BUILDING SITE BASED SCENARIOS: TOOLS AND APPROACHES FOR IMPLEMENTATION IN THE VALMER PROJECT

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January 2014

The VALMER project was selected under the European cross-border cooperation programme INTERREG IV A France (Channel) - England, co-funded by the ERDF.

Sommaire

Thank you to all the VALMER partners who have contributed to this document, by providing their suggestions and comments.

Document reference: Herry J., Dodds W., Philippe M. and Winder A., 2014. Building site based scenarios: tools and approaches for the implementation in the VALMER project. VALMER project, Scenario technical guidelines, January 2014, 62p.

Introduction

The way we make decisions relating to the coastal and marine environment has seen a gradual change over a number of years and the involvement of people and those affected by the decisions has become more prominent. One way of involving stakeholders actively is to involve them with building the route to possible outcomes or developing 'scenarios'. These guidelines have been published to support the delivery of the European Union funded Interreg IVa Channel VALMER project and it is hoped they may provide general help for others looking to involve people in natural resource management decisions. The VALMER project is looking at assessing and valuing ecosystem services within six case study sites within the Western Channel. The project seeks to recognise how natural systems and processes provide us with a vast range of important ecosystem services and benefits (economic, social and environmental) and will explore ways to assess and communicate their value, both in monetary and non-monetary ways.

A key component in VALMER is engaging various audiences and stakeholders. The use of scenarios has been chosen deliberately in the project, as it is seen as an effective way of moving from a theoretical framework to the influencing the delivery of policy. Stakeholder engagement, via scenario building exercises, will utilise ecosystem service assessments and valuations to explore stakeholder views and preferences on various management options and trade-offs. Good stakeholder engagement can give a sense of ownership of the process that will give the opportunity for better delivery of policy.

Scenarios are a proven tool and one that produces results. The method is simple in that it invites the 'audience' to react to a plausible set of events in the future or to build the future events themselves and then test these against a range of criteria. The criteria could be, for example, how real they are; how effective they are in delivering an outcome or whether all factors have been taken into account. The audience may wish to introduce their own criteria as they develop their scenario. The original hypothetical scenario can then be translated into one that represents a situation that can be achieved in reality by putting in place a series of policy decisions or actions. In this way it is possible to focus the scenario process on results, which is a strong driver for any participative activity. Scenario building can be a very flexible and adaptive process in that it can be used to develop ideas from a very basic starting point or to pick up and enhance ideas that have already been developed.

The VALMER project is to use scenarios to help deliver its work. Here is a simple description of the various work-packages in the VALMER project:

1. A framework for assessing and valuing different ecosystem services will be defined.

2. The data required for ecosystem service assessment will be identified and the management and governance frameworks in place will also be analysed.

3. An audience of stakeholders will be engaged to explore a range of management options and trade-offs using an ecosystem services approach.

4. Ways to improve understanding of the links between ecosystem services, their value, and effective marine and coastal governance will be identified.

This guide aims to help the VALMER's case study sites in the construction of their scenarios by providing a process with a number of tools. Although the tools presented below is not an exhaustive collection they have been selected to echo the needs of VALMER project site managers. They were sources from the scientific and other literature on scenarios and horizon scanning. They can be used for many other situations.

PART 1.
Scenarios: a tool to anticipate and consider the future

1. What do we mean by "scenarios"?

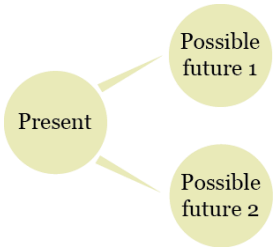
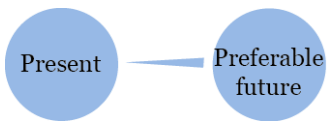
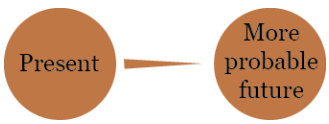
Scenarios are stories that portray plausible futures and are designed to systematically explore, create and test possible and/or desirable future conditions. Scenarios are a useful tool, often employed to help with complex management questions (e.g. environmental management, climate change, urban planning, etc.). Tran-sdisciplinary and collaborative, scenarios can support community-based management. Their **advantages** are **numerous.** They can:

- Combine qualitative and quantitative information;
- Identify uncertainties and knowledge gaps;
- Organise and interpret our thinking about the future;
- Help understand how to create the conditions in which our desired future can be achieved;
- Support decisions which are more likely to implemented successfully and
- Generate long term policies, strategies and plans.

Scenario building exercises can help people to process and interpret complex knowledge and information associated with multiple issues. Scenarios are a useful tool to create a range of possible futures by combining different elements in different way. In general many scenarios are developed in parallel (e.g. 3 to 4 narrative stories).

2. Different types of scenarios

There are three major types of scenarios: exploratory, normative and predictive scenarios. They can take many forms: a narrative story consisting of a few lines of text to many pages, with maps, graphics, drawings, pictures, etc. Modelling and/or simulations can also accompany scenarios.

EXPLORATORY	NORMATIVE	PREDICTIVE
		
WHAT MIGHT HAPPEN?	**HOW CAN A SPECIFIC TARGET CAN BE REACHED?**	**WHAT WILL HAPPEN?**
Different hypothesis of pathways leading to different possible futures.	Backcasting scenarios: knowing where we want to go, what has to be done between now and a future point in order to reach the objective.	From what we know about the present and the past, what is the most probable situation in the future?

The 3 major types of scenarios: exploratory, normative and predictive

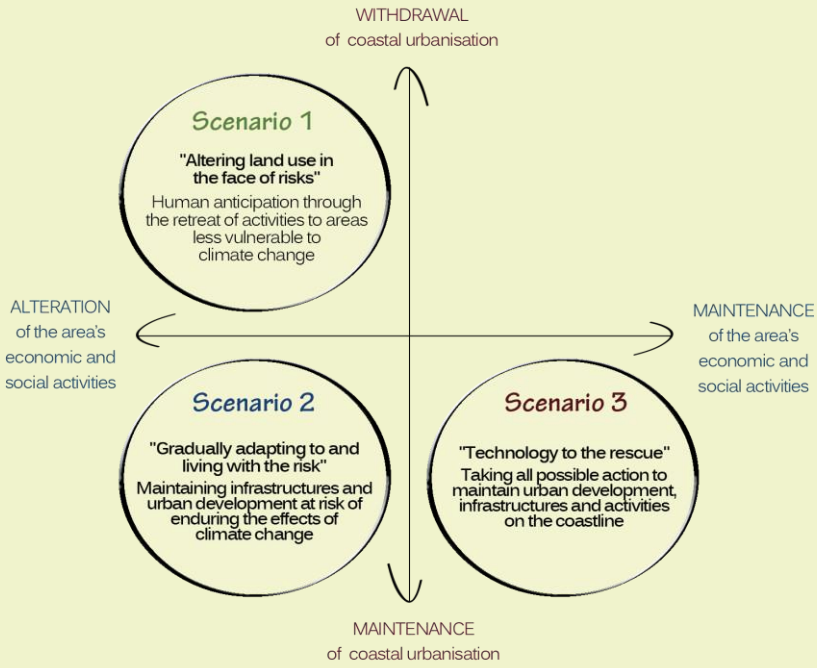
Exploratory scenario: What might happen?

The exploratory scenario describes events and trends as they could evolve based on alternative assumptions on how these events and trends may influence the future. They provide several plausible futures that include external factors (the ones we do not have any influence on) and internal factors (elements it is possible to affect).

Exploratory scenarios example

Within the context of the IMCORE project, stakeholders in the Golfe du Morbihan took part in 2 workshops in March and May 2010, supervised by members of UBO and SIAGM, to determine **how the area may evolve under climate change effects** (possible futures).

The scenario-building process focused on the theme of «**urban planning and infrastructures**». 3 scenarios around 5-6 pages each were developed and were then subjected to critical scrutiny by a panel of around sixty people to complete them, amend them and make them more realistic. These scenarios are available at this address: http://www.golfe-morbihan.fr/public/upload/files/action/plaquette-scenarios-anglais.pdf.



Normative scenario: How can a specific target be reached?

Normative scenarios explore the pathways that need to be taken in order to reach a desirable future situation. Normative scenarios are very effective for decision support, as they permit the exploration of strategies to reach the desired objective (Notten et al., 2003). This objective can be considered as the vision for the future.

Normative scenario example: "*Alternative futures for agriculture in Iowa*"

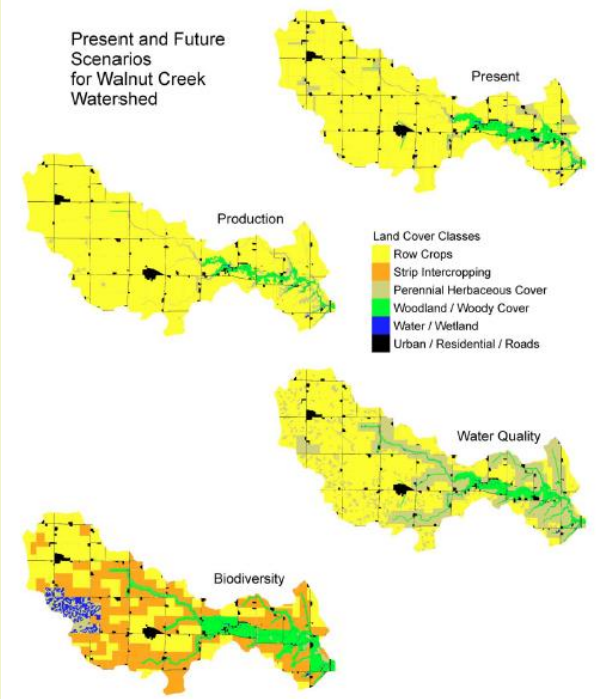
The Environmental Protection Agency with a number of research institutions used a normative landscape scenario approach to examine agricultural landscape futures, under different possible federal agricultural policies in Iowa in the US.

The question of scenarios was "**what might these landscapes be like in 25 years with continued priority given to corn and soya bean production?**". The project engaged disciplinary experts in agricultural policy, plant and animal ecology, wetlands ecology, and engaged farmers in workshops to determine landscape preferences.

Quantitative comparisons of spatially-specific future scenarios were realised, and GIS was used to generate maps and images to assess impacts of land use and land cover change on water quality, social and economic goals, and native flora and fauna. They created landscape mosaics characterised by changes in field size, cropping practices, perennial cover, croplands and pasture. Water quality modelling was used, as well other statistical models for flora and fauna densities.

3 scenarios have been developed:

- **Biodiversity scenario targeted restoration of indigenous biodiversity within landscape management**. Assumes that technology and agricultural practices response to a (hypothetical) new federal policy to increase the abundance of diversity of native plants and animals in the context of agriculture.
- **Water quality scenario targeted improvement in water quality within landscape management**. Assumes that agricultural enterprises change in response to a (hypothetical) new federal policy enforcing clear, measurable water quality performance standards for surface and groundwater, and supporting agricultural practices reduce soil erosion and improve aquatic habitats.
- **Production scenario targeted profitability of agricultural production within landscape management**. Assumes that policy encourages cultivation of all highly productive land, also assumes public support for large-scale, high-input agriculture, using fossil fuels, chemicals and technology.



(Santelmann et al., 2004)

Predictive scenario: What will happen?

The predictive scenario attempts to predict the future at a given date. It is based on science and probabilities. The usefulness of such scenarios is to make possible the planning and adaptation to situations that are expected to occur. **Predictive scenarios are mainly based on modelling** and try to calculate the most probable evolution of a situation under certain conditions. It is often used by managers to anticipate the question "What…if…?"

Predictive scenario examples

The simplest and most well-known predictive example is meteorological **prediction** (led by external events) knowing the present situation, the depressions and anticyclones around and there more probable behaviour known from the observation of past events leading to questions such as "**what will be the meteorological in the next 6 hours?"**

Another example could be energy consumption (led by internal decisions and external events): knowing the present needs for a country and its probable development (individual and for industry) leading to questions such as " **what will be the needs of energy during the next month / year?"**

Sometimes different types of scenarios can be also combined. This is the case, for example for the Intergovernmental Panel on Climate Change (IPCC) scenarios on climate change, which are both exploratory and predictive scenarios. If you refer to exploratory scenarios below, you will see that the example given are different scenarios of greenhouse gas emissions made from different options for the development of human activities. From these exploratory scenarios, by assuming relations between greenhouse gas concentration, the earth's temperature and the sea level rise, predictive scenarios can be created. See below the different predictions made from the different scenarios.

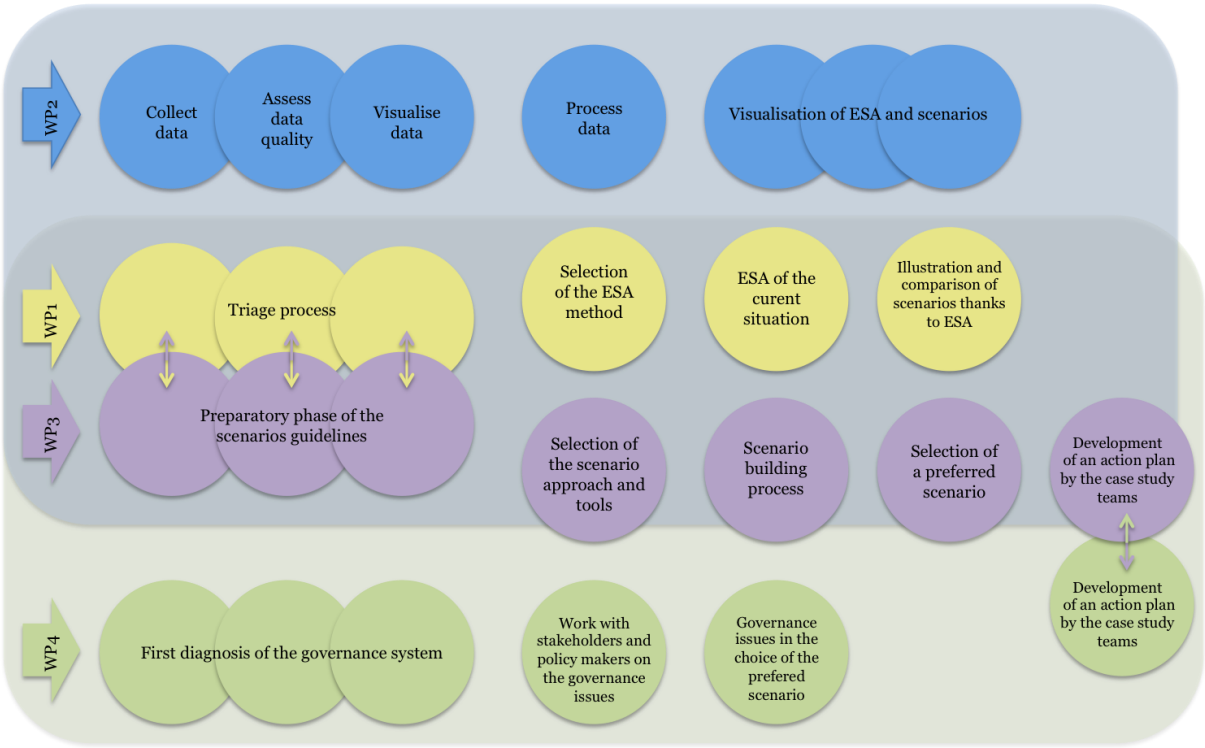
Case	Temperature change (°C at 2090-2099 relative to 1980-1999) [a, d]		Sea level rise (m at 2090-2099 relative to 1980-1999)
	Best estimate	Likely range	Model-based range excluding future rapid dynamical changes in ice flow
Constant year 2000 concentrations[b]	0.6	0.3 – 0.9	Not available
B1 scenario	1.8	1.1 – 2.9	0.18 – 0.38
A1T scenario	2.4	1.4 – 3.8	0.20 – 0.45
B2 scenario	2.4	1.4 – 3.8	0.20 – 0.43
A1B scenario	2.8	1.7 – 4.4	0.21 – 0.48
A2 scenario	3.4	2.0 – 5.4	0.23 – 0.51
A1FI scenario	4.0	2.4 – 6.4	0.26 – 0.59

(IPCC, 2007)

PART 2.
BUILDING SCENARIOS - WHY AND HOW?

Combined with ecosystem services assessment (ESA) methods in the VALMER project, scenarios are useful participative tools to engage stakeholders on marine and coastal management issues. All VALMER's work-packages (WP) are interconnected and can be associated in different ways depending of the context and skills of the case study site team. The scenario building process is one of a number of actions within the VALMER project. A number of activities undertaken since the project began, either within the project's work packages or at the case study sites, are all important for the scenario building process.

Some steps can be achieved in a different order, for example the ESA of WP1 can be achieved before, during or after the scenario building process of WP3.



Links between VALMER's work-packages

Why and how scenarios are built in VALMER?

