attention to Pr Cédric Vermeulen for his vision of participatory processes and his wise advice on the subject. I want to thank Bernard Segers and the IT department of the faculty, for their help in the development of the online survey. I especially thank him for his availability, speed and kindness.

I wish to express my deep gratitude to Diana Levicek Varela Belen, Julie Maron, Francesca Brera and Nadine Pitz for the valuable assistance they gave me to translate some texts in Spanish, German and Italian.

I gratefully acknowledge Crispin Dunn-Meynell for his proofreading and Dominique Carpas for her amazing help with the layout of the final report and for her availability and speed. I thank Dominique Vandecauter for helping me with the printing of the report. I address a special attention to Valérie who make it possible that I meet all those people at the early end and I thank her for the proofreading.

I would like to thank all my family for their support along my studies. I especially want to thank my dad, who was able to refer me throughout my life and make me believe that all the dreams are possible if you work for it. I thank him for his tireless support since I was little, for my wonderful childhood and the endless discussions we have about life. I also thank him for having been able to show me that I should enjoy every moment of life and fill it of eternity. I thank him also for being there to help me in this master thesis. I thank my mother for all the proofreading's made since I write reports and her long time support. I also want to thank my 'mamy', a strong foolproof woman that knows how to teach me that whatever happens, the most important in life is to enjoy what you have as if every day was the last. I express my deep gratitude to George and Laetitia for their tuition and for having supported and launched me in the beginning of my studies. I especially want to thank Françoise who allowed me to develop myself, who have guided me, supported and raised me as her own daughter. I thank Christine for her good humor and have been able to listen to me and support me daily.

Thirdly, I thank my friends, without who life would have no flavor. Special thanks to AnSo, Diana and Lindsey who were able to be present during my greatest moments of doubt and who were able to be my friends without judging me but by accompanying me in laughter and good humor. I also thank Syrah for its huge support during this difficult period and for the long discussions we had. I also thank my all lifelong friends: Drin', Lil, Naïs, Oli, Caïwette, Hln, Bobo. They are my anchorage, my benchmarks in life. I also address a special wink to N.

I thank Julien for his assistance to develop myself during those years of study. He allowed me to see life differently and to fully take part of it. I also thank all his family, Anso L., Nico and other of his friends with whom I have shared amazing moments. For cons, I strongly de-thank him for having fled in the most important period of my life and for its unrestrained attempts to wreck this master thesis.

Fourthly, I thank all my friends that were present during all my studies and that made those so much funnier and easier. I would specially focus on Lindsey, Glenn, Julie, Mapy, Toutoul, Roux, Berber, Yvette, Elo, Tomtom, Blaise, Charly, Maud, Jérôme, Louise, Robin, Greg, VDS and Pilou for all the good times exchanged during our forest studies. I also thank all the people from the Blokker were I spend amazing times: Anso (ones again), Emi, Roos, Sophie, Nico, Ber etc.

Eventually, I also express my gratitude to my many teachers who, despite their sometimes twisted and boring tests, have enriched my knowledge have allowed me to develop my mind and to open up to other perspectives and lighting up in life.

ABSTRACT

This study aims to establish a common Key Performance Indicators (KPIs) framework to report biodiversity for the Gypsum Industry at the European level. An original approach of participatory process has been developed in order to integrate the different opinions and to reach a consensus framework between different stakeholders' groups:

- Eurogypsum stakeholders
- European and local authorities
- Scientific panel : universities and consulting offices
- European and local associations for the conservation of nature
- Stakeholders from the mining sector

The strategy is based on five main steps: (i) To Build a stakeholders' network; (ii) To build a framework proposal to be submitted to stakeholders by selecting a maximum set of indicators based on the literature and reaching an agreement on indicators with Eurogypsum (Focus Group); (iii) Reaching a consensus framework with all the stakeholders and evaluating feasibility by a Delphi Policy survey, by the analysis of the EIAs of the Gypsum Industry and by visiting three European quarries; (iv) Final validation with Eurogypsum (meeting); (v) Creating indicators' Factsheets and a Eurogyspum report to the destination of the public.

The resulting framework contains eleven indicators which are the most acceptable set of indicators for all the stakeholders. It answers to European legislation and strategies for biodiversity. It is intended to improve sustainability in the quarries and to help managing biodiversity, to allow setting up of appropriate reporting systems. The aim is to maintain the biodiversity status of the gypsum quarries. It is a flexible framework adaptable given the local context of each gypsum quarry in order to prove if a No Net Loss has been reached at a quarry's scale.

Key words: Key Performance Indicators (KPIs) - Framework – Gypsum quarries – European strategies for biodiversity – Participatory processes

RÉSUMÉ

Cette étude vise à établir un cadre commun d'indicateurs clés de performance (ICP) pour l'industrie du gypse, afin d'évaluer la biodiversité à l'échelle Européenne. Une approche originale de processus participatif a été développée afin d'intégrer les différentes opinions et de parvenir à un cadre consensus entre les différents groupes de parties prenantes:

- Acteurs d'Eurogypsum
- Autorités Européennes et locales
- Panel scientifique: universités et bureaux d'études
- Associations Européennes et locales pour la conservation de la nature
- Acteurs du secteur minier

La stratégie développée est basée sur cinq étapes principales : (i) Constituer un réseau de parties prenantes; (ii) Construire une proposition de cadre par la sélection d'un maximum d'indicateurs basés sur la littérature, et d'atteindre un accord sur les indicateurs avec Eurogypsum (Focus Group); (iii) Atteindre un cadre consensus entre toutes les parties prenantes et en évaluer la faisabilité par un Delphi Policy par mail, une analyse des EIAs de l'industrie du gypse et la visite de trois carrières européennes; (iv) Validation finale par Eurogypsum (réunion); (v) Création de fiches détaillant les indicateurs et rédaction d'un rapport à destination du public pour Eurogypum.

Le cadre résultant, contenant onze indicateurs de biodiversité, constitue l'ensemble le plus acceptable pour toutes les parties prenantes. Il répond aux stratégies et législations Européennes pour la biodiversité. Il est destiné à améliorer le développement durable des carrières et à aider à la gestion de la biodiversité en permettant la mise en place de systèmes d'information appropriés. Le but étant de maintenir l'état de la biodiversité des carrières de gypse. C'est un cadre souple et adaptable en fonction du contexte local de chaque carrière afin d'établir si un No Net Loss a été atteint.

Mots-clefs : Indicateurs clés de performance (ICP) – Cadre – Carrières de gypse - Stratégies européennes pour la biodiversité – processus participatifs

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ABBREVIATIONS AND ACRONYMS

Acrea-Ulg	Unité de recherche du Département Biologie, Ecologie et Evolution de l'Université de Liège
AHP	Analytic Hierarchy Process
ANP	Network Analytic Approach
BDAP	Biodiversity Action Plan
BINU project	Biodiversity Indicators for National Use
BIP	Biodiversity Indicators Partnership
Birds Directive	Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds
BMS	Biodiversity Management System
CBD	United Nations Convention on Biological Diversity
CEC	Commission of the European Communities
CEMBUREAU	European cement association
CEPMC	Council of European Producers of Materials for Construction
CETEM	Centro de Tecnologia Mineral Ministério da Ciência e Tecnologia
CI	Consistency Index
COP	Conference of the Parties
CR	Consistency Ratio
DEFRA	Department for Environment, Food and Rural Affairs
DEMNA	Département de l'Etude du Milieu Naturel et Agricole (Belgium)
DG	Directorate General
DNF	Département de la Nature et des Forêts (Belgium)
DPSIR	Driver, Pressure, State, Impact and Response Model of indicators
EC	European Commission
ECNC	European Centre for Nature Conservation
EEA	European Environment Agency
EPER	European Pollutant Emission Register
ETC	European Topic Centre
EU	European Union
EU-27	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, the Netherlands, the United Kingdom
EUROMINES	European Association of Mining Industries
EUROROC	European & International Federation of Natural Stone Industries
EVM	Eigenvector Method
FEDIEX	Fédération des Industries Extractives de Belgique
GEF	Global Environment Facility
GIS	Geographic Information System
GRI	Global Reporting Initiative

GxABT-Ulg	Gembloux Agro-Bio Tech, University of Liège
Habitats Directive	Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
ICMM	International Council on Mining & Metals
IEEP	Institute for European Environmental Policy
IMA EUROPE	Industrial Mineral Association
INSPIRE/TWGBR	Infrastructure for Spatial Information in Europe - Thematic Working Group Bio-geographical Regions
IUCN	International Union for the Conservation of Nature
KPI	Key Performance Indicator
MA	Millennium Ecosystem Assessment
NEEIP	Non-Energy Extractive Industry Panel
NGO	Non Governmental Organisation
OECD	Organisation for Economic Co-operation and Development
PEBLDS	Pan-European Biological and Landscape Diversity Strategy (Council of Europe)
PSR	Pressure State Response Model of indicator
Quarry WG	Quarry Working Group of Eurogypsum
RGMM	Row Geometric Mean Method
RMSG	Raw Materials Supply Expert Group
SEBI 2010	Streamlining European 2010 Biodiversity Indicators
SER	Society for Ecological Restoration
SIDA	Swedish International Development Cooperation Agency
UEPG	European Aggregates Association
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
WWF EU	World Wide Fund for nature Europe
WWF	World Wide Fund for nature

EIAs of the Gypsum Industry - Quarries

FrP	Quarry of Le Pin and Villevaudé, in France
FrMa	Quarry of Mazan, in France
FrC	Quarry of Caresse, in France
FrMo	Quarry of Maurienne, in France
FrS	Quarry of Saint Soupplets, in France
Ge	Quarry of Lüthorst-Portenhagen, in Germany
ItG	Quarry of Cava di gesso di monte tondo, in Italy
ItM	Quarry of Masseria grossi, in Italy
SpC	Quarry of Cerro negro Moron de la Frontera Provincia de Sevilla, in Spain
SpS	Quarry of Soledad, in Spain
UK	Quarry of Bantycock Mine (Nottinghamshire), in the United Kingdom

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I Introduction

I.1 General context

This project is a voluntary initiative launched by the Quarry WG of Eurogypsum, the European Association for Plaster and Plasterboard Manufacturers, and has been sponsored by Eurogypsum. The Quarry WG decided to launch cooperation with the Biodiversity and Landscape Unit of the University of Liege to define a set of biodiversity indicators that may be used by the Gypsum Industry throughout Europe.

Since 1992, the awareness of biodiversity has risen throughout the world and a lot high-level delegations allowed commitments and defined targets to halt or reduce the rate of biodiversity loss by 2010 (IEEP, 2012; Mace & Baillie, 2007). Since 2003, the movement for biodiversity is still accelerating and especially in Europe. Targets have been discussed and there were concerted campaign to raise awareness and coordinate efforts to reduce biodiversity loss (Mace & Baillie, 2007). As it became clear that the global 2010 target had not been met and biodiversity loss had been continuing, a new European Union (EU) biodiversity strategy for 2020 was adopted by the European Commission in May 2011: ‘Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss’ (CEC, 2011). The cornerstone of this strategy is the concept of No Net Loss which exists to ‘maintain the biodiversity in an equivalent or better state than that observed before the project begins’ (Figure 1) (Morandeau & Vilaysack , 2012). Indicators are, more than ever, needed to assess whether the progress is achieving these ambitious 2020 targets (Mace & Baillie, 2007).

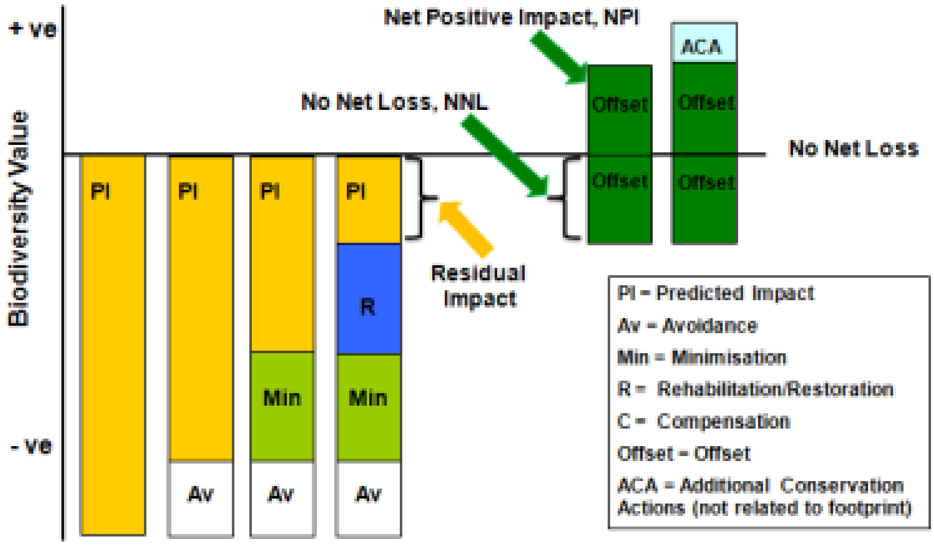


Figure 1 The achievement of No Net Loss in relation to the mitigation hierarchy, directly from IEEP (2012)

At the same time, environmental issues have become progressively important in mining business. The sustainability of a mining project has to be focused from the exploration throughout the mine opening, operation and closure. 'Sustainability implies the use of clean technologies, minimisation of raw materials and energy demand, reduction of emissions and effluent discharge into the environment and maximisation of social benefits' (SIDA, 2002). Eurogypsum is already dealing with all those subjects. The Gypsum Industry makes no exception to this objective of No Net Loss and raises its awareness about biodiversity to be part of all those commitments about biodiversity.

To develop biodiversity indicators for the Gypsum Industry, an original approach of participatory process was developed, including the stakeholders involved, to the elaboration of biodiversity indicators in order to integrate the different opinions and to reach a consensus framework. Participatory processes allow validating the elaborated framework step by step and bringing it a significant added value. Stakeholders involved in the elaboration of the KPIs are: direct actors of Gypsum Industry (Quarry WG, local quarry managers and future users of indicators), experts (gypsum's experts, external experts), policy makers and public representatives.

I.2 Objectives of the study

This study aims to establish a common Key Performance Indicators framework to report biodiversity for the Gypsum Industry at the European level. This framework has to be usable for gypsum industrials across the different environments in Europe. It has to be flexible and adaptable to the local context and meanwhile answer to European legislation and strategies for biodiversity. The aim of this indicators framework is to know if a No Net Loss has been reached at a scale of a quarry.

This framework should be accepted by other important stakeholders including European Commission and experts. The aim is to build a consensus framework, this is the most original and innovative part of this approach.

After this introductory chapter, the context of the study will be described precisely. First, the context of biodiversity at European level will be fixed, and then the concept of biodiversity indicator will be addressed. A presentation of the International Not-for-Profit Organization Eurogypsum will also be established. A chapter is then devoted to materials and methods. The fourth chapter presents the results obtained in thought different analysis. These results are discussed in Chapter 5. Finally, the last part of this work will present the conclusions and perspectives related to the study.

II Literature review

II.1 Context of biodiversity

Biodiversity was defined by the United Nations at the Convention on Biological Diversity during the Earth Summit in Rio de Janeiro, in the Article 2 of the CBD (1992). The CBD (1992) defined biodiversity as: 'the variability amongst 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'.

Biodiversity covers all the variety of life on Earth, embracing all the genetic variabilities, all the differences between living organisms and all the diversity of ecosystems and habitats. It ranges all the way from the golden eagle to maize's varieties, from unicellular bacteria to tropical forest. It includes a lot of different aspects and deals with three scales that are difficult to combine: genes, organisms and landscape.

Biodiversity is essential for human livelihoods and for life itself. Biodiversity brings essential ecosystem services on which all the balance of life depends (ICMM, 2006). The Millennium Ecosystem Assessment listed in 2003 such services as: provisioning services, like food; regulating services, like water purification and the control of pests; cultural services, like recreation; supporting services, like nutrient cycling and soil formation (MA, 2003). Biodiversity itself also has an intrinsic value (it has to be valued for its own value). Our society often takes all those services for granted, but they are intrinsically linked to the well functioning of ecosystems, and with it, the biodiversity (ICMM, 2006).

In the recent past, human activities have more than ever threatened biodiversity in exerting significant pressure, such as habitat destruction, pollution, overexploitation and climate change. Given the MA (2003), biodiversity loss is increasingly alarming with a rate of species extinction that is currently high. This biodiversity loss is due to the increasing human pressures all over the world (MA, 2003).

II.1.1 International responses to biodiversity loss: Policy and societal context of biodiversity in Europe

As a response to the biodiversity loss, political and societal commitments have been encountered for the conservation of biodiversity in Europe and throughout the world. The societal context is detailed in Table 1. During the period of 1992 to 2003 some very significant political commitments for biodiversity conservation were made. Firstly, in formal sessions of the CBD[1]/COP[2] and, following that, at the concluding sessions of the World Summit on Sustainable development in Johannesburg and at the meeting of European Ministers of Environment at the Pan-European Biological and Landscape Diversity in Kiev. These high-level delegations allowed commitments and defined targets to halt or reduce the rate of biodiversity loss by 2010. Those consist of the '2010 biodiversity targets' (IEEP, 2012; Mace & Baillie, 2007).

Since 2003, the movement for biodiversity is still accelerating and many bodies worked to promote and develop these 2010 biodiversity targets. Especially in Europe, targets have been discussed and there were concerted campaign to raise awareness and coordinate efforts to reduce biodiversity loss, or the so called policy of No Net Loss presented in Figure 1 (Mace & Baillie, 2007 & IEEP, 2012).

As it became clear that the global 2010 target had not been met and biodiversity loss had been continuing, a new EU biodiversity strategy for 2020 was adopted by the European Commission in May 2011. This followed the results of the CBD/COP 10 (EEA, 2012). This Strategy set out a long-term 2050 vision : 'By 2050, European Union biodiversity and the ecosystem services it provides - its natural capital - are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided' (CEC, 2011). And the 2020 headline target: 'Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss' (CEC, 2011). The cornerstone of this strategy is the concept of No Net Loss which exists to 'maintain the biodiversity in an equivalent or better state than that observed before the project begins' (Morandeau & Vilaysack , 2012). Indicators are, more than ever, needed to assess the progress towards achieving these ambitious 2020 targets (Mace & Baillie, 2007).

[1] United Nations Convention on Biological Diversity
[2] Conference of the Parties

Table 1 International responses to biodiversity loss, adapted from (EEA, 2007 and 2012b)

At global level	
CBD/COP 6 (The Hague, Netherlands, 7 - 19 April 2002) (CBD, 2002)	Adoption of a Strategic Plan for the Convention on Biological Diversity (Decision VI/26) including the **2010 target** 'to achieve a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth'.
World Summit on Sustainable Development (Johannesburg, 26 August–4 September 2002) (United Nations, 2002)	**Endorsement of the target** for 'achievement by 2010 of a significant reduction in the current rate of loss of biological diversity' and **recognition of the critical role played by biodiversity** in sustainable development and poverty eradication.
CBD/COP 7 (Kuala Lumpur, Malaysia, 9 - 20 February 2004) (CBD, 2004a)	**Adoption of a framework** (Decision VII/30): - To facilitate the assessment of progress towards the 2010 target and communication of this assessment; - To promote coherence amongst the programmes of work of the Convention; - To provide a flexible framework within which national and regional targets may be set, and indicators identified.
CBD/COP 10 (Nagoya, Aichi Prefecture, Japan, 18 - 29 October 2010) (CBD, 2010)	Adopted the **Strategic Plan for Biodiversity 2011-2020** (Decision X/2), as it became clear that the global 2010 target had not been met and biodiversity loss had been continuing. The Strategic Plan reconfirmed the relevance of setting clear goals and targets to guide actions aiming at halting biodiversity loss and proposed a new vision and mission, five strategic goals and 20 new targets. These **Aichi targets** provide a global framework for action across all CBD parties.
At pan-European level	
5th Environment for Europe Ministerial Conference (**Kiev**, 21–23 May 2003) (United Nations, 2003)	Endorsement of a **resolution to 'halt the loss of biological diversity at all levels by the year 2010'**, according to seven key targets in the areas of: forests and biodiversity; agriculture and biodiversity; a **pan-European ecological network**; invasive alien species; financing biodiversity; biodiversity monitoring and indicators; public participation and awareness.
At European level	
European Council (**Gothenburg**, 15–16 June 2001) (European Council, 2001)	Adoption of the **EU Strategy for Sustainable Development**, which has as a headline objective 'managing natural resources more responsibly' and states that biodiversity decline should be halted with the aim of **reaching this objective by 2010**.
Conference **'Sustaining Livelihoods and Biodiversity**: Attaining the 2010 Target in the European Biodiversity Strategy' (**Malahide**, 25–27 May 2004) (Message from Malahide, 2004)	A large stakeholder consultation was organised within the process for review of the EC Biodiversity Strategy and Biodiversity Action Plans which resulted in the **Message from Malahide**, identifying the need for further action under crosscutting themes and major sectors influencing European biodiversity to halt its loss by 2010. The Malahide Conference also **endorsed a first set of EU headline biodiversity indicators to assess progress towards the 2010 target**.
European Council (Brussels, 28 June 2004) (Council of the European Union, 2004)	Conclusions on **'Halting the loss of biodiversity by 2010'** (10997/04).
European Commission 2006 (CEC, 2006)	Communication on Halting the Loss of Biodiversity to 2010 and Beyond (COM(2006)216 final).
European Commission 2011 (CEC, 2011)	New EU biodiversity strategy: *'Our life insurance, our natural capital: an **EU biodiversity strategy to 2020**'* (COM(2011)244 final). Adopted in line with the results of the COP 10 of the CBD. This provided a framework for the EU to meet its own biodiversity objectives and its global commitments as a party to the CBD. The Strategy set out a **long-term 2050 vision** and the **2020 headline target**.

Concerning Europe, in the EU's biodiversity and nature conservation policy, there are two key legislative instruments: The Birds[3] and the Habitats[4] Directives. It is a common legislative framework for all the 27 European Member States (EU-27). The broad objective of those Directives is to protect some of Europe's most valuable species and habitats across their entire natural range within the EU, regardless of political or administrative boundaries (European Commission, 2007 and 2010b; ETC/NPB, 2003).

The Directives have two main objectives. The first one is to 'protect species in their own right across the EU (through species protection provisions)'. And the second is to 'conserve certain rare and endangered habitat types, or the core habitats of certain rare and endangered species, in order to ensure their continued survival (through site protection provisions leading to the establishment of the Natura 2000 Network)' (European Commission, 2010b).

An important fact is that the Natura 2000 Network is not designed like strict nature reserves and it does not exclude all human activities. Instead, the Directives ensure that activities are undertaken 'in a way that does not adversely affect the integrity of Natura 2000 sites' (European Commission, 2010b).

II.1.2 Interest of the mining sector for biodiversity

In past decades, the conception that quarries were dusty and sterile environments where animals and native plants were absent, has switched slowly to places where a real potential for biodiversity exists. In reality, quarries can promote wildlife in being refuges for biodiversity as they construct non-permanent and diversified habitats in sometimes homogeneous landscapes. Careful quarry management can significantly enhance biodiversity (Eurogypsum, 2010).

Given ICMM (2010) mining represents a significant economic activity in many countries over the world, and as the demand for raw materials is still accelerating with the constant population growth, it is obvious that the mining sector will continue, and will expand into ever more remote regions.

As gypsum activities can occur in places that are environmentally sensitive and where there is a high potential for biodiversity, public awareness is focused especially on biodiversity conservation performance of quarries (ICMM, 2006). At the same time, environmental issues have become progressively important in mining business. The sustainability of a mining project has to be focused throughout all the mining activities: exploration, mine opening, operation and closure. 'Sustainability implies the use of clean technologies, minimisation of raw materials and energy demand, reduction of emissions and effluent discharge into the environment and maximisation of social benefits' (CETEM, 2004).

[3] (Official Journal of the European Union, 2013a)

[4] (Official Journal of the European Union, 2013b)

And more particularly, mining and metals industry has to demonstrate their commitments to biodiversity as part of their sustainable development (CETEM, 2004).

In addition to the moral and ethical considerations, which are increasingly at the heart of corporate policies nowadays, companies are also addressing biodiversity for sound business reasons. A lot of mining companies encompass biodiversity in their commitments to establishing and maintaining a social or functional ‘licence to operate’ (ICMM, 2006).

Given the ICMM (2006), ‘adopting responsible practices with respect to biodiversity management is increasingly viewed as important’ in the mining industry with respect to the access to land, reputation, and the access to capital.

II.2 Eurogypsum context

This project is a voluntary initiative which was launched by the Quarry WG of Eurogypsum, the European Association for Plaster and Plasterboard Manufacturers, and has been sponsored by Eurogypsum. The Quarry WG decided to launch cooperation with the Biodiversity and Landscape Unit of the University of Liege to define a set of biodiversity indicators that may be used for the Gypsum Industry throughout Europe. The first meeting to set out this thesis was holding on the 29th of November 2012.

II.2.1 Presentation of the European Gypsum Industry

The European Gypsum Industry in figures is presented in Table 2. Eurogypsum has a turnover of over 7 billion Euros. The European Gypsum and Anhydrite Industry operate 160 quarries and some 200 factories including plaster powder plants, plaster block plants and plasterboard plants. It generates direct employment of over 28 000 people and indirect employment (plasterers and plasterboard erectors) to 85 000 people. It is one of the few fully integrated industries within the construction products field (Eurogypsum 2012b and 2013).

Table 2 European Gypsum Industry in figures, from (Eurogypsum 2012b)

Characteristic	Figure
Annual turnover in Europe	Around 7 Billion Euros
Number of quarries in Europe	Around 160
Number of plants in Europe	Around 220
Plasterboards	100
Plaster powder	65
Plaster blocks	15
Gypsum fiber boards	8
Gypsum ceiling tiles	30
Direct employment	28 000
Indirect employment (user of products in construction)	850 000
Three main players	Siniat, Knauf, Saint-Gobain Gypsum

'The Gypsum Industry covers the whole life-cycle of the product. Indeed, the companies which extract the mineral Gypsum also process it and manufacture the value-added products and systems mainly used in construction. Gypsum products are indefinitely and fully recyclable as they always keep their natural properties during use. Therefore, the gypsum companies strive to effectively recycle the products at the end of their life-cycle (demolition waste)' (Eurogypsum, 2013). 'Gypsum products and systems, which are used extensively in interior applications such as ceilings, walls, partitions and floors, contribute to the safety and well-being of the users of these buildings. For example, gypsum plasterboard is per nature fire resistant and offers a high qualitative solution to prevent the spread of fire in buildings and effectively protect the occupants.' (Eurogypsum, 2013).

II.2.2 General presentation of Eurogypsum, the quarry WG and links with other institutions

Founded in 1961 in Geneva, Eurogypsum is a European federation of national associations of gypsum products manufacturers. It has been based in Brussels since January 1996. It was registered in Belgium as an International Not-for-Profit Organization in October 2006. It is also registered on the European Union's Transparency Register (Europa.eu, 2013).

'Its role is to promote the interests of the European Gypsum Industry and ensure that there is awareness at a European level of the contribution the Gypsum Industry makes to society in general and to the built environment in particular. It does this through joint research projects on relevant scientific, technical, economic and legal matters and by initiating information and communication programmes. Particular emphasis is placed on building a constructive and efficient dialogue with the European Institutions (Commission, European Parliament and Council) in all subjects directly related to the competitiveness of the Gypsum Industry.' (Eurogypsum, 2013)

There are three commissions in the Eurogypsum general structure (Figure 2): one for scientific and technical matters (The Scientific and Technical Committee, STC), one for environmental and raw materials matters (The Environmental and Raw Material Committee, ERMC) and one for marketing and communication matters (Marketing and Communication Committee, MCC). (Eurogypsum, 2012a).

In each commission, different Working Groups (WG) takes place. They are working on a current thematic in the Gypsum Industry. The activities of a WG are: regulatory monitoring of the subject dealt by the WG, analysis of legislation impacting the subjects, advocacy for the subject, drafting briefing notes and position papers on the subjects dealt by the WG and attendance to commission meetings and other forum meetings (Eurogypsum, 2012a). This study was initiated by the Quarry WG which is dealing with subjects related to the quarry, like the biodiversity in the quarries or the Environmental Impact Assessments (EIAs).

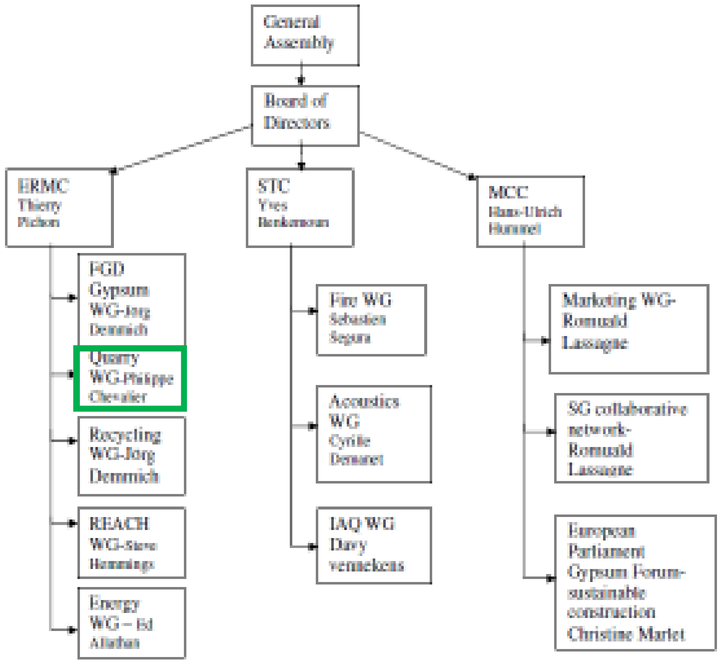


Figure 2 Presentation of the general structure of Eurogypsum. In green: the Quarry Work Group, directly from (Eurogypsum, 2012a)

Eurogypsum has three types of members: full, extraordinary and associate (Appendix 1). 'Full members are national associations of producers of gypsum products. Extraordinary members are companies operating in a European country where no industry-wide association exists. Associate members may be individuals – scientists, academics and researchers – who have distinguished themselves through their work in physical chemistry or gypsum applications in a given country or they may be companies with gypsum activities outside Europe.' (Eurogypsum, 2013).

Eurogypsum is an Associate Member of CEPMC (Council of European Producers of Materials for Construction). Eurogypsum also represents its members at the Raw Materials Supply Expert Group (RMSG) convened by DG Enterprise of the European Commission and is a member of the NEEIP (Non-Energy Extractive Industry Panel) whose aim is to represent the specific interests of the non-energy mineral community to the EU Institutions (Figure 3) (Eurogypsum, 2013).

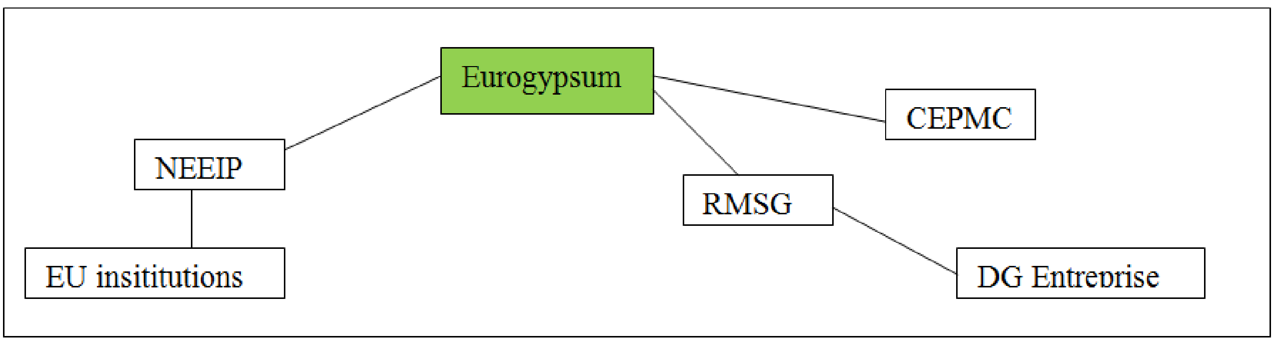


Figure 3 Presentation of the links between Eurogypsum and other institutions (Eurogypsum, 2013)

II.3 Biodiversity indicators

II.3.1 Introduction

In past decades, a lot of international, national or regional non-governmental organisations (NGOs) have needed to monitor aspects of biodiversity at different levels and scales (Duelli & Obrist, 2003). Measuring biodiversity, even in a small area, is too complex. Consequently, suitable indicators have to be found in comprehensively and quantified measure (Duelli & Obrist, 2003). The term biodiversity[5] is really complex and include a lot of different aspects. Because of this, no single biodiversity indicator can be developed. This implies making choices for values and measures and to focus on some aspects of the biodiversity (BIP, 2011 and Duelli & Obrist, 2003).

II.3.2 Quality criteria of indicators

In the literature, a number of criteria are considered in selecting and designing indicators for biodiversity, Normander & *al.* (2012) providing a summary of the literature of these quality criteria (Table 3). All criteria need not to be met because in lots of cases it is impossible. But this list is a useful tool to choose and develop biodiversity indicators (Normander & *al.*, 2012). Appendix 2 provides some examples of questions that can be asked to answer these quality criteria.

Table 3 Presentation of the quality criteria to choose relevant indicators, adapted from Normander & al. (2012)

Quality	Explanation
Representative and good coverage	Includes a large enough or representative group of species and has a good spatial coverage
Temporal and up-to-date	Shows temporal trends and can be updated routinely, e.g. annually
Simplifying information	Summarises a complicated phenomenon into a simple and intelligible form
Clear presentation	Possible to display clear messages with eye-catching graphics
Indicative	Indicates changes in a broader scale
Sensitive	Measured qualities are more sensitive to change than their environment (i.e. early warning)
Quantitative and statistically sound	Based on real quantitative observations and statistically sound data collection methods
Relatively independent of sample size	Usable data may be obtained even with relatively small sample sizes
Realistic	Based on existing monitoring programmes. Implementation is economically feasible
User-driven and acceptable	Responds to the needs of stakeholders and is broadly accepted amongst them
Normative and policy relevant	Linked to politically set goals and baselines.
Not sensitive to background changes	Enables assessing progress towards targets
Explainable	Buffered from natural fluctuations. Measures changes caused by humans
Predictable	May be forecast and linked to socio-economic models
Comparable	Enables comparison (e.g. benchmarking of Countries)
Aggregatable and disaggregatable	Data may be aggregated and disaggregated into different levels (e.g. country vs. community)

[5] The international Convention on Biological Diversity (CBD, 1992) defines biodiversity as 'the biological diversity means the variability amongst 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'.

II.3.3 Questions in order to have a relevant framework of biodiversity indicators

In order to understand what a biodiversity indicator is, and how to develop a coherent and reliable framework, the literature has been consulted. The aim of this review is to identify the basic key concepts and information useful for building a biodiversity KPIs framework adapted to the Gypsum Industry. For this purpose, several questions have been highlighted in the literature.

II.3.3.1.1 What is the definition of an indicator?

Clear definitions are essential in legislation, standards, and guidelines. Moreover, the importance of defining technical terms is widely accepted in science. A misunderstanding may lead to difficulties for communication. If different stakeholders do not have the same term's meaning, it is almost impossible to get to an acceptable agreement (Heink & Kowarik, 2010). 'Indicator' is a profoundly ambiguous term and may have different meanings in different contexts (Heink & Kowarik, 2010).

In order to develop a reliable framework of indicators, Heink & Kowarik (2010) suggest to define the indicator term clearly, but in a broad context, before any action. They establish a clear definition that mitigates all the opinions and which everyone can rely on: 'An indicator in ecology and environmental planning is a component or a measure of environmentally relevant phenomena used to depict or evaluate environmental conditions or changes or to set environmental goals. Environmentally relevant phenomena are pressures, states, and responses as defined by the OECD (2003)' (Heink & Kowarik, 2010). Some terms used in this definition (pressure, state and response indicators) are defined in Table 4.

Table 4 Explanation of pressure, state, response indicators, from (Manoliadis, 2002)

Indicator type	Explanation
Pressure indicators	'Describes the underlying cause of the problem. It can be an existing problem or it may be the result of a new project or investment'.
State indicators	'Usually describes some physical, measurable characteristic of the environment that results from the pressure'.
Response indicators	'Are those policies, actions or investments that are introduced to solve the problem. As responses to environmental problems they can affect the state either directly or indirectly, by acting at the pressures at work'.

Heink & Kowarik (2010) also suggest to clarify this definition depending on the specific issue. In this study we are talking about Key Performance Indicators (KPIs). Over all, this term has to be defined.

The term KPI is defined by Fitz-Gibbon (1990) as an 'industry jargon' for 'a type of performance measurement'. She defines a KPI as 'an item of information collected at regular intervals to track the performance of a system'.

In other words, Performance Indicators allow us to measure evidence 'to prove that a planned effort has achieved the desired result' (Kaufman, 1998). They may be used in two critical ways: a proactive one or a retrospective one. The first use identifies what should be accomplished, and the second provides criteria for determining success or failure (Kaufman, 1998)

In conclusion, the principal aim of a performance indicator is to provide 'the specific criteria from which the attainment of results can be planned and their accomplishment can be measured' (Kaufman, 1998).

II.3.3.1.2 Selection of indicator attributes?

It is essential to distinguish indicators based on the attributes defined in Table 5 (Heink & Kowarik, 2010). First of all, we have to know if we are looking for 'descriptive indicators' or 'normative indicators'. Secondly, we must fix if we want 'indicators as measures of ecological attributes' or 'indicators as ecological components'.

Table 5 Explanation of the attributes terms of indicators, based on Heink & Kowarik (2010)

Attribute	Explanation
Descriptive indicators	'Indicators used to describe environmental states or changes'.
Normative indicators	'Indicators not only used to describe environmental states or changes but also to evaluate them and to set objectives'.
Indicators as measures of ecological attributes	'Indicators that are measures of ecological attributes (e.g., species richness)'.
Indicators as ecological components	'Indicators that are components of ecological attributes (e.g., a certain taxon)'.

II.3.3.1.3 Simple or complex indicators?

Indicators can be simple or complex (Table 6). A simple indicator represents 'single, well demarcated environmental factors instead of a complex of different environmental conditions' (Heink & Kowarik, 2010). Currently, there are a lot of highly aggregated multispecies composite biodiversity indices. This kind of indicator provides a picture of trends in biodiversity in response to human activities in a wide scale (Vackar & *al.*, 2012).

Table 6 Explanation of simple or complex indicators, based on Heink & Kowarik (2010).

Name	Explanation
Complex indicator	Multidimensional: 'they include different fields for which information is needed and may integrate different information over a large area and a long period of time'.
Simple indicator	One-dimensional: 'reflect singular, short-term conditions'.

An example of a simple indicator is the chlorotic effects on the bean *Phaseolus vulgaris* that indicate directly the presence of a certain amount of NO_2. In opposition, the sustainability is a multidimensional indicator that aggregate environmental compatibility, social acceptability, justice, and sound economic development (Heink & Kowarik, 2010).

II.3.3.1.4 What is the goal, the role, and the motivations?

The classification by Failing & Gregory (2003), describe three key roles for indicators (presented in Table 7).

Table 7 Description of the three key roles for indicators by Failing & Gregory (2003)

Role	Explanation
To track performance	Results-based management
To discriminate amongst competing hypotheses	Scientific exploration
To discriminate amongst alternative policies	Decision analysis

But whatever the classification, Mace & Baillie (2007) suggest that the design of indicators will differ given their primary role, especially in the case of decision making. Thus we have always to keep in mind the role that these indicators will play. And at the same time it is important to avoid relying on indicators developed for different purposes, where possible (Mace & Baillie, 2007).

Personal and/or professional goals have a great influence on people who are involved in developing or using biodiversity indicators. Even if the purpose of the study is the same (measure or monitor biodiversity), they may address different aspects of biodiversity. Their focus depends on their motivation for dealing with biodiversity (Duelli & Obrist, 2003).

Consequently, it is really important to define precisely what the goals of developing biodiversity indicators are. Because the aspects on what we will focus will depend on the professional motivations. In other words, biodiversity indicators are purpose-dependant (BIP, 2011). The development or selection of biodiversity indicators should start with identifying the issue or decision-making need that the indicator will address. Describing this need in the form of a 'key question' helps to guide indicator selection and communication (BIP, 2011; Duelli & Obrist, 2003).

An example of motivation is enounced by Duelli & Obrist (2003) in an agricultural context in an industrialised country in Europe. The three most important motivations are, firstly, the species conservation and then to focus on rare and endangered species; secondly, the ecological resilience and focus on genetic or species diversity. And finally, the biological control of potential pest organisms and focus on predatory and parasitoid arthropods. If there is, like in this example, more than one motivation, the optimal approach is to select a basket of indicators for each motivation (Duelli & Obrist, 2003).

II.3.3.1.5 What aspect of biodiversity do we want to focus on?

Ones the goals and motivations are defined, it is crucial to know which aspect of biodiversity to focus on. Noss (1990) distinguished three kinds of attributes for biodiversity: compositional, structural and functional (Table 8). The most common approach is to measure compositional biodiversity (Duelli & Obrist, 2003).

In all likelihood, structural and functional diversity are based on a compositional biodiversity and, at the same time, lead to compositional biodiversity. Duelli & Obrist (2003) argue that ecosystem diversity, including structural and functional biodiversity, are reflected in the number of species. Moreover, if there is no correlation between that last biodiversity and the species richness, they must be special cases and not representative as biodiversity indicators (Duelli & Obrist, 2003).

Table 8 Explanation of the different attributes of biodiversity: Compositional, structural and functional, based on (Swingland, 2001)

Compositional
'Composition addresses the identity and richness of biotic components, and the relative amount (e.g., abundance, cover, biomass) of each'. 'Biotic components of ecosystems include genes, organisms, family units, populations, age classes, species and other taxonomic categories, trophic levels of animals (e.g., herbivores, predators), animal guilds and assemblages, plant communities, and interacting assemblages of plants, animals, and microorganisms (i.e., biotic communities)'.
Structural
'Refer to the various vertical and horizontal components of a community or landscape and the organizational levels of plant and animal populations and assemblages'. 'Considering only biotic, vegetative components of a landscape, horizontal structure consists of the size, shape, and spatial arrangement and juxtaposition of different plant communities; vertical structure consists of the foliage density and height of different vegetation layers. Structure can also refer to population, age and trophic structure, and other levels of community organization'.
Functional
'Include processes such as herbivory, predation, parasitism, mortality, production, vegetative succession, nutrient cycling and energy flow through biotic communities, colonization and extinction, genetic drift, and mutation'. 'Biotic processes can be addressed in terms of the identity and number of different types of processes, as well as the rate (e.g., predation rate) at which each process operates'.

II.3.3.1.6 Indicator FOR or FROM biodiversity?

There are several sources of misunderstanding about whether biodiversity itself is to be indicated or whether certain components of biodiversity are used as indicators for something else (Duelli & Obrist, 2003).

For example, a species may be a good indicator for lead contamination, but may not indicate biodiversity. Therefore, it is a contamination indicator, or an environmental indicator, rather than a biodiversity indicator. But biodiversity indicators may be needed to assess the impact of lead contamination on biodiversity itself. That is indicator FOR biodiversity. This last measure is not comparable from measuring the impact of lead on a selected taxonomic group, which has been chosen because it is especially sensitive to lead poisoning. That is an indicator FROM biodiversity (Duelli & Obrist, 2003).

II.3.3.1.7 Alpha-diversity or contribution to higher scale biodiversity?

In biodiversity indicators, an important question is if indicators concentrate on the species (or allele, or higher taxon unit) diversity of a given area (local, regional or national level), or if the focus is the contribution of the biodiversity of that area to a higher scale surface area (regional, national, global) (Duelli & Obrist, 2003).

In the first choice, the alpha-diversity (e.g. species richness of an area), the indicator has to be 'linear correlate to the biodiversity aspect or entity of the surface area in question. Each species has the same value' (Duelli & Obrist, 2003). In the second choice, 'the value of the measurable units of biodiversity (alleles, species, ecosystems) depends on their rarity or uniqueness with regard to a higher level area. A nationally rare or threatened species in a local assessment has a higher conservation value than a common species, because it contributes more to regional or national biodiversity than the ubiquitous species' (Duelli & Obrist, 2003).

II.4 Participatory processes

II.4.1 Why to use participatory processes in the definition of biodiversity indicators

Participatory[6] processes have been developed during the study in order to integrate the different opinions of stakeholders[7] and to reach a consensus biodiversity indicators framework. Participatory processes allow validating the elaborated framework step by step and bring a significant added value. This project aims at the participation of stakeholders involved in the framework that is developed. It does not concern all citizens.

Given Slocum (2003) participatory processes considerably increase the quality of decisions. In general, such process allows increasing the trust amongst the public for governance institutions and strengthens the perception of legitimacy. During participatory processes, stakeholders develop a better understanding of the aim and results reached and consequently a greater acceptance. Decision-makers are also part of the process and will learn things that lead to improving their judgment. They will receive direct feedbacks from all other stakeholders that will build a great overview to take decisions (Slocum, 2003).

In most cases, people think that participatory decision-making is only reserved 'to citizens who wish to play a more active role in the governance of their society' (Slocum, 2003). But it is not the case. Participatory processes may be implemented with any stakeholders' groups. It can go from regional, national and local governments, scientists and companies, up to development agencies or NGOs. Indeed, participatory processes can bring a lot of benefits not only to citizens (Slocum, 2003).

[6] In this thesis participation is defined as a 'process where individuals, groups and organisations choose to take an active role in making decisions that affect them'. 'This definition focuses on stakeholder participation rather than broader public participation' (Reed, 2008)

[7] Here, means 'Any group or individual who can affect or is affected by the achievement of the organization's objectives' (Freeman, 1984)

In this study, participatory processes have been implemented mainly with, and amongst, direct stakeholders of the Gypsum Industry (Quarry WG, local quarry managers and future users of indicators) and with/and amongst experts (gypsum's experts, external experts). Policy makers and representative of the society have been included likewise at some points. All the stakeholders are presented in Chapter III.1.

II.4.2 Iterative glossary

A glossary of terms has been produced to facilitate communication. It has been demonstrated in the preceding chapter that the concept of indicator is complex and can have a lot of meanings amongst domains and subjects. Technical terms are introduced throughout the thesis. Some of these terms may be unfamiliar to readers who are not ecologists, while others have multiple connotations from differential usages. To reduce the potential for misunderstandings, key terms have been explained in the manner in which they are used in this context.

This glossary was evolutionary. It has been compiled regularly during the study and has included all the concepts that were not understood by any participant. Important terms were also directly explained during the process to the stakeholders based on this glossary. For example, at each meeting or interaction the terms 'biodiversity' and 'indicator' were always detailed and explained to be sure that everybody had the same meaning.

The first glossary was proposed on the 28th of February, attached with an intermediate report. It was based on problematic concepts identified during the first meeting with the Quarry WG on the 29th of November 2012 and potentially problematic concepts in that last document.

The final version of the iterative glossary is presented in Appendix 37. It is a 15 page document. The glossary is divided in different chapters that answer questions that people had about some concepts like biodiversity, indicators, ecology or restoration. This structure is chosen in order that people really understand the links of the terms addressed and that they do not have to know what term to look for to understand a concept.

II.4.3 Level of participatory management given the context of the study

Given Pimbert & Pretty (1995), there are a lot of ways to interpret and use the term participation. Consequently, it has to be clearly qualified with an appropriate typology. Pimbert & Pretty (1995) defined a typology of participation from the passive participation to the self-motivation. The passive participation being the lowest level of participation, where people are just informed about what is happening or will happen. When people are taking initiatives that are independent of external institutions, the highest level is reached: the self-mobilisation. Those levels, elaborated in the context of the conservation of protected areas, are presented in Table 9.

Table 9 Presentation of the typology of participation, directly from Pimbert & Pretty (1995)

Typology	Components of each type
Passive participation	'People participate by being told what is going to happen or what has already happened. It is unilateral announcement by an administration or by a project management: people's responses are not taken into account. The information being shared belongs only to external professionals.'
Participation in information giving	'People participate by answering questions posed by extractive researchers and project managers using questionnaire surveys or similar approaches. People do not have the opportunity to influence proceedings, as the findings of the research or project design are neither shared nor checked for accuracy.'
Participation by consultation	'People participate by being consulted, and external agents listen to views. These external agents define both problems and solutions, and may modify these in light of people's responses. Such a consultative process does not concede any share in decision-making and professionals are under no obligation to take on board people's views.'
Participation for material incentives	'People participate by providing resources, for example labour, in return for food, cash or other material incentives. Much *in situ* research and bioprospecting falls in this category, as rural people provide the resources but are not involved in the experimentation or the process of learning. It is very common to see this called participation, yet people have no stake in prolonging activities when the incentives end.'
Functional participation	'People participate by forming groups to meet predetermined objectives related to the project, which can involve the development or promotion of externally initiated social organization. Such involvement does not tend to be at early stages of project cycles or planning, but rather after major decisions have been made. These institutions tend to be dependent on external initiators and facilitators, but may become self-dependent.'
Interactive participation	'People participate in joint analysis, which leads to action plans and the formation of new local groups or the strengthening of existing ones. It tends to involve interdisciplinary methodologies that seek multiple perspectives and make use of systematic and structural learning processes. These groups take control over local decisions, and so people have a stake in maintaining structures or practices.'
Self-motivation	'People participate by taking initiatives independent of external institutions to change systems. Such self-initiated mobilisation and collective action may or may not challenge existing inequitable distributions of wealth and power.'

In the context of this study, not all the levels of participation are possible. It is clear that self-motivation, for example, is unrealistic because the study is not independent of external institutions to change the system.

This study takes place in a particular context, because it is an initiative of a group of people inside an international Not-for-Profit Organization - the Quarry WG - in order to respond to European expectations. Indeed, this institution, which represents the interests of the Gypsum Industry at a European level, is closely related to the European authorities. The level of participation has therefore to be adapted. Moreover, the people who are taking the decisions about the implementation of the future KPIs framework are the Eurogypsum deciders for this topic: the Quarry WG. But they are directly dependant of the policy and societal context that the European authorities are building for biodiversity, even if, all these initiatives, in terms of a coherent framework, would be useless.

In this context, the only levels of participation possible are the three first ones: ‘Passive participation’, ‘Participation in information giving’ and ‘Participation by consultation’. Indeed, the ‘interactive participation’ and the ‘functional participation’ are impossible because of the time available, the budget and the fact that the European authorities, one of the stakeholders, may not allow us so much time. The ‘participation for materials incentives’ is directly excluded because we are not giving some money for people to work for us.

The passive participation is the lowest level and includes the stakeholders only to inform them that a decision will be taken. A highest level is possible in this context, therefore it is not chosen. The only two levels remaining are the ‘participation in information giving’ and ‘participation by consultation’. In this study, we are more turned to the ‘participation by consultation’, because the results are being built with the stakeholders and are adapted step by step, with their opinions and feedbacks they give all along the study.

II.4.4 Criteria to choose the tools of participatory processes

In the literature, there are many different participatory methods or tools. The participatory processes developed in this study are based on Slocum (2003). This hands-on toolkit written by Slocum (2003) and published by the King Baudouin Foundation and the Flemish Institute for Science and Technology Assessment, is a complete document available in order to start up and manage participatory projects. It lists no less than 50 methods, which with all the techniques derived from each method, are 73 possibilities. Moreover, the core of the toolkit includes 10 in-depth fiches of the most popular participatory methods.

To decide which methods are the most appropriate methods in the context of the study, all of these methods were compared according to the criteria defined in Table 10.

Table 10 Criteria used to select applicable methods of participatory processes in this study, from (Slocum, 2003)

Criteria	Explanation
Available time	Amount of time available
Available budget	Availability of resources
Possible Participants	Who is affected, interested or can contribute to solutions
Topic	The nature and scope of the issue
Objectives	Reasons for involvement and expected outcomes
Complexity	Level of complexity or technical requirence

The possible participants are presented in the following chapter that lists the stakeholders implicated. The comparison was made for the 50 methods listed by Slocum (2003). Appendix 3 and Appendix 4 are showing respectively the method and techniques of participatory processes listed in Slocum (2003) and a comparison chart of the method and techniques that are presented in the fiches of Slocum (2003). Moreover, the AHP proposed by Saaty (1980) and used by Oliver & *al.* (2007) in a context of biodiversity indicators, has also been taken into consideration. The latter is an approach of Group Decision Making. The Network Analytic Approach (ANP) has also been taken into account, because it's a generalisation of the AHP (Mu et *al.*, 2009).

Finally, three methods were relevant and applicable to this study: the Focus Group, the Delphi and the AHP.

II.4.5 Description of the three methods selected

Focus Group

Slocum (2003) defines a Focus Group as 'a planned discussion amongst a small group (4-12 persons) of stakeholders facilitated by a skilled moderator'. This tool of participatory process allows, for a given subject, analysing of the people's preferences and values and why they hold them. It must take place in a 'permissive and non-threatening' environment in order to observe the structured discussion. Consequently, Focus Groups are 'good for initial concept exploration and generating creative ideas'. It is a mix between a focused interview and a discussion group. It can be done face to face or online depending on the possibilities.

Delphi

The Delphi method consists on an iterative survey of experts. The principle is that each participant answers a questionnaire and after that the feedbacks from all the answers are given to them. Given the feedback, they rethink their answers and complete the questionnaire again, providing explanations on the points that were significantly different from the thinking of the others. They can change their opinions and answers on the basis of other participant's ideas. This process is repeated any time it is needed to build a consensus. The advantage of this technique is that some rare information may lead to the change of opinion of all participants. The aim of this technique is that the rate of consensus expands from each added round (Slocum, 2003). Traditionally this process was conducted by mail. Currently, other systems are possible: online or face to face, in which anonymity is eliminated.

A technique derived from the Delphi has been chosen for this study: the Policy Delphi. It is a variation of the traditional Delphi in which the aim is to display the different opinions about an issue and evaluate the principal pro and con arguments (Slocum, 2003). In contrast to the traditional Delphi that leads to a consensus amongst a homogeneous expert's group, the Policy Delphi intends to 'generate the strongest possible opposing views on the potential resolutions of a major policy issue'. A policy issue being a subject for whom there are only informed advocates and referees instead of experts.

An expert has the ability to estimate in a quantifiable or analytical way the effect of a particular decision about a given policy issue, while it is unlikely that a group of decision makers can do the same. For that reason, the expert becomes a representative of the effectiveness or efficiency of the question, while stakeholders' groups are advocates of the various interests existing in society. The Policy Delphi allows the final decision maker not to have a consensus on the policy question, but to get all the advice and evidence of these considerations on the question. The Policy Delphi is therefore a tool for the analysis of policy issues rather than a mechanism to arrive at a consensus decision. The purpose of a Policy Delphi is not to reach consensus but to get all the opinions on the topic discussed.

The implementation of a Policy Delphi is similar to traditional Delphi, but the questions asked to different stakeholders' groups are based more on the exploration of all the possibilities, opinions and reasons, rather than obtaining a consensus.

AHP

The AHP method is an Analytic Hierarchy Process often used for group decision making (Mu & *al.*, 2009). It is based on pair-wise comparisons. Ishizaka & Labib (2009) express that from a psychologist point of view, it is easier for people to give their opinion on only two alternatives than on all the alternatives simultaneously. Moreover, the AHP method does not require units in the comparison as the judgment is a relative value or a quotient of two quantities with the same units. It is easier for people as it is more familiar in our everyday life.

The AHP method is used to select and prioritise attributes in a structured and repeatable way. Moreover, it allows treatment of the contribution of each expert in numerical analysis which permits a more efficient and objective contribution to the negotiation. Indeed, in this technique, minority opinions are preserved but still contribute to the final result (Oliver & *al.*, 2007). The advantage of the AHP method is that it is based on statistical tests that are applying to each participant. That allows analysing the variability amongst all the opinions (Oliver & *al.*, 2007). More details are given in Chapter III.3.1.2.

III Materials and methods

General strategy

In 2011, the Biodiversity Indicators Partnership (BIP, 2011) has established guidance for the development and the use of biodiversity indicators at a national level. This guidance detailed a methodology to follow in order to have a relevant framework at a national level. The methodology of this study is inspired from that Development Framework. It has been adapted to the time and budget available, the scale and the kind of stakeholders involved.

Our strategy is based on five main steps (Table 11). This chapter details each step of the method. For the steps that include participatory processes it explains also how they are implemented in reality and what are the means implemented.

The first step aims to build a consistent network of stakeholders for the participatory process. The second step aims to build a first proposal of KPIs biodiversity framework based on the literature and validated in a participatory process (Focus Group) by Eurogypsum. During this step, motivation of the company should also be consolidated. This framework proposal serves as a basis for the consultation of all the stakeholders. The third step aims to reach the best consensus KPIs framework taking into account its feasibility. Three actions are developed. First, a participatory process (Policy Delphi) is held with all stakeholders in order to evaluate their opinion about the relative importance and feasibility of indicators and to reach a common framework. Second, biodiversity data collected by the Gypsum Industry in Environmental Impacts Assessments (EIAs) are synthesised to help selecting the most feasible indicators. Third, the proposed framework is confronted to quarry managers throughout Europe to evaluate its acceptability and the feasibility of its local implementation. The fourth step aims to make a final selection and validation of the list of KPIs indicators by Eurogypsum's Quarry WG on the basis of the evaluation provided in step 3 by all the stakeholders.

Additionally technical specifications and recommendations are synthesised in factsheets consigned in a Eurogypsum report to the destination of the public for communication on the final list of indicators. Eventually, after the delivery of the thesis to the Academic jury, interactions with Quarry WG will continue to finalise the report for publication and a presentation of the framework to all the stakeholders will be made on 26th of November 2013.

