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Executive summary

The 2nd meeting of the Study Group on Socio-Economic Dimensions of Aquaculture (Chair: Gesche Krause, Germany) was held in Stockholm (Sweden) between April 24-26 and was attended by 9 participants from France, Germany, Norway, Spain, Sweden and United Kingdom (Annex 1), among which was one representative from the FAO in Rome. The objective of the meeting was to work on the Terms of Reference that were decided upon at the last meeting of the SGSA in Bremen 2011. The ToRs were addressed separately within subgroups, followed by plenary sessions where subgroup activities were discussed by all members of SGSA. Since the issues raised in the SGSA are a rather novel topic to ICES that pulled together scientists with a wide range of different scientific backgrounds, the group agreed on a common scope and perspective which the SGSA will have in the future. These are summarized in a background chapter in the beginning of this report (Chapter 3).

ToR a) Develop, identify and evaluate methods on how to assess the direct and indirect socio-economic consequences of aquaculture operations and how they relate to an assessment framework

Social science consists of a diverse set of disciplines with many associated theories, paradigms and methods. Thus, the assessment framework can be supported by multiple methodological approaches and interpretations. Evidently, different disciplinary approaches may be necessary in different aquaculture assessments but it is important to take an integrated approach from within social science. Creative combinations of theories and methods are necessary to interpret complex scenarios of aquaculture. In this meeting, the group identified a preliminary list of methods, which could support an integrative assessment within a social-ecological framework. It is recommended to continue the ToR and to use the assessment framework to select an appropriate combination of methods (i.e. disciplinary and integrative) to address a specific case study. The group suggests rephrasing the ToR to "Identify individual and crosscutting, integrative methods to support the evaluation of the direct and indirect socio-economic consequences of aquaculture operations and how they relate to the assessment framework" (Chapter 4).

ToR b) Examine how inclusion and local ownership influence aquaculture

There are several different stages and arenas where aquaculture management and governance is performed in ICES-countries. These include European policies such as the Marine Strategy Framework, ICZM – designation of sea areas for different uses, including aquaculture, during the application for location of an actual aquaculture plant and the setting of rules and regulations that govern aquaculture at different scales, e.g. national, regional or local, and affect aquaculture day-to-day operations. Stakeholders can be included in all the decision making processes above in various ways and to varying degrees. Different types of stakeholders will have different levels of influence in the aquaculture process depending on the respective institutional setting and national context. Stakeholder inclusion helps make sure that decisions are based on relevant and correct information that represents various interests and viewpoints. The acceptance of policies is facilitated by transparent participative procedures which help to ensure that scientific information is operational and responds to societal demands. Therefore it is recommended to establish knowledge bases for decision-making via stakeholder inclusion, for example through an environmental or social impact assessment. This ToR shall be continued in the next year and addressed

in more detail (Chapter 5). It is recommended to include stakeholders and their supporting values in the decision-making process. Using case study approaches, a review and development of indicators for the assessment of stakeholder inclusion and ownership and its effects on aquaculture shall be conducted at the next meeting.

ToR c) Identify how social, economic, governance and environmental framing conditions influence aquaculture development

Many aquaculture assessments focus primarily on the impacts of the activity without enough consideration of the framing conditions that are driving those impacts or that influence how the impacts are managed. Understanding the local context (social, political, environmental, economic) is critical to the effective evaluation and management of aquaculture scenarios. This is especially pertinent with respect to socio-economic framing conditions which are often overlooked in scientific studies. Therefore, it is recommended to carry out a systematic identification of framing conditions of aquaculture as a key step towards informing management measures that will enable aquaculture to realize its full potential. Tools for the assessment of these framing conditions need to be identified. Potentially amenable tools include Rapid Rural Appraisal (RRA), Sustainable Livelihoods Approach (SLA) (e.g. Brugère *et al*. 2010) and New Institutional Economics (NIE). It is recommended to develop this ToR at the next meeting further and to identify the salient social framing conditions and associated indicators. (Chapter 6)

ToR d) Identify new emerging issues of socio-economic aspects of aquaculture

This ToR proved useful to raise critical points within the SGSA that need to be considered in the future. One issue was found to be of high importance here were the socio-economic implications of certification schemes. It was felt however, that prior to addressing this issue in more detail in this group, we will focus on the operationalisation of the developed assessment framework on real-world cases, as else these issues would stretch capacities of this small group (Chapter 7).

1 Opening of the meeting

The ICES Study Group on Socio-Economic Dimensions of Aquaculture [SGSA], chaired by Gesche Krause (Germany), held its second meeting in Stockholm (Sweden) on 24–26 April 2012 at the Beijer Institute for Ecological Economics of the Royal Swedish Academy of Sciences. .

The meeting was opened at 9:00 on Tuesday, 24 April, with the host Max Troell giving housekeeping information and Gesche Krause, chair of the SGSA, welcoming the group at the Beijer Institute. The chair welcomed the members to the meeting and thanked the participants for their willingness to engage in this new group and their respective institutions for allowing time and money to participate. Since many of the participants are from institutes which are not traditionally engaged in ICES, it was difficult for the members to allocate resources and to obtain a permission to attend. For instance, one member from UK was not able to come because of lack of funds, one other member from Germany was not permitted by his institute to come. The Agenda of the meeting was formally adopted (Annex 2). The first day of the meeting was devoted to establishing the baseline of common understanding of the ToRs to the diverse range of different disciplines involved in this new group. In this initial discussion, the ToRs were slightly modified in wording to make them more explicit. It was discussed in a plenary session at the beginning of the first and second day what issues would be most relevant for ICES, since this study group being a first trail effort on incorporating social sciences more strongly. The outcome of this discussion and further discussions with the separate groups is presented in paragraph 3 as background and scope of the SGSA. As a spin-off, a framework was developed to assess and analyze the different socio-economic dimensions of aquaculture and was then applied to tailor the analysis within the subsequent ToRs.

2 Adoption of the agenda

The agenda (Annex 2) was formally accepted. A general discussion about plans for each SGSA Term of Reference was held. The SGSA decided to discuss the ToRs initially in a plenary session to understand the background and viewpoints of each of the members of this new group and to formalise a common framework of analysis of the socio-economic dimensions of aquaculture. Since the group included 9 members the ToRs were critically reviewed to see if the wording was appropriate and how the work could be organised best. It was felt that the group first needed to capture the way of analysing the issues by developing jointly a framework for integrated assessment of the socio-economic dimensions of aquaculture. ToR a-c where slightly rephrased to capture better their respective meaning and implications to arrive at more stringent recommendations for ICES.

By midday on the first day, the group continued to address ToR b and c separately within subgroups, followed by plenary sessions where subgroup activities are discussed by the full SGSA. It was decided to address ToR d (*identify new emerging issues of socio-economic aspects of aquaculture*) in plenary sessions at the second and third day of the meeting.

3 Background and Scope of this Study Group

The following section reflects the deliberations of the SGSA in order to arrive at a common understanding of what the social dimension of aquaculture entails to the group. These will be further developed at the next meeting in 2013.

3.1 Introduction

Globally and regionally, consumption of living marine resource is increasing to levels that cannot be sustained by our oceans. The rapid development of aquaculture has been a remarkable contributor to meeting this growing demand; it has now risen to provide half of all fish destined to human consumption (FAO 2009) and is widely forecast to grow further. The gap between demand and supply is, however, increasing and the pressure is on aquaculture to develop even faster, which will require input from a wide range of social, technological, economic and natural resources (FAO 1996; 2000; 2002). North American and European markets have traditionally sourced very widely and have also stimulated a sizable aquaculture sector in their territorial waters.

However, its growth rate in Europe (excluding Norway) is slowing down whilst, at the same time, the more recent growth of aquaculture imports, particularly from Asia, are likely to become more limited. . This can be related to the fact that incomes in producer countries like China and India are growing in par with urbanization and the aspirations of a growing middle classes, all driving up demand and per capita seafood consumption of higher valued species. The European Union (EU27) imported €15.2 billion worth of fish and fishery products in 2009, accounting for more than 60% of it fish consumption (EUROSTAT). Total aquaculture production in the EU is only around 1.3 million tonnes (EUROSTAT) and of total seafood import a significant contribution comes from Asian aquaculture. EU will therefore increasingly have to depend on new exporting countries. Together with consumers and markets operating more globally, it will also have to do so amidst growing uncertainties of supply, market, production and trade conditions brought about through climate change. The search for resilient solutions in the aquaculture sector to meeting production, income, community development and food supply and security needs will be critical for the ICES countries and their global partners.

Aquaculture increasingly generates direct socio-economic benefits through the supply of highly nutritious foods and other commercially valuable products, providing jobs and creating incomes. In addition to its own economic contribution, aquaculture can also induce, as a spin-off, economic contribution to other sectors that supply materials to aquaculture or use aquaculture products as inputs. Thus the numbers of people engaged in other ancillary activities, such as processing, farm construction, manufacturing of processing equipment, packaging, marketing and distribution can be substantial. Indeed, estimates indicate that, for each person employed in aquaculture production, about three other jobs can be produced in secondary activities. Thus, fishers, aquaculturists and those supplying services and goods to them provide employment and livelihoods of a total of about 180 million people (FAO, 2010).

Over the past decades, scientists and policymakers have become increasingly aware of the complex and manifold linkages between ecological and human systems, which generated a strong research effort into social-ecological systems analysis. Social-ecological systems are understood to be complex adaptive systems where social and

biophysical agents are interacting at multiple temporal and spatial scales (Janssen and Ostrom, 2006). This has stimulated researchers across multiple disciplines to look for new ways of understanding and responding to changes and drivers in both systems and their interactions (Zurek and Henrichs, 2007). Integrated coastal zone management (ICZM) can be viewed as being part of this social-ecological system paradigm, in which special emphasis is placed on the complexities of coastal settings and their manifold drivers in ecological and human systems. Both, the social origins of unsustainable ecosystem management and the social repercussions of environmental management are central to these approaches.

