

ENVIRONMENTALLY SUSTAINABLE AQUACULTURE

A SYNTHESIS OF SOCIO-ECONOMIC GOALS AND SCIENTIFIC FACTS

Veitola, K., Kettunen, J. & Mäkinen, T.

Finnish Game and Fisheries Institute, Fisheries and Aquaculture Research

POBox 202, FIN-00151 Helsinki, Finland

ABSTRACT

In the following paper, the environmental sustainability of aquaculture was analysed as a problem of rational decision making. The goal of this study has been to support design of a goal oriented environmental protection policy for aquaculture in Finland. Available information on interactions between environmental assessment and economy of aquaculture was analysed aiming to find the preference of measures for environmental policy. Another aim was to develop methods for improving the communication between environmental authorities and other interest groups and direct the discussion to essential factors from a decision making point of view.

The problems were analysed using hierarchical preference analysis. It is a value tree method that applies analytical hierarchy process (AHP). Optimal decision alternatives depend on goals and subjective values of the decision makers. A characteristic feature of decision analysis is that facts and value assessments are separated. Value judgements of different interest groups were gathered by computer supported interviews. Facts about different measures were compiled by experts. Finally these two were connected and the model was applied to find out the preference of measures for the environmental policy. In addition main conflicts between interest groups were pointed out and analysed in details.

Keywords: Mariculture, Environmental policy, Decision analysis

1. Introduction

Environmentally sustainable activity is the one that will maintain the conditions for the future generations to carry out the same activity. Beneath of being economically feasible it should be harmless on environment.

Culturing of fish as such is rarely questioned or kept as a non-sustainable activity but the consequences of the activity in the vicinity of the farms are mentioned as a sign of unhealthy development. Thus, the focus is in local environmental impacts of the farming when a policy for a more sustainable aquaculture is thriven.

We may say that to achieve environmentally sustainable aquaculture the harmful effects, which in the case of aquaculture is a synonym of nutrient load into the environment, should be avoided. During the last years this has really been the major content of the environmental policy in many of the ICES countries. This policy has developed to a strictly controlled farming in some countries like Finland, Sweden and Denmark.

Why is the environmental policy of aquaculture so difficult to manage in many countries? Firstly, the decisions concerning it are made in different parts of the authorities, even in different ministries, like environmental and fishery or marine ministry. Secondly, other interest parties than central authorities are numerous, e.g. the farmers themselves, their neighbours, whether inhabitants or just summer guests, local authorities, nature conservation organisations, etc. Most of these parties probably will accept the decrease of nutrient loading as the most important factor for better aquaculture management.

However, it is not clear how their motivation for reducing the effect of the loading should be interpreted? A recreational fisherman is thinking in a quite opposite way than a farmer living all the year round in the archipelago. Moreover, the answers are again differing widely if the parties are asked how to achieve the goal of decreased nutrient loading. If their opinions are studied in details it is observed that the goals and criteria as well as measures are mixed. When the different parties are trying to discuss about their goals they are not only speaking about goals when the opposite party speaks about measures but in discussion it is tried to fix the measures needed first although the actual discussion regards to convince the others of goals or values behind them.

The aims of the study were:

- 1) To analyse the environmentally sustainable aquaculture as a rational decision making problem
- 2) To develop a systematic way that could advise the decisions by synthesising subjective values and goals of the decision makers with the scientific, economic and technical knowledge of experts.
- 3) To improve the dialogue among different interest groups, decision makers and experts
- 4) To apply the system in a practical decision problem

In this paper we discuss about the application. The problems were approached using Analytic Hierarchy Process, (AHP, Saaty, 1988) around which our approach has been constructed.

2. Materials and methods

2.1 The AHP

An essential feature of AHP is that the complex decision problem is structured into subproblems which are analysed separately. This feature is first utilised in analysing the overall goal and subgoals of the decision maker and, secondly, in comparing of the measures to achieve the goals.

The AHP model is normally constructed in a way that first an overall goal of the decision is formulated. In case of aquaculture it would be the developing of an environmentally sustainable aquacultural practice. Subsequently the overall goal is hierarchically decomposed into more precisely defined elements that can be compared and weighted with each other. In our example these elements are criteria for the economic and environmental sustainability. The upper levels of the hierarchy are typically those determined by the values of the decision makers. At the lowest level of the decision hierarchy are the actual measures and decision alternatives.

In the course of the process the alternatives on each hierarchy level in each branch are compared pairwise to find the preferences. By simple matrix algebra the preferences of various levels and branches are then combined in a way where the result is a ranking of the decision alternatives with respect to the overall goal.