The scenario building process involving stakeholders in VALMER is a way to:

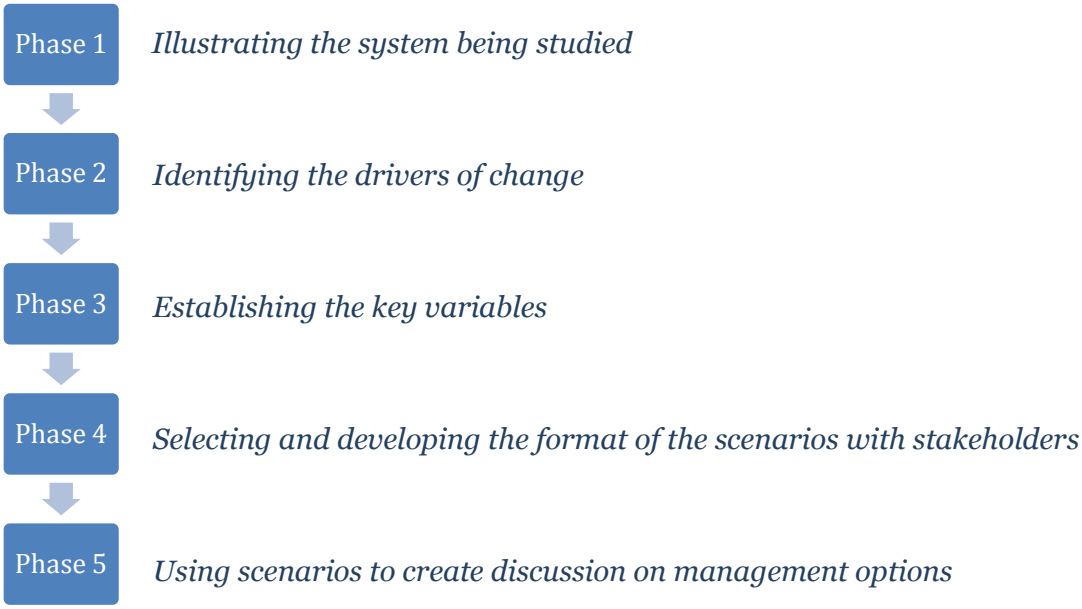
- Better understand longer-term issues;
- Better understand the links between the ecosystems and human activities;
- Create a "common culture" between stakeholders;
- Develop perspectives together on possible futures (exploratory scenarios);
- Compare these perspectives and choose the best one;
- Develop an action plan (normative scenario) and
- Inform decisions and actions that need to be taken to achieve the desired future.

The scenario building process can take several months but can be longer or shorter depending on the methodologies chosen, resources available and the required level of stakeholder participation.

The aims, and consequently the type of scenarios developed, will be different depending on:

- The management question studied;
- The governance and environmental contexts of the case study sites and
- The legitimacy and skills of the case study team (e.g. implementation of measures).

The scenario building process is divided into **5 complementary phases** that occur sequentially.



This guide puts forward several tools for each phase to allow each site to implement the most appropriate for them. These tools relate only to exploratory and normative scenario, because predictive scenarios (not developed here) are more specific and require mathematical modelling skills that are outside of VALMER's scope.

The preparatory phase

A good scenario process needs to begin with a clear statement as to "why the scenario should be built" and "what participants and those leading the process seek to achieve" (Millet, 2003). Before commencing it is important for sites to have defined:

- The **case study site team** (WP's representatives, site managers and stakeholders)
- The **common focus** and the **geographical scope** of the case study site (with WP1-3-4)
- The **governance context** (with WP4)
- The desired level of **stakeholder's engagement** (with WP1-3-4)
- The **data** availability and quality (with WP2)
- The **ecosystem service assessment and valuation methods** to use (with WP1)

These case study parameters are essential to start the scenario building process. They constitute the **preparatory phase** that can be realised in different ways on the various VALMER sites (e.g. internally to the case study site team, with specialist expertise and/or stakeholder participation). This phase can be implemented through the "Triage process method" that is presented in WP1 in the Economic Assessment Guidelines. By implementing a triage process, the VALMER partners should be able to collect all the elements presented here as a "scenario preparatory phase" and do therefore not need to implement the preparatory phase again.

1.1. Identify the common focus (management question, issues, topic)

The common focus may be a:
→ Broad scale approach with a set of local issues (e.g. climate change, coastal risks) or a;
→ Management question on a habitat (e.g. kelp forest), an ecological function (e.g. primary production), or an ecosystem services (e.g. recreational activities).

The common focus adopted depends on the local context and the aims and skills of the case study site team. It can be defined through interviews or workshops with the participation of stakeholders, managers, scientists and/or experts but also by using the triage process presented in the WP1 guide.

Tools:
INTERVIEWS
BRAINSTORMING

1.2. *Define the geographical scope of the study*

The geographical scope represents the case study site's perimeter. It must be coherent with the common focus studied and take into account the links and relationships between the environment and human activities.

Tools:
INTERVIEWS
BRAINSTORMING

1.3. Analyse the governance context and define stakeholder participation in the scenario process

It is important for the case study site team to define the stakeholders to involve, the degree of their participation (e.g. number of meetings) and the way in which they are involved (information, debate, decision, action…). At the same time it is important to

identify key stakeholders and organisations, legal and policy provisions, management measures, and existing or potential conflicts. The identification of relationships between stakeholders is a good way to understand their individual positions and strategies for action. Therefore identifying the governance context, the individual goals / interests and the existing or potential conflict are useful ways to recruit and engage stakeholders.

It is useful to have a global vision and a good understanding of the effectiveness of the governance arrangements and issues that could be addressed and influenced by ESA. This can be done with WP4.

This task is very important for the scenario building process and also for developing action plans. Indeed, if the scenarios are dealing with management options, their feasibility depends on the governance process. Scenario exercises are more effective when key stakeholders and policy-makers are involved; they can also help to build working relationships with key individuals and raise stakeholder's awareness and knowledge of management issues and options for the future. These benefits are in addition to the formal outputs generated at the end of the scenario building process.

Tools:
STAKEHOLDERS MATRIXES
DELPHI
REGNIER

1.4. Identify data availability and data issues

Data are essential, both for the scenario building process and the ESA. To consider how these data can be mapped to support the case study site's work on the common focus defined it is necessary to identify the available data, their quality and confidence, and the existing gaps. This will be helpful when selecting the ESA and scenario building methods to use and should be undertaken with the WP2.

1.5. Decide what assessment methods are to be used

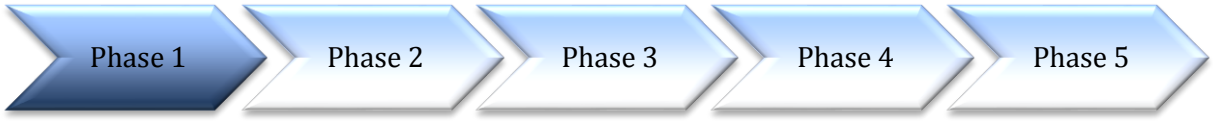
This task is realized through the WP1 and linked with:

→ WP2: because the assessment method that can be developed depends on the data available on the case study site;
→ WP3: because the assessment method chosen produce different qualitative and quantitative information that can illustrate the scenarios and
→ WP4: because the assessment method chosen depends on: 1) the governance context; 2) the aims agreed by the case study site's team; 3) the desired stakeholder engagement level.

Once this preparatory phase started, regular reference should be made to the checklist below to monitor the case study site's advancement (appendix 1):

Preparatory phase's checklist

- ☐ Identification of a common focus
- ☐ Definition of the geographical scope
- ☐ Analysis of the governance context and identification of the stakeholders to engage
- ☐ Identification of data availability and potential data management issues
- ☐ Selection of methods for ecosystem service assessment



PHASE 1
Illustrating the system being studied including natural processes and human activities

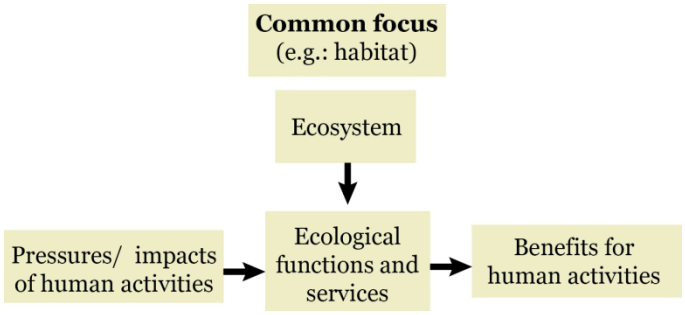
Phase 1 consists of building a "conceptual" diagram of the links between the environment and the human activities practiced in the case study site. This diagram gives the managers and stakeholders an overall vision of the system; it is useful to understand the qualitative, and if possible the quantitative links, between all the elements of the system considering natural processes and human activities.

Advantages: build a common culture shared by stakeholders; build relationships between stakeholders and managers; better comprehension of the ecosystem and local issues.

Difficulties: availability and involvement of stakeholders; availability and quality of data; uncertainties.

The diagram represents the links between habitats, species, ecosystem services, human activities, governance context and indicates the potential pressures or impacts, the management issues, the knowledge gaps and uncertainties, etc. The links can be represented in terms of direction, nature and intensity.

Example of information categories that can be in the diagram:



or in greater detail ...

Stakeholder participation in constructing the diagram can help to build and share a common understanding of the ecosystem. The challenge is to find a suitable representation, which contains as many information as possible while remaining understandable without incriminating some activity. It can be realized through several software packages (e.g. PowerPoint, C-Map, Mind Map and ExtendSIM).

Tools:
INTERVIEWS
BRAINSTORMING
DELPHI
TOOLS TO REPRESENT THE SYSTEM
ARDI
DPSIR

PHASE 2
Identifying drivers of change in the case study ecosystem

After having built the diagram of the ecosystem, and defined the temporal horizon of your scenarios (e.g. 2030), it is important to identify with the stakeholders the possible changes in the system (e.g. environmental changes, uses and human activities, governance and management contexts, etc.). Changes in the system may represent a risk or an opportunity, they can be influential or be influenced, they can enjoy a high or low flexibility, etc.

Advice: define at the start of the process a maximum number of critical uncertainties (e.g. 5 to 10 maximum). To identify these critical uncertainties it is useful to ask the following questions: "What determines the evolution of the system? On what can we act? ".

These changes, also called variables, are:

- The **heavy trends**, i.e. possible changes that are considered important and almost certain. Their evolution direction is known and will influence all the scenarios in a same way (e.g. climate change, demographic predictions).
- The **critical uncertainties**, i.e. major possible changes but uncertain.
- The **weak signals**, i.e. signal difficult to decode, or a signal which, after analysis, seems unlikely" (Vaughan, 2001) but can "announcing future major changes" (Blanco and Lesca, 2003).
- The **seeds of change**, i.e. elements that can cause a change.
- The **break possibilities**, i.e. elements that can cause a break with the actual situation (e.g. an oil spill).
- The **development opportunities** and main **sectors driving innovation**... (Fauchard and Mocellin, 2009)

To each possible change (e.g. variable) can then be associated different evolution hypotheses, in general between 2 to 4 hypotheses per variable. The identification of variable and associated hypotheses can be realised with the participation of stakeholders and experts during workshops, interviews and/or surveys.

It is useful to prepare a summary sheet for each variable to have a clearer view of all the possible changes. This sheet may contain the name of the variable, its definition, its descriptors, the past and future data and action levers. The variable sheets gather quantitative and qualitative data on which scenarios can rely, that enhance their credibility (Michel et al., 2013).

The variable sheets can be distributed to the participants at the beginning of a workshop to collect their suggestions/knowledge. The sheets can then be refined and used to select with the stakeholders 2 to 4 hypotheses per variable selected that will then be used to build the scenarios. The selection of variables and hypotheses must be justified and the reasons clear.

Tools:
INTERVIEW
BRAINSTORMING
DELPHI
REGNIER
DPSIR
PESTLE
BAYESIAN

PHASE 3
Establishing the key variables and associating them to explore and build the scenarios

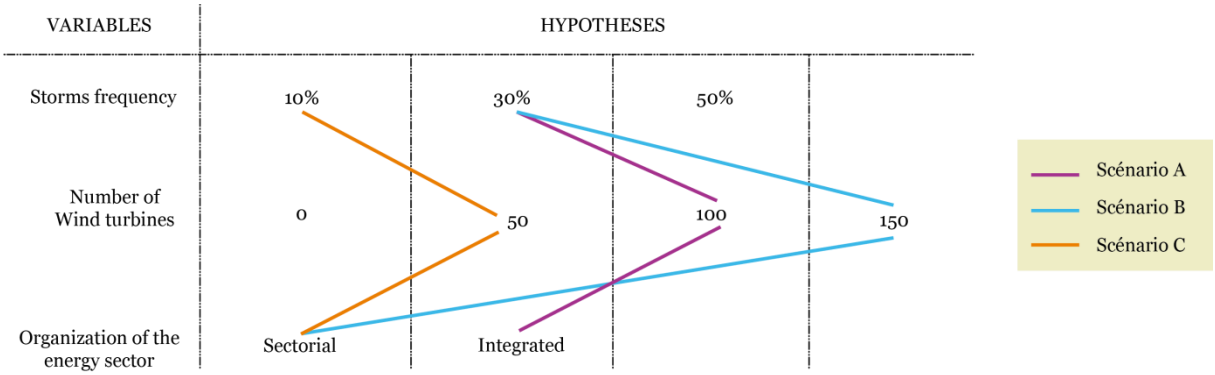
Once the critical variables of change selected, it is then possible to start constructing the scenarios by associating hypotheses.

Advice: be careful to the number of variables, and hypotheses per variable, to be able to manage the scenarios.

1 scenario = 1 association of hypotheses with 1 hypothesis per variable

The "hypotheses associations" reveal different possible pathways and form the scenario's skeletons.

Example of 3 possible exploratory scenarios (orange, pink, blue) created by associations of different hypotheses.



The hypotheses links matrix (see above) is a good communication tool to illustrate the "hypotheses associations" identified to create the scenarios, and view the key differences or similarities between them (Haines-Young and Potschin, 2010).

In the case of exploratory scenarios, generally 3 to 5 scenarios are designed, while in the case of a normative scenario, only 1 scenario is defined, the preferred future, that associates only the desired hypotheses. The choice to build exploratory or normative scenarios depends of the aims of the scenario building exercise (see pages 8-9).

Tools
Exploratory scenarios:
BRAINSTORMING
REGNIER
PESTLE

Normative scenarios:
REGNIER
BAYESIAN
BACKASTING

PHASE 4
Selecting and developing the format of the scenarios with stakeholders

Once the scenarios skeletons are defined, it is necessary to feed them with qualitative and quantitative data. It is essential to find the right information that will allow each scenario to be distinguished. The scenario's format is important as a means to generate stakeholder's interest. Finding the most relevant and clear information to disseminate will make this task easier. There are various possible scenario formats, from a narrative text to a creative visual presentation.

Examples of scenario's formats:

Narrative	**Visual**
Stories	Pictures
Letters	Maps
Postcards	Graphics
Newspaper articles (appendix 2)	Drawings
	Timelines

Advantages: helps the engagement in and ownership of the scenarios by stakeholders and citizens; can be a very creative and engaging process.

Limits: requires skills in graphic and communication techniques.

The choice of the scenario formats depends on:

- Their aims;
- The target audience (e.g. policy makers, scientists etc.) and
- The time and resources available within the case study site team.

Several formats can be combined and/or coupled with modelling and simulation using, for example, InVEST or ExtendSim softwares. Stakeholders can help to define the most appropriate scenario format. This approach can encourage buy-in, support and ownership.

When the scenarios are created in the format decided with stakeholders, it is important to submit them to the stakeholders and experts involved in the scenario building process in order to collect their suggestions, comments and advice. Scenarios can then be strengthened and finalised, with the stakeholders' trust. Feedback can be collected via workshops, focus groups or surveys online.

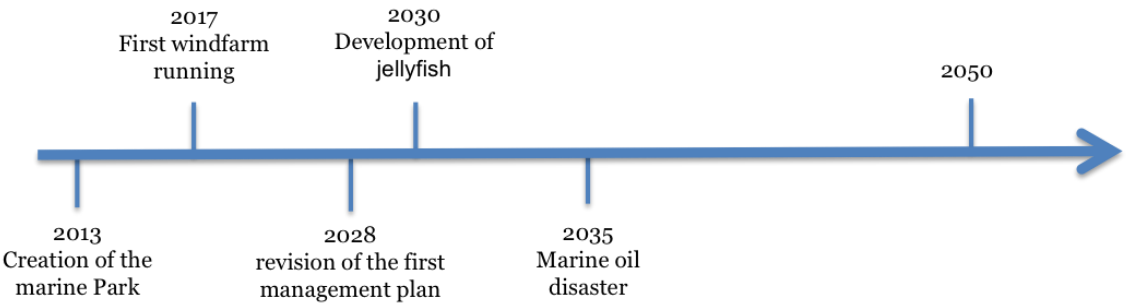
Examples of scenario's transcriptions:

Postcard

An imaginary postcard sent by someone to their parents explaining that due to the sea level rise, they have explored some underwater heritage (diving). The photo shows possible changes on the coastline with a city under the water.