Despite these positive effects, aquaculture also competes for economic, social, physical and ecological resources, and can result in environmental degradation. Its development may therefore generate negative impacts on other industries and people's livelihoods (e.g. fisheries, agriculture, and tourism). Decisions about aquaculture development are often based on incomplete information, particularly in relation to the socioeconomic dimensions. As a consequence, inadequate accounts for how trade-offs associated with different development options are made. Examples include aquaculture expansion in certain areas directly affecting resource systems that may already be under large pressure from other human activities. There is therefore a risk that anticipated and much needed socio-economic benefits from aquaculture expansion, may come at the expense of increased and possible unsustainable pressure on ecosystem goods and services (Naylor *et al*. 2000), ultimately jeopardizing people's food security and livelihoods. Unsustainable use, alteration and transformation of ecosystem services can undermine the productive resource base and divert resources away from other uses and users, bringing aquaculture in conflict with other stakeholders. In addition, benefits derived from aquaculture systems in some cases are steering away from the local communities directly affected by aquaculture, to stakeholders operating on global market scale (e.g. Norway).

When aquaculture started up as an industry in Norway in the late 1960s it was run by small family owned businesses. Many had their experience from fisheries and the fishing industry, and were depending on local resources and facilities for equipment, slaughtering and handling of their products. The industry consisted mainly from local ownership and local employment, providing benefits to the communities where the production plants were located. Since then the industry has grown tremendously, and, in 2010, the export value of the Norwegian aquaculture sector was larger than from the wild harvest fisheries, despite the major fish stocks in the Barents and Norwegian Sea being in very good condition giving large quotas and large catches. Together with the growth in volume for the Norwegian aquaculture industry there has been a quest for cost-efficiency. All sorts of rationalizing measures have taken place, bringing with them specialization, mechanization and automation, centralization of many functions including slaughtering, and also ownership concentration. A major consequence for the communities and municipalities along the Norwegian coast is that the benefits from aquaculture production are very unevenly distributed. Where there previously could be several slaughteries in a municipality there is now typically one shared between many municipalities, with highly mechanized well-boats bringing fish from the different aquaculture-plants to the slaughtery. The care-taker often lives on the site of the aquaculture plant, and may well commute from another municipality or region. Sales organisations, and all the support they require, is typically centralised with just one office per company. The industry is dominated by large corporations each having a large number of aquaculture licenses and pens, and being registered shareholding companies. The end-result from the local coastal community

viewpoint is that aquaculture either gives fairly large benefits to the local community and municipality, or it gives virtually nothing. It is then no surprise that some municipalities have tried to reserve themselves, through their coastal zone area-planning, against having new aquaculture plants in their waters, and especially so if they are not locally owned. The State has considered giving the municipalities more benefits from having aquaculture plants, through an area-tax, but eventually decided against this. Instead they have allowed the municipalities the right to levy a property tax on aquaculture production facilities, but it seems the municipalities feel this is too small, and much smaller than the area-tax they had hoped for. The Minister of fisheries and coastal affairs has asked that the aquaculture industry make sure local communities get benefits from aquaculture production in their areas. Climate change and some environmental problems may lead to a large re-localisation of aquaculture plants from South to North in Norway. If the municipalities in Norway, who are responsible for coastal zone planning, do not want aquaculture plants in their waters it could cause trouble for the industry and possibly limit national value creation from it. So far the state has generally not allowed municipalities to prohibit or severely limit aquaculture in their waters, having overruled municipal attempts to do so.

The question is how to balance the negative and positive socio-economic consequences from aquaculture development. The landscape and seascape are today increasingly managed for multiple functions and services in addition to provision of food, and this requires the integration of ecological and socioeconomic research, policy innovation, and public education. This dilemma has driven many researchers, experts, NGOs and policy makers to try to address issues related to the sustainability of aquaculture development from disciplinary/sectoral perspectives. However, disciplinary barriers and the lack of awareness of other, related initiatives and developments are rarely overcome. This can result in the pursuit of many individual lines of investigation, without the benefits associated with a more integrated and holistic understanding. Aquaculture development raises questions that cannot be addressed in isolation. If it is to bring about expected benefits, not only to local populations in producing countries outside EU, but also to consumers in Europe and other developed nations, aquaculture development would depend upon the early, and coordinated, tackling of the multiple issues that underpin its interactions and functioning within wider ecosystem, social, economic and political contexts.

Thus, aquaculture appropriates, but can also provide, a range of services as determined by factors such as location of production site, targeted species, production system, market structure and social context. A critical question is how to best guide the development of aquaculture that has the potential to support a portfolio of sustainable livelihoods and assist in poverty alleviation and food security. Aquaculture needs to be analyzed from an ecosystem service (ES) perspective. Additionally, life cycle analysis (LCA) can be used as a tool for identification of linkages to ES and to define appropriate system boundaries. This information will enable a deeper understanding of connections between farming and resource systems being relevant from a livelihood and poverty perspective. Broader systematic perspectives on aquaculture, such as the "Ecosystem Approach to Aquaculture" (Soto *et al*. 2008) may also enable analysis of trade-offs and sustainability aspects, especially with respect to net benefits for poorer resource users. However, they fall short of encompassing adequately "ecosystem services"as defined in the Millennium Assessment.

A key success factor for effective coordination and fostering synergies that make an impact on how proposed project outputs can aid targeted end-users is the ability to engage all stakeholders at the outset. Thus, participation and good governance are

fundamental to the sustainability of aquaculture development. Trust and buy-in generated through participation at all levels, and the application of transparent decision-making processes, are also the building blocks behind improved coordination of all the sector's stakeholders. Strengthening of institutional capacity and resources (including human capacity), both at national and international levels, are needed for enabling the development of aquaculture for poverty reduction and improved human well-being.

3.2 Development of a integrated framework to capture the social dimensions of aquaculture

Aquaculture can offer employment and income earning opportunities to local, often rural and marginal, communities. However, questions pertaining to social site-selection criteria, community impacts, right of access, ownership, taxation, liabilities of the negative repercussions from the environmental effects on society, ethical issues, to name but a few, have remained largely untackled in a comprehensive, integrated manner. Each of these issues follows particular interests, priorities and objectives. All operate within an array of federal, regional and international legislations, agreements and treaties. Practitioners note that sustainable aquaculture must not only maximize benefits, but also minimize accumulation of detriments, as well as other types of negative impacts on natural and social environment. Aquaculture is in this case not so different from other economic initiatives that depend on, and impact on, natural resources and social fabric.

Significant progress has been made towards evaluating the socio-economic and, perhaps even more, the ecological impacts of aquaculture. A wide range of data and tools have been obtained and developed with a view to achieving sustainability objectives, although less progress has been made towards utilizing this information to influence management decisions. In addition, approaches to evaluating aquaculture often do not take an interdisciplinary approach, which is necessary to capture the complexity of the linkages between aquaculture operations and their broader environment (economic, social, institutional and natural).

In order to address these needs, the SGSA has developed a **framework for an integrated assessment of the socio-economic dimensions of aquaculture**, shown in Figure 1. Although the focus of the SGSA is socio-economic, the group recognizes the importance of adopting an integrated approach that emphasises the interrelationship between the human and ecological dimensions of aquaculture, i.e. the social-ecological perspective. The proposed framework is designed to make best use of existing data and scientific tools, some of which are highlighted in the following subsections, with a view to ensuring the most efficient use of science for decision-making. The framework is applicable to multiple spatial scales, ranging from individual farms to addressing global impacts. Scale is not viewed as a dimension that can be pre-determined, but rather, as a dynamic characteristic of the social-ecological system which will be defined by the aquaculture scenario and key variables identified in the assessment stage (e.g. the impacts of the accumulation of organic material on the benthic habitats below a cage will be mainly localized whereas the impacts of sales on international markets will have a global scope).

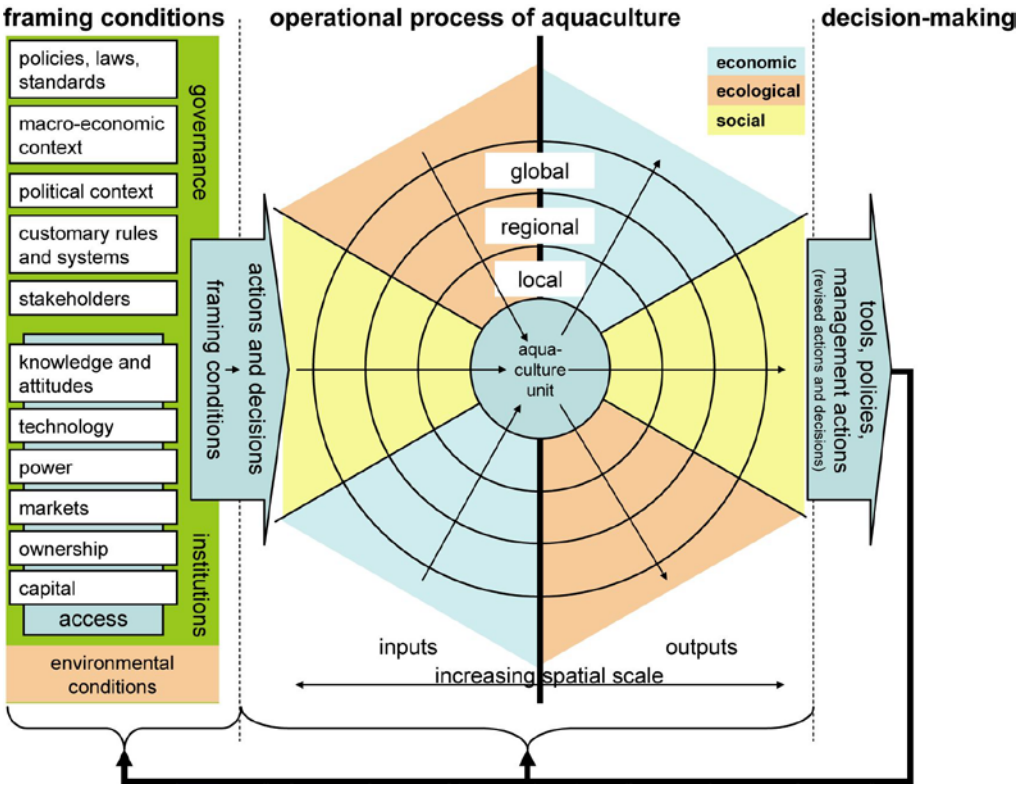

Figure 1. Framework for an integrated assessment of the socio-economic dimensions of aquaculture in three stages: Analysis of the operational processes of aquaculture, of framing conditions, and, subsequently, decision-making.