Table 11 Flow chart of the method of the study

Step 1. Building a stakeholders' network

- **Step 1.1** : Selecting stakeholders
- **Step 1.2** : Motivating stakeholders to participate

DELIVERABLE 1: A contact network with stakeholders

Step 2. Building a framework proposal to be submitted to stakeholders

- **Step 2.1** : Selecting a maximum set of indicators based on literature
- **Step 2.2** : Reaching an agreement on motivations and indicators with Eurogypsum (Focus Group)

DELIVERABLE 2: First consensus framework within Eurogypsum Quarry WG

Step 3. Reaching a consensus framework with all stakeholders and evaluating feasibility

- **Step 3.1** : Evaluating the level of consensus and priority on indicators with stakeholders (Delphi Survey)
- **Step 3.2** : Building on existing indicators included in EIAs
- **Step 3.3** : Testing acceptability and feasibility with quarry managers

DELIVERABLE 3 : Most acceptable framework for all the stakeholders given the relative importance of indicators and their feasibility

Step 4 : Final validation with Eurogypsum (Meeting)

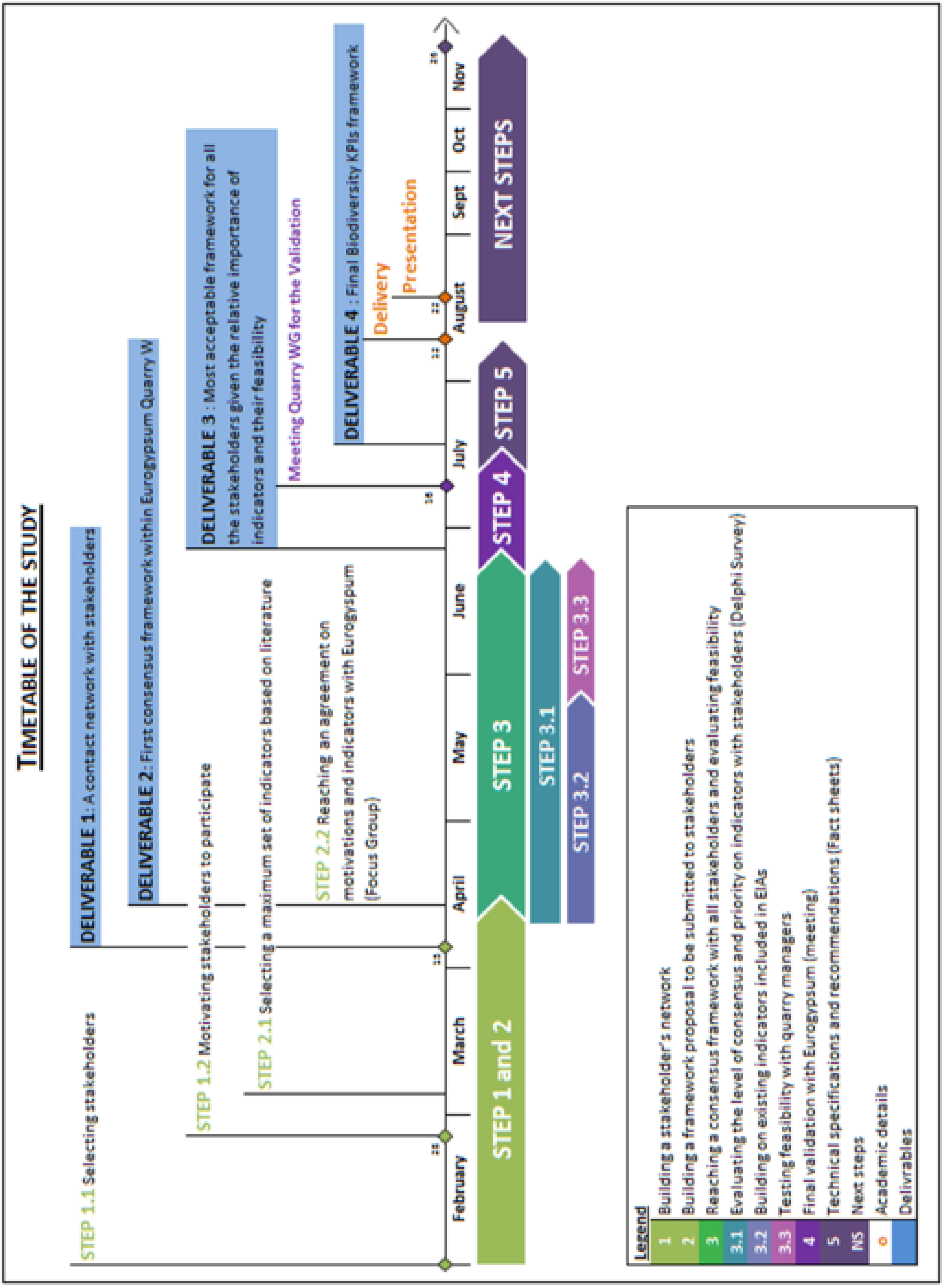
Step 5 : Factsheet of the indicators and Eurogyspum report

DELIVERABLE 4 : Final Biodiversity KPIs framework

Next steps

- Interactions with Quarry WG to finalise the Eurogypsum report for publication
- Presentation of the biodiversity KPIs framework to all the stakeholders: 26th of November 2013 and report publication

Figure 4 Timetable of the method fallowed during the study



III.1 Step 1. Building a stakeholders' network

III.1.1 Step 1.1. Selection of stakeholders

There are lots of possible misunderstandings in the context of biodiversity indicators. It is often the case that those 'who are responsible for comparing and evaluating biodiversity have a strong incentive to choose a scientifically reliable and repeatable indicator, which inevitably increases costs' (Duelli & Obrist, 2003). While the financing companies usually 'opt for a financially reasonable approach, which often results in programmes addressing only essential work'. 'The resulting compromises make optimisation of the choice of biodiversity indicators and methods of fundamental importance' (Duelli & Obrist, 2003). Hence, the KPIs framework should be best developed with the agreement of all stakeholders concerned in order to have a really usable tool. In this context, stakeholders' groups were identified to be representative of the mining sector, biodiversity experts, policy makers and public (Figure 5) which are the main stakeholders of biodiversity conservation in mining activities.

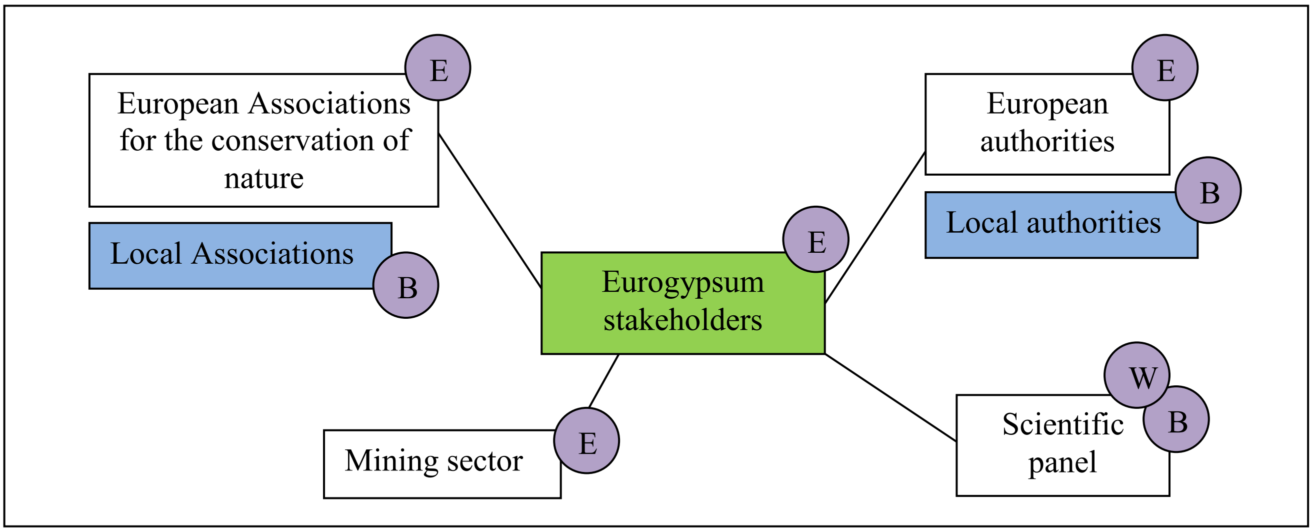


Figure 5 Presentation of the different stakeholders' groups identified for the study. In purple: the scale of consideration in the study: Europe (E), Belgium (B) and Wallonia (W).

Eurogypsum stakeholders

Eurogyspum stakeholders must be implicated at a first level because they have initiated the project and will be at the first front for implementation. The Eurogypsum stakeholders are divided into three types: the Quarry WG members, the quarries directors or managers and future users of indicators and the internal environment experts.

Internal environment experts are experts hired by the stakeholders to elaborate EIAs, to support the industry in environmental management or, specifically, to assist members of Quarry WG during the process of elaboration of biodiversity indicators. Their opinions are not independent from Eurogypsum or the companies they are working for, because they are hired and work for them.

European authorities

The European authorities pass new laws and establish strategies in terms of biodiversity for the European Commission (EC). Their participation in the process therefore ensures that the framework established will be aligned with European strategies. The European authorities involved in this study are from two departments, known as Directorates-General (DGs): the DG Environment and the DG Enterprise. The Units implicated are presented in Table 12.

Table 12 Presentation of the European authorities' stakeholders' group (from the European Commission) implicated in the study

DG	Directorate	Unit
DG Environment	B: Nature	Unit 1: biodiversity Unit 2: Natura 2000
	A: Legal Affairs and Cohesion	Unit A3: Cohesion Policy and EIA (environmental impact assessment directive)
DG Enterprise	F: Resource based and consumer goods industries	Unit: raw materials, steel and metals
	B: Sustainable growth and Europe 20	Unit: Sustainable industrial Policy and construction

Scientific panel

The scientific panel is composed of experts not connected to Eurogypsum and are therefore completely independent of their scientific opinions. It includes scientists at universities and consulting offices or independent experts from all around the world.

The scientist panel is constituted in three different ways. Firstly, the contact authors of the scientific articles judged as most important about the biodiversity indicators in this study, are included (Heink & Kowarik, 2010; Normander & *al*., 2012; Vackar & *al*., 2012). Secondly, the contact authors of the scientific articles given by Eurogypsum that include studies about gypsum quarries, are included (Martínez-Hernández & *al*., 2011; Margutti, 2009; Albert & *al*., 2008; Alguacil & *al*., 2009). In addition, a literature review on 'scopus' has been realized to identify scientific experts in the field of biodiversity and mining. Terms used in the scopus search were:

- Biodiversity and quarries, > 2009: 26 articles
- Biodiversity and indicator and quarry, -: 4 articles
- Biodiversity and mining and gypsum, -: 7 articles
- Biodiversity and indicator and gypsum, > 2009: 1 articles
- Biodiversity and indicator and mining, > 2009: 4 articles

A total of 59 articles were considered for a final selection of 45 scientific experts.

The consulting offices panel is constituted by consulting the Directory of Environment of Belgium (Annuaire de l'environnement, 2013). This directory lists the names of the authors approved for the study of Environmental Impacts, their contact and the categories of projects they have already addressed. The categories taken into account here are "Mining and quarrying" and "Planning, commercial and leisure activities". When the information about the contact persons is insufficient, an internet research is conducted in order to find all the information needed to contact the people directly: name, title, phone number and email address. Internet research is also conducted to find other consulting offices in France (3). Other European consulting offices are added to the panel on the basis of previous collaboration with the Biodiversity and Landscape unit at GxABT-ULg (3). In the end, a total of 43 consulting offices are contacted, that represent 55 persons. The hypothesis is taken that the experts from Belgium are representative of experts from other countries.

European NGOs for nature conservation

Public opinion is taken into account by including major European associations for the conservation of nature. The selection is restricted to European NGOs because the study is conducted at a European level. We hypothesized that European associations represent well the interest of citizens at a European scale in the field of biodiversity.

The major European associations contacted were:

- IUCN (International Union for Conservation of Nature)
- ECNC (European network for nature conservation)
- Fondation Faune Sauvage
- UNEP (United Nations Environment Programme)
- Earthmind
- WWF EU (World Wide Fund for Nature Europe)
- BirdLife

Local associations and authorities

To allow a comparison between the European scale and the local context, some local stakeholders' groups are taken into account: the authorities - DEMNA[8], DNF[9] - and the associations for the conservation of nature in Belgium - Natagora, Natagora/Aves, Ardenne et Gaume, Cercles des Naturalistes de Belgique (CNB), Faune & Biotopes, Fédération Inter-Environnement Wallonie (des associations au service de l'environnement) and Naaturpunt. The local context is Belgium, because contacts and communication are easier in the context of the time and budget we have available.

[8] Département de l'Etude du Milieu Naturel et Agricole (Belgium)
[9] Département de la Nature et des Forêts

Mining sector

Other stakeholders are the people who are working in the mining sector. They are included too, on the basis of previous collaboration with the Biodiversity and Landscape unit at GxABT-ULg (FEDIEX[10], Acrea-Ulg[11] and HeidelbergCement). Nineteen members of the Non-Energy Extractive Industries Panel (NEEIP) group were contacted by Christine Marlet. It includes people from CEMBUREAU (the European cement association), UEPG (the European Aggregates Association), EUROMINES (European Association of Mining Industries), EUROROC (European & International Federation of Natural Stone Industries) and IMA EUROPE (Industrial Mineral Association).

III.1.1 Step 1.2. Motivating stakeholders to participate

In order to motivate stakeholders to participate to the process, a 26 page report has been produced describing in detail the objectives and methods of the study (Appendix 17). An executive summary of this report is presented in Appendix 21. The report is sent to all stakeholders with a request for feedback including comments, suggestions and approval of the methodology. When launching participatory processes, the stakeholders have to be informed first of the process in order to be prepared to participate. During this step, some stakeholders that are particularly interested or have more questions about the project are encountered though different ways: meetings including conference calls and emails. The meetings conducted for the preparation of this step and the step itself, are listed in Table 13.

Table 13 Presentation of the meetings conducted for the step 1.2 motivating stakeholders to participate though the report presenting the method and objectives of the study

	Preparation meetings	Contacts with stakeholders (meetings, conference call)	Total
Number	9	4	13
Man/hour	11	4	15

III.2 Step 2. Building a framework proposal to be submitted to stakeholders

In this step, a first KPIs framework is built in interaction with Eurogypsum Quarry WG to be submitted further to all the stakeholders. In a first step, a list of indicators is built on the basis of the relevant literature describing existing institutional biodiversity indicators. The aim is to compile a first list as complete as possible. In a second step, this list of indicators is discussed in a Focus Group with the Eurogypsum Quarry WG in order to reach a first list of indicators acceptable by Eurogypsum.

[10] Fédération des Industries Extractives de Belgique
[11] Unité de recherche du Département Biologie, Ecologie et Evolution (BEE) de l'Université de Liège

III.2.1 Step 2.1. Selecting a maximum set of indicators based on literature

In order to select maximum set of indicators the literature is consulted.

Firstly, a wide variety of environmental indicators frameworks are presently in use. The FORCE Technology (2008) document was the basis for this analysis in order to highlight their potential utilisation by the Gypsum Industry as it includes a list of frameworks existing:

- The Benchmarking indicators used by investment research companies (Appendix 5).
- The DEFRA[12] Environmental KPIs (Appendix 6).
- The OECD[13] Key Environmental Indicators (Appendix 7).
- The EPER[14], a framework of industrial emissions into air and water.
- The GRI[15] (Appendix 8 and 9).

Secondly, different systems for reporting biodiversity indicators are also analysed:

The CBD indicators

The COP16 has fixed, in the decision VII/30 (CBD, 2004a), a provisional list of global headline indicators with the aim of assessing progress towards the 2010 target on the global level and to be able to report the trends in biodiversity according to the three objectives of the Convention. Moreover, in decision VIII/15 (CBD, 2004b), the COP distinguishes two classes of indicators: the ones that are considered as ready for implementation and indicators that need more work before using (CBD, 2013). The list of indicators is presented in Appendix 10.

The SEBI 2010

The EEA[17] has already made a big step forward in the biodiversity indicators field. In 2004, it begun with an inventory of biodiversity indicators in Europe (EEA, 2004) including no less than 31 frameworks of biodiversity indicators. Six hundred sixty five indicators were listed (including duplicates). In 2007, a first set of indicators to monitor progress in biodiversity conservation in Europe, was launched: the SEBI 2010 - Streamlining European 2010 Biodiversity Indicators (EEA, 2007).

'The SEBI 2010 was set up in response to a request from the EU Environment Council. Its aim was to streamline national, regional and global indicators and to crucially develop a simple and workable set of indicators to measure progress and help reach the 2010 target' (EEA, 2007). It proposes 26 biodiversity indicators.

[12] The Department for Environment, Food and Rural Affairs
[13] Organisation for Economic Co-operation and Development
[14] The European Pollutant Emission Register
[15] The Global Reporting Initiative
[16] Conference of the Parties
[17] European Environment Agency

Thirdly, different frameworks for environmental or biodiversity indicators developed for mining activities are also reviewed:

- Indicators for Environmental Monitoring in International Development Cooperation, developed by SIDA[18] (SIDA, 2002) (Annexe 11).
- Environmental performance indicators developed by CETEM[19] (CETEM, 2004) (Annexe 12).
- The HeidelbergCement's own indicators for the representation of successful reconstruction measures and for the measuring of biodiversity. Presented in (Rademacher & *al*., 2010) (Annexe 13).
- Cement International biodiversity indicators presented by (Tränkle & *al*., 2008) and (HeidelbergCement Technology & *al*., 2008) (Annexe 14).
- The Cement Sustainability Initiative (CSI) KPIs, founded in (Rademacher & *al*., 2010) (Annexe 15).

III.2.2 Step 2.2. Reaching an agreement on motivations and indicators with Eurogyspum (Focus Group)

A step that allows the *validation by stakeholders of the key concepts* is essential. The first target of this step is to make sure that everyone agrees on the concepts that form the basis of the study. The concepts approached are all the terms that could have some different meaning or are particular from an ecological domain, listed in the glossary of terms (see Appendix 37 and Chapter II.4.2). This first target includes also the *discussion and validation of the answer of 'the question in order to build a relevant indicators framework'* presented in Chapter II.3.3. For this purpose, a new report (named 'Content of the 17th of April') is written containing the definition of biodiversity and a summary of those questions and the possible answers for the Quarry WG given the first meeting with them on 29th of April 2012 (Appendix 18).

The second target is to *identify the values, motivations of the company and to validate the objectives and method of the study by the Quarry WG*. A key to build a relevant framework of indicators is to define clearly the motivations and the values in terms of biodiversity of the company for which those indicators are created. For that purpose, firstly, the report 'Content of the 17th of April' highlights the motivations and goals of the Quarry WG identified during the meeting of the 29th of November 2012. Secondly, a questionnaire to improve the knowledge on the motivation and the goals of Eurogypsum for having a biodiversity KPIs framework is build (Appendix 20). This questionnaire is answered during the Focus Group by all the members of the Quarry WG and the results are analysed directly with them in order to focus the discussion about their motivations and goals. The objectives and method (presented in the report used in Step 1.2: Motivating stakeholders to participate, Appendix 18) are summarised in an executive summary in order to synthesise the information in two pages (Appendix 21).

[18] Swedish International Development Cooperation Agency
[19] Centro de Tecnologia Mineral Ministério da Ciência e Tecnologia

The last target of this step is *to validate the list of stakeholders implicated in the study*. For that purpose, a document that list all the stakeholders and their contact is written and given at the meeting.

The Agenda of this meeting is presented in Appendix 19. All the documents needed were given to the Quarry WG by mail before the meeting and were printed and given in a folder to all the members during the meeting.

This is the first step of participatory process. It integrates the views of those directly affected by the implementation of this study: the representative of the European Gyspum Industry. This action was limited to this group because the first motivation was to answer Eurogypsum's request in being proactive to define a biodiversity indicators framework.

The method chosen for this step is a Focus Group (Solcum, 2003) (see Chapter II.4.5) led on the 17th of April 2013. This method implies the presence of a mediator who ensures an equal representation for all members during the discussion. This mediator was Christine Marlet, the co-promoter of this study. She is the Secretary General of Eurogypsum and a member of the Quarry WG. Her role in the Quarry WG is already to lead the discussions and the meetings, to take notes and to report the decisions. Therefore she has already undertaken the role of a mediator in all the Quarry WG meetings.

All the questions that have to be answered by the Quarry WG in order to succeed in this participatory process are asked step by step in relation with the three topics of the meeting. Three power points (one for each target of the meeting) are presented in order to put forward all the questions and to bring the stakeholders the content to answer. The number and duration of the meetings in order to prepare and having the Focus Group is presenting in Table 14.

Table 14 Presentation of the meetings conducted for the Step 2.2 reaching an agreement on motivations and indicators with Eurogyspum (Focus Group): for the preparation of the documents and the Focus Group itself

	Preparation meetings	Focus Group	Total
Number	8	1	9
Man/hours	7.25	4	11.25

III.3 Step 3. Reaching a consensus framework with all stakeholders and evaluating feasibility

In this step, a most acceptable framework is build for all the stakeholders given the relative importance of indicators and their feasibility. A first step is to evaluate with stakeholders the level of consensus and priority on indicators by a Delphi Survey. The aim is to have the opinions about feasibility and relative importance of indicators by a large panel. In a second step, the existing indicators included in the EIA,s are analysed in order to know the data availability in the Gypsum Industry. A third step is to test with quarry managers the acceptability and feasibility in three cases studies on the field.

III.3.1 Step 3.1. Evaluating the level of consensus and priority on indicators with stakeholders (Delphi Survey)

III.3.1.1 Delphi survey methodology

The aim of this step is to prioritise the indicators obtained to match the expectations of the stakeholders in term of feasibility and relative importance. It includes all the stakeholders identified in step 1, in order to compare the expectations and opinions of different stakeholders' groups. Only the Eurogypsum stakeholders are not represented in this step because their opinions about the feasibility and relative importance are discussed with them during the Step 2.2 (Focus Group) and Step 3.3 (Testing feasibility with quarry managers).

The resulting framework of the Step 2 (Deliverable 2: first consensus framework within Eurogypsum Quarry WG) resulted in a set of 23 indicators distributed in 7 classes of indicators corresponding to the 'focal CBD areas[20]'. This step included a prioritisation of those indicators classes.

The method used is a Policy Delphi approach using an online survey addressed to all the stakeholders. The survey includes three different methods to rank indicators that allow cross validation of the answers of stakeholders: i) evaluation of importance and feasibility of indicators individually (no comparisons), ii) selection of most important indicators and classes of indicators (indirect comparisons), and, iii) pair-wise comparisons of indicator's importance (AHP method) (direct comparisons). In addition, a section is dedicated to open comments and self-evaluation of the level of expertise of stakeholders.

[20] 'The CBD agreed upon a first headline indicator list in 2004, grouped in seven focal areas (Decision VII/30)' (EEA, 2007)

The survey is divided into eight sections:

Section 1: For each of the 23 indicators of the Eurogypsum framework proposal, respondents have to describe their agreement with the indicator (if not explain why) by noting a level of relative importance and feasibility on a scale of ‘low, medium or high’.

Section 2: Three opened questions:

- Do you have any idea of other potential relevant indicators?
- Do you have any comments on the indicators?
- Do you have any comments about the importance or feasibility of indicators?

Section 3: Classification of the 7 classes of indicators according to their relative importance.

Section 4: The choice of the most important indicator of each class of indicators.

Section 5: The choice of the 6 most important indicators for biodiversity within all the 23 indicators.

Section 6: AHP - the pair-wise comparison of each of the 7 classes of indicators.

This part of the survey is based on a simplified AHP method (Saaty 1980). AHP method allows pair-wise comparisons of proposals (class of indicators) in term of relative importance/feasibility. It leads to a consensus hierarchy of indicators’ classes. Because a full AHP assessment is fairly complex and requires long questionnaires, the method is adapted to the time and resources available. Therefore, a special attention is paid to the simplification of questions and to reduce the time to answer the survey. The simplification of the AHP consists: (i) in classifying only the classes of indicators instead of all the indicators; (ii) in comparing the classes one to each other without a numerical scale 1 to 9 normally associated with a conventional AHP method.

Section 7: The level of expertise of people to answer the survey.

Section 8: Final open questions about the survey:

- Do you have any comments about this questionnaire?
- Do you have anything to add or to say about this framework?
- Do you have any comments or questions on the framework development that is presented in the document ‘Eurogypsum Framework development’?

Appendix 22 presents all the questions of the survey. Appendix 23 displays the online interactive interface of the survey.

This survey was sent in French and in English in order for people to choose their preferred language. The mail was sent in the language of the people concerned to be sure that they understand directly the mail and do not delete it directly. A particular attention is paid to indicate that the survey is anonymous.

The survey was proposed online to stakeholders. It is available at http://www.gembloux.ulg.ac.be/enquete/index.php/728198/lang-en (in English) and at http://www.gembloux.ulg.ac.be/enquete/index.php/728198/lang-fr (in French) from the 26th of April 2013 to the 5th September 2013. The deadline to answer for the stakeholders was from the 28th of April (date of sending the survey by mail) to the 10th of June.

Before sending the mail, each person was contacted by phone to be sure to have the right mail addresses and that the people agree to receive the survey. A second target was to inform them about the approach and motivate them to answer. After that, the mail was addressed to each person in their native language. This method was used for all the stakeholders except the scientists for whose the phone numbers was not available and the NEEIP group of stakeholders that were contacted by Christine Marlet personally by mail. For the scientists, the mail was co-signed by the promoter of this study to have much impact. Three days later, all the stakeholders were called again to be sure that they have well received the survey and to answer their potential questions. Remind call was conducted for the people that did not answer two weeks later and two weeks before the end of the survey (around the 27th of May). For the scientists, a second mail was send at the persons that did not answer three weeks before ending. The presentation of the meetings and phone calls conducted for this Step are presented on Table 15.

Table 15 Presentation of thepreparation meetings and phone calls conducted for the Step 3.1 Evaluating the level of consensus and priority on indicators with stakeholders (Delphi Survey)

	Preparation meetings	**Initial Phone calls**	**Remind Phone calls**	**End Phone calls**	**Total**
Number	7	102	28	13	150
Man/hours	4.25	3.5	1	0.5	9.25

III.3.1.2 Analysis of survey data

III.3.1.2.1Analysis of individual indicators importance/feasibility (section 1)

To be able to interpret the results, a consensus scale is defined. For the indicators that reach a consensus of more than 50% of all the stakeholders on a level of importance or feasibility, we considered that a *high consensus* is reached. The level of importance is then:

- High importance
- Medium importance
- Low importance

For the indicators for which a high consensus of more than 50% is not reached, the trends are analysed in an intermediate scale and the consensus is defined on the consensus scale as medium. The global percentages of two levels of importance are merged and the result has to be more than 75% to consider that there is a *consensus on an intermediate scale (or medium consensus)*. This scale is then:

- High-Medium importance
- Medium-Low importance

When no consensus is reached, the consensus scale is defined as ‘0’ and of *no consensus*.

After that global analysis, the trends of each group of stakeholders is evaluated. The group of stakeholders that reaches an intern consensus of more than 50% for a level of importance/feasibility on the scale defining just before is graded of a value of 1. The sum is done on the entire four stakeholders’ groups. A maximum value (number of stakeholder groups taken into account in the analysis) means an agreement amongst all the stakeholders’ groups with more than 50% in all the groups. A value of 1 means an agreement only for one stakeholders’ group. And a value of 0 means that all the groups do not reached a 50% agreement about the level of importance/feasibility.

For the no consensus case ‘0’, the trends are analysed given the stakeholders’ groups anyway. But instead of considering only the scale of the consensus level of importance, all the levels are taken into account to highlight the majority (50%) of thinking for each level.

Table 16 Example of the method used for the interpretation of the analysis of individual indicators importance/feasibility (section 1) of the Step 3.1(evaluating the level of consensus and priority on indicators with stakeholders by a Delphi Survey). The table is presenting the percentage of stakeholders that have chosen each level (Low, Medium, High) of importance/feasibility (L, M, H) for given indicators (Ind) and stakeholders’ groups (SGroup). Indicators in blue reached a high consensus of High importance; in light blue, a consensus on an intermediate scale of Medium-High importance; in green, a consensus on an intermediate scale of Medium-Low importance; in white, no consensus

Ind	14			19			4			1			11			20			23			7		
SGroup	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
EC (%)	0	25	75	0	25	75	0	25	75	0	50	50	0	75	25	25	50	25	25	0	75	25	50	25
UN (%)	0	17	83	0	0	100	0	33	67	33	33	33	67	17	17	33	33	33	50	33	17	33	67	0
CO (%)	0	18	82	27	27	45	9	36	55	9	45	45	45	55	0	64	18	18	45	45	9	36	36	27
BN (%)	0	40	60	0	40	60	0	40	60	20	60	20	60	40	0	40	60	0	40	0	60	0	80	20
Tot %	3	26	71	13	26	61	3	39	58	16	42	42	48	45	6	45	32	23	42	29	29	26	48	26
Tot %											84		94			77			71				74	
EC: European Commission; UN: Universities; CO: Consulting Offices (CO); BN: Belgian NGOs.																								

An example of the method used for the interpretation is illustrated in Table 16. For example indicator 14 reaches an overall majority which is accompanied by a majority in each group. It has a scale consensus of high and stakeholders’ groups of 4. The indicator 11 does not reach a strict consensus, but an intermediate scale by merging the percentages of the two levels High and Medium. The merged percentage obtained is upper than 75%, so we can say that the indicator 11 belongs to the intermediate scale Medium-High. This intermediate consensus is accompanied by a majority in each group (stakeholders’ groups of 4).

III.3.1.2.2 Analysis of AHP data

The Excel template of Goepel (2013a) is used in order to analyse the results of the AHP. As the latest version of this template is designed for 20 participants, and that the survey included 31 stakeholder responses, the template is extended given the method described by Goepel (2013b). It is developed for 8 criteria. A detailed guidance on how to use the template is given in Goepel (2013c). After adding the participants, the template consists of 31 input worksheets for pair-wise comparisons, a sheet for the consolidation of all judgments and a summary sheet that displays the results. One sheet also shows the reference tables concerning the random index, the limits for geometric consistency index GCI, and the judgment scales. And the last one allows solving the eigenvalue problem when using the eigenvector method (EVM) (Ishizaka & Labib, 2009) and (Goepel, 2013c).

The AHP method is divided into four steps. Firstly the problem has to be modelled, after that the weights have to be evaluated and aggregated, and finally a sensitivity analysis has to be conducted.

Problem modelling

The target of this first step is to structure the problem. For this purpose, three choices have to be defined: the goal, the criteria, and the alternatives. The advantage of the AHP is that it allows a hierarchical structure of the criteria. That permits the stakeholders a better focus on specific criteria and sub-criteria when assigning the weights. The structure given to the problem is important because it may lead to different final rankings. Indeed, it has been observed that criteria with a large number of sub-criteria will receive more weight than when they are less detailed.

In this study, the goal is to prioritise the seven classes of indicators given their relative importance. The criteria are then the importance of the classes given by the stakeholders. Here, there are not any sub-criteria, so no other structure may be developed. And the alternatives are the ranking of the classes of indicators. In the Goepel (2013a) template, all the variables for the structure modelling of the problem are to be filled in the first sheet, the summary one.

Pair-wise comparisons

A matrix stores of all the pair-wise comparisons of each stakeholder (decision-maker), at each node of the criteria's hierarchy. In the Template, those are calculated in each input sheet of participants given their choices.

The matrix, in theory, is perfectly consistent and answers to the transitivity rule for all comparisons (Equation 1).

Equation 1 Transitivity rule for all the comparisons in a perfectly consistent matrix

$$a_{ij} = a_{ik}.a_{kj}$$

Given Ishizaka & Labib, 2009 our world is inconsistent by nature and the matrix is not perfectly consistent. Anyway, to derive meaningful priorities, a minimal consistency is required. It is noteworthy that the order of the successive choices may change the successive judgments of stakeholders.

Judgement scales

The conventional AHP method from Saaty (1980) is establishing the possibility to judge quantitative and qualitative criteria and alternatives on the same preference scale of nine levels (Table 17).

But, as the survey of this study had to be really quick in order that a maximum of people answer, a simplification of the AHP method was conducted in this step. Instead of defining a preference scale of nine levels, all the classes of indicator have been compared to one to each other without scaling, so that people just have to choose what class of indicator they prefer between the two. In the Goepel (2013a) template, the preference scale has to be complete for each comparison and for all the stakeholders. As the simplified AHP of this study does not integrate this scaling, the value is fixed in the Goepel (2013a) template as the same value for each participant and each comparison. All the values of the scale 1 to 9 are tested to know which one allows a better consistency (Table 17).

In the literature, there exist other scales than the 1 to 9 from Saaty (1980). They are presented in Appendix 24. Given Ishizaka & Labib, 2009 there is a lot of disagreement about the best scale to choose in the AHP method. Some scientists lay out that the choice depends of the decision problem and the person that is modelling the issue. But anyway, it is demonstrated that the balanced scale is superior to all the others when comparing two elements. Accordingly to that statement, the traditional linear scale from Saaty (1980) will be tested as with the balanced scale.

Priorities derivation

After obtaining the comparisons matrices, the priorities are calculated. In the Goepel (2013a) template, priorities are calculated in each participant's input sheet, using the row geometric mean method (RGMM) (equations presented in Appendix 25). The priorities calculated are exact when the matrix is consistent. When 'there is slight inconsistencies, priorities should vary only slightly according to the perturbation theory' Ishizaka & Labib, 2009.

Consistency

The priorities are relevant if they are deriving from consistent matrices. This has to be checked. In relation to the eigenvalue method, Saaty (1977)[21] developed a consistency index (CI) (Appendix 25). The consistency ratio (CR) calculation is presented in Appendix 25. A consistency is judged acceptable if the CR is less than ten per cent and is as better as it is close to zero (Ishizaka & Labib, 2009).

Aggregation of individual judgments

The final step consists of calculating the global priorities to summarise the local priorities across all criteria for each participant. For that purpose, in the Goepel (2013a) template, the consolidated mode is chosen in order that all the choices of the k participants are combined in a consolidated matrix that allows aggregating the group results. In the template, the individual participants weight as given in the input sheets are aggregated using the weighted geometric mean of the decision matrices elements (Appendix 25).

Sensitivity analysis

The final step of the AHP is the sensitivity analysis: 'the input data are slightly modified in order to observe the impact on the results'. The results are said to be robust if the ranking does not change.

After having collected the data of the pair-wise comparisons for all the participants, they were entered in the Excel template of Goepel (2013a). As in the survey, in order to skirt the issue of scaling 1 to 9 of the preferences, all the choices have been defined as all on the same scale. Sensitivity analysis was conducted: all the values of the 1 to 9 scale were tested to know which scale allow a better consistency (Table 17), except the value of 1 that represents on equal importance of two comparisons. The sensitivity analysis combined also the test of the traditional linear scale from Saaty (1980) and the balanced scale (Appendix 24).

Table 17 Scale of preferences used in the Template of Goepel (2013a), directly from Goepel (2013a)

Intensity of importance	Definition	Explanation
1	Equal importance	'Two elements contribute equally to the objective'
3	Moderate importance	'Experience and judgment slightly favor one element over another'
5	Strong Importance	'Experience and judgment strongly favor one element over another'
7	Very strong importance	'One element is favored very strongly over another, it dominance is demonstrated in practice'
9	Extreme importance	'The evidence favoring one element over another is of the highest possible order of affirmation'

[21] Saaty, T., 1977. A scaling method for priorities in hierarchical structures. *Journal of Mathematical Psychology*, **15**(3), 234–281.

III.3.2 Step 3.2: Building on existing indicators included in EIAs

Indicators included in the Eurogypsum framework proposal are compared to the different indicators already included in the EIAs in the Gypsum Industry. This comparison allows highlighting which are the indicators already used in the Gypsum Industry and what data is already available. In general in the EIAs no indicators or indices are clearly defined. But different aspects of the environment (fauna and flora, soil, aquatic system etc) are precisely determined. Consequently, some aspects of biodiversity are measured and can be considered as biodiversity indicators. The data collected in the EIAs are not measurements; they are prognosis and not monitoring. Eleven EIAs have been received from quarries of different countries: France, Germany, Italy, Spain and UK, all in the native language of the country. The details of the documents are presented in Table 18.

Table 18 Presentation of the type of documents of the eleven EIAs received for the Step 3.2(Building on existing indicators included in EIAs)

n	EIAs	Date	Type of document	Number of documents	Total pages	Company
1	FrP	November 2003	Pdf	2	138	Lafarge Plâtres
2	FrMa	February 1997	Scan	23	936	Lafarge Plâtres
3	FrC	January 2007	Pdf	1	207	Lafarge Plâtres
4	FrMo	October 2009	Pdf	5	196	Gypse de Maurienne SA
5	FrS	June 2004	Pdf	1	89	Knauf plâtres & Cie
6	Ge	January 2010	Pdf	6	1322	Knauf Gips KG
7	ItM	December 2005	Scan	51	254	Lafarge gessi S.p.A.
8	ItG	July 1991	Scan (rotated)	1	30	Davillia S.r.l.
9	SpC	April 2005	Pdf	1	84	BPB Iberplaco
10	SpS	October 2009	Scan	22	430	Ibéricos S.A.
11	UK	February 2006	Pdf	4	313	BPB Formula

Quarries of: FrP: Le Pin and Villevaudé, in France; FrMa: Mazan, in France; FrC: Caresse, in France; FrMo: Maurienne, in France; FrS: Saint Soupplets, in France; Ge: Lüthorst-Portenhagen, in Germany; ItG: Cava di gesso di monte tondo, in Italy; ItM: Masseria grossi, in Italy; SpC: Cerro negro Moron de la Frontera Provincia de Sevilla, in Spain; SpS: Quarry of Soledad, in Spain; UK: Bantycock Mine (Nottinghamshire), in the United Kingdom.

A lot of EIAs received were presented in different documents (Table 18). Consequently, the first step was to identify the document that includes the most complete version of the impact study for each EIA. After that, key terms were defined for each indicator in order to find the sections that were interesting in the context of the indicators, and they were translated in the different EIAs languages. Then a more detailed analysis was made for the species and the habitats. For that purpose, more specific key terms of the indicator related to those questions were searched for in all the EIAs. The taxonomic groups of species studied in the EIAs were determined together with the definition of habitats and protected habitats.

III.3.3 Step 3.3: Testing acceptability and feasibility with quarry managers

The aim of this Step is to confront the Eurogypsum framework proposal to the reality of the field and to the quarry stakeholders: the quarries directors or managers and future users of indicators as well as with the internal environment experts. This step allows collecting the key elements that will guide the choice of the most suitable scenario for users.

Three quarries from France, Spain and Germany were selected by the Quarry WG which belongs to the three main players in the Gypsum Industry: Siniat, Saint-Gobain and Knauf. The detailed situation of each quarry is presented in Table 19.

Table 19 Presentation of the three quarries visited on the 30th of May (France), the 5th of June (Spain) and the 10th and 11th of June (Germany) for the Step 3.3 (Testing acceptability and feasibility with quarry managers) and the duration of the meetings in each quarry

Locality	Company	Detailed situation	Meeting duration (Man/hours)
France, Caresse	Siniat	Town of Caresse-Cassaber, Pyrénées-Atlantiques Departement, Aquitaine Region.	17.5
Spain, Gelsa	Saint-Gobain	In the Province of Zaragoza	7.5
Germany, Markt-Nordheim	Knauf	In the District of Neustadt (Aisch)-Bad Windsheim in Bavaria.	11.25
		Total	36.25

Because the quarries are very busy and the quarries' directors or managers and future users of indicators together with internal environment experts had to attend the meeting, the visits of the quarries were restricted to one day. However, two buffer days on the site were planned in case of troubles in the production or undefined causes that would have for consequence that people cannot be present at the meeting.

Those visits were structured as presented in Table 20 and adapted to the time available on the field for each quarry. Consequently, specific agendas were written for each visit and sent before the arrival (Appendix 26, 27 and 28; respectively for France, Spain and Germany). Adapted PowerPoint presentations were also made including the agenda of the day and the content to present the project and the framework of indicators. The example of the PowerPoint presentation presented in Germany is shown in Appendix 29. The durations of the meeting in each quarry are presented in Table 19.

At the end of all the participatory processes, a total of more than 447 mails were sending to the stakeholders and more than 421 mails were received, without counting the mails exchanged within the Biodiversity and Landscape Unit Staff of GxABT-Ulg and given the mail box of Carline Pitz.

Table 20 Presentation of the structure of the visits days on the three cases studies: France (30th of May), Spain (5th of June) and Germany (10th and 11th of June) for testing acceptability and feasibility with quarry managers (Step 3.3)

1. Introduction (0,5 h)

- Overview of Eurogypsum and action on biodiversity, Eurogypsum expectations (person who is aware of the project in the quarry)
- Presentation of the work of Master 2 and objectives (Carline Pitz)
- General introduction to biodiversity
- General presentation of the quarry (person who knows the quarry well)

2. Presentation of the project (1,5 h)

- Presentation of the general context of the indicators
- Discussion
- Presentation of the indicators
- Round table and discussion

3. Visit of the quarry : biodiversity, running and productivity (1h)

4. Feasibility of the project on the site (2h)

- State of knowledge and issues identified for biodiversity in the quarry
- Capacity of internal and external expertise, training needs
- Time needed to set up the framework of indicators
- Local context for the indicators use: local communication (public, government, associations), communication within the group

5. Conclusions and following steps (0,5h)

III.4 Step 4: Final validation with Eurogypsum (meeting)

On the basis of Step 3 (Reaching a consensus framework with all stakeholders and evaluating feasibility) and the analysis of the results of the Delphi survey (Step 3.1), the EIAs (Step 3.2), and the visits of the three quarries (Step 3.3), a most acceptable framework for all the stakeholders given the relative importance of indicators and their feasibility is build (Delivrable 3). This framework consists of a proposal for the Quarry WG to take its final decisions about the indicators to implement.

This validation occurred on the 16th of July with all the Quarry WG members during four hours. Christine Marlet played the mediator of this meeting that can be seen as a Focus Group.

For this purpose the proposal framework and the motivation of each choose of the proposal were presented in a document given before the meeting. At the meeting, a Power Point explaining the main results of the study and all the motivations of all the choices of the indicators to keep or not was presented. After that, a structured discussion on which indicator to keep was conducted in order that the Quarry WG explicit they final choice.

III.5 Factsheet of the indicators and Eurogyspum report

Firstly, since the Quarry WG has chosen all the final indicators on the basis of the most acceptable framework for all the stakeholders, the factsheets of the final indicators can be written. Those factsheets are inspired by the one presented in (EEA, 2007b) and the BIP (2011). The factsheets aim to synthesise the information about each indicator to allow a better understanding of the results of this study. The content of the factsheets is presented in Appendix 33.

Secondly, a 'Eurogypsum report' to the destination of the public (the Gypsum Industry and the decision-makers) was written. This report includes presentations of: (i) biodiversity and biodiversity indicators, (ii) the context of mining and biodiversity, (iii) the motivations of Eurogypsum for having a KPIs framework, (iv) the headline of the method of the study and the main results associated, (v) the final framework and how to implement it (vi) the factsheets of each final indicators. This report is attached with this master thesis and includes all the factsheets that are written to the destination of the public.

III.6 Next steps

The agenda for the future steps after the delivery to the academic jury is presented in Table 21. First of all, interaction with Quarry WG to finalise the Eurogypsum report for publication will take place. The Eurogypsum report and the Master thesis will be sent to the Quarry WG on 12th of August, the day of the delivery to the academic jury. The Quarry WG will have until the 16th of September to send their comments on the Eurogypsum report. Those comments will be incorporated in the document. After that, it will be proofread and layout by a communications agency to be ready on the 15th of November for publication.

Finally, a presentation of the framework to all the stakeholders will be lead on the 26th of November 2013 during a Workshop named "Promoting Biodiversity in Gypsum Quarries". This workshop will present to all the stakeholders the results of this study and the future steps discussed. This workshop will be led by GxABT-Ulg and Eurogypsum in Brussels-Eurocities square De Meeus 1-1000 Brussels from 14h00 to 17h00. The Agenda of the workshop is presented in Appendix 34. The people invited are all the stakeholders that were implicated in the study and the national associations of gypsum.

Table 21 Agenda of the next steps of the study after the delivery to the academic jury including: (i) interactions with Quarry WG to finalise the report for publication (ii) the presentation of the biodiversity KPIs framework to all the stakeholders: 26th of November 2013 and report publication

Date	Agenda
12 August 2013	Report and Master thesis sent to quarry WG
22 August 2013	Defence of the Master thesis
1 September 20013	Christine Marlet will send the invitations to the Workshop
16 September 2013	Deadline for comments on the report by the quarry WG
17 to 20 September 2013	Incorporation of the changes in the report by Carline
23 September 2013	Communications agency-see quote for a printed version and proofreading
15 November 2013	Electronic format ready and/or printed version
26 November 2013	Workshop from 14h00 to17h00-Brussels- Eurocities square de Meeus

IV Results and discussions

IV.1 Step 2. Building a framework proposal to be submitted to stakeholders

IV.1.1 Step 2.1. Selecting a maximum set of indicators based on literature

Firstly, the environmental indicators frameworks compared in FORCE Technology (2008) have been analysed to highlight their potential utilisation for the Gypsum Industry:

- The benchmarking indicators used by investment research companies (Appendix 5) has been analysed with the DEFRA[22] Environmental KPIs (Appendix 6). Those two first frameworks do not contain relevant biodiversity indicators for this study.
- Three biodiversity indicators are relevant in the OECD[23] Key Environmental Indicators (Appendix 7). They are dealing with the threatened species, the habitat alteration and the protected areas. The EPER[24], a framework of industrial emissions into air and water indicators does not present relevant biodiversity indicators. Contrariwise, the GRI[25] (Appendix 8) contains five indicators that are all relevant for this study.

Only the GRI guidelines and set of biodiversity indicators (Appendix 8 and 9) both with the OECD biodiversity indicators (Appendix 7) contains relevant indicators for the Gypsum Industry which may be integrated in the study.

Secondly, different systems for reporting biodiversity indicators have been also analysed: (i) the CBD indicators framework includes relevant biodiversity for the Gypsum Industry (Appendix 10); (ii) the SEBI 2010 framework constitute the most complete set of biodiversity indicators reviewed because that framework is explicitly linked to biodiversity policy contexts. At a European level, it responds to:

- The 'Message from Malahide' (Message from Malahide, 2004)
- The EU Council Conclusions of 28 June 2004 (Council of the European Union, 2004)
- The EU Habitats and Birds Directives (Official Journal of the European Union, 2013a and b)
- The EU Strategy for Sustainable Development (European Council, 2001)
- The Lisbon Agenda (European Commission, 2010a)
- the EU biodiversity strategy (CEC, 2006)

[22] The Department for Environment, Food and Rural Affairs
[23] Organisation for Economic Co-operation and Development
[24] The European Pollutant Emission Register
[25] The Global Reporting Initiative

And at a Pan-European level it is consistent with:

- The Kiev Resolution on Biodiversity (United Nations, 2003)
- The UNECE[26] Environment for Europe process
- The Pan-European Biological and Landscape Diversity Strategy (PEBLDS).

Moreover, at a global scale, they are derived from the CBD indicators, adopted as part of CBD decision VII/30 in February 2004 (CBD, 2004a) and updated by CBD decision VIII/15 (CBD, 2004b). SEBI 2010 works in conjunction with the 2010 BIP[27]. It implicated a lot of stakeholders like the UNEP-WCMC[28], the GEF[29]-funded project called BINU[30] (which involves more than 40 partner organisations around the world). The Appendix 11 presents the 26 SEBI 2010 indicators and highlights the biodiversity indicators that are relevant for this study.

Thirdly, different frameworks for environmental or biodiversity indicators developed for mining activities has been also reviewed:

- Indicators for Environmental Monitoring in International Development Cooperation, developed by SIDA[31] (SIDA, 2002) present two relevant indicators for the Gypsum Industry. (Annexe 11)
- Environmental performance indicators developed by CETEM[32] (CETEM, 2004) does not include any relevant biodiversity indicators for this study. (Annexe 12)
- The HeidelbergCement's own indicators for the representation of successful reconstruction measures and for the measuring of biodiversity. Presented in Rademacher & *al.* (2010) include five relevant kinds of biodiversity indicators. (Annexe 13)
- Cement International biodiversity indicators presented by (Tränkle & *al.*, 2008) and (HeidelbergCement Technology & *al.*, 2008) contain four relevant kinds of biodiversity indicators. (Annexe 14)
- The Cement Sustainability Initiative (CSI) KPIs, founded in (Rademacher & *al.*, 2010) list two relevant biodiversity indicators. (Annexe 15)

[26] United Nations Economic Commission for Europe
[27] Biodiversity Indicators Partnership
[28] UNEP World Conservation Monitoring Centre
[29] Global Environment Facility
[30] Biodiversity Indicators for National Use
[31] Swedish International Development Cooperation Agency
[32] Centro de Tecnologia Mineral Ministério da Ciência e Tecnologia

After this analysis of the relevant biodiversity indicators for the Gypsum Industry, the maximum set of indicators based on existing institutional frameworks was constructed:

- Firstly, the SEBI's indicators that are not relevant for a quarry like 'the European commercial fish stocks' were removed (Appendix 11).
- Secondly, as they presented relevant biodiversity indicators, the OECD (Appendix 7), the GRI (Appendix 8 and 9) and the CBD (Appendix 10) relevant biodiversity indicators were added to this last SEBI 2010 framework is they were not already part of it.
- The mining sector (Appendix 12, 13, 14, 15 and 16) relevant indicators found were added to the framework.

The framework obtained contains ten "CBD focal area" (classes of indicators) declined in 25 "Headline indicators" that represent the headline indicators of the SEBI 2010 and headlines created for the other frameworks (Table 22). After that, the resulting framework has been adapted to our scale and context. For this, it has been decided to begin from the headline indicators of the SEBI and the indicators added. These general headline indicators form a complete set of indicators to report biodiversity. From those headline indicators, specific Eurogypsum indicators were proposed. At the end, 41 specific Eurogypsum indicators were obtained. This first theoretical framework is presented in Table 22. Within those 41 theoretical indicators, five were judged not relevant for this study; they were removed after internal discussion with the Biodiversity and Landscape Unit Staff (Table 22):

- The 2 'Distribution of selected species in the quarry' and the 6 'Distribution of protected/Red list species in the quarry': the number and abundance of species are already included in the framework.
- The 10 'Habitat alteration and land conversion from natural state: change in land cover': not applicable at a scale of a quarry as the conversion is not permanent, it is more interesting to focus on the habitats.
- The 17 'Strategies, current actions, and future plans for managing impacts on biodiversity': indicator of means and other indicators that were more relevant were already present in the framework.
- The 29 'Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside the quarry': The impacts of the quarry on the outside is deal by other indicators and the focus on the protected area outside the quarry is already part of one other indicator.

Table 22 DELIVERABLE 2: First consensus framework within Eurogypsum Quarry WG. The origin of each headline indicator is presented: SEBI, CBD, OECD and GRI frameworks and headline indicators for the mining sector (MS). The cross are presenting the indicators that have been removed during the two steps: internal discussion with the Biodiversity and Landscape Unit Staff (U) and with the Quarry WG during the Focus Group (FG). The remaining indicators are highlighted in grey.

n	CBD focal area	Headline indicator	SEBI	CBD	OECD	GRI	MS	Eurogypsum specific indicator	U	FG
1	Status and trends of the components of biological diversity	Trends in the abundance and distribution of selected species	x	x			x	Number of native species in selected taxonomic group		
2								Distribution of selected species in the quarry	x	x
3								Abundance of selected species in the quarry		
4		Change in status of threatened and/or protected species	x	x	x	x	x	Number of protected species in the quarry		
5								Number of Red list species in the quarry		
6								Distribution of protected/Red list species in the quarry	x	x
7								Abundance of protected/Red list species in the quarry		
8		Trends in extent of selected biomes, ecosystems and habitats	x	x			x	Number of habitats in the quarry		
9								Surface of selected habitats in the quarry		
10		Habitat alteration			x		x	Habitat alteration and land conversion from natural state: change in land cover.	x	x
11		Trends in extent of protected habitats	x	x			x	Number of protected habitats in the quarry		
12								Surface of protected habitats in the quarry		
13	Threats to biodiversity	Nitrogen deposition	x	x				Critical load exceedance for nitrogen		x
14		Trends in invasive alien species	x	x				Numbers of invasive alien species in the quarry		
15								Costs of invasive alien species in the quarry		x
16	Ecosystem integrity and ecosystem goods and services	Connectivity/fragmentation of ecosystems	x	x				Fragmentation of natural and semi-natural areas: Area of a scarce habitats in the quarry/ Area of the scarce habitat at a regional scale		
17								Fragmentation of river systems		
18		Health and well-being		x				Health and well-being of communities who depend directly on local ecosystem goods and services		x
19		Trophic integrity	x	x				Trophic integrity of ecosystems		
20		Incidence of human-induced ecosystem failure		x						x
21		Water quality in aquatic ecosystems	x	x			x	Freshwater quality		
22	Sustainable use	Area of forest ecosystems under sustainable management	x	x				Forest: growing stock, increment and felling		
23								Forest: deadwood		x
24		Sustainable products		x				Proportion of products derived from sustainable sources		x

25	Sustainable use	Ecological footprint	x	x				Ecological footprint and related concepts		x
26		Habitats protected or restored				x	x	Surface of habitats restored		
27		Strategies, current actions, and future plans for managing impacts on biodiversity.				x		-	x	x
28	Impact oustide/ Indirect impacts	Protected areas and areas of high biodiversity value				x	x	Is there adjacent protected areas or areas of high biodiversity value outside the quarry		
29		Significant impacts				x		Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside the quarry	x	x
30		Indirect threat: threats due to activity on the off-site habitats				x		Is there an impact due to noise on animal disturbance outside the quarry		
31								Is there an impact due to lighting on animals outside the quarry		
32								Is there an impact due to dust emission on animals or on habitats outside the quarry		
33								Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry		
34	Status of traditional knowledge, innovations and practices	Other indicator of the status of indigenous and traditional knowledge		x				-		x
35	Status of access and benefit-sharing	Indicator of access and benefit-sharing		x				Number of visitors in the quarry within a period cf (CBD & UNEP, 2004)		x
36	Means implemented for biodiversity	Management (For a compagny or Eurogypsum)					x	% of quarry with a Biodiversity Action Plan (BDAP)		x
37								% of quarry with a Biodiversity management system (BMS)		x
38								% of quarry that calculate biodiversity indicators		
39								% of quarry with a strategy and policy for biodiversity		x
40	Status of resource transfers	Funding to biodiversity	x					Financing biodiversity management		x
41	Public opinion (additional EU focal area)	Public awareness and participation	x					% of quarry that implement communication and participation actions (For a compagny or Eurogypsum)		
Tot	**10**	**25**	**13**	**16**	**2**	**6**	**9**	**Number of remaining indicators**	**36**	**23**

IV.1.2 Step 2.2. Reaching an agreement on motivations and indicators with Eurogyspum (Focus Group)

During the Focus Group with the Quarry WG, firstly the key questions they have about biodiversity have been highlighted. Secondly, some indicators judged non relevant in the context of a quarry have been removed: the number of indicators went from 36 to 23 (Table 22). The consensus framework of 23 indicators obtained is presented in Appendix 36.

Arguments developed by the Quarry WG to remove the 13 indicators are:

- 13 ‘Critical load exceedance for nitrogen’: it is an indicator that deals with agriculture and is not relevant for the quarries.
- 15 ‘Costs of invasive alien species in the quarry’: sometimes you can allocate resources and funding to address invasive species without any positive effects on the reduction of those species. This could therefore result in negative effects on biodiversity. Consequently, this indicator is considered dangerous. The indicator directly related to the outcome of the struggle against these species has been preferred and the Quarry WG decided to keep the 14 ‘Numbers of invasive alien species in the quarry’.
- 18 ‘Health and well-being of communities who depend directly on local ecosystem goods and services’: for Quarry WG, there are not communities who depend directly from the quarries local ecosystem goods and services in the context of gypsum extraction.
- 20 ‘Incidence of human-induced ecosystem failure’: was judged not relevant for the Gypsum Industry by the Quarry WG as the human-induced ecosystem failure is really difficult to define and assess.
- 23 ‘Forest: deadwood’: the quarry WG did not see the interest of that indicator for a quarry. 22 ‘Forest: growing stock, increment and felling’ was preferred and kept.
- 24 ‘Proportion of products derived from sustainable sources’: a lot of actions are currently made in the Gypsum Industry for the sustainability of the circle of gypsum production. Gypsum Industry is currently improving it and has developed indicators about this objective. It is not needful to include them in a biodiversity framework.
- 25 ‘Ecological footprint and related concepts’: those indicators are already tested in general in the Gypsum Industry and those indicators are not accurate enough for the moment. Moreover, the attribute of the indicators chosen during this Focus Group with the quarry WG is simple indicators and not complex like the footprint.
- 34 ‘Status of traditional knowledge, innovations and practices’ and 35 ‘Status of access and benefit-sharing’: not relevant for the Gypsum Industry according to Quarry WG.
- 36 ‘Percentage of quarry with a BDAP’ and 37 ‘Percentage of quarry with a BMS’: the step of having a BDAP or a BMS will be a long process. Currently, it would be preferable to restrict to indicator 38 ‘% of quarries that calculate biodiversity indicators’.

- 39 ‘Percentage of quarry with a strategy and policy for biodiversity’: the quarries or companies may have strategies and policies for biodiversity, and say that a lot of things are currently made for biodiversity, but in the end did not have a positive impact of biodiversity on a quarry site. So Quarry WG prefers to rely on indicators that actually measure biodiversity rather than indicators of means implemented.
- 40 ‘Financing biodiversity management’: was removed for the same reason as indicator 1 ‘Costs of invasive alien species in the quarry’. Sometimes you are financing a lot but do not have a lot of result for biodiversity. Quarry WG do not want people to just think that it is enough to finance to improve biodiversity. Sometimes you can do economical thinks to improve biodiversity. It is not directly related to the amount of money you are able to allow. It is also a problem for small companies that do not have a lot of money to spend for biodiversity but want to improve their management for biodiversity.