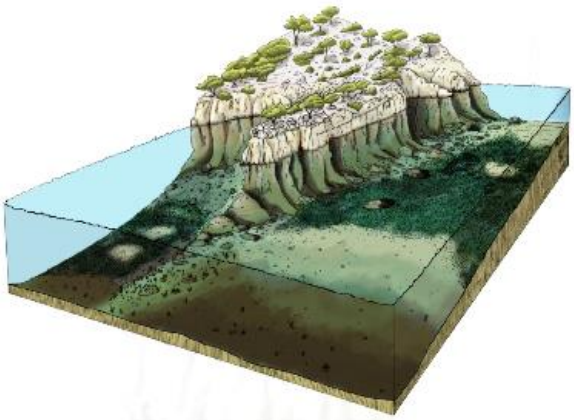
Timeline

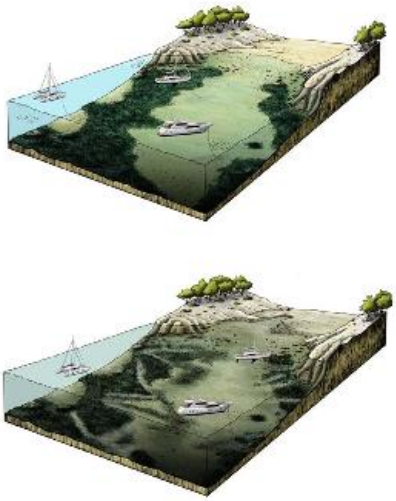
Scenario for a management plan dealing with a marine protected area and possible events.



Drawings

The designer Maxime Aubinet has developed these diagram blocks from diving observations. They illustrate the effect of anchorage on seagrass beds. More simple drawings can also be used depending on the skills in the case study team.





Tools:
Note: the tools used to develop the examples presented below are not developed in this guide. You can also use other tools such as:

TOOLS TO REPRESENT THE SYSTEM
INVEST

PHASE 5
Using scenarios to create discussion on management options

How to combine scenarios and ecosystem services assessment (ESA)?

As mentioned before in this guide, scenarios and ESA are very closely linked and can feed and influence each other. ESA can be used at the preparatory phase to assess the situation in the case study site and then be used to compare possible future scenarios by providing information to feed/illustrate these. For example, each scenario can include elements of ESA on different aspects of the problem from one scenario to another. Alternatively ESA can be undertaken on the different scenarios generated by stakeholders, if we consider that the different scenarios are management options that need to be evaluated and compared in order to make a management decision. The interaction between ESA and scenarios depends very much on your objective and the method you will use to make ESA. Please refer to the ESA VALMER guide (WP 1).

How can scenarios be used for management?

One of the deliverables of the VALMER project is the development of marine visions and action plans (WP3.2). The use of scenarios can support this objective. Scenarios can be the mechanism to engage stakeholders on a specific question by creating an informed debate on a management question and raising awareness of elected members, with ESA feeding these discussions.

In the case of exploratory scenarios, stakeholders can explore possible futures and their consequences can be evaluated and compared and help to shape discussions about management options and trade-offs. A preferred scenario chosen with the stakeholders is a basis to construct a common coastal and marine vision or actions plans. The scenario outputs can also input into, or influence, a range of existing policy frameworks and associated plans and strategies. This depends on the legitimacy and management role of the case study site team, the participants involved, and also of the governance context that needs to be well understood to make the best choices and take the best management decisions.

In the case of normative scenarios, the objective is different; the result should be a preferred scenario with concrete proposals to reach the desired future. The process can be used to devise plans or determine the concrete actions necessary to reach the desired management future sought by stakeholders with immediate or short-term implementation.

Tools:
INTERVIEW
BRAINSTORMING

PART 3.
Toolbox

List of tools that can be used for each phase of the scenario building process

	Preparatory phase	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
TRIAGE PROCESS (not developed here. Cf. ecosystem assessment methods)	√					
INTERVIEW	√	√	√			√
STAKEHOLDER	√					
BRAINSTORMING	√	√	√	√		√
DELPHI	√	√	√			
REGNIER	√		√	√		
TOOLS TO REPRESENT		√			√	
ARDI		√				
DPSIR		√	√			
PESTLE			√	√		
BAYESIAN			√	√		
BACKCASTING				√		
INVEST					√	

INTERVIEWS WITH STAKEHOLDERS AND/OR EXPERTS

Preparatory phase | PHASE 1 | PHASE 2 | PHASE 5

Interviews with stakeholders, scientists, experts and elected-members are a good way to collect information and knowledge on:

- The ecosystem studied;
- The interaction between the ecosystem services (ES) and human activities;
- The data available, gaps and uncertainties and
- The different perceptions of stakeholders.

Before the interviews it is essential to prepare a guide that gathers all the questions that need to be asked of the stakeholders and/or experts. It may be helpful to record the interviews; to keep all the information and to transcribe it later. However, some stakeholders may be concerned if they know that they are being recorded. In this case, you will have to decide if it is preferable to record them or not. You should gain the interviewee's agreement before any recording is undertaken.

Time: 1 to 2 hours/interview

Technical level: 1/4

Advantages: create links and confidence between the stakeholders and managers; better comprehension of the ecosystem studied and local issues; useful to collect expert's opinions.

Limits: availability and involvement of stakeholders; time consuming.

Resources needed: recording device.

Advice: well prepare the interview guide and collect information on the interviewees and their activities.

Interviews can take up to to 2 hours, plus the time necessary to transcribe the interviews and analyze them.

Example of an interview guide on interactions between maritime activities and seagrass beds

Date / Name of the interviewer / Name of the interviewee(s)

Seagrass beds
What is the present distribution of seagrass beds and their evolutions observed?
What are the essential parameters to the development of seagrass beds?
What are the sensitivities of seagrass beds?

Activity
How do you go about your work/business/activity (where? when?)?
Are seagrass beds a constraint for your activity?
What are the potential impacts of your activity on seagrass beds?
How could your activity change/ evolve in the future?

Opportunities
Do you think that the seagrass beds have a positive impact on your activities? If yes, why and how?

Contacts
Who could we contact to tell us about the seagrass beds and their management?
Do you have any publications or books to advise us on the subject?

Would you be interested in continuing to work with us and how?

STAKEHOLDERS MATRIXES

Preparatory phase

The case study team can do this step if they have a good knowledge of their stakeholders. They can also do individual interviews with key stakeholders or experts to help them to define the interactions between the stakeholders and complete the matrix.

An analysis sheet can be produced for each stakeholder to summarize their aims, interests, motivations and constraints.

Time: many weeks, depends of the number of stakeholders involved.

Technical level: 2/4

Advantages: better understanding of stakeholder's interactions, their positions concerning management objectives and their strategies.

Limits: based on personal judgements.

Advice: be sure to collect different views to be the most objective and impartial as possible.

Two matrixes can then be created to identify and describe the key stakeholders to engage in the scenario building process and the planning of their participation.

Stakeholders' positioning matrix

This matrix reveals the positions of stakeholders depending of their own objectives. The concept is to identify the conflicting and shared objectives of stakeholders.
This matrix's aim is to represent:

* The convergences and divergences between the stakeholders
* The unifying goals and conflict points
* The influences between the different stakeholders
* The apparent degree of freedom of stakeholders

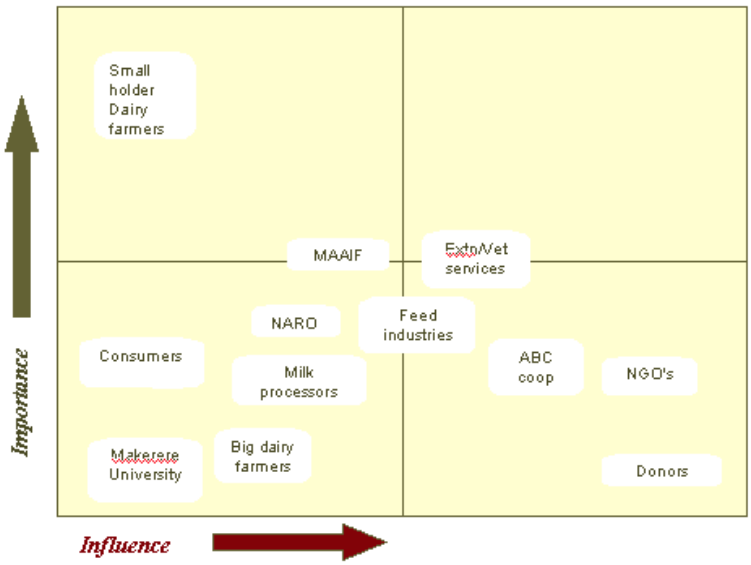
Stakeholder objective matrix for improved soil management

Pairs of key stakeholders	Conflicting objectives	Shared objectives
Local Administration, NGO, Ministry of Agriculture		Environmental conservation
Ministry of Agriculture and farmers	Cash crops versus food crops production	
Farmers, National Dryland Farming Research Centre, Kenya Soil Survey		(Research on) improved soil management practices to increase yield and facilitate weeding
Local Administration and NGO's versus farmers	Long-term conservation benefit versus short-term agriculture production benefit through mining resources	

(ICRA 1998a)

Stakeholder's influence/ importance matrix
This matrix plots stakeholders against two variables: the 'importance' of the stakeholder against the 'influence' of the stakeholder considering the question studied. This matrix provides a clearer understanding of stakeholders and can be used to define the best way to engage them in our approach.

The 'importance' refers to the priority given to satisfy stakeholders' needs and interests depending of the objectives defined. The 'influence' is the extent to which the stakeholder is able to persuade or coerce others into decision-making and/or implementation of actions.



(ICRA, 1998b)

Links

Stakeholder matrix by the Department of Environment and Primary Industries, state of Victoria (Australia):
http://*www.dse.vic.gov.au/effective-engagement/toolkit/tool-stakeholder-analysis-stakeholder-matrix*

Stakeholder matrix by the International Centre for Development Oriented Research in Agriculture (Foundation):
http://*www.icra-edu.org/objects/anglolearn/Stakeholder_Matrices-Guidelines%28new%29.pdf*

BRAINSTORMING

Preparatory phase | PHASE 1 | PHASE 2 | PHASE 3 | PHASE 5

Brainstorming is a creative technique based on the production of ideas by a group of people. It is a good method for working closely with stakeholders and finding the most original ideas in the shortest period of time. This exercise can be achieved just with the case study team but the output of a brainstorming workshop is richer if it involves more participants.

Brainstorming is a good way to:

- Collect information on the studied system
- Organize the ideas (phase 1);
- Identify and classify hypotheses of changes (phases 2 and 3) and
- Share reflections and ideas between stakeholders.

The ideal number of participants is between 15 to 20 people, above this number it will be more difficult to manage a constructive discussion and answer to all the questions. The risk is to cause a phenomenon of selflessness and "drop out" of some participants if there are too many. A facilitator should lead the workshop.

Time: 2 hours to 1 day

Technical level: 2/4

Advantages: quick and creative tool; helps to think outside the box; produces a lot of information; creates links and confidence between the stakeholders and managers; gathers knowledge and issues; useful in collecting experts' opinions.

Limits: availability and involvement of stakeholders; some people do not speak out in-group situations.

Resources needed: facilitator; sufficient amount of wall space; flip-charts; sticky-notes; pencils etc.

Advices: it is important to invite the stakeholders well before the workshop;

Explain to the stakeholders that this work concerns long-term reflection and will not necessarily respond to their immediate issues;

Manage time well and ensure there is enough time for discussion;

Involving external consultants or experts can be useful;

Take photographs of the flip-charts at the end of the workshop.

It is important for the facilitator to explain the topic of the workshop, its aims and the rules that the participants have to follow.

Facilitator conduct Code

- Present the topic and the aims of the brainstorming
- Present the approach as simply as possible
- Answer the questions from the participants
- Avoid criticizing, interpreting, commenting or censoring ideas and encourage the participation of everyone.
- Write down all ideas and make them visible to everyone
- Discourage competition and encourage listening to others

Attitudes expected of the participants

- Participating in a creative and inclusive way
- Cooperating rather than competing
- Collaborating and enjoying working together
- Accepting the challenge of finding ideas
- Preventing blockages by avoiding criticism
- Accepting the 'fun' nature of the technique

The basic rules of brainstorming

- Record all ideas; do not criticize, suspend 'reality' and think and speak freely
- Give free rein to the imagination, spontaneity, surprise and the unexpected
- Produce a lot of ideas
- Combine ideas to create a new ones

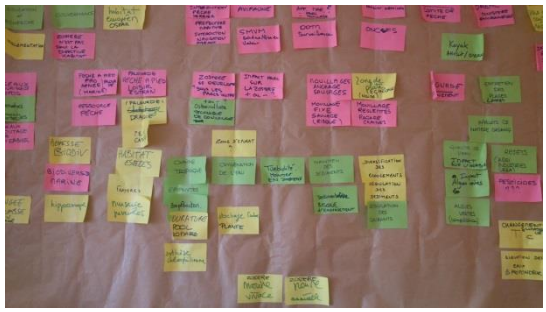
The facilitator should ask the participants to give their ideas as to the aim of the workshop:

* Construction of a system's diagram
* Identification and ordering of issues
* Identification of possible changes and hypotheses associated
* Association of hypotheses to build the scenarios

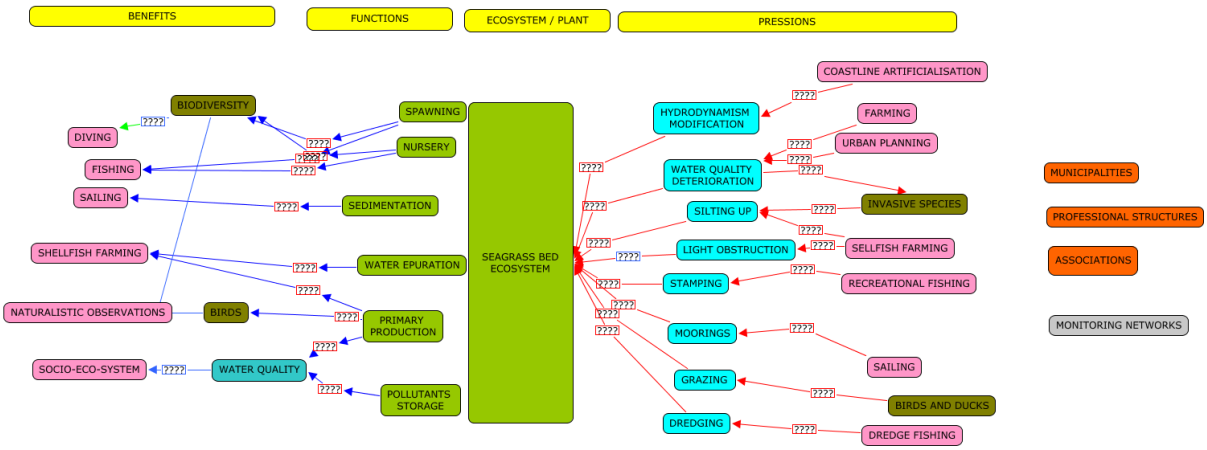
The participants should be invited to write their ideas on sticky-notes and give them to the facilitator for the flip-chart. Then, the facilitator removes any duplicate ideas on sticky-notes and asks the participants to explain their sticky-note to the others participants to confirm they have the same understanding. The facilitator then organizes the ideas on the flip-chart, respecting the stakeholder's choices. The ideas can be organised by category with a PESTLE analysis for example, and linked by arrows that indicate the relations between ideas.

At the end of the workshop, an individual written evaluation can be distributed to the participants to collect their opinions. This strengthens the spirit of democracy and contributes understanding to any following workshops, if needed. It can be beneficial to tell the participants during the introduction to the workshop that a written evaluation will be done at the end of it followed by a discussion time of 15 minutes to give them the opportunity to express their opinions on the workshop.

Example of the results of a brainstorming workshop undertaken in the Golfe du Morbihan on seagrass ecosystem.



Mapping (in progress) achieved after the brainstorming workshop: ecosystem services, activities, natural divers, pressures, organizations and legal framework.



DELPHI

Preparatory phase | PHASE 1 | PHASE 2

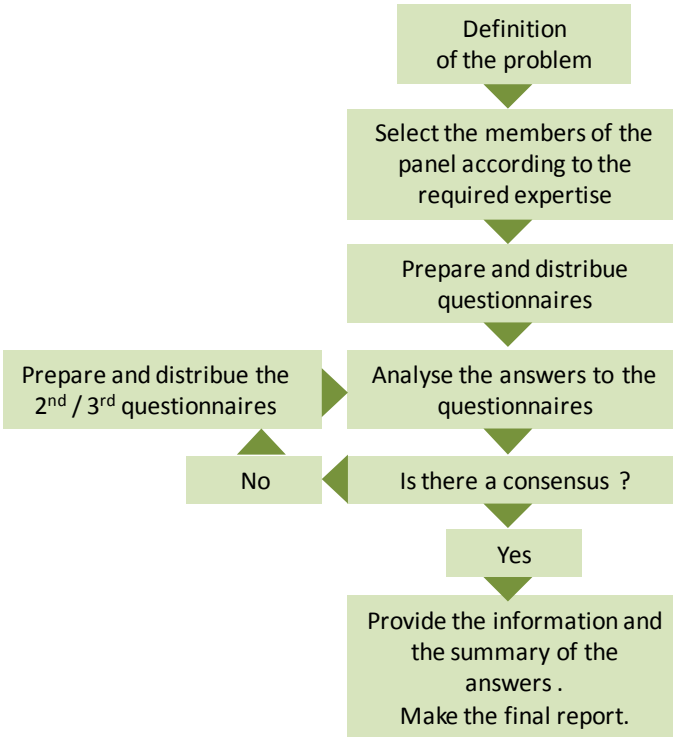
The "DELPHI" and "Régnier abacus" methods are presented separately but can be used simultaneously.