The framework for an integrated assessment of the socio-economic dimensions of aquaculture consists of a three interrelated, iterative stages: Analysis of the operational processes of aquaculture, of framing conditions, and, subsequently, decision-making. The major objectives of these stages, which are intended to be developed further in subsequent meetings of the SGSA and with input from other ICES working groups, are outlined in the following paragraphs. Next, guidance is provided on the specific information needs and scientific tools that may be used to support each of these stages. Although the stages are described as steps in the process, it is important to note that, in many cases, associated analyses and actions will need to be carried out concurrently and iteratively, where information from one feeds into and influences the development of the other.

First, in the **assessment of the operational processes of aquaculture** (the central core of figure 1), indicators and data should be identified and obtained to evaluate the interrelated social, economic and ecological dimensions, or impacts, of the aquaculture unit. The proposed framework categorizes variables as inputs or outputs. Although the specific interpretation of input and output may vary among disciplines, generally, inputs are considered to be resources (human, natural, economic) that are consumed, utilized or transformed as a result of aquaculture activity, where outputs are products and services that are produced or transformed as a result of aquaculture activity.

Second, the **framing conditions** (the left hand column of figure 1), relevant information should be compiled to define the characteristics of the social-ecological system that influence the intensity and tendencies of the impacts and variables identified in

the assessment of the operational process of aquaculture. The assessment of the operational process of aquaculture should result in the identification of impacts or related variable that may be impeding the achievement of sustainability objectives, where the framing condition stage should highlight the characteristics of the social-ecological system that influence, or drive, these phenomena. This information can then be utilized in the third **decision-making stage** (right side of figure 1). This stage should propose potential management actions for minimizing negative impacts and maximizing the benefits of aquaculture taking into account the local capacity to implement those actions. This framework is cyclical and iterative, thus supporting an adaptive management approach. Proposed management actions may have short-term or long-term effects on the framing conditions and/or the variables identified in the assessment stage which, in turn, will result in adapted management actions and so on. In this context, monitoring will be an important component of this framework.

It is important to note that a participative approach is integral to all stages of the framework. Although it is evident that scientists will play a more active role in the scoping and assessment stages of the framework and decision-makers in the final stage, iterative communication between them is critical throughout the process in order to ensure the effective integration of science with decision making. Additionally, key stakeholders identified in the scoping stage will play a critical role in shaping, informing and implementing the process[1].

Tools and information needs to support the Framework for an Integrated Assessment of the Socio–economic Dimensions of Aquaculture

The various stages of the proposed framework are dependent upon different, although sometimes overlapping, scientific tools and data. The following paragraphs are intended to highlight some of the tools and data that may be used in these stages. At this stage, potential supporting tools are only listed and not described or evaluated. A future focus of the SGSA could be to evaluate a selection of these tools in more detail.

a) Assessment of the operational process of aquaculture

The assessment stage consists of the identification and evaluation of indicators and data related to the social, economic and ecological dimensions, or impacts, of the aquaculture unit. This analysis is intended to be interdisciplinary and integrated, where crossover effects among the different systems/scales are taken into account. However, there are specific perspectives, data, and tools that will relate to each of the dimensions, which are described in more detail in the following subsections.

Economic aspects

A core problem associated with the assessment of the socio-economic aspects of aquaculture is to compare and balance the different dimensions of the system. For instance, if an aquaculture business pollutes the local environment more than another but brings more income to local stakeholders, it remains a societal decision as to whether which business would be assessed as being "better". Economists would prefer to compare all of these dimensions by valuing them and simply comparing monetary numbers, e.g. by Cost-Benefit-Analysis (C-B-A). However, as markets are not

[1] See ToR b for a more detailed discussion of the potentialities for identifying and strengthening inclusion and ownership in the aquaculture production chain.

always ideal and there are frequent external effects, economists and other scientists are often faced with severe methodological problems. Of course, valuation of non-market goods and services can be undertaken, e.g. by calculation of costs of avoiding negative external effects (pollution) or by calculating opportunity costs of non-market resources. Another method is to ask for peoples "willingness to pay" in order to value goods and services, e.g. the beauty of a landscape is then valued by asking people how much they are willing to pay to have this landscape unchanged. But the methodological problems remain serious. For example, are all alternative uses of a non-market resource known and valuable, so that the use with the highest value can be taken as opportunity cost? Is measurement of "willingness to pay" biased due to strategic behavior of agents? Another dimension to this is our incomplete understanding of how ecological systems work, i.e. complexity, non-linear responses and thresholds that can bring surprises and difficulties for restoration work. For example the role of biodiversity for ecosystem services is still something that we just are beginning to understand (http://www.teebweb.org).

An example of assessing the direct and indirect economic dimension of an aquaculture business

An example of general aquaculture impacts can be found in FAO 2008, pp. 15-22. Think about a single aquaculture enterprise. The site selection must be done, decisions about the organization of the farm have to be taken (including make or buy decisions and ownership structure), the species to be cultured has to be specified, workers must be hired and eventually trained, machines have to be bought or leased, feed sources must be identified and maybe feed has to be bought. Markets have to be identified and the accessibility must be evaluated and maybe secured. Land facilities have to be constructed, cages and nets have to be bought, etc. Finally, fish or other aquaculture products are produced and sold and by-products such as polluted water and other unwanted goods can be observed as a result of this production process. Income, profit and rents flow to the respective persons as income, being a direct consequence of aquaculture production. Goods and services purchased for the production also generate income in other sectors and taxes and fees maybe flow to the state authority. Spending the income manifests as demand in the retail sector, which is another measurable impact. These monetary flows can be easily observed (assuming the shadow economy is not too big) and direct and indirect impacts (by Leontief-Coefficients) can be measured by e.g. using input-output tables, having in mind the restriction of this method. It can also be used to analyze forward and backward linkages. This means to measure the strength and direction in which different sectors of an economy are interconnected and hence rely on each other. The impact of output (including intermediates) uses along the different stages of the production chain is named forward linkage, the impact of the purchase of inputs is called backward linkage.

These actions and decisions have impact on different stakeholders at different levels. Are the workers hired locally and trained, so that their skills are improved and the quality of the local workforce is enhanced? Does this have an impact on values and attitudes in this community? Alternatively workers may be hired from a different region and the local community is faced with migration problems. Is the profit transferred to a foreign country or is it available and maybe spent at a local or regional level? Is the land-based supply facility constructed by local companies or global firms? Does the aquaculture unit purchase its intermediate consumption from the local market or from the global market? What about the extent of the pollution of water or other ecologic dimensions like felling trees to get better access to the plant?

This could have different impacts on the acceptance of the aquaculture operation, on the local solidarity, the social peace etc; but how to assess all this in monetary terms?

Cost-Benefit analysis (CBA) aims to monetarize all these issues. As pointed out in the former paragraph, it is problematic and that is why additional methods have been developed. They are briefly described in the following paragraph. In general one has to have in mind that not all factors can be substituted by others easily or maybe not at all.

More tools and methods to assess socio-economic benefits

If impacts are incommensurable, CBA cannot be applied anymore. Methods like multiple criteria decision-making (MCDM) or multi-attributes decision-making (MADM) are possible ways to solve the problem. While multiple attribute utility theory (MAUT) is a MADM method which specifies utility functions to describe stakeholders' preferences, Analytical hierarchy process (AHP) does not attempt this. Instead, AHP uses a series of pair-wise comparisons to elicit stakeholders' preferences. It remains however unclear whether the use of these more stakeholder-oriented methods is practical useful and if their costs are justifiable when multiple stakeholders are scattered at local, regional and global levels.

Farm level – an example

One aspect of environmental sustainability is, by analyzing the output of an aquaculture farm, the eco-efficiency, i.e. the resources used to produce a certain amount of seafood. An indicator of this could be the Food Conversion Ratio (FCR) or the Biomass harvested per kilo/number of fingerlings. Similar farms in terms of species and environmental conditions could be compared in a benchmarking process and best-practices could be shared. This may be a very cost-effective and pragmatic way to improve a business e.g. in terms of eco-efficiency. The knowledge and service could and maybe should be done by independent scientists.

If someone is interested in economic efficiency, classic indicators for production efficiency and profitability could be applied: Net yield, growth rate, net farm income, rate of return on assets, rate of return on equity, return to labor etc. Here benchmarking is also an appropriate method to find best-practice examples. A possible obstacle to apply this method may be data availability for confidentiality reasons.

Link to new institutional economics approach

New institutional economics tools can be applied at all levels of this framework. Principal-agent theory, transaction-costs economics, property rights economics, new political economy and constitutional economics, the two latter ones especially on the macro-level. However, all economic variables are easily quantifiable, which calls for a range of methods to capture all "values".

Social aspects

In general, many past approaches to ecosystem management might be called "socially illiterate" (Glaser 2006a). Even if beyond reproach in ecological terms, many ecosystem management proposals can be outright failures due to a lack of stakeholder participation and/or understanding of social influences on ecosystems and of ecosystems on humans and society. Most interpretations of the social dimension of ecosystem management are also highly context-specific and lack universal core and general applicability. This makes the issue of a general strategy for sustainable aquaculture operations which takes the social dimension into account very difficult.

More often than not, aquaculture in Europe is faced with increased social conflicts between stakeholders (farmers, nature conservationists, recreation, fisheries). In the Netherlands for example, the use of mussel seed capture systems is promoted as an alternative to bottom dredging. But the supports of the capture systems are floating on the water surface affecting the landscape and the space for recreation and fisheries. These types of interactions and conflicts underline the importance of including the social dimensions of aquaculture. Decision-making, planning tools and alternative solutions need to be reviewed. How can we evaluate the cross-cutting effects of newly established aquaculture facilities? What are indicators of the status of social perception of aquaculture that can help in avoiding conflicts? How do social values and administrative organizations in different countries/regions affect trends in the intensity, methodology, structure and type of aquaculture?

Thus, in a planning perspective, next to the issue of siting, and monitoring of any kind of activities in the coastal and marine waters, an issue not yet being addressed in depth pertains to the social dimension of resource use. The systematic description of the social elements relevant to the sustainable management of marine ecosystems is still in its infancy (IUCN 2001; Lass and Reusswig, 2001; Glaser, 2006b). However, many socio-economic variables related to aquaculture can be "broken down" into a complex series of "second tier variables" (e.g. Ostrom *et al*. 2007) which relate to their interrelationship with different parts of the social-ecological system. For example, employment is more than just the number of people employed. It can be directly or indirectly related to, among others, improvements in quality of life, immigration, demographics, consumption of natural resources, etc. Future research should focus on methods for incorporating such complexity and interdisciplinarity into aquaculture assessments.

