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## **Sustainability Assessment of the societal costs of fishing activities in a deliberative perspective**

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### **Abstract**

The paper presents an assessment of fishing activities and policies in order to contribute to a better management of aquatic resources which affect sustainable development in coastal zones around the world. We propose to define the societal cost in a sustainability assessment process of (positive and negative) effects of fishery metiers in different eco-regions (West African coastal upwellings, and South-East Asian deltas). The originality of this article is (1) to consider the assessment process of the societal cost of fishing activities as a question of social choice and, (2) the comparison of fishing activities in a multi-criteria and multi-stakeholder approach in a deliberative perspective.

## 1. Introduction

As fisheries activity is a complex system, characterized by reciprocal interactions between fisheries activity and the harvested resource, it is difficult to define the effects of such activities in society. World-wide fishery resources continue to drift on the fringe of unsustainability, despite considerable effort in management and policy. In the past, biology, economics and sociology have each followed their own paths in analysing and advising fisheries management and policy, but have failed to be effective and helpful. Surely, multi-dimensional parameters characterise these situations, and the issues involved are themselves multiple, and cannot be reduced to one aspect, neither can the views of the actors on these issues.

Acknowledging the past failures and the complexity of fishery resource management, research has endeavoured to introduce an integrated assessment method to the fishery area, with the ECOST European international cooperation research project<sup>1</sup>. Adopting the logic of the Johannesburg Plan of Implementation (JPol) to restore as much marine ecosystems as possible by 2015 and following the philosophy of the Code of Conduct for Responsible Fisheries (CCRF), the project aims at developing a new approach for the evaluation of fishing activities and policies in order to contribute to a better management of aquatic resources affecting sustainable development in coastal zones around the world. It has to be seen from the wider perspective of equipping public decision-makers and society with the appropriate tools and methods needed to take into account, not only immediate economic and social profits, but also the costs generated by fishing activities, which relate as much to ecosystems as to societies.

In the economic tradition, this approach is often associated with the concept of social cost. It aims at identifying additional costs that are not supported by private agents. It is qualified as "externalities". Externalities are defined as, in the strict sense, damages caused by an agent (or a group of agents) to another agent (or to another group of agents) positively or negatively (see notably, Coase 1960). Social cost is then defined as the sum of all costs assumed for a given economic activity to be exercised. Due to the complexity of fisheries, the social cost approach has been developed in a sustainability perspective in order to take into account different dimensions (economic, social, environmental and institutional): the societal cost. As the information cannot easily be brought into a single unit of measure (as proposed in the Cost-Benefit Analysis), the monetary valuation procedures have to be incorporated alongside other methods for identifying the nature of the choices and trade-offs in question. A great variety of multiple criteria analysis methods have indeed been developed and applied in recent years, in efforts to help organize scientific as well as economic information as a basis for sustainability assessment and decision-making (cf., Munda 1995, 2004; Martinez-Alier, Munda & O'Neill 1999, and also Garmendia et al. 2010a, Garmendia et al. 2010b).

By incorporating the monetary valuation in a multi-criteria analysis, the construction of the societal cost is not only associated to the process of determining a value (often monetary) to costs and benefits. It is an opportunity for a deliberative process building up of shared understanding for producing meaningful evaluations for public decision makers (Dryzek & List, 2004 ; Habermas, 1997 ; Elster, 1999 ; Fishkin, 1991 ; Bohman *et al.*, 1997 ; Blondiaux, 2008 ; Blondiaux *et al.*, 2002).<sup>2</sup> The approach we propose is to define the societal cost as a

<sup>1</sup> EcOST stands for "Ecosystems, Societies, Consilience, Precautionary principle: Development of an assessment method of the societal cost for best fishing practices and efficient public policies". It is a European funded project with 23 partners from Asia, Africa, Caribbean and Europe and designed under the INCO-DEV Priority Research Area A.2.2 (Reconciling multiple demands on coastal zones). [www.ecostproject.org](http://www.ecostproject.org)

<sup>2</sup> Deliberation process can be defined as informal (confronting individuals with new facts or new perspectives about a given problem and corroborating or invalidating existing beliefs and perspectives), argumentative (calling the attention of individuals on new arguments, clarifying controversies, reflexive (bringing individuals to reveal their preferences and share their knowledge) and social, creating a context of interaction in which the individuals can talk and listen to each other, allowing each of them to find their own place within this group (Dryzek & List, 2004).

social choice dilemma. The social choice approach deals with collective decision based on measuring individual interests, values, or welfares as an aggregate (see notably, Arrow, 1951/1963). In a deliberative perspective, we propose to develop a social choice approach by (1) starting at the problem definition (identifying key questions), and by (2) framing the assessment process in order for stakeholders to identify the positive and negative externalities of fisheries through the chain value in different eco-regions (O'Connor, 2004, Dryzek & List, 2004). Such approach aims, in a sustainability assessment, at comparing fishing activities in a deliberative perspective.

Section 2 proposes to build societal cost as a social choice dilemma using a multi-criteria analysis of fishery in a sustainability assessment. Section 3 proposes the use of deliberation support tools used to assess the societal cost of métiers. Section 4 aims at identifying the process of selection of indicators in the deliberation process. Section 5 and 6 presents outputs of the application of the multi-criteria and multi-stakeholders analysis to compare fisheries (1) within an eco-region (South-East Asia eco-regions) and (2) of West-Africa and South Asia eco-regions. Finally, section 6 provides a discussion on the assessment of the societal cost of fishery in a sustainability assessment perspective.