IV.1.2.1 Identification of the motivations of Eurogypsum and decisions on key concepts on indicators

Motivations

According to the first meeting with the Quarry WG on the 29th of November 2012 and validated by the Focus Group, the objective to create a framework of biodiversity indicators were:

- For reporting: the Gypsum Industry may use the indicators for reporting purposes but it is not the primary aim of the project.
- For improving sustainability in the quarries: the Gypsum Industry wants to prove that with biodiversity management, it is able to quarry everywhere in a sustainable way (Natura 2000 and non Natura 2000 sites).
- To manage the biodiversity aspects of the quarry the Gypsum Industry wants to improve the biodiversity aspects in the running quarries and therefore develop tools to achieve enhanced biodiversity (measured and monitored by our staff) in the running quarries;
- To maintain the biodiversity status of the Gypsum quarries.
- Two other objectives - certification and management system - could be considered in a second step. Those objectives were confirmed during the Focus Group with the Quarry WG.

In this context the key issue about biodiversity for Eurogypsum is to improve sustainability in the quarries. It follows that Eurogypsum want an efficient framework of indicators which demonstrate that the quarries may be managed for biodiversity through the setting-up of appropriate reporting systems in order to maintain the biodiversity status of the Gypsum quarries.

In this study, normative indicators are chosen because the aim of the study is to monitor biodiversity. The indicators of this study are also chosen as measure of ecological attributes, because values are needed to compare and demonstrate the evolutions of biodiversity amongst different periods.

Decisions on key concepts on indicators

During the Focus Group, the Quarry WG agreed on the following:

Simple indicators (or one-dimensional) will be preferred to composite ones, because they provide more information about environmental factors that are interesting for management. Composite indicators are not suitable to measure biodiversity at the scale of a quarry. Some KPIs could be appropriate for some ecosystems but at the same time they are not suitable for others. Each quarry is part of a larger ecosystem and each ecosystem has its own specific KPIs. If composite KPIs are developed, then improvement might be very subjective. Management systems in relation to biodiversity should cover a previously defined ecosystem, the quarry and the neighboring area, as this enables to show the added-value of a quarry inside an ecosystem. Specific KPIs are derived from the management system and adapted to local ecosystems. KPIs change according to the changes in the ecosystem and are recorded in the restoration plan foreseen in the impact assessment for the quarry. Thus, a management system is flexible and adaptable to a specific situation in a specific area across Europe. It is thus a good way forward to improve biodiversity.

The key role of the future indicators is to track performance (results-based management). They are reflections of the Gypsum Industry around the potential establishment of a biodiversity management system.

Compositional biodiversity aspects will probably be the main class of indicators used in this study. However, if feasibility is demonstrated, other aspects should also be included.

Indicators FOR biodiversity are needed, because the aim is to measure the biodiversity itself.

Eurogypsum stakeholders are interested in a higher scale of biodiversity than only the quarry footprint. The first opinion of the Quarry WG (29th November 2012) was that the quarry is integrated within an ecosystem and that a reference point should be the ecosystem. The surroundings may have negative impacts on the achievements of the biodiversity targets in the quarry and the quarry may have positive impacts on the surroundings. So basically, it was agreed that the contribution of the quarry habitat to the other habitats around the quarry should be considered. In other words, indicators of the relationship of the quarry with the landscape should be considered. It was confirmed though the Focus Group with the Quarry WG.

IV.2 Step 3. Reaching a consensus framework with all stakeholders and evaluating feasibility

IV.2.1 Step 3.1. Evaluating the level of consensus and priority on indicators with stakeholders (Delphi Survey)

IV.2.1.1 Participation rate

Forty persons out of 148 (27%) contacted answered to the survey. Twenty % of surveys were incomplete (Table 23).

Table 23 Presentation of the person contacted, the participation rate and the percentage of incomplete answers, for the online Delphi survey by stakeholders' group for the Step 3.1

Stakeholders' group	Number of			Percentage of answer (%)	Percentage corrected (%)	Percentage Incomplete (%)
	Person contacted	Answer	Incomplete answer			
EC - DG Environment	6	2	0	**33.3**	**66.7**	0.0
EC - DG Enterprise	5	2	0	**40.0**	**100.0**	0.0
Universities	45	7	1	**15.6**	15.6	14.3
Consulting offices	46	15	4	**32.6**	32.6	26.7
European NGOs	8	3	1	**37.5**	37.5	**33.3**
Belgian NGOs	11	6	1	**54.5**	54.5	16.7
Belgian authorities	4	3	1	**75.0**	75.0	33.3
Mining sector	23	2	0	**8.7**	8.7	0.0
Total	148	40	8	**27.0**	-	20.0

For the European authorities, two people have answered in the name of the entire Unit they are part of. The result of responses for that stakeholders' group has to be interpreted by the Unit that has answered. Within the DG Environment, three Units have been contacted (Unit 1: biodiversity, Unit 2: Natura 2000, Unit A3: Cohesion Policy and EIA) and two Units did answer. Two Units of the DG Enterprise have been contacted and all did answer (Unit: raw materials, steel and metals, Unit: Sustainable Industrial Policy). That led to a percentage of response respectively of 66.7% and 100%, for the DG Environment and DG Enterprise. The global percentage of response for the European Commission is therefore 80%. Thereby, it allows concluding that the EC group is the stakeholders' group that had the most important participation rate.

After the European commission, the Belgian authorities and NGOs were active in responding to the survey, with a majority of them having answered. The Universities meanwhile did answer but only with a level of 16%, in comparison with the Consulting offices that answered at a level of 33% for nearly the same amount of people contacted. Maybe this last issue is due to the fact that the phone number of professors at universities is difficult to find and that they have been contacted only by mail, whereas the phone number of consulting offices are available on the net and a lot of phone calls have been conducted. A lot of those phone calls allowed redirecting to other persons who felt more competent or free to respond to the survey.

Nevertheless, 27% of the consulting offices that have answered did not answer completely to the questionnaire, but when only 14% of the Universities did not finish it. The mining sector did answer at a rate of only 8.7%. It is due to the fact that none of the NEEIP members contacted by mail by Christine Marlet did answer.

Only, three European NGOs out of eight did answer to the survey. And within those three, one did not answer completely. So we only get two complete answers. However, all the eight NGOs were really interested in the project and we had a lot of contact with them. A first hypothesis may be that those European agencies are really busy and do not have the time to answer. But they did take the time to have some telephone conferences or meetings. Consequently, a second hypothesis may be that they are interested in the project but before making any real comments in a survey they want to see the final result. If they are expressing their opinions too early, they may feel it is dangerous for them. If they are giving an opinion, they are already placed in the political arena. They are really wary to give their opinions before the end of the study, even if the survey is anonymous.

Table 24 Average time to answer and level of expertise by stakeholders' group for responding to the survey

Stakeholders' group	**Average time of answer (min)**	**Level of expertise**					
		Low		**Medium**		**High**	
		N	**%**	**N**	**%**	**N**	**%**
European Commission	33.5	2	**50**	2	**50**	0	0
Universities	33.1	0	0	4	**67**	2	33
Consulting offices	29.2	3	**27**	4	**36**	4	**36**
European NGOs	14.3	0	0	1	**50**	1	**50**
Belgian NGOs	27.0	1	20	3	**60**	1	20
Belgian authorities	30.1	0	0	2	**100**	0	0
Mining sector	40.4	0	0	0	0	2	**100**
Total	**29.9**	6	18.8	16	**50.0**	10	31.3

The average time of answer was 30 minutes (Table 24) instead of the 15 minutes expected. Fifty percent of the stakeholders estimated their expertise to answer the survey as medium. Only 19% of them judged that they have a low expertise. Those people belong in major part to the European Commission, but there are also some people of the consulting offices and Belgian NGOs. The stakeholders from the European Commission estimated their expertise between low and medium, whereas, the mining sector stakeholders estimated it as high. The Universities, Belgian NGOs and authorities estimated in majority their expertise as medium. The European NGOs meanwhile are wavering between a medium and high level, and the consulting offices are distributed from a low to a high level.

IV.2.1.2 Result of the survey

Section 1: Importance and feasibility of each indicator

Some stakeholders' groups had to be removed from the data for analysis: (i) the Belgian authorities, (ii) the mining sector and (iii) the European NGOs. Firstly, the sampling was really small for those groups that included only 2 persons. Secondly, the people inside the groups did not have the same opinion on more than 50% of the indicators.

Table 25 Result of the survey (Step 3.1) – Section 1: assessment of the relative importance of each indicator of the framework by the stakeholders

	Indicator	CS	SG	Ccl
	High consensus			
4	Number of Red list species in the quarry	H	4	H4
14	Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry	H	4	H4
15	Numbers of invasive alien species in the quarry	H	4	H4
19	Freshwater quality	H	3	H3
12	Is there an impact due to lighting on animals outside the quarry	M	3	M3
13	Is there an impact due to dust emission on animals or on habitats outside the quarry	M	2	M2
	Medium consensus			
2	Abundance of selected species in the quarry	M-H	4	M-H4
6	Number of habitats in the quarry	M-H	4	M-H4
21	Surface of habitats restored	M-H	4	M-H4
3	Number of protected species in the quarry	M-H	3	M-H3
5	Abundance of protected/Red list species in the quarry	M-H	3	M-H3
8	Number of protected habitats in the quarry	M-H	3	M-H3
9	Surface of protected habitats in the quarry	M-H	3	M-H3
16	Fragmentation of natural and semi-natural areas	M-H	2	M-H2
1	Number of native species in selected taxonomic group	M-H	2	M-H2
18	Trophic integrity of ecosystems	M-H	1	M-H1
11	Is there an impact due to noise on animal disturbance outside the quarry	M-L	4	M-L4
20	Forest: growing stock, increment and felling	M-L	3	M-L3
	No consensus			
7	Surface of habitats in the quarry	0	3 H	03 H
10	Is there adjacent protected areas or areas of high biodiversity value outside the quarry	0	3 M-H	03 M-H
17	Fragmentation of river systems	0	3 M-H	03 M-H
22	% of quarry that calculate biodiversity indicators	0	3 M-H	03 M-H
23	% of quarry that implement communication and participation actions	0	H-L	0H-L

CS: Consensus scale; H, M, L: high consensus on a High, Medium or Low importance; M-H, M-L: intermediate consensus of Medium-High or Medium-Low importance; 0: no consensus reached; H-L: Trends in the level of importance according to the stakeholders is High to Low importance; SG: Number of Stakeholders' groups that have reached a majority on the Consensus Scale defined; Ccl: Conclusion on the relative importance of the indicators

Six indicators reached a high consensus on their High importance (4) or Medium importance (2) (Table 25). Meanwhile, twelve indicators reached a medium consensus; ten of them get a Medium-High importance and only two a Medium-Low importance. Five indicators did not reach any consensus, but a majority has been reached for four of them in three stakeholders' groups for a High importance (indicator 7) and Medium-High importance (indicator 10, 17, 22). Indicator 23, meanwhile, did not reach any consensus and any majority was reached in any stakeholders' groups.

The conclusion is that a high consensus is difficult to reach spontaneously on the importance of each indicator. We can also see that a lot of indicators have been classified as Medium-High or High importance but only 2 in Medium-Low and none in Low. Instinctively, when stakeholders do not have to choose or to prioritise some indicators, they tend to classify all the indicators as important.

Eleven indicators reached a high consensus on their feasibility (Table 26). Two of them get a High level of feasibility (indicators 15 and 19), six a Medium level (indicators 1, 9, 2, 14, 17 and 18). Meanwhile the indicators 11, 12, 13 (concerning the noise, the lightening and dust emission), get a Low feasibility. Nine reached a medium consensus, all on a Medium-High level of feasibility, and three did not reach any consensus.

Table 26 Result of the survey (Step 3.1) – Section 1: assessment of the relative feasibility of each indicator of the framework by the stakeholders

	Indicator	**CS**	**SG**	**Ccl**
	High consensus			
15	Numbers of invasive alien species in the quarry	H	3	H3
19	Freshwater quality	H	2	H2
1	Number of native species in selected taxonomic group	M	3	M3
9	Surface of protected habitats in the quarry	M	3	M3
2	Abundance of selected species in the quarry	M	2	M2
14	Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry + GROUND WATER (level/management)	M	2	M2
17	Fragmentation of river systems	M	2	M2
18	Trophic integrity of ecosystems	M	2	M2
12	Is there an impact due to lighting on animals outside the quarry	L	4	L4
11	Is there an impact due to noise on animal disturbance outside the quarry	L	3	L3
13	Is there an impact due to dust emission on animals or on habitats outside the quarry	L	2	L2
	Medium consensus			
6	Number of habitats in the quarry	M-H	4	M-H4
16	Fragmentation of natural and semi-natural areas	M-H	4	M-H4
4	Number of Red list species in the quarry	M-H	3	M-H3
7	Surface of habitats in the quarry	M-H	3	M-H3
8	Number of protected habitats in the quarry	M-H	3	M-H3
21	Surface of habitats restored	M-H	3	M-H3
5	Abundance of protected/Red list species in the quarry	M-H	2	M-H2
10	Is there adjacent protected areas or areas of high biodiversity value outside the quarry	M-H	2	M-H2
22	% of quarry that calculate biodiversity indicators	M-H	2	M-H2
	No consensus			
3	Number of protected species in the quarry	0	4 M-H	04 M-H
20	Forest: growing stock, increment and felling	0	3 M-L	03 M-L
23	% of quarry that implement communication and participation actions	0	4 H-L	04 H-L

CS: Consensus Scale; H, M, L: high consensus on a High, Medium or Low feasibility; M-H, M-L: intermediate consensus of Medium-High or Medium-Low feasibility; 0: no consensus reached; H-L: Trends in the level of feasibility according to the stakeholders is High to Low feasibility; SG: Number of Stakeholders' groups that have reached a majority on the Consensus Scale defined; Ccl: Conclusion on the relative feasibility of the indicators

Section 2: Open questions about indicators

Table 27 presents the result of the first set of opened questions of the survey. The opinions expressed are listed in categories that have been highlighted amongst all the answers.

Table 27 Result of the survey (Step 3.1) – Section 2: Opened question about indicators. The first question was about any idea of other potential relevant indicators (QA); the second about any comments on some indicator (QB); the third about any comments about the importance or feasibility of indicators (QC). The table shows the opinions expressed in categories that have been highlighted amongst the answer and the number (Nb) and percentage (%) of people that expressed it

Answers	**Nb**	**%**
QA		
No comments	12	**38**
Idea of other indicator	18	**56**
Clinging to existing frameworks	1	3
Other comments	1	3
QB		
No comments	12	**38**
Some indicators are not clearly define or not measurable	6	**19**
See comments before	4	**13**
An important issue is the spatial/temporal reference on which the indicator is based	3	9
Comment on the limits of indicators to take into account	3	9
Be careful about the work needed and integration in a BMS	2	6
Large number of indicators, some has to be selected	1	3
Some indicators are not maybe essential for the conservation of biodiversity	1	3
Other comments	0	0
QC		
No comments	17	**53**
Hard to tell if something is easy/medium/hard to measure since techniques/budgets/methods vary	4	**13**
Keep it simple and select indicators	4	**13**
The feasibility and the relevancy has to be studied	2	6
They could be useful for evaluating environmental impacts	1	3
The term 'feasibility' miss a definition	1	3
Other comments	3	9

The first question was about any idea of other potential relevant indicators (QA). A majority of stakeholders (56%) gave other ideas on indicators, 38% did not have any comments and one person said that the framework should be based on existing frameworks.

The suggestions of indicators made by the stakeholders are divided into four categories (the detailed results are listed in Appendix 35):

1. Fourteen proposals were judged as already included in the framework.
2. Four proposals were already removed by the quarry WG.
3. Four proposals were judged not precise enough or are not a measurement.
4. One reaming idea to take into account: 'A site management plan with clear objectives in terms of maintaining habitat restoration.'

Concerning the second question about free comments on indicators (QB), 38% of the stakeholders did not have any comments. Six of them said that the indicators are not clearly defined or not measurable, and four said to look to the comments before in QA.Some of the stakeholders gave some advice on the implementation of the indicators: to be careful about the spatial/temporal reference on which the indicator is based (9%), comment on the limits of indicators to take into account (9%), to be careful about the integration of the framework in a BMS (6%).

The third question was about any comments about the importance or feasibility of indicators (QC). The majority (53%) of the stakeholders did not have any comments. 13% said that it is hard to tell if something is easy/medium/hard to measure since techniques/budgets/methods vary, and 13% said to keep it simple and to select only some indicators of the framework.

Section 3: Classification of the importance of the 7 classes of indicators

The Table 28 indicates the number of times each class of indicators was chosen for each rank. For each rank the greatest value has been highlighted repeatedly. A rank was then assigned to each class by the greater number of repetition: Rank assigned (RA). An average rank was also estimated taking into account all the values obtained for each class in each rank (RM).

Table 28 Result of the survey (Step 3.1) – Section 3: Classification of the seven classes of indicators by the stakeholders. [x] rank. A rank was assigned to each class by the greater number of repetition: Rank assigned (RA). An average rank was also taken into account with all the values obtained for each class in each rank (RM).

Class of indicator	RM	RA	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Ecosystem integrity and ecosystem goods and services	2.6	1	**11**	6	6	4	4	1	0
Status and trends of the components of boil.div.	3.1	2	5	**12**	4	5	1	3	2
Threats to biodiversity	3.1	4	6	6	7	**9**	1	2	1
Impact outside/ Indirect impacts	4.2	3	1	4	**7**	6	6	5	3
Means implemented for biodiversity	4.3	6	5	3	4	1	8	**7**	4
Sustainable use	4.6	5	3	1	4	3	**12**	5	4
Public opinion	6.2	7	1	0	0	4	0	**9**	**18**

The ranks assigned are quite different from the averages ranks (Table 28). The classes of indicators 'Ecosystem integrity and ecosystem goods and services', and 'Status and trends of the components of biological diversity' had the same ranking though the two methods, respectively ranking 1 and 2. Public opinion is ranking number 7. The intermediates ranking switched between the two methods. But the values are really close to each other.

That means that the opinions of all the stakeholders are divided and that a clear consensus hasn't been reached.

Section 4: the most important indicator of each class

Table 29Table 29 shows the number of times an indicator has been chosen by the stakeholders as the most important indicator regarding the other indicators of the same class. In the first class of indicator (Status and trends of the components of biological diversity), the indicators 2, 4, 5 and 6 are the most cited (abundance of selected species, number and abundance of Red list species and number of habitats) (Table 29). In the second class (Impact outside/ indirect impacts) 62% of the stakeholders have chosen indicator 14 (water quality outside the quarry). Indicator 10 (adjacent protected areas or areas of high biodiversity value outside the quarry) has also to be considered as important because 31% of the stakeholders have chosen it. In the fourth class (Ecosystem integrity and ecosystem goods and services) a majority of the stakeholders had chosen indicator 6 (Fragmentation of natural and semi-natural areas). In the fifth class (sustainable use) the majority had chosen indicator 21 (Surface of habitats restored).

Table 29 Result of the survey (Step 3.1) – Section 4: the most important indicator of each class. The table shows the number of times that the stakeholders have chosen the indicators (Nb) and the percentages of times (%). On these basis, conclusions about the most important indicators of each class are decided (x)

	Indicator of each class	**Nb**	**%**	**Ccl**
	1 Status and trends of the components of biological diversity, in the quarry			
2	Abundance of selected species in the quarry	**7**	21.9	x
4	Number of Red list species in the quarry	**7**	21.9	x
5	Abundance of protected/Red list species in the quarry	**5**	15.6	x
6	Number of habitats in the quarry	**4**	12.5	x
1	Number of native species in selected taxonomic group	2	6.3	
7	Surface of habitats in the quarry	2	6.3	
8	Number of protected habitats in the quarry	2	6.3	
9	Surface of protected habitats in the quarry	2	6.3	
3	Number of protected species in the quarry	1	3.1	
	2 Impact outside/ Indirect impacts			
14	Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry	**20**	**62.5**	x
10	Is there adjacent protected areas or areas of high biodiversity value outside the quarry	**10**	**31.3**	x
13	Is there an impact due to dust emission on animals or on habitats outside the quarry	2	6.3	
11	Is there an impact due to noise on animal disturbance outside the quarry	0	0.0	
12	Is there an impact due to lighting on animals outside the quarry	0	0.0	
	3 Threats to biodiversity			
15	Numbers of invasive alien species in the quarry	-	-	-
	4 Ecosystem integrity and ecosystem goods and services			
16	Fragmentation of natural and semi-natural areas	**23**	**71.9**	x
18	Trophic integrity of ecosystems	6	18.8	
19	Freshwater quality	2	6.3	
17	Fragmentation of river systems	1	3.1	
	5 Sustainable use			
21	Surface of habitats restored	**28**	**87.5**	x
20	Forest: growing stock, increment and felling	4	12.5	
	6 Means implemented for biodiversity			
22	% of quarry that calculate biodiversity indicators	-	-	-
	7 Public opinion			
23	% of quarry that implement communication and participation actions	-	-	-

Section 5: the six most important indicators

Table 30Table 30 shows the number of times that each indicator has been chosen as one of the six most important of the 23 indicators.

No consensus is reached in the identification of the 6 most important indicators. The percentage of selection is rather low for all indicators indicating a large range of selection by stakeholders. The six indicators that have been chosen most times by the stakeholders are taken into consideration for the conclusions (Table 30), but as the percentages are equal for the last two (the Surface of habitats restored and the numbers of invasive alien species) the two are considered. Amongst those seven indicators retained for the conclusions, the percentage of selection by stakeholders varies between 19% and 11%.

Table 30 Result of the survey (Step 3.1) – Section 5: the six most important indicators. The table shows the number of times that the stakeholders have chosen the indicators (Nb) and the percentages of times (%). On these basis, conclusions about the most important indicators amongst the 23 indicators are decided (x)

Nb	Indicator	Nb	%	Ccl
2	Abundance of selected species in the quarry	**19**	9.9	x
16	Fragmentation of natural and semi-natural areas	**16**	8.3	x
6	Number of habitats in the quarry	**14**	7.3	x
5	Abundance of protected/Red list species in the quarry	**13**	6.8	x
4	Number of Red list species in the quarry	**13**	6.8	x
21	Surface of habitats restored	**11**	5.7	x
15	Numbers of invasive alien species in the quarry	**11**	5.7	x
19	Freshwater quality	10	5.2	
14	Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry	10	5.2	
9	Surface of protected habitats in the quarry	9	4.7	
8	Number of protected habitats in the quarry	9	4.7	
1	Number of native species in selected taxonomic group	9	4.7	
18	Trophic integrity of ecosystems	8	4.2	
10	Is there adjacent protected areas or areas of high biodiversity value outside the quarry	8	4.2	
7	Surface of habitats in the quarry	8	4.2	
23	% of quarry that implement communication and participation actions	7	3.6	
22	% of quarry that calculate biodiversity indicators	6	3.1	
3	Number of protected species in the quarry	5	2.6	
17	Fragmentation of river systems	3	1.6	
20	Forest: growing stock, increment and felling	2	1.0	
13	Is there an impact due to dust emission on animals or on habitats outside the quarry	1	0.5	
12	Is there an impact due to lighting on animals outside the quarry	0	0.0	
11	Is there an impact due to noise on animal disturbance outside the quarry	0	0.0	

Section 6: AHP

Sensitivity analysis was conducted: all the values of the 1 to 9 scale were tested to know which scale allow a better consistency (Table 31), except the value of 1 that represents on equal importance of two comparisons. The sensitivity analysis combined also the test of the traditional linear scale from Saaty (1980) and the balanced scale (Table 31).

Table 31 Result of the survey (Step 3.1) – Section 6: AHP. Sensitivity Analysis of the AHP method: test of the different scales in the Excel template of Goepel (2013a): traditional linear scale from Saaty (1980) (3, 5, 7 and 9) and the balanced scale (B).

AHP tests		**3**	**3B**	**5**	**5B**	**7**	**7B**	**9**
Class	**Ranking**	Weights (%)						
1	1	20.6	**16.7**	23.3	19.2	25.0	22.1	26.2
4	2	19.9	**16.5**	22.1	18.7	23.5	21.2	24.4
3	3	16.6	**15.4**	17.1	16.2	17.3	16.9	17.4
6	4	14.7	**14.7**	14.1	14.8	13.6	14.4	13.2
5	5	12.3	**13.8**	10.9	12.9	9.9	11.5	9.2
2	6	11.7	**13.5**	10.2	12.4	9.2	10.8	8.5
7	7	4.3	**9.4**	2.4	5.8	1.6	3.1	1.1
EVM check (*e-11)		2.799	4.155	1.658	3.370	1.054	2.136	7.174
Consistency Ratio (%)		1.5	**0.2**	3.3	0.9	4.8	2.4	6.2
Consensus (%)		41.5	**50.5**	31.7	45.5	24.9	36.1	19.8

For all the tests, the EVM checks are acceptable (Table 31). Indeed, the EVM check represents 'the convergence of the EVM calculation using the power method. The value should be close to zero' (Goepel, 2013c). All the tests of the sensitivity analysis conducted to the same global result on the ranking of the classes of indicators, but the weights and consistency ratios of each class are different. All the consistency ratios are less than 10 per cent; consequently, all the tests are acceptable. Anyway, the scaling of 3 in combination with the balanced scale gives the best result of consistency with only 0.2%. This model is then chosen. The AHP consensus index ranges from 0% when there is no consensus between decision makers and to 100% when there is a full consensus between decision makers. Triantaphyllou & Mann (1995) argue that there is sufficient evidence to say that the results made by the AHP should not be taken literally. Indeed, the user of AHP has to be as careful as the final priority values are closer with each other. The Table 31 shows that. **The prioritization obtained with the AHP method has to be taken carefully as the consensus may be qualified as medium (consensus index of 50.5%) and the weight for all indicators classes are really close to each other except for class 7.**

Section 8: Final open questions

Table 32 synthetises the results of the second set of opened questions of the survey. The opinions expressed are listed in categories that have been highlighted amongst all the answers. The first question was about any comments about this survey (QA); the second if they had anything to add or to say (QB); the third if they had any comments or questions on the framework development that is presented in the document 'Eurogypsum Framework Development' that was attached to the survey (QC).

Table 32 Result of the survey (Step 3.1) – Section 8: final questions. The first question was about any comments about this survey (QA); the second, if they had anything to add or to say (QB); the third, if they had any comments or questions on the framework development presented in the document 'Eurogypsum Framework Development' that was attached to the survey (QC). The table shows the opinions expressed in categories that have been highlighted amongst the answer and the number (Nb) and percentage (%) of people that expressed them

Categories of answers	Nb	%
QA		
No comments	18	**56**
Precisions needed about the context, the questions, the indicators	9	**28**
Choose 2-2 not easy, some have the same weight	3	**9**
The survey is a basis for more discussion	1	3
Hard to say what are the 6 most important indicators	1	3
QB		
No comments	23	**72**
Keep simple, local, adapted	4	**13**
Interesting waiting for the conclusions	3	**9**
Other comments	2	6
QC		
No comments	26	**81**
The document was not red	4	**12**
Other comments	2	6

Table 32 shows that the majority of the stakeholders (56%, 71% and 81%) does not have any comments on the first, second and third questions, respectively. Concerning the first question, 28% said that some precisions are needed about the context, the questions or the indicators, and 9% said that the choice of the classes of indicator compared two by two was not easy because some have the same weight. During the second question, 13% advised to keep the framework simple, local and adapted; 9% are waiting for the conclusions and thinks the survey interesting. For the third question, 12% did not take the tie to read the document, so they did not have any comments.

IV.2.1.3 Conclusion of the survey

For the global conclusion on the importance and feasibility of all the indicators, the conclusions of the section 1 about the relative importance and feasibility of indicators (S1-I and S1-F respectively), the section 4 about the most important indicator of each class (S4) and the section 5 about the six most important indicators (S5) have been merged (Table 33).

Table 33 Conclusion of the Survey (Step 3.1): global conclusion (Ccl) on the importance and feasibility of all the indicators based on the conclusions of the Section 1 about the relative importance and feasibility of indicators (S1-I and S1-F respectively), the Section 4 about the most important indicator of each class (S4) and the Section 5 about the six most important indicators (S5)

Nb	Indicator	S1- I	S1 - F	S4	S5	Ccl
1	Number of native species in selected taxonomic group	**M-H2**	M3			x
2	Abundance of selected species in the quarry	**M-H4**	M2	**x**	**x**	x
3	Number of protected species in the quarry	**M-H3**	04 M-H			x
4	Number of Red list species in the quarry	**H4**	M-H3	x	x	x
5	Abundance of protected/Red list species in the quarry	**M-H3**	M-H2	**x**	**x**	x
6	Number of habitats in the quarry	**M-H4**	M-H4	**x**	**x**	x
7	Surface of habitats in the quarry	**03 H**	M-H3			x
8	Number of protected habitats in the quarry	**M-H3**	M-H3			x
9	Surface of protected habitats in the quarry	**M-H3**	M3			x
10	Is there adjacent protected areas or areas of high biodiversity value outside the quarry	**03 M-H**	**M-H2**	**x**		x
11	Is there an impact due to noise on animal disturbance outside the quarry	M-L4	**L3**			LF
12	Is there an impact due to lighting on animals outside the quarry	M3	**L4**			LF
13	Is there an impact due to dust emission on animals or on habitats outside the quarry	M2	**L2**			LF
14	Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry	**H4**	M2	x		x
15	Numbers of invasive alien species in the quarry	**H4**	H3	-	x	x
16	Fragmentation of natural and semi-natural areas	**M-H2**	M-H4	**x**	**x**	x
17	Fragmentation of river systems	03 M-H	M2			
18	Trophic integrity of ecosystems	M-H1	M2			
19	Freshwater quality	**H3**	H2			x
20	Forest: growing stock, increment and felling	M-L3	03 M-L			
21	Surface of habitats restored	**M-H4**	M-H3	**x**	**x**	x
22	% of quarry that calculate biodiversity indicators	03 M-H	M-H2	-		
23	% of quarry that implement communication and participation actions	0H-L	04 H-L	-		

H, M, L: High consensus on a high, medium or low feasibility; M-H, M-L: Intermediate consensus of medium-high or medium-low feasibility; 0: No consensus reached; H-L: Trends in the level of feasibility according to the stakeholders is high to low feasibility; LF: conclusion of low faesability of the indicator. For S4 and S5: x: Indicator that have been highlighted though the sections 4 or 5. For the conclusions (Ccl): x in grey: indicators which are selected with a high importance though all the survey; x: indicators which are selected with a level of importance throughout the survey

The indicators are selected with a high importance though all the survey on the following criteria (Table 33):

- The indicator that have reached a high consensus of high importance by S1-I, have been directly chosen.
- The indicators that have reached a medium consensus of medium-high importance by S1-I, and that have been highlighted as important in the S4 and S5, have been chosen.
- The indicator 10 concerning the adjacent protected areas or areas of high biodiversity value outside the quarry have been taken because even if a consensus was not reached on the importance, a majority have been reached in three stakeholders' groups out of four and, in addition, it was highlighted though S4. Moreover, this indicator gets medium-high feasibility.

The indicators are selected with a level of importance throughout the survey on the following criteria (Table 33):

- The indicators that have reached a high consensus of medium-high importance with a majority of more than 2 stakeholders' groups (M-H2) by the S1-I and have not been highlighted by S4 and 5.
- The indicator 7 concerning the surface of habitats has been taken because, even though no consensus has been reached, three stakeholders' groups out of four have reached a majority on a high importance. It was not highlighted by the S4 and 5.

Indicators that have reached a consensus of a low feasibility have been highlighted as low feasibility (Table 33).

Finally, ten indicators have been selected as having a high importance and five indicators as having an importance. Meanwhile, three have been highlighted as having a low feasibility (Table 33).

For the global conclusion on the prioritisation of the classes of indicators, the conclusions of the Sections 3 about the classification of the seven classes (S3) and the Section 6 including a ranking by the AHP method have been merged (Table 34).

Table 34 Conclusion of the Survey (Step 3.1): global conclusion (Ccl) on the prioritisation of the classes of indicators based on the conclusions of the section 3 about the classification of the seven classes by an average rank (S3-RM) and a rank assigned (S3-RA) and the section 6 including the ranking obtained by the AHP method (S6-AHP)

	Class	S6-AHP	S3-RM	S3-RA
1	Status and trends of the components of biological diversity, in the quarry	1	3.1	2
4	Ecosystem integrity and ecosystem goods and services	2	2.6	1
3	Threats to biodiversity	3	3.1	4
6	Means implemented for biodiversity	4	4.3	6
5	Sustainable use	5	4.6	5
2	Impact oustide/ Indirect impacts	6	4.2	3
7	Public opinion	**7**	**6.2**	**7**

The Table 34 shows that the results from the AHP and the direct ranking are different except for the class 'public opinion' that is ranking in last with the two methods. As the AHP method is based on pair-wise comparisons, the results are more reliable than when people prioritise themselves directly. However classification with AHP should not be taken literally as the weights are really close to each other. As a conclusion, the ranking of the AHP is highlighting a possible prioritisation, but it is relative as the consensus is not really strong. People highlight during the opened Section S8-A that it is not easy to choose which class is the most important as some classes may have the same importance. Finally, in the two methods, the classes 1 and 4 – respectively corresponding to the status and trends and the ecosystem integrity – are ranking as the most important, followed by the classes 3, 6, 5 and 2 – respectively dealing with the threats, the means implemented, the sustainable use and the impacts outside – and at the end, the less important is the class 7 dealing with the public opinion.

IV.2.2 Step 3.2. Building on existing indicators included in EIAs

An analysis of all the eleven EIAs has been made to highlight the type of data that they provide (Table 35).

Table 35 Result of Step 3.2 : Building on existing indicators included in the EIAs received from the Gypsum Industry in order to highlight the type of data they provide in comparison with the first consensus framework obtained with the Quarry WG. The table presents the quarries that are dealing with subject of the indicators (x) and the total percentages of quarries that are dealing with subject of the indicators (%). For the Freshwater quality a distinction is made if the EIA is dealing with ground (G) or surface water (S) or the two (2).

	Indicator	FrP	FrMa	FrC	FrMo	FrS	Ge	ItM	ItG	SpC	SpS	UK	%
	Indicators already aborted in the EIAs												
6	Number of habitats in the quarry	x	x	x	x	x	x	x	x	x	x	x	**100**
1	Number of native species in selected taxonomic group	x	x	x	x	x	x		x	x	x	x	**91**
3	Number of protected species in the quarry	x	x	x	x	x	x		x	x	x	x	**91**
8	Number of protected habitats in the quarry	x	x	x	~	~	x		x		x	x	**82**
19	Freshwater quality			2	2		S		2	2	2	2	**64**
5	Abundance of protected/Red list species in the quarry											x	**9**
9	Surface of protected habitats in the quarry						x						**9**
	Indicators already aborted in the EIAs, but not in an entire part												
11	Is there an impact due to noise on animal disturbance outside the quarry	x	x	x	x	x	x		x	x	x	x	**91**
13	Is there an impact due to dust emission on animals or on habitats outside the quarry	x		x	x	x	x		x	x	x	x	**82**
12	Is there an impact due to lighting on animals outside the quarry		x	x			x					x	**36**
15	Numbers of invasive alien species in the quarry			x		x			x			x	**36**
	Indicators not aborted in the EIAs												
4	Number of Red list species in the quarry												
2	Abundance of selected species in the quarry (indicators species)												
7	Surface of selected habitats in the quarry												
10	Is there adjacent protected areas or areas of high biodiversity value outside the quarry												
14	Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry												
16	Fragmentation of natural and semi-natural areas												
17	Fragmentation of river systems												
18	Trophic integrity of ecosystems												
20	Forest: growing stock, increment and felling												
21	Surface of habitats restored												
22	% of quarry that calculate biodiversity indicators												
23	% of quarry that implement communication and participation actions												

Quarries of: FrP: Le Pin and Villevaudé, in France; FrMa: Mazan, in France; FrC: Caresse, in France; FrMo: Maurienne, in France; FrS: Saint Soupplets, in France; Ge: Lüthorst-Portenhagen, in Germany; ItG: Cava di gesso di monte tondo, in Italy; ItM: Masseria grossi, in Italy; SpC: Cerro negro Moron de la Frontera Provincia de Sevilla, in Spain; SpS: Quarry of Soledad, in Spain; UK: Bantycock Mine (Nottinghamshire), in the United Kingdom.

The Table 35 shows that there are seven indicators that are already used in the EIAs More than 60% of the EIAs are already dealing with five indicators: 6, 1, 3, 8 and 19 (number of habitats, number of species, number of protected species, number of protected habitats and freshwater quality). The last one, the freshwater quality is used for the ground water and/or the surface water. Only one of the EIAs dealing with the freshwater considered only the surface water. Indicators 5 and 9 (abundance of protected/Red list species and surface of protected habitats) are included in only one of the eleven EIAs.

Table 35 also presents four indicators that are used in the EIAs but not in relation to biodiversity or not in a quantitative way. Impact of the noise and the lighting (indicators 11 and 12) are assessed in the EIAs, but as a human impact only, not in relation to biodiversity. Dust emission (indicator 13) is assessed for environment, like shrub and tree species, but not in direct relation to biodiversity. The presence of some invasive species (indicator 15) is only highlighted in the EIAs, but there is never a comprehensive inventory of all the invasive species in the quarry. Twelve of the indicators are meanwhile not assessed in the EIAs that have been analysed.

A complete analysis of the aspects of species and habitats are provided respectively in Table 36 and Table 37. Table 36 presents the taxonomic groups or species for which there is a list of species and a list of protected species. Table 36 present also the species for which the abundance is measured (APS).

Table 36 Result of Step 3.2 : Building on existing indicators included in the EIAs. The Table presents the taxonomic groups or species for which there is a list of species and a list of protected species (List of species) and the species for which the abundance is measured (Abundance).

EIA	**List of species**													**Abundance**
	P	**B**	**B-b**	**R**	**A**	**M**	**M-b**	**I**	**I-b**	**I-d**	**I-g**	**I-db**	**I-a**	
FrP	x		x	x	x	x			x	x				
FrMa	x		x	x	x	x								
FrC	x	x		x	x	x		x						
FrMo	x		x	x	x	x					x	x		
FrS	x		x	x	x	x	x		x	x		x		
Ge	x	x					x			x	x	x		
ItG	x	x				x		x						
ItM														
SpC	x	x		x	x			x						
SpS	x	x		x	x			x						
UK	x		x	x	x	x							x	M-ba, M-v
Tot S %	-	45	45	-	-	64	18	36	18	27	18	27	9	9
Tot T %	**91**	**91**		**73**	**73**	**73**			**82**					**9**

P: Plants; B: Birds; B-b: Breeding birds; M: Mammals; M-b: Bats; M-ba: Badgers; M-v: Water Voles; I: Insects; I-a: Aquatic Invertebrates; I-b: Butterflies (Lepidoptera); I-d: Dragonflies (Odonata); I-db: Dirunal Butterflies (Lepidoptera Rhopalocera); I-g: Grasshoppers (Orthoptera); R: Reptiles; A: Amphibians.
Quarries of: FrP: Le Pin and Villevaudé, in France; FrMa: Mazan, in France; FrC: Caresse, in France; FrMo: Maurienne, in France; FrS: Saint Soupplets, in France; Ge: Lüthorst-Portenhagen, in Germany; ItG: Cava di gesso di monte tondo, in Italy; ItM: Masseria grossi, in Italy; SpC: Cerro negro Moron de la Frontera Provincia de Sevilla, in Spain; SpS: Quarry of Soledad, in Spain; UK: Bantycock Mine (Nottinghamshire), in the United Kingdom.

Table 36 shows that more than 70% of the EIAs are presenting a list of all the taxonomic groups founded in the EIAs: plants, birds, reptiles, amphibians, mammals and insects. All the EIAs are presenting a list of minimum four taxonomic groups within the six founded in the EIAs, except one - the Quarry of Masseria Grossi in Italy EIA - which is presenting no list of species. The taxonomic group's plants, birds and insects, meanwhile, are the most established lists with more than 80% of the EIAs.

For some taxonomic groups, particular species are listed instead of all the taxonomic groups. It is the case for the birds, the mammals and the insects. 45% of the EIAs focus on breeding birds only, and 18% on the bats. The EIAs whose are dealing with the insects are focused on all the taxonomic groups at a rate of 36% out of the 82% that are dealing with insects, the other EIAs are focusing nearly equally on: butterflies (Lepidoptera), diurnal butterflies (Lepidoptera Rhopalocera), dragonflies (Odonata) and grasshoppers (Orthoptera). Meanwhile only one EIA focused on the aquatic invertebrates.

Table 36 allows concluding that the EIAs are dealing with a large panel of taxonomic groups. It is normal because the EIAs are assessments of the global state of the environment at the beginning/before/at a specific state of the quarrying.

As a conclusion, some taxonomic groups should be monitored in all quarries: plants, one group of insect, birds. Those groups are considered in the majority of environmental assessments. They are representative of different trophic levels and of well being of ecosystem. Other taxonomic groups should be considered depending on the local context. For example dragonflies or amphibians when aquatics habitats are created, or some groups for which the diversity level is high (hotspots) in the eco-region.

Table 37 Result of Step 3.2 Building on existing indicators included in the EIAs. The Table shows the main reference used in the definition of the habitats of the quarry and the type of protection considered in the definition of protected or scarce habitats

	Definition of habitats		**Protection-scarcity**		
EIA	Corine Biotope	Other system	Habitat Directive	Local protection	Scarcity defined
FrP	x		x		
FrMa	x		x		
FrC	x		x		
FrMo	x				x
FrS	x				x
Ge		x		x	
ItG		x	x		
ItM					
SpC		x			
SpS		x			
UK		x	x	x	
%	45	55	45	18	18

Quarries of: FrP: Le Pin and Villevaudé, in France; FrMa: Mazan, in France; FrC: Caresse, in France; FrMo: Maurienne, in France; FrS: Saint Soupplets, in France; Ge: Lüthorst-Portenhagen, in Germany; ItG: Cava di gesso di monte tondo, in Italy; ItM: Masseria grossi, in Italy; SpC: Cerro negro Moron de la Frontera Provincia de Sevilla, in Spain; SpS: Quarry of Soledad, in Spain; UK: Bantycock Mine (Nottinghamshire), in the United Kingdom.

All the EIAs established lists of habitats within quarry. All the French quarries identified habitats with the system of Corinne Biotope and the other quarries are dealing with other different systems. Table 37 shows also that 82% of the EIAs establish the lists of the protected habitats within the quarry. The protection state (Table 37) is defined for 45% of the EIAs on the basis of the Habitat Directive. 18% of the others are defining a local protection and meanwhile in 18% of the EIAs a scarcity is defined. This scarcity is estimated with respect to the frequency of habitats, this frequency being estimated empirically from knowledge of the consulting office.

IV.2.3 Step 3.3. Testing acceptability and feasibility with quarry managers

In the field, different situations have been encountered concerning the people met and the principal issue of the site (Table 38).

Table 38 Presentation of the different kind of people encountered during the three cases studies. CO: Consulting offices; UNI: University; QD: Quarry Directors; QM: Quarry Managers; Q WG: Quarry Working Group

Case study	Nb attendees	Experts		QD	QM	Eurogypsum		Principal issue
		CO	UNI			Q WG	Other	
France	5	2	0	1	1	1	0	The water
Spain	10	0	2	1	6	0	1	Restorations
Germany	3	1	0	0	0	2	0	System Trankle/Rademacher

Five, ten and three people attended the meetings respectively in France, Spain and Germany. In France, two persons of a consulting office, a quarry manager and a member of the Quarry WG attended the meeting. Meanwhile in Spain, the majority of people were quarries managers', with people from university and one other person, coming from the company. In Germany, on the other hand, one person from a consulting office and two members of the Quarry GW where encountered.

In France, the main focus is on water, because this quarry deals a lot with surface and ground water for its production. In Spain, the main concern is restorations because a lot of studies have been conducted by the Polytechnical University of Madrid about the ecological restorations on the site. The focus is not on water or forests because the quarry does not have either forest habitats on the site, or ground or surface water. Meanwhile, in Germany the main issue was the system of indicator already implemented there: the system of indicator of Trankle and Rademacher presented by Rademacher & *al.* (2012) (Appendix 14). All this diversity of situation shows that the framework has to be the most flexible possible in order to be equally applicable to every quarry throughout Europe and to meet the expectations of all the local contexts.

The meeting notes of each visit are presented in Appendix 30, 31 and 32; respectively for France, Spain and Germany.

The conclusions of the opinion about the implementation in the field in the three case studies have been summarised into five categories:

- The indicators that reached a consensus amongst the three quarries : 8 indicators;
- The indicators for which some different opinions are expressed : 5 indicators;
- The indicators for which doubts are expressed and more explanations are needed: 3 indicators;
- The indicators that are not applicable everywhere : 4 indicators;
- The indicators that are judged impossible to implement currently as a lack of literature on the subject exist: 3 indicators.

Eight indicators achieved a consensus of agreement among the three case studies: indicators 1, 4, 6, 7, 15, 21, 22, 23 (Table 39). In Germany, they have already implemented some of those indicators with the system of Dr Trankle/Rademacher. They are already evaluating the number of species for selected taxonomic groups. They are assessing an indicator 'wonder biotopes', which is dealing with the number of habitats and surface of habitats gathered. The indicator 'After use' translates also the Surface of habitats restored. The indicators 22 and 23 – respectively concerning the percentage of quarry that calculate biodiversity indicators and that implement communication and participation actions - were accepted directly on the sites because they are not dealing with the quarry scale, but at a scale of a company or Eurogypsum. All the local stakeholders supposed that they are feasible for Eurogypsum or a company as they were validated by the Quarry WG. They have to be discussed during the last validation by the Quarry WG.

Some indicators were proposed for addition during the visits to the three case studies. Firstly, concerning the invasive species;, all the stakeholders were interested to add some details about that indicator. Firstly, the idea of measuring the abundance of some problematic species had emerged. For plant species it consists of the coverage. Secondly, a consensus throughout the case studies was that the animal species do not have to be included in that indicator because the scale of the quarry is too small to include them. The species are moving everywhere and throughout the quarry. So they cannot have a real impact on them, unlike the plant species. Moreover, the invasive plant species are often favoured by the temporary biotopes that a quarry has generated. It is consequently important to focus on those species more than the animal species that are more favoured at a larger scale (regional, national, continental). Finally, the actions leading to invasive plants, or the means implemented for invasive plants, have been noted as important in the quarries of France and Germany.

Secondly, an agreement thoughout the quarries was to change the title of the indicator 16 and 17 (concerning respectively the fragmentation of natural and semi-natural areas and of river systems). The proposal was to change the word 'fragmentation' to 'connectivity' which has a better connotation for public opinion as it is the positive view of the fragmentation. It is better to use this term to support the fact that the quarries may have a positive effect of the connectivity of scarce habitats in a given region.

Finally, concerning indicator 21, dealing with the surface of habitats restored, the quarries of France and Germany insisted on the fact that it is important to develop an indicator which assesses the success of restoration in addition with the area restored. In Germany for this purpose they used the indicator of 'After use' that divides the restorations into three types: restoration for nature, for agriculture and for forest. Another suggestion from those quarries was to add an indicator that reveals if the quarries have a plan of restoration clearly defined and well followed.

Table 39 Conclusions on Step 3.3: Testing acceptability and feasibility with quarry manager during the three visits to the sites of France, Spain and Germany

	Indicator	**France**	**Spain**	**Germany**
	Concensus			
1	Number of native species in selected taxonomic group	x	x	T-R
4	Number of Red list species in the quarry	x	x	x
6	Number of habitats in the quarry	x	x	WB
7	Surface of selected habitats in the quarry	x	x	WB
15	Numbers of invasive alien species in the quarry	x	x	x
21	Surface of habitats restored	x	x	AU
22	% of quarry that calculate biodiversity indicators	x	x	x
23	% of quarry that implement communication and participation actions	x	x	x
	Different opinions are expressed			
2	Abundance of selected species in the quarry (indicators species)	x	exp	o
5	Abundance of protected/Red list species in the quarry	x	exp	o
3	Number of protected species in the quarry		x	x
8	Number of protected habitats in the quarry		x	WB
9	Surface of protected habitats in the quarry		x	WB
	Precisions needed			
10	Is there adjacent protected areas or areas of high biodiversity value outside the quarry	o	x	o
16	Fragmentation of natural and semi-natural areas	o	o	o
18	Trophic integrity of ecosystems	x	o	o
	Not applicable everywhere			
14	Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry	x	~	o
17	Fragmentation of river systems	o	~	~
19	Freshwater quality	x	~	~
20	Forest: growing stock, increment and felling	x	~	x
	Impossible to implement currently			
11	Is there an impact due to noise on animal disturbance outside the quarry			
12	Is there an impact due to lighting on animals outside the quarry			
13	Is there an impact due to dust emission on animals or on habitats outside the quarry			

x : Agreement about the indicator; exp: Agreement about the indicator but it may be expensive; o: doubt about the indicators, more precisions are needed; ~ : indicator not applicable on the site because there is no water or no forest on the site; T-R: Indicator already implemented on the site by the Trankle-Rademacher system including the indicator of species, WB and AU: Indicator already implemented on the site by the Trankle-Rademacher system including the 'Wonder Biotope' indicator and the 'After Use' , 'noting': Indicator that could not be implemented currently because of the lack of literature on the subject

IV.2.4 Definition of the quarry

In the field, it is absolutely necessary to define on which areas the indicators will be implemented, so that the measures are meaningful, and secondly, to facilitate comparisons or implementation of objectives. Consequently, the first question asked on the field was the definition of the quarry and what it includes. A first definition proposal was elaborated. It considers that the quarry is divided into different areas inside the surface owned by the quarry. First of all, the quarry includes exploited areas. It is the zone where there are current mining activities. Secondly, we must found old and future exploited areas. And finally, other areas that are part of the surface owned by the quarry, but that will never be affected by mining activities.

Thoughout the three cases studies, the definition proposed was globally agreed. In France, the surface owned by the quarry includes a lot of other areas that are not and will never be exploited for mining activities. Those areas are part of the owned area but they are far from the exploited areas and are rented for agricultural purposes. So they wanted to change the ‘other areas’ zone to ‘other land under the control of the company’. A careful attention has to be paid to this area, because if this area is included for the indicators, it sets up a zone of potential compensation. The question is whether this zone may be taken into account or not.

The delimitation of the different zones is somewhat problematic given the different approaches to land rights in different countries. Indeed, on the field, those areas are not well demarcated and people do not really know where the areas are stopping or beginning. Consequently, it would be impossible to work with indicators related to those administrative areas. It may be more relevant to measure indicators at a scale of a project, where there is a license for the exploitation.

Default at least requires that biodiversity indicators are monitored on the exploited and old exploited areas. To the extent possible, indicators should be followed in other areas in order to have a global impact. The level should be clearly determined and specified in the monitoring process across Eurogypsum. Everyone should at least calculate indicators in the exploited and old exploited areas.

IV.3 Deliverable 3: Most acceptable framework for all the stakeholders and Step 4 Final validation with Eurogypsum (Meeting)

On the basis of all the conclusions of the analysis of the EIAs, the survey and the cases studies, a first framework proposal of the most acceptable framework for all the stakeholders was built. On this proposal, the Quarry WG took their final decisions about the indicators they are willing to implement. The two frameworks obtained are presented in Table 40.

Table 40 DELIVERABLE 3: Most acceptable framework for all the stakeholders and Result of Step 4(Final validation with Eurogypsum). The table shows the main results which lead to the first proposal set of indicators and to the final decision of the Quarry WG.

	Indicator	**Results**					**First Proposal**	**Quarry WG Ccl**
		EIAs	**Survey**	**Case studies**				
				Fr	**Sp**	**Ge**		
1	Number of native species in selected taxonomic group	91	x	x	x	T-R	x	x
2	Abundance of selected species in the quarry		x	x	exp	o	x	x
3	Number of protected species in the quarry	91	x		x	x	x	x
4	Number of Red list species in the quarry		x	x	x	x	x	x
5	Abundance of protected/Red list species in the quarry	9	x	x	exp	o	x	x
6	Number of habitats in the quarry	100	x	x	x	WB	x	x
7	Surface of selected habitats in the quarry	9	x	x	x	WB	x	x
8	Number of protected habitats in the quarry	82	x		x	WB	x	P
9	Surface of protected habitats in the quarry		x		x	WB	x	P
10	Is there adjacent protected areas or areas of high biodiversity value outside the quarry		x	o	x	o	x	
11	Is there an impact due to noise on animal disturbance outside the quarry	91	LF					
12	Is there an impact due to lighting on animals outside the quarry	36	LF					
13	Is there an impact due to dust emission on animals or on habitats outside the quarry	82	LF					
14	Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry		x	x	~	o		
15	Numbers of invasive alien species in the quarry	36	x	x	x	x	x	x
16	Fragmentation of natural and semi-natural areas : Connectivity		x	o	o	o	x	P
17	Fragmentation of river systems : Connectivity			o	~	~		
18	Trophic integrity of ecosystems			x	o	o		
19	Freshwater quality	64	x	x	~	~	x	x
20	Forest: growing stock, increment and felling			x	~	x		
21	Surface of habitats restored		x	x	x	AU	x	x
22	% of quarry that calculate biodiversity indicators			x	x	x	x	
23	% of quarry that implement communication and participation actions			x	x	x	x	A
	Total						**16**	**14**

EIAs: Results of the Step 3.2 (Building on existing indicators included in the EIAs) expressed in percentages of EIAs that are dealing with the subject of the indicator.
Survey: The results of the Step 3.1 (Evaluating the level of consensus and priority on indicators with stakeholders by a Delphi Survey) presenting the indicators that have been highlighted as highly important (grey x), important (x) and for having a low feasibility (LF).
Case studies: Results of the Step 3.3 (Testing acceptability and feasibility with quarry managers on the field) presenting the different opinions: agreement (x), agreement but indicator may be expensive (exp), doubt about the feasibility (o), impossible to implement currently by lack of knowledge (nothing), already implemented in the quarry (T-R, WB, AU).
First Proposal: presented the indicators that have been highlighted by the stakeholders (x) and highlighted by the survey and reached a local consensus (grey x).
Quarry WG Ccl: final decision of the Quarry WG for the indicators: x: indicators to keep in the final framework; P: indicators that are postponed until experts agree; A: indicator that have been adapted by the Quarry WG.

The proposal of the most acceptable framework for all the stakeholders included sixteen indicators including 6 that are really important to keep (Table 40). The Quarry WG decided in the end to keep fourteen indicators, including three that are postponed until the experts agree, and one that was adapted.

The following proposals and decisions of the Quarry WG was concluded for each indicator:

- 1 'Number of species': reached a local consensus and 91% of the EIAs are already dealing with it. Moreover, the survey allows concluding that it was a 'M-H importance 2'. The Quarry WG decided to keep this indicator.
- 2 'Abundance of selected species' may be expensive. The proposal was therefore to select the indicator species that help to answer another indicator like the one related to the invasive species or the trophic integrity. Indeed, on the field they proposed to add an indicator about the coverage of invasive species. The Quarry WG agreed with the proposal and decided to keep this indicator.
- 3 'Number of protected species': it appears on the field that it does not add much work to the indicator 1 as experts have data of local protected species. The quarries of Spain and Germany noted that protected species are complementary to the Red list. Moreover 91% of the EIAs are already dealing with it and it was highlighted by the survey. The Quarry WG decided to keep this indicator.
- 4 'Number of Red list species': reached a high consensus amongst all the stakeholders including the local stakeholders. Moreover, it does not add much work to the indicator 1. The Quarry WG decided to keep this indicator.
- 5 'Abundance of protected/Red list species' may be expensive. The proposal was then to select species that are threatened in the local context and that may have a high importance for the conservation agencies or in the local opinion. The Quarry WG agreed with the proposal and decided to keep this indicator.
- 6 'Number of habitats' reached a high consensus amongst all the stakeholders even the local ones. Furthermore, every EIAs analysed are already listed the habitats of the quarry. In Germany, they have their specific system about the habitats: Wonder Biotopes that are related and may be used in this set of indicator. The Quarry WG decided to keep this indicator.
- 7 'Surface of selected habitats in the quarry': reached a high consensus amongst all the stakeholders, but was listed in only one of the EIAs analysed. The Quarry WG decided to keep this indicator.
- 8 'Number of protected habitats in the quarry': France is the only stakeholder that does not agree with that indicator. Even the EIAs are already dealing with protected habitats at a level of 82%. The system of Germany is compatible because they deal with habitats of interest for biodiversity. A short justification will suffice to be used here. The Quarry WG decided to postpone this indicator until the experts agree on a definition of the protected habitats, because there are a lot of different definitions among the countries.

- 9, ‘Surface of protected habitats in the quarry’: the proposal was to keep it only if the surface of habitats is available. Then it does not add much work. France is the only stakeholder that does not agree with that indicator. Only one EIA is dealing with the surface of protected habitat. Sometimes the surface is really short but has an interest; consequently the aim of this indicator is to maintain the surfaces. Quarry WG decided to postpone this indicator until the experts agree on a definition of the protected habitats, because there are a lot of different definitions among the countries.
- 10 ‘Is there adjacent protected areas or areas of high biodiversity value outside the quarry’. This indicator is important for the stakeholders of the survey. There are doubts on the field because they cannot act on this indicator except to choose the new quarries in a particular zone. The opinion of the field’s stakeholders is that the question is to know what is better for a quarry: to have or have not adjacent protected areas. It is a descriptive indicator. It establishes the context of the ‘outside of the quarry’. It is great to have a high level of biodiversity outside; it means that the connectivity will be better and that the quarries bring some more biodiversity. The problem of that indicator is public opinion, because a lot of people may say that it is not great to have protected areas adjacent to the quarry because the quarries have a negative impact. But this is not the case. So if this indicator is taken, careful attention will be paid to the definition to show people the possible positive impacts of the quarry. Quarry WG decided to remove this indicator because a clear definition of the outside of the quarry was impossible to determine.
- 11, 12 and 13 – respectively concerning the noise, the lightening and the dust emission: The proposal was to remove this indicator. Those impacts are assessed in the EIAs but as an impact on humans. As the literature is missing for defining and measuring the impact on biodiversity, they have to be removed currently from the framework. Moreover, the survey reached a consensus of the low feasibility of those indicators. The Quarry WG agreed the removal.
- 14 ‘Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry’: Although the survey has highlighted it, the freshwater quality is already taken into account in the indicator 19 (the freshwater quality). This indicator takes into account the impact outside the quarry. But on the field it has been highlighted that the water outside may be impacted by other sources. Considering only the water inside the quarry is taking into account the source of the impact of the quarry on water so it is sufficient. The proposal was to remove it and the Quarry WG agreed.
- 19 ‘Freshwater quality’: The proposal was to keep this one instead of the freshwater quality outside because it may be preferable as it is more feasible: 64% of the EIAs already deal with it for ground and surface water. The Quarry WG agreed.