2.2 The approach

A committee for compiling an environmental protection programme for the south-western Finland and Åland was nominated in June 1994. The task of the committee was formulated in the way that the results were applicable for the whole Finland. The members of the committee (Table 1) were representing the aquaculture industry, environmental authorities and experts, fisheries authorities and experts and the municipalities of the area.

TABLE 1. The participants of the environmental policy design

Fish Farmers
Finnish fish farmers association
Fish farmers association of Åland
Environmental authorities
Environment District of SW-Finland
Ministry of agriculture and Forestry
Local environmental authority of Korppoo*
Fishery authorities
Ministry of agriculture and forestry
Local fishery district
County Council of Åland
Finnish Environment Agency
Municipalities of the area
Professional fishermen*
Recreational fishermen*
Water Protection association*
Nature conservation organisation*
Fish retail merchants*

* interviewed, not member of the committee

The work of the committee proceeded in the following steps (Fig. 1). Firstly, the decision hierarchy was negotiated in the series of meetings of the whole committee as a group. After this, representatives of the interest groups were interviewed individually by using the AHP-model that was applying the hierarchy of the previous step. By this the subjective values and weightings of the various actors were found out. The third step of the work was to analyse the values of the various actors. Furthermore, the compromises between the interest groups about the goals were negotiated in the committee. Next, the expert knowledge about the available

measures (over 50 different were considered) was gathered for each sub-criterion. After this the the measures optimal for achieving the goals were selected.

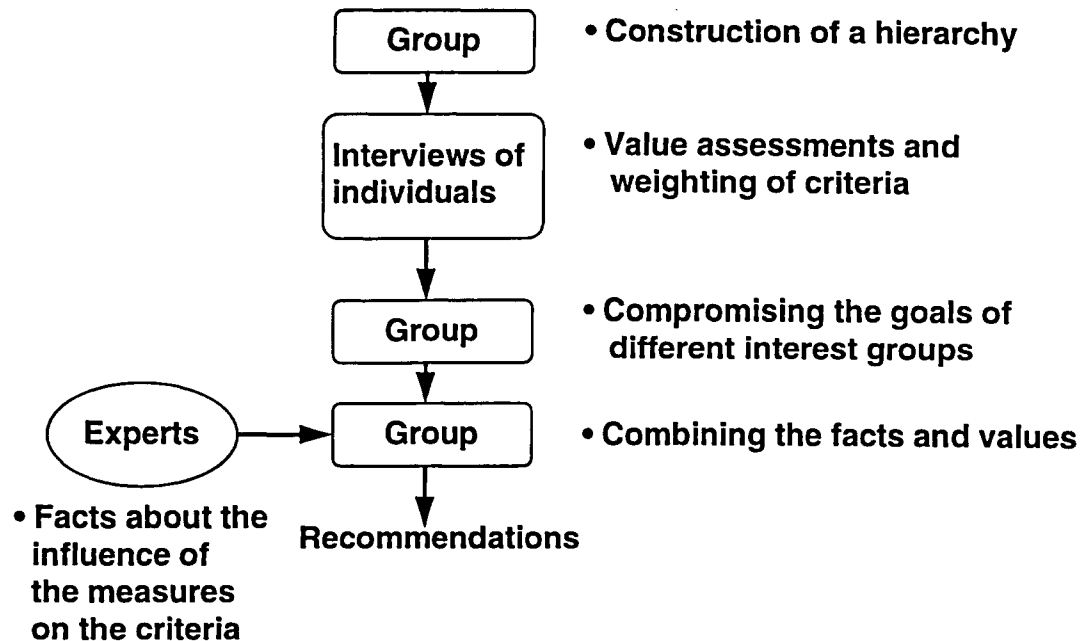


Fig. 1. The steps of the environmental policy design

3 Results

3.1 Criteria

The hierarchy of criteria used is shown in Fig. 2. It was used to get the weightings of different interest parties as well as to compare the water protection measures. Each criterion represented change in a variable due to a measure. Criteria were divided into two levels. The upper level criteria consist of lower level sub criteria. Five upper level criteria were: costs, efficiency and functionality, secondary effects on environment and social effects of a measure. Primary effects on environment were supposed to result from nutrition load, which is included in efficiency criterion.