## 2. Towards a new approach of sustainability assessment of fishery

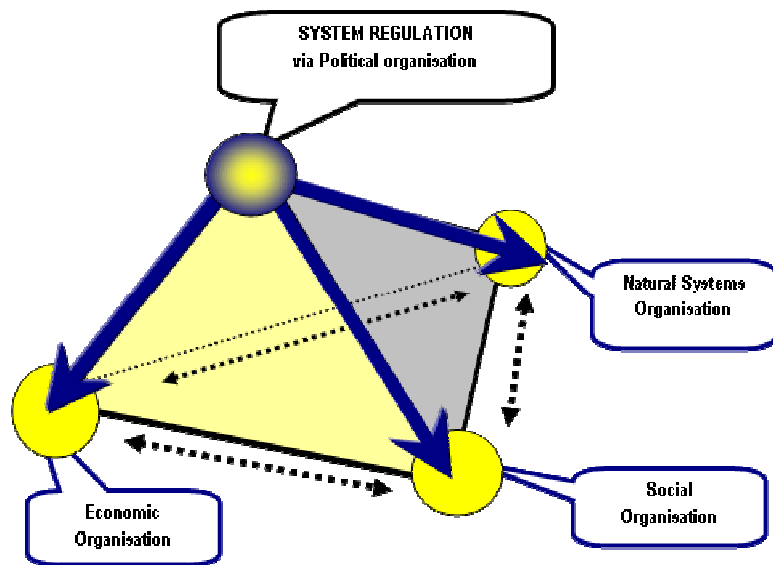
The concept of sustainability is clearly the basis of sustainability assessment. First works are in the literature of environmental impact assessment and strategic environmental assessment (George, 1999, Pope et al., 2004). Sustainability Assessment (SA) as mobilised in this article does not mean the process of developing and applying measurement tools and indicators to assess the sustainability dimensions (Ness et al., 2007; Garmendia et al., 2010a; De Lara et al. 2009; Adrianto et al., 2004; Chiou et al., 2010; Zhou et al., 2008). It is defined as what sorts of guiding concepts, frameworks and information sets might be appropriate for decision support as we enlarge our scope of concern from fisheries to the ecosystems of eco-regions and the long term. In order to allow SA to be framed, the question of sustainability should address commitments to uphold: Sustainability of what, why and for whom? Following arguments of O'Connor et al. (2006), we propose to obtain a SA through embedding multi-criteria representation and evaluation methods in a multi-stakeholder deliberative evaluation process. We adopt the view of "sustainable development" as a challenge of coexistence across multiple key questions concerning fisheries activities, informed by a diversity of knowledge. The role of SA is thus to provide guidance.

Since 1950, bio-economic modelling of fisheries permitted significant theoretical advances in the practice of fishery management. Maximization of individual profit and the fishery rent under technical and resource scarcity constraints, and the adjustment of supply and demand through the mechanism of prices, had seemed to offer insight into effective fisheries management. The development of the concepts of resource and market equilibrium ("Maximum Sustainable Yield" and "Maximum Economic Yield") were applied to the management of commercial species and, in the majority of cases, helped to explain stock decline. However, their actual application failed. Taking into account the external effects associated with a fishing activity requires a change in our understanding of the operational dynamics of fisheries.

The complex systems approach to sustainability, as proposed for example by Passet (1979), highlights the interdependence of four "spheres" or classes of system organisation. These are the economic, social and environmental spheres — usually recognised as the "three dimensions of sustainability" — complemented by a fourth category of organisation, the political sphere of conventions, rules and institutional frameworks for the regulation of the economic and social spheres. This leads to a systems model of "four spheres", named by O'Connor (2006b) the Tetrahedral Model of Sustainability (see Figure 0).

**Figure 0:** The Tetrahedral Model of Sustainability

Analyses for sustainability must focus attention on the interactions between the economic, social and environmental spheres, on the characterisation of principles of performance in each sphere, and on the principles of interdependency of one sphere in relation to another. The political sphere has the role of the “referee” that arbitrates in relation to the different — and often incompatible — claims made by the actors of the social and economic sphere for themselves and with regard to the other spheres (including the environmental sphere). Achieving sustainability would mean a process of co-evolution respecting a “triple bottom line”, that is, the simultaneous respect for performance goals pertaining to each of the three spheres. In order to frame this process, the “social choice” problem or, as rephrased in our context, the problem of “sustaining what, why and for whom?” led to framework for analysis of combining individual preferences, interests, or welfares to reach a collective decision(see Arrow 1963; also Sen 1970).



It is difficult to formulate a commitment to sustainability without, firstly, embracing a complex view of the challenges of governance of fisheries with a view to enhancing prospects of coexistence and, secondly, the requirement of a commitment to deliberation. The fundamental scientific and normative preoccupations of SA would have to be established along two axes.

- First, when the sustainability goal is affirmed, from which point of view different dimensions of system feasibility and opportunity costs can be explored; and
- Second, when attention is given to the question of how to reconcile the diversity of sustainability concerns expressed by the spectrum of “stakeholders in sustainability”.

A sustainability commitment even if affirmed individually must find collective expression and be accommodated with other stakeholders’ concerns (O’Connor 2002; Funtowicz & O’Connor (1999). This is the matter of the socially governed distribution of sustainability.

Deliberative process is intended to allow discussion and debate, meaning the raising into visibility of the distinct and often contrasting concerns that may be held by different stakeholders about fisheries, on long and short term. More specially, it is asserted that actors in deliberation can build up and exercise judgement capacity concerning social choice dilemmas in ways that are inaccessible to analytical procedures alone. Accepting the plurality of justification principles as irreducible in SA, portrays again the ‘classic’ multi-criteria situation, where no single option ‘dominates’ all the others on all criteria. This leads us to frame the generic problem of ‘social choice’ as a *multi-criteria multi-stakeholder deliberation* about the societal costs of fisheries in different eco-regions.

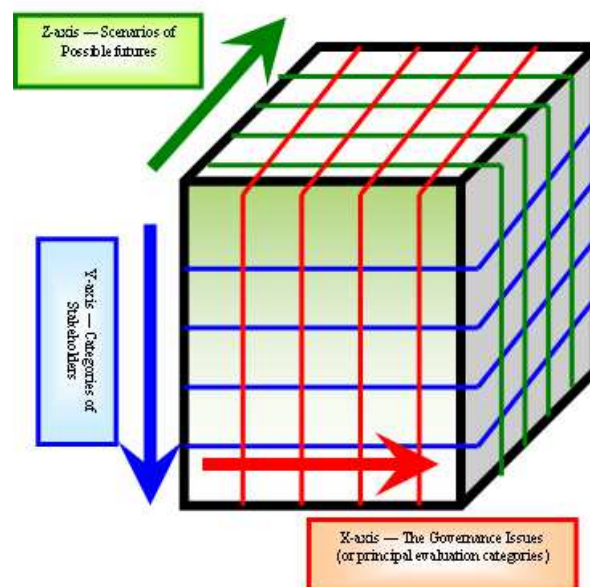


### 3. Sustainability Assessment of Metier using a multi-criteria analysis

Keeping the focus on sustainable development, the ECOST project suggests to deal with fishing activities using the *metier* concept and to identify positive and negative effects through the fisheries chain value. The « metier » concept represents a multi-dimensionality approach of fishing activities. When several fishing fleets are present, with several fishing methods having different impacts on the resource, a classification of fishing actions is needed according to these impacts. Classes of this typology are usually called “métier” or “tactic” (see Laurec *et al.* 1991; Pech *et al.* 2001; Ulrich *et al.* 2001). For each eco-regions studied within ECOST project characterised respectively by ecosystems of coastal upwelling (West Africa), delta (Southeast Asia) and coral reef (Caribbean), a set of major metiers has been identified.