- 15 'Numbers of invasive alien species in the quarry': a high consensus amongst all the stakeholders is reached. On the field it was proposed to add to this indicator the notion of coverage of invasive plants (Abundance of species) and the actions leaded for invasive plants - means implemented for invasive. The Quarry WG agreed on the indicator and on measuring the coverage of invasive plants though the indicator 2 - Abundance of selected species in the quarry. The Quarry WG decided to remove the means implemented for biodiversity already included in the first theoretical framework proposed on the 17th of April 2013. They maintain their position and rejected this proposal of adding a new indicator.
- 16 'Fragmentation of natural and semi-natural areas': The proposal was to measure this indicator by the measurement of the scarce habitat in the quarry divided by the scarce habitat on a regional scale. This indicator aims to highlight the connectivity between the scarce habitats outside the quarry and the added value of the quarry. On the field the proposal was to rename this indicator as 'connectivity' instead of 'fragmentation' because it has a more positive connotation for the public. This indicator was highlighted as important by the stakeholders of the survey but a lot of doubts have been issued on the field because more precisions were needed. The Quarry WG decided to postpone this indicator until the experts agree because the domain is not mature enough in this field.
- 17 'Fragmentation of river systems': the survey did not highlight it and the feasibility is low on the field. The proposal was then to remove it and the Quarry WG agreed.
- 18 'Trophic integrity of ecosystems': The survey does not highlight it as important. This indicator may be measured indirectly by the presence of some species that are characteristic for the trophic level. The proposal was to remove it and include some comment in the technical specifications of the indicator 1 and 2 – respectively concerning the number of species and the abundance of species. The Quarry WG agreed on the proposal.
- 20 'Forest: growing stock, increment and felling': On this field a lot of people say that they prefer deadwood instead of that indicator. But finally this indicator is only to assess the success of a restoration or a status of one specific habitat. The question is why to focus on this habitat and not another that is more specific for the quarries. Moreover, some other indicators are linked indirectly to this one: the 1 'number of species', the 7 'number of habitats', the 21 'Surface of habitats restored' and others. The survey does not highlight it as important. The proposal was to remove it from the framework, the Quarry WG agreed.
- 21 'Surface of habitats restored: 'after use' or for natural purposes': reached a high consensus among all the stakeholders. Indeed the survey highlighted it as having a high importance. On the field, they wanted to add an assessment of the success of the restoration. In Germany they are using the system of Trankle/Rademacher which fixes the indicator 'After use' that takes into account restoration: for nature, for agriculture or for forest. On the field they highlighted also the importance to have a plan of restoration clearly defined and well followed. The proposal was to keep it, and the Quarry WG agreed.

- 22 and 23, respectively ‘percentage of quarry that calculates biodiversity indicators’ and ‘that implement communication and participation actions’: those indicators are on the company or Eurogypsum scale. Consequently, a system of reporting has to be implemented so that the data is going directly to the level of the company or Eurogypsum. But as the aim of this project is to report to European authorities, a system of reporting has to be developed anyway. So this indicator consists of additional information on quarries that are involved in biodiversity. The proposal was to keep those two even if the survey did not highlighted it and if at a local context everybody agreed, because the Quarry WG did so, as it is at a Eurogypsum/company level. The Quarry WG did not agree on those indicators because in the end they are thinking that the framework has to be homogeneous for all the indicators and have to be applicable at a level of the quarry. They decided then to remove the indicator 22. They decided also to change indicator 23 to make it applicable to a quarry: ‘For one quarry, state the communication and participation activities organised for the last 5 years’.

IV.4 Step 5. Factsheets of the indicators and Eurogyspum report

The final framework of indicators includes eleven indicators and three indicators postponed (Table 40). The factsheets of those eleven indicators are presented in the Eurogyspum report to the destination of the public attached with this master thesis.

V General discussion

V.1 Consensus on biodiversity indicators

No clear consensus on the most important biodiversity indicators was reach amongst all the stakeholders thought the online Delphi survey (Step 3.1). While some indicators were pointed out as important by a majority of stakeholders, opinions were discordant for a large part of indicators even in a same group of stakeholders. Three reasons may be responsible for this situation: (i) intrinsic difficulty to reach a consensus on biodiversity indicators due to the complexity of the concept of biodiversity, (ii) lack of full involvement by some stakeholders' groups, and (iii) the limit of the Delphi method used;

(i) The BIP (2011) state a general consensus on biodiversity indicators may never be reached due to the complexity of biodiversity concept that includes a lot of different aspects and scales. Moreover, Peireira & *al*. (2013) identifies that in biodiversity indicators 'a key obstacle is the lack of consensus about what to monitor' and insist on the fact that 'given the complexity of biodiversity change, the challenge of developing a global observation system can appear insurmountable'. Oliver & *al*. (2007) faces also 'considerable variation in expert opinion' that resulted in no statistical differences amongst the attributes which they wanted to priorities. BIP (2011) argues that in this case of no clear consensus there will be some points on which individuals and groups will disagree. Each stakeholder may have different opinions and perspectives on how to approach the problem. The inputs and critics are always valuable in the construction of indicators. But after all, a first set of indicator must be decided. No approach or solutions are perfect and criticisms will always exist. The most important in developing indicators is to have an overview of the opinions to be able to take the suitable decision.

(ii) It was obvious from the participatory rates of the Delphi survey that some groups of stakeholders were less prone to engage themselves in the quest of a consensus at this stage of the process. For example, only two European NGOs out of height did answer completely to the survey. However, all the eight European NGOs were really interested in the project and we had a lot of contact with them. A hypothesis may be that they are interested in the project but before making any real comments on a survey, they want to see the final result. If they give an opinion, they are already placed in the political arena. They are worried to give their opinions before the end of the study, even if the survey is anonymous. The Mining sector group also did answer only at a rate of 9% due to the fact that all the 19 NEEIP members contacted did not answer to the survey. Those stakeholders explicitly stated that they wait for the results before giving any comments. In contrast, the more local stakeholders including the Belgian authorities and NGOs did answer actively to the survey (participation rate of 75% and 55% respectively). The universities and consulting offices answered at a rate of 16 and 33% respectively. Consequently, the result shows that people not directly including to the political arena of the subject are more active to respond. Contrariwise, the European Commission, the cornerstone of this initiative about biodiversity indicators, did respond at a level of 80%. Moreover, a bias exists in participatory process: people implicated in the study may not be fully representative of the group they represent. This bias is really difficult to quantify. Representativeness of the people implicated in the study, has been granted as a hypothesis for all the stakeholders' groups included in this study.

(iii) The method used for this survey was a Policy Delphi. To reach a greater consensus inside and amongst the stakeholders' groups, it would have been useful to go back to them with the results and all the feedbacks of all the answers of their groups. Given the feedbacks, stakeholders can rethink about their answers and complete the questionnaire again with providing explanations on the points that were significantly different from the thinking of the others. They could change their opinions and answers on the basis of the other participant's ideas. This process could be repeated any time it is needed to build a consensus. The advantage of this technique is that some rare information may lead to opinion changes of all participants. In other words, it could have been possible to implement a traditional Delphi by mail in each stakeholders' group in order to reach a consensus amongst them. But the BIP (2011) argues that after the initial consultations of the stakeholders, most of them 'will only have the time or interest to be consulted again on the utility of the final products for their needs'.

At the same time, throughout the different participatory processes, it was showed that a clear consensus is difficult to reach amongst all the stakeholders. While in intern, the consensus is reached more easily as it includes a restricted number of people who are meeting each other. Slocum (2003) highlighted that participatory approaches allow building social cohesion by expressing the different opinions and mutual understanding as all voices can be heard. But this cohesion – and then consensus – is easier to reach generally in small groups of individuals that may express themselves directly. Oliver & *al.* (2007) argues also that 'where smaller groups of experts are sufficient for the task, a workshop setting is clearly preferable'.

Consequently, the stakeholders will probably not take the time or interest to be consulted again and small groups lead to a greatest consensus. In those conditions, to go back to all the stakeholders with a Delphi survey appears difficult to implement. It will probably not lead to a higher consensus.

As a conclusion, the resulting framework has been decided by the Quarry WG on the basis of all the stakeholders' opinions. Even if a high consensus amongst all the stakeholders hasn't been reached, the trends of the opinions and global majorities expressed in the survey have been highlighted in order to be able to take a suitable solution for all the stakeholders. This framework could be the basis for future tests and refines of the indicators with an iterative process with all the stakeholders in order to go forwards in the development of biodiversity indicators. The framework will be presented at all the stakeholders on the workshop of the 26th of November 2013 (Next steps of the method). This workshop will allow confronting all the opinions from the different groups in a same place, and in a same time, around the resulting framework. This is a good opportunity to collect all the opinions on the resulting framework to go forwards in its development.

V.2 Discussion on the resulting Framework

The resulting framework, including eleven indicators, is a guideline in order to assess biodiversity in its different aspects. It is an innovative project in comparison to the existing frameworks in the mining sector. The mining sector has developed biodiversity indicators but, to our knowledge, the process does not include a large participatory process (e.g. Rademacher & *al*. (2010), Tränkle & *al*., 2008 and HeidelbergCement Technology & *al*., 2008). The Eurogypsum KPIs biodiversity framework includes indicators related to: the status and trends of the components of biological diversity, the trends in the threat on biological diversity, the well being of ecosystems goods and services, the sustainable use and the societal dimension of biodiversity (Table 41). In general, existing frameworks focus only on the trends and status of the biological diversity and deal almost exclusively with species, habitats and restorations (e.g. Rademacher & *al*. (2010), Tränkle & *al*., 2008 and HeidelbergCement Technology & *al*., 2008). The Eurogypsum biodiversity KPIs framework is based on the European SEBI 2010 framework and includes other institutional framework and framework from the mining sector. It responds to the expectations of the European strategies and policies for biodiversity. It constitutes then a complete set to assess biodiversity at a European scale. As a high consensus amongst all the stakeholders has not been reached, this most acceptable framework will probably be discussed and criticised. But it is a first step for the Gypsum Industry in participation on biodiversity indicators.

At the beginning of the study (Step 2.2), Eurogypsum stakeholders were interested in a higher scale of biodiversity than only the quarry footprint. But at the end, the quarry WG decided to postpone the indicator related to the outside, until they agreed on a concrete definition of the quarry outside. However, some indicators, chosen for the final framework, integrate the outside indirectly. For example the 'Number of protected species in the quarry' focuses on any species that has protected status in legislation at the European, national or regional level.

VI Conclusions and perspectives

The final consensus KPIs framework for gypsum quarries contains eleven indicators which are the most acceptable set of indicators for all the stakeholders and answers to European legislation and strategies for biodiversity (Table 41). This framework is intended to improve sustainability in the quarries and to help managing biodiversity to allow setting-up of appropriate reporting systems in order to maintain the biodiversity status of the Gypsum quarries.

Indeed, a system of reporting has to be implemented to allow communication and reporting of the indicators to the companies, Eurogypsum and the public. To establish this reporting system, trainings will be needed in the quarries. Those trainings will consist in building biodiversity knowledge and awareness to the indicators users and reporters, and to train people on how to implement this reporting system at their scales. People have to be trained to have contacts with experts to collect the needed data's, to follow and write the reporting independently.

The implementation of such a reporting system will need some budgets and time. This could be done with the help of a co-funding by the EU through a 'LIFE+ Nature and Biodiversity' or a 'LIFE+ Information and Communication'. Another possibility is a 'Interreg IVC Project' financed by the European Regional Development Fund.

Thereafter, each indicator should be developed and refined to reach conclusions about the performance. It is a flexible adaptable framework given the local context of each Gypsum quarry. That means that it is a set that may be implemented differently given the local context of each quarry. It is developed to follow the biodiversity management at a scale of a quarry, over time, in order to be able, at the closure of the quarry, to establish if a No Net Loss is reached.

Table 41 Presentation of the final Consensus KPIs Framework for Gypsum Quarries

n	Indicator	CBD focal area
1	Number of native species in selected taxonomic group	Status and trends of the components of biological diversity
2	Abundance of selected species in the quarry	
3	Number of protected species in the quarry	
4	Number of Red list species in the quarry	
5	Abundance of protected/Red list species in the quarry	
6	Number of habitats in the quarry	
7	Surface of selected habitats in the quarry	
8	Numbers of invasive alien species in the quarry	Threats to biodiversity
9	Freshwater quality	Ecosystem integrity and ecosystem goods and services
10	Surface of habitats restored	Sustainable use
11	For one quarry, state of the communication and participation activities organised for the last five years	Public opinion

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LIST OF APPENDIX

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2. TABLE SHOWING EXAMPLES OF QUESTIONS TO ASK TO MEET QUALITY CRITERIA TO CHOOSE RELEVANT INDICATORS, ADAPTED FROM NORMANDER AND *AL*. (2012)

Quality criteria	Example of questions to ask for the quality
Representative and good coverage	Where is the indicator in the system 'pressure, state, response'?
Temporal and up-to-date	Can we measurer this indicator annually or periodically?
Simplifying information	Can this indicator aggregate a complex phenomenon into a simple measure?
Clear presentation	Can this indicator be illustrated on graphs?
Indicative	Does this indicator may be used at a larger scale?
Sensitive	Does this indicator indicate sensitive changes?
Quantitative and statistically sound	Is it scientifically valid? It really shows biodiversity changes?
Relatively independent of sample size	Is it usable even with a small size of population?
Realistic	Indicator based on available data, and measurable data? Not too expensive? Does it maximize the accuracy for limited resources?
User-driven and acceptable	Is it feasibility and easy to use? Does it allow monitoring the biodiversity? Does it allow monitoring biodiversity to provide No Net Loss?
Normative and policy relevant	Does the indicator is relevant according to the vision of the CBD[33]?
Not sensitive to background changes	
Explainable	Is this indicator linked to causes of trends?
Predictable	Does the indicator allow to know the future trends of biodiversity?
Comparable	Does it allow comparisons between sites, between countries?
Aggregatable and disaggregatable	

[33] Convention on Biological Diversity

3. METHODS AND TECHNIQUES OF PARTICIPATORY PROCESSES LISTED BY SLOCUM (2003)

n	Method or Technique from (Slocum, 2003)	Derived	Fiches
1	Access to Resources		
2	Analysis of Tasks		
3	Appreciation-Influence-Control (AIC)	1	
4	Beneficiary Assessment (BA)		
5	Brainstorming		
6	Charrette		x
7	Citizens' Juries	2	x
8	Consensus Conferences	4	x
9	Critical/Key Technologies		
10	Cross Impact Analysis	2	
11	Deliberative Polling 20		
12	Delphi Method	2	x
13	Envisioning Workshops		
14	Expert Panels		x
15	Focus Groups	1	x
16	Forecasting (Normative and Exploratory)		
17	Futures Wheel		
18	Gender Analysis (GA)		
19	Interactive Backcasting		
20	Mapping		
21	Mediation	1	
22	Mind Mapping		
23	(Participatory) Modelling (or Group Model Building)	1	
24	Needs Assessment Exercise		
25	Objectives Oriented Planning (ZOPP)		
26	Participatory Assessment, Monitoring and Evaluation Techniques (PAME)		x
27	Participatory Impact Monitoring (PIM)		
28	Participatory Organisational Evaluation Tool (POET)		
29	Process Monitoring (ProM)		
30	(Participatory) Planning (also called Planning Cells)	2	x
31	Pocket Charts		
32	Policy Exercises		
33	Regulatory Negotiation and the Rulemaking Process	1	
34	Relevance Trees and Morphological Analysis	1	
35	Role-playing		
36	(Participatory) Rural Appraisal (PRA) (Community based methods)		
37	SARAR		
38	Scenario Analysis	3	x
39	Social Assessment (SA)		
40	Structural Analysis with the MICMAC Method and Actors' Strategies Analysis with the MACTOR method		
41	SWOT Analysis (also called SWAP/SWPO)	1	
42	SYNCON		

n	**Method or Technique from (Slocum, 2003)**	**Derived**	**Fiches**
43	Systematic Client Consultation (SCC)		
44	Target Group Analysis (TGAs)		
45	TeamUp	1	
46	Technology Sequence Analysis		
47	Tree Diagrams		
48	Turoff Method		
49	Vulnerability Analysis		
50	World Café		x
	Total	23	10

4. COMPARATIVE CHART FOR PARTICIPATORY METHODS IN THE FICHES, DIRECTLY FROM SLOCUM (2003)

Method	Objectives	Topic*				Participants	Time		€
		Knowledge	Maturity	Complexity	Controversial		Event	Total	1-4
Charrette	Generate consensus among diverse groups of people and form an action plan.	+/-	+/-	-	+/-	Average citizens or stakeholders. Others give input.	1-5 days	2-3 months	3
Citizens Jury	A decision that is representative of average citizens who have been well informed on the issue. Aims	+/-	+/-	+/-	+	12-24 randomly selected citizens. Experts, stake-holders & politicians give input.	3 days	4-5 months	4
Consensus Conference	Consensus and a decision on a controversial topic.	+	+/-	+	+	10-30 randomly selected citizens. Others give input. weekends	3 weekends	7-12 months	4
Delphi	Expose all opinions & options regarding a complex issue.	-	-	+	+/-	Experts	Variable	Variable	1-3
Expert Panel	Synthesise a variety of inputs on a specialised topic and produce recommendations.	-	-	+	+/-	Experts	Variable	Variable	2
Focus Group	Expose different groups' opinions on an issue and why these are held (reasoning).	+/-	-	m	+/-	Stakeholders and/or citizens	2 hours – 1 day	1 month	1
PAME	Evaluating and learning	+/-	+/-	+/-	+/-	All stakeholders	Variable	Variable	Var
Planning Cells	Citizens learn about and choose between multiple options regarding an urgent & important issue. Develop action plan.	+/-	-	m	-	25 average citizens. Experts & stakeholders present positions.	5 days	5 months	4
Scenarios	Planning and preparedness for uncertain future. Vision-building.	-	-	+	+/-	Anyone	2-5 days	6 months	1-3
World Café	Generating and sharing ideas	+/-	-	-	+/-	Anyone	4 hours – 1 day	1 month	1

Legend: Explanation of chart symbols:

*Topic	+	m = medium	-
Knowledge	A lot of common knowledge exists.		There is little common knowledge.
Maturity	Most people have already formed opinions on the subject.		The subject is new; people are still forming their opinions.
Complexity	Highly complex or technical		Not very complex or technical
Controversial	Highly controversial		Not very controversial

Note: +/- means that the method can address subjects with either + or –.

€ : 1 = inexpensive; 2 = moderate; 3 = expensive; 4 = very expensive

5. QUANTITATIVE ENVIRONMENTAL INDICATORS OF BENCHMARKING INDICATORS USED BY INVESTMENT RESEARCH COMPANIES, DIRECTLY FROM (FORCE TECHNOLOGY, 2008)

There are no biodiversity indicators relevant for the study.

	Indicator / Unit
Energy consumption	GJ
Water consumption	1,000 m^3
Discharge to water	Total (Kg.)
GHG emissions	Metric ton CO_2 equivalent
VOC emissions	Dioxin (g teq/year)
ODC (CFC_{11} eq.) use	
Industrial and common waste	Ton
Total nutrient emissions to water	Ton N+(10*P)
COD	Ton
Metal emissions to air	Total (Kg.)
Acid emissions to air	Acid Deposit Potential expressed as 1000 Acid equivalents.
Source: www.siricompany.com	

6. DEFRA ENVIRONMENTAL KPIS, DIRECTLY FROM (DEFRA, 2006)

There are no biodiversity indicators relevant for the study.

Figure 3: Sample Company Plc – Environmental Key Performance Indicators

Environmental Key Performance Indicators – Financial Year 2005								
Direct Impacts (Operational)			**Quantity**					
Greenhouse Gases	**Definition**	**Data source & Calculation Methods**	**Absolute Tonnes CO2**		**Normalised Tonnes CO2 Per £M Turnover**			
			2004	**2005**	**2004**	**Target**	**2005**	**Target**
Gas	Emissions from utility boilers.	Yearly consumption in kWh collected from fuel bills, converted according to Defra Guidelines.						
Vehicle Fuel	Petrol and diesel used by staff and van hire fleet.	Expense claims and MOT recorded mileage, converted according to Defra Guidelines.						
Waste	**Definition**	**Data source & Calculation Methods**	**Quantity**					
			Absolute Tonnes		**Normalised Tonnes Waste Per £M Turnover**			
			2004	**2005**	**2004**	**Target**	**2005**	**Target**
Landfill	General office waste, which includes a mixture of paper, card, wood, plastics and metals.	Volume of waste generated per annum, calculated by recording the number of bins and skips removed, converted to tonnes according to Defra Guidelines.						
Recycled	General office waste recycled, primarily cardboard.	Volume of waste recycled per annum, calculated by recording the number of bins and skips removed for recycling, converted to tonnes according to Defra Guidelines.						
Indirect Impacts (Supply Chain)								
Greenhouse Gases	**Definition**	**Data source & Calculation Methods**	**Quantity**					
			Absolute Tonnes CO2		**Normalised Tonnes CO2 Per £M Turnover**			
			2004	**2005**	**2004**	**Target**	**2005**	**Target**
Energy use	Directly purchased electricity, which generates Greenhouse Gases including CO2 emissions.	Yearly consumption of directly purchased electricity in kWh, converted according to Defra Guidelines.						
Water	**Definition**	**Data source & Calculation Methods**	**Quantity**					
			Absolute Cubic Metres		**Normalised Cubic Metres Water Per £M Turnover**			
			2004	**2005**	**2004**	**Target**	**2005**	**Target**
Supplied water	Consumption of piped water. No water directly abstracted by the Group.	Yearly consumption of purchased water.						

7. OECD KEY ENVIRONMENTAL INDICATORS AND SPECIFICALLY BIODIVERSITY INDICATORS, DIRECTLY FROM (OECD, 2003A)

In green boxes: biodiversity indicators which are relevant for the study.

Table 2-2: OECD key environmental indicators.

Pollution issues	Key indicator	Measured in	Comment
Climate change	CO_2 emission intensities	• Greenhouse gases emissions per unit of GDP (ton CO_2-eq/USD) • Greenhouse gases emissions per capita (ton CO_2-eq/capita) • CO_2 emissions from energy use per capita (ton CO_2-eq/USD)	
Ozone layer	Indices of apparent consumption of ozone depleting substances	• Consumption of CFCs and halons – indexed (first year equals 100) • Consumption of HCFCs and methyl bromide – indexed (first year equals 100)	Does only show trends – a fall or increase in emissions. Does not reveal anything about the different countries' emissions compared to each other – non-comparable.
Air quality	SO_x and NO_x emission intensities	• SO_x emissions per unit of GDP (kg/USD) • NO_x emissions per unit of GDP (kg/USD)	
Waste generation	Municipal waste generation intensities	• Municipal waste per capita (kg/capita) • Municipal waste per unit of PFC (private final consumption) (kg/USD)	
Freshwater quality	Waste water treatment connection rates	• Percent of waste water connected to sewage treatment plant (with/without treatment)	Does not reveal anything about the total amount of wastewater
Freshwater resources	Intensity of use of water resources	• Freshwater use per capita per year (m^3/capita) • In percent of total renewable resources • In percent of internal resources	
Forest resources	Intensity of use of forest resources	• Harvest of forest in percent of annual growth	
Fish resources	Intensity of use of fish resources	• Share of world catches (in percent)	Is only relevant to compare on a national level. Says more about the size of the fishing industry in the different countries.
Energy resources	Intensity of energy use	• Energy supply per capita (toe/capita) • Energy supply per GDP (toe/USD)	
Biodiversity	Threatened species	• Threatened species in percent of species known (for birds, mammals and vascular plants)	Is only relevant to compare on a national level.

Biodiversity	Pressures	Habitat alteration and land conversion from natural state to be further developed (e.g. road network density, change in land cover.)	L
	Conditions	Threatened or extinct species as a share of total species known	S
		Area of key ecosystems	M
	Responses	Protected areas as % of national territory and by type of ecosystem	S/L
		- Protected species	S

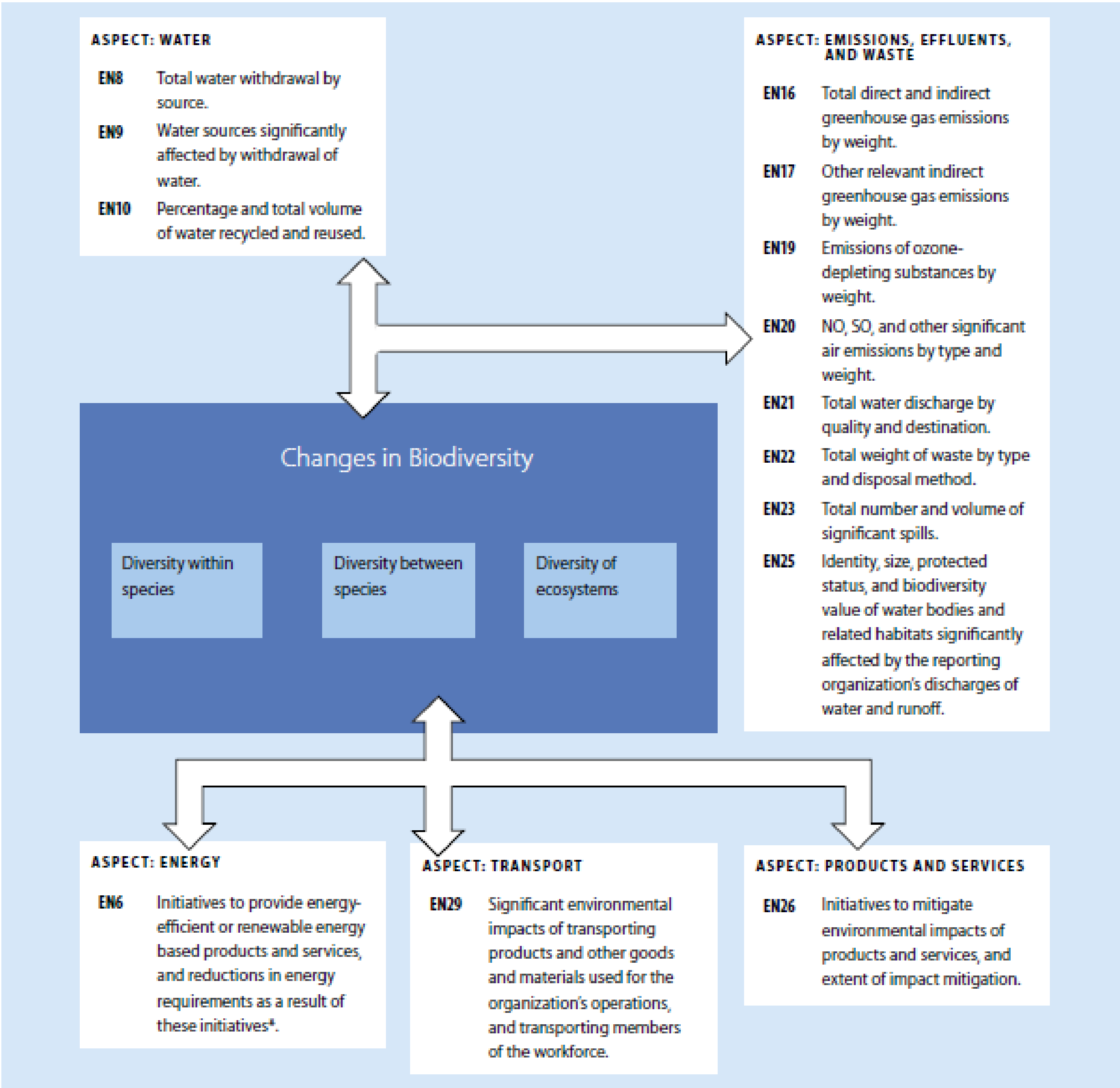
8. GRI BIODIVERSITY INDICATORS, DIRECTLY FROM (GRI, 2011)

They are all relevant for the study.

Aspect: Biodiversity

CORE	**EN11**	Location and size of land owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas.
CORE	**EN12**	Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas.
ADD	**EN13**	Habitats protected or restored.
ADD	**EN14**	Strategies, current actions, and future plans for managing impacts on biodiversity.
ADD	**EN15**	Number of IUCN Red List species and national conservation list species with habitats in areas affected by operations, by level of extinction risk.

9. BIODIVERSITY IN RELATION TO OTHER GRI ENVIRONMENTAL PERFORMANCE INDICATORS, DIRECTLY FROM (GRI, 2007)



10. CBD BIODIVERSITY INDICATORS, DIRECTLY FROM (CBD, 2004A)

The indicators in red boxes are not relevant for the study, all the others are relevant.

In decision VIII/15, the COP distinguished between:

- indicators considered ready for immediate testing and use (green),
- indicators confirmed as requiring more work (red)

Provisional Indicators for Assessing Progress towards the 2010 Biodiversity Target

A: Focal Area	
Status and trends of the components of biological diversity	- Trends in extent of selected biomes, ecosystems, and habitats - Trends in abundance and distribution of selected species - Coverage of protected areas - Change in status of threatened species - Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socioeconomic importance
Sustainable use	- Area of forest, agricultural and aquaculture ecosystems under sustainable management - Proportion of products derived from sustainable sources - Ecological footprint and related concepts
Threats to biodiversity	- Nitrogen deposition - Trends in invasive alien species
Ecosystem integrity and ecosystem goods and services	- Marine Trophic Index - Water quality of freshwater ecosystems - Trophic integrity of other ecosystems - Connectivity / fragmentation of ecosystems - Incidence of human-induced ecosystem failure - Health and well-being of communities who depend directly on local ecosystem goods and services - Biodiversity for food and medicine
Status of traditional knowledge, innovations and Practices	- Status and trends of linguistic diversity and numbers of speakers of indigenous languages - Other indicator of the status of indigenous and traditional knowledge
Status of access and benefit-sharing	- Indicator of access and benefit-sharing
Status of resource transfers	- Official development assistance provided in support of the Convention - Indicator of technology transfer

11. SEBI 2010 BIODIVERSITY INDICATORS FRAMEWORK, PRESENTATION OF THE RELEVANT INDICATORS FOR THIS STUDY, DIRECTLY FROM (EEA, 2007).

In green: biodiversity indicators relevant for this study. In red: the one which are not relevant.

CBD focal area	Headline indicator	SEBI 2010 specific indicator
Status and trends of the components of biological diversity	Trends in the abundance and distribution of selected species	1. Abundance and distribution of selected species a. Birds b. Butterflies
	Change in status of threatened and/or protected species	2. Red List Index for European species
		3. Species of European interest
	Trends in extent of selected biomes, ecosystems and habitats	4. Ecosystem coverage
		5. Habitats of European interest
	Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socioeconomic importance	6. Livestock genetic diversity
	Coverage of protected areas	7. Nationally designated protected areas
		8. Sites designated under the EU Habitats and Birds Directives
Threats to biodiversity	Nitrogen deposition	9. Critical load exceedance for nitrogen
	Trends in invasive alien species (numbers and costs of invasive alien species)	10. Invasive alien species in Europe
	Impact of climate change on biodiversity	11. Impact of climatic change on bird populations
Ecosystem integrity and ecosystem goods and services	Marine Trophic Index	12. Marine Trophic Index of European seas
	Connectivity/fragmentation of ecosystems	13. Fragmentation of natural and semi-natural areas
		14. Fragmentation of river systems
	Water quality in aquatic ecosystems	15. Nutrients in transitional, coastal and marine waters
		16. Freshwater quality
Sustainable use	Area of forest, agricultural, fishery and aquaculture ecosystems under sustainable management	17. Forest: growing stock, increment and felling
		18. Forest: deadwood
		19. Agriculture: nitrogen balance
		20. Agriculture: area under management practices potentially supporting biodiversity
		21. Fisheries: European commercial fish stocks
		22. Aquaculture: effluent water quality from finfish farms
	Ecological Footprint of European countries	23. Ecological Footprint of European countries
Status of access and benefits sharing	Percentage of European patent applications for inventions based on genetic resources	24. Patent applications based on genetic resources
Status of resource transfers	Funding to biodiversity	25. Financing biodiversity management
Public opinion (additional EU focal area)	Public awareness and participation	26. Public awareness

12. SIDA ENVIRONMENTAL INDICATORS FOR MINING ACTIVITIES, DIRECTLY FROM SIDA (2002).

The indicators in green boxes are including in the first framework.

Examples of indicators	Comments on the indicators
Support given to capacity building and policy development	
• Are environmental considerations integrated in the capacity building and policy development? (yes/no)	The integration of environmental considerations in the creation of an enabling environment, institutional development, and human resource development indicates that there is a possibility for increased environmental awareness among groups such as mining company staff and policy-makers. Note, however, that the indicator does not say anything about the effectiveness of the integration. What environmental considerations the indicator should capture need to be identified from project to project. *Data collection:* project document study and interviews with involved parties.
• Number of policy-makers, mining company staff, local population and other stakeholders who take environmental aspects into consideration in their daily activities (number; %)	This indicator is included to be able to monitor any changes in the "effectiveness of the awareness". Different groups can be distinguished between in reporting this indicator, e.g. women and men, youth and elderly. What environmental aspects the indicator should capture need to be identified from project to project. *Data collection:* interviews, questionnaires, and assessments of plans and policies.
Support to start-up, development and modification of mining activities:	
• Land use change (hectares; description)	By a classification system, it is possible to track the development of residential areas, agricultural areas, forests, plains, wetlands and environments of cultural value. This indicator becomes more meaningful if a qualitative description of the land use change is included. Such a description can capture whether, for example, sensitive ecosystems, untouched areas, cultural assets or traditional land uses are changed. This indicator could also function as a proxy for environmental changes that occur due to migration. This indicator can monitor the potential development of barriers and access to previously unexploited land. It can also be related to studies of changes in land ownership, evacuation issues and potential conflicts. The geographical resolution of the data should reflect the size of the project area. *Data collection:* field studies, local statistics (if they exist), satellite pictures. *For information and reference data, see UN (1996) (FAO).*
• Emissions of air pollutants (can include the parameters carbon dioxide, sulphur dioxide, nitrous oxides) (tonnes/year)	This indicator can be relevant in order to indicate the energy consumption and industrial processes associated with the activities. *Data collection:* statistics from the mine authority or company.
• Groundwater quality (can include the parameters oil, metals, pH-level) (various units)	Leakage and spillage of substances hazardous to human health and ecosystems negatively affect groundwater quality. *Data collection:* local statistics or regular sampling at selected stations.
• Number of people exposed to nuisances, e.g. noise or dust (number)	The perception of nuisances by the local population such as noise or dust, but also social factors such as conflicts with the mining company or staff, is an indicator of the overall sustainability of the project. *Data collection:* interviews and questionnaires.

13. ENVIRONMENTAL PERFORMANCE INDICATORS, DIRECTLY FROM CETEM (2004)

Table I: Examples of indicators of a mining and mineral processing facility in the context of environmental performance analysis (adapted from CETEM, 2001)

Phase	**Environmental management indicator (Management)**	**Environmental performance indicator (Operational)**	**Environmental indicator (State of the environment)**
Exploration	% Reduction of the number of trees removed	Number of trees removed	Number of hectares of forest lost
Overburden Removal and disposal	Investments in reduction of energy consumption	Air emissions of particulates and gases	Quality of air in the operation area
Mining	Investments to reduce impacts on aquifers	Hectares of pasture or farming land lost	Change in the local level of aquifers
Mineral processing	% Reduction of water consumption	m^3 of water per ton of ore processed	Local reduction of water supply
Waste disposal	% Reduction of contaminants in the effluents	Concentration of contaminants in effluents	Concentration of contaminants downstream
Decomissioning	Investments to sale equipments and debris	Number of equipments for sale	Land returned to other uses after decommissioning
Reclamation	Investments in reclamation	Revegetated area	Number of animal species living in the area

14. HEIDELBERGCEMENT INDICATORS FOR THE REPRESENTATION OF SUCCESSFUL RECONSTRUCTION MEASURES AND FOR THE MEASURING OF BIODIVERSITY, DIRECTLY FROM (RADEMACHER & AL., 2010).

The indicators in green boxes are including in the first framework.

Tab. 1: List of HeidelbergCement's own indicators for the representation of successful reconstruction measures and for the measuring of biodiversity

Indicator	Computation
Set of indicators "habitats"	
Subcategory habitats	
Habitats	Number of habitats per extraction site / area of the extraction site (ha)
Subcategory after-use	
After-use	Area of the extraction site with after-use nature conservation (ha) / area of the extraction site (ha) / area of the extraction site with after-use cultivated landscape (ha) / area of the extraction site (ha)
Subcategory wanderbiotopes	
Wanderbiotopes	Area of the wanderbiotopes in an extraction site (ha) / area of the extraction site (ha)
Set of indicators "number of species"	
Subcategory number of species	
Number of species plants A	Number of plant species in the extraction site / area of the extraction site (ha)
Number of species plants B	Number of plant species in the extraction site / number of plant species in the surroundings
Number of species animals A	Number of selected animal groups in the extraction site / area of the extraction site (ha)
Number of species animals B	Number of selected animal groups in the extraction site / number of selected animal groups in the surroundings
Subcategory ecologically significant species	
Endangered species A	Number of species in a given taxocoenosis based list of species / total number of species on the same given taxocoenosis based list of species
Endangered species B	Number of endangered species in an extraction site / number of endangered species in the surroundings
Species of the Species Action Plans	Occurrence and/or number of individuals of the species of the Species Action Plans

15. CEMENT INTERNATIONAL BIODIVERSITY INDICATORS, DIRECTLY FROM (TRÄNKLE & AL., 2008) AND IN (HEIDELBERGCEMENT TECHNOLOGY & AL., 2008).

The indicators in green boxes are including in the first framework.

Table 2: List of selected indicators

Indicator	Evaluation
"Habitats" Indicator Set	
Habitats section	
Number of Habitats Var. 2	Number of habitats in the mining sites/Areas of the mining sites (ha)
Subsequent utilization Section	
Subsequent utilization Var. 7	Areas of the mining site with reuse of nature conservation (ha)/ Areas of the mining sites with reuse of cultural landscape (ha)/Areas of the mining sites (ha)
Migratory Biotypes Section	
Surface section of the migratory biotopes Var. 1	Areas of the migratory biotopes of the mining sites (ha)/Areas of the mining sites (ha)
„Diversity of Species" Indicator Set	
Species Figures Section	
Species figure Var. 2	Species figures for plant species on the mining site/Area of the mining site (ha)
Species figure Var. 3	Species figure for the plant species on the mining site/Species figure for the plant species in the surrounding area
Species figure Var. 4	Species figure for selected animal groups on the mining site/Area of the mining site (ha)
Species figure Var. 5	Species figure for selected animal groups on the mining site/Species figure for selected animal groups in the surrounding area
Special Species Section	
Percentage of endangered species Var. 5	Percentage of endangered species on the mining site/Percentage of endangered species in the surrounding area
Figure for endangered species Var. 7	Figure for species on a specified taxocoenosis-related species list/Total species figure for a specified taxocoenisis-related species list
Types of Species Action Plans	Sources and/or individual figures for the types of Species Action Plans

16. THE CEMENT SUSTAINABILITY INITIATIVE (CSI) KPIS, DIRECTLY FROM (RADEMACHER & AL., 2010).

The indicators in green boxes are including in the first framework.

- KPI 1: Number of active quarries within, containing or adjacent to areas designated for their high biodiversity value, as defined by GRI 1.
- KPI 2: Percentage of sites with high biodiversity value (according to KPI 1) where biodiversity management plans are actively implemented.

17. Report for the step 1.2 Motivating stakeholders to participate: Report on the Method and Objectives of the Master Thesis

- SECOND VERSION –

10 AUGUST 2013

DEVELOPING A COMMON KEY PERFORMANCE INDICATORS FRAMEWORK FOR BIODIVERSITY MANAGEMENT IN GYPSUM QUARRIES THROUGHOUT EUROPE FOR EUROGYPSUM

OBJECTIVES AND METHODOLOGY

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Contents

Summary of Feedback expected

- ***For Task 1***
  - Focus group with Quarry WG on 17 April 2013 or earlier if possible? In March?
  - If it is not: Delphi by mail in place of Focus group?
  - Chistine Marlet may play the role of the mediator during Task 1 – Focus group?
- ***For Task 2***
  - Mail contacts with the internal experts of Eurogypsum and with external experts.
- ***For Task 3***
  - Mail contacts with all the stakeholders in Table 1.
- ***For Task 4***
  - Contacts with quarries that willing to welcome me.
- ***Indicator concepts***
  - Your feedback on proposals is needed for Task 1.

1. Target of the study

This study aims to establish a KPI[1]s framework to monitor biodiversity performance in European gypsum industry. This framework has to be usable for gypsum industrials across the different environments in Europe. It should answer to European legislation and strategies for biodiversity.

The study will present the different scenarios of KPI's framework according to the different opinions that emerge from the analysis. A consensus framework will be built in order to maximise both scientific rigor and feasibility of implementation.

1.1. Expected results of the study

The outputs of the study will be:

- A report to the destination of gypsum industry and decision-makers. This report will include:
    1. Biodiversity and Eurogypsum context;
    2. Legal and societal context;
    3. An explanation of the meaning of 'indicators' and its signification in the context of the study;
    4. The different scenarios elaborated during the participatory process;
    5. A consensus biodiversity KPIs framework;
    6. A glossary of terms;
    7. Additional folders to explain how to use the indicator framework, and how to use the indicators on the field in a conveniently way.
- A document written as a scientific article to expose to the scientific community the methodology used to develop the biodiversity indicator framework.

[1] Key Performance Indicator

2. Methodology and means implemented

2.1. Introduction

For Quarry WG

- Read carefully the methodology.
- Direct Questions to you are indicated in red.
- Boxes, like this one, point to the most important information.

2.2.Participatory process – Tasks of the thesis

In order to integrate the different opinions of stakeholders[2] and to reach a consensus Biodiversity KPIs framework, participatory[3] processes will be developed during the study. Participatory processes will allow validating the elaborated framework step by step and will bring it a significant added value.

2.2.1. Why to use participatory processes?

This project aims at the participation of stakeholders involved in the framework that will be developed. It will not concern all citizens.

Participatory processes considerably increase the quality of decisions (Slocum, 2003). In general, such processes allow increasing the trust among the public for governance institutions and strengthens the perception of legitimacy.

During participatory processes, stakeholders gain building capacities. It allows a better understanding of the aim and results reached and then a better acceptance. Decision-makers are also part of the process and will learn things that lead to improve their judgement. They will receive directly feedbacks from all others stakeholders that will build a great overview to take decisions (Slocum, 2003).

In most cases, people think that participatory decision-making is only reserved "to citizens who wish to play a more active role in the governance of their society" (Slocum, 2003). But it is not the case. Participatory management may be implemented with any group of stakeholders.

In this study participatory process will be implemented mainly with and among direct actors of gypsum industry (Quarry WG, national federations, local quarry managers) and with/and among experts (gypsum's experts, external experts).

It is also proposed to include policy makers and representative of the society at some points for limited interactions.

It can go from regional, national and local governments, scientists and companies up to development agencies or NGOs. Indeed, participatory processes can bring a lot of benefits not only to citizens (Slocum, 2003).

[2] "Any group or individual who can affect or is affected by the achievement of the organization's objectives" (Freeman, 1984)
[3] In this thesis participation is defined as a "process where individuals, groups and organisations choose to take an active role in making decisions that affect them". "This definition focuses on stakeholder participation rather than broader public participation" (Reed, 2008)

2.2.2. *Tasks of the thesis*

Five tasks have been distinguished (Figure 1). Each task is linked to an interaction/validation with Quarry WG:

- Tasks i and 4 don't include participatory processes;
- Task 1 to 3 includes participatory processes.

Figure 1 provides for each Task stakeholders implicated and the method proposed. Tasks and Methods are explained in detail in the following chapters.

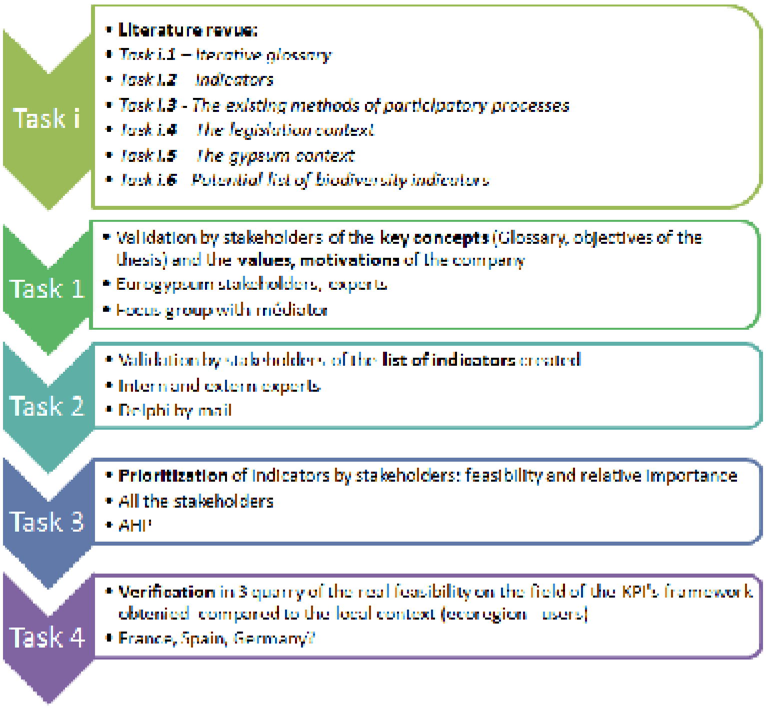


Figure 1 Summary of stakeholders implicated, the method and some details for the five Tasks of the study

Task i – Literature revue

This preliminary task aims to provide a 'potential list of indicators identify' and to fix the key concepts among the participants. It includes different steps based mainly on literature review[4].

➢ ***Task i.1 – Iterative glossary***

A **glossary of term** will be produces to facilitate communication. Chapter 4.2 demonstrates that the concept of "indicator" is complex and can have a lot of meanings among domains and subjects. Technical terms will be introduced throughout the thesis. Some of these terms may be unfamiliar to readers who are not ecologists, while others have multiple connotations from differential usage. To reduce the potential for misunderstandings, key terms will be explained in the manner in which they will be used.

This glossary is evolutive. It will be completed regularly during the study and will include all the concepts that will be not understood by any participant.

Details for Task i.1
- Timing: First glossary proposed on 28 February (attached with this report): based on problematic concepts identified during the Quarry WG, November 29-2012, and potentially problematic concepts in the current document. Glossary will be completed during future tasks. It will be used in Task 1 to validate the key concepts. - Method: Literature review

➢ ***Task i.2 – Indicators***

Objectives: identify basic key concepts and information useful for building a biodiversity KPIs framework adapted to gypsum industry.

- ***Indicators in general***: Identify key concepts and key questions related to :
  - What is an indicator? What are the different sorts of indicators?
  - What are the key questions to elaborate a good framework of indicators?
  - Which quality criteria are associated to a relevant indicator?
  - What is the scope of the indicator?
- ***Biodiversity indicators that are relevant for the study***: To list the potential biodiversity indicators that may be relevant to the context of the study. After they will be assessed with quality criteria.
- ***The EIA***: To identify the biodiversity indicators used in the EIAs of gypsum companies in order to integrate them to the list of potential indicators.

Details for Task i.2
- Timing: A general review on key questions/concepts linked to biodiversity indicators is proposed in this report (chapter 4). This summary was the basis to establish this methodology and to understand the keys to make a relevant framework. It was useful to create Task 1. - The others steps will be achieved for the 17 April 2013.

[4] Summary of the scientific literature on a subject

➢ *Task i.3 - Identify methods of participatory processes*

Review the existing methods of participatory processes and select the methods relevant for the study.

Details for Task i.2
- Literature review done (chapter 3). - Methods to be used in this study are identified and described in the following chapters

➢ *Task i.4 – The legislation context*

To understand the legislation context for indicators at a European level. A careful attention will be given at the European strategies for environment to be sure that the framework of biodiversity indicators elaborated will not be obsolete after a short period.

➢ *Task i.5 – The gypsum context*

To establish the context of gypsum industry in its environment and its implication for biodiversity indicators.

- *The ecoregions of Europe*: To know the distribution of the ecoregions of Europe (natural regions) and the characteristics of the vegetation or specific biodiversity associated with these regions.
- *Quarries through ecoregions*: To map all the quarries implicated in this study in a map including the ecoregions so that all the quarries will know the local condition to take into account when they use the future indicator framework.

➢ *Task i.6 - Potential list of biodiversity indicators*

Tasks i.1 to i.5 provide the basic information necessary to built an initial potential list of biodiversity performance indicators (KPI's). This first list will be used as a basis for further participatory processes to reach a consensus framework.

In order to have a relevant potential list of indicators, the Task 1 has to be achieved. It is why we have to wait the end of the Task 1 to complete the Task i.

Details for Task i
- Timing: The 26 April 2013 the Potential list of biodiversity indicators will be given. To achieve the Task i.6, the Task 1 has to be complete. Possible on 29 March if we make the Quarry WG meeting before the 17 April. - Participants: None (Carline's work with the collaboration of experts) - Method: Literature revue

Task 1 - Validation by stakeholders of the key concepts (Glossary, objectives of the thesis) and the identification of the values, motivations of the company

There are lots of misunderstandings possible. So, this is important to develop the KPIs framework with the agreement of all stakeholders to have a really usable tool. A Task that allows the validation by stakeholders of the key concepts is essential.

The first target of Task 1 is to make sure that everyone agreed on the concepts that form the basis of the thesis. The concepts approached will concern all the terms that may have some different meaning or are particular from ecological domain (from the glossary).

The second target is to identify the values, motivations of the company and to validate the objectives of the thesis by stakeholders. In the chapter 4.2, it is noticed that a key to build a relevant framework of indicators, is to define clearly the motivations and the values in term of biodiversity of the company for whose those indicators are created. Task 1 is the first step of a participatory process. It will integrate the views of those directly affected by the implementation of this study: the Quarry work group. It has been decided to initially restrict the action to this group because the first motivation is to answer their request in being proactive to define a biodiversity indicator framework.

This Task with two targets, may take place in one day and with the same method of participatory management. The method chosen for this phase is the method Focus Group (Solcum, 2003). All the participatory methods are explained in Chapter 3.3.

This method implies the presence of a mediator who will ensure an equal representation from all members during the discussion. If we see that the Focus group is not optimal, we can go to a Delphi in face to face to structure and allow a better discussion. If direct meeting is not possible a Delphi by mail is also possible.

Details for Task 1

- Timing: Because the Quarry WG is already meeting on 17 April 2013, this day may correspond to this Task. But this meeting is really late in the planning. The Task i.6 is limiting by Task 1. So, if it is possible, an earlier date will be better. If no meeting is possible because everyone is too busy, we can go to a Delphi by mail (beginning before 17 April). The two scenarios (Task 1 on 17 April and earlier) are presentenced in timesheets (chapters **Erreur ! Source du renvoi introuvable.** and **Erreur ! Source du renvoi introuvable.**). Let me know what your decision is.
- Participants: Members of Quarry WG.
- Method: Focus Group or Delphi by mail.
- Carline's preparation: To prepare all the questions we have to answer to validate the key concepts (Glossary, objectives of the thesis) and the values, motivations of the company.
- Resource needed: A mediator – If possible, Christine Marlet may play this role?

Task 2 - Validation by stakeholders of the list of indicators created

This Task will bring together the opinion of different environmental experts to be sure that the list of biodiversity proposed for the framework is really scientifically sound.

In this participatory process, the participants are internal[5] and external[6] experts. The external experts may be external consulting offices or professors at universities to be identified in collaboration with Quarry WG.

The method chosen for this phase is the Delphi by mail. It will enrich the list of biodiversity indicators gradually according to the different experts (internal and external) in an iterative process.

<u>Details for Task 2</u>

- Timing: After the all list of indicators is achieved. During 3 weeks or more.
  Beginning around 26 April 2013. Ending around 6 May 2013.
- Participants: Internal and external experts.
- Method: Delphi by mail.
- Carline's preparation: A list of potential indicators and a Delphi questionnaire. Identify a panel of external experts and validate the list with Quarry WG.
- Resource needed: Mail contacts with the internal experts of Eurogypsum and with external experts.

[5] Inside the frame of gypsum quarries (experts from gypsum companies)
[6] Outside the frame of gypsum quarries (independent experts)

Task 3 - *Prioritization of indicators by stakeholders: feasibility and relative importance*

The aim of this Task is to prioritize the indicators obtained to match the expectations of the stakeholders in term of feasibility and relative importance. This Task will include all the stakeholders possible to compare the expectations and opinions of different stakeholders.

The stakeholders implicated in this Task will be of different nature (more details are presented in the

Table 1):

- Eurogypsum stakeholders;
- Experts (internal or external);
- European institutions;
- Population: Not-for-profit association for environment (AISBL) like WWF, Residents associations.

Table 1 Presentation of the different stakeholders to include on Task 4.

Nature of stakeholder		Stakeholder	Explanation
Eurogypsum stakeholders		Quarry WG – members	Proactive stakeholders of the management of biodiversity in quarries. They initiated the project.
		National associations (full members of Eurogypsum)	National associations of producers of gypsum products. The secretary represents the interest of all the gypsum producers of a country. So it is interesting to have their opinion on indicators.
		Quarries directors and future users of indicators	Stakeholders directly involved in the use of indicators in the careers. They are the ones who use these indicators directly, or via consulting offices.
Experts	Internal	Stakeholder's experts	Experts engaged by the stakeholders to elaborate EIA's or to give their opinion on the environmental management.
	External	Consulting offices or professors at universities	Experts not connected to Eurogypsum and are therefore independent on their scientific opinions.
European institutions		DG Environnement - UNIT 1: biodiversity or UNIT 2: Natura 2000	They pass new laws and establish strategies in terms of biodiversity. Consult them will therefore ensure that the framework established is aligned with European strategies.
Population		Not-for-profit association for environment (AISBL)	It is interesting to have their opinion to validate publicly the framework
		Residents associations	It is interesting to have their opinion to take into account the "NIMBY[7]" phenomenon

This is important to have the largest point of view possible. Because it is only when all the opinions are clearly displayed for all the stakeholders, that it is possible to bring to decisions-makers all the keys to choose the best compromise in a given situation of time and budget. The final aim is to present several scenarios of KPI's framework according to the different opinions that emerge from the analysis.

It is often the case that those "who are responsible for comparing and evaluating biodiversity have a strong incentive to choose a scientifically reliable and repeatable indicator, which inevitably increases costs" (Duelli & Obrist, 2003). While the financing companies usually "opt for a financially reasonable approach, which often results in programmes addressing only essential work". And so, "the resulting compromises make optimisation of the choice of biodiversity indicators and methods of fundamental importance" (Duelli & Obrist, 2003).

[7] Not In My Back Yard

This Task will allow comparing views of different types of stakeholders that may have really different view about the project. This is precisely what will bring keys to find a resulting compromise that will best maximizes the scientific precision and means available. This second step will therefore develop a final scenario that can be used in the gypsum sector (see Task 4).

This task will be based on a simplified AHP method (Saaty & Peniwati, 2008). AHP method allows pairwise comparisons of proposals (indicators) in term of relative importance/feasibility. It will lead to consensus hierarchy of indicators. Because a full AHP assessment is fairly complex and requires long questionnaires, we will try to adapt the method to the time and resources available. Therefore, a special attention will be paid to the simplification of questions and to reduce the time to answer the questionnaire.

<u>Details for Task 3</u>

- Timing: After the results of Task 2. Duration 2 months.
  Early May, until June.
- Participants: All the stakeholders defined in Table 1.
- Method: a simplification of the AHP method.
- Carline's preparation: To build an AHP questionnaire adapted to this study. To prepare the methodology to process future collected data.
- Resource needed: Mail contacts with all the stakeholders in Table 1.

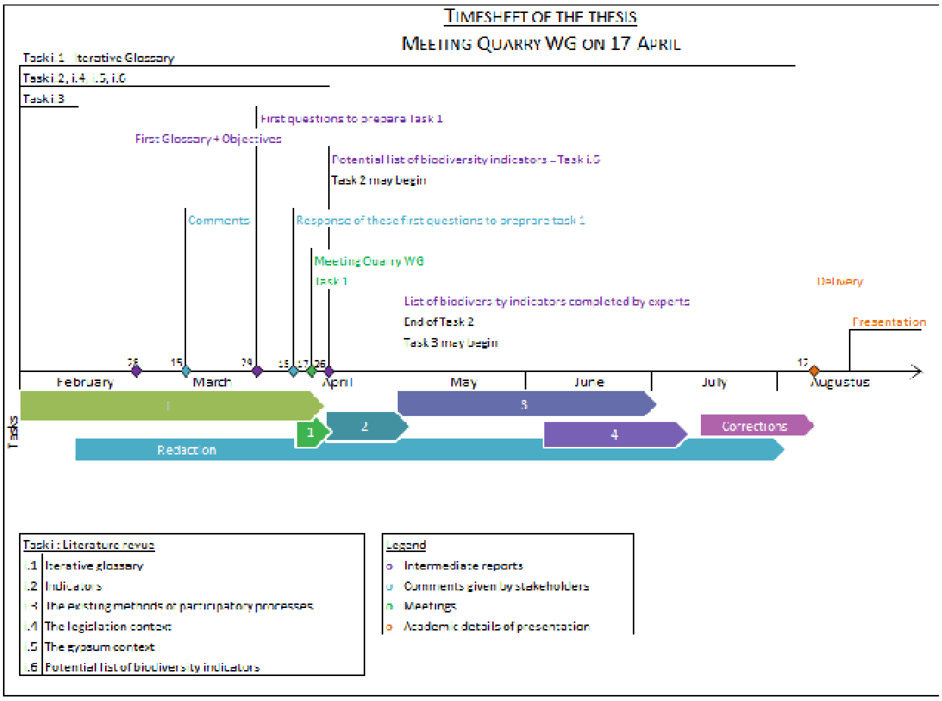
Task 4 - Verification of the real feasibility on the field of the KPI's framework

The aim of this Task is to confront the different scenarios obtained in Task 4 to the reality of the field and to bring a final scenario. This Task will allow the collect the key elements that will guide the choice of the most suitable scenario for users.

