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Scenario analysis: Exploring the future of fisheries

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ABSTRACT

In order to make rational decisions about policy, research strategies and investments in the present, it is necessary to have some idea about possible developments and problems in the future. Although the future is principally unknown, it is not impossible to explore future possibilities in a systematic way. One technique to accomplish this is scenario analysis.

The first part of this paper will go into scenario analysis as a way to generate and evaluate future policy options and to identify future research needs. After a brief discussion of the objectives of scenario-analysis and the results that may be expected from it, the technique of scenario building will be described. Specific attention will be paid to the role of present uncertainties and trends.

In the second part, a scenario study on the future of North Sea fisheries will be presented. In this study three scenarios were developed with different options for the development of government regulations and different levels of consumer preferences for sustainable resource use. These scenarios will be briefly described and analysed.

Finally, conclusions will be drawn on the possibilities of the technique of scenario analysis for identifying the implications of policy choices.

1. INTRODUCTION

All institutions, commercial enterprises and individuals continuously make decisions in relation to possible future situations. This applies to fisheries as well as to any other area. Policy measures attempt to prevent overexploitation of stocks, creation of overcapacity or erratic market fluctuations. Fishing firms invest in the expectation to earn their investment back within a reasonable span of time. Local authorities or fishermen organizations are promoting the improvement of the available infrastructure. Also the research institutes are continuously faced with the questions of choices in research topics in order to meet the future needs.

Such decisions are made on the basis of the experience in the past and expectations regarding the future. The ideas about the past or the future may be (heavily) biased by the perception of the individuals who are responsible for these decisions. And, of course, who knows what the future will bring anyway? Future is almost by definition an unknown, particularly when the horizon is far away in the future. Therefore in most instances choices are made in a rather intuitive manner. Sometimes quite successfully, sometimes less so. One of the disadvantages of making intuitive decisions is for example that they are difficult to explain to others. Particularly in institutional decision making this is often required as many people may be involved.

There are various methods which may help to think about the future. These methods 'organize' the analytical process in a number of well distinguished steps. With the aid of these steps those who are charged with the preparation of a decision are able to formalize their own 'thinking process' but also (and that is at least as important) to communicate it and explain it to others. Quantitative as well as qualitative methods exist: econometric models, investment and sensitivity analysis, force field analysis or building scenarios.

The present paper reports on the experience of LEI-DLO with scenario analysis, based on two projects carried out in 1996/97. Objectives of the paper are:

1. *To show how scenarios can be developed and used for exploring the possible futures of the fisheries sector; and*
2. *To evaluate the relevance of scenarios for various purposes, like policy preparation or research planning.*

It must be stressed that building scenarios must not be confused with forecasting of the future. In the past all too future situations were determined by various ways of extrapolation through which just one well determined picture of the future could be specified. Indeed, these futures became reality only in very exceptional cases. The decision maker was then taken by surprise. Value of deterministic forecasting must be viewed in the light of the intrinsic dynamics of the human as well as natural systems. Building scenarios focuses on the process of thinking about possible futures. The result is not a description of one future situation, but rather an identification of major trends and relations between them which will have to be reckoned and dealt with.

Although scenarios may contain quantitative indicators, they mainly include qualitative considerations and judgments. However, it is not a 'free wheeling' exercise. Econometric modelling as well as proper scenario analysis have both in common that they produce an internally consistent analysis, specifying assumptions, variables and criterion the basis of which the results may be assessed

The paper discusses first general considerations regarding scenarios analysis (chapter 2). In third chapter three scenarios are presented which were developed on the questions of 'Relation between fisheries and ecology in the North Sea'. Finally, the value of scenario analysis is assessed in chapter 4.

2. SCENARIO THEORY: TRENDS, FORCES AND ACTORS

The objective of developing scenarios is to explore possible future developments which are relevant to a well specified question. Usually two to four such scenarios will be useful. Evidently, one scenario boils down to deterministic forecasting and is therefore inconsistent with the general principles of scenario building. On the other hand more than four scenario will produce more confusion than clarity. The scenarios will than overlap, making it difficult to distinguish between them. As scenarios do not intend to forecast the future, it is not always necessary or relevant to make them 'realistic'. On the contrary, scenarios may well overstress certain aspects far beyond reality, precisely in order to find out whether certain extreme situations will also have far reaching consequences or not on the issue under study. In case of fisheries new oil crisis of abrupt collapse of certain stocks may be good examples.