Linking the four spheres of the tetrahedral Model of sustainability make explicit the complexity of *métiers* which exerts pressures on the marine resource, and which is directly related to the organization of the fisheries supply chain (production, processing, transportation, final market). The comparison of societal costs for different *métiers* in a sustainability perspective would allow us to compare different forms of fishing practices, taking into account performance issues not only related to the economic sphere (profitability of the *metier*), but also to the interaction of social and economic sphere (Sustainable livelihoods) and so on. The development of such an approach is a way to classify from responsible fishing practices to risky ones using multi-criteria analysis.

Sustainability is a multi-faceted challenge, and hence there is a certain naturalness to a multi-criteria indicator based approach to SA. Using the 3-dimensional KerBabel™ Deliberation Matrix, the problem is framed for different eco-regions, the assessment of the effects, as perceived by different stakeholders, of *each* category of *métiers* under evaluation, with reference to a *spectrum* of performance issues. The logic of this 3-dimensional KerBabel™ Deliberation Matrix (KerDST) is to allow a didactic presentation of the process and outcomes of judgements offered by *each* eco-regions, for *each* categories of *métiers* under evaluation, with reference to a *spectrum* of performance issues (see O'Connor 2006c). In this framing of SA, the spectrum of performance issues and the range of stakeholder categories must be established on the basis of prior discussions and analyses and by real-time deliberation amongst those participating in the SA. The scale of analysis and the range of countries (grouped in eco-regions), *métiers* (etc.) to be assessed must also be determined. Then, by focussing on each cell of the “Cube”, the prospect is that stakeholders should offer a judgement (*satisfactory, poor, intolerable, etc.*) of each *metier* in each eco-region in relation to each of the key performance issues. One then obtains in this way, for each *métiers*, a rectangular array of cells, which is a layer of the Matrix, within which each row represents the evaluations (issue by issue) provided by a given class of *métiers* for successive eco-regions. Or, looked at from another angle, one gets the evaluations for each eco-region, of a given metier (See Figure 1).



**Figure 1:** The KerBabel Deliberation Matrix

As a general rule, this process will not produce a conclusion about the ‘best’ option. It might allow a partial ranking. But, what is seen as most important is the role of the 3-D array as a

deliberation support tool (DST) providing all participants in the SA process with an opportunity of “collaborative learning”.

This evaluation process puts into evidence the problems of coexistence between the different issues. The analysis of the texts of the Johannesburg Plan of Implementation and Code of Conduct for Responsible Fisheries (CCRF) leads to the identification of six categories of criteria expressing preoccupations at the international level (Bavinck and Monnereau, 2007). These preoccupations can be considered as performance issues that should help in guiding actions:

1. Ecosystem health: Emphasizing the impact of fishing activities on the conservation & restoration of species and ecosystems.
2. Sustainable Livelihoods (employment, income, job satisfaction and gender): Focusing on poverty reduction, the creation of opportunities, access to assets, and developing an enabling environment.
3. Social Justice (income distribution and equity): Referring to the distribution and use of income and resources. It is highly dependent on the fisheries’ national and international economic structure, and is closely related to the next issue (food security and sovereignty).
4. Food (security, safety and sovereignty): Referring to the availability of food to people in sufficient quantity and quality; food sovereignty being the right of people to define their own food.
5. Profitability: Measuring the capacity of fishing equipment, techniques and people to generate enough profit to sustain economically their activities.
6. Regulations and Policies: Referring to the elaboration, implementation and enforcement of legal rules, as well as voluntary mechanisms.

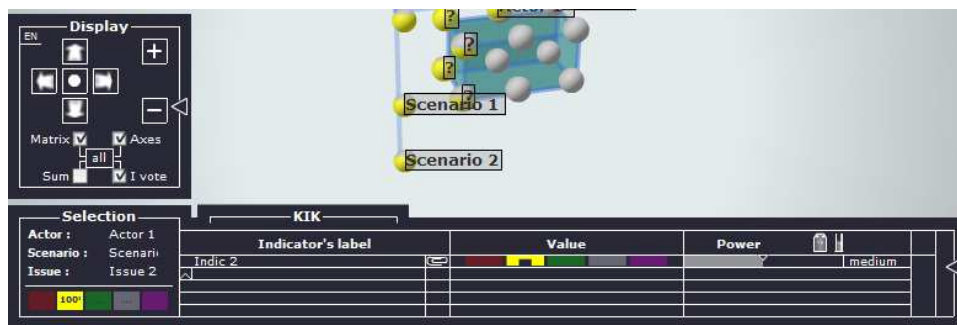
The assessment approach of the metier in a deliberative perspective is not purely analytical. Rather, it is a social process that may have strong interactive and inter-subjective dimensions, opening up the possibility of ‘emergent’ properties. In this context, a social process of comparative evaluation of metiers can readily become a framework for assessing societal costs. The Kerbabel™ ‘Deliberation Matrix’ (KerDST) (see O’Connor, 2006b; O’Connor et al., 2010; Bureau *et al.*, 2007) provides a framework to carry out an indicator-supported multi-stakeholder multi-criteria assessment. With this evaluation tool, available on-line since 2006 at <http://kerdst.kerbabel.net/>, the basic idea is that FOR EACH ECOREGION, a group of stakeholders will make a judgement (good, fair, bad, etc.) about EACH METIER with reference to EACH PERFORMANCE ISSUE. These judgments produce a composite picture, visualised on-screen as a 3-D array of “cells” somewhat akin to the well-known Rubik’s Cube. For example, from one angle of observation, one obtains rectangular arrays of cells, each being a layer of the Matrix, within which each row represents the evaluations (issue by issue) provided by a given class of *métiers* for successive eco-regions (see Figure 2). Or, looked at from another angle, one gets the evaluations by each eco-regions, of a given metier. And so on.



**FIGURE 2:** Screen image from the Kerbabel™ Deliberation Matrix



Several ways to use the KerDST are available, with increasing structure. The first and simplest variation is simply to colour the cells (stakeholder x Metier x performance issue) using an intuitive code such as [red = bad], [green = good],... Within the ECOST project, a more 'objective' basis or motivation for the judgement (colour) suggested in each cell can be constructed through the selection, for each cell of the Deliberation Matrix, of a 'basket' of indicators that are chosen to specify relevant attributes of the metier under scrutiny. With this procedure, the judgement at the cell level in the Matrix is obtained not by a simple choice of colour for the cell, but as a weighted "amalgam" of the qualitative judgements assigned to each indicator in the "basket". (In the case shown below, only one indicator has so far been put in the "basket", its colour code being YELLOW). In general, the colour (or composite) of each Matrix cell is a function of the relative weight and significance attributed to each indicator in the corresponding basket. In the ECOST project, we used the KerDST version using indicators in order to express judgements.