<u>Details for Task 4</u>

- Timing: Ideally after the Task 3, but it will be a little short. So maybe in June.
- Participants: Quarries directors and future users of indicators.
- Method: Verification of the feasibility on the field of the KPI's framework thought contacts with users and observations.
- Carline's preparation: To find a methodology to observe and to verify the feasibility in a scientific way.
- Resource needed: Contacts with quarries that willing to welcome me.

2.3.Timesheet: Meeting Quarry WG on 17 April



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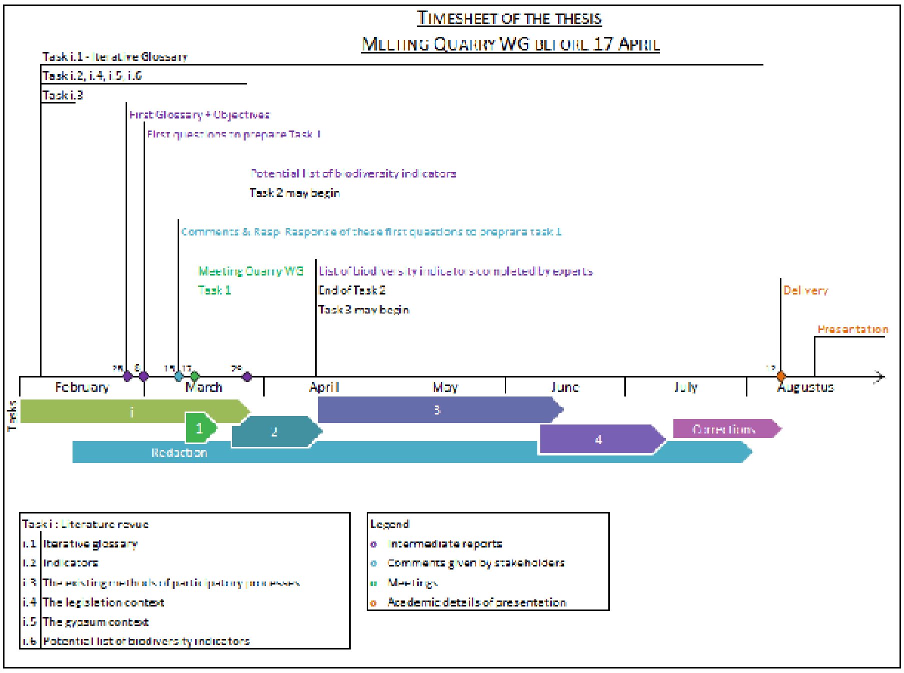
2.4.Timesheet: Meeting Quarry WG before 17 April



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3. Method of participatory process

3.1. Introduction

For Quarry WG
The chapter describes the methodology adopted to select the participatory processes and explain the three methods used in the study (for task 1 to 3). This is for your information.

3.2. Criteria to choose the method

Three Tasks needed participatory processes: Task 1 to 3. In the literature, there are many different participatory methods. For example, Slocum (2003) list no less than 40 methods, which with all the techniques derived from each method, are 71 possibilities. To decide which methods are the most appropriate methods in the context of the study, all of these methods were compared according to the criteria defined in

Table 2. The comparison was made for the 40 methods proposed by Slocum (2003). The AHP proposed by Saaty & Peniwati (2008) and used by (Oliver & *al.*, 2007) in a context of biodiversity indicators has also been taken into consideration. The latter is an approach of Group Decision Making. The Network Analytic Approach (ANP) has also been taken into account, because it's a generalization of the AHP (Mu et *al.*, 2009).

Table 2 Criteria used to select applicable methods in this study, from (Slocum, 2003).

Criteria	Explanation
Disponible time	Amount of time available
Disponible budget	Availability of ressources
Possible Participants	Who is affected, interested or can contribute to solutions
Topic	The nature and scope of the issue
Objectives	Reasons for involvement and expected outcomes
Complexity	Level of complexity or technical requirence

Finally, three methods were relevant and applicable to this study: Focus Group, Delphi and AHP. These three methods are explained in the fallow chapter.

3.3. The three methods selectioned - explanation

- ***Focus Group***

"A focus group is a planned discussion among a small group (4-12 persons) of stakeholders facilitated by a skilled moderator. It is designed to obtain information about (various) people's preferences and values pertaining to a defined topic and why these are held by observing the structured discussion of an interactive group in a permissive, non-threatening environment. Thus, a focus group can be seen as a combination between a focused interview and a discussion group. Focus groups can also be conducted online." (Slocum, 2003).

Focus groups are good for initial concept exploration, generating creative ideas. They are often used to test, evaluate and/or do a programme review." (Slocum, 2003).

> ➢ ***Delphi***

"Delphi involves an iterative survey of experts. Each participant completes a questionnaire and is then given feedback on the whole set of responses. With this information in hand, (s)he then fills in the questionnaire again, this time providing explanations for any views they hold that were significantly divergent from the viewpoints of the others participants. The explanations serve as useful intelligence for others. In addition, (s)he may change his/her opinion, based upon his/her evaluation of new information provided by other participants. This process is repeated as many times as is useful. The idea is that the entire group can weigh dissenting views that are based on privileged or rare information. Thus, in most Delphi processes the mount of consensus increases from round to round." (Slocum, 2003).

"While traditionally conducted via mail, other variations of Delphi can be conducted online or face-to-face. In the original Delphi process, the key characteristics of this method were (1) structuring of information flow, (2) feedback to the participants and (3) anonymity for the participants. In a face-to-face Delphi, the anonymity is eliminated. Another variation of the Delphi is the 'Policy Delphi', the main goal of which is to expose all the different options and opinions regarding an issue and the principal pro and con arguments for these positions." (Slocum, 2003).

➢ ***AHP***

The AHP method is an analytic hierarchy process often used for group decision making (Mu & *al*., 2009). The AHP method is used to select and prioritize attributes in a structured and repeatable way. Moreover, it allows to treat the contribution of each expert in numerical analysis which allows a more efficient and objective contribution to the negotiation. Indeed, in this technique, minority opinions are preserved and still contribute to the final result (Oliver & *al*., 2007).

"The AHP is a decision-making framework that uses a hierarchical structure to describe a problem (decomposition), pairwise comparisons to rank elements at each level with respect to importance (or feasibility), and matrix multiplication to convert level-specific, local priorities into global decision priorities (aggregation) (Schmoldt & Peterson 2000). The question addressed by the AHP is how strongly do the individual elements at the lowest level in the hierarchy influence the top level? The aim of grouping in the hierarchy is to restrict pairwise comparisons to similar attributes and to keep the number of pairwise comparisons within each node small. The pairwise comparison process is a critical part of the AHP" (Oliver & *al*., 2007).

"Another advantage of the AHP is the ability to apply statistical tests to the individual contributions from experts and so explore the variability among expert opinions"

"Use of the AHP not only leads to a defensible set of high importance/ high feasibility attributes, but can also highlight potential areas for further investigation, that is, those attribute that rate highly for importance but low for feasibility" (Oliver & *al*., 2007).

4. Indicator context

In order to understand what an indicator is and how to develop a coherent and reliable framework, the literature has been consulted.

For Quarry WG

The following paragraphs explain how to select indicators and how to build a relevant framework of biodiversity indicators. The answers of these questions and the choices made for this study are in the boxes.

- Timing: These choices are proposals that will be discussed in **Task 1** - During the meeting of the 17 April or before if it's possible.

- Participants: Quarry WG - Your feedback on proposals is needed.

4.1. Introduction

In the past decades, a lot of international, national or regional non-governmental organisations (NGOs) have needed to monitor aspects of biodiversity at different levels and scales. (Duelli & Obrist, 2003)

Measuring biodiversity, even in a small area is too complex. Consequently, suitable indicators that comprehensively measured and quantified it have to be found (Duelli & Obrist, 2003).

The term biodiversity[8] is really complex and include a lot of different aspects. Because of this, no single biodiversity indicator can be developed. This imply to make choices for values and measures and to focus on some aspects of the biodiversity (Duelli & Obrist, 2003). These choices will be discussed here more in detail.

4.2. What are the questions in order to have a good framework of indicators?

- ***What is the definition of an indicator?***

Clear definitions are essential in legislation, standards, and guidelines. Moreover, the importance of defining technical terms is widely accepted in science. A misunderstanding may lead to difficulties for communication. If different stakeholders don't have the same term's meaning, it is almost impossible to get to an acceptable agreement (Heink & Kowarik, 2010).

'Indicator' is a profoundly ambiguous term and may have different meanings in different contexts (Heink & Kowarik, 2010).

[8] In the international Convention on Biological Diversity "the biological diversity means 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" (Johnson, 1993).

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In order to develop a reliable framework of indicator, Heink & Kowarik (2010) suggest defining the indicator term clearly, but in a broad context before any action. They established a clear definition that mitigate all the opinions and on which everyone can rely on:

<u>Definition</u>

"An indicator in ecology and environmental planning is a component or a measure of environmentally relevant phenomena used to depict or evaluate environmental conditions or changes or to set environmental goals. Environmentally relevant phenomena are pressures, states, and responses as defined by the OECD (2003)"(Heink & Kowarik, 2010)

Some terms used in this definition (pressure, state and response indicators) are defined in Table 3.

Table 3 Explanation of pressure, state, response indicators, from (Manoliadis, 2002).

Type of indicator	Explanation
1. Pressure indicator	"Describes the underlying cause of the problem. It can be an existing problem or it may be the result of a new project or investment".
2. State indicator	"Usually describes some physical, measurable characteristic of the environment that results from the pressure".
3. Response indicators	"Are those policies, actions or investments that are introduced to solve the problem. As responses to environmental problems they can affect the state either directly or indirectly, by acting at the pressures at work".

Heink & Kowarik (2010) also suggest clarifying this definition depending on the specific issue. In this study we are talking about KPI, this term has to be defined.

<u>Definition of KPI</u>

The term KPI is defined by Fitz-Gibbon (1990) as an "industry jargon" for "a type of performance measurement". She defines a KPI as "an item of information collected at regular intervals to track the performance of a system".

In other words, Performance Indicators allow to measure evidence "to prove that a planned effort has achieved the desired result" (Kaufman, 1998). They may be used in two critical ways: a proactive one or a retrospective one. The first use identifies what should be accomplished, and the second provide criteria for determining success or failure (Kaufman, 1998)

In conclusion, the principal aim of a performance indicator is to provide "the specific criteria from which the attainment of result can be planned and their accomplishment can be measured" (Kaufman, 1998).

<u>Proposal for Eurogypsum KPI's</u>

To establish a KPI's framework we must clearly define the expected result. In this study, the aim of the project is to measure the biodiversity in careers in order to show that the extraction of gypsum does not harm biodiversity but can instead improved it. This approach fits within a No Net Loss of biodiversity target.

➢ ***Selection of indicator attributes?***

It is essential to distinguish indicators based on the following attributes (Table 4) (Heink & Kowarik, 2010):

- Descriptive indicators -versus- normative indicators
- Indicators as measures of ecological attributes -versus- indicators as ecological components.

Table 4 Explanation of the attributes terms of indicators, based on Heink & Kowarik (2010).

Attribute	Explanation
1. Descriptive indicators	"Indicator used to describe environmental states or changes".
2. Normative indicators	"Indicator not only used to describe environmental states or changes but also to evaluate them and to set objectives".
3. Indicators as measures of ecological attributes	"Indicator that are measures of ecological attributes (e.g., species richness)".
4. indicators as ecological components	"Indicator that are components of ecological attributes (e.g., a certain taxon)".

<u>Proposal for Eurogypsum KPI's</u>

In this study, we will use normative indicators because the aim of the study is to monitor biodiversity. The indicator of this study will also be as measure of ecological attributes, because we want to have values to compare and demonstrate the evolutions of biodiversity among different periods.

We have also to use a coherent terminology for indicator concept (Figure 2) (Heink & Kowarik, 2010):

- Ecological indicators -versus- environmental policy indicators
- Indicators conceived as indicator measures -versus- Indicator components

Relevance of the criteria that different indicator concepts should address

Indicator concept	Correlation between indicator and indicandum	Normative legitimation	Possible complexity of the indicator	Application point of the indicator
1. Ecological indicator	Required	Irrelevant	Simple or complex	Pressure, state or response
2. Environmental policy indicator	Negligible	Required	Simple or complex	Pressure, state or response
3. Ecological indicator component	Irrelevant, but relevant for the measured attribute of the component	Irrelevant	Irrelevant	State of an ecological component (organism, structure, process)
4. Indicator component for environmental policy	Irrelevant	Required	Irrelevant	State of an ecological component (organism, structure, process)

In the left column we present four different indicator concepts (ecological indicators = indicators as descriptive measures; environmental policy indicators = normative measures; ecological indicator components = components used to measure environmental attributes; and indicator components for environmental policy = components used for evaluation and goal setting in environmental policy). We analyze whether correlation between indicator and indicandum, normative legitimation, and complexity of the indicator are relevant and at which point the indicator is applied. Complexity refers to the number of environmental conditions that are integrated in one indicator. Application points can be pressures from human activities exerted on the environment, exposure to a stress or an impact (e.g., accumulation of a contaminant in soil or levels of road noise), the state of biotic and abiotic conservation resources and effects on these resources, and responses of society towards environmental concerns.

Figure 2 Presentation of the coherent terminology to use for indicator concept

<u>Proposal for Eurogypsum KPI's</u>

In this study, the indicators will be environmental policy indicators because the aim of this project is to monitor biodiversity in order to adapt industry's environmental policies. They are also going to be indicators conceived as indicator measures.

➢ ***Simple or complex indicator?***

Indicators can be simple or complex (Table 5). Simple indicator represents "single, well demarcated environmental factors instead of a complex of different environmental conditions" (Heink & Kowarik, 2010). Currently, there are a lot of highly aggregated multispecies composite biodiversity indices. This kind of indicators provides a picture of trends in biodiversity in response to human activities in a wide scale (Vackar & *al.*, 2012).

Table 5 Explanation of simple or complex indicators, based on Heink & Kowarik (2010).

Name	Explanation
1. Complex indicator	Multidimensional: "they include different fields for which information is needed and may integrate different information over a large area and a long period of time".
2. Simple indicator	One-dimensional: "reflect singular, short-term conditions".

An example of simple indicator is the *chlorotic effects on the bean Phaseolus vulgaris* that indicate directly the presence of a certain amount of NO_2. In opposition, the *sustainability* is a "multidimensional indicandum that comprises environmental compatibility, social acceptability, justice, and sound economic development" (Heink & Kowarik, 2010).

Proposal for Eurogypsum KPI's

In this study, we will prefer simple indicators (or one-dimensional) because they provide more information about environmental factors that are interesting for management.

During Quarry WG meeting (November 29-2012): "the Eurogypsum thinking that general indicators are not suitable to measure biodiversity. Some KPI´s could be appropriate for some ecosystems but at the same time they are not suitable for others. Each quarry is part of a bigger ecosystem and each ecosystem has its own specific KPI´s. If we go towards global KPI´s, then improvement might be very subjective. Management systems in relation to biodiversity should cover a previously defined ecosystem, the quarry and the neighbouring area as this enables to show the added-value of a quarry inside an ecosystem. Specific KPIS are derived from the management system and adapted to local ecosystems. KPIs change according to the changes in the eco-system and are recorded in the restoration plan foreseen in the impact assessment for the quarry. Thus, a management system is flexible and adaptable to a specific situation in a specific area across Europe. It is thus a good way forward to improve biodiversity."

➢ ***What are the goal, the role, the motivations, and what to focus on?***

A. The role

The classification by Failing & Gregory (2003), describe three key roles for indicators:

1. "To track performance (results-based management)",
2. "To discriminate among competing hypotheses (scientific exploration)",
3. "To discriminate among alternative policies (decision analysis)".

But whatever the classification, Mace & Baillie (2007) suggest that the design of indicators will differ given their primary role, especially in the case of decision making. Thus we have always to keep in mind the role that these indicators will play. And at the same time, it is important to avoid relying on indicators developed for different purposes, where possible (Mace & Baillie, 2007).

Proposal for Eurogypsum KPI's

In this study, this is obvious that the key role of the futures indicators will be to track performance (results-based management).

According to the Quarry WG meeting (November 29-2012): they are "reflections of the Gypsum industry around the potential establishment of a biodiversity management system".

A. The goal, motivations, focus

Personal and/or professional goals have a great influence on people who are involved in developing or using biodiversity indicators. Even if the purpose of the study is the same (measure or monitor biodiversity), they may address different aspects of biodiversity. Their focus depends on their motivation for dealing with biodiversity (Duelli & Obrist, 2003).

So, this is really important to define precisely what the goals of developing biodiversity indicators are. Because the aspects on what we will focus will depend on the professional motivations.

Proposal for Eurogypsum KPI's

In this study, the goal is to monitor biodiversity. But the motivations aren't really defined. It is important that a clear definition is integrated early in the study.

According to the Quarry WG meeting (29 November 2012): "the objective was to create a framework of biodiversity indicators:

- For reporting: the Gypsum Industry may use the indicators for reporting purposes but it is not the primary aim of the project.
- For improving sustainability in the quarries: the Gypsum Industry wants to prove that with biodiversity management, we are able to quarry everywhere in a sustainable way (natura 2000 and non natura 2000 sites).
- To manage the biodiversity aspects of the quarry by our staff: the Gypsum Industry wants to improve the biodiversity aspects in the running quarries and therefore develop tools to achieve enhanced biodiversity (measured and monitored by our staff) in the running quarries;
- To maintain the biodiversity status of our quarries".

"The other two objectives – certification and management system - could be considered in a second step".

✓ It will be define thought participatory processes in Task 1.

An example of motivation is enounced by Duelli & Obrist (2003) in an agricultural context in an industrialised country in Europe. The Three most important motivations there are:

- "Species conservation (focus on rare and endangered species).
- Ecological resilience (focus on genetic or species diversity).
- Biological control of potential pest organisms (focus on predatory and parasitoid arthropods)."

If there is, like in this example, more than one motivation, the optimal approach is to select a "basket of indicators for each motivation" (Duelli & Obrist, 2003).

➢ ***What aspect of biodiversity do we want to focus on?***

Ones the goals and motivations defined, we have to know on what aspect of biodiversity we want to focus on.

Noss (1990) distinguished three kinds of attributes for biodiversity: compositional, structural and functional. They are defined in Table 6. The most common approach is to measure compositional biodiversity (Duelli & Obrist, 2003). "Presumably, both structural and functional biodiversity are either based on or lead to higher compositional diversity. We are convinced that ecosystem diversity, as well as structural and functional diversity, is somehow reflected in the number of species present. If they are not correlated with species richness, they must be special cases and not representative as biodiversity indicators." (Duelli & Obrist, 2003).

Table 6 Explanation of the different attributes of biodiversity (Compositional, structural and functional), based on (Swingland, 2001).

Compositional
"Composition addresses the identity and richness of biotic components, and the relative amount (e.g., abundance, cover, biomass) of each". "Biotic components of ecosystems include genes, organisms, family units, populations, age classes, species and other taxonomic categories, trophic levels of animals (e.g., herbivores, predators), animal guilds and assemblages, plant communities, and interacting assemblages of plants, animals, and microorganisms (i.e., biotic communities)".
Structural
"Refer to the various vertical and horizontal components of a community or landscape and the organizational levels of plant and animal populations and assemblages". "Considering only biotic, vegetative components of a landscape, horizontal structure consists of the size, shape, and spatial arrangement and juxtaposition of different plant communities; vertical structure consists of the foliage density and height of different vegetation layers. Structure can also refer to population, age and trophic structure, and other levels of community organization".
Functional
"Include processes such as herbivory, predation, parasitism, mortality, production, vegetative succession, nutrient cycling and energy flow through biotic communities, colonization and extinction, genetic drift, and mutation". "Biotic processes can be addressed in terms of the identity and number of different types of processes, as well as the rate (e.g., predation rate) at which each process operates".

<u>Proposal for Eurogypsum KPI's</u>

Compositional biodiversity aspect will probably be the main class of indicators used in this study. However, if feasibility is demonstrated, other aspects should also be included. This has to be discussed later in the study.

✓ It will be define thought participatory processes in Task 1.

➢ ***Do we want an indicator FOR or FROM biodiversity?***

"A first major source of misunderstanding is, whether biodiversity itself is to be indicated, or whether certain components of biodiversity are used as indicators for something else" (Duelli & Obrist, 2003).

For example, "if a species or a group of species is a good indicator for lead contamination, it may not indicate biodiversity". "It is fundamentally a contamination indicator, or an environmental indicator rather than a biodiversity indicator". "However, real biodiversity indicators may be needed to measure the impact of lead contamination on biodiversity itself (indicator FOR biodiversity). Such an assessment is different from measuring the impact of lead on a selected taxonomic group, which had been chosen because it is especially sensitive to lead poisoning (indicator FROM biodiversity)" (Duelli & Obrist, 2003).

<u>Proposal for Eurogypsum KPI's</u>

In our case, we want indicator FOR biodiversity, because the aim of this study is to measure the biodiversity itself.

➢ ***Alpha-diversity or contribution to higher scale biodiversity?***

"An important question is whether the species (or allele, or higher taxon unit) diversity of a given area is to be indicated (local, regional or national level), or if the contribution of the biodiversity of that area to a higher scale surface area (regional, national, global) is important" (Duelli & Obrist, 2003)

"In the first case (alpha-diversity, e.g. species richness of an ecological compensation area), an indicator ideally has to be a linear correlate to the biodiversity aspect or entity of the surface area in question. Each species has the same value. In the second case, the value of the measurable units of biodiversity (alleles, species, ecosystems) depends on their rarity or uniqueness with regard to a higher level area. A nationally rare or threatened species in a local assessment has a higher conservation value than a common species, because it contributes more to regional or national biodiversity than the ubiquitous species" (Duelli & Obrist, 2003).

<u>Proposal for Eurogypsum KPI's</u>

In this study, the Eurogypsum stakeholders are interested about a higher scale of biodiversity. And the scale and what it involved will be define precisely in the study.

The first opinion of the Quarry WG (29 November 2012) was that "the quarry is integrated in an ecosystem and that we should have the ecosystem as a reverence point. The surroundings may have a negative impact on the achievements of the biodiversity targets in the quarry and the quarry may have positive impact on the surroundings.

So basically, it was agreed that the contribution of the quarry habitat to the other habitats around the quarry should be considered. In other words, indicators of the relationship of the quarry with the landscape should be considered".

✓ It will be define thought participatory processes in Task 1.

4.3. Quality criteria for an indicator

In the literature, it exist a number of criteria to consider in selecting and designing indicators for biodiversity. Normander & *al*. (2012) provide a summary of the literature of these quality criteria (

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Table 7 Quality criteria to obtain relevant biodiversity indicators, based on Normander & *al.* (2012). Table showing examples of questions to ask in order to meet the quality criteria.

Quality	Explanation	Example of questions to ask for the quality
1. Representative and good coverage	Includes a large enough or representative group of species and has a good spatial coverage	- Where is the indicator in the system "pressure, state, response"? [1]
2. Temporal and up-to-date	Shows temporal trends and can be updated routinely, e.g. annually	- Can we measure this indicator annually or periodically? [1]
3. Simplifying information	Summarises a complicated phenomenon into a simple and intelligible form	- Can this indicator aggregate a complex phenomenon into a simple measure? [1], [6]
4. Clear presentation	Possible to display clear messages with eye-catching graphics	- Can this indicator be illustrated on graphs? [1]
5. Indicative	Indicates changes in a broader scale	- Does this indicator may be used at a larger scale? [2], [6]
6. Sensitive	Measured qualities are more sensitive to change than their environment (i.e. early warning)	- Does this indicator indicate sensitive changes? [6]
7. Quantitative and statistically sound	Based on real quantitative observations and statistically sound data collection methods	- Is it scientifically valid? [1], [2] - It really shows biodiversity changes? [1] [6]
8. Relatively independent of sample size	Usable data may be obtained even with relatively small sample sizes	- Is it usable even with a small size of population? [1]
9. Realistic	Based on existing monitoring programmes. Implementation is economically feasible	- Indicator based on available data, and measurable data? [2] - Not too expensive? [2] - Does it maximize the accuracy for limited resources? [1],[2]
10. User-driven and acceptable	Responds to the needs of stakeholders and is broadly accepted amongst them	- Is it feasibility and easy to use? [1] ,[3], [5] - Does it allow monitoring the biodiversity? [1] - Does it allow monitoring biodiversity to provide no net loss?
11. Normative and policy relevant	Linked to politically set goals and baselines.	- Does the indicator is relevant according to the vision of the CBD?[1]
12. Not sensitive to background changes	Enables assessing progress towards targets	- Is it enables assessing progress towards targets? [1]
13. Explainable	Buffered from natural fluctuations. Measures changes caused by humans	- Is this indicator linked to causes of trends? [4], [6]
14. Predictable	May be forecast and linked to socio-economic models	- May it forecast and linked to socio-economic models? [1]
15. Comparable	Enables comparison (e.g. benchmarking of Countries)	- Does it allow comparisons between sites, between countries? [4]
16. Aggregatable and disaggregatable	Data may be aggregated and disaggregated into different levels (e.g. country vs. community)	- Does the data may be aggregated and disaggregated into different levels? [2], [3]

5. Academic details

5.1. Confidentiality protection

- Training convention within a clause of confidentiality
- Signed the Competition rules of the association

5.2. Delivery and presentation

Agenda	
Delivery of the thesis	12 August 2013
Presentation of the thesis	Between 19 and 31 August
Presentation details	
Document language	English
Presentation language	French
Promoter	Pr G. MAHY
Co-promoter	C. MARLET
Jury member of the presentation	Pr P. LEJEUNE, Pr M. DUFRENE, Pr J. BOGAERT, Pr C. VERMEULEN

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18. REPORT FOR THE STEP 2.2 (FOCUS GROUP): CONTENT OF THE 17TH OF APRIL 2013

FRAMEWORK OF BIODIVERSITY INDICATORS
CONTENT FOR THE 17TH OF APRIL

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The 17th of April we will discuss the following proposals. Read carefully the following paragraphs.

1. Biodiversity and motivations

1.1 Biological diversity is:

- The variability amongst 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:

1.2 Motivations to promote a biodiversity KPIs Framework

The main motivation is to **increase the performance of biodiversity management** in quarries. Have the best possible result in terms of biodiversity in our careers. For this we need indicators that measure the performance (KPIs), **Facilitate access to resources.** The Gypsum Industry wants to demonstrate that with biodiversity management, we are able to quarry everywhere in a sustainable way (Natura 2000 and non Natura 2000 sites).

A biodiversity KPIs framework is a tool to:

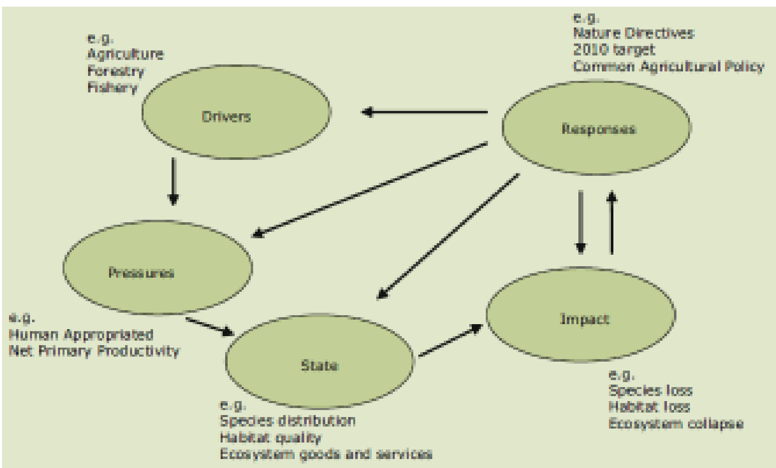
- Facilitate biodiversity **monitoring** in gypsum quarries
- **Facilitate reporting** at quarries and industry scale
- **Support biodiversity management aspects of the quarry by our staff**

To improve our knowledge on motivation and goals for a Biodiversity KPIs framework, answer following question. **What is the importance of those proposed questions: Low – Medium – High?**

	Key questions	L	M	H
S	1. What is the state of biodiversity of our focal ecosystems?			
S	2. What is the state of biodiversity in the pit in regards with the outside?			
P	3. What are the main factors causing pressures on biodiversity in the quarry?			
S	4. Do we have a No Net Loss or not with an exploitation?			
R	5. How to improve biodiversity at different stages of the exploitation?			
P	6. Which are the factors that influence biodiversity in the quarries?			
D	7. Has climate change an impact on biodiversity in our quarries?			
R	8. Are the restorations after exploitations influencing biodiversity in our quarries?			
S	9. How is doing biodiversity in our quarries?			
R	10. How to change our activities to improve biodiversity?			
I	11. With an exploitation do we improve or not biodiversity?			
I	12. Is biodiversity better after or before exploitation?			
R	13. Are we doing good actions for biodiversity?			
R	14. How many hectares of land have been preserved?			
R	15. Which activities have been undertaken to enhance biodiversity at the production sites?			
R	16. How many EIAs have been carried out prior to undertaking new or extended activities?			
S	17. What has happened to the populations of keystones species in our area?			
R	18. Which stakeholders have been involved and how often have dialogues taken place?			
I	19. Does the exploitation have impacts on biodiversity outside the quarry?			
I	20. Does our activity have an impact on the water system includes outside the quarry? And on the biodiversity related?			
I	21. Does our activity have an impact on the connectivity of the habitats outside the quarry in the landscape			
I	22. Does our activity promote invasive species?			
I	23. Is there more invasive species in the quarries or outside?			

Do you have another question about biodiversity in quarries?

The DPSIR framework may help you (definitions in the 'Glossary_version_2').



2. Indicators

The term biodiversity is really complex and include a lot of different aspects. Because of this, no single biodiversity indicator can be developed. This implies to make choices for values and measures and to focus on some aspects of the biodiversity. Biodiversity indicators are interest-dependant - the interpretation or meaning given to the data depends on the purpose or issue of concern.

An indicator in ecology and environmental planning is a component or a measure of environmentally relevant phenomena used to depict or evaluate environmental conditions or changes or to set environmental goals. Environmentally relevant phenomena are pressures, states, and responses as defined by the OECD (2003).

The principal aim of a performance indicator is to provide 'the specific criteria from which the attainment of result can be planned and their accomplishment can be measured'.

In this study, the key role of the futures indicators will be **to track performance (results-based management).**

We will use **normative indicators** and these indicators can be **measure of ecological attributes** and **environmental policy indicators**.

We will prefer s**imple** indicators (or one-dimensional) because they provide more information about environmental factors that are interesting for management.

We want indicator **FOR** biodiversity, because the aim of this study is to measure the biodiversity itself.

We are interested about the link with biodiversity outside quarries. The scale and what it involved will be define precisely in the study.

Compositional biodiversity aspect will probably be the main class of indicators used in this study. However, if feasibility is demonstrated, **other aspects (structural, functional) should also be included**. This has to be discussed later in the study.

A last question is if we are going to use **relative** or **absolute** indicators. Absolute indicators show an absolute state of biodiversity. Relative ones highlight a difference between an initial and a final state of biodiversity.

3. Quality criteria for an indicator

In this study we will use these criteria to evaluate and choose potential indicators. They include criterias founded in (EEA, 2004),

Quality	Explanation
1. Representative and good coverage	Includes a large enough or representative group of species and has a good spatial coverage
2. Temporal and up-to-date	Shows temporal trends and can be updated routinely, e.g. annually
3. Simplifying information	Summarises a complicated phenomenon into a simple and intelligible form
4. Clear presentation	Possible to display clear messages with eye-catching graphics
5. Indicative	Indicates changes in a broader scale
6. Sensitive	Measured qualities are more sensitive to change than their environment (i.e. early warning)
7. Quantitative and statistically sound	Based on real quantitative observations and statistically sound data collection methods
8. Relatively independent of sample size	Usable data may be obtained even with relatively small sample sizes
9. Realistic	Based on existing monitoring programmes. Implementation is economically feasible
10. User-driven and acceptable	Responds to the needs of stakeholders and is broadly accepted amongst them
11. Normative and policy relevant	Linked to politically set goals and baselines.
12. Not sensitive to background changes	Enables assessing progress towards targets
13. Explainable	Buffered from natural fluctuations. Measures changes caused by humans
14. Predictable	May be forecast and linked to socio-economic models
15. Comparable	Enables comparison (e.g. benchmarking of Countries)
16. Aggregatable and disaggregatable	Data may be aggregated and disaggregated into different levels (e.g. country vs. community)

4. Legal and societal context

In the European Union’s biodiversity and nature conservation policy they are two key legislative instruments: The Birds[34] and the Habitats[35] Directives. It is a common legislative framework for all the 27 European Member States. The broad objective of those Directives is to protect some of Europe’s most valuable species and habitats across their entire natural range within the EU, regardless political or administrative boundaries (EC, 2007 and 2010; ETC/NPB, 2003).

The Directives have two main objectives. The first one is to ‘protect species in their own right across the EU (through species protection provisions)’. And the second is to ‘conserve certain rare and endangered habitat types or the core habitats of certain rare and endangered species in order to ensure their continued survival (through site protection provisions leading to the establishment of the Natura 2000 Network)’ (EC, 2010).

An important fact is that the Natura 2000 Network is not designed like strict nature reserves and it does not exclude all human activities. Instead, the Directives ensure that activities are undertaken ‘in a way that does not adversely affect the integrity of Natura 2000 sites’ (EC, 2010).

The societal context is detailed in Annexe 1. During the period of 2002 and 2003 some very significant political commitments for biodiversity conservation were made. Firstly, in formal sessions of the CBD/COP, and after at the concluding sessions of the World Summit on Sustainable development in Johannesburg and at the meeting of European Ministers of Environment at the Pan-European Biological and Landscape Diversity in Kiev. These high-level delegations allowed commitments to halt or reduce the rate of biodiversity loss by 2010 and defined targets for reducing biodiversity loss (Mace & Baillie, 2007).

Since 2003, the movement for biodiversity is still accelerating and many bodies worked to promote and develop these 2010 biodiversity targets. Especially in Europe, targets have been discussed and there were concerted campaign to raise awareness and coordinate efforts to reduce biodiversity loss (Mace & Baillie, 2007)

As it became clear that the global 2010 target had not been met and biodiversity loss had been continuing, a new EU biodiversity strategy for 2020 was adopted by the European Commission in May 2011. This fallowed the results of the CBD/COP 10 (EEA, 2012).

This Strategy set out a long-term 2050 vision and the 2020 headline target (EC, 2011).

- **The 2050 vision:** ‘By 2050, European Union biodiversity and the ecosystem services it provides - its natural capital - are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided.’ (EC, 2011).

[34] Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds, (2009/147/EC). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:020:0007:0025:EN:PDF
[35] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, (92/43/EEC). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0043:EN:NOT

- **The 2020 headline target:** 'Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss.' (EC, 2011).

In the current climate of No net loss indicators are, more than ever, needed. They are really important in order to assess whether the progress are achieving these ambitious 2020 targets. (Mace & Baillie, 2007).

5. Indicator framework Development

5.1 Relevant frameworks at a National scale

A number of different systems for reporting environmental/biodiversity indicators exist. Several approaches/practises have been examined.

5.1.1 Environmental KPIs Frameworks

A wide variety of environmental indicators frameworks is presently in use. The following frameworks (compared in FORCE Technology, 2008) were analysed to highlight their potential utilization in our framework:

- **Benchmarking indicators used by investment research companies** (Annexe 2).
- **DEFRA**[36] Environmental KPIs (Annexe 3).
- **OECD**[37] Key Environmental Indicators (Annexe 4).
- The **EPER**[38], a framework of industrial emissions into air and water indicators. There are no biodiversity indicators relevant for our study.
- The **GRI**[39] (Annexe 5 and 6).

As a conclusion, only the GRI guidelines and indicators and the OECD framework are interesting and will be integrated in the study.

[36] The Department for Environment, Food and Rural Affairs
[37] Organisation for Economic Co-operation and Development
[38] The European Pollutant Emission Register
[39] The Global Reporting Initiative

5.1.2 Biodiversity indicators frameworks

Different systems for reporting biodiversity indicators have been analysed:

The CBD indicators

'The Conference of the Parties (COP) agreed on a provisional list of global headline indicators, to assess progress at the global level towards the 2010 target (decision VII/30), and to effectively communicate trends in biodiversity related to the three objectives of the Convention. In decision VIII/15, the COP distinguished between: indicators considered ready for immediate testing and use and indicators confirmed as requiring more work' (CBD, 2013). The list of indicators is presented in Annexe 7.

The SEBI 2010

The EEA[40] have already made a big step forward in the biodiversity indicators field. In 2004, they have already made an inventory of biodiversity indicators in Europe (EEA, 2004) that comprised not less than 31 frameworks of biodiversity indicators. They have listed 655 indicators (including duplicates). They have assessed different habitats in order to provide evidence of progress, or lack of progress, towards the 2010 target of halting the loss of biodiversity (EEA, 2006). They concluded that conceptual framework for indicators and their interpretation are essential for assessing progress (EEA, 2006). And finally, in 2007 they published a first set of indicators to monitor progress in Europe: the SEBI 2010 - Streamlining European 2010 Biodiversity Indicators (EEA, 2007).

'The SEBI 2010 was set up in response to a request from the EU Environment Council. Its aim was to streamline national, regional and global indicators and, crucially, to develop a simple and workable set of indicators to measure progress and help reach the 2010 target' (EEA, 2007b). It proposes 26 biodiversity indicators.

Moreover, the SEBI 2010 is explicitly linked to biodiversity policy contexts. At a European level, it responds to:

- The 'Message from Malahide' (Message from Malahide, 2004)
- The EU Council Conclusions of 28 June 2004 (Council of the European Union, 2004)
- The EU Habitats and Birds Directives (Official Journal of the European Union, 2013a and b)
- The EU Strategy for Sustainable Development (European Council, 2001)
- The Lisbon Agenda (European Commission, 2010a)
- the EU biodiversity strategy (CEC, 2006)

And at a Pan-European level it is consistent with:

- The Kiev Resolution on Biodiversity (United Nations, 2003)
- The UNECE[41] Environment for Europe process
- The Pan-European Biological and Landscape Diversity Strategy (PEBLDS).

[40] European Environment Agency
[41] United Nations Economic Commission for Europe

Finally, at a global scale, they are derived from the CBD indicators, adopted as part of CBD decision VII/30 in February 2004 (and updated by CBD decision VIII/15). SEBI 2010 works in conjunction with the 2010 BIP[42]. It implicated a lot of stakeholders like the UNEP-WCMC, the GEF[43]-funded project called 'BINU'[44] (which involves more than 40 partner organisations around the world).

The Annexe 8 presents the 26 SEBI 2010 indicators and highlights the biodiversity indicators that are relevant for our study.

The BIP guidance

In 2011, the BIP have established guidance for the development and the use of biodiversity indicators at a national level (BIP, 2011). This guidance detailed a methodology to follow in order to have a relevant framework at a national level (see Annexe 9). The methodology of this study is inspired from that Development Framework. We have adapted it to the time and budget available, the scale and the stakeholders involved.

5.1.3 Conclusions: Proposal for Eurogypsum

In this study, it is proposed to rely on the **SEBI 2010** framework, because that framework is:

- Really complete and include all aspects of biodiversity;
- Current, as it is developed in 2007 and have been revised in 2012 (EEA, 2012);
- Many stakeholders were involved, including the European Commission and UNEP;
- Responds to the legal and societal context of biodiversity at a European, pan European and global scale;
- It is part of the Communication on Halting the Loss of Biodiversity to 2010 and Beyond (COM(2006)216 final) (CEC, 2006).

The SEBI will be adapted at our scale, as it is conceived for a national level. As the **GRI** and the **OECD** framework presented relevant biodiversity, they will be added to the SEBI is they are not already part of it. The **CBD** indicators will be also be part of the framework. If other existing relevant frameworks are founded later in the study they will be added.

5.1.4 Adaptation of the SEBI 2010 and integration of the GRI, CBD and OECD indicators

Firstly, the GRI, the CBD and OECD biodiversity indicators were added to the SEBI 2010 framework and the SEBI's indicators that are not relevant for our study like 'the European commercial fish stocks' were removed (see Annexe 10).

[42] Biodiversity Indicators Partnership
[43] Global Environment Facility
[44] Biodiversity Indicators for National Use

After that, the framework obtained has been adapted to our scale and context. For this, we have decided to begin from the headline indicators of the SEBI and the indicators added. These general headline indicators form a complete set of indicators to report biodiversity. From those headline indicators, specific Eurogypsum indicators are proposed (see Section 6. Proposed framework and 'KPIs_Framework_Eurogypsum'). At the end, 38 specific Eurogysum indicators were obtained.

5.2 Frameworks already developed for mining activities

Some indicators frameworks developed for mining activities have been founded:

- Indicators for Environmental Monitoring in International Development Cooperation. From **SIDA**[45] (2002). (Annexe 11)
- Environmental performance indicators from **CETEM**[46] (2004). (Annexe 12)
- The **HeidelbergCement**'s own indicators for the representation of successful reconstruction Measures and for the measuring of biodiversity. Presented in (HeidelbergCement AG, 2010). (Annexe 13)
- **Cement International** biodiversity indicators presented by (Tränkle & *al*., 2008) and (HeidelbergCement Technology & *al*., 2008). (Annexe 14)
- The **Cement Sustainability Initiative** (CSI) KPIs, founded in (HeidelbergCement AG, 2010). (Annexe 15)

Those frameworks were analysed and the relevant indicators founded were added to our framework.

5.3 Analysis of the EIAs

At this theoretical framework, derived from the literature, it will be compared the different indicators already used in the EIA[47]'s in the Gypsum Industry. This comparison will highlight which are the indicators already used in the Gypsum Industry and what are the data already available.

Eleven EIAs have been received from quarries of different countries: France, Germany, Italy, Spain and UK (Table1). In those EIAs no 'indicators' or 'indices' are clearly defined. But different aspects of the environment (the fauna and flora, the soil, the aquatic system etc) are precisely determined. Because to assess the impacts on the environment, they have to precisely define the original state of the quarries. Consequently, some aspects of biodiversity are measured and can be considered as biodiversity indictors.

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[45] Swedish International Development Cooperation Agency
[46] Centro de Tecnologia Mineral Ministério da Ciência e Tecnologia
[47] Environmental Impact Assessment

Table 142 List of the eleven EIAs received and abbreviations associated

Abb	Country	Quarry's name
FrP	France	Le Pin et Villevaudé
FrMa		Mazan
FrC		Caresse
FrMo		Maurienne
FrS		Saint Soupplets
Ge	Germany	Lüthorst-Portenhagen
ItG	Italy	Cava di gesso di monte tondo
ItM		Masseria grossi
SpC	Spain	Cerro negro - Moron de la Frontera - Provincia de Sevilla
SpS		Soledad II
UK	UK	Banticock Mine (Nottinghamshire)

An analysis of all the EIAs of those quarries has been made to highlight the type of data that they provide. A complete analysis were made in an Excel document and summarized in the indicator framework obtained from the previous steps ('KPIs_Framework_Eurogypsum'). Some abbreviations used in this document are presented in Table 2.

Table 2 Abbreviations given to the species lists founded in the EIAs

Abb	Species
Bi	Birds
Bi-b	Breeding birds
M	Mammals
M-b	Bats
M-ba	Badgers and otters
M-v	Water voles
I	Insects
I-a	Aquatic Invertebrates
I-b	Butterflies (Lepidoptera)
I-d	Dragonflies (Odonata)
I-db	Dirunal Butterflies (Lepidoptera Rhopalocera)
I-g	Grasshoppers (Orthoptera)
R	Reptiles
A	Amphibians
F	Fishes
P	Plants
H	Habitats

6. Proposed framework

Here are the 38 specific Eurogyspum indicators obtained (for more details see 'KPIs_Framework_Eurogypsum').

- In **black**: basic indicators to monitor biodiversity
- In **green**: indicator that have to be discussed
- In **purple**: indicators that will probably be removed because they are not feasible

N	Focal area	Headline indicator	Eurogypsum specific indicator
1	**Status** and trends of the components of biological diversity	Trends in the abundance and distribution of **selected species**	Number of native species in selected taxonomic group
2			Abundance of selected species in the quarry (indicators species)
3		Change in status of threatened and/or protected species	Number of protected species in the quarry
4			Number of Red list species in the quarry
5			Abundance of protected/Red list species in the quarry
6		Trends in extent of selected biomes, **ecosystems and habitats**	Number of habitats in the quarry
7			Surface of selected habitats in the quarry
8		Trends in extent of **protected habitats**	Number of protected habitats in the quarry
9			Surface of protected habitats in the quarry
10	**Threats** to biodiversity	**Nitrogen** deposition	Critical load exceedance for nitrogen
11		Trends in **invasive** alien species	Numbers of invasive alien species in the quarry
12			Costs of invasive alien species in the quarry
13	**Ecosystem integrity** and ecosystem goods and services	**Connectivity**/fragmentation of ecosystems	Fragmentation of natural and semi-natural areas
14			Fragmentation of river systems
15		Health and well-being	Health and well-being of communities who depend directly on local ecosystem goods and services
16		Trophic integrity	Trophic integrity of ecosystems
17		Incidence of human-induced ecosystem failure	-
18		**Water quality** in aquatic ecosystems	Freshwater quality
19	**Sustainable use**	Area of forest ecosystems under **sustainable management**	Forest: growing stock, increment and felling
20			Forest: deadwood
21		Sustainable products	Proportion of products derived from sustainable sources
22		Ecological footprint	Ecological footprint and related concepts
23		Habitats **protected or restored**	Surface of habitats restored
25	**Impact oustide/ Indirect impacts**	Protected areas and areas of high biodiversity value	Is there adjacent protected areas or areas of high biodiversity value outside the quarry
27		Indirect threat: threats due to activity on the off-site habitats	Is there an impact due to noise on animal disturbance outside the quarry
28			Is there an impact due to lighting on animals outside the quarry
29			Is there an impact due to dust emission on animals or on habitats outside the quarry
30			Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry

31	Status of **traditional knowledge**, innovations and Practices	Other indicator of the status of indigenous and traditional knowledge	-
32	Status of access and benefit-sharing	Indicator of access and benefit-sharing	Number of visitors in the quarry within a period cf (CBD & UNEP, 2004)
33	**Means implemented** for biodiversity	Management	% of quarry with a BDAP
34			% of quarry with a BMS
35			% of quarry with that calculate biodiversity indicators
36			% of quarry with a strategy and policy for biodiversity
37	Status of **resource** transfers	**Funding** to biodiversity	Financing biodiversity management
38	**Public opinion**	**Public awareness** and participation	Number of careers that implement communication and participation actions

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19. AGENDA FOCUS GROUP FOR STEP 2.2 : QUARRY WG MEETING OF THE 17TH OF APRIL 2013

For this day some documents will be provide:

- **An executive summary**: a summary of the objectives and methodology of the thesis and of the glossary.
- **A list of potential experts and stakeholders and their contacts.**
- **The first indicator framework:** will be given the 16 of April 2013**.**

Validation of the key concepts and the objectives

➢ ***Validation of key concepts - glossary***

Document[48]: Glossary.
Presentation[49]: Brief presentation of the glossary and the important terms.
Interaction[50]: Structured questions.

➢ ***Validation of the objectives of the thesis***

Document: Objectives and method of the master thesis: Methodology and objectives.
Presentation: Brief presentation of the methodology and participatory processes implicated.
Interaction: Structured questions.

Validation of the values, motivations of the company

Document: Objectives and method of the master thesis: Indicator context.
Presentation: Brief presentation of the indicator context and why a validation is needed.
Interaction: Structured questions with proposals to help the debate.

Presentation of the first indicators framework

Presentation: Presentation of the first indicators framework and the content that will be given the 16 of April.
Interaction: First discussion about this framework.

Preparation of Task 2

Document: List of potential experts and contacts
Presentation: Brief remind about Task 2 and what is needed
Interaction: Identify a panel of internal and external experts

- **Proposition of Quarry WG for internal or external experts?**
- Proposition of a list of external experts
- Check the contact addresses of the panel of experts

[48] Document on which the discussion will be based
[49] PowerPoint presentation by Carline
[50] Period during which we are going to discuss

Presentation of Task 1

There are lots of misunderstandings possible. So, this is important to develop the KPIs framework with the agreement of the Quarry WG to have a really usable tool. A Task that allows the validation by stakeholders of the key concepts is essential.

The **first target** is to make sure that everyone agreed on the concepts that form the basis of the thesis. The concepts approached will concern all the terms that may have some different meaning or are particular from ecological domain (from the glossary).

The **second target** is to identify the values, motivations of the company and to validate the objectives of the thesis by stakeholders. A key to build a relevant framework of indicators is to define clearly the motivations and the values in term of biodiversity of the company for whose those indicators are created. Task 1 is the first step of a participatory process.

It will integrate the views of those directly affected by the implementation of this study: the Quarry WG. It has been decided to restrict the action to this group because the first motivation is to answer their request in being proactive to define a biodiversity indicator framework. This Task will take place in one day. The method chosen for this phase is the Focus Group (Solcum, 2003).

This method implies the presence of **moderators** who will ensure an equal representation from all members during the discussion and the interactivity of everyone. They will help to facilitate the debate.

What is a Focus Group?

'A Focus Group is a planned discussion amongst a small group (4-12 persons) of stakeholders facilitated by a skilled moderator. It is designed to obtain information about (various) people's preferences and values pertaining to a defined topic and why these are held by observing the structured discussion of an interactive group in a permissive, non-threatening environment. Thus, a Focus Group can be seen as a combination between a focused interview and a discussion group. Focus Groups can also be conducted online.' (Slocum, 2003).

How implement that in our case?

- **Interaction**: I'll ask opened questions about the subject to the Quarry WG to structure the discussion and to be sure we are meeting the objectives of this task. Sometimes some possible answers will be providing to help the discussion. These answers will be obtained on the basis of what has already been said on the 19 of November.
- **Presentations**: To be sure that everyone has the key to answer the questions some presentations about the subject addressed will be made. It is to be sure that everything is fresh in mind.
- **Moderators** will be: Christine Marlet, Pr Mahy and me.

Role of Christine Marlet as a moderator

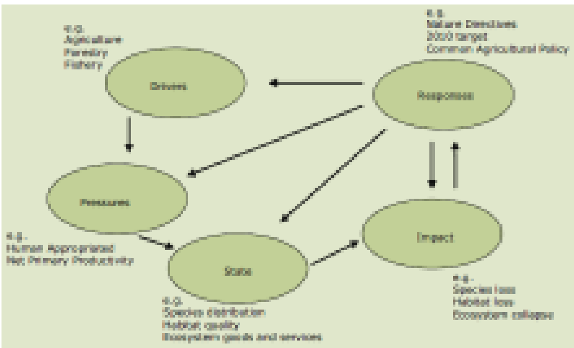
Chrsitine Marlet will help us to facilitate the debate. She will ensure that all the opinions are expressed. She will then ensure that everyone have spoken during the Focus Group. If several people want to talk at the same time she will give a talk time for each person.

20. PRESENTATION OF THE QUESTIONNAIRE GIVEN TO THE QUARRY WG DURING THE FOCUS GROUP TO IMPROVE OUR KNOWLEDGE ON MOTIVATION AND GOALS OF EUROGYPSUM FOR HAVING A BIODIVERSITY KPIS FRAMEWORK

What is the importance of those proposed questions: Low – Medium – High?

	Key questions	L	M	H
S	24. What is the state of biodiversity of our focal ecosystems?			
S	25. What is the state of biodiversity in the pit in regards with the outside?			
P	26. What are the main factors causing pressures on biodiversity in the quarry?			
S	27. Do we have a No Net Loss or not with an exploitation?			
R	28. How to improve biodiversity at different stages of the exploitation?			
P	29. Which are the factors that influence biodiversity in the quarries?			
D	30. Has climate change an impact on biodiversity in our quarries?			
R	31. Are the restorations after exploitations influencing biodiversity in our quarries?			
S	32. How is doing biodiversity in our quarries?			
R	33. How to change our activities to improve biodiversity?			
I	34. With an exploitation do we improve or not biodiversity?			
I	35. Is biodiversity better after or before exploitation?			
R	36. Are we doing good actions for biodiversity?			
R	37. How many hectares of land have been preserved?			
R	38. Which activities have been undertaken to enhance biodiversity at the production sites?			
R	39. How many EIAs have been carried out prior to undertaking new or extended activities?			
S	40. What has happened to the populations of keystones species in our area?			
R	41. Which stakeholders have been involved and how often have dialogues taken place?			
I	42. Does the exploitation have impacts on biodiversity outside the quarry?			
I	43. Does our activity have an impact on the water system includes outside the quarry? And on the biodiversity related?			
I	44. Does our activity have an impact on the connectivity of the habitats outside the quarry in the landscape			
I	45. Does our activity promote invasive species?			
I	46. Is there more invasive species in the quarries or outside?			

The DPSIR framework may help you (definitions in the 'Glossary_version_2').



21. PRESENTATION OF THE EXECUTIVE SUMMARY OF THE METHOD OF THE STUDY FOR STEP 2.2

EXECUTIVE SUMMARY – OBJECTIVES AND METHODOLOGY

Corresponding: Tel.: +32 478436880 (C. Pitz).
E-mail address: carline.pitz@gmail.com (C. Pitz),
g.mahy@ulg.ac.be (Pr G. Mahy).

Target of the study

- To establish a KPI[51]s framework to monitor biodiversity performance in European Gypsum Industry.
- It has to be usable for gypsum industrials across the different environments in Europe.
- It should answer to European legislation and strategies for biodiversity.

The study will present the different scenarios of KPIs framework according to the different opinions that emerge from the analysis. A consensus framework will be built in order to maximise both scientific rigor and feasibility of implementation.

Expected results

The outputs of the study will be:

- **A report** to the destination of Gypsum Industry and decision-makers. This report will include:
    1. Biodiversity and Eurogypsum context;
    2. Legal and societal context;
    3. An explanation of the meaning of 'indicators' and its signification in the context of the study;
    4. The different scenarios elaborated during the participatory process;
    5. A consensus biodiversity KPIs framework;
    6. A glossary of terms;
    7. Additional folders to explain how to use the indicators framework, and how to use the indicators on the field in a conveniently way.
- A document written as **a scientific article** to expose to the scientific community the methodology used to develop the biodiversity indicator framework.

Methodology

The method has been improved to reflect recent discussions and integrate some comments received from the European Commission, Christine Marlet and Mr. Chevalier.

[51] Key Performance Indicator

1. Introduction to the subject

- **Literature review**
  - *First version of the iterative glossary*
  - *Literature about indicators and biodiversity*
  - *Existing methods of participatory processes*
  - *Legislation context*
  - *Gypsum context*

- **Establishment of the objectives and the methodology of the thesis**

- **Establishment of a contact network and definition of an Audience**
  - First contacts with the **Audience** through 'The objectives and the methodology'

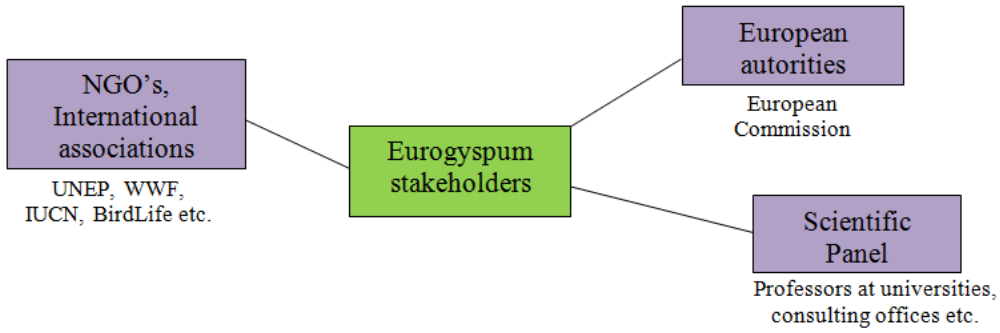
- **Identification of a first framework of indicators**

Meeting of the 17th of April with the Quarry WG

Validation of the key concepts and the values, motivations of the company
Presentation of the first framework

2. Validation of the framework, feasibility and relative importance of indicators

- Survey by mail
- Implicated: Eurogypsum stakeholders and the **Audience** that will bring much societal and scientific credibility to the framework



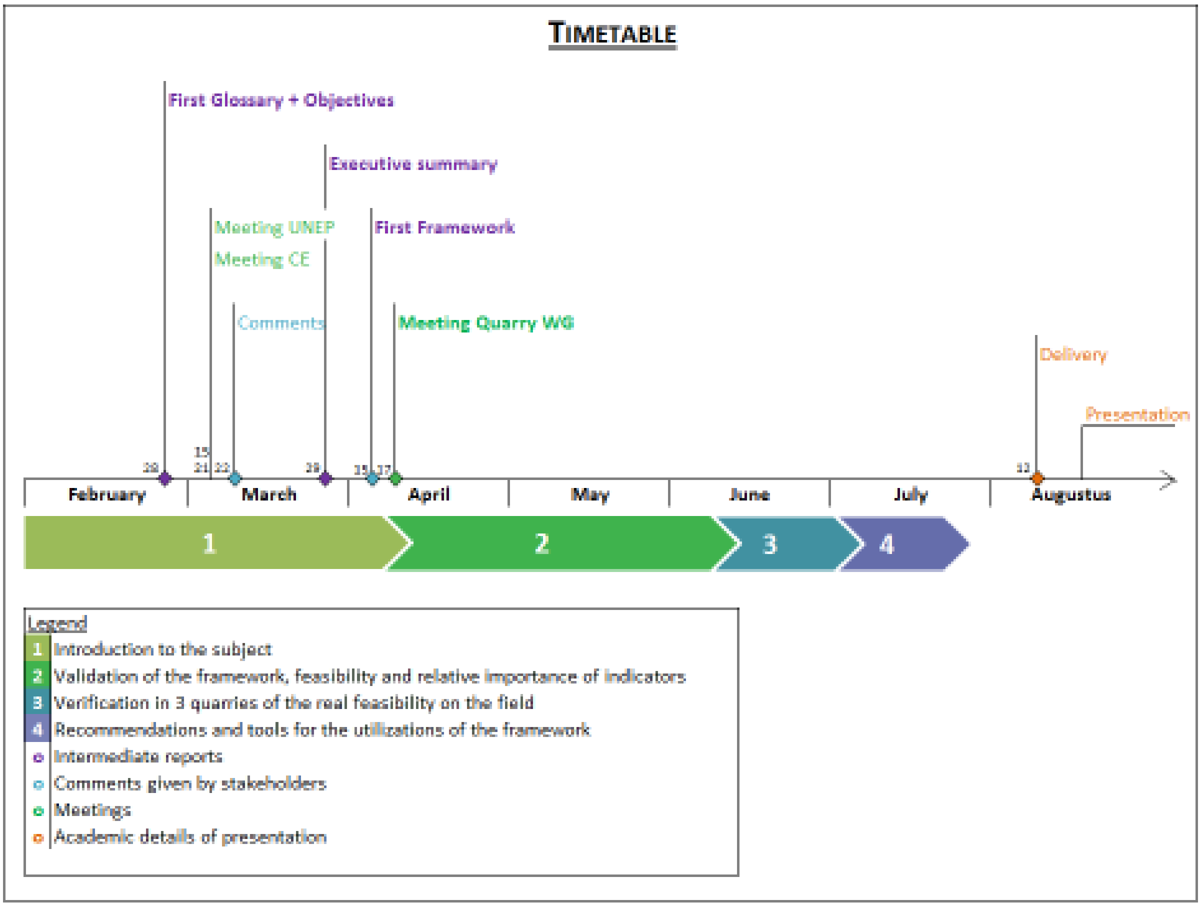
Different frameworks possible given the opinions of stakeholders and the Audience

3. Verification in 3 quarries of the real feasibility on the field of the frameworks obtained compared to the local context : biogeographic regions and users

- **France, Spain, Germany**

One feasible and usable framework
validated by field stakeholders, the Audience, and Eurogypsum

4. Writing of the folders and recommendations for the use of the framework


TIMETABLE
First Glossary + Objectives
Executive summary
Meeting UNEP
Meeting CE
First Framework
Comments
Meeting Quarry WG
Delivery
Presentation
February
March
April
May
June
July
Augustus
1
2
3
4
Legend
1 Introduction to the subject
2 Validation of the framework, feasibility and relative importance of indicators
3 Verification in 3 quarries of the real feasibility on the field
4 Recommendations and tools for the utilizations of the framework
Intermediate reports
Comments given by stakeholders
Meetings
Academic details of presentation

22. PRESENTATION OF THE QUESTIONS OF THE ONLINE SURVEY FOR STEP 3.1

Your name and the institution to which you belong are requisite to contact you if we **have any questions** about the survey and to correctly **analyse the results**.