Hierarchy of the criteria

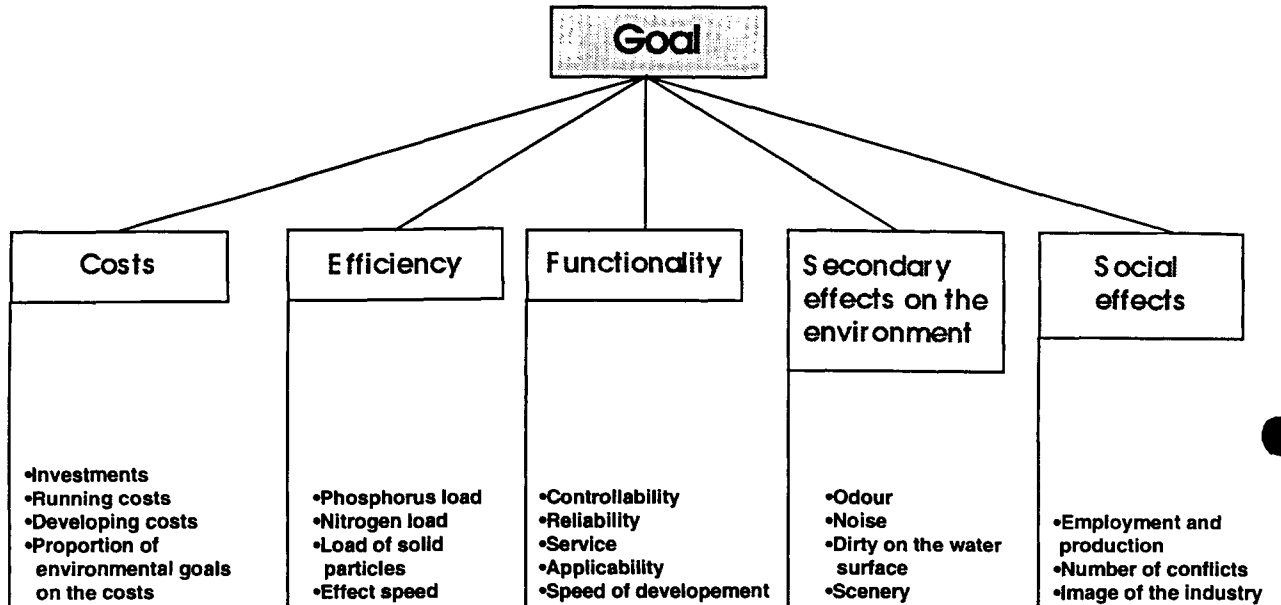


Fig. 2. Used hierarchy of the criteria

3.2 Value assessments and grouping of interest parties

The interviewed representatives were divided into six groups according to the weights they gave to the main criteria. In the following each group is described. Average weighting of main criteria in each group is shown in Fig. 3.