**Figure 3:** Screen image of the indicator basket in KerDST

The evaluation done within the ECOST project was conducted with different national experts, scientists and institutions for each country during the seminar in Can Tho, Vietnam, in September 2009. Practically, the exercise was done over two days of the seminar, in 3 hour sessions.

#### 4. Process of selecting “candidates indicators” in KerDST for expressing judgement

The KerDST evaluation process and outcome is thus built on several layers of judgements: the selection, from amongst the range of “candidate indicators” of a set of (not more than 5) indicators for each basket; the interpretation (significance) to be attributed to each indicator in a basket; the relative or absolute importance (weight) of each indicator in relation to the others in the basket, all leading to a synthetic judgement for the cell as a whole; the overall comparison, via the Deliberation Matrix, between metiers based on the multi-stakeholder multicriteria profile of each one. The underlying vision of collaborative learning is based on the hypothesis that individual reflection and/or exchanges of views between protagonists in a deliberation/negotiation process may lead to modifications at any or all or the steps of the choices and judgements leading up to an entry in a cell of the Matrix table. Those ‘representing’ stakeholders of one type may try to persuade stakeholders of another type to modify their criteria or relative weighting, and so on (O’Connor et al., 2010).

The indicator mobilisation process with KerDST has several successive cycles or components which can be pursued in a progressive way. This is the feature that allows, by design, a progressive initiation to evaluation considerations.

- It may well be that, to start with, the indicators selected for each ‘basket’ are simply declared, without their exact values being yet known, specified or estimated. Indicators can also be proposed by stakeholders. In such a situation, the evaluation process is still qualitative and functions as an “alignment exercise”, where indicators, by being placed in “baskets”, are being linked (by or on behalf of different actors) to specified categories of performance or

social values. In this sense a judgement is being made about the pertinence of the indicator or “fitness” for its evaluation function (Douguet *et al.*, 2009).

- As indicators are identified in this way as relevant, it becomes clear to those involved that it will be necessary to measure or estimate the values (qualitative or quantitative) for each nation/eco-region, metier (etc.), and also to specify Reference Values (RV) against which an indicator will be scored as good (green) or bad (red) etc. The process of RV specification (or debate!) reinforces the alignment exercise, through the focus being placed not on which indicators or what scores for the indicators are chosen, but rather on why (and by whom) this or that indicator is considered to signal something of societal importance.
- Thereafter, an iterative process can be developed, for as long as deemed interesting (within the available resources for the analysts and concerned stakeholders), of focusing analytical work (models, etc.) in order to improve estimates for high-pertinence indicators; of putting money values onto key indicators for that part of the appraisal that is deemed ‘monetisable’, of discussing RVs relative to community goals, and so on, etc. In this context, there will generally be uncertainties and controversies; and these fundamental issues of Knowledge Quality Assessment are thus mentioned plainly within the context of the evaluation or governance problem being appraised (Douguet *et al.*, 2009).

In the preparation phase, the facilitation team first gathered the indicators used within the ECOST project, through the production of the ISEE-Fish model (Failler *et al.*, Submitted) and the existing ECOPATH model (Pauly *et al.*, 2000; Christensen & Walters, 2004). Performance issues were chosen as one of the criteria for classifying the pertinence of the indicator. As most of the indicators were specific to one performance issue (Ecosystem health, Sustainable Livelihoods, Social Justice, Food (security, safety and sovereignty), Profitability, Regulations and Policies), they were labelled E01 to E22 for environmental health (see Table 1), S01 to S22 for social justice, and so forth. A complete description of each indicator is accessible in the Kerbabel™ Indicator Kiosk in KerDST. This did not preclude however the possibility for an indicator to cross issues. A collection of a total of 128 indicators was produced.

This issue emphasizes conservation & restoration of the ecosystem and species / The health of the ecosystem and its capacity to resist to the perturbation induced by fishing activities				
Ecopath : Resilience of ecosystem vs perturbation by fishing	Conservation of species	Conservation of ecosystem	Capacity of ecosystem to maintain the services it provides	Impact of climate and other changes due to external sources : Fragility
Ind. E01 : Fishing resource biomass Ind. E02 : Ecosystem Richness Ind. E03: Gross efficiency of the catch (catch / net P.P.) Ind. E04 : Mean trophic level of the catch. Ind. E05: Impact of fishing on other trophic levels (detailed in column 3)	Ind. E06 : Length-frequency analysis of catches Ind. E07 : Existence of juveniles in sufficient proportion Ind. E08 : The species is in a position to reproduce itself (no overfishing past or present) or: Total catches / Primary production of species Ind. E09 : The species is not impacted by gear, as a secondary involuntary catch, in any significant way	Ind. E10: Impact of fishing on other species higher in the trophic chain (see Ecopath flow chart) Ind. E11 : Impact of fishing on other species lower in the trophic chain (see Ecopath flow chart) Ind. E12 : Impact of fishing techniques on marine ecosystem besides fish (seabed biomass, etc.) Ind. E13: Impact of fishing techniques on coastal ecosystems (mangrove, etc.)	Ind. E14: Capacity to maintain support services (primary production) Ind. E15: Capacity to maintain provisioning services (food, other) Ind. E16: Capacity to maintain regulating services (climate, flood, disease control etc.) Ind. E17: Capacity to maintain recreational and educational services	Ind. E18: Are they any changes observable in area parameters, due to global change (temperature, currents, pH, etc.) ? Ind. E19: Are they any predictable changes in area parameters, due to global change (temperature, currents, pH, etc.) ? Ind. E20 : Is there any observable and significant pollution, perturbing the ecosystem, in the area ? Ind. E21 : Impact of human activities besides fishing on marine ecosystem (agriculture, etc.) Ind. E22: Are they any other external parameters that account for the ecosystem fragility ?

**Table 1:** Selection of indicators per issue: Example of the Ecosystem health issue

Among the array of 128 indicators suggested, almost half seemed meaningful to the country teams for the métiers evaluation. Others didn't seem meaningful to them, often because they seemed too technical. Some country experts asked for time to refer to their country colleagues, experts in specific issues. Some comments were delivered in the KerDST, to explain the votes made on the judgment.