The RAND CORPORATION produced DELPHI method in the 1950's originally to forecast the impact of technology on warfare.

The DELPHI method **aims to highlight convergences of opinion and to identify some consensus on specific topics through the interrogation of experts**, using successive questionnaires.

The major objective of DELPHI studies is to collect experts opinions on a subject on which you have some uncertainties in order to help you to take a decision. By expert, we mean persons who have a good knowledge on the topics the DELPHI analysis is dealing with whatever is its job or scientific level. Experts are also selected for their ability to envision the future. They have to be chosen according to these criteria.

The DELPHI method is not a questionnaire sent to a divers audience but a **questionnaire sent to a chosen panel**.



Steps of a DELPHI study

Questions should be specific and independent of each other (e.g. 20 questions divided into five themes). They must be relatively concise in their content and discuss only one topic.

Questionnaires (usually 3 to 4) are sent successively to identify a consensus. The method is interesteding to use to collect at least 25 opinions. Generally considered that it is necessary to have a **panel of 100 people** in order to collect 25 answers. The questionnaires are sent by post or e-mail with a note explaining the goals, the spirit of DELPHI, and the practical conditions of the investigation (the response time should be specified and anonymity guaranteed). In order to increase the level of responses, experts can be contacted individually before sending them the first questionnaire in order to explain what is expected from them. In the second round, the experts should be informed of the results of the first round before to provide their new answer in light of the first results. They are required especially, to justify their opinions if they are very different from one of the majority of the group.

In the third round, each expert is asked to comment on the arguments of those with a different opinion. The fourth round gives the final answer: consensus opinion median and dispersion of opinions (interquartile ranges).

The questions are modified during the second and third rounds, depending on the responses obtained in the previous rounds (some deeper questions, new topics suggested by the experts at the end of their response etc.). It is important to have a question that identifies areas of questioning that had possibly not been covered previously.

Example of a DELPHI questionnaire about priority for mental health prevention in Geneva (Schaller and Fournier, 1998)

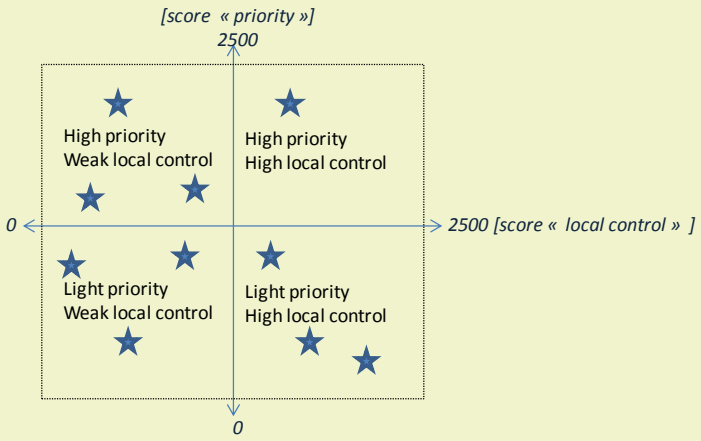
The expert group has been contacted by phone before sending them the 1st questionnaire. The result was a response level of 90%.

1st questionnaire
This was an 'open' question: "considering the general objectives of public health in France (fewer deaths of young people, less suffering, better prevention), please make a list of 10 problems (maximum) that it is important to consider for your county council in order to contribute to the national objectives? Can you please rank those objectives from 1 (major) to 10 (minor)? Please justify your opinion in a few words?"

Result of the 1st questionnaire
The answers from the 1st questionnaire gave a table of 30 issues ranked according to the answers from the 1st questionnaire (10 points given to the 1st priority, 9 points to the 2nd one, etc. for each answer). The issues defined are the reformulation of issues that emerged from the answers. It was the basis of the 2nd questionnaire sent to the same panel.

2nd questionnaire
For that round, a table presenting the 30 issues was sent to participants. They were asked to rank, within these 30 proposals, the 10 that were most important for them, if necessary to link proposals and to comment on their choices. The result of this 2nd questionnaire is a consensus on the 10 first priorities to deal with.

3rd questionnaire
Using the 10 priorities emerging from the 2nd questionnaire, the 3rd questionnaire asks, "what are, among those 10 priorities, the ones that are well managed at local level/ the ones that have to be considered as a priority at local level?" The result is a priority matrix, ready to use for decision making:



Example in appendix 3.

To save time you can realise a mini-DELPHI by not using the first questionnaire. This supposes that the case study team identifies in advance a number of issues to rank. You can also use online survey tools such as Survey Monkey: http://fr.surveymonkey.com/

Time: at least 1 month

Technical level: 3/4

Advantages: it is possible to obtain the opinion of each stakeholder not influenced by the group (no leader). It permits the generation of a consensus and the identification of deviations from the consensus, and explanations of this

Limits: time consuming; the need to conserve a high level interest of the panel so that the experts respond to each round

Resources needed: a questionnaire; postage costs or an email address or a website

Advice: it is important to limit the number of hypotheses so as not to be overwhelmed. It is possible to achieve a mini DELPHI in a shorter time as part of a workshop with the experts or stakeholders and discuss each question before answering

Links

*Recording of an interview of Denis Loveridge (*Honorary Visiting Professor at the University of Manchester) about the aims and advantages of the DELPHI method*:*
http://hsctoolkit.bis.gov.uk/images/stories/hsc_audio/denis_loveridge_delphi.mp3

DELPHI explained on the Encyclopedia of business:
http://www.referenceforbusiness.com/encyclopedia/Cos-Des/Delphi-Technique.html

DELPHI explained by the New Jersey Institute of Technology:
http://is.njit.edu/pubs/delphibook/

DELPHI explained by the Rand Corporation
http://www.rand.org/pubs/papers/P3925.html

REGNIER'S ABACUS

Preparatory phase | PHASE 2 | PHASE 3

The Regnier's abacus is an original method, effective, simple and quick based on questions to be asked to stakeholders and/or experts. It can be achieved through workshops, interviews, by post, or online. The aim of this tool is to obtain the participants' opinions on a specific subject. It is not the consensus that is sought but rather the **exchange and discussion between individuals on their different opinions**.

The Regnier's abacus is an excellent communication tool very useful in reducing uncertainties by confronting participant's opinions. It can also help to **find out what the issues or the possible changes are that they consider as likely or otherwise**

This exercise can be achieved during a workshop in **4 steps**:

1) In introduction to the workshop, the facilitator explains to the stakeholders the aims of the exercise, distributes to each participants one sheet with items to mark (appendix 4) and explains the items if needed. The item must be simple: subject + verb + complement. They can have been identified by stakeholders during a previous workshop or selected by the case study team.

2) The participants read and mark each item using this notation:

Item	Notation
Very likely	1
Light likely	2
Mixed opinions	3
Unlikely	4
Very unlikely	5
No opinion	6

3) Then, the facilitator collects all the individual sheets and integrates the marks in an Excel file (prepared in advance.[1]) that will allow the calculation of average results for each item. To do this, a scoring method is used. It provides a score for each notation:

Item	Notation	Score
Very likely	1	+6
Light likely	2	+3
Mixed opinions	3	0
Unlikely	4	-3
Very unlikely	5	-6
No opinion	6	0

[1] Ask the WP3 team for the Excel sheet prepared for VALMER partners and adapt it to your site.

An average is calculated for each item in order to identify and help agree the issues or possible changes that are likely or unlikely, and the issues or possible changes on which there is no consensus.

Example of scoring method

- An item is considered likely if its positive value is at least twice its negative value, given the condition that there was not more than a quarter of respondents who have no view one way or the other.
- When the spread between the very likely and very unlikely opinions is significant (and was not changed by those with no fixed view) the item is classified as likely. When no trend emerges, the item is undecided and may be subject to debate.

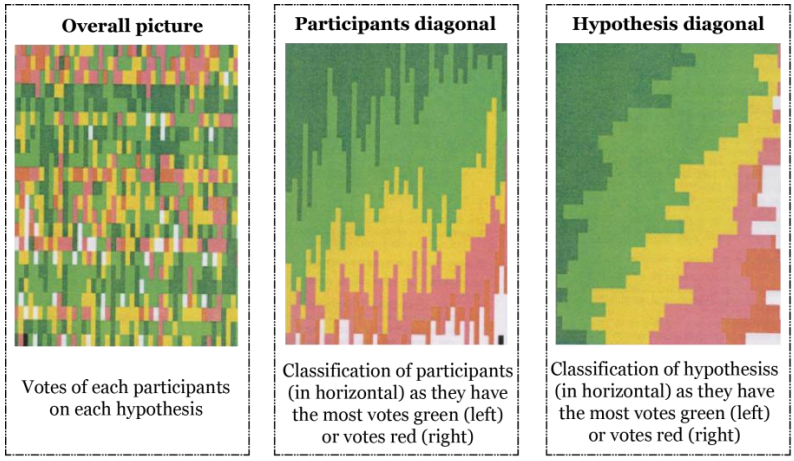
(FUTUROUEST©)

A colour scale can be used to make the results more visual.

Item	Colour
Very likely	Dark Green
Light likely	Green
Mixed opinions	Orange
Unlikely	Red Light
Very unlikely	Dark Red
No opinion	White

It is possible to use different visual representations to reveal:

- An overall picture of the votes;
- The proportion between participants who have judged the majority of items as very likely and the ones who have judged the majority of items as very unlikely (participants diagonal)
- The proportion between the items judged as more likely, and the ones judged as the more unlikely (hypotheses diagonal)



A dominant colour means a consensus while opposite colours indicate a lack of consensus.

4) At the end of the workshop, participants discuss the average of each item and more particularly on the ones for which no consensus has been found. This is a good way to create links between stakeholders who can then discuss and exchange arguments. The facilitator must ensure that the discussion is constructive.

Time: 4 hours to 1 day

Technical level: 2/4

Advantages: easy method with visual outputs; allows debate between stakeholders.

Limits: need a good organisation and time management.

Resources needed: a facilitator; a computer with Excel software.

Advice: schedule time during the workshop to enter and analyze the stakeholder's votes.

TOOLS TO REPRESENT THE SYSTEM

PRESENT AND COMBINE INFORMATION, SYNTHESIZE KNOWLEDGE

PHASE 1 PHASE 4

At different steps of the VALMER approach (ESA and scenarios building process), it can be useful to find a way to visually represent the information collected in order to organise information and data and share them with stakeholders. Many tools can be used to complete diagrams; some are simple while others are of a higher technical level. Nevertheless, depending on the experience and resources of the teams, they can be very useful tool.

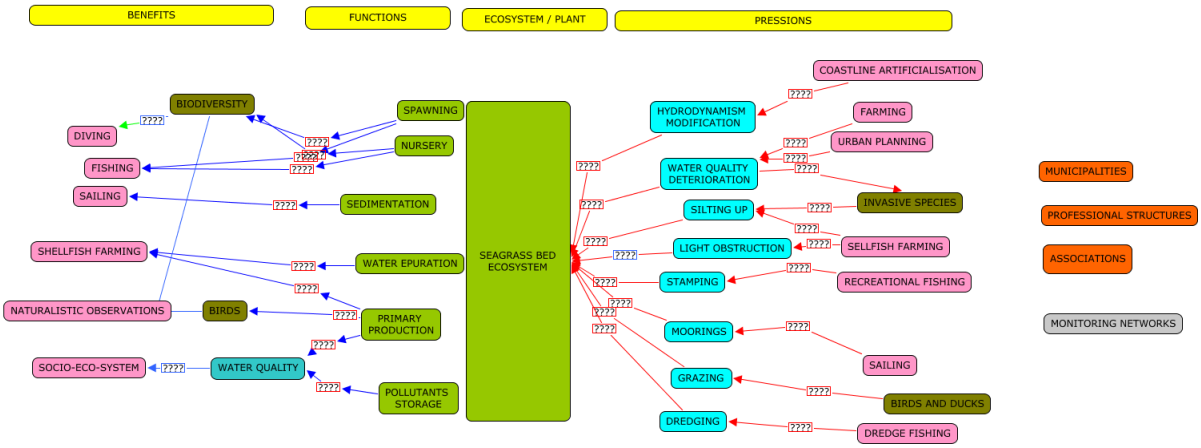
Time: many weeks to many months

Technical level: 1 /4

Resources needed: CMAP or Mindjet Mind Manager software

CMAP tools ®

This software can be freely downloaded from the Internet. It will be helpful to work in a co-operative way from an early stage, either alone or in small groups to draw diagrams of a system. It is easy to use and can be seen as a way to organise "posts-it" on a computer.



Mindjet Mind Manager ®

This is commercial software that helps to represent the system in a hierarchic way. It helps organise information with different levels.

The 2 software tools represented are useful for internal work on phase 1 but it is essential to think about how to present the information collected and how to make it available for the stakeholders, decision makers and policy makers, because the type of information collected during the work can be of many types (qualitative, quantitative, texts, maps (images and GIS), photos, films, and even modelling in some cases).

Most of these elements can be presented on websites and it seems to be a good way to make the information available for decision makers. However, web designers need to be mindful about some aspects of presentation in order to make it clear. Thought needs to be given to:

- Different levels of knowledge from the very simple to scientific or technical articles, guidelines and reports.
- Different approaches: by a question ("As a manager, how can I engage stakeholders in a process of ESA?"); by location with examples ("The Poole Harbour experience and lessons learned by implementing such methodology") or by a technical approach (scenarios building, ESA...).

The designer needs to be very careful to identify the target audience so that, the content of the site is appropriate and then explain how that audience can reach their objective, using the information presented on the site.

What cannot be done through the tools presented above is mathematical modelling of natural and social processes. Modelling is useful in order to build an understanding of a complex system in which the relationships cannot be illustrated by simply. An assumption has to be made that there is knowledge about the level of interaction between the different elements of a system. If necessary, tools such as ExtendSIM® can be used (see below).

ExtendSim®

One way to combine the needs of collecting and presenting different kinds of information and perform mathematical modelling is to use the ExtendSim® software which was originally designed for modelling but can be used for different purposes. It uses a hierarchical organisation of the information and presents it in independent blocks. The software includes some ready to use examples, however it is also possible for an advanced user to build their own blocks according to their needs, with graphical interfaces, a dialog box for parameters and a "help" box for comments and documentation (Balle-Beganton et al, 2010).

In addition to the boxes, it is possible to include links to different type of documents (images, videos, pdf, etc.) by making ExtendSim® use other software. Nevertheless, the use of this software supposes a certain level of technical understanding.

By using this software, we are aiming to build platforms to communicate knowledge integration. The objective is to facilitate group sharing of knowledge (Balle-Beganton et al., 2012). The development of the platform commences at the start of the project and it is used for the discussions with stakeholders and modified through the project in order to make a version so that end-users understand the processes, find information (classified according to different scientific and technical levels), and help them to implement a decision process for management.

Time: at least 6 months

Technical level: 4/4

Resources needed: ExtendSim software

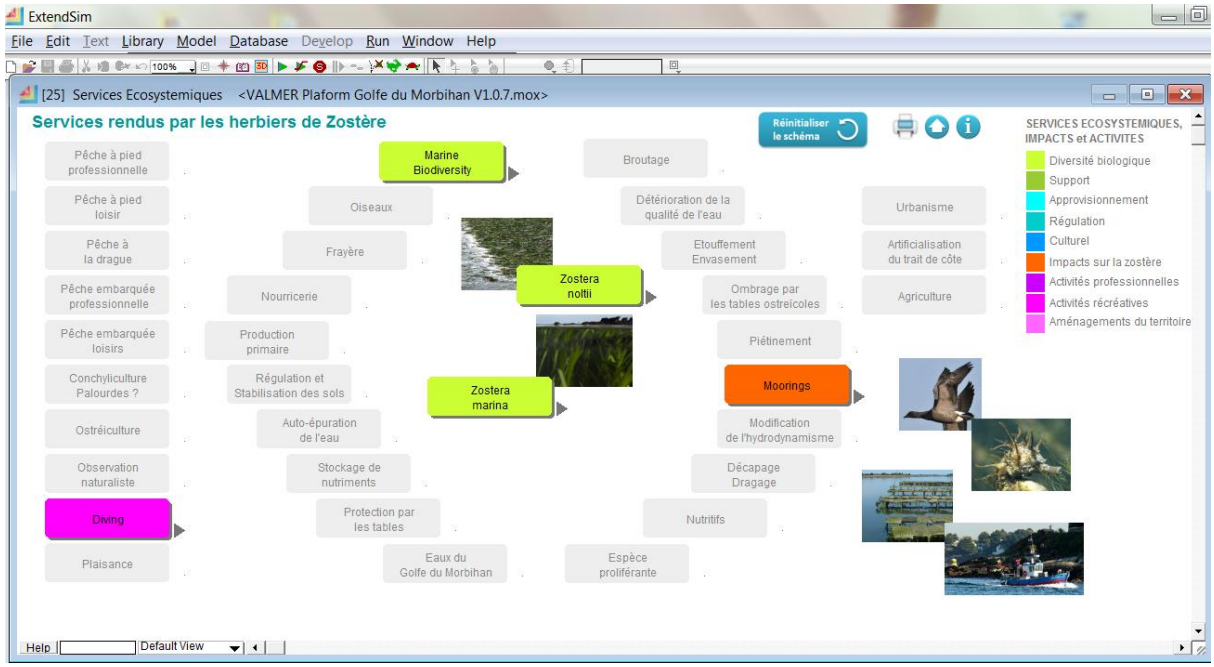
Links

The System Approach Framework using ExtendSim developed under the SPICOSA project (AMURE team, UBO, France)

http://www.spicosa.org/SAF-Toolbox/SAF-ExtendSim-Platforms

Presentation of the ExtendSim platform built for the VALMER project dealing with the seagrass beds in the Golfe du Morbihan in France (draft version, design by J.Beganton, UBO).