Peter Schwartz in his book 'The Art of Long View' specifies eight steps for development and application of scenarios:

1. Formulation of the question.
2. Definition of the critical success factors (CSFs).
3. Specification of the driving forces.
4. Setting priorities in terms of importance (impact) and uncertainty.
5. Selection of scenario logic.
6. Expansion of the scenarios.
7. Assessment of consequences.
8. Choice of major signals/criteria.

In this paper attention is primarily given to the first five of these steps and the experiences made by LEI-DLO in this respect.

Formulation of the question

In the first place it is essential to question and specify as precisely as possible what the scenarios should aim at. If the formulation of the *question* is too vague or ambiguous the subsequent steps become more and more confused when assessing the critical success factors or the major trends and their impact. There are various ways to make this first step: interviews with major players or experts, brainstorming sessions, etc. Alternative formulations of the main question may be reduced to their core contents and the formulation to be accepted should contain as far as possible all identified major elements. Formulation of the proper question goes already a long way towards finding relevant answers.

A general question, e.g. regarding 'sustainable fisheries', leaves many open ends: which species, which areas, which fleets, which time span, etc. If indeed all these aspects are to be taken into consideration such general formulation may do well. However, if the area which is to be explored is already restricted, such restriction should be made explicit from the outset in order to focus on what is really important.

Definition of the critical success factors

The scenario analysis is a tool for making well founded decisions which affect the future of the decision maker himself. Therefore, the second step aims to determine which factors will be crucial for success or failure, e.g. in relation to policy or investment. In this respect it is possible to critically question our own past experiences, to look at experiences in other (comparable) non-fisheries situations and review forecasts for general trends, e.g. FAO assessments. *Critical success factors (CSFs)* may be also interpreted as criteria for success.

Taking again the example of 'sustainable fisheries', critical success factors may be intensity of enforcement or involvement and support by fishermen in relation to conservation policies. The critical success factors are the criteria on which the policy makers or the fishermen decide whether sustainability has been achieved or not.

Specification of the driving forces

The next issue to be addressed regards the *driving forces* behind the current and expected developments. While the CRFs may be seen as being in the direct vicinity of our central question, the driving forces are rather on 'macro' level. They are so to say the forces behind the forces. The LEI-DLO studies identified the driving forces in a force field in six dimensions: ecology, culture, economics, policy, technology and 'space' (in terms of time and place) (Salz et. al., 1996).

Driving forces may be for example the interest rate which affects the level of investment in fisheries; or the trends in EU policies (e.g. regionalisation, subsidiarity or free market) which in turn affect the Common Fisheries Policy.

The review of the driving forces may become a relatively complex exercise as 'everything appears to depend on everything else'. The LEI-DLO studies, therefore, analyse the driving forces in matrices where the above mentioned six forces are set horizontally as well as vertically against each other and their mutual influences are indicated in keywords.

Setting priorities in terms of importance (impact) and uncertainty

In the fourth step, the driving forces should be characterized and prioritized in terms of *importance and uncertainty*. Importance may be viewed as 'impact' on the central question which is being analysed. It is possible that trends which in general are of major importance (e.g. introduction of EMU), may have little impact and vice versa. It is also essential to assess the likelihood of the trend and its impact. Giving too much attention to trends which are rather certain will produce very similar scenarios, which may not offer the insight sought for. This is again closer to future forecasting than to scenario building.

Two (or at the most three) most uncertain and most important trends should be selected and these will define the 'scenario axes', i.e. the variables (or dimensions) by which the scenarios will be defined. The selected positions on these axes are the points of departure for further analysis.

An example of a possible axe is the state of stocks. Future stocks are evidently of major importance for sustainable fisheries and at the same time they are highly uncertain because of the natural phenomena involved. Various scenarios may be specified according to assumptions regarding the state of stocks.

Selection of scenario logic

In the previous step the major variables which determine the scenarios have been identified. The *scenario logic* requires that all scenarios must be specified in terms of the same variables as otherwise they will not be comparable.