The lack of a systematic description of the social dimensions of sustainable management has surfaced prominently in the current ongoing debate on new forms of marine spatial planning. Although international maritime policies (e.g. Canadian *Oceans Act* and EU *Water Framework* and *Marine Strategy Directives*) include components such as: 1) a knowledge-based approach for decision making, and 2) an ecosystem-based approach for integrative management, a shortage is visible of the mostly environmentally motivated approaches to recognise the social functions of nature. Still now, making nature a commodity remains a moral problem even in a market-driven economy (McCay, 1998). Questions on who decides what and when as well as ownership issues remain unanswered. For instance for the latter, the large-scale aquaculture developments in Norway have triggered a debate on who decides on the future of the sea and what criteria are used to take such decisions.

As an example, drawing on the experiences made with shellfish cultivation in several places within the ICES scope, unresolved issues of ownership in terms of process, which stakeholders are involved in the consent procedure and their relative influence appear to crucial. Social dimensions in aquaculture operations, e.g. emotional ownership of the sea/coastal area by the local residents/stakeholders and the social and cultural values that drive this ownership are difficult to capture. However, precisely these stakeholders and their supporting values are not included in the decision-making process (ICES WGMASC 2010). Next it remains difficult to keep all stakeholders in agreement on the matter—the "contracting costs" (the cost, not necessarily in money, of getting a group of people to agree on an issue) that make it so difficult to enact major institutional change that affects natural resources and their use (McCay, 1998).

Ecological aspects

Coastal aquaculture depends on the state of marine environment and influence the environment significantly.

Many studies about aggregated effects at the ecosystem level have been carried out so far (e.g. FAO, 2007; GESAMP, 2008), depending on the cultivated species, site and production system. Common effects of aquaculture practices on coastal ecosystem may include changes of water quality and eutrophication, changes in aquatic biodiversity including natural fish and shellfish stocks, nutrient and organic enrichment of recipient waters resulting in an increase of anoxic sediments. Further risks are connected to the combined effect of temperature and salinity changes caused by climate warming. Related effects are e.g. changes in production and seasonality processes in plankton and fish populations, introduction of invasive species and the increasing acidity of the world's oceans (FAO, 2010).

Looking to the quality of aquaculture products environmental conditions such as food availability, food quality and water quality are important input factors as well.

The framework for an ecosystem approach to aquaculture (EAA) was proposed to minimize negative ecological impacts and to ensure a long-term aquaculture production. One of the principles aiming to enhance aquaculture contribution to sustainable development is to develop aquaculture "in the context of ecosystem functions and services with no degradation of these beyond their resilience capacity" (Soto *et al*. 2008). Thus, despite its name ("ecosystem"), it (intends to) include human dimensions too. A further milestone in sustainable aquaculture production is the implementation of rules for organic aquaculture at EU level ((EC) 710/2009). It is based on organically produced feeds and should minimize risks for environmental impacts by e.g. density limits and provisions for optimal feeding.

To analyze dimensions and impacts of aquaculture on ecosystems the following methods can be used: environmental impact assessment (local, regional scale), life cycle framework (local to global scale), and benefit-cost approach (local to global scale).

b) Framing conditions stage

As discussed in more detail under ToR c of this report and previously in this section, there are a number of characteristics, or framing conditions, of the social ecological-system that are likely to influence various elements related to sustainability of the aquaculture scenario that is being managed. It is important to identify these characteristics to better understand how and why they influence the system and, conversely, to ensure the tools, policies and actions that are proposed to address impacts are relevant and practical at the societal level. Specifically, as shown on the left side of figure 1, these include: Policies, laws and standards; macro-economic context; political context; customary rules and systems; stakeholders; knowledge and attitudes; technology; power; markets; and ownership. Access, particularly as it relates to knowledge, technology, and markets, is also an important element of the framing conditions. In these contexts, access is also related to power and ownership in the aquaculture scenario. Finally, the environmental preconditions (space, habitats, state, protection measures, etc.) will also influence the aquaculture scenario.

Essentially, the framing conditions are constituted by the "rules of the game" and consist of social, economic, political, technological, legal and environmental components. Given this framework, actions and decisions at the micro-level take place at the business level, where the input of resources is transformed into outputs of the aqua-

culture unit. Inputs and outputs can have direct and indirect impacts on different spatial scales (local, regional and global) as well as on different dimensions of the system, since there are social, economic and ecological dimensions to be taken into account and with respect to different stakeholders as well. The stakeholder dimension could be thought to be a third dimension of the diagram and is not shown to reduce the complexity of the figure.

Methods

Recognition of the growing importance of aquaculture and the need to improve its socio-economic benefits has resulted in various targeted studies, among them different FAO driven initiatives. The Sub-Committee on Aquaculture of the Committee on Fisheries (COFI) has repeatedly been arguing for the needs for broader thematic evaluation of the social and economic impacts of aquaculture (i.e Trondheim 2003, New Delhi 2006, Rome 2007). The FAO "Expert Consultation on the Assessment of Socio-economic Impacts of Aquaculture" which took place in Turkey in 2008, aimed to agree on methodologies for assessing socio-economic impacts of aquaculture and to determine future needs for socio-economic analyses, socio-economic assessments and indicators (FAO 2008). The main conclusion from this meeting was that the many impacts from aquaculture activities have profound interdependence and far-reaching socio-economic implications, something that makes any assessment difficult. Even if consensus was reached amongst the experts over that multiple criteria decision-making (MCDM) framework using analytical hierarchy process (AHP) would be suitable techniques for assessing socio-economic impacts, they also acknowledged that there is no single method which could be used to assess the socio-economic impacts of aquaculture. In addition to MCDM using AHP, "costs benefits analysis" (CBA) was also identified as suitable method. Recommendations from the meeting involved the need for proper testing of the identified methods, developing user guides on the implementation of the methods and building capacity in developing countries for implementing and using the techniques.

In addition, the FAO report "Commercial aquaculture and economic growth, poverty alleviation and food security" (Hishamunda *et al*. 2009) aimed at providing policy-makers with the necessary tools suitable for quantitative appraisal of the impact of aquaculture. "Aquaculture value-added multiplier" and "aquaculture employment multiplier" (calculated analogue to Leontief multipliers) were suggested as examples of appropriate indicators for representing the increase in gross domestic product corresponding to a one-unit increase in aquaculture value-added and total employment for the entire economy corresponding to one extra job created in aquaculture. The methodologies proposed however focused on measuring economic impact, not social.

c) Decision-making

The appropriate and efficient use of scientific information for decision-making has been recognized as a significant challenge to the achievement of sustainability of coastal and marine ecosystems (Lubchenco and Sutley, 2010; Perrings *et al*. 2011). The specific objective of this stage is to use the results of the previous two stages to develop policy tools and recommendations for actions to support operational processes of aquaculture for the achievement of sustainability. Essentially, this stage denotes the integration of science into decision-making. Proposed management actions may have short-term or long-term effects on the conditions in which aquaculture takes place and be implemented by actors on different scales. Monitoring will be necessary

to track the impacts of proposed actions and adapt them accordingly to continue to progress towards desired objectives (i.e. an adaptive management approach).

As mentioned previously, although scientists will play a dominant role in the previous stages of the framework and decision-makers in this final stage, collaboration between scientific and social actors is critical throughout the process in order to ensure its overall effectiveness in addressing sustainability problems. The role of key stakeholders and potential ways for including them is discussed in more detail in ToR b.

Supporting tools for the decision-making stage

A number of integrated management frameworks have been developed and implemented in ICES countries. They aim at the incorporation of interdisciplinary scientific data and multiple stakeholders into decision-making and policy development. These include Marine Spatial Planning (Ehler and Douvere, 2009) and Integrated Coastal Zone Management (Cicin-Sain and Knecht, 1998). These frameworks are complementary, and in many ways similar, to the framework proposed in Figure 1. In particular, the approaches applied in MSP and ICZM could help to ensure the effective use of the information generated in stages 1 and 2 for developing realistic, effective decision-making actions in the third stage.

However, difficulties remain regarding the evaluatation of direct and indirect socio-economic consequences of aquaculture. This should include the assessment of social site selection criteria, community impacts, right of access, ownership etc. For instance, the FAO Fisheries Report No. 861 of 2008 evaluated a former assessment of socio-economic aspects of aquaculture. The evaluators in particular ask called to "Develop perspectives from institutional economics (particularly new institutional economics) on the problem of aquaculture impact assessment)", page 7, point xi.

These demands could be met by applying an Ecosystem Approach to Aquaculture (EAA). The EAA has been defined as "a strategy for the integration of the activity within the wider ecosystem in such a way that it promotes sustainable development, equity, and resilience of interlinked social and ecological systems" (Soto *et al*. 2008). According to GESAMP (2008), an ecosystem approach strives to balance diverse societal objectives. Although sustainability may be widely understood in general terms, it is a concept that varies considerably at the operational level. Among others, the key characteristics, challenges, priority objectives, threats, and implementation capacities associated with different social-ecological systems will strongly influence how sustainability may be defined and achieved. In this context, scientific assessments of aquaculture scenarios designed to support the achievement of sustainability should be adaptable to complex, varied social-ecological systems and to multiple spatial scales (e.g. see figure 2 in ToR c). In addition, they should be amenable to the incorporation of multiple, interdisciplinary scientific tools and data.

Showcase example to test developed framework

Box 1. Worked Example: Analysis of the inputs and outputs of aquaculture projects and the spatial scales on which they act

Building upon the schematic framework for integrated assessment of the socio-economic dimensions of aquaculture, the tables below (1 and 2) are meant to:

- show and disentangle the complex nature of the social, economic and ecological dimensions related to aquaculture

- provide a guideline for an analysis of the framing conditions and the inputs and outputs of aquaculture (i.e. the assessment of the operational stage) and for the development of appropriate management tools and responses to rectify negative impacts and steer aquaculture development onto a desirable path

The FAO Fisheries Report No. 861 (FAO, 2008) provides a good framework, guidelines and tools for the assessment of socio-economic impacts of aquaculture. It can thus serve as an appropriate point of departure for assessment. However, it was felt that this basis should be expanded to include:

- more detailed analysis of the actual inputs and outputs of aquaculture
- explicit acknowledgement of the social, economic and ecological dimensions involved
- assessment of the spatial scales at which the variables act
- thorough assessment of the socio-economic framing conditions under which aquaculture projects are developed and implemented
- development of management tools and policies to address the identified impacts and to reach the stated objectives of a given aquaculture project, e.g. improved human well-being and food security.