Those names will be **completely anonymous**. The results of the study will show the different scenarios possible according to the different views of institution's groups. The opinions expressed in the future report will reflect those of the authors and will not represent those of any of the contributors, reviewers or organisations supporting this work.

1) Do you agree with the fallowing indicators? If not, please explain. Give it a level of relative importance and feasibility on a scale of 'low, medium or high'.

    1. Number of native species in selected taxonomic group

o Yes o No Why? 'Empty box'	Importance o Low o Medium o High	Feasibility o Low o Medium o High

    2. Abundance of selected species in the quarry (indicators species)
    3. Number of protected species in the quarry
    4. Number of Red list species in the quarry
    5. Abundance of protected/Red list species in the quarry
    6. Number of habitats in the quarry
    7. Surface of selected habitats in the quarry
    8. Number of protected habitats in the quarry
    9. Surface of protected habitats in the quarry
    10. Is there adjacent protected areas or areas of high biodiversity value outside the quarry
    11. Is there an impact due to noise on animal disturbance outside the quarry
    12. Is there an impact due to lighting on animals outside the quarry
    13. Is there an impact due to dust emission on animals or on habitats outside the quarry
    14. Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry
    15. Numbers of invasive alien species in the quarry
    16. Fragmentation of natural and semi-natural areas
    17. Fragmentation of river systems
    18. Trophic integrity of ecosystems
    19. Freshwater quality
    20. Forest: growing stock, increment and felling
    21. Surface of habitats restored
    22. Percentage of quarry that calculate biodiversity indicators
    23. Percentage of quarry that implement communication and participation actions

2) Do you have any idea of other potential relevant indicators?
    - 'Empty box'
3) Do you have any comments on some indicators?
    - 'Empty box'

4) Do you have any comments about the importance or feasibility of indicators?
   - ‘Empty box’

5) Please reclassify these classes of indicators according to their relative importance:
   (1 most important, 7 less important)

   - ☐ Status and trends of the components of biological diversity
   - ☐ Impact outside/ Indirect impacts
   - ☐ Threats to biodiversity
   - ☐ Ecosystem integrity and ecosystem goods and services
   - ☐ Sustainable use
   - ☐ Means implemented for biodiversity
   - ☐ Public opinion

6) Please choose the most important indicator of each class:

   - Status and trends of the components of biological diversity
     - Number of native species in selected taxonomic group
     - Abundance of selected species in the quarry (indicators species)
     - Number of protected species in the quarry
     - Number of Red list species in the quarry
     - Abundance of protected/Red list species in the quarry
     - Number of habitats in the quarry
     - Surface of selected habitats in the quarry
     - Number of protected habitats in the quarry
     - Surface of protected habitats in the quarry
   - Impact outside/ Indirect impacts
     - Is there adjacent protected areas or areas of high biodiversity value outside the quarry
     - Is there an impact due to noise on animal disturbance outside the quarry
     - Is there an impact due to lighting on animals outside the quarry
     - Is there an impact due to dust emission on animals or on habitats outside the quarry
     - Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry
   - Ecosystem integrity and ecosystem goods and services
     - Fragmentation of natural and semi-natural areas
     - Fragmentation of river systems
     - 'Trophic integrity of ecosystems
     - Freshwater quality
   - Sustainable use
     - Forest: growing stock, increment and felling
     - Surface of habitats restored

7) Choose the 6 most important indicators for biodiversity within all the 23 indicators:

- Number of native species in selected taxonomic group
- Abundance of selected species in the quarry (indicators species)
- Number of protected species in the quarry
- Number of Red list species in the quarry
- Abundance of protected/Red list species in the quarry
- Number of habitats in the quarry
- Surface of selected habitats in the quarry
- Number of protected habitats in the quarry
- Surface of protected habitats in the quarry
- Is there adjacent protected areas or areas of high biodiversity value outside the quarry
- Is there an impact due to noise on animal disturbance outside the quarry
- Is there an impact due to lighting on animals outside the quarry
- Is there an impact due to dust emission on animals or on habitats outside the quarry
- Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry
- Numbers of invasive alien species in the quarry
- Fragmentation of natural and semi-natural areas
- Fragmentation of river systems
- Trophic integrity of ecosystems
- Freshwater quality
- Forest: growing stock, increment and felling
- Surface of habitats restored
- Percentage of quarry that calculate biodiversity indicators
- Percentage of quarry that implement communication and participation actions

8) In the fallowing group of two classes choose always the one that is the most important?

- Status and trends of the components of biological diversity, in the quarry
- Impact oustide/ Indirect impacts

- Status and trends of the components of biological diversity, in the quarry
- Threats to biodiversity

- Status and trends of the components of biological diversity, in the quarry
- Ecosystem integrity and ecosystem goods and services

- Status and trends of the components of biological diversity, in the quarry
- Sustainable use

- Status and trends of the components of biological diversity, in the quarry
- Means implemented for biodiversity

- Status and trends of the components of biological diversity, in the quarry
- Public opinion

- Impact oustide/ Indirect impacts
- Threats to biodiversity

- Impact oustide/ Indirect impacts
- Ecosystem integrity and ecosystem goods and services

- Impact oustide/ Indirect impacts
- Sustainable use

- Impact oustide/ Indirect impacts
- Means implemented for biodiversity

- Impact oustide/ Indirect impacts
- Public opinion

- Threats to biodiversity
- Ecosystem integrity and ecosystem goods and services

- Threats to biodiversity
- Sustainable use

- Threats to biodiversity
- Means implemented for biodiversity

- Threats to biodiversity
- Public opinion

- Ecosystem integrity and ecosystem goods and services
- Sustainable use

- Ecosystem integrity and ecosystem goods and services
- Means implemented for biodiversity

- Ecosystem integrity and ecosystem goods and services
- Public opinion

- Sustainable use
- Means implemented for biodiversity

- Sustainable use
- Public opinion

- Means implemented for biodiversity
- Public opinion

9) How would you rate your level of expertise to respond to this questionnaire?

   - Low
   - Medium
   - High

10) Do you have any comments about this questionnaire?
   - 'Empty box'

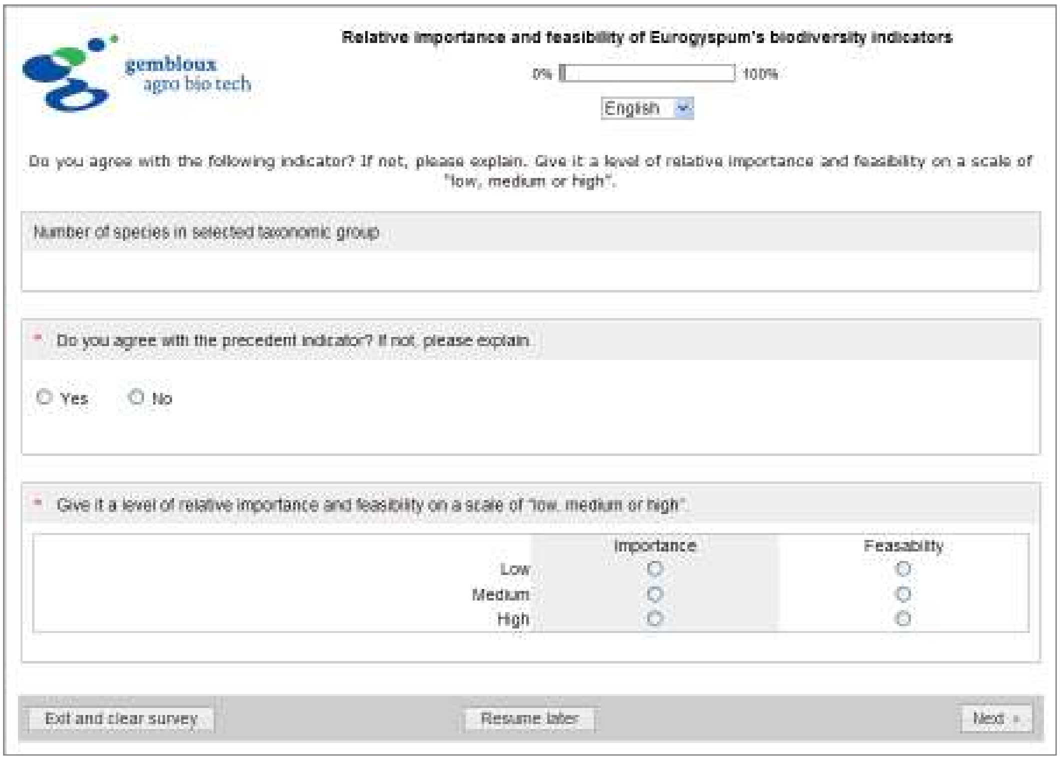
11) Do you have anything to add or to say about this framework?
   - Empty box'

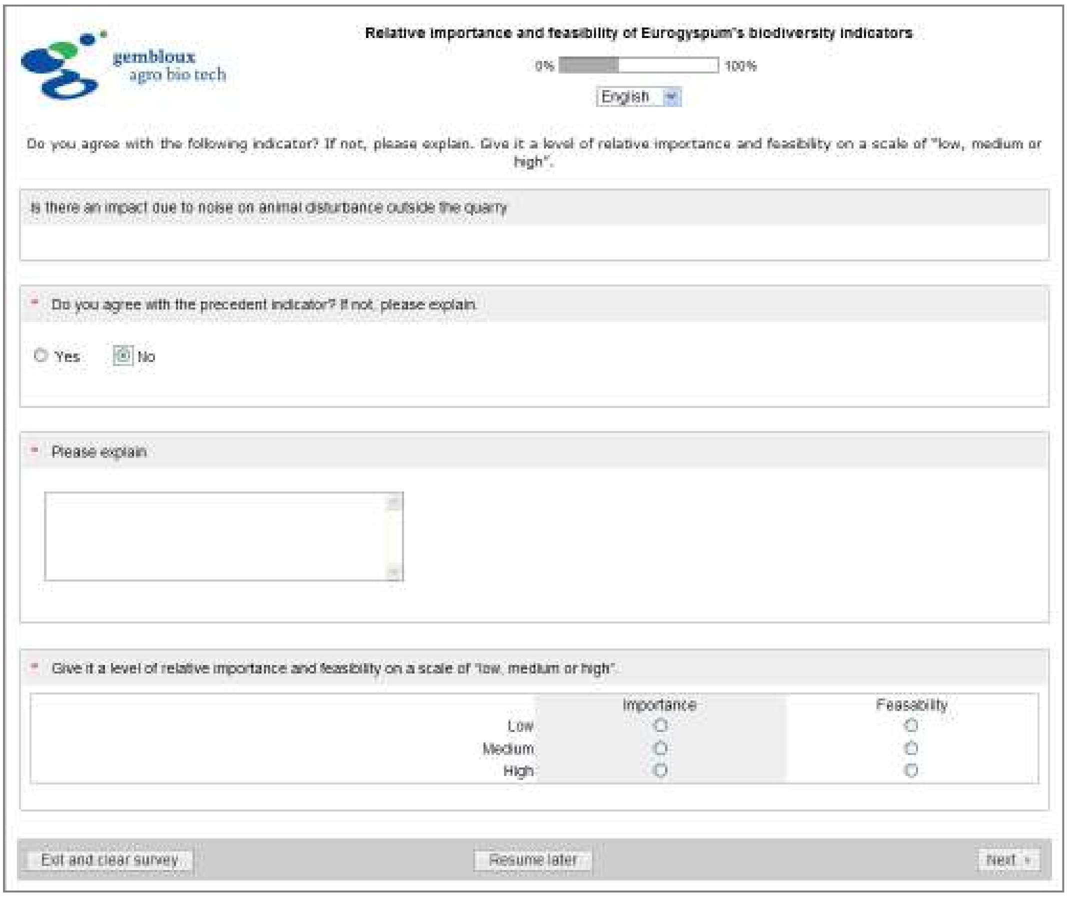
12) Do you have any comments or questions on the framework development that is presented in the document 'Eurogypsum Framework development'?
   - Empty box'

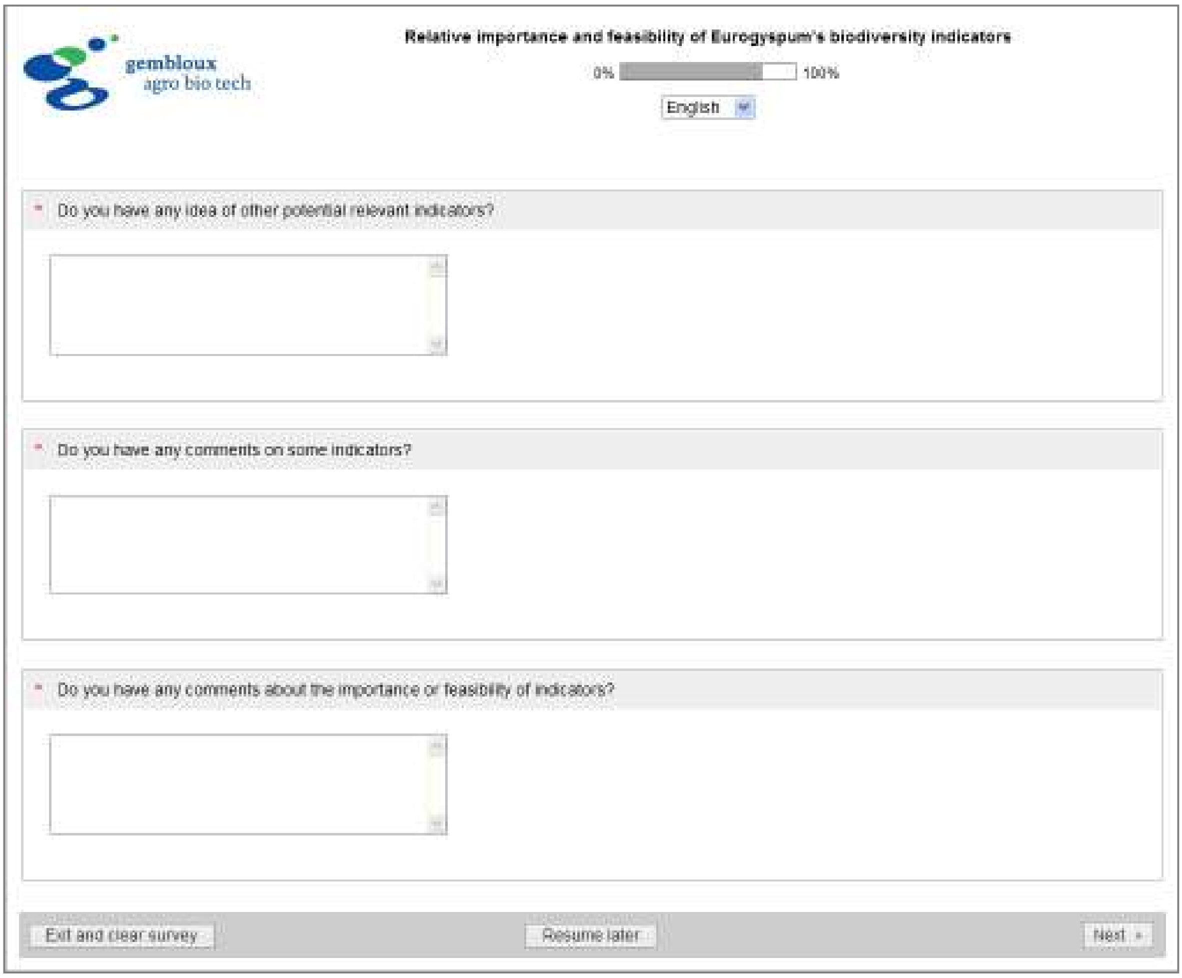
Thank you very much for responding to the survey. Hoping it will be a good step for conservation of biodiversity.

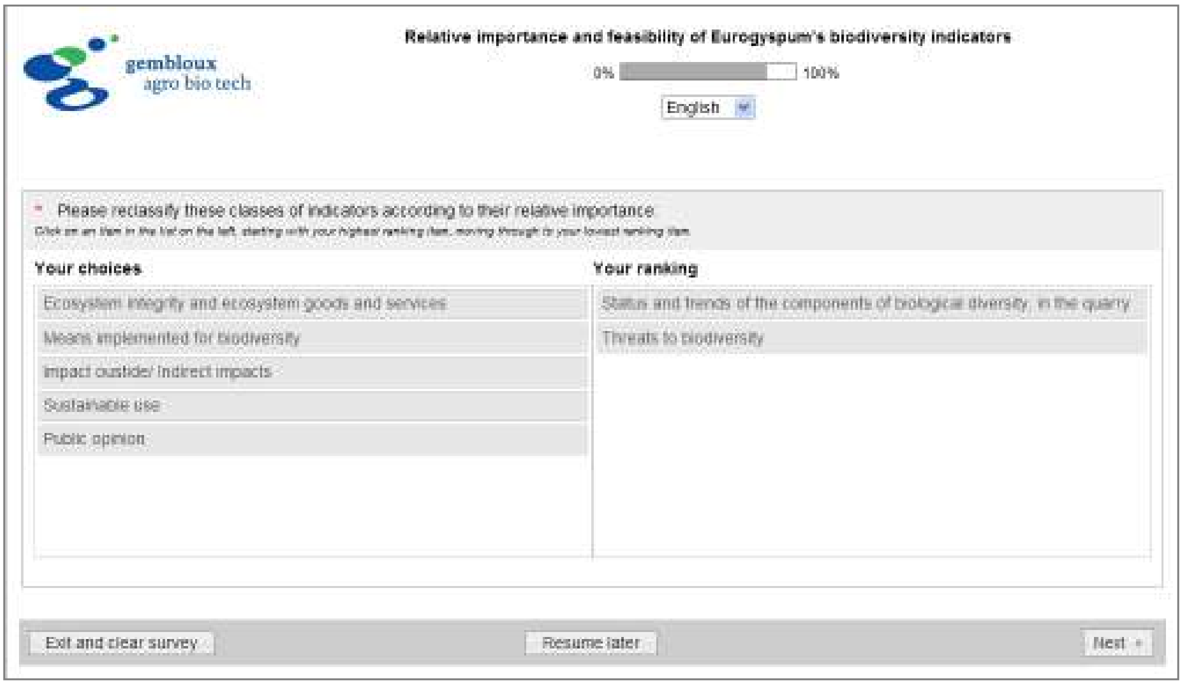
Feedbacks (in the future report): **5th of September 2013**.

23. PRESENTATION OF ONE EXAMPLE OF THE INTERACTIVE INTERFACE OF THE ONLINE SURVEY (STEP 3.1)






gembloux
agro bio tech
Relative importance and feasibility of Eurogyspum's biodiversity indicators
0%
100%
English
* Do you have any idea of other potential relevant indicators?
* Do you have any comments on some indicators?
* Do you have any comments about the importance or feasibility of indicators?
Exit and clear survey
Resume later
Next »


gembloux
agro bio tech
Relative importance and feasibility of Eurogyspum's biodiversity indicators
0%
100%
English
* Please reclassify these classes of indicators according to their relative importance
Click on an item in the list on the left, starting with your highest ranking item, moving through to your lowest ranking item.
Your choices
Ecosystem integrity and ecosystem goods and services
Means implemented for biodiversity
Impact outside/ indirect impacts
Sustainable use
Public opinion
Your ranking
Status and trends of the components of biological diversity, in the quarry
Threats to biodiversity
Exit and clear survey
Resume later
Next »

gembloux agro bio tech

Relative importance and feasibility of Eurogyspum's biodiversity indicators

0% 100%

English

Please choose the most important indicator of each class

* Status and trends of the components of biological diversity, in the quarry
Choose one of the following answers

- ○ Number of species in selected taxonomic group
- ○ Abundance of selected species in the quarry (indicators species)
- ○ Number of protected species in the quarry
- ○ Number of red list species in the quarry
- ○ Abundance of protected/red list species in the quarry
- ○ Number of habitats in the quarry
- ○ Surface of habitats in the quarry
- ○ Number of protected habitats in the quarry
- ○ Surface of protected habitats in the quarry

* Impact oustide/ indirect impacts
Choose one of the following answers

- ○ Size of land owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside the quarry
- ○ Is there an impact due to noise on animal disturbance outside the quarry
- ○ Impact due to lighting on animals outside the quarry
- ○ Impact due to dust emission on animals or on habitats outside the quarry
- ○ Impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry

* Ecosystem integrity and ecosystem goods and services
Choose one of the following answers

- ○ Fragmentation of natural and semi-natural areas
- ○ Fragmentation of river systems
- ○ Trophic integrity of ecosystems
- ○ Freshwater quality

gembloux agro bio tech

Relative importance and feasibility of Eurogyspum's biodiversity indicators

0% 100%

English

In the following group of two classes choose always the one that is the most important?

*
Choose one of the following answers

- Status and trends of the components of biological diversity, in the quarry
- Impact oustide/ indirect impacts

*
Choose one of the following answers

- Status and trends of the components of biological diversity, in the quarry
- Threats to biodiversity

*
Choose one of the following answers

- Status and trends of the components of biological diversity, in the quarry
- Ecosystem integrity and ecosystem goods and services

*
Choose one of the following answers

- Status and trends of the components of biological diversity, in the quarry
- Sustainable use

gembloux agro bio tech

Relative importance and feasibility of Eurogyspum's biodiversity indicators

0% 100%

English

* How would you rate your level of expertise to respond to this questionnaire?

Choose one of the following answers

- ○ Low
- ○ Medium
- ○ High

Do you have any comments about this questionnaire?

Do you have anything to add or to say about this framework?

Do you have any comments or questions on the framework development that is presented in the document "Eurogypsum Framework development"?

Thank you very much for responding to the survey. Hoping it will be a good step to promote biodiversity.

Feedbacks (in the future report): 5th of September 2013.

Relative importance and feasibility of Eurogyspum's biodiversity indicators

0% 100%

English

* Choose the 6 most important indicators for biodiversity within all the 23 indicators

Please select 6 answers

- ☐ Number of species in selected taxonomic group
- ☐ Abundance of selected species in the quarry (indicators species)
- ☐ Number of protected species in the quarry
- ☐ Number of red list species in the quarry
- ☐ Abundance of protected/red list species in the quarry
- ☐ Number of habitats in the quarry
- ☐ Surface of habitats in the quarry
- ☐ Number of protected habitats in the quarry
- ☐ Surface of protected habitats in the quarry
- ☐ Size of land owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside the quarry
- ☐ Is there an impact due to noise on animal disturbance outside the quarry
- ☐ Impact due to lighting on animals outside the quarry
- ☐ Impact due to dust emission on animals or on habitats outside the quarry
- ☐ Impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry
- ☐ Numbers of invasive alien species in the quarry
- ☐ Fragmentation of natural and semi-natural areas
- ☐ Fragmentation of river systems
- ☐ Trophic integrity of ecosystems
- ☐ Freshwater quality
- ☐ Forest: growing stock, increment and felling
- ☐ Surface of habitats protected or restored
- ☐ Percentage of quarry that calculate biodiversity indicators
- ☐ Percentage of quarry that implement communication and participation actions

Exit and clear survey | Resume later | Next »

24. PRESENTATION OF THE OTHER DIFFERENT SCALES OF THE AHP METHOD EXISTING IN THE LITERATURE, DIRECTLY FROM (GOEPEL, 2013C)

Intensities x, with $x = 1$ to 9 (integer) are transformed into c using following relations:

1- Linear $c = x$

2- Logarithmic $c = \log_2(x+1)$

3- Root square $c = \sqrt{x}$

4- Inverse linear $c = 9/(10-x)$

5- Balanced $c = w/(1-w); \quad w = \{0.5, 0.55, 0.6, \ldots, 0.9\}$

$$c = \frac{0.45 + 0.05x}{1-(0.45+0.05x)}$$

6- Power $c = x^2$

7- Geometric $c = 2^{x-1}$

c is then used as element in the pair-wise comparison matrix.

25. PRESENTATION OF THE EQUATIONS USED IN THE TEMPLATE OF GOEPEL (2013A), FROM (GOEPEL, 2013C)

Priorities derivation

Equations of the row geometric mean method (RGMM) used in Goepel (2013a): calculation of $r_{i:}$

$$r_i = \exp\left[\frac{1}{N}\sum_{j=1}^{N}\ln(a_{ij})\right] = (\prod_{i=1}^{N} a_{ij})^{1/N}$$

Equations of the row geometric mean method (RGMM) used in Goepel (2013a): normalization:

$$p_i = \frac{r_{i.}}{\sum_{i=1}^{N} r_i}$$

Where: The pair-wise N x N comparison matrix $A = a_i$

Consistency

Consistency index (CI) developed by Saaty (1997)

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

Consistency ratio (CR) developed by Saaty (1997)

$$CR = \frac{CI}{RI}$$

Where:

- λ_{max} : maximal eigenvalue
- RI: the random index (the average CI of 500 randomly filled matrices). Saaty (1977) defined the RIs as:

n	1	2	3	4	5	6	7	8	9	10
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49
CGI			0.31	0.35	0.37	0.37	0.37	0.37	0.37	0.37

The Goepel (2013a) template use the Alonson/Lamata[52] linear fit resulting in CR:

$$CR = \frac{\lambda_{max} - n}{2.7699\, n - 4.3513 - n}$$

And the Geometric consistency index (GCI) is given by:

$$GCI = \frac{2\ \sum_{i<j} \ln a_{ij} - \ln \frac{p_i}{p_j}}{(n-1)(n-2)}$$

Aggregation of individual judgments

Calculation of the elements of the consolidated matrix, by Goepel (2013a)

$$c_{ij} = exp\ \frac{\sum_{k=1}^{N} w_k ln\ a_{ij(k)}}{\sum_{k=1}^{N} w_k}$$

[52] Alonso, Lamata, 2006. Consistency in the analytic hierarchy process: a new approach. *International Journal of Uncertainty, Fuzziness and Knowledge based systems*, **14**(4), 445-459.

26. AGENDA OF THE VISIT OF THE FIRST CASE STUDY (STEP 3.3): SITE OF CARESSE (FRANCE), MEETING OF THE 30TH OF MAY 2013

Ordre du jour de la réunion Eurogypsum du 30 mai 2013

Mise en œuvre d'un cadre d'indicateurs de biodiversité pour les carrières de gypse européennes : mission d'évaluation sur le site de Caresse

Personnes prévues :

Personne	Société	Fonction
Philippe Chevalier	SINIAT International	Gypsum Ressources Director
Marc Thauront	Ecosphère	Directeur général
Carline Pitz	ULg – GxABT	Etudiante Master 2

M. Chevallier n'arrivant que vers 9:30 – 10:00, la réunion démarrera par une présentation générale de l'exploitation par les responsables du site.

09:00 - 10:00 : Présentation générale de l'exploitation.

Introduction (0,5 h)

10:00 - 10:30

- Présentation générale d'Eurogypsum et de son action sur la biodiversité, attentes d'Eurogypsum (Philippe Chevalier)
- Présentation générale du travail de master 2 et de ses objectifs (Carline Pitz)
- Introduction générale sur la biodiversité

Présentation du projet (0,5 h)

- 10:30 - 10:50 : Présentation du cadre général
- 10:50 - 11:00 : Discussion
- 11:00 - 11:20 : Présentation du tableau des indicateurs
- 11:20 - 12:30 : Tour de table et débat

12:30 - 14:00 Repas

14:00 - 15:00 Faisabilité du projet sur le site de Caresse

- Etat des connaissances et enjeux identifiés concernant la biodiversité de Caresse
- Capacités d'expertises internes ou externes, besoin de formation
- Pas de temps nécessaire pour mettre en place le cadre d'indicateurs
- Usage locale du cadre d'indicateurs : communication locale (publics, administrations, associations), communication au sein du groupe

15:00 - 16:30 Visite « biodiversité » de la carrière et de ses abords

16:30 - 17:00 Conclusions et étapes suivantes

27. AGENDA OF THE VISIT OF THE SECOND CASE STUDY (STEP 3.3): SITE OF GELSA (SPAIN), MEETING OF THE 5TH OF JUNE 2013

Agenda of the Eurogypsum Meeting of the 5th of June 2013

Implementation of a framework of biodiversity indicators for European gypsum quarries: assessment mission on the site of Gelsa

Attendees provided:

Name	Company	Function
Eva-Lian Lay Gayo	Saint-Gobain Gypsum Activity	Mining Engineer Mineral Resources Department Gypsum Activity
RICARDO CASTELLÓ MONTORI	Polytechnical University of Madrid	Professor
ANA ISABEL G. SAN CRISTÓBAL	Polytechnical University of Madrid	PhD
Carline Pitz	GxABT, ULg	Master 2 student

Introduction (0,5 h)

11:00-11:30

- Overview of Eurogypsum and action on biodiversity, Eurogypsum expectations (Person who is aware of the project in the quarry)
- Presentation of the work of Master 2 and objectives (Carline Pitz)
- General introduction to biodiversity
- General presentation of the quarry (Person who know well the quarry)

Presentation of the project (1,5 h)

- 11:30 – 11:50 : Presentation of the general context of the indicators
- 11:50 – 12:00 : Discussion
- 12:00 – 12:30 : Presentation of the indicators
- 12:30 – 13:00 : Round table and discussion

13:00 – 14:00 Dinner

14:00 – 15:00 Visit of the quarry (biodiversity, running and productivity)

15:00 – 17:00 Feasibility of the project on the Gelsa site

- State of knowledge and issues identified for biodiversity in the quarry
- Capacity of internal and external expertise, training needs
- Time needed to set up the framework of indicators
- Local context for the indicators use: local communication (public, government, associations), communication within the group

17:30 – 18:00 Conclusions and following steps

28. AGENDA OF THE VISIT OF THE THIRD CASE STUDY (STEP 3.3): SITE OF MARKT-NORDHEIM (GERMANY), MEETING OF THE 10TH AND 11TH OF JUNE 2013

Agenda of the Eurogypsum Meeting of the 10th and 11th of June 2013

Implementation of a framework of biodiversity indicators for European gypsum quarries: assessment mission on the Markt-Nordheim site.

10/06/2013: Discussion on Company Issues

Attendees:

Name	Company	Function
Hans-Jörg Kersten	Knauf	Technical Advisor environment
Matthias Reimann	BV Gips	Director mineral resources Knauf worldwide
Carline Pitz	Gembloux Agro-Bio-Tech, ULg	Master 2 student

Introduction at Iphofen Office (0,75 h)

10:15 - 11:00

- Overview of Eurogypsum and action on biodiversity, Eurogypsum expectations (Person who is aware of the project in the quarry)
- Presentation of the work of Master 2 and objectives (Carline Pitz)
- General introduction to biodiversity
- General presentation of the quarry (Person who know well the quarry)

Presentation of the project (1,5 h)

- 11:00 – 11:20 : Presentation of the general context of the indicators
- 11:20 – 11:30 : Discussion
- 11:30 – 12:00 : Presentation of the indicators
- 12:00 – 12:30 : Round table and discussion

12:30 – 14:00 Dinner

14:00 – 15:00 Feasibility of the project on the Markt-Nordheim site

- State of knowledge and issues identified for biodiversity in the quarry
- Capacity of internal and external expertise, training needs
- Time needed to set up the framework of indicators
- Local context for the indicators use: local communication (public, government, associations), communication within the group

15:00 – 17:00 Visit of the plaster production

17:00 – 17:30 Conclusions and following steps

11/06/2013: Discussion with the biodiversity expert

Attendees:

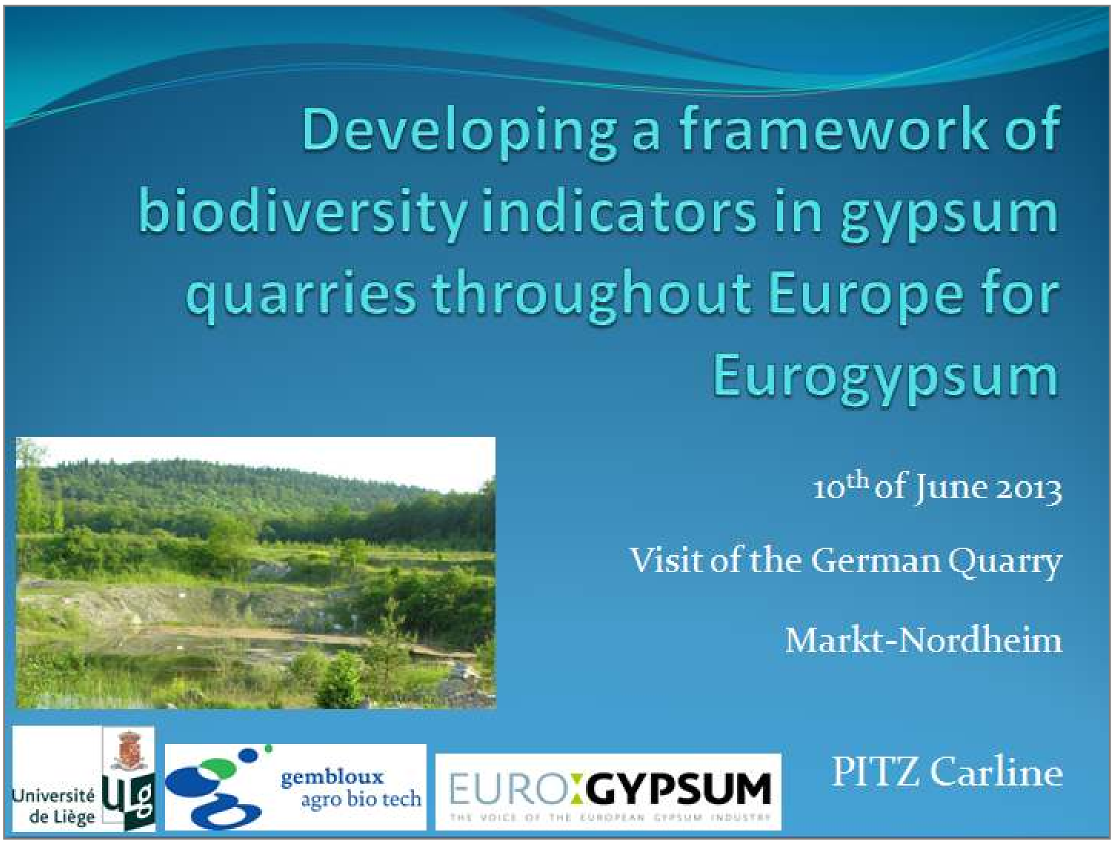
Name	Company	Function
Hans-Jörg Kersten	Knauf	Technical Advisor environment
Matthias Reimann	BV Gips	Director mineral resources Knauf worldwide
ULRICH TRÄNKLE	AG.L.N. Landscape planning and nature conservation management .	Environmental expert
Carline Pitz	Gembloux Agro-Bio-Tech, ULg	Master 2 student

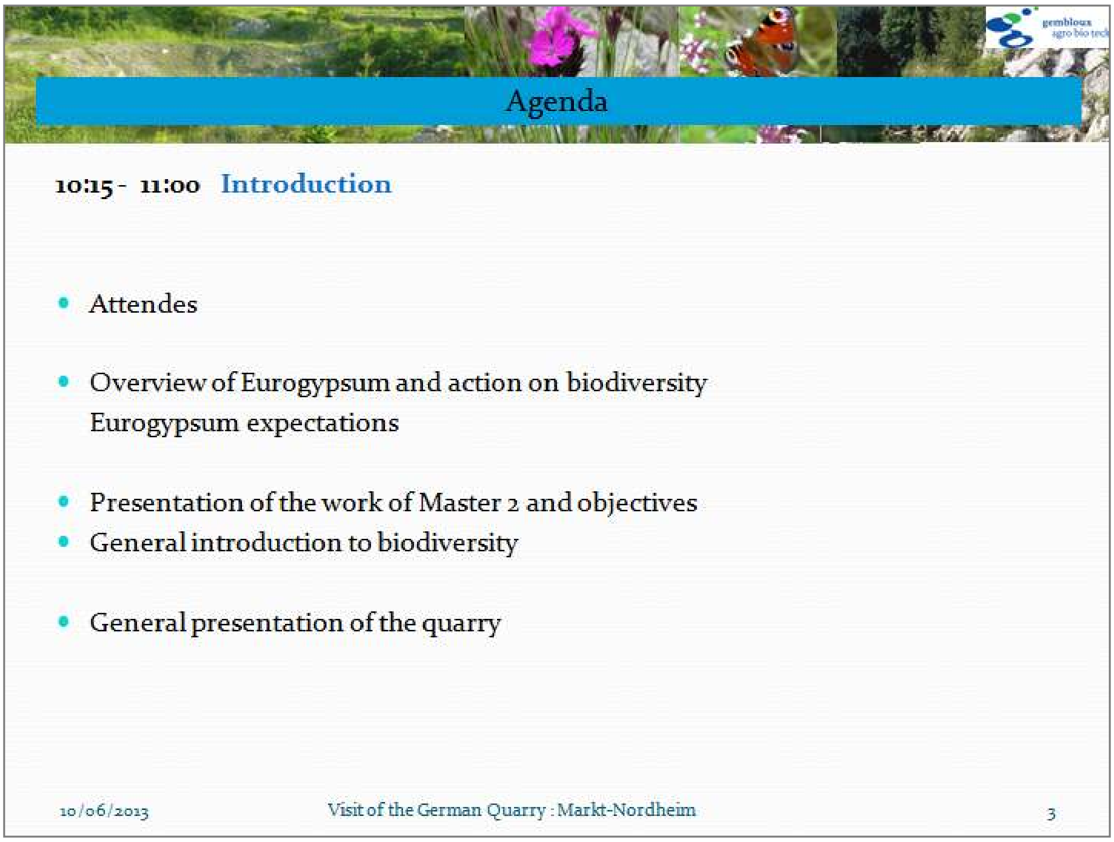
- **09:00 - 10:00** Introduction and Discussion about the indicators at Iphofen Office

- **10:00 - 10:30** Driving from Iphofen Office to the quarry (car: Carline Pitz 4 seats)
- **10:30 - 11:30** Visit of the quarry and discussion with the experts about biodiversity
- **11:30 - 12:00** Driving to the Iphofen Office (car: Carline Pitz 4 seats)

- **12:00 - 12:30** Conclusions and following steps

29. Example of PowerPoint presentation (Step 3.3): Meeting of the 10th of June 2013 on the site of Markt-Nordheim (Germany)

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Agenda
10:15 - 11:00 Introduction
• Attendes
• Overview of Eurogypsum and action on biodiversity
Eurogypsum expectations
• Presentation of the work of Master 2 and objectives
• General introduction to biodiversity
• General presentation of the quarry
10/06/2013
Visit of the German Quarry : Markt-Nordheim
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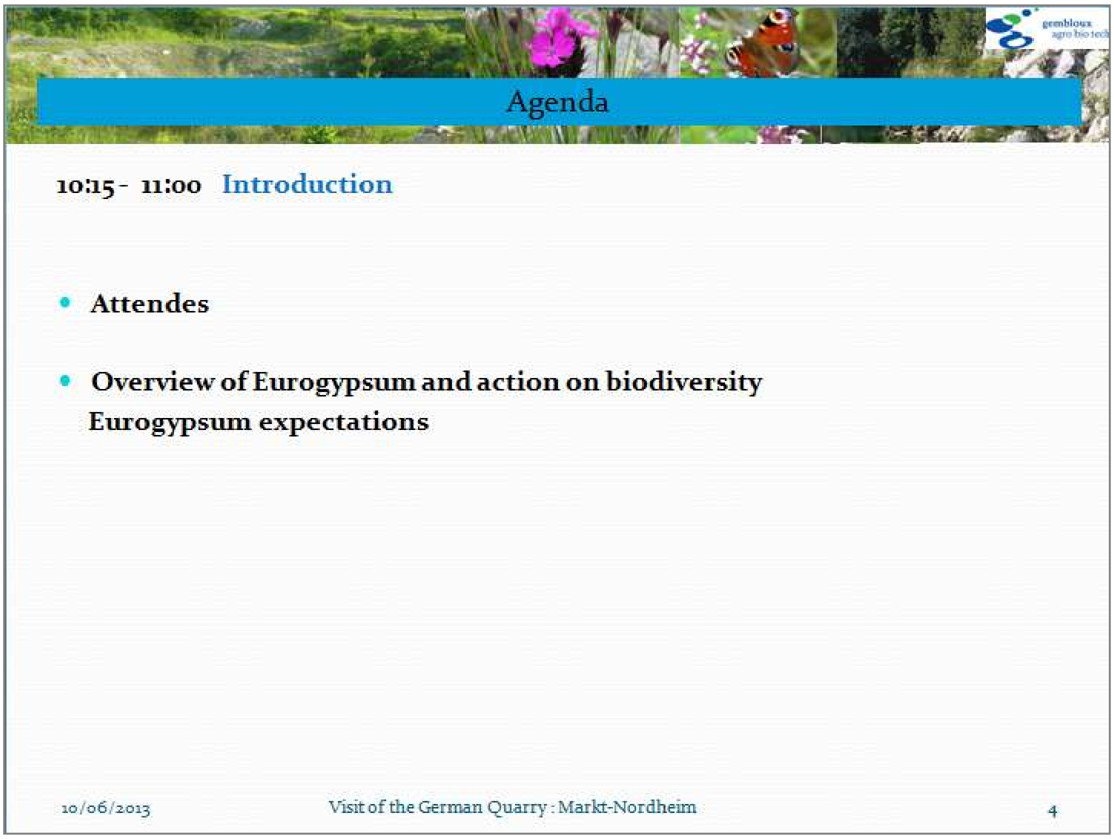
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Agenda
10:15 - 11:00 Introduction
• Attendes
• Overview of Eurogypsum and action on biodiversity
Eurogypsum expectations
10/06/2013
Visit of the German Quarry : Markt-Nordheim
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Eurogypsum | Context | Objectives | Biodiversity indicators | Method | KPI framework

EUROGYPSUM

EUROGYPSUM
THE VOICE OF THE EUROPEAN GYPSUM INDUSTRY

- AISBL
- Interests of the gypsum industry in Europe
- Official list of the lobby to the EC : Transparency Register europa
- List of accreditations from the EP
- Links : other institutions - common interests
  - NEEIP : Non Energie Exctractive Industry Panel → EU institutions
  - RMSG : Raw Material Supply Expert Group → organised by EC, DG entreprise
  - CEPMC : Council of European Producers of Materials for Construction

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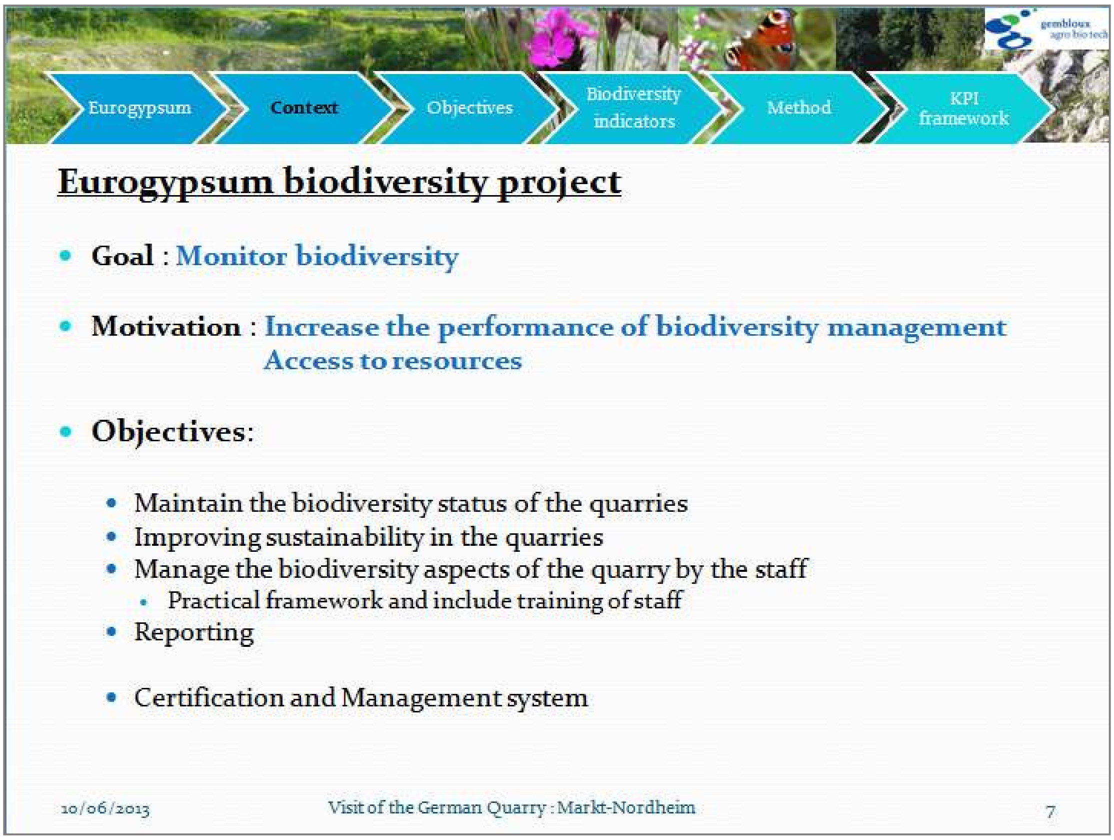
Agenda

10:15 - 11:00 **Introduction**

- Attendes
- Overview of Eurogypsum and action on biodiversity
  Eurogypsum expectations
- **Presentation of the work of Master 2 and objectives**
- **General introduction to biodiversity**

10/06/2013 Visit of the German Quarry : Markt-Nordheim 6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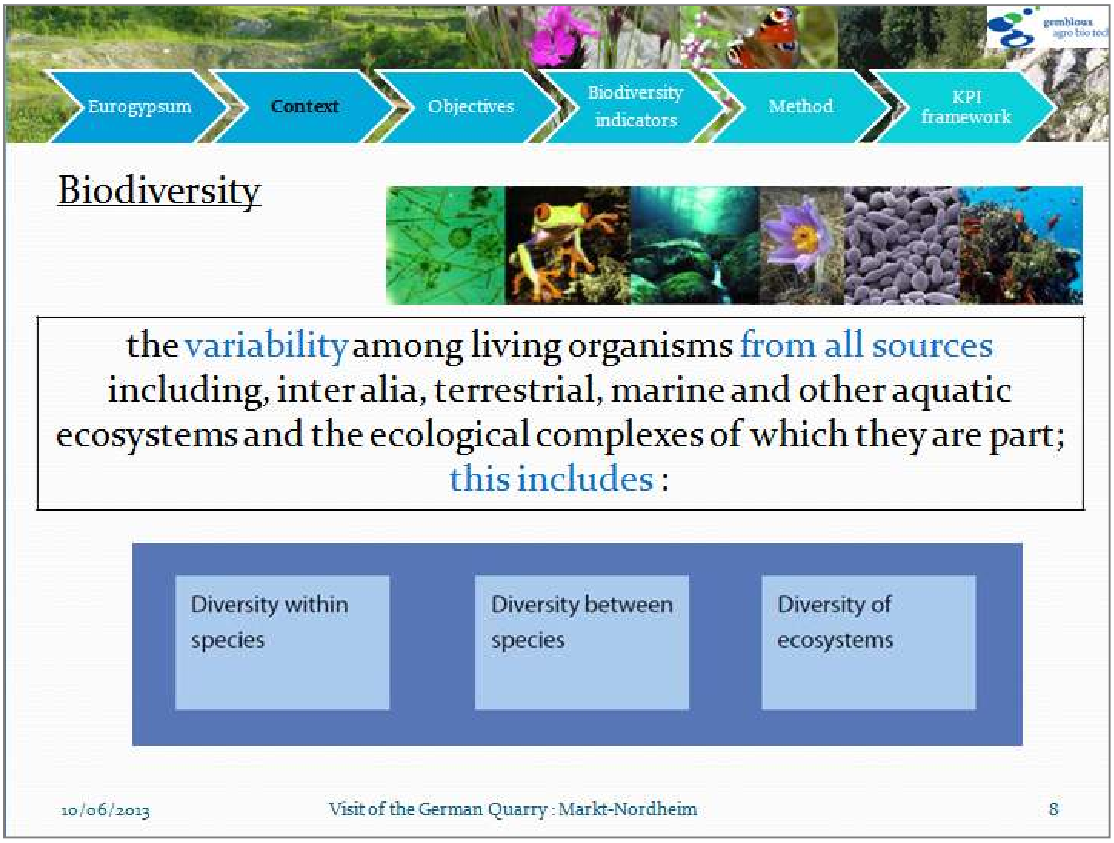
Eurogypsum
Context
Objectives
Biodiversity indicators
Method
KPI framework
Eurogypsum biodiversity project
Goal : Monitor biodiversity
Motivation : Increase the performance of biodiversity management
Access to resources
Objectives:
Maintain the biodiversity status of the quarries
Improving sustainability in the quarries
Manage the biodiversity aspects of the quarry by the staff
Practical framework and include training of staff
Reporting
Certification and Management system
10/06/2013
Visit of the German Quarry : Markt-Nordheim
7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Eurogypsum
Context
Objectives
Biodiversity indicators
Method
KPI framework
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
Diversity between species
Diversity of ecosystems
10/06/2013
Visit of the German Quarry : Markt-Nordheim
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Eurogypsum | **Context** | Objectives | Biodiversity indicators | Method | KPI framework

European legal context

NATURA 2000

- Birds and Habitats Directives
  - Protect the ecological state of important species and habitats
  - Natura 2000 Network + protection of species
  - Doesn't exclude human activities

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Eurogypsum | **Context** | Objectives | Biodiversity indicators | Method | KPI framework

European policy and societal context

At global level	
CBD/COP 6 (The Hague, Netherlands, 7 - 19 April 2002)	The 2010 target
World Summit on Sustainable Development (Johannesburg, 26 August–4 September 2002)	Endorsement of the 2010 target
CBD/COP 7 (Kuala Lumpur, Malaysia, 9 - 20 February 2004)	Adoption of a framework
CBD/COP 10 (Nagoya, Aichi Prefecture, Japan, 18 - 29 October 2010)	Strategic Plan for Biodiversity 2011–2020 - Aichi targets
At pan-European level	
5th 'Environment for Europe' Ministerial Conference (**Kiev**, 21–23 May 2003)	Resolution to 'halt the loss of biological diversity at all levels by the year 2010', pan-European ecological network
At European level	
European Council (**Gothenburg**, 15–16 June 2001)	EU Strategy for Sustainable Development
Conference '**Sustaining Livelihoods and Biodiversity**' (**Malahide**, 25–27 May 2004)	Message from Malahide : endorsed a first set of EU headline biodiversity indicators to assess progress towards the 2010 target.
European Council (Brussels, 28 June 2004)	Conclusions on 'Halting the loss of biodiversity by 2010'
European Commission 2006	Communication : Halting the Loss of Biodiversity to 2010
European Commission 2011	EU biodiversity strategy to 2020

Eurogypsum | Context | **Objectives** | Biodiversity indicators | Method | KPI framework

Target of the study

- Framework of biodiversity indicators
- Monitor
- European legislation and strategies
- European level – flexible and adaptable
- Usable

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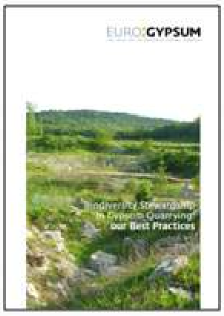
Eurogypsum | Context | **Objectives** | Biodiversity indicators | Method | KPI framework

Expected results

- Report : Gypsum industry and decision-makers
    - Framework
    - Glossary of terms
    - Folders :
        - Description of the indicators
        - How to use the indicators
    - Recommendations for the implementation



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Agenda

10:15 - 11:00 Introduction

- Attendes
- Overview of Eurogypsum and action on biodiversity
  Eurogypsum expectations
- Presentation of the work of Master 2 and objectives
- General introduction to biodiversity
- **General presentation of the quarry**

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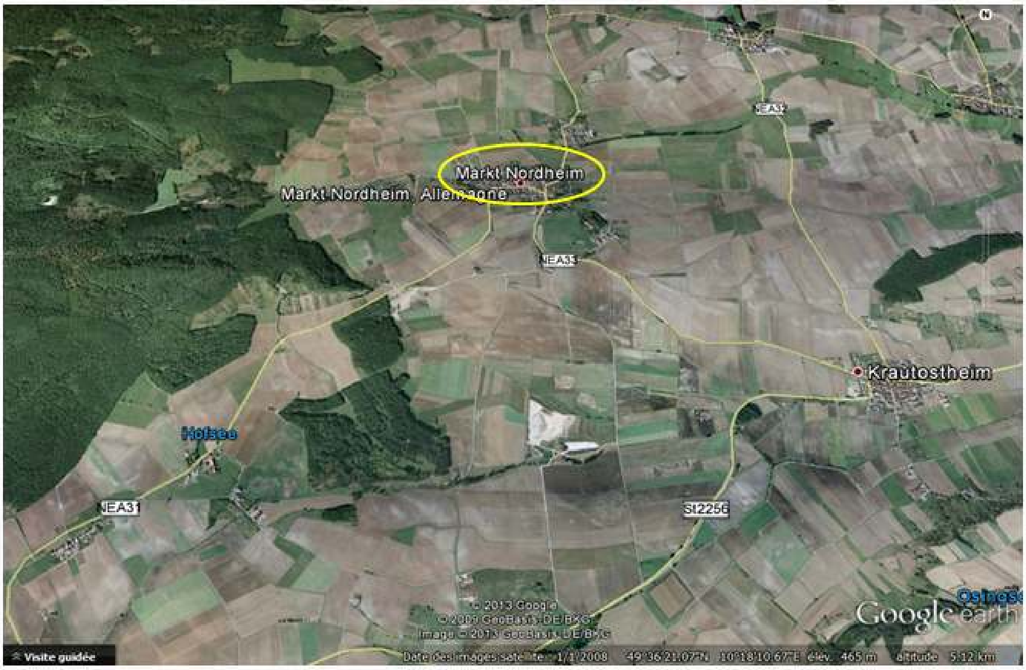
Agenda

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Agenda
Markt Nordheim
Markt Nordheim, Allemagne
NEA31
NEA33
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Image © 2013 GeoBasis-DE/BKG
Google earth
Visite guidée
Date des images satellite : 1/1/2008 49°35'28.83"N 10°19'49.34"E élév. 354 m altitude 2.62 km


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Agenda
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Google earth
Visite guidée
Date des images satellite : 1/1/2008 49°34'38.38"N 10°21'08.38"E élév. 330 m altitude 869 m

Agenda

11:00 - 12:30 Presentation of the project

- 11:00 – 11:20 **Presentation of the general context of the indicators**
- 11:20 – 11:30 **Discussion**
- 11:30 – 12:00 Presentation of the indicators
- 12:00 – 12:30 Round table and discussion

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Eurogypsum | Context | Objectives | **Biodiversity indicators** | Method | KPI framework

Biodiversity indicator

- Biodiversity : complex, different aspects
- No single indicator
- Interest-dependant
- Make choices for values and measures
- Focus on aspects