If scenarios relating to sustainable fisheries would be characterized by state of stocks and level of prices than these two variables will also be the dimensions of the two axes. Within these two axes four general scenarios may be set as combinations of high resp. low prices and good resp. poor stocks. These scenarios may be than analysed in terms of criteria which determine the sustainability (critical success factors), i.e. which policy actions may be taken to push the situation towards the desired sustainability. This is illustrated in the figure below.

The scenarios should be given names which typify well the situation to which they relate. These names should further stimulate the imagination of the scenario builder as well as those to whom he wishes to communicate. The scenarios should clarify the situation as well as the dynamics which will be encountered.

Expansion of the scenarios

In a further step the *scenarios may be expanded* to include an assessment of the crucial success factors. Finally, the question may be posed which developments would have to occur or which further actions would have to be taken in order to make the conclusions of a specific scenario credible (or realistic). However, LEI-DLO experience demonstrates that this step may be rather time consuming and it is difficult to produce conclusive results.

Assessment of consequences

In this step *consequences* of a specific action (e.g. implementation of a specific management measure) is reviewed in each scenario and the results are compared. The purpose of this step is to identify measures which will produce the desired results in as many scenarios as possible, or in other words which are independent of the identified trends (driving forces).

Choice of major signals/criteria

The internal consistency within the scenarios makes it possible to determine indicators or *signals* which can be monitored on on-going basis and which will show whether the developments are as expected (i.e. expectations on which the final decision has been based) or not. This indicates if results can still be expected as in the original analysis or whether adjustments should be considered. This last point is more of relevance to later operational implementation of specific decisions than to the analytical reconnaissance of the future for which scenario analysis is intended.

3. APPLICATION OF SCENARIO ANALYSIS: THE FUTURE OF NORTH SEA FISHERIES

3.1 Subject and objectives of the scenario study

The subject of this scenario study is the development of North Sea fisheries between now and the year 2015. The study was focussed on the consequences for the relation between fisheries and the ecosystem in the North Sea. The project was performed by a group of biologists, ecologists and one economist from several Dutch research institutes.

The objectives of the study were:

- To sketch the possible future consequences of alternative developments. These consequences should be taken in account in present policy choices.
- To identify future research needs with respect to North Sea fisheries in order to make rational decisions about present research strategies.

The scenarios were developed in four steps:

- Identification of present trends that are expected to be continued in the near future. These trends are the input for each of the scenarios.
- Assessment of uncertainties with respect to future developments relevant to North Sea fisheries.
- Choice of the scenario-axes. The scenario-axes should be the most crucial uncertainties. These are the factors that determine the differences between the scenarios.
- Description of the scenarios.

The trends and uncertainties were assessed on the basis of interviews with policy makers and representatives of the fishing industry and of NGOs.

3.2 Trends and uncertainties

Some of the present trends in fisheries and fishery policy are considered likely to be continued in the future. These trends are input for each of the scenarios.

The trends that were identified as most important are:

- Integration of the fish chain: increasing cooperation between the fishing industry, the processing companies and retail chains.

- Decreasing influence of the national Governments on fisheries policy and further increasing power of Brussels. In fisheries policy, like in other areas, traditional tasks and responsibilities of national governments are transferred to the EU level.
- Concentration and increases of scale in the fishing industry.

Scenarios are built because the future is uncertain. However, some things are more uncertain than others and some uncertainties have more impact than others. In a scenario study, those alternatives should be taken into account that are most uncertain and that have the greatest impact on the subject of the study.

The most crucial uncertainties that were identified and that determine the differences between the scenarios are:

- The nature of Government regulation with respect to fisheries management. The extreme dimensions of this factor are on one side strict Government regulation with no influence for the fishing industry and on the other side no Governmental regulation at all. In between there is the possibility of further development in the co-management system, which is defined as the delegation of tasks and responsibilities toward the fishing industry. Each of these possibilities is explored in the scenarios.
- The development of public opinion and consumer preferences with respect to natural resource use. On one side one can assume a development in the direction of hedonism or consumerism, which means that consumers concentrate on satisfying their personal needs and that they are not concerned with the long term consequences of their behaviour. On the other side, ecological awareness may increase, consumers may become more aware of the constraints regarding the use of natural resources and consumer preferences may shift toward more sustainably produced food.