As a first step of an exemplary analysis of a generic aquaculture project, a list of different aspects of the aquaculture project was compiled (Table 1, building upon Tab. 2 in FAO 2008). The aspects were divided into input and output variables and assigned to either the social, ecological, or economic dimension[2]. For the rationale behind the division into input and output variables, see the introduction of chapter 4.1. For each aspect, the most important respective framing conditions were identified. The identification of framing conditions helps a more holistic site selection and feasibility assessment, which up to date mostly involve ecological, and to a lesser extent economic, considerations.

For each aspect, the scale at which it acts is identified. Most aspects directly translate into impacts resulting from aquaculture (such as pathogen release or generation of employment opportunities). Following from the listing of the various impacts, specific tools or management options to address these impacts can be developed.

Most of the broader aspects of aquaculture and other social-ecological scenarios can be disaggregated into more detailed lower-level and secondary aspects (Ostrom *et al*., 2007). For example, the aspect of employment contains finer aspects such as demographic dimensions, links to job satisfaction, associated labour costs, and so on. Disaggregating the first-tier aspects in this way allows accounting for the complex upstream and downstream linkages associated with aquaculture operations, provides flexibility to accommodate a wide range of case examples, and gives a more detailed view of the involved scales at which impacts occur. Table 2 shows an example of the second-tier aspects associated with Direct Employment.

The analysis of input and output variables and an assessment of the resulting impacts of aquaculture (using Fig. 1 and Tables 1 and 2) allow for an evaluation of desirable and undesirable outcomes. Where undesirable outcomes are identified, the framing conditions resulting in these outcomes can then be assessed in more detail.

2 In some cases, the distinction between social and economic aspects is somewhat difficult and not clear-cut.

In the following, a hypothetical example of the data needed for the assessment stage of the framework is provided using direct employment in aquaculture as an example (see box 1).

Table 1: Overview of different first-tier input and output variables for aquaculture.

Dimension	Framing conditions	Input variables	Output variables	Scale	Tools/management options
Social	Labor laws and labor markets	Labor			
	Labor laws and labor markets		Employment (direct and indirect)		
	Distribution, markets		Supply of food		
	Existing infrastructure and social services		Resulting infrastructure and social services		
	Existing education and training		Resulting education and training		
	Existing population and demography		Resulting population and demography		
			Social order		
			Health		
			Leisure		
			Family relations		
			Social interactions		
ecological		Land			
		Water			
		Seed			
		Feed			
			Antibiotics		
			Pathogens		
			Nutrients		
			Aquaculture product		
			Change in pressure on wild stock		
economic		Financial resources			
		Equipment and material infrastructure			
			Income		
			Tax revenue		

The impact of each factor should be assessed e.g. following the methodology of FAO 2008, FAO 2009 (AHP, comparative advantage assessment) and the net benefits and costs weighed. This should include a scale dimension to assess what kinds of impacts occur on which level (e.g. local net benefits vs. regional net losses).

Table 2: Second-tier variables related to a particular aspect of aquaculture, using Direct Employment as example.

Dimension	Framing conditions	Input variables	Output variables	Scale	Tools/management options
Social	Willingness and capacity to engage	Number of people employed		Local	
	Social security				
			Proportion of local population employed	Local	
			Change in crime rate	Local	
			Change in spiritual utility / mental health	Local - ?	
			Demographic dimensions of employment	Local - ?	
			Immigration rate	Local	
			Change in number of skilled people	Local – regional (?)	
			Change in job satisfaction	Local	
ecological	Natural potential for aquaculture	Natural resources to feed workers		Local	
			Change in demand for wild resources	Local – global	
economic	Labor market	Owner: salary		Local	
		Quantity and quality of workforce		Local - ?	
		Secondary costs of labor (e.g. transport)		Local	
			Worker: salary	Local	
			Change in purchasing power	Local – regional (?)	
			Change in skill of work force	Local - ?	

3.3 References

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4 Develop, identify and evaluate methods on how to assess the direct and indirect socioeconomic consequences of aquaculture operations and how they relate to the assessment framework. (ToR a)

4.1 Background

Social science consists of a diverse set of disciplines with many associated theories, paradigms and methods. Thus, the assessment framework can be supported by multiple methodological approaches and interpretations. Evidently, different disciplinary approaches may be necessary in different aquaculture assessments but it is important to take an integrated approach from within social science.

In order to respond to the overall objective of the study group on assessing the social-ecological dimensions of aquaculture, the socio-economic dimensions assessment framework should be part of a holistic assessment that also takes into account the ecological dimensions.

Therefore integrative methodological tools are needed to link social and ecological data. In table 1 we provide a non-exhaustive, preliminary list of examples from some of the relevant social-science disciplines. There are also some cross-cutting social science methods, which are outlined below.

Table 3: Disciplinary approaches for assessing the social dimensions of aquaculture.

Discipline	Sample branches	Sample methods
Economics	New Institutional Economics (NIE) Environmental Economics Ecological Economics Behavioural economics	e.g. CBA CVM, input-output model, analytical hierarchical process, travel-cost, hedonic pricing
Psychology	Environmental psychology Social psychology	Experimental psychology; surveys;
Anthropology	Political ecology Human ecology Cultural anthropology Ethnography Evolutionary anthropology	Ethnographic methods; oral history; participant observation; local and traditional knowledge; cultural consensus analysis; ethnobiology
Political science		Institutional analysis, policy analysis
Law	Public law Private law	
Sociology	Gender studies	Surveys and interviews Participatory observation, social network analysis, demographics studies, gender and class assessment
Geography	Human geography	GIS

Crosscutting social science methods:

- Qualitative and quantitative social science methods (e.g. perception surveys; focus groups; interviews; participant observation)
- stakeholder mapping (identify power relations, networks)
- Multi-criteria decision analysis
- Rapid Rural Appraisal (RRA)

Creative combinations of theories and methods are necessary to interpret complex scenarios of aquaculture. In the following, some tools are identified, which would support an integrative assessment within a social-ecological framework.

Integrative tools for linking social-ecological dimensions and to support decision-making:

- GIS
- MSP/ICZM
- Sustainable Livelihoods Approach (SLA)
- System modelling
- Ecosystem goods and services assessment
- Scenario building

4.2 Recommendation

The SGSA recommends to continue ToR a and to use the assessment framework to select an appropriate combination of methods (i.e. disciplinary and integrative) to address a specific case study. The group suggests rephrasing the ToR to "Identify individual and crosscutting, integrative methods to support the evaluation of the direct and indirect socio-economic consequences of aquaculture operations and how they relate to the assessment framework"

4.3 References

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5 Examine how stakeholder inclusion and ownership influences aquaculture (ToR b)

There are several different stages and arenas where aquaculture management and governance is performed in ICES-countries. These include:

- European policies such as the Marine Strategy Framework
- Coastal zone management – designation of sea areas for different uses, including aquaculture
- Application for location of an actual aquaculture plant
- Setting of rules and regulations that govern aquaculture at different scales, e.g. national, regional or local, and affect aquaculture day-to-day operations

Stakeholders can be included in all the decision making processes above in various ways and to varying degrees. Different types of stakeholders will have different levels of influence in the aquaculture process depending on the respective institutional setting and national context. Stakeholders can be defined as anyone who finds that their interests are potentially affected by a decision. Some stakeholder groups have a long history and a strong voice in coastal zone management in a region, while others can be new and may struggle to be accepted as legitimate or important. This can affect both whether new groups are invited and included to meetings that are not open to the public (for example ad-hoc advisory groups), and how much weight is given to this groups' statements and opinions.

Stakeholder inclusion can apply to different areas, including:

- the formation of a knowledge base to support aquaculture development,
- the actual decision making process for aquaculture,
- the ownership of processes, the materials and products of aquaculture, and the risks and responsibilities of aquaculture operation.

Stakeholder inclusion helps make sure that decisions are based on relevant and correct information that represents various interests and viewpoints. The acceptance of policies is facilitated by transparent participative procedures which help to ensure that scientific information is **operational and responds to societal demands**. Establishing knowledge bases for a decision, for example through an environmental or social impact assessment, varies from being purely expert/science-based to including all stakeholders. Knowledge can be co-produced by experts and stakeholders in a

process of co-operative research, and when they in such a process jointly verify the input from each other and agree on the factual basis for a decision, it can strengthen the legitimacy of it. Of course, they can also dispute information amongst each other. The selection of stakeholders to participate in the establishment of a knowledge base is important for the legitimacy of the factual basis among different groups, and thus ultimately the decisions based on it, and can be a source of conflict.

Drawing on the experiences made with shellfish cultivation in several places within the ICES scope, the role of different types of ownership, adequate involvement of all relevant stakeholders and their relative influence appear important factors in affecting the implementation and outcome of aquaculture. However, these aspects are difficult to measure due to a lack of adequate indicators and assessment frameworks. For instance, social dimensions of shellfish cultivation operations, e.g. emotional ownership of the sea/coastal area by the local residents/stakeholders and the social values that drive these ownerships are difficult to capture. Ownership of aquaculture includes physical ownership, such as of the materials and products of aquaculture, as well as intellectual and emotional ownership such as of processes and procedures, and also relates to who holds the risks and responsibilities of aquaculture operation. It ranges along different dimensions, such ownership by few versus many or by local versus global actors. Aquaculture may be in the form of small-scale, family owned operations or of industrial farms run by multinational corporations. Type of ownership has the potential to severely affect the impacts and outcomes of aquaculture. While a multitude of owners can make oversight and management of the sector difficult, ownership by local stakeholders potentially increases the role of local ecological knowledge and a concern for the environmental sustainability of aquaculture operation. However, precisely these stakeholders and their supporting values are frequently not included in the decision-making process. Next it remains difficult to keep all stakeholders in agreement on the matter—the "transaction costs" (the cost, not necessarily in money, of getting a group of people to agree on an issue) that make it so difficult to enact major institutional change that affects aquaculture production. Especially in the light of the “industrialisation of the oceans”, it is necessary to balance the interests of internationally-acting aquaculture companies and the interests of those affected by the local effects of aquaculture operations.

Site-selection for aquaculture production sites tends to draw lines on maps and within communities by creating limited access permits and complex management structures. Issues of the access to, and ownership and distribution of the resources are cases where the appropriators of the marine and coastal resources sometimes are not being involved in decision making. However, these constructions are contested and negotiated by coastal communities, whose actors developed their own diverse coastal spaces, according to their social practices, economic activities, and environmental perceptions, leading to a much more fragmented coast. This has serious implications, particular spatial distributions of access rights, as in the case of aquaculture producers arriving as a potential new stakeholder group in some coastal and marine areas.