### 5. Comparing *Métiers* Profiles within the South-East Asian estuaries eco-region

As in many other parts of the world, fishing is a very popular and ancient activity in the South Asian estuaries involved in the Ecost project, and métiers are diversified (see Table 2).<sup>3</sup> *Métiers* profiles were built for South-Asia Deltas eco-region gathering the case studies in China (CH), Vietnam (VN) and Thailand (TH). It was small ships (purse seiners or canoes) and light gear (CH3 to CH5, TH2, VN2), and an industrial sector equipped with trawlers (CH1 and CH2, TH1, VN1 and VN3).

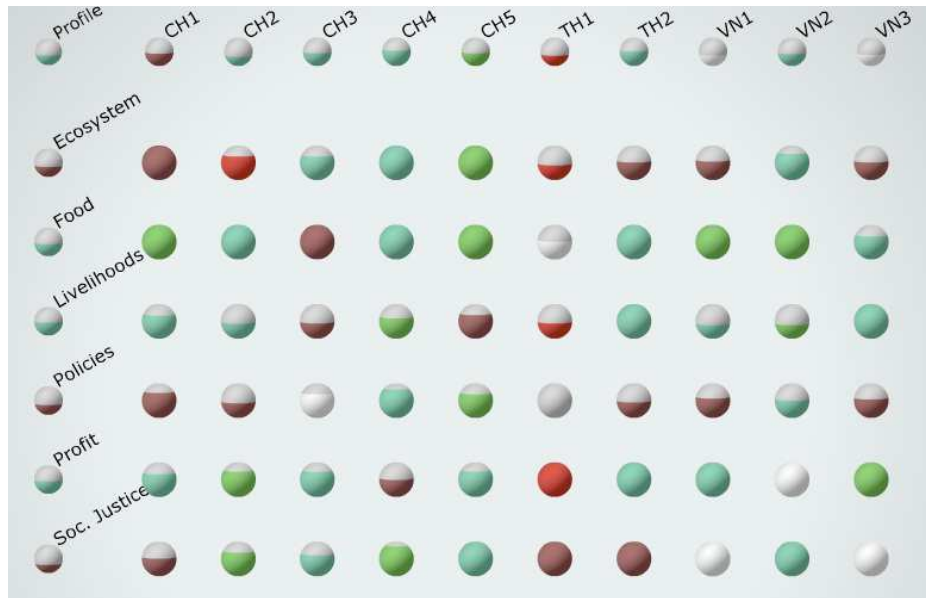
Code	Vessel	Gears	Species
TH1	Trawler	Otter board trawl	Trash fish and demersal catches
TH2	Purseiner	Anchovy purseine	Anchovy
CH1	Trawler	Single and pair trawl	Blie scad, Golden threadfin bream, Big eye perch, Mullet, Cutlassfish, Jack mackerel, Pacific mackerel, Conger eel, Black scraper, Squid, Prawn
CH2	Trawler	Single and pair trawl	crevall jack, treadfish, largehead hairtail, shrimps, squid
CH3	Seine Boat	Purse Seine	Shrimps
CH4	Canoe	Gill net	Golden threadfin bream, Large yellow croaker, Conger eel, Black pomfret, Cutlassfish, Banded, Tuna, tunny, Big eye perch, Deep-sea bass, Squid
CH5	Canoe	Hook and line	Golden threadfin bream, deep-sea bass, squid
VN1	Trawler	Trawl net	Demersal fish
VN2	Gill Boat	Gill net	Demersal fish
VN3	Trawler	Trawl net	Shrimps

**Table 2:** *Métiers* in South Asian estuaries Eco-region

The evaluation in the region makes two groups of métiers stand out: a small-scale sector, with small ships (purse seiners or canoes) and light gear (CH3 to CH5, TH2, VN2), and an industrial sector equipped with trawlers (CH1 and CH2, TH1, VN1 and VN3). Using the KerDST to evaluate the societal cost of métiers, the spheres in lines correspond to judgments for a given performance issue of all the métiers, and, in column, to judgments for a given métier of all performance issues (see Figure 4). In order to express a judgment for each sphere (stakeholder x Metier x performance issue), the set of colours used was: [red = very bad], [dark red = bad], [white = medium], [green = good], [dark green = very good].<sup>4</sup>

<sup>3</sup> To access to the on line ECOST Deliberation Matrix applied to South Asian estuaries Eco-region : <http://kerdst.kerbabel.net/?q=node/344/matrice/261/view>

<sup>4</sup> Spheres in the first line and the first column correspond to an aggregation of individual judgment for each métier and for each issue. Each sphere has the same weight in the aggregation process.



**Figure 4:** Profile of métiers in South Asian estuaries

The discussion about the societal cost with the country experts allowed them to specify its meaning for their region, and to suggest other specific means of measuring Ecosystem health, Food, Livelihood, Policies, Profit and Social justice. As shown in Table 3, indicators used by performance issue to define societal cost of metier are different within the eco-region: In “Ecosystem issue”, indicators that are systematically used are : Conservation of ecosystem, Conservation of species; in “Food issue” - Food security & safety, Food sovereignty; in “Livelihoods issue” - Employment provided by fishing chain, Income provided by fishing chain, Gender balance and equity - Opportunities for women ; in “Policies issue” - Legal and institutional activities with regard to the fishery sector, Existence of illegal fishing activities, Efficiency of existing regulations, Enforcement of law and regulations ; in “Profit issue” - Economical profitability of fishing ; in “Social Justice issue” - Distribution of income within the fishery sector, Distribution of income along the chain. Other indicators are specific to metier: for example, the indicator “Existence of juveniles in sufficient proportion” is used only for metier CH4 and, “The species is in a position to reproduce itself”, only for metier CH1.