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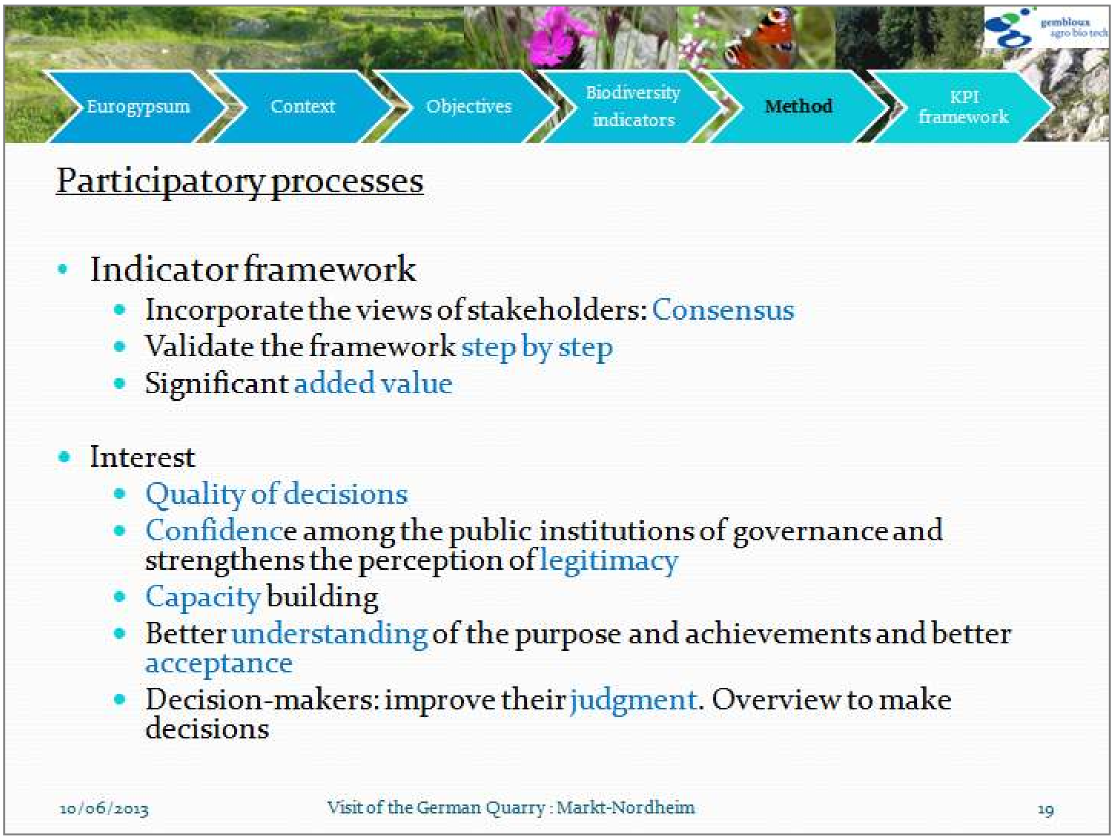
Eurogypsum
Context
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Biodiversity indicators
Method
KPI framework
Participatory processes
Indicator framework
Incorporate the views of stakeholders: Consensus
Validate the framework step by step
Significant added value
Interest
Quality of decisions
Confidence among the public institutions of governance and strengthens the perception of legitimacy
Capacity building
Better understanding of the purpose and achievements and better acceptance
Decision-makers: improve their judgment. Overview to make decisions
10/06/2013
Visit of the German Quarry : Markt-Nordheim
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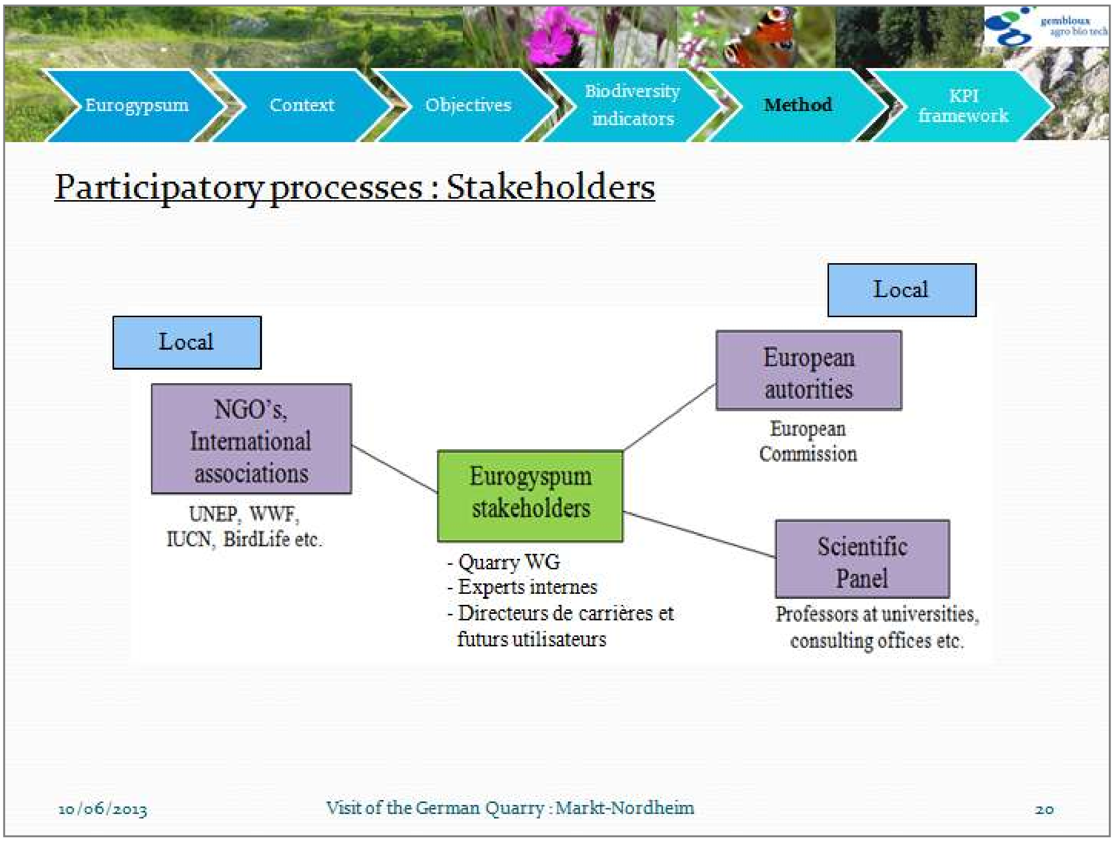
Eurogypsum
Context
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KPI framework
Participatory processes : Stakeholders
Local
NGO's, International associations
UNEP, WWF, IUCN, BirdLife etc.
Local
European autorities
European Commission
Eurogyspum stakeholders
- Quarry WG
- Experts internes
- Directeurs de carrières et futurs utilisateurs
Scientific Panel
Professors at universities, consulting offices etc.
10/06/2013
Visit of the German Quarry : Markt-Nordheim
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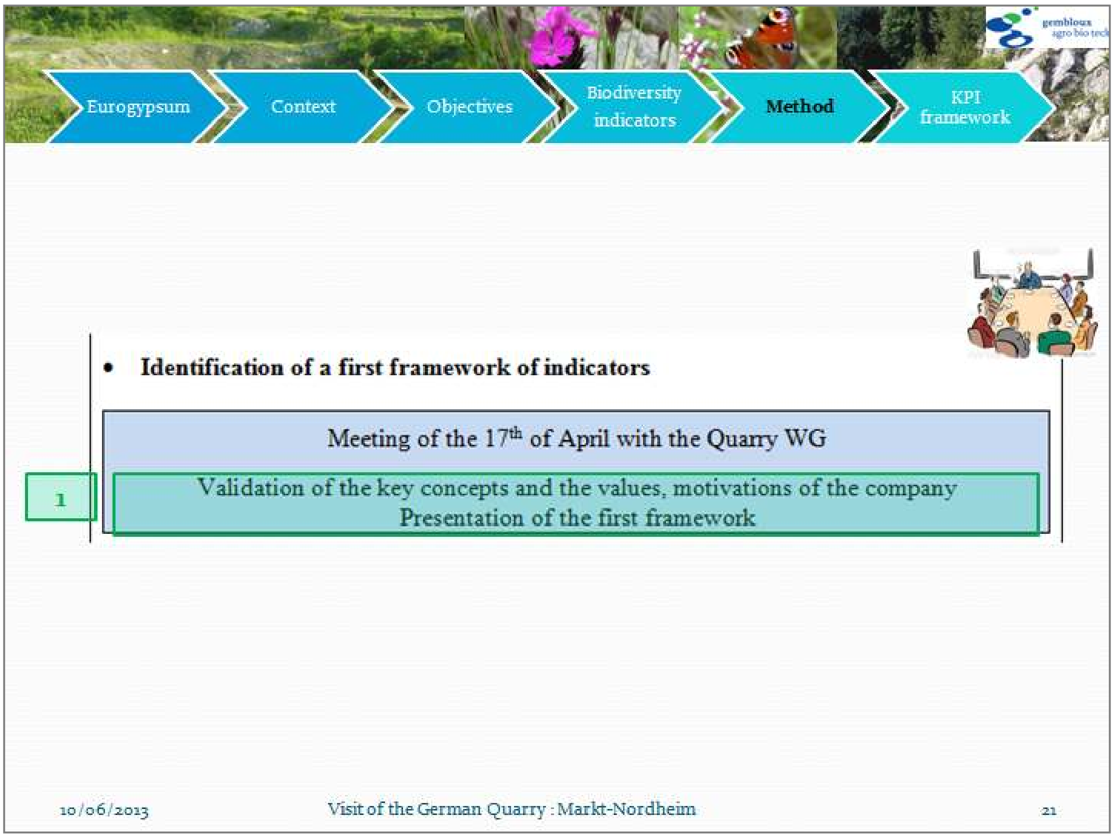
Eurogypsum
Context
Objectives
Biodiversity indicators
Method
KPI framework
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Identification of a first framework of indicators
Meeting of the 17th of April with the Quarry WG
1
Validation of the key concepts and the values, motivations of the company
Presentation of the first framework
10/06/2013
Visit of the German Quarry : Markt-Nordheim
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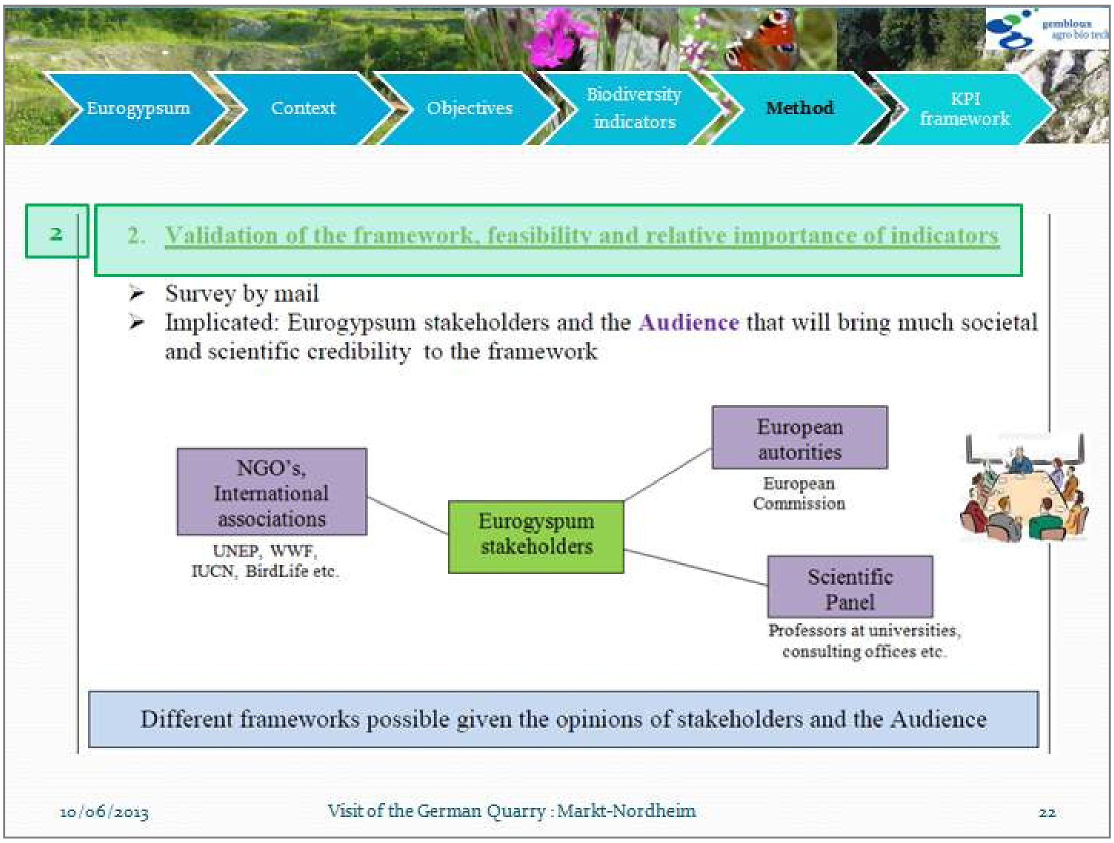
Eurogypsum
Context
Objectives
Biodiversity indicators
Method
KPI framework
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2
2. Validation of the framework, feasibility and relative importance of indicators
Survey by mail
Implicated: Eurogypsum stakeholders and the Audience that will bring much societal and scientific credibility to the framework
NGO's, International associations
UNEP, WWF, IUCN, BirdLife etc.
Eurogyspum stakeholders
European autorities
European Commission
Scientific Panel
Professors at universities, consulting offices etc.
Different frameworks possible given the opinions of stakeholders and the Audience
10/06/2013
Visit of the German Quarry : Markt-Nordheim
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Eurogypsum
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KPI framework
3
3. Verification in 3 quarries of the real feasibility on the field of the frameworks obtained compared to the local context : biogeographic regions and users
France, Spain, Germany
One feasible and usable framework
validated by field stakeholders, the Audience, and Eurogypsum
4
4. Writing of the folders and recommendations for the use of the framework
10/06/2013
Visit of the German Quarry : Markt-Nordheim
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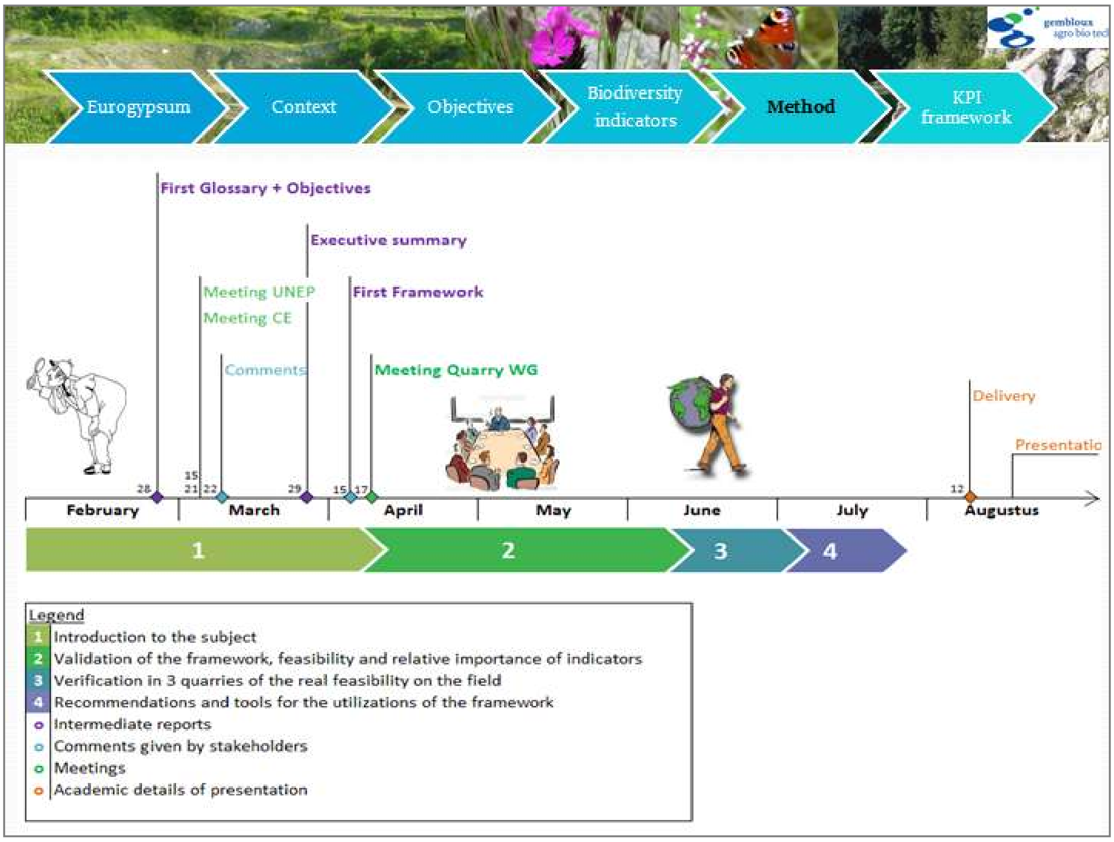
Eurogypsum
Context
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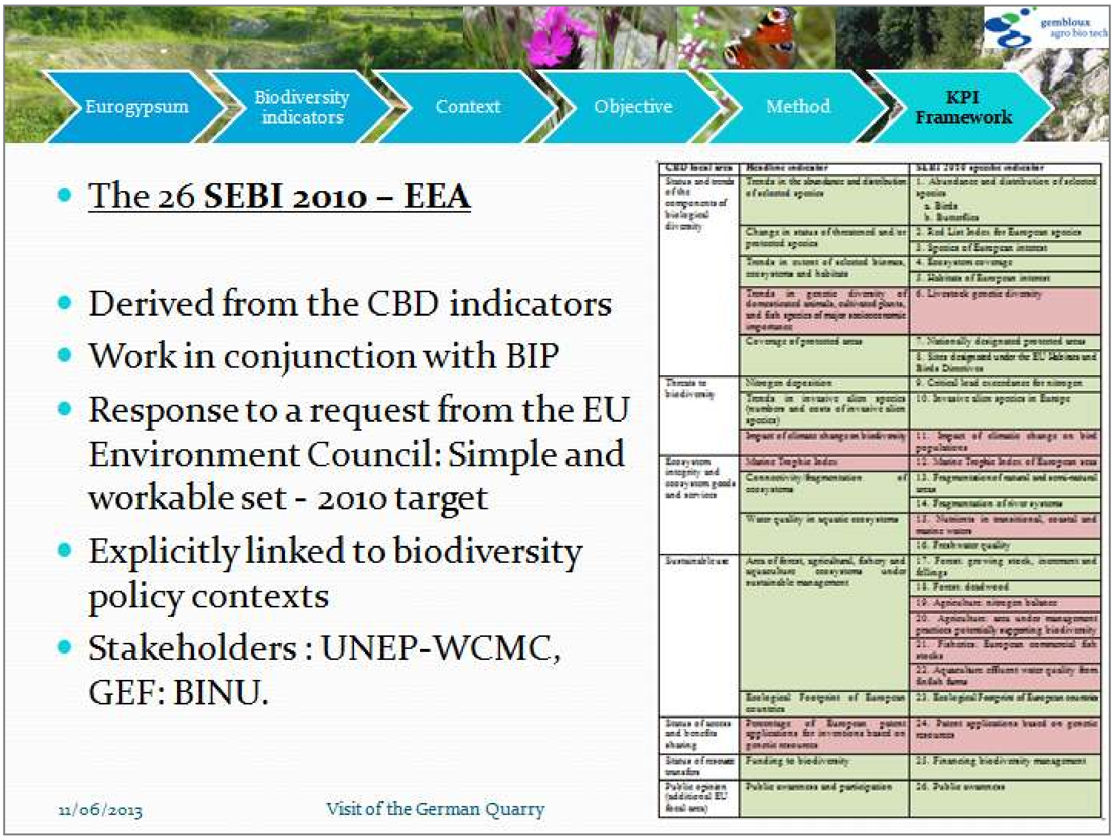
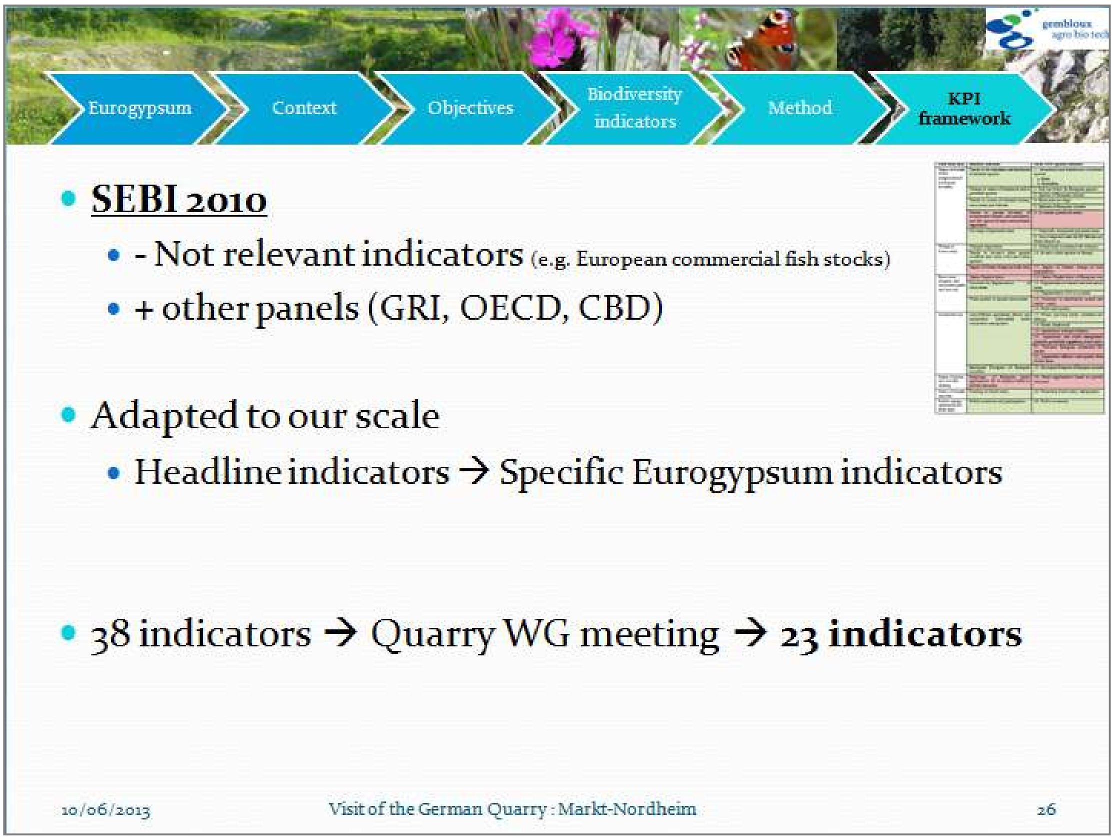
KPI framework
First Glossary + Objectives
Executive summary
Meeting UNEP
Meeting CE
First Framework
Comments
Meeting Quarry WG
Delivery
Presentatio
February
March
April
May
June
July
Augustus
1
2
3
4
Legend
1 Introduction to the subject
2 Validation of the framework, feasibility and relative importance of indicators
3 Verification in 3 quarries of the real feasibility on the field
4 Recommendations and tools for the utilizations of the framework
Intermediate reports
Comments given by stakeholders
Meetings
Academic details of presentation



CBD focal area	Headline indicator	SEBI 2010 specific indicator
Status and trends of the components of biological diversity	Trends in the abundance and distribution of selected species	1. Abundance and distribution of selected species a. Birds b. Butterflies
	Change in status of threatened and/or protected species	2. Red List Index for European species
		3. Species of European interest
	Trends in extent of selected biomes, ecosystems and habitats	4. Ecosystem coverage
		5. Habitats of European interest
	Trends in genetic diversity of domesticated animals, cultivated plants, and fish species of major socioeconomic importance	6. Livestock genetic diversity
	Coverage of protected areas	7. Nationally designated protected areas
		8. Sites designated under the EU Habitats and Birds Directives
Threats to biodiversity	Nitrogen deposition	9. Critical load exceedance for nitrogen
	Trends in invasive alien species (numbers and costs of invasive alien species)	10. Invasive alien species in Europe
	Impact of climate change on biodiversity	11. Impact of climate change on bird populations
Ecosystem integrity and ecosystem goods and services	Marine Trophic Index	12. Marine Trophic Index of European seas
	Connectivity/fragmentation of ecosystems	13. Fragmentation of natural and semi-natural areas
		14. Fragmentation of river systems
	Water quality in aquatic ecosystems	15. Nutrients in transitional, coastal and marine waters
		16. Freshwater quality
Sustainable use	Area of forest, agricultural, fishery and aquaculture ecosystems under sustainable management	17. Forest: growing stock, increment and fellings
		18. Forest: deadwood
		19. Agriculture: nitrogen balance
		20. Agriculture: area under management practices potentially supporting biodiversity
		21. Fisheries: European commercial fish stocks
		22. Aquaculture: effluent water quality from finfish farms
	Ecological Footprint of European countries	23. Ecological Footprint of European countries
Status of access and benefits sharing	Percentage of European patent applications for inventions based on genetic resources	24. Patent applications based on genetic resources
Status of resource transfers	Funding to biodiversity	25. Financing biodiversity management
Public opinion (additional EU focal area)	Public awareness and participation	26. Public awareness



Eurogypsum | Context | Objectives | Biodiversity indicators | Method | **KPI framework**

- Eurogypsum framework
- 23 Indicators, 3 kind of indicators:
  - Of biodiversity
  - Of sustainable management
  - For associations : Eurogypsum or other
- See Excel document

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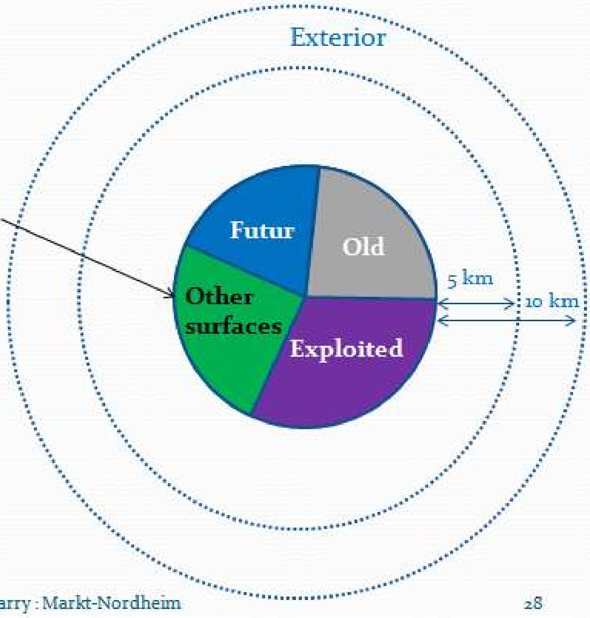
Eurogypsum | Context | Objectives | Biodiversity indicators | Method | **KPI framework**

- Cadre Eurogypsum
- ! Scale of the quarry

Surface owned by the quarry

- Not comparable: relief



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Agenda

11:00 - 12:30 Presentation of the project

- 11:00 – 11:20 Presentation of the general context of the indicators
- 11:20 – 11:30 Discussion
- 11:30 – 12:00 **Presentation of the indicators (Excel)**
- 12:00 – 12:30 **Round table and discussion**

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Agenda

- **12:30 – 14:00 Dinner**
- **14:00 – 15:00 Feasibility on the Markt-Nordheim site**
- **15:00 – 15:30** Driving
- **15:30 – 16:30 Visit of the quarry (running and productivity)**
- **16:30 – 17:00** Driving
- **17:00 – 17:30 Conclusions and following steps**

10/06/2013 Visit of the German Quarry : Markt-Nordheim 30

30. MEETING NOTES (STEP 3.3): MEETING OF THE 30TH OF MAY 2013, SITE OF CARESSE (FRANCE)

Personnes présentes

Personne	Société	Fonction
Marc Thauront	Ecosphère	Directeur général
Sébastien Roué	Ecosphère, agence Sud-Ouest	Adjoint au directeur de l'agence Sud-Ouest basée à Mérignac (Bordeaux) depuis 2 ans
Frédéric Conte	SINIAT France	Ingénieur carrière – Caresse. Ingénieur en environnement sur le site. Travaille depuis septembre
Jacques Desclaux	SINIAT France	Directeur de la carrière de Caresse. Carrière + Usine de fabrication du plâtre, depuis 25 ans.
Philippe Chevalier	SINIAT International	Gypsum Ressources Director
Carline Pitz	ULg – GxABT	Etudiante Master 2

Présentation d'Ecosphère

Société spécialisée en étude sur les milieux naturels,

- Audit et réglementation ;
- Restauration écologique ;
- Politique de biodiversité (CE, Natura 2000) ;
- Etudes d'impacts.

Ingénieur carrière en environnement sur le site :

Il s'occupe de la carrière de manière plus approfondie que Mr Desclaux. Il règle les problématiques liées à l'environnement de la carrière, l'usine et l'atelier. Il gère les poubelles, les fumées, les plaintes du voisinage (par exemple : un renard qui a mangé des poules), effectue le suivi réglementaire comme couper l'herbe, organiser des battues si nécessaire, etc. Il a l'appui d'un délégué HSE régional (Hygiène Sécurité Environnement) qui s'occupe de plusieurs sites. Il doit rendre des comptes à cet HSE régional qui lui-même dépend, au niveau SINIAT, d'un directeur environnement hygiène sécurité qui se trouve au siège. Tous doivent rendre des comptes au siège du groupe ETEX qui est en Belgique.

Depuis 2011, le groupe ETEX a acheté la partie Europe et Amérique du Sud de Lafarge Plâtre. La partie Océanie et Asie a été achetée par quelqu'un d'autre.

Attentes de Jacques Desclaux

- Il ne sait pas ce qu'est exactement la biodiversité, il ignore ce qui se cache derrière ce terme ainsi que ses aboutissants.
- Il souhaiterait des indicateurs facilement utilisables par des gens de terrains.
- Il voudrait savoir concrètement ce que les indicateurs vont impliquer sur le terrain et comment s'en servir

Attentes de Philippe Chevalier :

Il préfèrerait que l'on quitte l'aspect conviction, lobbying auprès de l'administration. Il souhaiterait fixer un objectif : partant de la situation actuelle, rechercher des moyens pour améliorer la biodiversité. Si ce n'est pas suffisant, les carrières devront en tirer des conclusions. Ainsi, on aura l'impression d'avoir fait le maximum en matière de biodiversité, sachant aussi qu'un travail méticuleux devient une obligation pour obtenir les autorisations.

Site de Caresse :

- Site de Caresse : 30 personnes
- Carrière (Siniat) : 11 personnes
- Ouvert du lundi 4h au vendredi 20h. Ils travaillent en 2 postes : 8h-12h, 12h-20h et aussi certains samedis.
- 9 ha en zone exploitée.
- Terrains à droite et à gauche, aucune liaison avec l'exploitation, achetés historiquement dans des propositions d'échanges. Terrains agricoles dans la plaine, loués à des agriculteurs.
- Art 101. Visibilité sur les ressources à long terme.
- Arrêté préfectoral d'autorisation d'exploitation qui se termine en 2023.
- Réaménagement final : lac très profond.

Présentation de la carrière :

- Carrière de gypse sur la Commune de Caresse-Cassaber (Pyrénées Atlantiques), située au nord du centre du bourg de Caresse.
- A l'ouest : Carrière de calcaire SEMEX, séparation par le ruisseau du Saleys.
- Historique : Carrière exploitée depuis le début 20^{ième} siècle (avant guerre), sous forme de galeries souterraines, jusque dans les années 1963.
- Profondeur : sur la plaine 20 m MGF, fond de la carrière vers 90-100 m MGF.
- Zones:
  - Zones en exploitation
  - Zones d'exploitations futures
  - Anciennes galeries souterraines : risques de fonti (dépression locales) possibles. Anciennes galeries semi-inondées.
  - Zones de verses stériles re-végétalisées

Hydrologie :

- Pompage : permanent de la nappe phréatique vers le Saleys. En 3 niveaux, dont un utilise les anciennes galeries.
- Saleys a été détourné à 2 reprises durant le siècle dernier
- Une partie du Saleys est classé en Natura 2000 au sein du site.

Vocabulaire

- Zone de verse stérile : zone de décharge de stérile (petite colline)
- Stérile : gisement qui est trop pauvre en gypse
- Découverte (overburn): matériau que l'on doit sortir pour pouvoir accéder au gisement

Re-végétalisation:

Sur les zones de verse stériles : placement d'une couche plus ou moins épaisse d'une couche de terre végétale de découverte (conforme à ce que l'on trouve dans le contexte géochimique local), plantation en acacias majoritairement, chênes, noisetiers... Plan de réaménagement ou de gestion non consigné dans des carnets. De ce fait, on ne sait pas ce qu'on a réalisé, à quel endroit, à quel moment et de quelle manière. Gros problèmes de reprise en raison du broutage par le chevreuil dont la population est très importante.

Les verses sont parfois déplacées au cours du temps. D'un point de vue minier, ce qui coûte cher ce sont les transports. La remise en état s'effectue au m² ; ce qui ne constitue pas un problème en soi. On peut très bien avoir intérêt, sur un grand gisement, à mettre les verses provisoirement près de l'endroit où l'on se trouve, puis à les transporter 30-40 ans après à un autre endroit. Dans la logique économique, on ne peut pas prévoir ce qui va se passer dans 30 ans. On préfère donc voir l'avantage du moment, tout en sachant que, peut-être dans 30 ans, les miniers ne seront pas satisfaits de ce qu'ont fait les anciens. Il est cependant possible de plus ou moins évaluer quelles seront les verses qui resteront permanentes et celles qui seront susceptibles d'être déplacées un jour.

Il n'y a pas d'obligation de mettre tel type de stérile à un certain endroit et d'autres ailleurs. Mais dans la pratique, c'est ce qui est souvent opéré. Les tas de stériles sulfatés sont séparés des tas de terres de découverte, car celles-ci sont en général utilisées pour recouvrir les verses de stériles par la suite.

Les provisions sur les changements de place des stériles sont interdites. Mais, par contre, des provisions peuvent être faites pour les réaménagements futurs.

Pas de temps :

Dans la carrière, les autorisations sont valables pour une durée de 30 ans. De ce fait, le cadre d'indicateurs doit prévoir cette vision à 30 ans. Evidemment, les carriers ont une vision à plus long terme. L'important est de gérer le site dans le cadre des programmes miniers qui sont définis sur 30 ans et qui sont renouvelés tous les 20 ans. Sur 30 ans, en termes de gestion, ils doivent donc avoir un cadre qui tienne la route.

Par contre, le laps de temps du calcul des indicateurs et des rapports sur les indicateurs doit être le plus court possible (1 à 2 ans) pour éviter une démotivation des carriers. Il est préférable qu'ils puissent constater une évolution de la biodiversité sinon ils risquent de se lasser et abandonner cette problématique. De plus, pour tout ce qui est de la communication, il faut que les résultats soient présentables régulièrement. Les indicateurs qui fonctionneront et qui seront choisis et mis en place seront ceux qui permettront un suivi régulier de l'évolution.

Géologie :

Tout d'abord une couche dite de découverte : composée de grave alluvionnaire sableuse, 15ène de mètres d'épaisseurs. Le massif exploité date du trias, massif assez hétérogène avec des marnes infra-gypseuses, gypse, argile, écailles de dolomies. Installations pas comme en région Parisiennes où le gypse est en tablette (couches sédimentaires organisées).

Ils ont des amas « diaphyre » de gypse (un genre de « gros chewing-gum » de gypse mélangé avec de la dolomie, des argiles, etc). Il s'agit d'un Gypse très impure par rapport à d'autres régions comme en région Parisienne où ils peuvent avoir 90-92% de pureté, alors qu'ici la richesse moyenne du gisement de gypse est de 60-65%. Pour qu'il soit utilisable, on doit remonter à une pureté de 79%.

Méthode de forage

La première étape est de choisir un front (zone) puis de procéder au minage. Une fois que le produit est abattu à l'explosif, on procède à un premier tri à front visuel (le matériau paraît bon ou pas, selon la pureté, recherche visuelle des « cerises » et élimination de la pâte). Ensuite, on passe dans une installation de concassage - criblage (une étude qui dit que les parties les plus fines sont les moins riches). Ils ont des mailles de coupures qui permettent d'extraire les parties les plus pauvres ; on va donc enrichir mécaniquement ce qui en ressort. Cette installation secondaire permet de faire des tas, d'analyser ces tas et de les mélanger pour arriver à une pureté constante désirée (79%).

Pour 1 tonne de gypse utilisée, 1 à 1.5 tonne jetée en stérile sulfatée (tri en carrière et tri au criblage), 1 partie de découverte.

Natura 2000 :

Ils sont très fiers qu'une zone N2000 ait pu être définie sur leur site, et particulièrement sur le Saleys alors qu'il a déjà été dévié deux fois.

Ils ne voient pas N2000 comme une menace ou un risque, mais justement comme un facteur qui montre que l'exploitation de gypse n'est pas incompatible avec le développement d'une flore et d'une faune qui a été jugée intéressante. N2000 montre qu'il y a une faune et une flore (« un biotope comme vous dites ») qui a prospéré au sein de la carrière.

Pas d'inquiétudes administratives ou réglementaires sur N2000 en lui-même mais sur le fait qu'ils ont des obligations de contrôle sur les rejets vers le Saleys.

Problématique de l'eau

C'est dans le ruisseau du Saleys qu'ils rejettent toutes les eaux de pompages de la nappe phréatique. Or, le gypse se dissout dans l'eau et charge l'eau en sulfates. Il y a des rejets des nappes, qui sont presque saturées en sulfates, lors du pompage pour avoir accès à la ressource.

<u>Présentation d'Eurogypsum par Mr Chevalier</u>

Eurogypsum est l'association européenne qui regroupe des associations de producteurs de chaque état membre (ex France : SNIP). Au sein d'Eurogypsum, il y a différentes commissions dans lesquelles sont représentées des associations : commissions sur le recyclage, sur la matière première. A l'intérieur de la commission gypse naturel, ils travaillent sur l'obligation de suivre les normes européennes quand elles sortent (sur les déchets miniers, sur l'eau, études d'impacts, etc).

<u>Présentation du projet par Mr Chevalier</u>

En ce moment, une problématique qui revient régulièrement est que la CE veut mettre en place un système d'indicateurs environnementaux pour le management des carrières. Il y a deux façons de prendre ces indicateurs : une purement managériale et une autre qui permet de répondre à un questionnaire : « est-ce que vous avez un responsable de la biodiversité au sein de l'entreprise ?... ». Ensuite, ils font une compilation au niveau européen. C'est l'approche qui est souhaitée par CE en raison du nombre de carriers indépendants qui n'ont pas mis en place des systèmes environnementaux très organisés. Ce qui n'est pas le cas du groupe Lafarge qui a déjà travaillé avec le WWF, et qui a déjà mis en place pas mal d'actions pour l'environnement. Au niveau d'Eurogypsum, ils ont pensé que, malgré toutes ces questions générales, au final ça ne leur apportera pas grand-chose au niveau de la gestion de la biodiversité au sein de la carrière. Ils vont simplement être repris dans des tableaux de statistique européennes, sans intérêt majeur pour leur propre gestion. Ils auraient préféré avoir des questions plus précises sur la biodiversité au sein de leur carrière. Ils ont donc voulu voir s'il était possible de définir des indicateurs de performance de biodiversité, de même qu'ils ont défini des indicateurs de performance pour la sécurité, l'économie etc. Serait-ce possible dans une carrière comme Caresse de dire qu'on a 5 ou 10 indicateurs qui sont suivis régulièrement et sur lesquels on s'engage pour mesurer et voir l'évolution de la biodiversité ?

Il y a deux domaines en pleine expansion au sein de la CE : l'eau (ex. Directive cadre sur l'eau) et la biodiversité. Avec Eurogypsum, ils ont décidé de mettre toutes leurs « billes » sur la biodiversité.

On ne rentre pas dans le cadre d'un lobbying normatif où il faut mettre quelque chose en place et se contenter de dire par la suite qu'on a essayé et a testé. Ce n'est pas l'objectif ici. Le but c'est de voir si on a vraiment progressé sur cette question, de définir les techniques scientifiques les plus adéquates pour y arriver. Ensuite, ils (QUI ?) écriront des recommandations au sein d'Eurogypsum sur base de ce travail et en profiteront pour faire de la communication auprès de la CE pour s'assurer que ce qui a été réalisé est intéressant ou non. L'important, c'est de montrer aux gens qu'ils agissent et répondent donc à l'attente de tout le monde.

Mr Thauront : Lorsque la CE met en place des normes et directives, celles-ci s'adressent et s'appliquent aux Etats. Après, c'est aux Etats de mettre en place ces directives dans leur pays et de les adapter à leurs droits. Pour le moment, au sein de la CE, il n'y a donc pas de volonté de définir des indicateurs précis et fixés qu'il faudra appliquer. Mais par contre, il y a un effort collectif qui est demandé sur des sujets importants tel que la biodiversité. Les indicateurs sont des éléments de mesures qui peuvent permettre de voir si l'objectif fixé est atteint.

Après, chaque structure peut avoir envie de participer à l'effort pour des raisons éthiques, d'image ou d'accès à la ressource. Il y a plusieurs structures qui travaillent dans cette réflexion comme le groupe Holcim qui œuvre en collaboration avec l'IUCN pour mettre en place un système (IUCN ROWA and Holcim Lebanon have signed an agreement to restore an old quarry in Lebanon and provide a model for the restoration of abandoned quarries in the country, http://www.iucn.org/about/work/programmes/business/?10361) de restauration d'anciennes carrières. Lafarge a, par exemple, également travaillé avec le WWF à propos de leur empreinte carbone (http://users.skynet.be/idd/documents/energie/SE3D2.pdf). Ici, on passe à un stade intéressant car on n'est plus à l'échelle de l'entreprise. Ce travail vise une filière : la filière gypse-plâtre en Europe. Après, si cette filière gypse-plâtre met en place quelque chose de bien, elle bénéficiera d'une bonne image qui lui permettra de rentrer dans le contexte européen en matière de biodiversité. Par la suite, les indicateurs définis ne deviendront cependant pas une norme obligatoire. Si le système développé ici est repris ailleurs, c'est qu'appliqué au sein de la filière gypse, son bon fonctionnement aura été démontré. N2000 donne une obligation de résultats : les espèces et habitats importants doivent avoir un bon état de conservation. On ne sera donc pas dans l'obligation, par exemple, de respecter 3mg de ceci ou cela. Ils vont mettre en place des choses plus fines et intelligentes, peut-être plus contraignantes mais mieux adaptées. Entre-autre, ils prévoient l'obligation de prise en compte par les industriels d'un certain nombre de problèmes. Ce sera à eux de dire et de prouver que ce qu'ils font est bien et qu'ils pourront même faire mieux. Le travail Eurogysum rentre bien dans les intérêts locaux car, s'il y a des intérêts sociaux et environnementaux, il y a aussi un intérêt économique.

Pourquoi Caresse :

Ils ont choisi la carrière de Caresse en France car c'est une carrière du trias. Or, en France, des carrières du trias, on en compte quatre, dont deux sont dans des zones de hautes montagnes et deux sont proches l'une de l'autre. Il en existe d'autres en région parisienne où le gypse est en tablette. Ils n'ont pas choisi la région parisienne car la biodiversité y est beaucoup plus affectée et la problématique de la biodiversité dans cette région est devenue un concept très artificiel (On y met des ruches sur les toits etc.)

Ensuite, ils ont opté pour Ecosphère car leur expertise en termes d'environnement est reconnue en France.

Espèce invasive:

Vrai problème local avec l'herbe de la pampa et le buddleia. Arrachage à certains endroits par des sociétés extérieures. Grande discussion sur les espèces invasives. Des solutions sont recherchées : ils ont contacté la commune pour qu'ils restreignent ces plantations.

Indicateurs

Opinion du public : un exemple d'action de sensibilisation du public pourrait être, en plus de leur intervention auprès de la mairie pour tenter d'endiguer l'invasion par ces plantes, de mener une action de sensibilisation pour cette herbe de la pampa. Ce serait une opération relativement simple et facile à mettre en place.

Indicateur 1 : Nombre d'espèces

Problème de compréhension du mot « taxon ».

T : Nombre d'espèces n'est pas un indicateur en soi. Il faut une valeur de référence pour évaluer si la biodiversité à augmenté ou non. On doit arriver à une performance (Régression, augmentation). Ce n'est pas possible de comparer le nombre d'espèces de deux milieux différents : pas le même nombre d'espèces en foret qu'en prairie…

On se pose donc la question de savoir si c'est normal ou pas. En fonction de ce résultat, on peut prendre des mesures de gestion afin de permettre une évolution de l'indicateur. Il faut donc des fiches pour aider à comprendre l'indicateur et savoir comment l'interpréter.

L'ingénieur environnement : je n'ai pas la compétence de savoir comment augmenter le nombre d'espèces et de connaître les moyens à mettre en place.

Le lien entre les indicateurs doit être marqué.

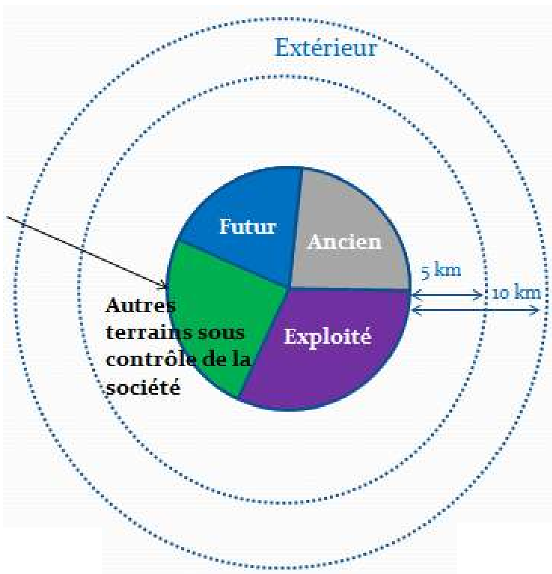
Indicateur 3 - 4 : Espèces protégées ou sur liste rouge

T : Espèce protégée, notion très hétérogène au niveau de l'Europe alors que la réflexion sur la liste rouge existe de manière un peu plus similaire et plus homogène. En France, Allemagne ou Grande-Bretagne, il y a une tradition d'espèces protégées. Alors que dans la Directive Oiseaux, Habitats, ils vont plus loin. Je ne suis pas certaine par exemple, qu'en Espagne, il y ait des listes d'espèces protégées. De plus, il peut y avoir sur ces listes beaucoup d'espèces qui ne s'adaptent pas bien à une carrière. Tandis que, dans la liste rouge de l'IUCN, il y a une réflexion sur le fait qu'une espèce serait menacée, vulnérable ou en danger. La méthode a été développée au niveau des Etats, des régions et est effectuée par des scientifiques. Il y a des listes nationales françaises, voir régionales.

T : il propose de supprimer l'indicateur sp protégée et ne garder que l'sp IUCN.

Echelle de la carrière:

Surface maitrisée par la carrière = Zone de maitrise d'usage, contrôle d'usage.



Problème avec la détermination « autres zones » : définies comme « autres terrains sous le contrôle de la société ». Il faut faire attention à cette zone verte, parce qu'elle implique la notion de compensation. Si tient compte de cette zone pour les indicateurs, on met en place une zone de compensation potentielle. Il faut décider de les prendre en compte ou non.

Au final pour eux, la définition de la carrière est : « La carrière, l'endroit où l'on peut agir, c'est la zone de carrière proprement dite qui comprend la zone déjà exploitée, en exploitation, future exploitation, plus toutes les zones où la société a un contrôle. Donc ça comprend toutes les parcelles. » Les zones où la société à un contrôle peuvent être prises en compte au cas-par-cas en fonction du bon sens (par exemple si la zone est à 20km de la zone exploitée ; elle ne doit pas être prise en compte).

Il n'y a pas de problème de définition pour toutes les zones de la carrière, à part la zone verte qui pose également des problèmes de prise en compte pour les indicateurs.

Nombre d'espèces dans la carrière en exploitation, dans les restaurations… Le travail à fournir n'est pas très compliqué pour obtenir cette donnée qui doit être prise en compte, car le nombre d'espèces dans une zone restaurée ne peut pas être comparé à celui d'une zone en exploitation.

Indicateur 2 et 5 : Abondance en espèce

Important par exemple pour les espèces à problèmes (menacées), qui sont à valeur patrimoniales ou indicatrices. C'est la carrière qui va influencer quelles espèces on va choisir pour l'abondance. Ces indicateurs doivent être flexibles sur l'espèce à prendre en compte selon les problématiques particulières de la carrière (espèces indicatrices de la fragmentation du paysage, du niveau trophique…). De plus, des informations doivent y être associées sur la manière d'interpréter les fluctuations en fonction de l'espèce prise en compte et la façon d'y réagir (management) et d'en améliorer la gestion. Le type d'espèce doit être choisi par des experts qui vont mettre en évidence des problématiques particulières au sein de la carrière. Cependant, le choix des espèces indicatrices doit vraiment rester libre en fonction de chaque site.

L'abondance peut se mesurer qualitativement ou quantitativement. On peut juste :

- définir un seuil de viabilité de la population,
- dire si l'espèce est présente rarement ou abondamment.

Le problème également pour les indicateurs est de savoir qu'elles sont les données déjà disponibles (EIA).

Indicateurs 6, 7, 8, 9 : Relatifs aux habitats

T : Habitats = formation végétale donnée. Chênaie, frênaie, pinède… Définition de cette nature.

Nombre d'habitats et surface : OK. Toutefois, la notion d'habitats protégés en France n'existe quasiment pas.

Il y a un problème avec les habitats de la directive Habitats (ils ne sont pas tous protégés) : les habitats de la directive sont définis tels que représentatifs d'une zone géographique donnée. Par exemple, la chênaie verte y est présente parce qu'elle est représentative de la zone méditerranéenne. Elle est même trop présente dans cette zone méditerranéenne. Mr T éliminerait donc cette notion d'habitats protégés. N2000 = habitats remarquables mais pas protégés ! La connaissance sur les habitats même rares est beaucoup trop superficielle que pour prendre en compte cet indicateur. Ca n'apporte pas grand-chose et c'est trop compliqué.

Question : un nombre d'habitats en Europe au sein d'une carrière peut varier de combien à combien ??

Néanmoins, dans l'indicateur le nombre d'habitats et surfaces peut être relié à : « vous avez tel ou tel habitat », ceux-ci sont intéressants et il faut y faire attention. D'autre part, quel est l'état de bonne conservation de l'habitat en question ?? Cette question peut être jugée par un expert. On pourrait ajouter l'état de conservation : mauvais, bon, moyen. Le problème de l'habitat est sa définition : une chênaie est définie selon la présence d'un certain cortège floristique. Si on n'a pas ce cortège, on ne peut pas définir cet habitat comme une chênaie… On risque donc d'avoir des problèmes. Certains habitats peuvent avoir une très petite surface mais pour autant être d'intérêt.

<u>Indicateur 10.</u>

Le but : savoir si l'environnement à l'extérieur de la carrière est riche en biodiversité ou possède des aires protégées.

La réflexion est de savoir si on a des aires protégées à proximité pour identifier s'il s'agit d'un contexte particulier, voir ce qu'on peut faire et ce que la proximité de cette aire implique pour la carrière. Ce n'est pas général à toutes les carrières mais cela peut être intéressant pour certains contextes locaux. Cet élément peut constituer un système d'alerte, un indicateur de ce qu'il y a autour de la carrière. On ne peut pas, par contre, agir dessus. C'est seulement une information pour les carriers sur le contexte local des alentours.

La surface de carrière détenue par contre n'as pas beaucoup de sens. Cet indicateur peut être vu au niveau de la compagnie : on a 20% des carrières qui sont à proximité d'aires protégées ou de zones riches en biodiversité. Cela implique indirectement le questionnement : les carrières ont-elles un impact sur ces zones riches ? Donc, c'est dangereux d'un point de vue opinion publique.

On peut garder cet indicateur pour le moment. Il faut voir au niveau d'Eurogypsum ce qu'ils pensent de cet indicateur.

<u>Indicateur 11, 12, 13 : Impacts en dehors de la carrière</u>

Le bruit, la poussière et la lumière sont des notions que les habitants locaux perçoivent et sur lesquelles ils nous interpellent en tant que carriers.

Par contre, en matière de pure biodiversité, dire s'il y a un impact dû au bruit sur les animaux est assez difficile. Pour eux, l'impact est souvent assimilé à un risque dû à la présence de prédateurs (d'humains). Par exemple, certains oiseaux s'envolent lorsqu'il y a un bruit si celui-ci est inhabituel, donc assimilé à un risque. Si ce n'est pas le cas, ils ne s'envoleront pas. C'est très difficile à appliquer sur une carrière parce que c'est du domaine de la recherche pure.

Pour la poussière, il peut y avoir un impact indirect sur le développement de champignons pour les végétaux, ou des ralentissements de croissance. Mais ce phénomène est très générique, il n'est pas propre à une carrière donnée et donc impossible à mesurer sur un site. En plus, la poussière due au calcaire est différente de celle du gypse qui est sulfaté. Le gypse sous forme de poussière est revendu comme de l'engrais.

Indicateur 14 : Qualité de l'eau

L'évaluation est plus facile à mettre en œuvre car il existe déjà des paramètres bien définis pour la qualité de l'eau et les carriers ont déjà des obligations dans ce domaine. Par exemple, dans le contexte de Caresse, on peut se poser la question du sulfate. Il y a la directive cadre sur l'eau au niveau Européen qui fixe des normes.

Le problème pour évaluer la qualité de l'eau en dehors de la carrière est de savoir ce que rencontre l'eau lors de son parcours. Le saleys par exemple passe à côté de nombreux champs qui ont plus d'impact sur la qualité de l'eau que dans la carrière en raison de la présence d'engrais.

Mais, si on part de la carrière pour savoir s'il y a un impact de celle-ci sur les alentours, on peut se rapporter à la directive cadre sur l'eau et vérifier si on est dans les normes de rejets en composants sulfatés.

Question : retrouve-t-on les mêmes espèces à l'amont qu'à l'aval de la carrière ? Mais là on n'est plus dans l'analyse de l'indicateur.

Un indicateur peut être la présence d'une espèce indicatrice pour répondre à cette question.

Indicateur 15 : Espèces invasives

Les espèces invasives animales posent problème car, à l'échelle d'une carrière, ils peuvent se développer, passer, … sans vraiment être dus à la carrière. La question se pose également de savoir si on doit mettre des barrières pour empêcher les espèces animales ou justement laisser le libre passage. D'autre part, les espèces de plantes sont intéressantes à étudier.

Indicateur 16 et 17 : Fragmentation

Outils pertinents à l'échelle nationale, régionale. Cependant, à l'échelle de la carrière, un degré de fragmentation est très difficile à établir.

Les espèces indicatrices de la fragmentation peuvent être intéressantes : si telle espèce est présente, c'est que la carrière a un impact positif sur la connectivité de telle espèce au niveau du paysage. Thème intéressant et important au niveau national. Néanmoins difficile à mettre en œuvre au sein d'une carrière.

Indicateur 18 : Intégrité trophique

T : intégrité trophique qui peut être mesuré par le niveau trophique du milieu et donc par la présence de plantes nitrophiles ou rudérales.

Indicateur 19 : Qualité de l'eau à l'intérieur de la carrière

Impact à l'intérieur. Un peu redondant avec le 14 !

On peut se baser sur la qualité de l'eau de la nappe phréatique. Des références existent pour la qualité de l'eau, on peut les reprendre. Ensuite, il faut voir si on peut agir sur cette qualité car l'important c'est d'obtenir une performance. La directive cadre sur l'eau peut nous aider à définir si on est dans la norme. Après, on peut décider soit de stagner, soit d'améliorer.

Il convient également de voir s'il y a présence de grands bassins, de lacs, etc au sein de la carrière et savoir si la carrière a un impact sur ces eaux, vérifier si la qualité augmente ou diminue. Par exemple, constater s'il y a eutrophisation de ces plans d'eau.

Le risque est d'avoir alors un lac où il n'y en avait pas. Mais ça, c'est le problème de la restauration après exploitation. Est-ce que le plan d'eau d'après exploitation est conçu de manière à avoir un milieu semi-naturel intéressant écologiquement ? On peut ne rien faire pour l'accueil de la biodiversité ou au contraire créer des berges ou autre qui favorisent la biodiversité.

Indicateur 20 : Forêt

Sur le site de Caresse, il y a des bois tout autour. Ils n'ont jamais envisagé vraiment une gestion forestière de ces zones. On peut voir cet indicateur comme un objectif de forêt ancienne et de maximisation de la biodiversité dans ces zones. On pourrait donc aussi mesurer la présence d'espèces indicatrices de foret riches en biodiversité. Il conviendrait également de vérifier s'il y a la présence d'espèces indigènes après replantation ; ainsi que le nombre de bois morts.

Quand il y a de la forêt sur un site, la question qui se pose est ce qu'on va en faire ?

La gestion des parties forestières par quelqu'un d'autre à été abordée. Réactions : « personne ne rentre chez nous ! ».

Pareil pour les indicateurs… Les mesures en forêt (bois mort nbr…) : dangereux car il y a des sangliers, des gens qui tombent dans les ronces….

Indicateur 21 : Surfaces restaurées

ok

Indicateur 22 : Pourcentages de carrières qui calculent les indicateurs de biodiversité et Indicateur 23 : Pourcentages de carrières qui mettent en place des actions de participation et de communication

Ils sont d'accord si Eurogypsum est d'accord.