ExtendSim platform built for the VALMER project dealing with the seagrass beds in the Golfe du Morbihan in France. Presentation of the seagrass beds system (ecosystem services, interaction with activities, impacts, pressures. Draft version, design by J.Beganton, UBO).



ARDI METHOD

PHASE 1

The **ARDI** method (**Actors, Resources, Dynamics,** and **Interactions**) allows the progressive emergence of a shared representation of the system by identifying the key stakeholders, the resources, the processes, and the interactions between them according to an overarching question (Etienne, 2011). This method is very useful to create a graphical representation of how the stakeholders perceive the system functions. It focuses on co-construction of the meaning and the sharing of information and understanding regarding a particular context that is to be managed and helps to create a shared representation of the whole system using a common structural framework that might help to improve the management of natural resources (Mathevet, 2011).

The ARDI method needs the definition of **the site or location** under question, the **formulation of the question** to be addressed (clear, precise and easily understood) and the **identification of facilitator(s).**

The **facilitator's role** is to:

- Ensure clarity and general agreement of the terms or concepts used to avoid confusion.
- Care must be taken to ensure that each participant has the opportunity to voice their opinion
- Amend the participant's input if needed
- Observe and record the exchanges between participants (attitudes / arguments / choices/ changes)

The ARDI method can be achieved in 4 steps:

Step 1: Identifying key actors
First the participants list the stakeholders that they consider to be associated with the question. The facilitator adds each input on the computer or flip-chart by using a new label and colours to distinguish the stakeholder's categories (professionals, associations, elected members, etc.). Next, the facilitator asks the participants to specify the links that exist between the identified stakeholders to clarify the relationships. Arrows are then added according to suggestions made by the participants. The facilitator progressively shapes the diagram by bringing closer together the stakeholders who have many relations and moving those apart that do not have any (Etienne, 2011).

Step 2: Identifying key resources
The second stage consists of listing the relevant resources (goods or products) of the site or location according to the key stakeholders previously identified.

Step 3: Identifying key dynamics / processes
The third stage of the ARDI process consists of listing the main processes that drive changes in the territory in relation to the question (ecological / economic / social dynamics). If the list is large, the facilitator asks the participants to rank the 10 main processes by assigning "10" to the most important one and "1" to the least. The facilitator then sums up the scores given by each participant and selects the five processes that get the highest score (Etienne, 2011).

Step 4: Eliciting interactions
The last stage of the ARDI method consists of synthesizing answers to the three preceding questions by stressing the interaction between users and resources. This phase generally takes one half-day for a simple diagram (3-4 direct actors, 3-4 resources), and one day for a more complex diagram (5-8 direct actors, 5-10 resources).

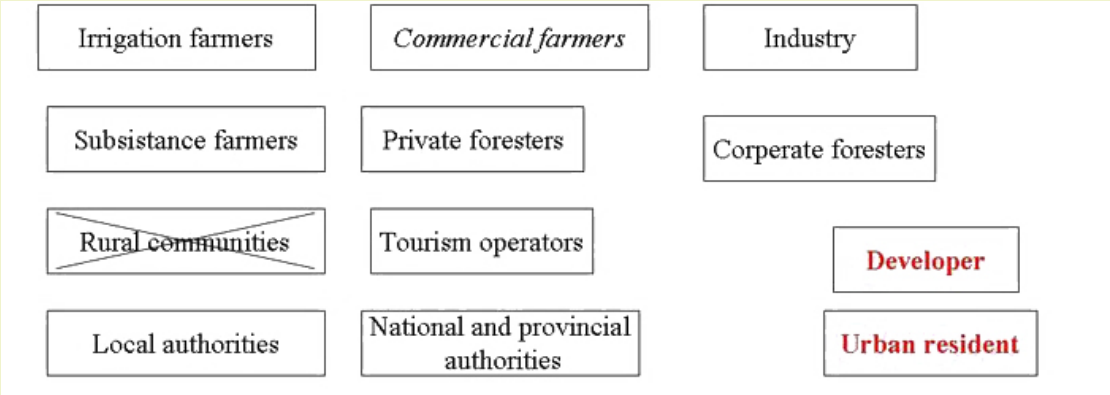
The group must then answer the following ***central question: How does each stakeholder use the resources and modify the processes?***

The facilitator invites the participants to collectively, construct an interaction diagram. For that, the facilitator puts the main resource in the middle of the diagram and asks the group to identify the main stakeholders that are related to this resource. Each participant, in turn, chooses to add an interaction between a stakeholder and a resource or between a stakeholder and another stakeholder. Each new interaction suggested must include a verb that specifies the type of action that generates the link. Finally, when all the arrows are drawn, the participants locate (on the diagram) the key processes by writing down their acronym besides the arrow to represent an interaction that is believed to strongly affect the resource or stakeholder. If the diagrams become too complex, the exercise can be divided up into several manageable portions.

Example of ARDI application on the Crocodile River (Etienne, 2011)

Question: What is driving change in the flow of the Crocodile River?
1. What are the main stakeholders that interact with the river and its flow?
2. What are the main resources of the catchment in relation to water flow?
3. What are the main processes that drive changes in the Crocodile Catchment that affect the river flow?

Step 1. Stakeholders identified *(words written in red were added during the later steps of the ARDI. A crossed box means that the idea was finally rejected).*



Step 2. Resources identified in the Crocodile River case study

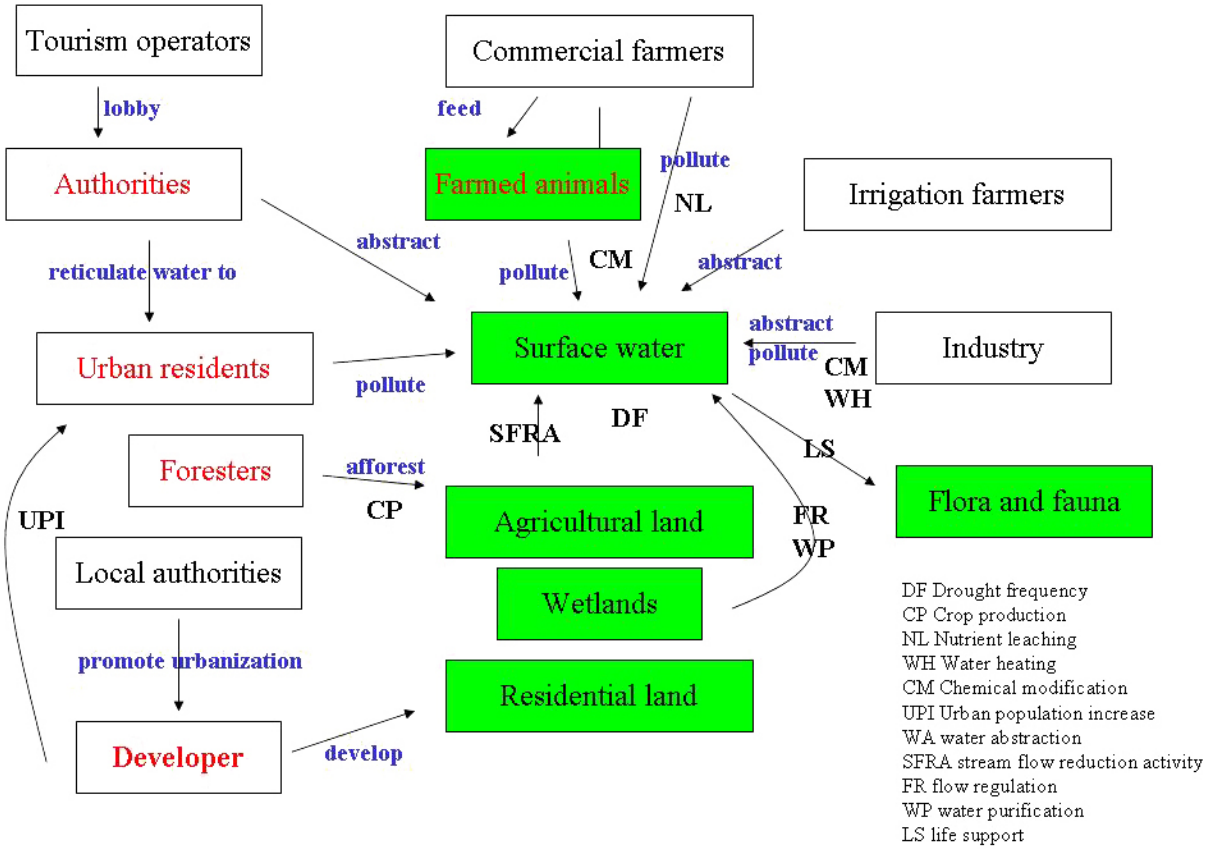
Flora and fauna / Residential land / Agricultural land / Wetlands / Surface water / Farmed animals

Step 3. Dynamics identified in the Crocodile River case study

- Drought production
- Crop production
- Nutrient leaching
- Water heating
- Chemical modification
- Urban population increase
- Water abstraction
- Stream flow reduction activity
- Flow regulation
- Water purification

Example of completed representation developed in the Crocodile River case study

"How does each stakeholder use the resources and modify the processes?" White boxes indicate stakeholders, green boxes indicate resources, boldfaced letter codes indicate processes, and blue text indicates actions. Words or concepts written in red were added during the later steps of the ARDI (Etienne, 2011).



Time: the ideal is to conduct all the workshops over a period not exceeding one month. The meetings may be held in one of the following formats: (a) in a two-and-a-half-day workshop, (b) during one half-day per week, or (c) over three separate days. Ideally, the choice should be negotiated with the participants.

Technical level: 2/4

Advantages: strengths in understanding stakeholders' perspectives and values / effective way to get to a shared representation of a complex system.

Limits: stakeholder's availability

Resources needed: skills in facilitation / skills to anticipate unexpected reactions

Advices: pay special attention to the composition of the working group: the choice of partners and meeting place (neutral and easily accessible), the periodicity of the workshops, and the method of invitation / invite a scientist to benefit from its expertise / keep a record of the process

DPSIR

PHASE 1 PHASE 2

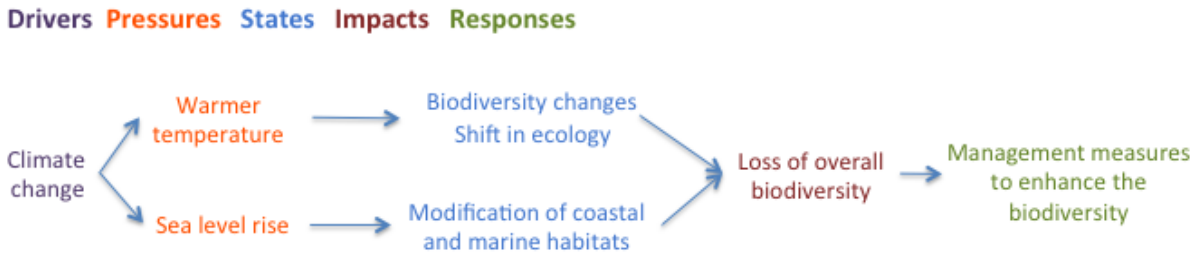
The DPSIR framework has been adopted by the European Environment Agency. It is a general framework for organising information about state of the environment by identifying:

- **Driving forces** Elements that have an influence on the system and that we cannot easily change (e.g. climate change, growth population)
- **Pressures** Human activities (e.g. urban development, tourism)
- **State of the environment** Changes actually observed (e.g. shift in ecology)
- **Impacts** Direct and indirect consequences of the pressures (e.g. loss of biodiversity)
- **Responses** Actions or measures implemented to avoid the negative impacts or take advantage of new opportunities (e.g. new management measures)

Example of DPSIR identified on a marine site

Drivers	Pressures	State	Impacts	Responses
Climate change	Warmer temperature	Shift in ecology	Loss of overall biodiversity	Management measures to enhance the biodiversity
Growth in population	Sea level rise	Biodiversity change	Decrease of water quality	Agreement to preserve landscapes
Financial resources	Urban development	Modification of coastal and marine habitats	Decrease of water's pH	
	Tourism	Landscape's modification	Decline of health and well-being	

Once the DPSIR elements identified, they need to be linked. Thereby, the DPSIR is a useful tool to represent the cause-effect relationships between interacting components of social, economic, and environmental systems. This framework can encourage and support decision-making by pointing to the steps where it is possible to act to improve the situation (e.g. take new management measures, create partnerships).



Time: many weeks to many months

Technical level: 1 /4

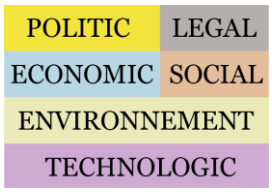
Link

Publication in the International Journal of Sustainable Development & World Ecology
www.edwardrcarr.com/Publications_files/Carr%20et%20al%20Applying%20DPSIR%20to%20Sustainable%20Development.pdf

PESTLE AND MATRIXES

TO CLASSIFY THE POSSIBLE CHANGES

PHASE 2 PHASE 3



The PESTLE analysis is a means to organize the ideas, the trends or possible changes in the future into different categories: Political, Economic, Social, Technologic, Legal, and Environmental.

This analysis can be done during a workshop or as internal work to help you to implement the analysis of the system studied. The PESTLE analysis can be useful to:

- Identify the links between environment and human activities)
- Identify the possible changes in the future that will be used to build the scenarios

In a concrete way, if you use the PESTLE analysis for scenario building, you will have to ask to the participants, considering the common focus and the system studied, **"What possible changes or trends could happen in the future, concerning the political, economic, social, technological, legal, and environmental aspects?".**

If you aim to build exploratory scenarios, there is no limit to the imagination of participants whereas if you build normative scenarios, the participants are limited in their options by the fact that they have to reach the objective to achieve a result.

The PESTLE analysis describes a framework of macro-environmental factors used in helping to identify the different driving forces in play in a particular situation. Sometimes this is also represented as PEST (without the Legal and Environmental). It is a very useful and widely employed tool as it offers a wide-ranging framework from which to build scenarios (While, 2010).

Time: ½ day to 1 day

Technical level: 2/4

Advantages: permits the organisation of ideas, not forgetting any category. Involves participants building the diagnosis or the options for scenarios. Contributes to creating a common understanding of a subject. Creates debate.

Resources needed: a facilitator, materials (pencils, brown-paper, flip-charts etc).

Advice: the facilitators should be prepared for the potential results (do the exercise as a deskwork before the workshop).

Some ideas can be prepared before the workshop as "starters" to be kept or not by the participants, in order to initiate the working groups.

Example of a PESTLE analysis realized to develop exploratory scenarios concerning the adaptation of coastal populations under climate change (www.coastaladaptation.eu).

During a workshop, the participants were divided into 3 groups to identify:

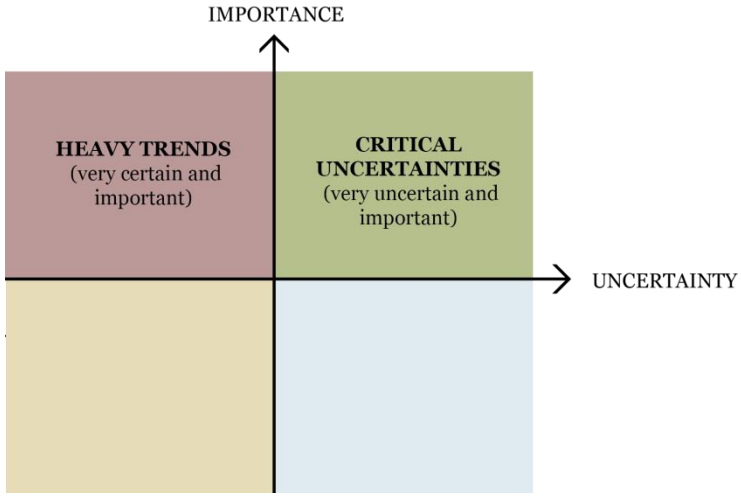
- Group 1: the possible environmental and social changes
- Group 2: the possible political and legal changes
- Group 3: the possible technological and economical changes

For each possible change, participants must give a clear indication of the meaning, such as the trend (increase / decrease) or a movement. After about an hour the participants in the working groups share their ideas by writing them on posts-it notes. The facilitator then combines similar proposals and facilitates the discussion to explain the meaning of each idea. The next step is to identify the possible changes as stakeholders classified them on an "importance/uncertainty" matrix.