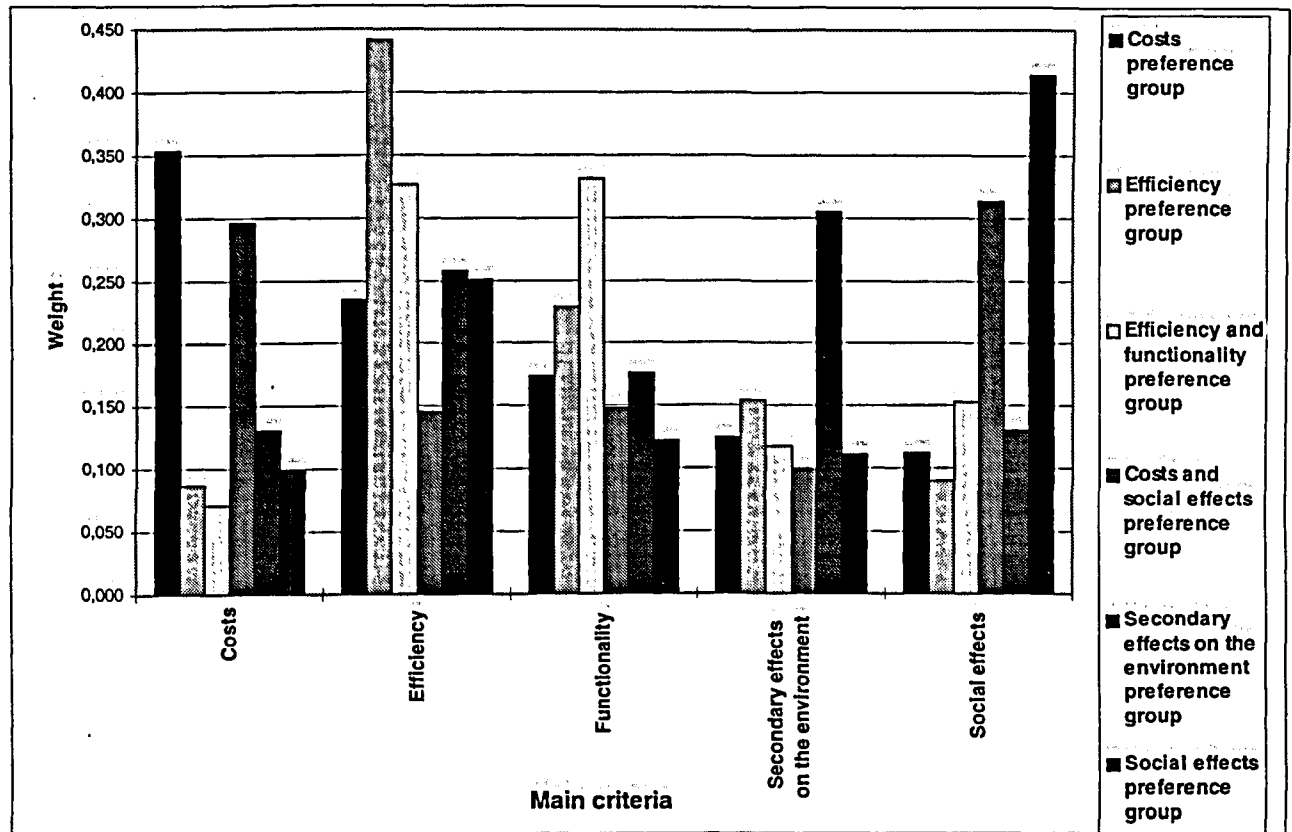


Fig. 3. Average weights to main criteria given by different groups of interest parties

Cost preference. Actors in this group were both national and regional fisheries authorities. In their opinion most attention should be paid to the costs of a measure which should be minimised. Authorities are worried about enterprises' capability to survive if large and expensive measures are demanded.

Efficiency preference. This group included local nature conservation organisation, Finnish environmental agency, professional fishermen, national and regional environmental authorities and country council of Åland. They saw that efficiency is the most important criterion and least attention should be paid to costs.

Efficiency and functionality preference. Group included local environmental authorities, water protection association, Finnish Environmental Agency and fish farmers. They were emphasising the importance of efficiency and functionality and regarding costs as a least important criterion.

Social effects preference. Actors in this group were municipalities of the area. Municipalities were worried about employment and production capacity in the aquaculture industry.

Cost and social effect preference. Fish retail merchants and fish farmers belonged to this group. They considered both costs and social effects as important.

Secondary environmental effect preference. The only actor in this group was recreational fishermen. The most serious problems to them were dirty on water surface, fouling of fishing gears, etc. Probably the representatives of the recreational fishermen did not know enough to connect fouling and changes in composition of species to efficiency criterion instead of secondary effects on environment.

The six groups above were combined into two main groups whose interests differ from each other.

- Actors representing environmental protection and environmental authorities emphasise the importance of efficiency and functionality of water protection measures no matter what it costs.
- Representatives who had economical connections with aquaculture industry such as fish retail merchants or municipalities of the area as well as fishery authorities saw that costs and social effects caused by water protection measures are the most important criteria.

Recreational fishermen were the only group which emphasised the importance of secondary effects on environment.

4. Discussion and conclusions

According to interviews over 90 per cent of the actors agreed that an important goal for water protection programme for aquaculture is to reduce the nutrition load and improve the water quality. Though there exists a consensus over the main goals, different interest parties had quite different views on which criteria should be given most weight when comparing the available measures. About a half of interviewed persons emphasised efficiency or functionality of a measure or both. Another half wanted to stress the importance of costs and social effects especially production capacity and employment.

On this basis a compromise would be that effective and functioning measures were preferred and the financing of measures would be organised and the negative effects on production and employment would be minimised.

Our knowledge of environment is often uncertain and hard to handle. In decision analytical methods information of goals and values as well as expert knowledge on available measures can easily and effectively be combined. Decision analysis and AHP are applicable methods in decision making concerning environmental management. They can be useful especially in situations where there are many interest parties with different and incompatible goals. On environmental management problems the decisions usually can't be made on the basis of financial aspects only because many factors are non-measurable like recreational value or image of the industry branch. With decision analysis also the commitment of the interest parties to the resulting action recommendations and their execution will be deeper.

Typical for conflicts concerning environmental management is that unessential points are dominating the discussion. With the aid of AHP communication became more concrete and better organised. Discussion was directed on the decisive factors. Analysing the problem ensured that all interest parties understood decision alternatives and criteria in the same way. Facts and values were separated and decision makers were driven to analyse which are the values behind their preference.

Reference

Saaty, T, L, 1988. Decision making for leaders. RWS Publications, Pittsburgh, 291 pp. ISBN 0-9620317-0-4