Stakeholder inclusion can be through meetings organized as part of the legislative/management process, public hearings inviting oral or written responses (like when a draft plan is announced in newspaper or on authorities’ web-page, inviting such responses), by stakeholders taking direct contact with bureaucrats and politicians, and stakeholders using media to get their opinions across. Stakeholders frequently organize their own public meetings or actions and invite media, write comments and letters to newspapers, or use web-pages, blogs and social media to get their messages across.

Stakeholder inclusion in the decision making processes relating to aquaculture are in some cases guaranteed by law, or it can be up to the bureaucrats and politicians arranging a specific decision making process to decide whether, how much and what form stakeholder participation shall have. Stakeholder participation can occur when a formal knowledge base for decisions is produced (if such a formal stage is included), and through the process until a final decision is made.

In the south of Europe, decision-making processes in aquaculture are generally implemented within co-management frameworks. In this case, one important question is how scientists can interact with aquaculture stakeholders in order to build an operational scientific support, i.e. how scientists can help stakeholders and supply the necessary knowledge for accompanying the implementation of sustainable policies.

The inclusion of stakeholders can be implemented in two processes:

i) In the construction of a common vision. That process rises of the question of the construction of sustainable indicators. Examples are:

- a highly formalized set of indicators for fish farming (EVAD European project) see: http://151.1.154.86/faosipam/htm/content/Workshop_Montpellier_Nov_2008.pdf
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ii) In deliberative processes which discuss the policies that could be implemented. Scientists can accompany theses processes by supplying analytical tools. Modeling approaches enable the construction of analytical representation of the real world in order to explore possible futures depending on the dynamics of ecological and socioeconomic processes and depending on different measures that can drive the system analyses.

- Stakeholders can support an empirical advise of the processes represented (if they are correctly represented)
- Stakeholders can propose the exploration of pertinent scenarios related to their vision of how to reach (i) a good ecological status and (ii) the sustainability of their sectors

Stakeholder inclusion and ownership thus have the potential to significantly affect the implementation and outcomes of aquaculture. However, specific information on stakeholder inclusion and ownership and their effect on aquaculture are still rare and difficult to assess, posing the challenge of how to measure these aspects. An analytical framework and adequate indicators are thus needed for an assessment of the role of stakeholder inclusion and ownership in determining the outcomes of aquaculture.

Limitation of stakeholder involvement

Due to the early stage of aquaculture development in many countries (compared to fisheries) there is limited experience on the stakeholder involvement in aquaculture policy-making, planning and management. In some countries plans and management of aquaculture are still under development and many stakeholder organizations are either in their infancy or nonexistent.

Critical aspects affecting implementation of the stakeholder approach can be: the institutional capacity of stakeholder organizations; legitimacy of the organizations and process, costs of stakeholder involvement, degree of stakeholder competition, and levels at which stakeholders are involved.

Example 1: Norway

Coastal Zone planning: In Norway, the municipality is the legislative level that decides on CZ plans. CZ plans zone a municipality's sea-areas into different classes of uses (fisheries, aquaculture, transport, recreation, nature-areas). Both stakeholders and regional and national sector authorities can and do provide input in the planning process. Coastal zone planning is required to include public hearings by law (The Norwegian Planning and Building Act).

Locality application: When a company wants to establish (or expand) an aquaculture plant at a specific locality, they have to make an application to the County Municipality, which is an intermediate level between municipalities and Government. Before a company can apply for a locality it must have an aquaculture license. They are issued by county or a larger region consisting of several counties, by the Fisheries Directorate, and do not normally include stakeholder involvement in the process. The County Municipality quality-assures the locality-application and considers whether a formal impact assessment is required. After that they send it out to the municipality where the locality is, as well as to state sectoral authorities responsible for environment, coastal administration, fisheries and food administration. The municipality must publicly announce that an application for an aquaculture locality is made, and invite comments from the public with a 4 week deadline. The municipality gathers all hearings, considers whether the locality-application is in accordance with the municipal coastal zone plan, sums up, and sends it to the County municipality. The County Municipality considers all input, from the municipality and from the state sectoral authorities, and decides on the application, in accordance with the Aquaculture Act.

Aquaculture operations regulations: There are a number of laws and regulations that affect the day-to-day operations of an aquaculture plant in Norway. Laws are national, while regulations can be national, regional or local (municipal). There are formalized arrangements for stakeholder involvement in the making of laws in Norway, with formalized public hearings. When regulations are introduced or adjusted, stakeholder involvement varies with type. It is a general obligation of authorities to get all relevant and necessary information when regulations are made or adjusted (The Norwegian Administration Law (forvaltningsloven, §37; http://www.lovdata.no/all/tl-19670210-000-007.html#37)), and they are normally obliged to have stakeholder involvement in the process. Exceptions to such stakeholder involvement are accepted if it is "obviously not necessary", if it would make the implementation of the regulation difficult, or if it is not practically possible to do. There are also official "Instructions for Official Studies and Reports" that determines and clarifies how authorities shall arrange stakeholder participation for "consequence assessment, submissions and review procedures in connection with official studies, regulations , propositions and reports to the Storting" (see http://www.regjeringen.no/upload/FAD/Vedlegg/Statsforvaltning/Utredningsinstruksen_eng.pdf)

See Buanes *et al* 2004, 2005, and Stokke and Hovig 2009 for more on stakeholder participation in Norwegian Coastal Zone management.

Aquaculture ownership in Norway: Osmundsen *et al* (2012) have studied how ownership and local attachments of Norwegian aquaculture companies affect their role both as an industrial actor and as a political activist in the coastal zone. Local ownership affects the aquaculture companies' priorities and concerns on several issues, including other stakeholders, environment, employment and entrepreneurship. Isaksen and Mikkelsen (2012) discuss the effects of changing ownership structure in Norwegian aquaculture on municipalities' willingness to prioritize aquaculture in coastal zone planning, and the possible long-term implications of that. There has been a concentration of ownership of Norwegian aquaculture industry, which together with changed organization and technology of

production has led to a much more geographically skewed distribution of benefits from the industry.

Norwegian example references:

Buanes, A., Jentoft, S., Karlsen, G. R., Maurstad, A., and Søreng, S. 2004: In whose interest? An exploratory analysis of stakeholders in Norwegian coastal zone planning, Ocean & Coastal Management 47, 207-.

Buanes, A, Jentoft, S., Maurstad, A., Søreng, S. U., and Karlsen, G. R. 2005: Stakeholder participation in Norwegian coastal zone planning - Ocean & Coastal Management, 48: 658–69.

Isaksen, J. and Mikkelsen, E. 2012: Økonomer i kystsona: Kan kunnskap om verdiskapning bidra til bedre arealforvaltning? (Economists in the coastal zone: Can knowledge on value creation contribute to better area-management?). Ed. by B. Hersoug and J. P. Johnsen. In Kampen om plass på kysten. Interesser og utviklingstrekk i kystsoneplanleggingen. Universitetsforlaget, Oslo.

Osmundsen, T, Størkersen, K. V., and Fenstad, J. 2012: I storm og stille – havbruksbedriften som næringsaktør og politisk aktivist i norsk kystsoneforvaltning (In storm and calm – the aquaculture company as an industrial actor and political activist in Norwegian coastal zone management). Ed. by Hersoug, B and JP Johnsen. In Kampen om plass på kysten. Interesser og utviklingstrekk i kystsoneplanleggingen. Universitetsforlaget, Oslo.

Stokke, K. B. and Hovik, S. 2009: Local Coastal Zone Planning and Stakeholder Participation in Norway. Chapter 21 in E Moksness, E Dahl and J Støttrup (eds.): Integrated Coastal Zone Management. Wiley. DOI: 10.1002/9781444316285.ch21.

Example 2: Germany

In Germany, there is no special law on aquaculture. Aquaculture as a general topic is considered in regional development plans on state level including both territorial waters and the hinterland. In principle, the set of legal (planning) instruments provides suitable tools for horizontal, vertical, territorial and time-related integration in the coordination of the development of coastal zones. Furthermore, different legislation is used for aspects of aquaculture planning and management, as environmental impact assessment, building law and water act. Public participation is part of regional planning and in case of environmental impacts also of local licensing procedures (Law on public participation in environmental matters - EG-Richtlinie 2003/35/EG (Öffentlichkeitsbeteiligungsgesetz) <http://www.bmu.de/gesetze_verordnungen/bmu-downloads/doc/37436.php>. Persons, legal bodies and associations as NGOs can take the opportunity to make representations that have to be considered in the decision making process. Public announcements can be realized by publishing in official registers or in newspapers. Further, informal public participation is possible, e.g. in optional ICZM discussions. In the German strategy on ICZM, published by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety in 2006, it is mentioned that "participation and communication are fundamentally provided for through broad, early and extensive involvement of all relevant policy sectors, economic actors, social groups and administrative levels in the various processes through the existing set of legal instruments". However, there is need for extended communication and resolution of conflicts also by means of informal participation procedures.

German example references:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2006:

ICZM - Assessment and steps towards a national ICZM strategy

Innenministerium Schleswig-Holstein, 2009: Landesentwicklungsplan Schleswig-Holstein 2009.

Ministerium für Arbeit, Bau und Landesentwicklung Mecklenburg-Vorpommern, 2005: Landesraumentwicklungsprogramm Mecklenburg-Vorpommern.

5.1 Recommendation

This ToR shall be continued in the next year and addressed in more detail. It is recommended to rephrase this ToR from “review the role of local stakeholder inclusion and local ownership in the aquaculture production chain” to “Examine how stakeholder inclusion and ownership influences aquaculture”. It is recommended to:

- review and develop indicators for the assessment of stakeholder inclusion and ownership and its effects on aquaculture, using case study approaches.
- use the Sustainable Livelihoods Approach as an analytical framework for assessing the role of inclusion and ownership.
- test Ostrom governance framework on role of ownership in aquaculture

5.2 References

Brugère, C., Ridler, N., Haylor, G., Macfadyen, G., and Hishamunda, N. 2010. Aquaculture planning: policy formulation and implementation for sustainable development. FAO Fisheries and Aquaculture Technical Paper 542. FAO: Rome.