"Importance/uncertainty" matrix

The "important" axis refers to the potential impact level of the change, while the "uncertainty" axis refers to the probability of occurrence of the change. The participants plot the possible changes, from the sticky-notes, on the following matrix depending of their "importance" and "uncertainty". In this way stakeholders can debate and discuss their choices.

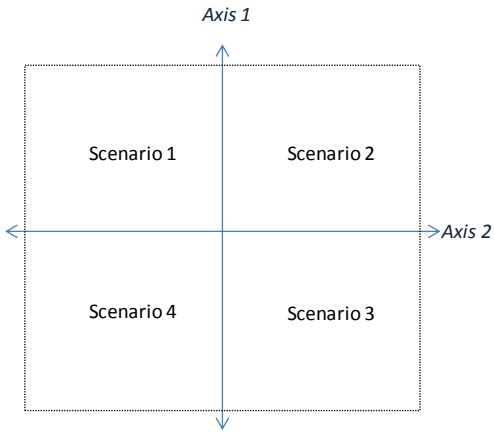
Defining the "uncertainty" of possible changes is sometimes easier than defining their "importance". To help you to classify the possible changes in order of "importance", a score can be assigned to them according to their level of impact. Each participant can for example give a score of "importance" for each possible change, in order to give them an average "importance" score.



The possible changes that are very uncertain and important are called "**critical uncertainties**". They need to be focused on because we can try to influence or act on them as they are 'uncertain'. It is preferable to keep a maximum of 10 to 15 "critical uncertainties" to be able to manage them.

Participants then work just on the "critical uncertainties" identified. Each sticky-note must be associated to a clear sentence describing the "critical uncertainties" (e.g. increase of the earth temperature of 4°C).

Next the participants have to define 2 independent axes that allow to associate "critical uncertainties" in order to form 3 to 4 different groups that represent extreme situations. The axes can be very diversified (see below).



Example of possible axis themes

- Top down vs bottom up
- Big solutions to economic and environmental imperatives vs small incremental solutions to economic and environmental imperatives
- Long term vs short term
- Ecosystem-centric vs community well being-centric
- Reduced number of integrated strategies vs proliferation of single-issues strategies
- Maintain urbanism and habitat on the coast line vs withdrawal from the coastline
- Maintain economic activities vs adapt economic activities

The exploratory scenarios will then be created from each quarter of the matrix. The first step is to link the "critical uncertainties" of one quarter together by writing 3 to 4 descriptive sentences. It is then possible to arrange additional workshops or focus groups in order to develop the scenarios and make them more consistent (phase 4).

Time: 4 hours

Technical level: 2/4

Advantages: quick method to organize the possible changes function or their "importance" and "uncertainty"; create links and confidence between stakeholders and managers; help the appropriation of changes and issues.

Limits: availability and involvement of stakeholders.

Resources needed: facilitator, materials (pencils, brown-paper, flip-charts etc).

Advices: invite stakeholders at least 1 month before the workshop; explain that this work concerns must be considered in the long-term and will not necessarily respond to immediate issues; there must not be too many changes to place on the matrix as there is a risk of not having enough time to complete it; be careful with time management and keep enough of time during the workshop for discussion.

Example see appendix 5.

Link

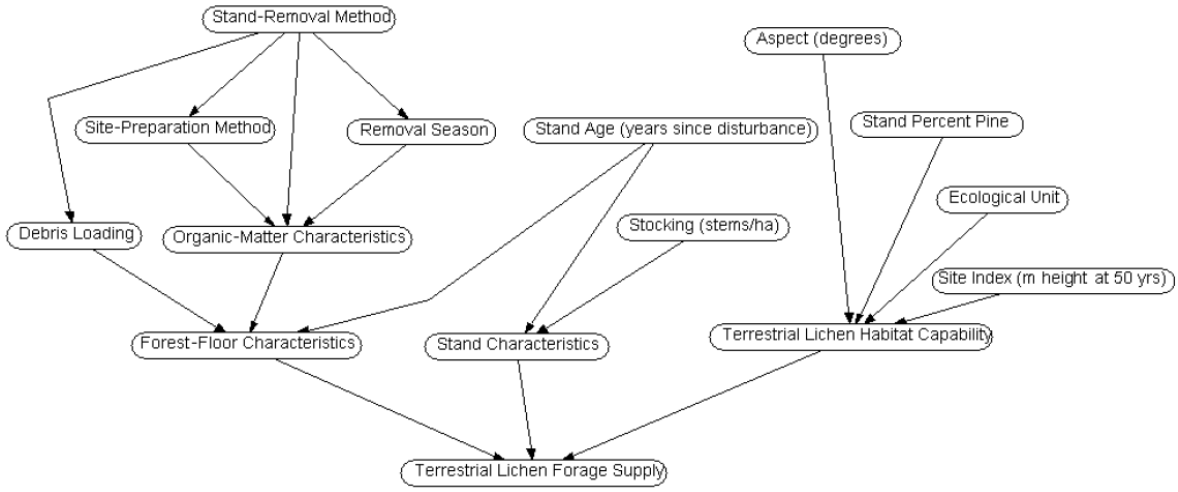
Website devoted to the PESTLE analysis: http://pestleanalysis.com

BAYESIAN ANALYSIS

PHASE 2 PHASE 3

Bayesian Belief Networks (BBNs) are diagrams depicting influence, constructed graphically as networks of variables and their interactions, referred to as nodes linked with arrows representing a wide range of influences on the system being examined. They can display correlative linkages and explore causal relations among variables, such as actions on system components and alternative outcomes (Nyberg et al., 2006). By identifying the system variables or 'nodes', BBNs can be used to identify those variables that have the greatest influence on outcomes, thus they can focus research or action by decision makers within their management decisions and strategies. Their ability to represent and communicate different potential outcomes of management options makes them valuable analytical tools for managers. They have been applied in ecological modelling and natural resource management, for example, to represent species-habitat relationships and population viability and to depict the influence of alternative management activities on key ecological variables to help support researchers and managers, respectively (McCann et al., 2006).

The diagram below depicts various environmental factors and forest management measures upon lichens in British Columbia (Nyberg et al., 2006):



BBNs allow the structuring of the internal logic of scenarios by using conditional probabilities on the relationships between variables (logical and strength). These conditional probabilities can be gathered through empirical data, stakeholder input, expert judgement or model output. Such networks thus offer a way of combining both quantitative and qualitative data within a single framework, and of expressing the uncertainties associated with the underlying assumptions and the impacts that appear to follow from them.

Bayesian modelling is probabilistic, and therefore, can include data and other sources of information even though either may be incomplete (McNay R.S. et al., 2006). In general, BBNs consist of nodes and linkages, where nodes represent environmental correlates, disturbance factors, and response conditions. All nodes are linked by probabilities. Input nodes (the range and environmental prediction variables) contain marginal ("prior") probabilities of their states determined from actual existing conditions; intermediate nodes (e.g., describing attributes of caribou range) contain tables of conditional probabilities based on empirical studies and (or) expert judgment; and output nodes (caribou range values) are calculated as posterior probabilities. Some input nodes, which we refer to as "management levers," can represent correlations to the environment that are dynamic either through unmanaged or

managed disturbance. These levers can be adjusted based on scenario simulations to estimate management effects during BBN applications. (McNay R.S. et al., 2006)

Bayesian belief networks can serve many purposes, from illustrating a conceptual understanding of system relations to calculating joint probabilities for decision options and predicting outcomes of management policies. Nevertheless, when properly used, Bayesian networks can benefit most adaptive-management teams by promoting a shared understanding of the system being managed and encouraging the rigorous examination of alternative management policies. (Nyberg et al., 2006).

Time: this depends on the need or not to develop the network of interactions before running the survey and the choice to run the survey during workshop(s) or on line. Starting from the building of the network of interdependencies for a specific issue and going through an online survey may require 6 to 8 months. The short version: a small expert group to adapt a pre-existing view of the issue and on large workshop to run and interpret the survey can be done in 3-4 months including writing the narrative.

Technical level: 4

Advantages: inclusive in terms of engaging experts into the definition of the problem; provides quantitative estimates (probability chains) that can be used to explore alternative pathways towards a given future.

BBNs as a tool for researchers and managers can be considered to have considerable merit, in summary they can (McCann et al, 2006):

- Represent and combine empirical data with experts understanding of ecological systems;
- Graphically express complex relationships and problems in resource management;
- Address, in a structured way, uncertainties within systems;
- Structure and evaluate alternative decision within the system;
- Can be created and amended with ease;
- Allow flexible use of information, and can be used in both data-rich and data-poor situations, however in the latter case, caution is advised;
- Present complex system through graphical representation that can be easily understood by various stakeholders, who may not have training in the underlying scientific disciplines, and facilitate important management-related discussions.

Limits: requires some mastering of the approach and methodology to be seriously implemented. Some temporal dynamics and relationships can be difficult to illustrate within a BBN; similarly feedback functions cannot always be represented within these models. Models can be easily developed entirely from expert judgement, with an unknown degree of bias and inaccuracy. Where this is the case, judgements need to be recorded to validate the basis for the model's structure. Nodes in the model, for example, should be empirically observable, quantifiable or defensible (McCann et al, 2006).

Resources needed: organize 2 or 3 meetings of small "expert" groups to develop the structure of the problem and questionnaire. The resources required are a meeting facilitator and statistician with knowledge in Bayesian approach; a meeting or online survey to complete the questionnaire; a meeting to run the scenarios. Time must then be allocated for writing the narratives, which will be based on results of the scenarios.

Advice: work with somebody familiar with developing questionnaires for Bayesian statistics and a facilitator familiar with running scenario discussions.

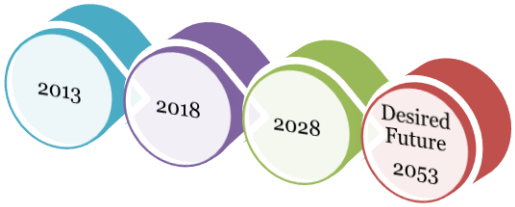
Link

Carnegie Mellon University, Research Showcase, department of Statistics. Bayesian Environmental Policy Decision: two case studies.
http://repository.cmu.edu/cgi/viewcontent.cgi?article=1043&context=statistics

BACKCASTING

PHASE 3

The backcasting technique is very useful to develop a normative scenario. Instead of starting as is usual from the present situation, the Backcasting approach takes its starting point from a future situation and designs possible paths back to the present to achieve the desired future. This desired future is described by a text with qualitative and/or quantitative goals.

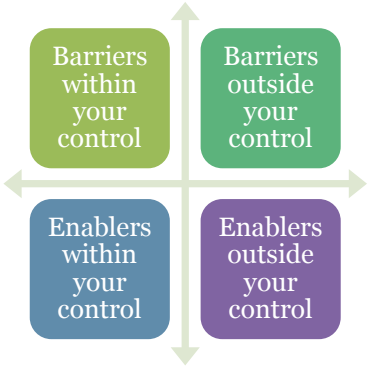


To do this, the time period until the point in time identified in the future is divided ideally, into 3 time units of 2, 5 or 10 years. Each time unit corresponds to a step for which it is necessary to identify those things that could prevent reaching the desired future state.

Here, the term "scenario" covers both the images of the future and the trajectory leading back to the present. The conditions needed to achieve the desired future can be defined during a workshop by asking to stakeholders **"what shall we do today to get there?"**. Thereby, Backcasting can be used to test different combinations of policy options that can feature new future conditions. As a participatory process, Backcasting can be used to generate debate over alternative and challenging futures (Holmberg and Robert, 2000).

8 steps of a Backcasting exercise employed to build a normative scenario

1. **Describe a desired future**
2. Define **key differences** between the desired future and today
3. Identify **key steps and actions** needed to achieve the desired future
4. Identify **drivers and trends**, which could impact on your ability to achieve the desired future
5. **Map the drivers and trends** onto a 2x2 matrix according to whether they are barriers (to achieving the desired future) or enablers (towards achieving the desired future); and whether they are in your control or out of your control



6. Discuss **what you need to do** to ensure that barriers inside your control are minimised and that enablers inside your control are optimised
7. Explore **how to get around barriers** outside your control
8. Define **performance indicators** that will help you monitor progress towards your desired future

Example of Backcasting workshop's agenda (While, 2010)

TIME	ACTIVITY
9.30 (15')	Introduction Describe purpose and agenda Confirm the aim of the workshop
09.45 (45')	Describe with stakeholders the desired future through a discussion group What is our vision of success? Capture key points and issues and ensure that everyone agrees
10.30 (30')	Define key differences and describe the key differences between: The actual situation and the desired future Identify the external and internal environments now and in the desired future
11.00 (45')	Identify the key steps to achieving the future Build a timeline between now and the desired future Describe the key events and steps that need to occur to achieve the desired future Map them on the timeline
11.45 (60')	Split into breakout groups Explore the possible trends, drivers and events that might have an impact on the key steps towards delivering the future Capture trends, drivers and events on sticky-notes Map sticky notes on 2x2 matrix according to whether they are barriers (to achieving the preferred vision) or enablers (towards achieving the preferred vision); and whether they are in your control or out of your control
12.45 (60')	Lunch *(could be served in the workshop rooms as a buffet to allow further flexibility of schedule and continuation of the drivers mapping)*
13.45 (45')	Controlling the future: participants separate into 4 breakout groups: **Group 1 focus on barriers in our control:** *What are they? How will they affect our ability to deliver the desired future?* *What steps do we need to take to remove them?* **Group 2 focus on enablers in our control:** *What are they? How will they affect our ability to deliver the desired future?* *How do we harness them to strengthen the strategy?* **Group 3 focus on barriers outside our control:** *What are they? How will they affect our ability to deliver the desired future?* *What can we do to minimise their impact?* **Group 4 focus on enablers outside our control:** *What are they? How will they affect our ability to deliver the desired future?* *How can we harness them to strengthen the strategy?*
14.30 (30')	Feedback and discussion
15.00 (30')	Next steps / What are they? / To be done when? / By whom?
15.30	Close

Time: 4 hours to 1 day

Technical level: 2/4

Advantages: good way to create strategic purpose.

Limits: it may be difficult for participants to plan for the future.

Resources needed: materials (pencils, brown-paper, flip-charts etc).

Advice: do a preliminary PESTLE analysis to identify the drivers of change.

Link

Article from the International Journal of Sustainable Development and World Ecology: Back-casting From Non-overlapping Principles – A Framework for Strategic Planning
http://www.naturalstep.org/en/backcasting-non-overlapping-principles-framework-strategic-planning

INVEST

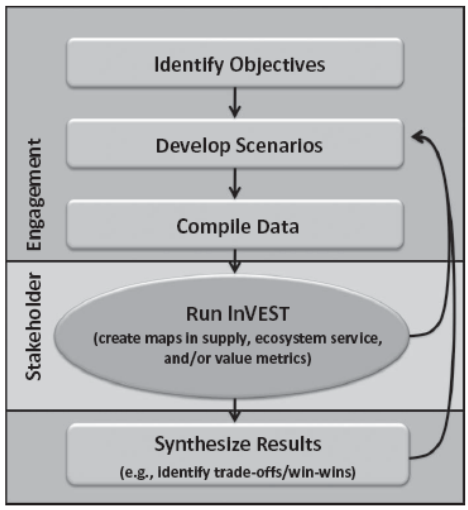
PHASE 4

InVEST (Integrated Valuation of Ecosystem Services and Trade-offs) is a framework of "open source" models for mapping and valuing ecosystem services (ES) developed by Natural Capital Project. It proposes 15 models:

- **Coastal vulnerability**
- **Habitat risk assessment**
- **Coastal protection**
- **Sediment retention**
- **Biodiversity**
- **Marine fish aquaculture**
- **Marine water quality**
- **Water quality**
- **Wave energy**
- **Overlap analysis**
- **Aesthetic quality**
- **Carbon**
- **Crop pollination**
- **Managed timber production**
- **Reservoir hydropower production**

These models are based on production functions that define how an ecosystem's structure and function affect the flows and values of ecosystem services. This allows assessing economic and biophysical consequences of alternative scenarios. The models are coupled with a Geographic Information System (GIS) and produce different outputs: maps, balance sheets and tables. InVEST can be downloaded on: http://www.naturalcapitalproject.org/.

InVEST is designed to be used as part of a stakeholder engagement process who participate in every step of the process. First, stakeholders identify a set of objectives and several alternative management scenarios that may help achieve stated objectives. InVEST models estimate the level of ecosystem services produced in each scenario. The outputs of InVEST can be visualized as maps of ecosystem service delivery, trade-offs, or balance sheets. After evaluating scenarios with respect to objectives and within the context of local social and cultural values, stakeholders may choose to reiterate the process with newly created scenarios (Guerry et al, 2012).