Issue	Indicator Title	Used X time	CH1	CH2	CH3	CH4	CH5	TH1	TH2	VN1	VN2	VN3
Ecosystem	Conservation of species	9x										
	Conservation of ecosystem	9x										
	Trophic level of catch	5x										
	Impact on ecosystem services	3x										
	Existence of juveniles in sufficient proportion	1x										
	The species is in a position to reproduce itself	1x										
Food	Food security & safety	10x										
	Food sovereignty	4x										
	Fair use of natural resources	1x										
Livelihoods	Income provided by fishing chain	10x										
	Employment provided by fishing chain	10x										
	Gender balance and equity - Opportunities for women	7x										
	Basic material needs & Health	6x										
	Freedom (place and control indicators)	6x										
	Self-actualization	3x										
	Extra-income from tourism	2x										
Policies	Efficiency of existing regulations	9x										
	Existence of illegal fishing activities	9x										
	Enforcement of law and regulations - Effective inspection and surveillance...	9x										
	Legal and institutional activities with regard to the fishery sector (sufficient or not).	4x										
	Subsidies to the fishery sector	3x										
Profit	Economical profitability of fishing	5x										
	Is total net income minus total net costs	5x										
	Revenue for this metier	5x										
	Total costs for métier	5x										
	Other occupation takes time and brings additional revenue	1x										
Soc. Justice	It could be salary or income link to catches	4x										
	Distribution of income	4x										
	Distribution of income along the chain	4x										
	Comparison of fishery incomes /other economic sectors	3x										
	Gender balance and equity - Opportunities for women	1x										
	Extra-income from tourism	1x										

**Table 3:** Mobilisation of indicators for Metiers evaluation in South-East eco-region (in the table, judgment using white colour is grey coloured)

Small-scale boats focus on species that contribute to food security, but also on exports, such as anchovies. Pressures on several resources are high, as captures, despite the legislation, also target juveniles. In China legislation is better enforced, and also in Vietnam particularly for open sea shrimps. Fishing provides overall good employment, but the distribution of revenues is often evaluated as unfair in the case of larger vessels, such as trawlers, or wherever fishermen receive wages rather than being independent. Here also, trawlers are poorly evaluated on the environmental sphere. As in West Africa, women are involved in processing of local species to a variable extend, depending mainly on the country.

With regards to the policy performance of the fishery sector in the two eco-regions that provided results (i.e. South Asia and West Africa), the overall picture is that regulations are not always well designed or innovative (Richardson, 1997). Although the rule of law ensures a good preservation of several threatened species in Asia, more juridical innovation is needed to enhance the regulatory effectiveness in specific cases. Such cases are represented by bottom trawling, mangrove depletion, which cause threats to food security, since species that might be consumed locally are, instead, massively exported or depleted. A very common issue in the regulatory domain is the distortion that oil subsidies and taxes on equipment by the government causes, inducing a lack of internalization of societal costs. Above all, oil subsidies continue to encourage unsustainable forms of fishing (such as trawling of depleted species) even were métiers are profitable.

## 6. Comparing Métiers Profiles of West-Africa and South-Asian estuaries eco-regions

The fisheries sector in West Africa plays an important part in national economies of the three coastal states involved in this study (SE stands for Senegal, GN for Guinea and GB for Guinea Bissau), through the promotion of exports, the creation of jobs and the satisfaction of food needed by the rural and urban populations. It was small ships (canoes and salans) and light gear, such as different types of gillnets or hand lines (GB2, GB4 and GB5, GN1 to GN4, SE1 to SE3), and an industrial export-oriented sector equipped with trawlers (SE4, GN5 and GN6, GB1 and GB3). The screenshot below shows the KerDST for West Africa. The Profile line indicates the codes of all the 15 métiers identified in the three countries.<sup>5</sup>

Code	Vessel	Gears	Species
SE1	Pair of canoes	Purse seine	Sardinella, bonga, horse mackerel and chub mackerel
SE2	Canoe	Surrounding gillnet	Sardinella and bonga
SE3	Canoe	Hand line bottom ice-box canoe	pandora, chub mackerel, catfish, seabream, biglipp grount, snapper
SE4	Trawler	Coastal fish trawling	crevall jack, treadfish, largehead hairtail, shrimps, squid
GB1	Demersal fishery	Trawl	Demersal fish
GB2	Pirogue	Gill net	Demersal fish
GB3	Shrimp fishery	Trawl	Shrimps
GB4	Pirogue	Gill net	Shrimps
GB5	Simple monoxyle pirogue	Gill net	Ethmalose
GN1	Salan (artisanal)	Gillnets	Croacker
GN2	Salan (artisanal)	Gillnets	Bobo Croacker
GN3	Salan boat	Drifting Gillnets	80% Ethmalosa
GN4	Salan (artisanal)	Handline and set longline with or without icebox	Snaper, Emperor
GN5	Trawler	Fish trawling	Catfish, Bobo croaker, croaker
GN6	Trawler	Shrimp trawling	Shrimp

**Table 4:** Metiers in Africa Eco-region

<sup>5</sup> To access to the on line ECOST Deliberation Matrix applied to West-Africa Eco-region : <http://kerdst.kerbabel.net/?q=node/344/matrice/267/view>



Regarding to the métier and the country, a set of various indicators are mobilised for the evaluation of societal cost of métiers by country experts, meaning that the societal cost of each métier depends on the context in which it takes place.<sup>6</sup> Each indicator is used with a different value (characterized by colours).