EVAD European project - http://151.1.154.86/faosipam/htm/content/Workshop_Montpellier_Nov_2008.pdf

FAO. 2008. Expert consultation on the assessment of socio-economic impacts of aquaculture. Report 861.

FAOSIPAM. 2010. Defining sustainability indicators for Mediterranean Aquaculture.

GFCM. 2011. Indicators for the sustainable development of finfish Mediterranean aquaculture: highlights from the InDAM Project. Studies and Reviews. General Fisheries Commission for the Mediterranean. No. 90 Rome, FAO. 2011: 218p.

Rey-Valette, H. *et al*. 2008. Guide to the Co-Construction of Sustainable Development Indicators in Aquaculture., EVAD. Cirad, Ifremer, INRA, IRD, UM1 November 2008. 144 Pp.

6 Identify how social, economic, governance and environmental framing conditions influence aquaculture development (ToR c)

In the development and implementation of aquaculture projects, considerable progress has been made in methods and tools that assess biophysical and economic preconditions, e.g. in terms of site selection. On the other hand, social, cultural or political framing conditions surrounding aquaculture projects are seldom explicitly addressed in planning. As a consequence, the implementation of projects sometimes fails due to factors that could have been foreseen if a more thorough analysis that pays sufficient attention to the socio-economic dimension had been conducted, or implementation results in unexpected and undesirable outcomes (e.g. Thomas, 1994). In addition, projects that result in tangible benefits at one scale can also generate negative impacts at other scales that may not be immediately obvious. These may be more readily predicted or identified by understanding the framing conditions.

Framing conditions are the contextual factors that influence how aquaculture is more likely to develop and the probability of certain impacts of occurring. Assessing the framing conditions can help to define key characteristics of social-ecological systems related to sustainability such as well-being, coping and adaptive capacity, risks, vulnerability, resilience, and natural resource base sustainability. Understanding these system characteristics would help identify the most appropriate intervention measures. We consider a number of contextual dimensions to be especially relevant to aquaculture scenarios (see Figure 1). These include:

1) Environmental conditions

2) Institutions

3) Social and economic conditions

For example, mariculture is frequently listed as a potential supplementary or alternative livelihood option for fishing communities, yet this activity may not be seen as a desirable or viable option for fisherfolk due e.g. to cultural or economic reasons (Pollnac *et al*., 2001). Furthermore, rather than reducing their fishing effort as a result of income generated by mariculture, fishers may opt to invest this revenue into fishing gear, thus actually increasing fishing efforts and pressure on wild stocks (Sievanen *et al*., 2005).

Additionally, while a key rationale for aquaculture development is to strengthen food and economic security of large parts of the population, prevailing policies, incentive and power structures, and distribution of knowledge, technology and ownership may lead to the development of aquaculture projects that produce organisms not consumed or traded locally, and that benefit only a small and specific group of stakeholders (Armitage, 2002; Barrett *et al*. 2002; Belton and Little, 2008; Bergquist, 2007; Tapia and Zambrano 2003; see Figure 2).

Finally, stakeholders of aquaculture projects encompass a wide range of actors with different and often contrasting views, objectives and capacities (BRS, 2004).

Hence, it is argued that a thorough assessment of the framing conditions of aquaculture development that encompasses environmental, governance and institutional, and social and economic dimensions is crucial to a) improve sustainability and b) achieve more desirable outcomes for aquaculture and associated stakeholders (e.g. increases in well-being, resilience and adaptive capacity). The point of departure for the analytical process suggested by the study group is an assessment of the input and output variables of aquaculture projects (see ToR a). Here, this assessment is expanded to include the socio-economic framing conditions of aquaculture. For example, a detailed understanding of community characteristics such as level of participation, modes of communication, and demographics, allows for a better analysis of the reasons for success or failure and ultimately for socio-economic outcomes of aquaculture (e.g., Bergquist, 2007; Kularatne *et al*. 2009; Tam, 2006).

6.1 Recommendation

Many aquaculture assessments focus primarily on the impacts of the activity without enough consideration of the framing conditions that are driving those impacts or that influence how the impacts are managed. Understanding the local context (social, political, environmental, economic) is critical to the effective evaluation and management of aquaculture scenarios. This is especially pertinent with respect to socio-economic framing conditions which are often overlooked in scientific studies.

Therefore, the study group recommends the following:

- To carry out a systematic identification of framing conditions of aquaculture as a key step towards informing management measures that will enable aquaculture to realize its full potential.
- To develop and identify tools for the assessment of socio-economic framing conditions. Potentially amenable tools include Rapid Rural Appraisal (RRA), Sustainable Livelihoods Approach (SLA) and New Institutional Economics (NIE).
- To follow up this ToR at the next meeting in order to develop the proposed assessment framework further and to identify the salient social framing conditions and associated indicators as a part of a case study analysis.

6.2 References

Armitage, D. 2002. Socio-institutional dynamics and the political ecology of mangrove forest conservation in Central Sulawesi, Indonesia. Global Environmental Change, 12: 203–217

Barrett, G., Caniggia, M. I., and Read, L. 2002. "There are more vets than doctors in Chiloé": social and community impact of the globalization of aquaculture in Chile. World Dev. 30: 1951–1965.

Belton, B, and Little, D. 2008. The development of aquaculture in Central Thailand: domestic demand versus export-led production. Journal of Agrarian Change, 8: 123–143.

Bergquist, D. 2007. Sustainability and Local People's Participation in Coastal Aquaculture: Regional Differences and Historical Experiences in Sri Lanka and the Philippines. Environ. Manage., 40: 787–802.

BRS. 2004. Community perceptions of aquaculture: summary of key findings from the Eyre Peninsula Case Study. Social Sciences Program, Bureau of Rural Sciences (BRS), Australian Government: Canberra.

Brugère, C., Ridler, N., Haylor, G., Macfadyen, G., and Hishamunda, N. 2010. Aquaculture planning: policy formulation and implementation for sustainable development. FAO Fisheries and Aquaculture Technical Paper 542. FAO: Rome.

Kularatne, M. G., Amarasinghe, U. S., Wattage, P., and De Silva, S. S. 2009. Evaluation of community participation for the development of culture-based fisheries in village reservoirs of Sri Lanka. Aquaculture Economics & Management, 13: 1–17.

Pollnac, R. B., Pomeroy, R. S., Harkes, I. H. T. 2001. Fishery policy and job satisfaction in three southeast Asian fisheries. Ocean Coast. Manag., 44: 531–544.

Sievanen, L., Crawford, B., Pollnac, R., and Lowe, C. 2005. Weeding through assumptions of livelihood approaches in ICM: seaweed farming in the Philippines and Indonesia. Ocean Coast. Manag., 48: 297–313.

Tam, C. L. 2006. Harmony hurts: participation and silent conflict at an Indonesian fish pond. Environ. Manage., 38: 1–15.

Tapia, M, and Zambrano, L. 2003. From aquaculture goals to real social and ecological impacts: carp introduction in rural Central Mexico. Ambio 32: 252–257.

Thomas, D. H. L. 1994. Socio-economic and cultural factors in aquaculture development: a case study from Nigeria. Aquaculture 119: 329–343.

7 Identify new emerging issues of socio-economic aspects of aquaculture (ToR d)

The SGSA identified a number of emerging issues related to the socio-economic aspects of aquaculture that could be addressed by future research. These include:

- What are the socio-economic implications of certification schemes?
- Who will be the aquaculture operators of tomorrow and where will be the fishermen of today?
- Should/can aquaculture serve the growing worldwide demand for seafood products?
- Do aquaculture products affect markets for wild catch fisheries and other food markets and if so, to what extent? E.g. Effects of aquaculture on world fish supplies (Naylor *et al*., 2000, 2009) and the use of wild fish as aquaculture feed and its effects on income and food for the poor and the undernourished (Wijkström, 2009)

- Related to other protein sources, what is the burden of aquaculture production compared to other protein sources (e.g. carbon footprint of aquaculture products compared to beef or poultry)? Is the usage of LCA analysis as a method to address these issues practical?
- Can aquacultured biomass serve as a source for energy production and what does this mean e.g. in ethical terms to not use it as food?
- How can science be better integrated into decision-making in order to address socio-economic concerns?
- Is aquaculture a real alternative livelihood option for coastal communities?
- What is the potential of social network analysis tools to address socio-economic issues of aquaculture?

7.1 Recommendation

One issue that was found to be of high importance here was the socio-economic implications of certification schemes. It was felt however, that prior to addressing this issue in more detail in this group, we will focus on the operationalisation of the developed assessment framework on real-world cases, as else these issues would stretch the capacities of this small group.

7.2 References

Naylor, R., Goldberg, R., Primavera, J. *et al*. 2000. Effects of aquaculture on world fish supplies, Nature, 405: 1017–1024.

Naylor, R. L., Hardy, R. W., Bureau, D. P. *et al*. 2009. Feeding aquaculture in an era of finite resources. Proceedings of the National Academy of Sciences, 106: 15103–15110.

Wijkström, U.N. 2009. The use of wild fish as aquaculture feed and its effects on income and food for the poor and the undernourished. Ed. By M.R. Hasan and M. Halwart. *In* Fish as feed inputs for aquaculture: practices, sustainability and implications. Fisheries and Aquaculture Technical Paper. No. 518. Rome, FAO. pp. 371–407.

Annex 1: List of participants

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Annex 2: Agenda

Monday 23 April

For those who arrive early
18:00 Informal gathering, ice-breaker at the Pub Movitz

Tuesday 24 April

09:00 Welcome Note from Max Troell and Gesche Krause (Chair)
09:10 Housekeeping information from Max Troell
09:30 Introductory round and adoption of the agenda
10:00 Presentation of 2012 ToRs of SGSA by chair
10:30 Health Break
11:00 Discussion on 2012 ToRs and identification of subjects of mutual interest

- General discussion of ICES activities and Terms of Reference
- Adoption of agenda
- Develop work plan, identify subgroups, subgroup leaders and rapporteurs

Subgroups:

- ToR a: Develop, identify and evaluate methods on how to assess the direct and indirect socio-economic consequences of aquaculture operations and how they relate to an assessment framework.

- ToR b: Examine how inclusion and ownership influence in the sustainability of aquaculture
- ToR c: Adress how different socio-economic framing conditions affect trends in the intensity, methodology, acceptance, structure and type of aquaculture.