These two crucial uncertainties were chosen to be the scenario axes: they determine the main differences between the scenarios. Three scenarios were developed in which the most interesting combinations of different positions on both axes are explored. Each of the scenarios can thus be located in one of the quadrants determined by these scenario axes.

3.3 The scenarios

In figure 3.2 a river chart is presented in which the most important characteristics of the scenarios are displayed.

Common input for each of the scenarios are the characteristics of the present situation: overcapacity of the North Sea fleet, overfishing of major North Sea stocks and the main elements of the present CFP: conservation policy by means of TACs, relative stability as the leading principle for distribution of quotas among the Member States and MAGPs as the major instrument for structural policy.

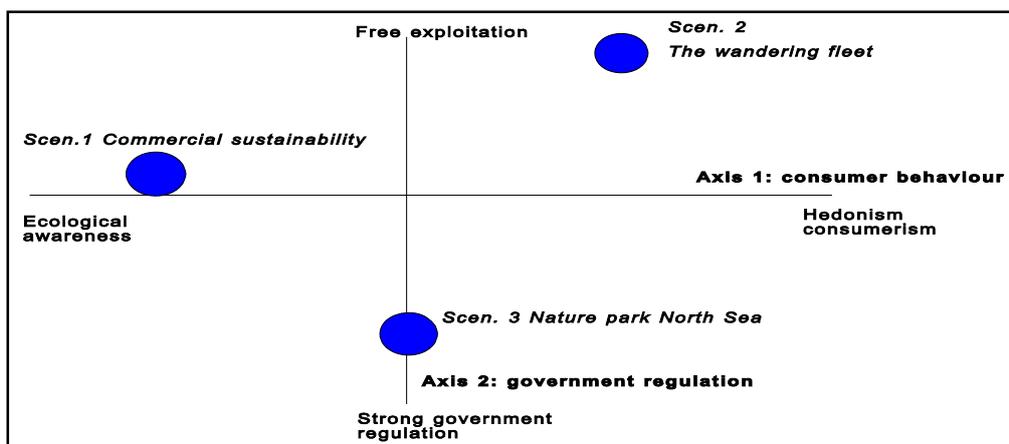


Figure 3.1 The scenario axes

Scenario 1 Commercial sustainability.

In this scenario the combination of an increase in ecological awareness of the public and the delegation of responsibilities to the fishing industry is analysed. At the revision of the CFP in 2002, Individually transferable Quotas are introduced on EU level, which means that the division of TACs is entirely left to the market. TACs are no longer divided into national quotas but directly translated into individual fishing rights which are freely tradable throughout the European Union. At the same time a new type of Producer Organisations is introduced. These POs are organised around a 'biological management unit': a stock, a combination of stocks or the fisheries in a certain area. A legal framework is created to give the fishing industry an opportunity to take more responsibility for fish stock management:

- Obligatory PO membership for ITQ owners
- Voting right in the PO proportional to ITQ size
- Decisions of a PO are binding for all members.

In search of continuity of supplies, trade and processing companies start investing in fishing rights. In this way they gain influence on fish stock management through their voting right within the POs. They use their influence in the POs in favour of a more cautious fish stock management, in order to create a buffer above the Minimum Biological Acceptable Level. In this way stock fluctuations are reduced as well as fluctuations in TACs and catches. This guarantees a more stable supply for the trade and processing industry. The fishing rights are rented to fishing companies with which long term contracts are negotiated in order to assure more continuity in supplies.

Growing ecological awareness of leads to the introduction of labels for ecological caught fish (ecofish). These ecolabels play an important role in the EU fish market in 2015, because large groups of consumers are prepared to pay a premium for ecologically produced products. This stimulates the fishing industry to satisfy the criteria of the ecolabel, for instance by introduction of new catch techniques which are less harmful to the ecosystem.

The result of these developments is a more sustainable North Sea fishery, which is accomplished on the initiative of the fishing industry, because the industry recognizes that ecological sustainability is in its own interest.