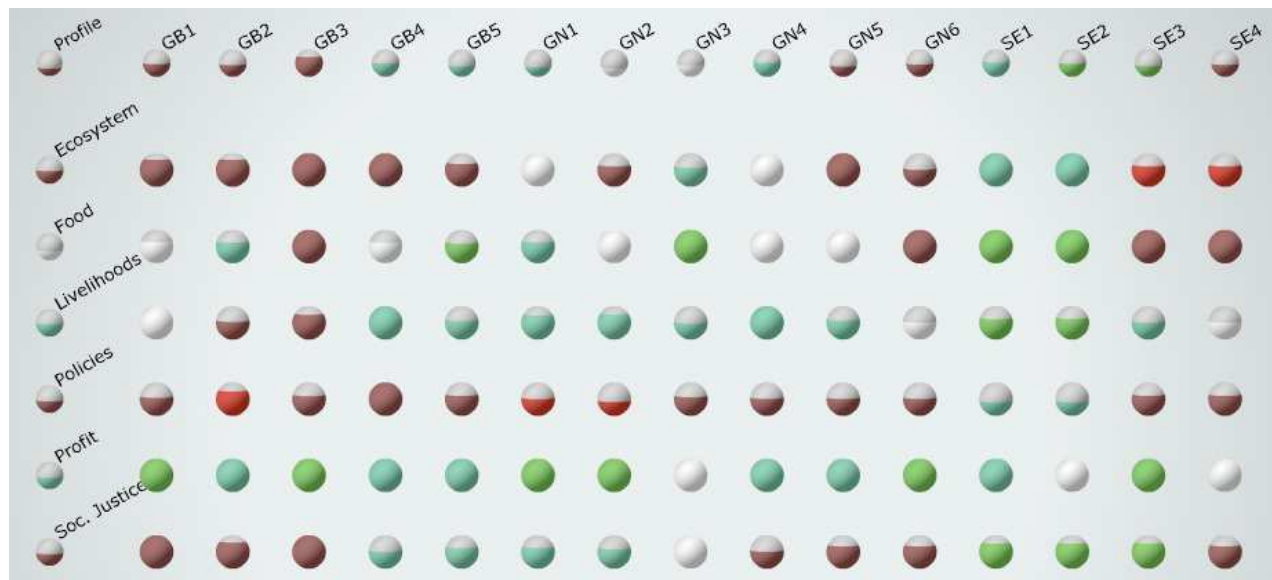


Figure 5: Profile of métiers in West Africa

The evaluation exercise shows that métiers in the ecoregion can be roughly grouped into a domestic small-scale sector, with small ships (canoes and salans) and light gear, such as different types of gillnets or hand lines (GB2, GB4 and GB5, GN1 to GN4, SE1 to SE3), and an industrial export-oriented sector equipped with trawlers (SE4, GN5 and GN6, GB1 and GB3). Globally, the performance of small-scale métiers were evaluated as more positive regarding a variety of issues, from social justice to livelihoods, as providing income, revenues, including for women (in processing) and food security to local populations.

Though more profitable, métiers related to trawling provide less local revenues and food security. They also have an almost systematic negative impact on ecosystems, both on fish stocks on sea bottoms. This low evaluation of performances of trawlers on the ecosystem doesn't mean other métiers all have higher evaluations.

Low evaluation of performance issues of some artisanal métiers are related to inadequate conservation techniques by the local population (smoking fish with wood from the mangrove, as in GB2 and GB4) or fishing highly valued species for exportation (croakers, emperors and snappers in Guinea – GN4). Policies in the ecoregion don't receive a good evaluation, and should thus be adjusted to the situation.

<sup>6</sup> To access to the list of indicators for West-Africa eco-region : <http://kerdst.kerbabel.net/?q=node/344/matrice/267/axe/3&filter=-1> and for South Asian estuaries Eco-region: <http://kerdst.kerbabel.net/?q=node/344/matrice/261/axe/3&filter=-1>

Issue	Indicator Title	Asian countries (used X time)	African countries (used X time)	GB1	GB2	GB3	GB4	GB5	GN1	GN2	GN3	GN4	GN5	GN6	SE1	SE2	SE3	SE4
Ecosystem	Conservation of ecosystem	9x	15x	Dark Red	Dark Red	Dark Red	Dark Red	Red	Grey	Grey	Light Green	Grey	Dark Red	Dark Red	Light Green	Light Green	Light Green	Dark Red
	Conservation of species	9x	15x	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red	Grey	Dark Red	Grey	Grey	Dark Red	Grey	Light Green	Light Green	Red	Red
	Trophic level of catch	5x	3x	Grey	Grey						Light Green							
	Existence of juveniles in sufficient proportion	1x	2x				Dark Red	Dark Red										
	Length-Frequency Analysis of catches	-	2x				Dark Red	Dark Red										
	Impact on ecosystem services	3x	-															
	The species is in a position to reproduce itself	1x	-															
Food	Food security & safety	10x	15x	Grey	Light Green	Dark Red	Dark Red	Light Green	Light Green	Grey	Dark Green	Grey	Grey	Dark Red	Dark Green	Dark Green	Dark Red	Dark Red
	Food sovereignty	4x	15x	Dark Red	Dark Red	Dark Red	Grey	Grey	Grey	Grey	Dark Green	Grey	Grey	Dark Red	Dark Green	Dark Green	Dark Red	Dark Red
	Fair use of natural resources	1x	-															
Livelihoods	Employment provided by fishing chain	10x	15x	Grey	Dark Red	Dark Red	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Grey	Grey	Dark Green	Light Green	Light Green	Grey
	Income provided by fishing chain	10x	14x	Grey		Dark Red	Light Green	Light Green	Light Green	Dark Red	Light Green	Light Green	Light Green	Light Green	Light Green	Grey	Dark Green	Dark Green
	Gender balance and equity - Opportunities for women	7x	7x	Grey	Dark Red				Grey	Grey								
	Freedom (place and control indicators)	6x	1x		Grey	Grey	Light Green	Dark Green										
	Basic material needs & Health	6x	1x								Dark Green							
	Self-actualization	3x	-															
	Extra-income from tourism	2x	-															
Policies	Legal and institutional activities with regard to the fishery sector (sufficient or not).	4x	14x	Dark Red		Grey	Dark Red	Red	Light Green	Light Green	Light Green	Light Green	Light Green	Light Green	Dark Green	Dark Green	Dark Red	Dark Green
	Enforcement of law and regulations - Effective inspection and surveillance...	9x	14x	Red	Dark Red	Dark Red		Dark Red	Red	Red	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red	Red	Red
	Existence of illegal fishing activities	9x	9x	Red	Red	Red			Red	Red					Dark Green	Dark Green	Grey	Dark Red

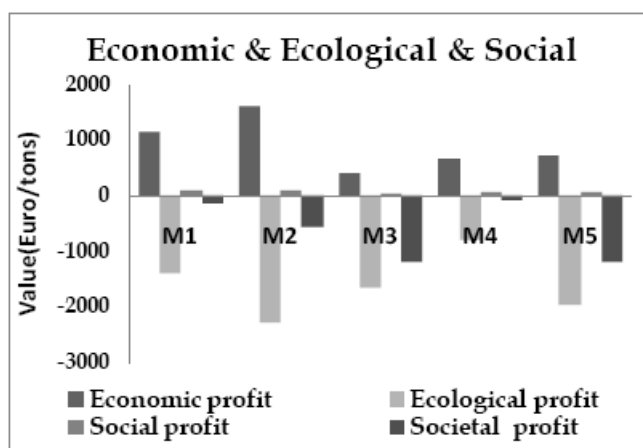


eco-region or by metier: for example, for the “Ecosystem” issue and for some metiers, only in Africa ecoregion, the indicator “Length-Frequency Analysis of catches” is used; and “Impact on ecosystem services indicator” only in Asia ecoregion.

The diversity of selected indicators resulting from expertise and stakeholder dialogue and deliberation processes, gave rise to a sort of “patchwork” vision of societal cost. This “patchwork” character is both a representation of the diversity of the effect of fisheries and a common basis for a better management of aquatic resources affecting sustainable development in coastal zones.