Split up in working groups to discuss how to proceed for remainder of week

12:30 Lunch (at University campus)
13:30 Continue ToR subgroup sessions
15:30 Health Break
16:00 Continue ToR subgroup sessions
17:00-18:00 Plenary update and wrap-up discussions

Wednesday 25 April

09:00 Plenary overview of work status and start of ToR d: Identify new emerging issues of socio-economic aspects of aquaculture
10:30 Health Break
11:00 Discussion and revision of joint publication for Science Policy Forum
12:30 Lunch (at University campus)
13:30 ToR subgroup sessions
15:00 Health Break
15:30 – 17:00 Reconvene ToR subgroup sessions and prepare first drafts
17:00 – 18:00 Plenary discussion and drafting of recommendations

19:00 Dinner down town

Thursday 26 April

09:00 Plenary discussion on first drafts
10:30 Health Break
11:00 ToR subgroup sessions to revise text
12:30 Lunch (at University campus)
13:30 Second round of discussions/revisions for joint publication
14:00 ToR subgroup sessions to revise text 15:00 Health Break
15:30 -17:00 Plenary Session:

- Review and adoption of the scientific text of the report
- Discussion and drafting of recommendations
- Prepare Executive Summary
- Discussion on possible new Terms of Reference
- Discussion on Annual Science Conference in Bergen 2012
- Location and time of next meeting

17:30 -18:00 Meeting adjournment

Friday 27 April

For those travelling on Friday
10:00 Boat trip to Drottningholm Castle. Picnic lunch if weather permits.

Annex 3: SGSA terms of reference for the next meeting

The **Study Group on Socio-Economic Dimensions of Aquaculture** (SGSA), chaired by Gesche Krause, Germany, will meet in Newcastle (UK) between April 23-26st 2013 to:

a) Identify individual and crosscutting, integrative methods to support the evaluation of the direct and indirect socio-economic consequences of aquaculture operations and how they relate to the assessment framework.

b) Examine how stakeholder inclusion and local ownership influences aquaculture.

c) Identify how social, economic, governance and environmental framing conditions influence aquaculture development.

d) Identify new emerging issues of socio-economic aspects of aquaculture.

SGSA will report by 31 of May 2013 (via SSGHIE) for the attention of the SCICOM.

Supporting Information

Priority	The new SGSA is of fundamental importance to ICES environmental science and advisory process and addresses many specific issues of the ICES Strategic Plan and the Science Plan. The scope and aims of this group will lead ICES into issues related to the socio-economic effects of the continued rapid development of aquaculture, especially with regard to the implications of changing environmental conditions. Consequently, these activities are considered to have a high priority.
Scientific justification	**Term of Reference a)** Identify individual and crosscutting, integrative methods to support the evaluation of the direct and indirect socio-economic consequences of aquaculture operations and how they relate to the assessment framework. Aquaculture can offer employment and income earning opportunities to local, often rural and marginal, communities. However, questions pertaining to social site-selection criteria, community impacts, right of access, ownership, taxation, liabilities of the negative repercussions from the environmental effects on society, ethical issues, to name but a few, have remained largely untackled in a comprehensive, integrated manner. Each of these issues follows particular interests, priorities and objectives. All operate within an array of federal, regional and international legislations, agreements and treaties. The systematic description of the social elements relevant to the sustainable management of aquaculture in general is still in its infancy. The social repercussions of environmental effects from aquaculture are central here. A clear definition of socio-economic and ecological objectives for all aquaculture operations is necessary which acknowledge the social, economic and ecological dimensions. A stronger consideration of the distribution of benefits (related to inputs and outputs) throughout the social-ecological system is necessary. Specifically, this dimension addresses questions about who is benefiting and to what extent (i.e. employment, wages, improved quality of life) and the geographical distribution and of these benefits. Future research should focus on methods for incorporating such complexity and interdisciplinarity into aquaculture assessments. The assessment framework developed by the SGSA shall be revisited and futher elaborated **Term of Reference b)** Examine how stakeholder inclusion and local ownership influences aquaculture Site-selection for aquaculture production sites tends to draw lines on maps and within communities by creating limited access permits and complex

management structures. More often than not, local communities have little political representation with only marginal links to key decision-makers. However, these constructions are contested and negotiated by coastal communities, whose actors developed their own diverse coastal spaces, according to their social practices, economic activities, and environmental perceptions, leading to a much more fragmented coast. Drawing on the experiences made with shellfish cultivation in several places within the ICES scope, unresolved issues of ownership in terms of process, and which stakeholders are involved in the consent procedure and their relative influence appear to crucial. Issues of the access to, and ownership and distribution of the resources are cases where the appropriators of the marine and coastal resources are not being involved in decision making For instance, social dimensions of shellfish cultivation operations, e.g. emotional ownership of the sea/coastal area by the local residents/stakeholders and the social values that drive these ownerships are difficult to capture. However, precisely these stakeholders and their supporting values are not included in the decision-making process. Next it remains difficult to keep all stakeholders in agreement on the matter—the transaction costs (the cost, not necessarily in money, of getting a group of people to agree on an issue) that make it so difficult to enact major institutional change that affects aquaculture production. Especially in the light of the "industrialisation of the oceans", the balancing of interests of internationally acting aquaculture companies and local effects of these needs to be addressed.

Term of Reference c) Identify how social, economic, governance and environmental framing conditions influence aquaculture development

To address the social transformations caused by the new technological innovations that competes, and threatens to replace, a capture fishery imbued with history and mythology about traditional practices is a major challenge that science if facing today. If aquaculture is to play a vital role in the well-being of coastal communities, it must be better integrated into social life. Hereby aquaculture farms (and their value chain) or aquaculture zones which are the areas where these enterprises operate must be distinguished, as well as whether the aquaculture operation is intensive, semi-intensive, extensive or multi-trophic. Many aquaculture assessments focus primarily on the impacts of the activity without enough consideration of the framing conditions that are driving those impacts or that influence how the impacts are managed. More often than not, aquaculture productions and their assessment can be outright failures due to a lack of stakeholder participation, acceptance and/or understanding of social influences on ecosystems and of ecosystems on humans and society. Understanding the local context (social, political, environmental, economic) is critical to the effective evaluation and management of aquaculture scenarios. This is especially pertinent with respect to socio-economic framing conditions which are often overlooked in scientific studies. It is recommended to develop/review a methodological framework and tools for the assessment of socio-economic framing conditions. Potentially amenable tools include Rapid Rural Appraisal (RRA), Sustainable Livelihoods Approach (SLA) and New Institutional Economics (NIE). The SGSA recommends that future research related to aquaculture should place more emphasis on these dimensions.

Whilst addressing the interactions and feedbacks between issues (e.g. economic, social and environmental consequences of aquaculture) in a spatial planning context, it becomes evident that many of these play out over time (i.e. in past, present and future contexts) and space (i.e. at local, regional and ecosystem/global scale)—these are referred to as 'cross-scale' or 'multi-scale' processes. Processes commonly unfold at different geographical scales and over different time scales: the more aggregated the geographical scale (e.g. the regional ecosystem scale), the slower a system's dynamics unfold. Conversely, at a less aggregated geographical scale (e.g. the local scale) the social-ecological dynamics are more responsive. To capture this increased complexity in the context of sustainable aquaculture and its interrelation with socio-economics, new tools in the planning process are in mandate.

	Term of Reference d) Identify new emerging issues of socio-economic aspects of aquaculture This TOR allows the identification of emerging socio-economic issues of aquaculture and related science advisory needs for maintaining the sustainability of living marine resources and the protection of the marine environment. The task is to briefly highlight new and important issues that may require additional attention by the SGSA and/or another Expert Groups as opposed to providing a comprehensive analysis
Resource requirements	None required other than those provided by the host institute.
Participants	The Group is normally attended by some 10–12 members and guests.
Secretariat facilities	None.
Financial:	No financial implications.
Linkages to advisory committees	SCICOM
Linkages to other committees or groups	WGMASC, WGEIM, WGIZCM, ++
Linkages to other organizations:	The work of this group is aligned with similar work of the World/European Aquaculture Society (WAS/EAS), European Society of Ecological Economics (ESEE), FAO, ++ and numerous scientific and regulatory governmental departments in ICES countries.

Annex 4: Recommendations

Recommendation	For follow up by:
1. The SGSA recommends to continue ToR a and to use the assessment framework to select an appropriate combination of methods (i.e. disciplinary and integrative) to address a specific case study.	SCICOM, SGSA
2. The SGSA recommends that there should be an explicit acknowledgement of the complex, interrelated social, economic and ecological dimensions of aquaculture operations. These pertain to direct and indirect impacts but alos to the socio-economic and environmental framing conditions under which aquaculture projects are developed and implemented.	SCICOM
3. The SGSA recommends that any detailed analysis of the inputs and outputs of aquaculture should include an assessment of the spatial scales at which the variables act and the distribution of benefits (related to inputs and outputs).	SCICOM
4. The SGSA recommends a stronger emphasis on the development of science-based management tools and policies to evaluate, address, and monitor identified impacts and additional elements highlighted in the previous recommendation and to achieve the stated objectives of a given aquaculture project.	SCICOM
5. SGSA recommends to continue ToR b and to establish knowledge bases for decision-making via stakeholder inclusion, for example through an environmental or social impact assessment.	SCI COM, SGSA
6. The SGSA recommends that ToR c remains active to develop/review a methodological framework and tools for the assessment of socio-economic framing conditions for aquaculture. This will be further developed by applying the framework to a possible series of real-world case studies.	SCICOM, SGSA
7. The SGSA recommends that understanding the local context (social, political, environmental, economic) is critical to the effective evaluation and management of aquaculture scenarios. This is especially pertinent with respect to socio-economic framing conditions which are often overlooked in scientific studies.The role of faming conditions must be stronger emphasis in future research	SCICOM,
8. It is recommended to include stakeholders and their supporting values in the decision-making process.	SCICOM
9. The SGSA recommends to continue ToR d to identify and report on emerging socio-economic issues and related science advisory needs for maintaining the sustainability of living marine resources	SCICOM, SGSA
10. The SGSA recommends to increase their efforts to advocate and scope more strongly outside their tradtional science community, thus to draw new institutions, e.g. social science institutions (social sciences, law, politics, physology) into the work of ICES. This would be a strong support to make the topics of the SGSA more attractive and would help to maintain the positive momentumn of this group.	SCICOM
11. The SGSA recommends that ICES encourages member states for better participation to WGs dealing with aquaculture issues.	SCICOM