Scenario 2 The wandering fleet

This scenario is the nightmare of many conservationists. At the revision of CFP in 2002, the Common Fisheries Policy is considered a complete failure. Twenty years of TACs and quotas have led to ever increasing overfishing and overcapacity of the EU fleet. TACs and quotas are abolished and only one alternative management instrument is introduced: a tax on fuel. Fisheries management is entirely left to the market and consumer behaviour shifts (further) toward hedonism. The tax on fuel gives the industry an incentive to develop new less energy intensive catch techniques. These new techniques, however, are not less effective and a classical race for fish develops. Every ingredient for a 'tragedy of the commons' is present. As EU fish stocks become overexploited the cutter fishery gets unprofitable and many fishermen have to leave the industry. The large trawlers hit international waters and start buying fishing rights in third countries. This fishery could be characterised as hit and run fishery: fish stocks are tracked down by means of sophisticated technology and exploited as long as this is profitable. When exploitation is no longer profitable, the fleet moves on to other areas. This kind of fishery requires large vessels and is very capital-intensive.

In 2015, the international trawler fleet is controlled by a few multinational companies. The fish is landed all over the world, especially in the low wage countries where it is processed. The EU processing industry has largely been moved to these low wage countries.

The EU imports fish products from these countries that are caught by its own fleet. Employment in the EU processing and fishing industry has been heavily reduced.

Scenario 3 Nature park North Sea

In this scenario, a stronger Government control over the fishery industry is combined with no major changes in consumer preferences with respect to sustainable resource use. The public chooses a green government to handle environmental problems, but does not take the consequences in private consumption. In this scenario nature management and environmental policy become more important. In 2002, nature management of the North Sea ecosystem is delegated to the North Sea commission: an EU commission consisting of the national ministers of environment and fisheries of the North Sea countries. The North Sea commission is responsible for the management of all activities which affect

the North Sea ecosystem, including fisheries. In this way, fishery policy is fully embedded in environmental policy. The North Sea fishing industry is considered a guest in the ecosystem and its interests are subordinated to the interests of nature management.

TACs are set on a much lower level than in the present: 20% of the average spawning stock biomass (SSB) over the last 20 years. The control of catches is intensified by means of sophisticated electronic control systems. All subsidies for the building of new vessels are abolished.

The combination of lower TACs and heavier control leads to a considerable decrease of the North Sea fleet, to higher fish prices and to rising unemployment among fishermen. In the long term it leads to the recovery of commercial fish stocks. The remaining fleet benefits by increased productivity. The landings in the North Sea countries are heavily reduced and imports from other EU Member States as well as from third countries have been increased.

3.4 Further research

This project has not been finished yet. In the next few months some workshops will be organised with actors from the fishing industry, policy-makers and researchers. In these workshops they will be confronted with the three scenarios and they will be questioned for their opinion on

- the implications for the different groups of actors;
- the consequences for future research priorities. The research team is particularly interested in research needs that are common to all scenarios because on these research needs present research strategies can be based.

The objective of these workshops is not just to discuss the scenarios as such. The scenarios should be able to stimulate the participants to think about other possible developments and management options. For instance, one could ask questions like: 'What if in scenario 1 ecological awareness does not increase?' This way, more variations of each of the scenarios may be obtained and additional conclusions may be drawn about the likeliness of the results.

4. CONCLUSIONS

1. Scenario analysis is a technique to explore future possibilities in a systematic and internally consistent way. Building scenarios increases the understanding of the logic of developments that may occur. It seeks to identify characteristics of future and their dependence on current trends.
2. It is not the aim of scenario analysis to produce a realistic forecast of the future. The scenarios are meant to be a basis for discussion about possible futures. Scenarios should be provocative and credible at the same time. They should stimulate thinking about the future in a way that is independent of the present situation. Sometimes it is even useful to deliberately overstress certain aspects in order to find out the implications of extreme situations.
3. The choice of the scenario axes is crucial. The factors that determine the differences between the scenarios must be the most crucial uncertainties, that will have a high impact. If the participants of the discussion feel that other uncertainties are much more crucial, the scenarios lose their effectiveness as a means of communication.

4. Positive elements in scenario analysis are:
- It is possible to include a broad scope of trends.
 - Efficient communication is promoted through systematic approach, which leads to internal logic.
 - It is independent of formal theories (possibly a disadvantage for theoretical addicts).
- Some disadvantages are:
- Different perception of trends may lead to different conclusions by different individuals.
 - Scenario analysis does not provide quantitative answers.

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