## 7. Discussion on indicators used to build societal cost in sustainability assessment

In developing the SA approach, the evaluation process could be the basis to determine what might seem a good, legitimate and socially acceptable decision or policy through structured argument and practical judgement for a better management of marine resources. Simultaneously and complementarily, a first attempt to build the societal cost of *métiers* in monetary terms. It has been define as the sum of social, economic and ecological costs. The social, economic and ecological costs are conceptually different and conventionally measured in different metric - social cost in various types of relative indicators, economic cost in monetary term, and ecological cost in quantitative changes of species and environmental indicators. By developing the Integration of Social, Economic and Ecological Systems for Fisheries (ISEE-Fish) model, ECOST Project adopts the approach to measure the societal costs and benefits of fishing activity in value, which involve the measurement or conversion of social and ecological costs and benefits in monetary term (Failler and Pan, 2007). An application of the use of the ISEE model is the calculation of the societal cost of metiers in Perl River in China (see Figure 6, Duang, 2009).<sup>7</sup>



**Figure 6:** Societal cost of metiers in China in monetary terms

Such an approach highlights the necessary conditions for establishing monetary commensurability in this sense are very restrictive (see Table 6).

<sup>7</sup> In this figure, Métier M1 correspond to métier CH1, etc.

Issue	Indicators chosen in a deliberative approach	Total used (X time)	Related Indicators used in the monetary evaluation
Ecosystem	Conservation of ecosystem	24x	Biomass stock change ; Growth of biomass; Potential growth of the biomass stock
	Conservation of species	24x	Total catch of a species; Catch per unit of effort; Fishing effort of métier; Catch of species by métier; Total removal of a specie; Total catch of a species; Price of species ; Maximum sustainable yield (MSY) ; Ecological cost by species ; Net Ecological cost by species
	Trophic level of catch	8x	
	Impact on ecosystem services	3x	
	Existence of juveniles in sufficient proportion	3x	
	Length-Frequency Analysis of catches	2x	
	The species is in a position to reproduce itself (no overfishing past or present). Total...	1x	
Food	Food security & safety	25x	
	Food sovereignty	19x	
	Fair use of natural resources	1x	Total catch of species by métier; Fishing effort of métier; Catch of species by métier; Biomass stock; Catch per unit of effort; Total removal of a species; Value of potential growth of the biomass stock of a specie; Total production value; Ecological cost of extended metier; Ecological benefit of extended métier; Value of potential growth of an extended métier; Ecological cost of an extended metier
Livelihoods	Employment provided by fishing chain	25x	
	Income provided by fishing chain	24x	
	Gender balance and equity - Opportunities for women	14x	
	Basic material needs & Health	7x	Household expenses for material needs; Household expenses for health; Household expenses for social relations; Household expenses for personal security; % Labor in Production costs
	Freedom (place and control indicators)	7x	Household expenses for freedom and choice
	Self-actualization	3x	
	Extra income from tourism	2x	
Policies	Legal and institutional activities with regard to the fishery sector (sufficient or not).	18x	
	Existence of illegal fishing activities	18x	
	Efficiency of existing regulations	16x	
	Enforcement of law and regulations - Effective inspection and surveillance...	14x	
	Enforcement of law and regulations - Effective inspection and surveillance...	9x	
	Subsidies to the fishery sector	9x	
	Existence of conflicts between different métiers	4x	
Profit	Economical profitability of fishing	20x	Fish harvested; In harvesting, processing, supporting and marketing domains: Economic benefit
	is total net income minus total net costs	5x	Net Economic benefit, Total Net Economic benefit ;
	Revenue for this metier	5x	
	Total costs for métier	5x	Full economic cost of extended métier; % Fish harvested in Production costs; % Fish processed in Production costs; % Non-fishery product in Production costs; % Labor in Production costs ; % Capital in Production costs
	Other occupation takes time and brings additional revenue	5x	
Social Justice	Distribution of income within the fishery sector	19x	Social benefits of each of social services related to each fisheries sector; Total social benefit of all social services; Social cost related to each fisheries sector; Total social cost of all social services related to each fisheries sector; Social benefit of an

		extended métier; Social cost of an extended métier; Net social cost of an extended métier
<i>Distribution of income along the chain</i>	18x	
<i>Gender balance and equity - Opportunities for women</i>	9x	
<i>Comparison of fishery incomes /other economic sectors</i>	6x	
<b>It could be salary or income link to the catches</b>	4x	Person income (for basic material needs, health care and other social services);
<i>Organization of production, processing and distribution</i>	3x	
<i>Fair use of natural resources</i>	2x	
<i>Extra income from tourism</i>	1x	

**Table 6:** Selection of indicators for a monetary assessment of societal cost of métiers

Table 6 relates the selection of a set of indicator which is the basis of a monetary assessment of societal cost of metiers. For each performance issue (except “Policies” issue) only part of the selected indicators (in bold and coloured) are corresponding to those identified in the monetary approach of societal cost: Conservation of ecosystem and of species (Performance Issue: Ecosystem); Fair use of natural resources (Food); Basic Materials Needs and Health, Freedom (Livelihoods); Economic profitability of fishing, Total net income, Total cost of a metier (Profit) and Distribution of income within the fishery sector and Salary and Income link to catches (Social Justice).

From a decision-making and policy assessment point of view there are both advantages and disadvantages of choosing monetary and deliberative evaluation procedures. The choice of using monetary valuations methods arise directly in the context of the attempt to transpose traditional economic valuation methodology into an arena for which it was not originally devised and where it may not be able to be applied in a meaningful way. Deliberative evaluation processes are intended to exploit the knowledge and deliberative capacities of interested members of the society in distinctive ways, compatible with democratic principles of debate and public accountability (cf. Holland, 1997; Sagoff, 1998, Aldred and Jacobs, 2000). Using monetary or multicriteria analysis highlight a problem of arbitration over ends and purposes in a sustainability perspective, this is in this sense, a social choice problem. By this way, the evaluation the societal cost of metier, within deliberative and monetary approaches, contribute to resolve socially the question “sustainability of what, why and for whom?”

## 8. Conclusion

As outlined by O’Connor et al. (2006), from starting points within or, at least, familiar to economic analysis, the requirements for a *dialogue model of knowledge* as an underpinning for Sustainability Assessment characterised by *conditions of complexity*. This means that the SA performance issues and the individual indicators that have been suggested through discursive process are of varying scope regarding data availability and possibility for governance. The two approaches, on the multi-stakeholder deliberation one hand, and monetary quantification on the other hand, are often set in opposition; yet, once the intrinsic limits of each approach are appreciated, it is obvious that neither the one nor the other alone can provide a guarantee of a successful and pertinent SA outcome. A social choice decision about the profitability, sustainable livelihoods, social justice, Food security, Regulations and policies and, ecosystem health are matters of responsibility and justice (Martinez-Alier, 2002) that have to be arbitrated through political processes.



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