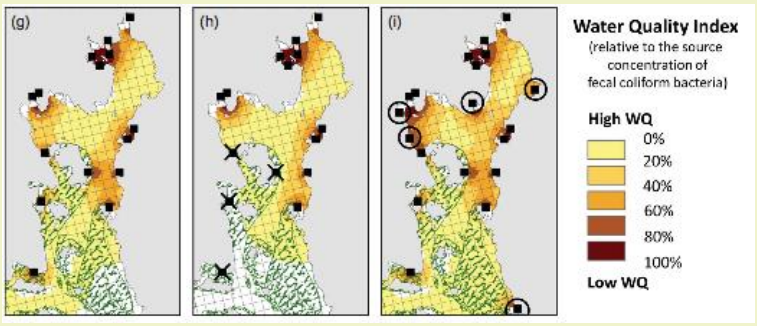


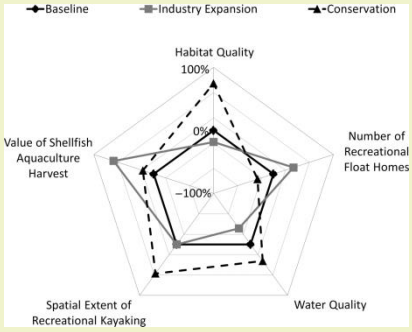
For more information a user's guide is available on: www.naturalcapitalproject.org/InVEST.html that explains how to install the software and run InVEST, provides the theory behind each model and describes the input data requirements and how to interpret output results.

Example of InVEST running on the West Coast of Vancouver Island, Canada (Guerry et al, 2012)

Following interviews with stakeholders, 3 management scenarios have been built:
1) Industrial expansion (five new floating home leases are added, as shown in black circles; five new oyster tenures are added, as shown in black squares; and wild geoduck harvest is allowed)
2) Conservation (zoning rules restrict floating homes and aquaculture in areas near eelgrass beds)
3) Baseline (no changes to current uses or zones)

Example of outputs





Expansions of the shape toward the exterior represent gains relative to the baseline and contractions represent losses. A scenario with only gains (and no trade-offs) would be represented by a shape that completely includes or exceeds the baseline shape.

Time: at least 6 months

Technical level: 4/4

Advantages: downloadable tool; visual outputs.

Limits: availability and quality of data; limited number of models; understanding of the models; communicate model uncertainty.

Resources needed: data; ESRI's ArcGIS software; basic to intermediate skills in ArcGIS.

Advice: install the software and try it with demo data to have a good idea of what is possible to do with InVEST.

Conclusion

The VALMER project tries to help the managers to define better management options thanks to the ecosystem services approach that considers the interactions between species, habitats, human activities and governance context.

This integrated approach is developed in VALMER through the combination of two major processes: the ecosystem services assessment (ESA) and the scenario building process.

These tools are complementary and feed each other. The ESA can be used as a starting point to explain the current situation on a site or location but also to illustrate possible scenarios and compare the consequences of different management options.

The ESA and scenarios can help managers to:

- Structure knowledge, data and information on the socio-eco-system
- Create trust and understanding between stakeholders
- Find technical solutions
- Identify the best management options
- Highlight management measures and decisions
- Define a coastal and maritime vision

This guide tries to explain the 5 phases of the scenarios building process in the wider VALMER context. Each phase is linked to the others and need to be achieved in the correct order. However, the scenario building process can take place at different stages of any project.

Because each site study situation is unique (governance context, skills, time available), this guide describes 12 tools useful for the different phases. There may be other tools that are not described here. It is suggested that the case study teams choose the most appropriate approach to build scenarios with their stakeholders according to their own context and using all their creativity in order to use the proposed tools in the best way for them.

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Glossary

Backcasting: Instead of starting as is usual from the present situation, the Backcasting approach takes its starting point from a future situation and designs possible paths back to the present to achieve the desired future. The fundamental question of backcasting is: "if we want to achieve this goal, what actions must be taken to get there?" This backwards work allows the identification of policies and programs that will connect the future to the present.

Critical uncertainties: character of something that is very uncertain and can have important effects/consequences.

Future: refers to a time, a period to come, says what will happen in this time period.

Heavy trends: orientation, direction of an important evolution for the system.

Hypothesis: assumption, conjecture on the possibility of the occurrence of 'future' events.

Models: mathematical equation(s) through which we try to represent how variables interact among themselves within a subsystem that we have already isolated; i.e., equation systems, which serve to generate simulations of the future.

Modelling: a simplified description, especially a mathematical one, of a system or process, to assist calculations and predictions.

Scenario: scenarios are stories that portray plausible futures, which are designed to systematically explore, create and test possible and/or desirable futures conditions.

Seeds of change: "tiny signs by their present size but huge in their virtual effects".

Simulation: technique that aims to represent the real world by a computer program which is based on one or many models; "a simulation should imitate the internal processes and not merely the results of the thing being simulated".

System: set of elements considered in their relationship within a whole operable unit.

Appendices

APPENDIX 1: Example of a working document to be completed by the case study's team to define what phases are done and what needs to be done.

APPENDIX 2: Example of scenario presented as a newspaper article or as stories (example of the future of a territory in the context of climate change. Golfe du Morbihan, IMCORE project).

APPENDIX 3: Theoretical example of DELPHI. This example has been imagined for the VALMER Scenario workshop held in Auray in July 2013. It uses a hypothetical site.

APPENDIX 4: Example of sheet distributed during a Regnier's abacus exercise.

APPENDIX 5: Theoretical example of PESTLE analysis done with stakeholders. This example was created for the VALMER Scenario workshop held in Auray in July 2013 and represents a hypothetical situation.

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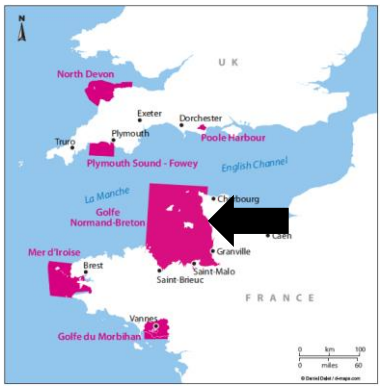


Site: Golfe Normand Breton

Contributors:.....

"What have you already done on your site?"

PREPARATORY PHASE

- ***Identify the common focus*** ***(issues, management question)***

e.g. Slipper limpet / Seagrass bed

- ***Define the geographical scope of the study***

- ***Analyse the governance context and define stakeholder participation in the scenario process***

- ***Identify data availability and data management issues***

e.g. ecological data (links habitats + functions + services) /data on activities and economic issues

* ***Decide what assessment methods are to be used***

SCENARIO BUILDING PHASES

- **PHASE 1: Conceptualising the case study ecosystem: understanding the interlinkages between the human and environmental systems**

e.g. Invest / Stakeholders meetings

- **PHASE 2: Identifying drivers of change in the case study ecosystem**

Exploratory scenarios?

- **PHASE 3: Establishing key variables and associating them to explore and build the scenarios**

Management actions: activities/conservation areas

- **PHASE 4: Selecting and developing the format of the scenarios with stakeholders**

- **PHASE 5: Using scenarios to create debate on management options**

Create a common culture with stakeholders

- **What tool(s) would you like to be more precisely informed about?**

BAC		Backcasting
BRS		Brainstorming
BAY		Bayesian analysis
DEL	√	DELPHI
DPS		DPSIR

INT		Interviews
INV	√	Invest models
MAT	√	Matrixes to classify the possible changes
PES		PESTLE analysis
REG		Régnier abacus
STA		Stakeholders interactions matrixes
TOO		Tools to represent the human and environmental system

APPENDIX 2: Example of scenario presented as a newspaper article (example from the Jurassic coast) or as stories (example from the Golfe du Morbihan, future in the context of climate change, IMCORE project).

SCENARIO FOR PRESTON BEACH ROAD

The Jurassic Coast Daily

17th October 2060

The A353 - a key road link between Weymouth and the communities of Preston and Bowleaze to the east - was first closed due to overtopping of the sea wall almost thirty years ago. Ever since, stormier winters have made temporary closure of the road an annual event. This year, however, both the road and the sea wall have sustained significant damage as a result of rising sea levels and a shrinking beach. Amid public outcry over its rumoured closure, Weymouth and Portland Borough Council have this week called a meeting to discuss the future of the road.

The sea-wall defending the A353 was first overtopped in 2033 during the 'Great Storm'. A huge swell combined with a spring high tide and hurricane force winds driving a surge of water and shingle over the sea-wall and into the nature reserve beyond. Experts at the time, pointed to the fact that the Environment Agency had been due to replenish the beach with new material – a costly process they had been undertaking every 15 years. However, a stormy September prevented the EA from carrying out the planned replenishment and, when the storm hit, the low beach levels left the back wall exposed and vulnerable.

For three weeks, the road was closed as Highways teams laboured to repair the damaged road, removing the shingle left by the powerful waves. The closure of the road severed links to Weymouth from the east, significantly impacting both businesses and residents within the Preston and Bowleaze area.

At the time, the closure of the A353 was thought to be a one-off event; brought about by the 1 in 200 year storm event. Unfortunately, the following decades revealed that this would not be the case. To date, almost half a metre of sea-level rise has progressively squeezed Preston beach against the sea-wall. Efforts to replenish the beach with new shingle have provided some alleviation of the problem, only for the next big storm to once again plunder the beach of shingle. With little protection provided by the beach the sea-wall is now so exposed to winter storms that it overtops on almost a yearly basis.

The constant closure and reopening of the road every winter has hit the communities at Preston and Bowleaze hard. Residents frequently find themselves accessing Weymouth via lengthy diversions. The community's elderly population many of whom rely on the local bus network find it difficult to access Weymouth town centre, leading to concern over isolation amongst that group. In addition, whilst most businesses along the Jurassic Coast have enjoyed booming visitor numbers, businesses at Overcombe and Bowleaze attribute their declining profits to the frequent road closures plaguing their community.

If the future of the A353 wasn't distressing enough for the local community, the unchecked erosion of Furzy Cliff poses additional cause for concern. In some areas, the cliff line has retreated some 50 metres, outflanking the defences which protect the community at Overcombe. Much to the dismay of affected property owners, the SMP recommends a policy of 'No Active Intervention' for the area. As a result, the Spyglass Inn faces imminent closure on safety grounds. The residential flats and water sports centre will soon follow if no action is taken. Applications by Weymouth and Portland Borough Council for a new coastal defence scheme were refused after they were deemed too costly and technically challenging.


SCENARIOS
ON THE EVOLUTION OF THE GULF OF MORBIHAN
DUE TO CLIMATE CHANGE
Scenario 2
"GRADUALLY ADAPTING TO AND LIVING WITH THE RISK"
Maintaining infrastructures and urban development
at risk of enduring the effects of climate change
This scenario, of which certain aspects are very similar to the current situation, considers the maintenance of infrastructures and urbanised areas on the coast despite the risks generated by climate change. These risks are clearly identified yet society has chosen to live with them: it reacts «on the flyx, without anticipation. The area is therefore confronted with new pressures which induce unplanned economic, social and environmental changes.
Flooding risks
Alerted/mobilised by the various storms that hit coastal areas, States services identify vulnerability areas for marine flooding.
Implementation of alert and response systems
In unbuilt areas, urbanisation is strongly discouraged, and is left to the discretion of mayors. If they constitute interesting entities in terms of natural heritage (and if they are put up for sale), such plots may be purchased by the Conservatoire du Littoral.
In built up areas, if human safety is seriously endangered, the State offers the choice of leaving homes and buildings in exchange for minimal compensation. However, it does not force people to leave, as it has experienced failure of this policy in the past. It nevertheless declines all responsibility if the buyout offer is refused. Meanwhile, local and national information campaigns on the risks are set up to give the population a sense of responsibility. Residents are therefore free to decide on their fate with full knowledge of the facts, through information distributed by the State, local authorities, associations and scientists.
Alongside information campaigns, high performance emergency prevention, alert and response systems are introduced, often requiring major investments. The aim is not however to implement major technical means such as a continuous network of walls and protection systems.
No major protective structures
Communes therefore strive for instance to reduce soil sealing and deterioration of wetlands which act as a buffer zone. They address the issue of water management according to the means they have available for example by creating retention tanks, improving drainage systems and protecting them against flooding.
Possibility of developing new activities
Growing social disparity
Impacts on governance
The State is unable to look beyond immediate local issues and invest in the long term in the twofold challenge of sustainable environmental protection and the preservation of public finances. It cannot stand up to the pressure of economic lobbying to truly satisfy the most common and long term requirements. Local councillors continue to be the main local decision-makers/developers, on a scale that is not necessarily relevant for action against climate change and its effects.
Local councillors are the main decision-makers

APPENDIX 3: A theoretical example of DELPHI. This example has been created for the VALMER Scenario workshop held in Auray in July 2013. It represents a hypothetical situation.

Example of DELPHI

Valmer case study **"Plymouth to Fowey"**

Definition of the problem

- We want to identify the most important subjects to deal with in order to build a management at this scale.
- We identify the major decision makers, managers of the territory and groups of stakeholders we would like to collect the opinions of

Select the members of the panel according to the required expertise

- Cornwall Council*
- Plymouth City Council
- Harbour Authorities (Fowey Harbour Commissioners, Ministry of Defence, Looe Harbour Commissioners)
- Fowey Estuary Partnership*
- Tamar Estuaries Consultative Forum*
- Smaller partnerships, e.g. Looe Harbour and Conservation Area
- Government agencies: Marine Management Organisation, Natural England, Crown Estate, Cornwall IFCA, Environment Agency
- Devon Maritime Forum
- National Trust*
- Cornwall Marine Network
- Fishermen's Associations
- Fisheries Local Action Groups (FLAGs)
- Cornwall Fish Producer Organisation
- Cornish Federation of Sea Anglers
- Cornwall Marine Liaison Group
- Cornwall Biodiversity Initiative
- Cornwall AONB Partnership
- Cornwall and Isles of Scilly Coastal Advisory Group (CISCAG)
- Cornwall and Isles of Scilly Local Enterprise Partnership
- South West Water
- Major Landowners: Dutchy of Cornwall, Crown Estate, National Trust, Cornwall Council, Ministry of Defence/Defence Estates
- Local Nature Partnerships (Cornwall and the Isles of Scilly, Plymouth, Devon)
- Cornwall Green Infrastructure Steering Group
- Ministry of Defence
- Queens Harbour Master

Questionnaire 1.

Only one question. Free answers.

Prepare and distribue questionnaires

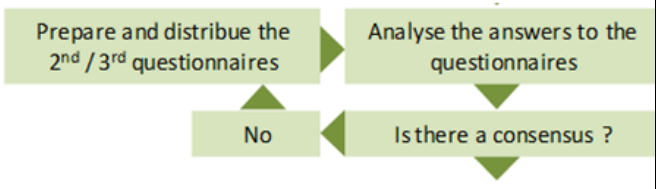
"What are the issues that require management at the scale of the territory between Plymouth and Fowey? Propose all your ideas."

Analyse the answers to the questionnaires

- Tourism (coordination of economic offer)
- Environment
- Governance of the sea
- Fishing
- Aggregate extraction
- Dredge spoil dumpsite
- Erosion
- Water Pollution
- Coordination of port activities (distribution between Plymouth and Fowey)
- Coastal hazards
- Protection of biodiversity
- The management of coastal pathways
- The urbanism and housing areas management
- The organization of recreational activities
- The use of wave energy through the establishment of offshore installations
- Agricultural spraying
- The distribution of the space between the recreational activities
- The organization of activities between the uses of leisure, marine traffic, extraction activities (fishing, aggregates), military applications
- Landscape preservation

Questionnaire 2.

"Considering the following issues rank from 1 to 10 the most important for you in order to implement its management at the scale of the territory between Plymouth and Fowey? Comment your choice"



- Tourism (coordination of economic offer)
- Environment
- Governance of the sea
- Fishing
- Aggregate extraction
- Dredge spoil dumpsite
- Erosion
- Water Pollution
- Coordination of port activities (distribution between Plymouth and Fowey)
- Coastal hazards
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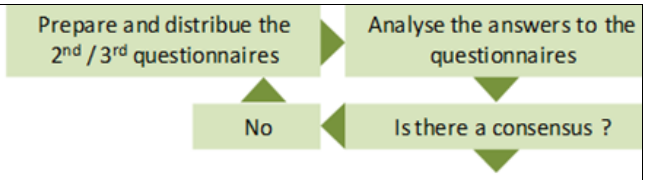
- The urbanism and housing areas management
- The organization of recreational activities
- The use of wave energy through the establishment of offshore installations
- Agricultural spraying
- The distribution of the space between the recreational activities
- The organization of activities between the uses of leisure, marine traffic, extraction activities (fishing, aggregates), military applications
- Landscape preservation

Questionnaire 3.