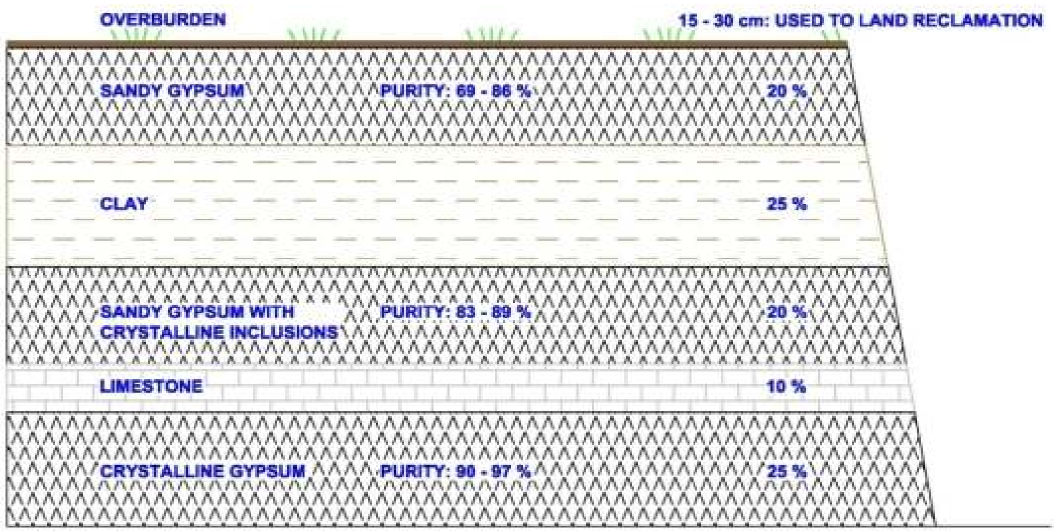
31. MEETING NOTES (STEP 3.3): MEETING OF THE 5TH OF JUNE 2013, SITE OF GELSA (SPAIN)

Attendees

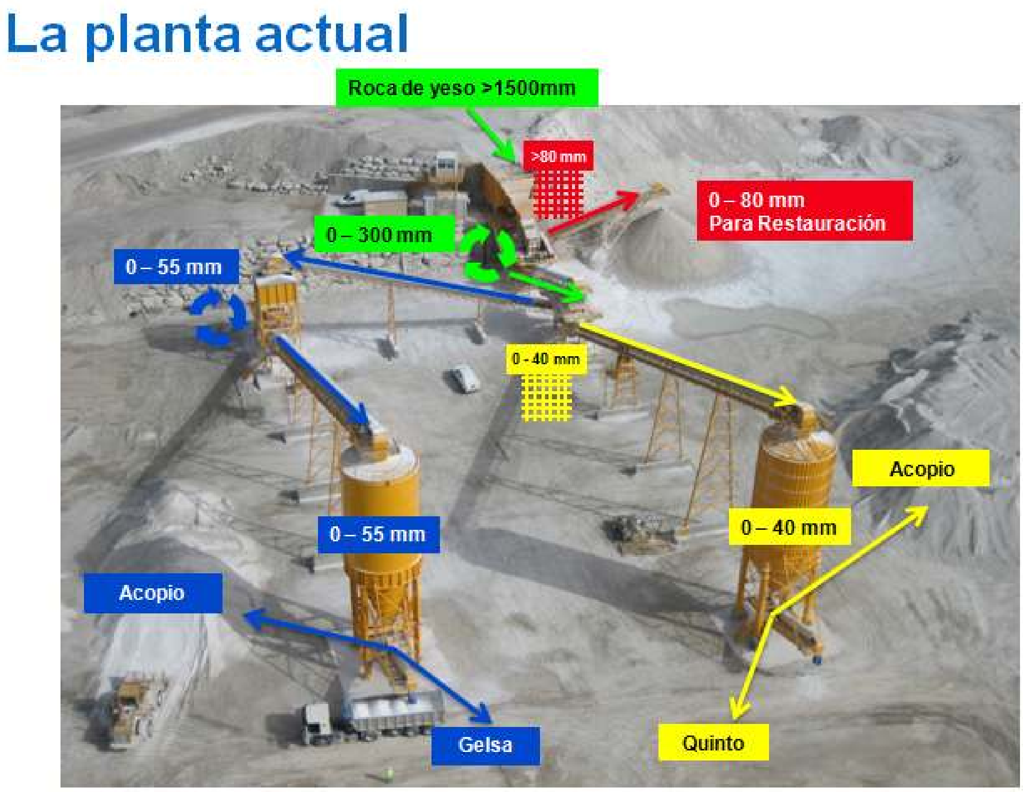
Name	Company	Function
Eva-Lian Lay Gayo	Saint-Gobain Gypsum Activity	Mining Engineer Mineral Resources Department Gypsum Activity
JOSÉ JOAQUÍN ECHÁNIZ SERRANO	Saint-Gobain Placo Ibérica, S.A.	-
PEDRO JOSÉ GARCÍA RAMÓN	Saint-Gobain Placo Ibérica, S.A.	-
CARLOS PAUNER CHULVI	Saint-Gobain Placo Ibérica, S.A.	-
ALEJO ALCARAZ PASEIRO	Saint-Gobain Placo Ibérica, S.A.	-
JOSÉ S. BENITO LAFUENTE	Saint-Gobain Placo Ibérica, S.A.	-
MARIO MORALES	Aridos EL Manchego	-
ANTONIO MANCHEGO	Aridos EL Manchego	-
RICARDO CASTELLÓ MONTORI	Polytechnical University of Madrid	Professor
ANA ISABEL G. SAN CRISTÓBAL	Polytechnical University of Madrid	PhD
Carline Pitz	GxABT, ULg	Master 2 student

Presentation of the quarry of Gelsa

See ppt: 'SGPlaco - Explotación - Restauración Yesos Alfa'



- One front of operating: height of 20 m and length of 1km.
- Gypsum is layered between clay and limestone. The topsoil is very thin and is located directly on a sandy layer of gypsum.
- Exploitation process:



Rehabilitation of land

Objective :

- Creating an integrated agroecological system in the landscape (steppe important for threatened birds, Falco naumanni)
- Recovery of vegetation. Focusing mainly on threatened flora, Senecio auricola
- Reducing the visual impact

Indicators

Indicator 1 to 5: Species

There was a problem with the definition of taxon: Explanation.

They are mostly interested in plants and birds.

- They already know the number of species for the restored areas. And know some birds that are breeding there.
- They already know all the protected plant species in the site and fallowing them in the restorations.

They think that the regional list of protected species is more restricted than the red list species. Red list is clear. But the protected species is more difficult, because there are different levels of protection. So what level to take into account?

They think that we have to take into account the two levels of protection: the red list and the local, because they are complementary. The red list is too broad and do not include all the local species, so to take into account the local protected species is really important.

The abundance is at a first sight really too expensive to measure. To have quadras and extrapolate is complicated, time consuming and expensive. And for measurement of abundance some trainees is needed. So, all of that is expensive. But maybe it will be interesting to have a minimum value for the species community to be ecologically viable. Or a qualitative measurement likes: rare, medium, high. They proposed to talk about the coverage instead of the abundance of plant species.

They were a lot of discussion about the abundance and different opinions. But at the end they said that that indicator is necessary and they agreed with it for species and for protected species.

In the quarry, people are already trained to recognize some of protected plant species on the field. They are really interested about that and motivated. They have pictures of protected species on their technical office and they are really proud to show them.

In general they think that biodiversity indicators mean more costs and more money to expend. Especially in Spain, this is the crisis. And so, they are really cautious for those indicators, despite the fact that they think that this framework is relevant for environmental purposes. We do not have to forget that the economy is difficult at the moment.

<u>Indicator 6 to 9: Habitats</u>

They did not understand what the surface of habitats is. They directly agreed with the number of habitats and the surface, both for protected or not.

<u>Indicator 10</u>

Adjacent has to be defined: how much? 10km? They have protected areas outside the quarry. They agreed directly with the indicator.

<u>Indicator 11-13</u>

Not relevant because of the references lack in the science.

<u>Indicator 14</u>

Not relevant for this quarry because they do not have water at all, nor on the surface, nor under the ground. They just have big rainfalls sometimes.

<u>Indicator 15: Invasive species</u>

The abundance/coverage of invasive species is important too and has to be included. They are just interested about the coverage because they are interested about only plant species for invasive. Indeed, the animals are moving through the quarry and are going everywhere. So we are not able to know if it is due to the activity of the quarry or not. It is a regional problem for animals and not a quarry scale.

The actions taken for invasive are also important.

<u>Indicator 16: Fragmentation</u>

There were a lot of problem with the definition of fragmentation.

- Indirect measurement of the presence of a given specific species that represent the connectivity

They just wanted it for plants, but they understood that the other connectivity of other species is also important. They just not really agreed with that indicator because they did not understood how to implement it in reality and want to know more about it before to decide.

<u>Indicator 17</u>

No water

<u>Indicator 18</u>

Yes but they do not really understand but they agreed with the concept.

<u>Indicator 19</u>

No water

<u>Indicator 20</u>

No forest

<u>Indicator 21</u>

Important for them because they do a lot of restorations and they take care about that.

But it is important also to qualify the restoration. We have to know if it is an ecological restoration or just replant or crops. But maybe it is not necessary to have an indicator for the success of the restoration, because it is difficult to really measure the success of a restoration. And anyway, it is indirectly linked to the number of species and so on.

<u>Indicator 22</u>

ok

<u>Indicator 23</u>

ok

<u>Timing of the indicators</u>

They think that some indicators do not have to be measured every year. For example the number of protected species does not change every year. It depends of the indicator, and they want to measure it the less possible because it is expansive.

They have a 30 year view for the management of the quarry (authorization).

<u>Limit of the quarry</u>

They have one front at the moment. The project is clearly delimited with stakes.

32. MEETING NOTES (STEP 3.3): MEETING OF THE 10TH AND 11TH OF JUNE 2013, SITE OF MARKT-NORDHEIM (GERMANY)

Name	Company	Function
Hans-Jörg Kersten	Knauf	Technical Advisor environment
Matthias Reimann	BV Gips	Director mineral resources Knauf worldwide
ULRICH TRÄNKLE	AG.L.N. Landscape planning and nature conservation management .	Environmental expert

<u>After use indicator</u>

$$\left(\frac{\text{areas with renaturation [ha]}}{\text{area extraction site [ha]}}\right) - \left(\frac{\text{area with restoration/rehabilitation [ha]}}{\text{area extraction site [ha]}}\right)$$

It will be perfect if we reach 100% of land back to nature after exploitation. But it is impossible, because in Germany the laws said that if you are going to use or to mine arable lands or wood land you have to restore it as it was before. So, this is normally not possible to have 100% for the indicator of restoration. You have to deal with it. But you can have a target at the level of the company to have for example 20% of land is under N2000. The message for us, what our society have discussed, is that we give our land back to nature.

If we have a license agreement, and you have to restore only arable lands the extraction site will get a minus value for the after use indicator. And so we have to change the indicator. For that site the indicator after use wouldn't be a good indicator for that extraction site. So in that case, we can only use the number of plant species in the extraction site in comparison with the environment outside. If you have arable land in the extraction side and outside, you will get the same level of plant species. And so the indicator is also works here.

We have 5 BI and 3 of them have to be positive. So if we see that an indicator will be negative, we forget it and concentrate on the others.

Sometimes an indicator depends on the data available. For example, we have some NGOs involved in the quarry that are managing a project on dragonflies. So in that quarry it makes no sense to choose the amphibians instead of the dragonflies. You have to choose the species on which you can have the data. Sometimes it makes more sense to change a little the indicator to adapt to the local context. And another example, if you have a high amount of temporary lakes inside the extraction site, it has less sense to deal with the dragonflies than with the amphibians. The environment outside changes also, from regions to regions. So we have to adapt a little bit the indicators. If you use the same indicator all over Germany it does not work.

- In green: the indicators that the company and experts agreed and that think that it is possible to implement
- In yellow: the indicators that shows some doubts and have to be defined more precisely
- In red: the indicators those are not possible to measure on the field
- In pink: the indicators those are not relevant for that case

Indicator 11, 12, 13

The main problem with those indicators is to implement them on an extraction site. It seems really difficult. For example, the impact due to noise, to lightening or to dust; it is really hard to deal with it. So we do it, we try to do it, normally in the EIAs. For that you need all the external surveys from the technical people and so on. To put the results in an indicator for the directors and the public is nearly impossible.

Ind 15: Invasive species

It is difficult to deal with it at an excavation site scale. Normally it is used at a national or regional level. In Germany, here, we know maybe 2 or 3 invasive species in an excavation site, that's all.

- Only the number makes no sense. We have to complete it with the **coverage** or the abundance of invasive species.
- **Means implemented** for the invasive species is important too. This is a descriptive indicator.

Comment on all the system

'Germany thinks that only 3 or 4 of the indicators have to be positive'. It will be good to say that some indicators make no sense for Atlantic or Continental regions. It is important for them that each quarry may choose the indicators they want. For example, the invasive is not a problem for them.

Indicator set from Mr Trankle

Mister Micheal Rademacher and Mr Trankle have developed together a set of 10 indicators for the non-metallic industry. And they have restricted them to a set of 5 or 6 indicators at the moment. That is those that we want to implement here. Those indicators are dealing and working only directly with the extraction site in combination with the environs, and with the restorations and the rehabilitations of the extraction sites. The whole indicators set is based on the result from Mr Rademacher and Mr Trankle about the nature conservation value of the operating extraction site. They have now data collected over the last 20 years, all over Europe. Together they have seen more than 300 operating extraction sites. They have a lot data on plant species, birds' species all over these extraction sites. All these data are included in their indicators, and they have also tested the indicators on large scale with large extraction sites and Dr Trankle will do it here on gypsum quarries. All these indicators are joining the 'Status and trends of the components of biological diversity, in the quarry'. That is what they have. They decide not to deal with that impact indicators because they are negative for the industry and these impacts indicators will come automatically from the NGOs or come from the authorities or agencies and so on. Consequently they decide that it was not their challenge to deal with that impact indicators. What they want to have is the influence on operating extraction to make it better and better as possible as much. It is why they developed their indicator about the number of plant species per extraction site.

<u>Indicator 1: number of species.</u>

To choose one selected species to analyze for biodiversity is really difficult. It is different form regions to regions, from country to country. South of Europe you have given species, North of Europe you have other species. It is nearly impossible to generate a list to deal with such selected species. And so, they decided to use the whole plant species in the extraction sites. That gives them the Number of species.

<u>Taxonomic group</u>

To choose the taxonomic group, they have already a system in their indicator set, given the size of the extraction site.

They build this system dependant of the size of the quarry because there is a relationship between an area and the number of plant species inside. There is a linear correlation between the two (Figure 1). From that relation you know that for a small extraction site you will found a given number of species and for a larger extraction site you will found a higher amount of plant species. Consequently, it is possible to compare the small extraction sites with such big extraction sites, only if you divide directly the number of plant or birds species thought the area. Then you will get exactly the relationship between area and the number of species. And they are now much more comparable. With just a number of species without this link to the area you cannot compare the extraction sites between each other.

$$\left(\frac{\text{number of plant species}}{\text{area extraction site [ha]}}\right)$$

Equation: Indicator about the Plant species (birds, amphibians, dragonflies, etc. : same method)

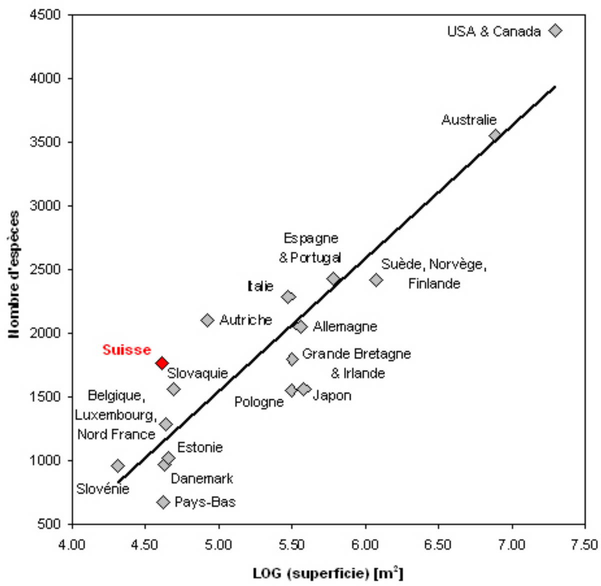


Figure1

Exemple from http://www.ville-ge.ch/musinfo/bd/cjb/cataloguelichen/index/informations

Timing

They already discussed about measuring the indicators with a five years period. Dr Trankle read 8 or 10 years ago, a European paper that was dealing with 5 years. He thinks that 5 years is ok in an operating extraction site, but it will be also possible to do it also every 7 or 8 years. He thinks that 5 year for a first start is ok. Markt-Nordtheim is an extraction site that is working very fast over the landscape, the larger quarries have much more time to do it, and the larger quarries have much more areas for plants, birds and so on. Te timing can change a little bit. But 5 years is the base for our after use indicator, it work also very fine with the indicators about plant species.

TAV

In their project they worked also on further steps: the target achievement values (TAV). This is the value to reach with the indicators. This is a complicate problem, but they have deal with that in their project already.

For example for the plant species indicator, they have at the moment around thirty extraction sites with the measurement of the number of plant species, with the area. That give directly the BI for each extraction sites that they have reported on a diagram: BI - area of the extraction site. After they used excel to generate a simple trends line. Consequently, now when they have a new extraction site they only have to look to this diagram the area of the extraction site to have the TAV of the BI. It is the BI that the specific extraction site has to fulfill in the context of all their extraction sites. So there is a direct connection between all the extraction sites. As nature is variable, from years to years, they decide to fix that 90% around this TAV is also ok.

They have already quite good data about the plant species and the bird's species, in the extraction site and in the environs. And for all these indicators they can create a TAV: a value that the extraction site has to go to have a more or less acceptable BI. We have worked with the whole system for 8 or 10 years. They need more data to increase the accuracy, but the system is already working well.

Those data come from Heidelberg Cement and him in a major part; they are not public at the moment.

They are working on a data base where the extractive industry can put on the data on birds and plants from the EIA. These data could maybe be used in 5 or 10 years to calculate the BI. The more data they will get the more stable the line will be.

They are convincing that this system of TAV will work the same way, with the same relation for all the regions in Europe. Sometime, it is possible to have a really specific site where the TAV will not working because they have a particularly poor number of species. This may be because of a specific geology that implies a poor biodiversity of plant. They conclude that the TAV is not working there, and they dealing with the number of species of the extraction site with the environs. So the base extraction site is poor and the environs are poor also. They can conclude then that the number of species both in the extraction site and in the envrions is decreasing. For example in Markt-Northeim, they will have 270 plants species in the quarry and maybe 370 in the environs. And in another site you can have for example only 80 plants species but in the environs also 160. So the two BI are quite the same for two different geology contexts. So, all the values all over Europe will be comparable.

Time needed for the collect of data

They need only 2 days more work to collect the data about the environs. They estimated all the working time.

Average time estimation sheet for biologists visiting quarries to get a clear picture about possible costs (source MIRO, adapted):

Size (ha)	Plants	Migratory Biotopes	Surroundings	Avifauna	Amphibians	Dragonflies Butterflies	SUM
> 75	3 - 4	1 - 2,5	1 - 2	5 - 7	4	4	18 – 23,5
25 – 75	2,5 - 3	1 - 2	1 - 1,5	4 - 5	4	-	12,5 – 15,5
10 – 25	1,5 - 2	1 - 1,5	1	4 - 5	-	-	7,5 – 9,5
< 10	1 - 1,5	1	-	-	-	-	2 – 2,5
							working days

The small extraction site less than 10 ha, normally, every 5 years have 2 - 2,5 working days. And a large extraction site, if you do all of these indictors you will have 18 to 23.5 days of working time. For such large extraction sites, from the Cement industry, every 5 years 20 days of working is ok. The data are collected with experts. A working day may cost around 600 Euros, depending on the regions and the qualifications.

Indicator: Protected species

Mr Rademacher and Mr Trankle decided not to use those indicators about the protected species or Red list species because it changes over time. Indeed, a lot of these Red list species are very old and past 20 or 30 years old. They think that they are totally wrong. And for the protected species, you have the problem that you have the regional lists, the list for the whole country, etc. And every 5 or 10 years, it will change. Then you made an indicator 5 years ago, and then the Red list changes and you have to change the indicator. And then you have an indicator that is not comparable.

But as they are already dealing with the number of species, dealing with the protected species will not really add more work. Because you have all the information's, what you just have to do is to look to the list of the species and highlight the one that have a specific status based on different lists of protection. You can create this indicator automatically and really easily when you have the list of species. They heard a lot of countryside's that are going to those protected species. Moreover, the public, the agencies, even the European commission is interested and is dealing with protected species. So, this is quite important to incorporate them in the framework. But of course, biodiversity do not have to be restricted to the protected species. So of course this indicator cannot be implemented without the Number of species. It is a complementary and additional indicator to compete the number of species. This is a descriptive indicator. You can do it without any more work, maybe 1 hour more and that's all.

Indicator: Abundance

This is the measurement of the individuals of a selected species.

The problem with this indicator is if you have some protected species it is difficult to have the permission to catch individuals to extrapolate the number of individuals of the population. For example, ones they leaded a project about bats, and they had a lot of problems to get the allowance to catch them. And another problem was to find people that were competent to do that. It was really expensive and complicated.

The purpose of this indicator is to know if you have in the quarry a viable population of a selected species, and not only one individual that have just crossed the quarry ones. But they are thinking that this indicator is already taken into account in their species indicators, because they are comparing the diversity inside the quarry with the outside.

We have also to define what a selected species is. We have to define also selected species to have comparable data all over Europe.

In the system of Mr Trankle, they wanted too to take into account this abundance. For that indicator you have to generate a list of species for every country or regions, to define what the target species (the selected species) is. But it is really hard to generate such a list because of th variability between countries or regions. They tried also in their project with indicator species, what they are calling the target species for their biodiversity actions plans. Every extraction site has to make every five years a biodiversity action plan. And for this BAP we fix the target species. And those species has to be surveyed every five years. But they decided also not to use it, because it is very expensive and what they founded is that their target species or indicator species have a very variable abundance from year to year. For example, if you are in a year with a lot of rain, you will get a lot of amphibians and nearly no butterflies in the landscape. So, if your target species is a specific butterfly, you will find no individuals on that year. And in you 5 years mapping, on this year you will get no results.

They think that the abundance indicator is a really good idea. But the problem is how to work, to deal with it. The first problem is to generate a list to select the species in order to have comparable measurement thought Europe. And the second problem is the big variability between year to year of the abundance of species.

Indicators are different from Management plans (BAP). They deal a little bit with the abundance in their indicator system by the management plan of the target species. Heidelberg Cement has guidelines and the management plans are fixed. But the indicators and the management plan are different. The actins plans help to improve the values of the indicators, but you do not need it. You can deal only with the indicators.

Simplification of the indicators

Mr Rademacher and Mr Tankle, at the beginning of the developing of the indicators deal with more than fifty indicators. They were so complicated, included great and crazy ideas. What they learned is that they had to break down the system of indicators to simplify more and more the set. The simpler indicators you have the better it is. Indeed, to explain people in a meeting that the indicators are dealing with the number of species is too complicated. They are interested only about the value. They want only to understand that they have a given value, and that they have to reach a target value and how to improve the situation. That is what is coming in a business meeting with directors. All the ecological other parts are too complicated and useless for them. It is why they simplify all the set to only 5 or 6 indicators.

All they have deal with the last 20 years is nature conservation value of extraction site due to the scarce face, to the nutrient poor sites, its location and so, and that is rot make an extraction site so perfil in our arable used landscape. It is on what their indicators set is based on.

Surrounding

They take a 500 meter buffer zone outside the license area of the exploitation site. They do it with a GIS system. The 500 meters have been fixed during the phd thesis of Dr Trankle, 20 years ago. It was fixed base on the literature as this is the distance on which a plant species must be able to distribute themselves in several years.

Scale of indicators

The indicators must be calculated on a project scale.

Indicators: Habitats

There is a problem for defining clearly a habitat at a scale of a quarry, because there are a lot of temporary and small habitats.

There is some problem of interpretation with the definition of N2000 habitats. Sometimes you are missing one of the species that have to be there to define a specific habitat and so you cannot identify your habitat. And there is not any list on temporary biotopes.

It is why Mr Trankle decided to measure and defines the wonder biotopes because t was to difficult to deal with the habitats in a quarry.

Indicator 10: Size of quarry leased, managed in, or a…

Sometimes the decision to protect an area is more political than for a biodiversity point of view. For example the N2000 forests are often chosen because it belongs to the state and not to private people. This is easier to put them under N2000. Protection is a political thing. And here we want to have the status of the quarry.

Moreover, it is difficult to compare the different country of Europe, because the status of protection may be different from country to country.

Adjacent: how much kilometer is taken into account?

To implement that it is not too difficult. Normally all the protected areas are available, there are already digitized on the computer. Normally every environmental consultant has it on their own computer. And normally you have also the license perimeter on the computer. So you just have to make a buffer zone outside this license perimeter and see if you have protected areas in that buffer. The buffer zone may be for example a distance of 1km around the license perimeter. Is is a description indicator.

The question is what is behind this indicator? What do we really want to answer?

It is dangerous for them because the public thinks all the time that the quarry has a negative impact on the protected areas. And so it is dangerous to say that they are located near protected areas because everybody will say that they are bad for them.

And does really make sense for quarry? They cannot act on this indicator. Or they have to choose an area for the quarrying without any protected around the activity? It is just because of the opinion of people, but in reality they do not have negative impact on protected areas and to have protected areas around them is great because it is a pool of species that may disperse themselves to the quarry. So this indicator is dangerous because of the public opinion. We cannot really make an interpretation: is it good or bad to have protected areas adjacent to the quarry?

<u>Indicator 17</u>

They do not have river system inside the quarry

<u>Indicator 18</u>

It is an indirect measurement by the trophic level of the soil, measured by the floristic association in place. In the gypsum quarry they are working very fast over the landscape. But if you are going to the cement industry they are dealing with such indicator up to 70 years.

<u>Indicator : Forest</u>

They do not want it here because they are cutting the forest and do not leave the forest; so they do not have any old forest.

<u>Indicator : Fragmentation</u>

Maybe connectivity is a better term because fragmentation is negative. The measurement of connectivity will be better.

We have to define what the regional scale is: 5km, 10km, a political recommended area. The bio-geographic regions are too big. Maybe it has to be adapted at for each country and leave it flexible. The scarce habitat at a regional scale corresponds to the list of protected areas, so you have this data on GIS. This indicator developed is really interesting.

<u>Indicator :Restoration</u>

= after use.

Indicator 22, 23

Eurogypsum so, ok

Indicator Name	**Name of the indicator (Number of the indicator)**
Lead agency	Institution responsible for calculating and communicating the indicator.

European ID

The indicators developed in the framework are based on the SEBI 2010 which relies on the Focal CBD areas (worldwide biodiversity target) and the European indicator headline (European biodiversity target). Each indicator is set in the DPSIR model.

- **Focal CBD area**: ‘The CBD agreed upon a first headline indicator list in 2004, grouped in seven focal areas (Decision VII/30)’ (34).
- **European indicator headline**: The CBD list was ‘adapted to the European context and presented in the Message from Malahide (2004) as a first set of 15 European headline biodiversity indicators’ (34).
- **Indicator type, DPSIR**: Classification of the indicator in one of the DPSIR categories. ‘A number of approaches have been used to develop and structure indicators. One of the commonly used causal frameworks for describing the interactions between society and the environment is the driver, pressure, state, impact and response (DPSIR) model, based on the PSR framework model proposed by OECD in 1993’ (34).

Use an interpretation

Key Eurogypsum question
The key Eurogypsum question the indicator helps to answer.

Definition

Definition of the indicator
Definitions of the terms used in the definition

Description of source data

Units in which it is expressed: (e.g. km2, number of individuals, % change)
Data availability in gypsum quarry:
Main result analysis of the eleven EIAs received from the Gypsum Industry.

Description of the opinion expressed by the stakeholders

Stakeholder’s opinion: Main result about the opinions of all the stakeholders thought the survey.
Gypsum actor’s opinion: Main result of the opinions of the local stakeholders about the implementation of the indicator on the field.

Implementation

What is taken into consideration for a future implementation

34. AGENDA OF THE BIODIVERSITY WORKSHOP OF THE 26TH OF NOVEMBER 2013 (NEXT STEPS)

Workshop: Promoting Biodiversity in Gypsum Quarries

26 November 2013 - 14h00-17h00

Venue : Eurocities-Square de Meeus 1-1000 Brussels

Developing a common KPIs framework for biodiversity management in gypsum quarries throughout Europe for Eurogypsum: Methodology and Results

Master Thesis bio-engineer: Carline Pitz
Professor: Gregory Mahy,
Head of Biodiversity & Landscape Unit, Gembloux Agro-Biotech-ULg

13h30: **Registration and Welcome Coffee**

14h00: **Welcome Address**
Mr. Philippe Chevalier, Head of the Eurogypsum Quarry WG

14h15: **KPIs Framework development for Gypsum Quarries -Methodology**
By Prof. Mahy and Carline Pitz

- Literature review and assessment of 11 Gypsum Environmental impact assessment
- The validation of the KPIs framework by Eurogypsum
- The survey on agreed KPIs framework: stakeholder contribution
- The case studies-three pilot Gypsum quarries: validation of the agreed KPIs framework on the ground

15h15: **Q&A followed by coffee break**

15h45: **KPIs Framework Results for Gypsum Quarries**
By Prof. Mahy and Carline Pitz

- General Consensus KPIs Framework for Gypsum Quarries
- Description of each indicator
- Recommendation for the future

16h30: **Q&A**

17h00: **Conclusions by Philippe Chevalier, head of the Eurogypsum Quarry WG**

35. RESULTS OF THE FIRST OPENED QUESTION OF THE SURVEY (STEP 3.1), ABOUT ANY IDEA OF OTHER POTENTIAL RELEVANT INDICATORS (QA). THE IDEAS OF OTHER INDICATORS THAT MAY BE USED GIVEN BY THE STAKEHOLDERS ARE DIVIDED INTO THE FOUR FOLLOWING CATEGORIES

1. Fourteen proposals were judged as already included in the framework:
   - ‘Ecosystem and ecosystem service indicators. Also indicators on the downstream of the supply-chain. However these depend on the scope.
   - Similarity of the restored community to the natural surroundings.
   - Usage of restored quarries to increase connectivity amongst habitats of interest.
   - It should be able to express the contribution of career to preserving a habitat or species population that overflows. For habitats it is important to take into account their dynamic and what is eventually done to curb.
   - The quality standards for surface water (see Water Code).
   - Position of the quarry as a relay or wildlife / flora in the circulation / dissemination of fauna / flora.
   - Quarry with a number of internal communication for biodiversity.
   - Old knowledge’s of current extinct species on the site and that a management action could take back.
   - Sustainability of facilities and of the management to ensure the maintenance of habitats over time.
   - The conservation status of habitats and species populations.
   - If you are interested in birds, you can also look at the reproductive success of individuals who are reproducing in the quarry (e.g. number of fledglings produced in a colony of gulls nesting in a quarry over other colonies).
   - The percentage of (temporary) Wander Biotopes on the mining area.
   - ‘% of quarry surface with stable/unstable slopes.
   - Presence of steep cliff and area / meter of untapped size front.’

2. Four proposals were already removed by the quarry WG:
   - ‘Presence of a biodiversity policy in the management plan.
   - % of quarry surface with human disturbance (i.e. discharge of material, etc).
   - The implementation of biodiversity action plans to coordinate biodiversity protection.
   - The ‘IBP’, developed by the INRA in Nancy. http://www.foretpriveefrancaise.com/ibp/‘: it was removed by the quarry WG as it is a composite indicator.’

3. Four proposals were judged not precise enough or is not a measurement:
   - 'Soil properties/quality should be monitored. What about monitoring productivity in mountain habitats, etc?
   - The degree of pedogenesis, soil characteristics (for example: pH, nutrient content), landscape features.
   - Water ph. This could determine the type of species that may be found in the area. It may result from residue of quarrying.
   - GDI certification could be a most useful means for establishing and articulating a biodiversity management system. See http://gdi.earthmind.net.'

4. Ideas
   - 'A site management plan with clear objectives in terms of maintaining habitat restoration.'

36. DELIVERABLE 2: FIRST CONSENSUS FRAMEWORK WITHIN EUROGYPSUM QUARRY WG. PRESENTATION OF THE FRAMEWORK PROPOSAL OBTAINED AFTER THE FOCUS GROUP WITH THE QUARRY WG

N	CBD focal area	Headline indicator	Eurogypsum specific indicator
1	Status and trends of the components of biological diversity	Trends in the abundance and distribution of selected species	Number of native species in selected taxonomic group
2			Abundance of selected species in the quarry (indicators species)
3		Change in status of threatened and/or protected species	Number of protected species in the quarry
4			Number of Red list species in the quarry
5			Abundance of protected/Red list species in the quarry
6		Trends in extent of selected biomes, ecosystems and habitats	Number of habitats in the quarry
7			Surface of selected habitats in the quarry
8		Trends in extent of protected habitats	Number of protected habitats in the quarry
9			Surface of protected habitats in the quarry
10	Impact oustide/ Indirect impacts	Protected areas and areas of high biodiversity value	Is there adjacent protected areas or areas of high biodiversity value outside the quarry
11		Indirect threat: threats due to activity on the off-site habitats	Is there an impact due to noise on animal disturbance outside the quarry
12			Is there an impact due to lighting on animals outside the quarry
13			Is there an impact due to dust emission on animals or on habitats outside the quarry
14			Is there an impact due to quarry activities on water quality in freshwater and riparian environments outside the quarry
15	Threats to biodiversity	Trends in invasive alien species	Numbers of invasive alien species in the quarry
16	Ecosystem integrity and ecosystem goods and services	Connectivity/fragmentation of ecosystems	Fragmentation of natural and semi-natural areas. Area of a scarce habitats in the quarry/ Area of the scarce habitat at a regional scale
17			Fragmentation of river systems
18		Trophic integrity	Trophic integrity of ecosystems
19		Water quality in aquatic ecosystems	Freshwater quality
20	Sustainable use	Area of forest ecosystems under sustainable management	Forest: growing stock, increment and felling
21		Habitats protected or restored	Surface of habitats restored
22	Means implemented for biodiversity		% of quarry with that calculate biodiversity indicators
23	Public opinion	Public awareness and participation	% of quarry that implement communication and participation actions

1. Introduction

Various technical terms will be introduced throughout the thesis. Some of these terms may be unfamiliar to readers who are not ecologists, while others have multiple connotations from differential usage. To reduce the potential for misunderstandings, key terms are explained in the manner in which they are used.

This glossary is not definitive; it will be progressive and will include all the futures concepts that will be not comprehensible for everyone.

2. Glossary

2.1. What is biodiversity, ecosystem and landscape?

Biodiversity

- **Biological diversity** or **Biodiversity**: 'is the variability amongst 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' (CBD, 1992).
- **Biological resources**: 'Includes genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity' (CBD, 1992).

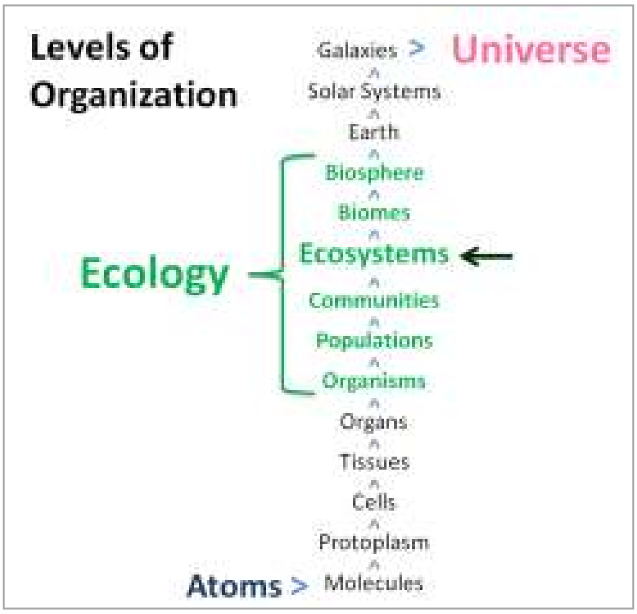


Figure 6 Levels of organization of Ecology, highlighting ecosystems (Ellis & Duffy, 2013)

- **Genetic resources**: 'Means genetic material of actual or potential value' (CBD,1992).
- **Genetic material**: 'Means any material of plant, animal, microbial or other origin containing functional units of heredity' (CBD,1992).

Ecosystem and the environment

- **Ecosystem**: 'Means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit' (CBD,1992). 'An ecosystem is a community of organisms interacting with each other and with their environment such that energy is exchanged and system-level processes, such as the cycling of elements, emerges' (Ellis & Duffy, 2013).
- **Biomes**: 'Organize the biological communities of the earth based on similarities in the dominant vegetation, climate, geographic location, and other characteristics. Aspects of the physical environment such as precipitation, temperature, and water depth, have a strong influence on the traits of species living in that natural environment, and thus biological communities experiencing similar environmental conditions often contain species that have evolved similar characteristics' (McGinley & *al.*, 2013).
- **Biosphere**: 'Is the biological component of earth systems, which also include the lithosphere, hydrosphere, atmosphere and other "spheres" (e.g. cryosphere, anthrosphere, etc.). The biosphere includes all living organisms on earth, together with the dead organic matter produced by them' (Ellis & Bledzki, 2013).
- **Community structure**: 'Mean the physiognomy or architecture of the community with respect to the density, horizontal stratification, and frequency distribution of species-populations, and the sizes and life forms of the organisms that comprise those communities' (SER, 2004).
- **Species**: 'A group of organisms capable of interbreeding and producing fertile offspring of both genders, and separated from other such groups with which interbreeding does not characteristically occur: however, for asexual organisms, a distinct species may be considered a collection of organisms which have very similar DNA or physical characteristics. Certain species are further subdivided into subspecies' (Hogan & Millikin, 2013).
- **Taxonomy**: 'is the scientific classification scheme of grouping and categorizing organisms, including the concepts of genus or species' (Hogan & McGinley, 2011; Bock, 2004).
- **Taxon**: 'is any inividual species or subspecies that has distinct and recognizable characteristics' (Hogan & McGinley, 2011; Bock, 2004).
- **Habitat**: 'Refers to the dwelling place of an organism or community that provides the requisite conditions for its life processes' (SER, 2004). 'That means the place or type of site where an organism or population naturally occurs' (CBD,1992).
- **Abiotic factor**: 'Is any of a number of the non-living components of a habitat' (Hogan & Monosson, 2013).
- **Biotic factor**: In opposition with abiotic factor, it is any of a number of the living components of a habitat (Hogan & Monosson, 2013).

Ecosystem and relates

- **Ecological processes** *or* **ecosystem functions**: 'Are the dynamic attributes of ecosystems, including interactions amongst organisms and interactions between organisms and their environment. Ecological processes are the basis for self-maintenance in an ecosystem' (SER, 2004).
- **Ecosystem interactions**: 'Exchanges of materials and energy amongst ecosystems' (MA, 2003).
- **Ecosystem boundary**: 'The spatial delimitation of an ecosystem, typically based on discontinuities in the distribution of organisms, the biophysical environment (soil types, drainage basins, depth in a water body), and spatial interactions (home ranges, migration patterns, fluxes of matter)' (MA, 2003).
- **Ecosystem properties**: 'The size, biodiversity, stability, degree of organization, internal exchanges of materials and energy amongst different pools, and other properties that characterize an ecosystem' (MA, 2003).

Landscape

- **Landscape**: 'Commonly refers to the landforms of a region in the aggregate or to the land surface and its associated habitats at scales of hectares to many square kilometres. Most simply, a landscape can be considered a spatially heterogeneous area' (Turner, 1989).

Biogeographical regions

- **Biogeographical region**: 'The Inspire Directive[53] defined Biogeographical regions as 'Areas of relatively homogeneous ecological conditions with common characteristics'. The most important guiding document in regard to Biogepgraphical regions in Europe is the Habitats Directive (EEC/92/43), which contains a list of the 'biogeographical regions' (Article 1.iii). These biogeographical regions are the basis of a series of seminars evaluating the Natura2000 network and for reporting on the conservation status of the habitats and species protected by the Directive as required every 6 years.' (INSPIRE/TWGBR, 2011).

[53] Official Journal of the European Union, 2013c. Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32007L0002:EN:NOT, last accessed April 2013.

2.2. Why is biodiversity so important?

Ecosystem services

- **Ecosystem services**: 'The benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth. The concept 'ecosystem goods and services' is synonymous with ecosystem services' (MA, 2003).
- **Provisioning services**: 'The products obtained from ecosystems, including, for example, genetic resources, food and fiber, and fresh water' (MA, 2003).
- **Regulating services**: 'The benefits obtained from the regulation of ecosystem processes, including, for example, the regulation of climate, water, and some human diseases' (MA, 2003).
- **Supporting services**: 'Ecosystem services that are necessary for the production of all other ecosystem services. Some examples include biomass production, production of atmospheric oxygen, soil formation and retention, nutrient cycling, water cycling, and provisioning of habitat' (MA, 2003).
- **Capital value (of an ecosystem)**: 'The present value of the stream of future benefits that an ecosystem will generate under a particular management regime. Present values are typically obtained by discounting future benefits and costs; the appropriate rates of discount are often a contested issue, particularly in the context of natural resources' (MA, 2003).

Ecosystem stability and resilience

- **Ecosystem stability**: 'A description of the dynamic properties of an ecosystem. An ecosystem is considered stable if it returns to its original state shortly after a perturbation (***resilience***), exhibits low temporal variability (***constancy***), or does not change dramatically in the face of a perturbation (***resistance***)' (MA, 2003).
- **Resilience**: 'The capacity of a system to tolerate impacts of drivers without irreversible change in its outputs or structure' (MA, 2003).
- **Ecosystem health**: 'A measure of the stability and sustainability of ecosystem functioning or ecosystem services that depends on an ecosystem being active and maintaining its organization, autonomy, and resilience over time. Ecosystem health contributes to human wellbeing through sustainable ecosystem services and conditions for human health' (MA, 2003).
- **Ecological security**: 'A condition of ecological safety that ensures access to a sustainable flow of provisioning, regulating, and cultural services needed by local communities to meet their basic capabilities' (MA, 2003).

2.3. What are the Impacts on natural environment?

Anthropisation

- **Natural** *landscape or ecosystem*: 'Is one that developed by natural processes and that is selforganizing and self-maintaining' (SER, 2004).
- **Cultural** *landscape or ecosystem*: 'Is one that has developed under the joint influence of natural processes and human-imposed organization' (SER, 2004).

Impacts on natural environments

'The terms degradation, damage, destruction and transformation all represent deviations from the normal or desired state of an intact ecosystem. The meanings of these terms overlap' (SER, 2004).

- **Degradation**: 'Pertains to subtle or gradual changes that reduce ecological integrity and health' (SER, 2004).
- **Damage**: 'Refers to acute and obvious changes in an ecosystem' (SER, 2004).
- **Destruction**: 'An ecosystem is destroyed when degradation or damage removes all macroscopic life, and commonly ruins the physical environment as well' (SER, 2004).
- **Transformation**: 'Is the conversion of an ecosystem to a different kind of ecosystem or land use type' (SER, 2004).
- **Stressors**: 'Processes that have for effect to stress the biota' (SER, 2004).
- **External processes**: 'Some dynamic processes are external in origin, such as fires, floods, damaging wind, salinity shock from incoming tides and storms, freezes, and droughts. These external processes stress the biota and are sometimes designated as stressors' (SER, 2004).

Invasions

'Much confusion exists in the English language literature on plant invasions concerning the terms 'naturalized' and 'invasive' and their associated concepts' (Richardson & *al.*, 2000).

- **Alien plants** (synonyms: exotic plants, non-native plants; nonindigenous plants): 'Plant taxa in a given area whose presence there is due to intentional or accidental introduction as a result of human activity' (Richardson & *al.*, 2000).
- **Casual alien plants**: '*Alien* plants that may flourish and even reproduce occasionally in an area, but which do not form self-replacing populations, and which rely on repeated introductions for their persistence' (Richardson & *al.*, 2000).
- **Naturalized plants**: '*Alien plants* that reproduce consistently (cf. *casual alien plants*) and sustain populations over many life cycles without direct intervention by humans (or in spite of human intervention); they often recruit offspring freely, usually close to adult plants, and do not necessarily invade natural, seminatural or human-made ecosystems' (Richardson & *al.*, 2000).

- **Invasive plants**: '*Naturalized plants* that produce reproductive offspring, often in very large numbers, at considerable distances from parent plants (approximate scales: > 100 m; < 50 years for taxa spreading by seeds and other propagules; > 6 m/3 years for taxa spreading by roots, rhizomes, stolons, or creeping stems), and thus have the potential to spread over a considerable area' (Richardson & *al.*, 2000).
- **Weeds**: 'Plants (not necessarily *alien*) that grow in sites where they are not wanted and which usually have detectable economic or environmental effects (synonyms: plant pests, harmful species; problem plants). 'Environmental weeds' are *alien plant* taxa that invade natural vegetation, usually adversely affecting native biodiversity and/or ecosystem functioning' (Richardson & *al.*, 2000).
- **Transformers**: 'A subset of *invasive plants* which change the character, condition, form or nature of ecosystems over a substantial area relative to the extent of that ecosystem' (Richardson & *al.*, 2000).

2.4. Possible Actions to react to the impacts on biodiversity

Monitoring and related activities

- **Monitoring**: 'Intermittent (regular or irregular) surveillance carried out in order to ascertain the extent of compliance with a predetermined standard or the degree of deviation from an expected norm' (McGeoch, 1998).
- **Surveillance**: 'An extended programme of surveys undertaken in order to provide a time series, to ascertain the variability and/or range of states or values which might be encountered over time (but again without preconception of what these might be)' (McGeoch, 1998).
- **Survey**: 'An exercise in which a set of qualitative or quantitative observations are made, usually by means of a standardized procedure and within a restricted period of time, but without any preconception of what the findings ought to be' (McGeoch, 1998).

Conservation

- **Ex-situ** conservation: 'Means the conservation of components of biological diversity outside their natural habitats' (CBD, 1992).
- **In-situ** conservation: 'Means the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties' (CBD, 1992).
- **Protected area**: 'Means a geographically defined area which is designated or regulated and managed to achieve specific conservation objectives' (CBD, 1992).

Restoration and other activities

- **Ecological restoration**: 'Is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed' (SER, 2004).
- **Rehabilitation**: 'Shares with restoration a fundamental focus on historical or pre-existing ecosystems as models or references, but the two activities differ in their goals and strategies. Rehabilitation emphasizes the reparation of ecosystem processes, productivity and services, whereas the goals of restoration also include the re-establishment of the pre-existing biotic integrity in terms of species composition and community structure' (SER, 2004).
- **Reclamation**: 'As commonly used in the context of mined lands in North America and the UK, has an even broader application than rehabilitation. The main objectives of reclamation include the stabilization of the terrain, assurance of public safety, aesthetic improvement, and usually a return of the land to what, within the regional context, is considered to be a useful purpose' (SER, 2004).
- **Revegetation**: 'Which is normally a component of land reclamation, may entail the establishment of only one or few species' (SER, 2004).
- **Creation**: 'Has enjoyed recent usage, particularly with respect to projects that are conducted as mitigation on terrain that is entirely devoid of vegetation' (SER, 2004).
- **Fabrication**: 'Is sometimes employed. Frequently, the process of voiding a site causes sufficient change in the environment to require the installation of a different kind of ecosystem from that which occurred historically' (SER, 2004).

Mitigation hierarchy

- **Mitigation**: 'Is an action that is intended to compensate environmental damage' (SER, 2004).
- **Mitigation hierarchy**: 'The principle that appropriate actions to address potential biodiversity impacts are taken in the following order of priority: (1) avoidance of impacts; (2) reduction of negative impacts; (3) rehabilitation/restoration measures; and (4) compensation measures for significant adverse residual impacts.' (IEEP, 2012).
- **Avoidance**: measures taken to avoid creating impacts from the outset, such as careful spatial or temporal placement of elements of infrastructure, in order to completely avoid impacts on certain components of biodiversity.' (IEEP, 2012).
- **Minimisation**: measures taken to reduce the duration, intensity and / or extent of impacts (including direct, indirect and cumulative impacts, as appropriate) that cannot be completely avoided, as far as is practically feasible.' (IEEP, 2012).
- **Rehabilitation/restoration**: measures taken to rehabilitate degraded ecosystems or restore cleared ecosystems following exposure to impacts that cannot be completely avoided and/ or minimised.' (IEEP, 2012).
- **Offset (Compensation)**: 'Measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised and / or rehabilitated or restored, in order to achieve NNL or a net gain of biodiversity.' (IEEP, 2012).

- **No Net Loss (NNL)**: 'Is to maintain the biodiversity in an equivalent or better state than that observed before the project begins' (Morandeau & Vilaysack , 2012).

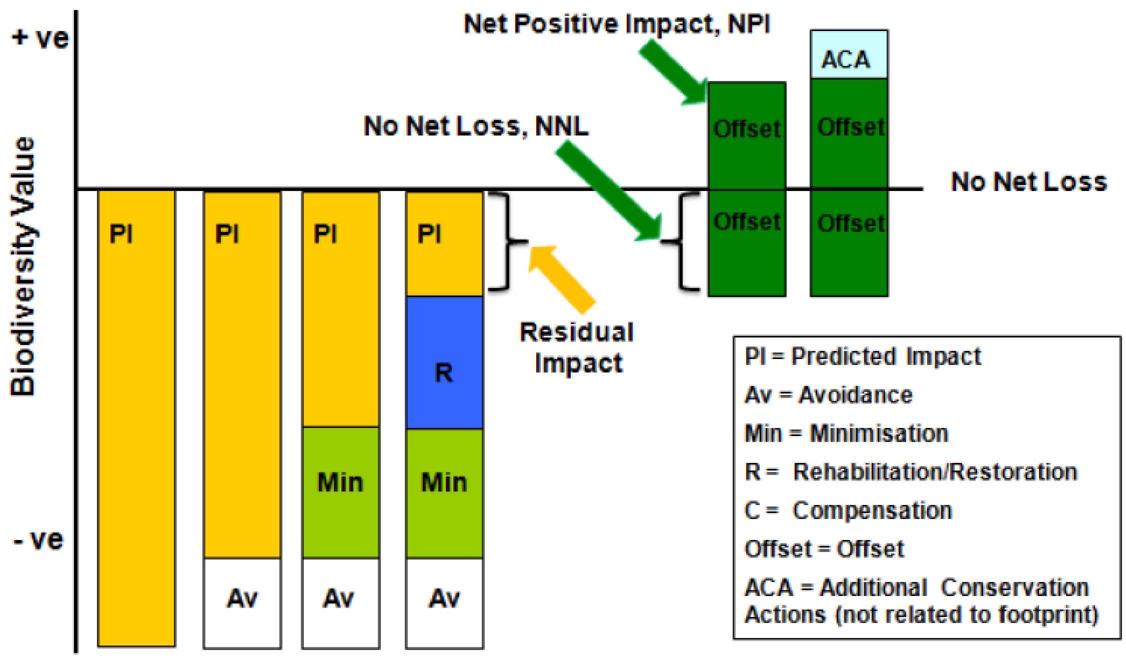


Figure 7 The achievement of No Net Loss in relation to the mitigation hierarchy, directly from (IEEP, 2012)

Ecosystem approach

- **Ecosystem approach**: 'A strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way. An ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential structure, processes, functions, and interactions amongst organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems' (MA, 2003).
- **Ecosystem assessment**: 'A social process through which the findings of science concerning the causes of ecosystem change, their consequences for human well-being, and management and policy options are brought to bear on the needs of decision-makers' (MA, 2003).
- **Adaptive management**: 'The mode of operation in which an intervention (action) is followed by monitoring (learning), with the information then being used in designing and implementing the next intervention (acting again) to steer the system toward a given objective or to modify the objective itself' (MA, 2003).
- **Precautionary principle**: 'The management concept stating that in cases 'where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation,' as defined in the Rio Declaration' (MA, 2003).

2.5. What is an indicator?

- **Indicator**: 'In ecology and environmental planning, an indicator is a component or a measure of environmentally relevant phenomena used to depict or evaluate environmental conditions or changes or to set environmental goals. Environmentally relevant phenomena are pressures, states, and responses as defined by the OECD (2003)' (Heink & Kowarik, 2010).

2.6. What kinds of indicators did exist?

Attributes of an indicator

- **Descriptive indicators** (versus normative): 'Indicators used to describe environmental states or changes' (Heink & Kowarik, 2010).
- **Normative indicators** (versus descriptive): 'Indicators are not only used to describe environmental states or changes but also to evaluate them and to set objectives' (Heink & Kowarik, 2010).
- **Indicators as measures of ecological attributes** (versus as ecological components): 'Indicator that are measures of ecological attributes (e.g., species richness)' (Heink & Kowarik, 2010).
- **Indicators as ecological components** (versus as measures of ecological attributes) : 'Indicator that are components of ecological attributes (e.g., a certain taxon)' (Heink & Kowarik, 2010).

The DPSIR Framework

- **Driving forces**: 'Are the social, demographic and economic developments in societies and the corresponding changes in lifestyles, overall levels of consumption and production patterns. Primary driving forces are population growth and development in the needs and activities of individuals. These primary driving forces provoke changes in the overall levels of production and consumption.' (EEA, 2007).
- **Pressures**: 'include the release of substances (emissions), physical and biological agents, the use of resources and the use of land. The pressures exerted by society are transported and transformed into a variety of natural processes which manifest themselves in changes in environmental conditions.' (EEA, 2007).
- **States**: 'is the abiotic condition of soil, air and water, as well as the biotic condition (biodiversity) at ecosystem/habitat, species/community and genetic level.
- **Impacts**: 'on human and ecosystem health, resource availability and biodiversity result from adverse environmental conditions.' (EEA, 2007).

- **Responses**: 'are the measures taken to address drivers, pressures, state or impacts. They include measures to protect and conserve biodiversity (*in situ* and *ex situ*), and include, for example, measures to promote the equitable sharing of the monetary or non-monetary gains arising from the utilisation of genetic resources. Responses also include steps taken to understand the causal chain and develop data, knowledge, technologies, models, monitoring, human resources, institutions, legislation and budgets required to achieve the target.' (EEA, 2007).

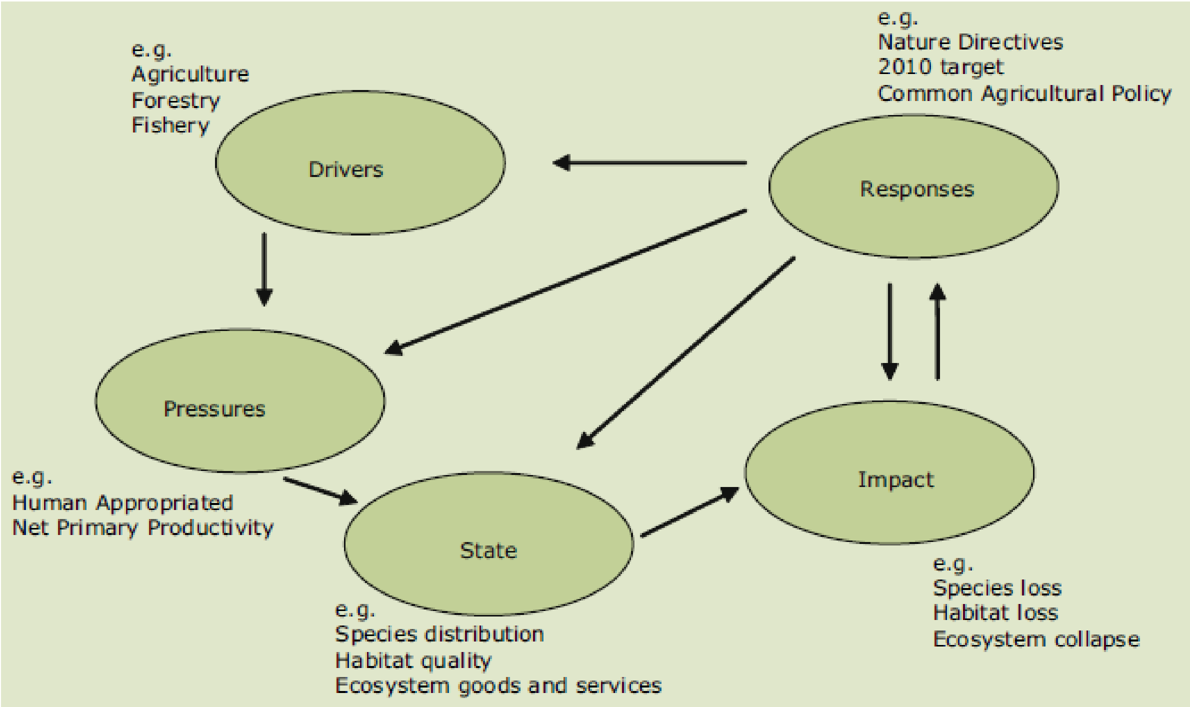


Figure 8 Presentation of the DPSIR framework, directly from EEA (2007b)

Indicator species

- **Indicator species**: 'A species that is of narrow amplitude with respect to one or more environmental factors and that is, when present, therefore indicative of a particular environmental condition or set of conditions' (Allaby, 1992).
- **Environmental indicators species**: 'An environmental indicator is a species or group of species that responds predictably, in ways that are readily observed and quantified, to environmental disturbance or to a change in environmental state' (McGeoch, 1998).
- **Ecological indicators species**: 'A characteristic taxon or assemblage that is sensitive to identified environmental stress factors, that demonstrate the effect of these stress factors on biota, and whose response is representative of the response of at least a subset of other taxa present in the habitat' (McGeoch, 1998).
- **Biodiversity indicators species** or **indicators of biodiversity species**: 'A group of taxa (e.g. genus, tribe, family or order, or a selected group of species from a range of higher taxa), or functional group, the diversity of which reflects some measure of the diversity (e.g. character richness, species richness, level of endemism) of other higher taxa in a habitat or set of habitats' (McGeoch, 1998).

- **Biological indicator species**: 'A species or group of species that readily reflects: the abiotic or biotic state of an environment; represents the impact of environmental change on a habitat, community or ecosystem; or is indicative of the diversity of a subset of taxa, or of wholesale diversity, within an area' (McGeoch, 1998).

2.7. What is participation?

Definitions

- **Participation or participatory process**: In this thesis participation is defined as a 'process where individuals, groups and organisations choose to take an active role in making decisions that affect them'. 'This definition focuses on stakeholder participation rather than broader public participation' (Reed, 2008).
- **Stakeholder**: 'Any group or individual who can affect or is affected by the achievement of the organization's objectives' or decisions (Freeman, 1984).

Kind of people that may be involved

- **Decision-maker**: 'A person whose decisions and actions can influence a condition, process, or issue under consideration' (MA, 2003).
- **Policy-maker**: 'A person with power to influence or determine policies and practices at an international, national, regional, or local level' (MA, 2003).

2.8. What are the tools used in the indicator's field?

- **Geographic information system (GIS)**: 'A computerized system organizing data sets through a geographical referencing of all data included in its collections. A GIS allows the spatial display and analysis of information' (MA, 2003).