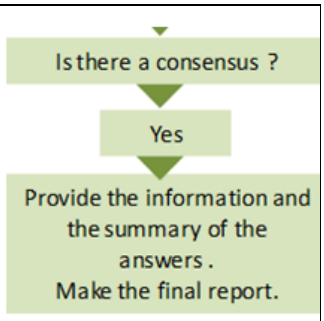
"There is a consensus on the following 10 issues to consider in order to implement its management at the scale of the territory between Plymouth and Fowey. The issues are ranked as followed. We indicate you in every case if there is a consensus and if not, why. Considering these different information, can you comment if you agree or if you have a different opinion any why?

Rank

1. The organization of recreational activities : because....bla bla bla
2. The management of coastal pathways : because....bla bla bla
3. The organization of activities between the uses of leisure, marine traffic, extraction activities (fishing, aggregates), military applications : because....bla bla bla
4. Tourism (coordination of economic offer) : because....bla bla bla
5. Environment : because....bla bla bla
6. Protection of biodiversity : because....bla bla bla
7. Landscape preservation : because....bla bla bla
8. Erosion : because....bla bla bla
9. Water Pollution : because....bla bla bla
10. Coastal hazards : because....bla bla bla

Report

On the territory between Plymouth and Fowey, the issues that are considered as the major ones to be managed are dealing with well being (pathways, landscapes…)…bla bla bla



APPENDIX 4: Example of sheet distributed during a Regnier's abacus exercise.

The managers of the XXX study site organise a meeting with stakeholders to identify the more likely possible changes identified during a previous workshop. For this, participants have to score each item using the following notation.

Item	Notation
Very likely	1
Light likely	2
Mixed opinions	3
Unlikely	4
Very unlikely	5
No opinion	6

1	In the next years, the distribution of the common dolphin will move	Notation
Comments		

2	It is difficult to find new kelp harvesters	Notation
Comments		

3	The water quality improves gradually	Notation
Comments		

4	The marine biodiversity is decreasing	Notation
Comments		

5	The pressures on maerl beds increase	Notation
Comments		

6	New species appear in the perimeter of the NMP	Notation
Comments		

7	Storms are more frequent	Notation
Comments		

Example of the Excel sheet that can be used during a Regnier's abacus exercise (contact WP3 support team to use the Excel sheet for your own case). The items chosen are theoretical; they are not dealing with the real issues for consideration in a VALMER case study.

- Answers of the participants for each item:

Scenarios workshop - VALMER Project

10th and 11th July 2013

Exercise with the Régnier's abacus tool

This file is protected in order to avoid any unexpected modification. Only the content of the first table can be changed. It is designed for a max of 19 participants and 8 items.

Nevertheless, if you want to use it freely, record it under a new name and use the password "valmer" in order to remove the protection of the cells.

ACCEPT MACROS !

Fill in only the cells of the first table
The other cells are calculated automatically
Number of participants : 14
Answers to the questionnaire :

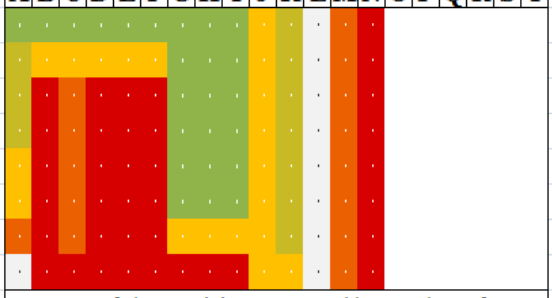
participants:	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Item 1	2	5	5	5	5	5	5	5	5	3	2	6	4	5						
Item 2	2	1	1	1	1	1	1	1	1	3	2	6	4	5						
Item 3	3	5	4	5	5	5	1	1	1	3	2	6	4	5						
Item 4	4	5	4	5	5	5	1	1	1	3	2	6	4	5						
Item 5	3	3	3	3	3	3	3	3	3	3	3	6	4	5						
Item 6	6	5	4	5	5	5	1	1	1	3	2	6	4	5						
Item 7	1	5	4	5	5	5	1	1	1	3	2	6	4	5						
Item 8	2	5	4	5	5	5	1	1	1	3	2	6	4	5						

- Visual representation of the answers sorted by participant or by item :

PARTICIPANTS DIAGONAL

Accept Macro, then CTRL + W to refresh

A B C D E F G H I J K L M N O P Q R S T

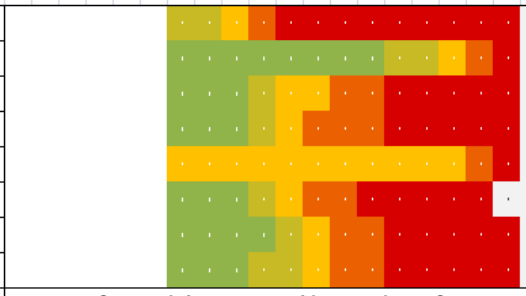


Answers of the participants sorted by number of answers from "totally agree" (green)" to "do not agree"(red) + don't know (grey). [not sorted by items]

HYPOTHESIS DIAGONAL

Accept Macro, then CTRL + N to refresh

Item 1
Item 2
Item 3
Item 4
Item 5
Item 6
Item 7
Item 8



Answers for each item sorted by number of answers from "totally agree" (green)" to "do not agree"(red) + don't know (grey). [not sorted by participants]

- Visual representation of the fact that there is a consensus on the answer for each item or not and why (to be used to explain to the participants on which subject there is a need to discuss further) :

Exercise with the Régnier's abacus tool			Is there a consensus about the fact that it is probable or not?			If yes, is it probable or not probable?
Item 1	In the next years, the distribution of the common dolphin will move due to warmer water.		CONSENSUS		✗	not probable
Item 2	It is difficult to find new kelp harvesters.		CONSENSUS		✓	probable
Item 3	The water quality improves gradually.		TALK AGAIN	big disensus		
Item 4	The marine biodiversity is decreasing		TALK AGAIN	big disensus		
Item 5	The pressures on maerl beds increase		TALK AGAIN	too many 'sharred view'		

APPENDIX 5: Theoretical example of PESTLE analysis undertaken with stakeholders. This example has been created for the VALMER Scenario workshop held in Auray in July 2013. It represents a hypothetical situation.

I. BEFORE THE WORKSHOP

1. **Identify the question** you want the participants to answer:

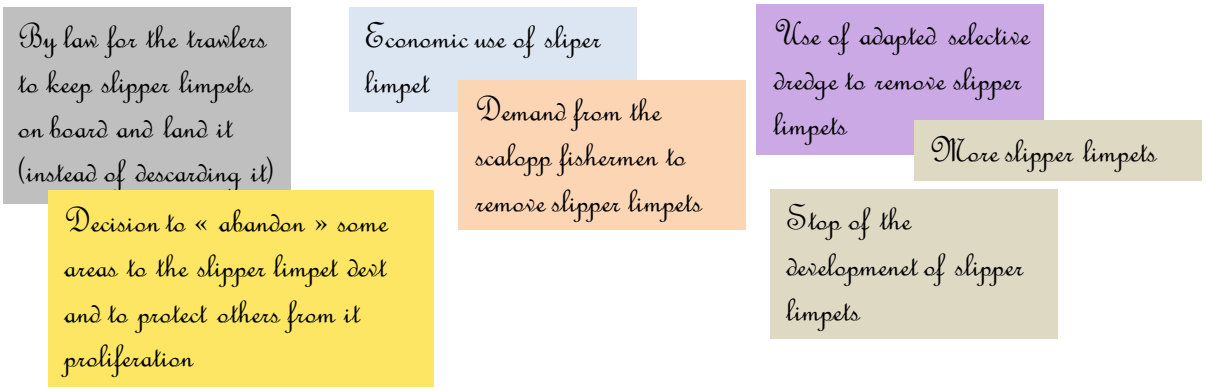
"Considering the fact that there is a problem of invasive species in the Golfe Normand-Breton (slipper limpet), what are the possible futures of this territory?"

2. **Invite "experts" or stakeholders** who have a particular interest in the subject
3. **Prepare work is small groups** (everybody can't work on all the aspects)

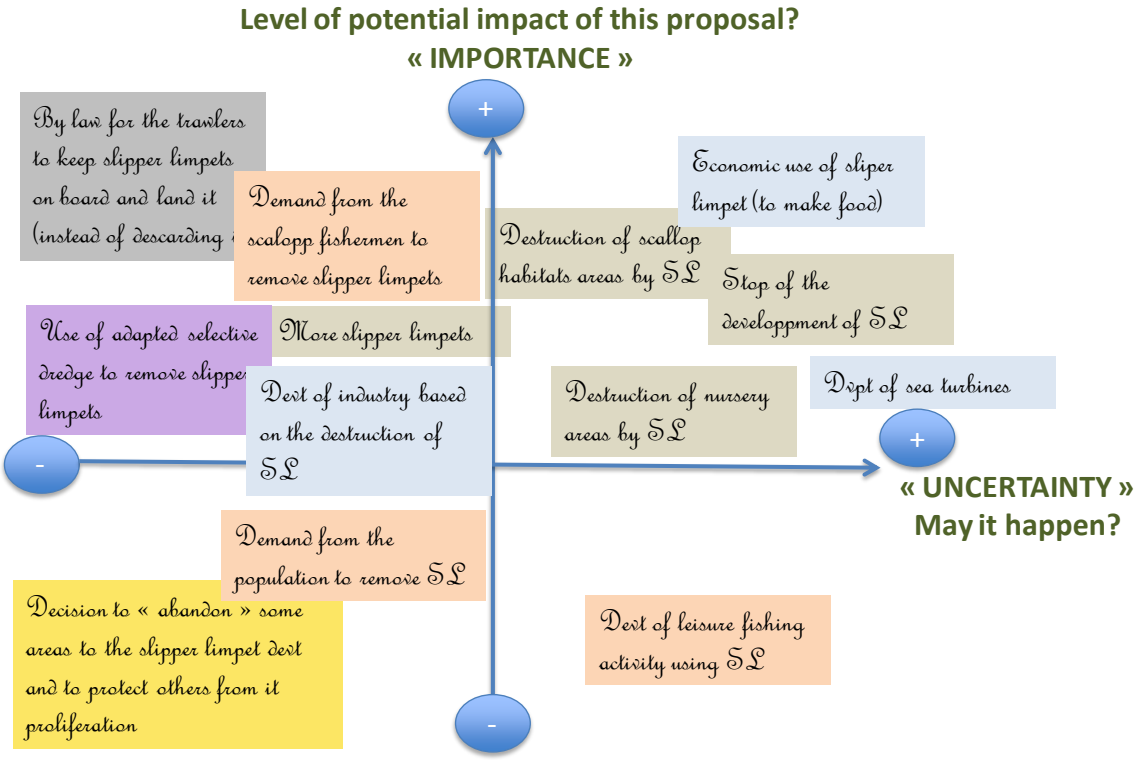
II. DURING THE WORKSHOP

1. Begin by an **information on the subject**
2. Explain what are the **rules of the workshop** (open mind on possible futures)
3. **Work in groups** (made according to the participant's interests or pre-determined)

4. If necessary, propose some **examples as "starters"**

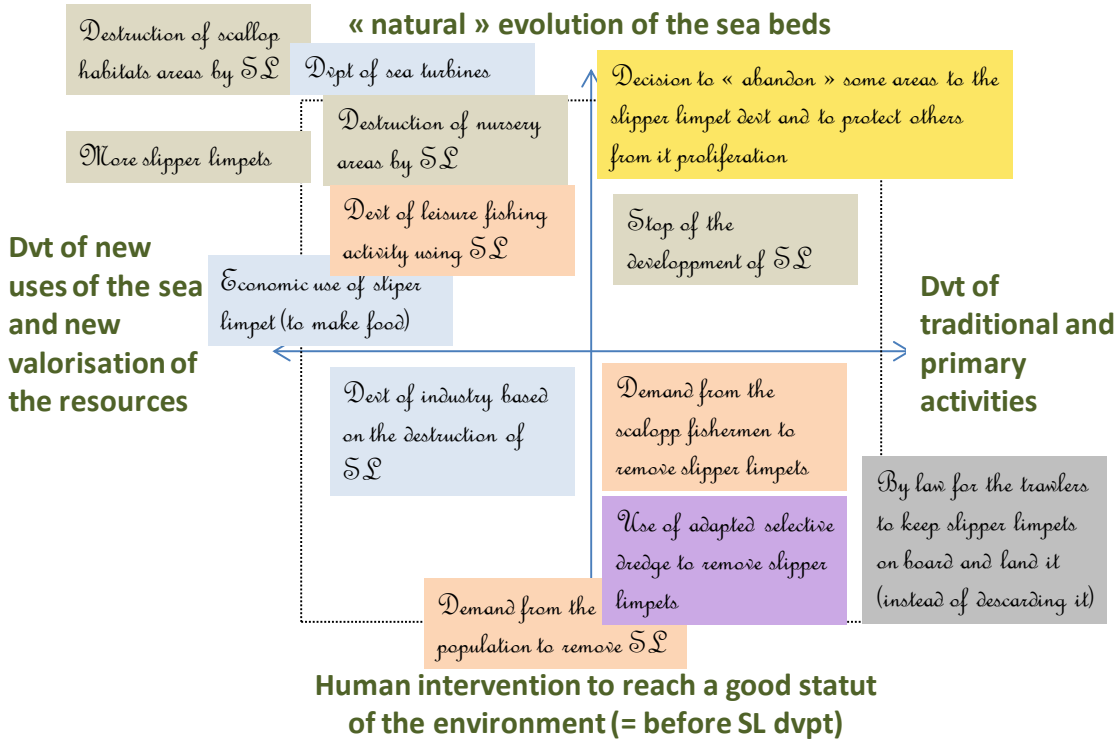


5. **Collect the different proposals and classify them on a matrix with all the workshop participants**



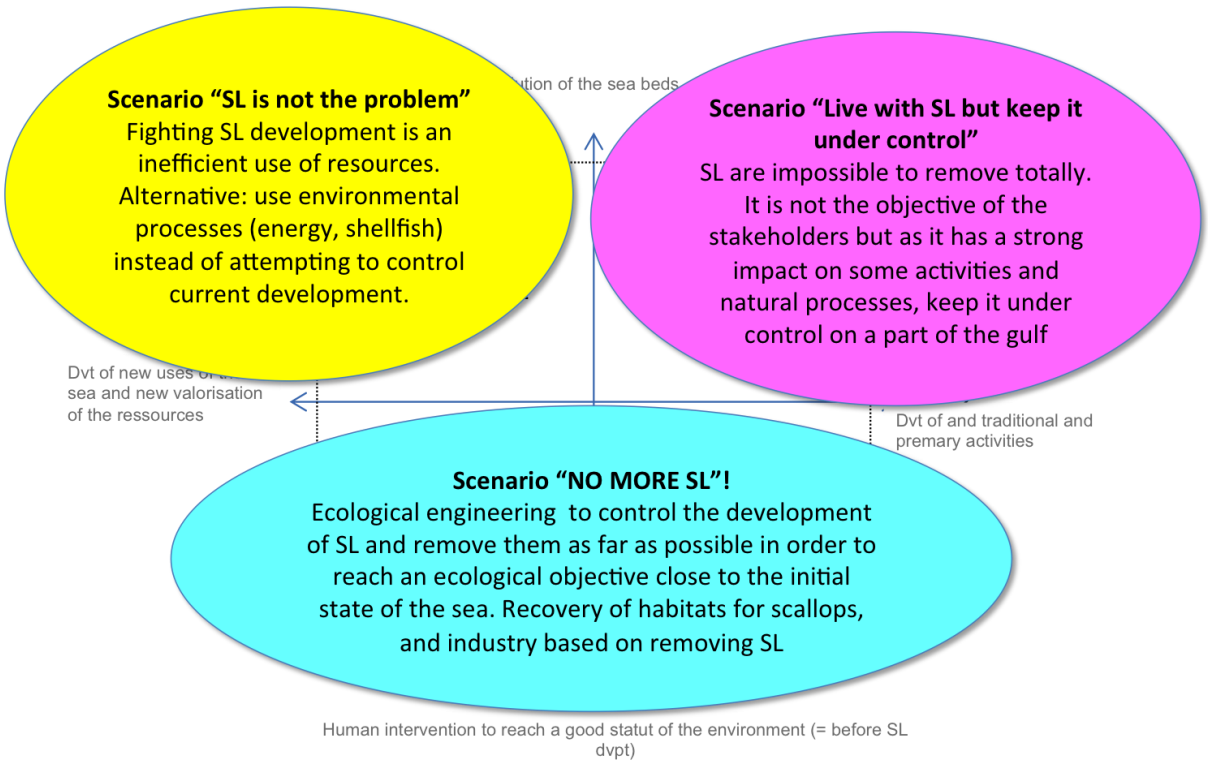
6. Chose 2 independent trends in order to determine the future axis (among the most important and uncertain proposals made during the previous phase)

7. Sort the different proposals according to a matrix with the axis decided with stake-holders



III. AFTER THE WORKSHOP

Use the different proposals on each quarter of the matrix to build a story. You have the first draft/short version of your scenarios. (Note: SL = slipper limpet).



The VALMER project was selected under the European cross-border cooperation programme INTERREG IV A France (Channel) - England, co-funded by the ERDF.