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Deliverable D 2.2

Recommendations for RFMS potential indicators, to be used by policy makers, scientists and stakeholders in general

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“Indicator is a variable, pointer, or index related to a criterion. Its fluctuations reveal the variations in those key elements of sustainability in the ecosystem, the fishery resource or the sector and social and economic well-being. The position and trend of an indicator in relation to reference points or values indicate the present state and dynamics of the system. Indicators provide a bridge between objectives and actions”

(FAO, 1999)

Summary

In deliverable 2.2 a summary list of potential ecological, economic, social and governance indicators are presented (Tables 2.1-2.4) to be used in Responsive Fisheries Management Systems in accordance to well defined fishery outcome targets (OT) of a management plan.

Each performance indicator has to be related to a specific OT and to the high-end management goals and objectives defined for each fishery case study. The OTs can be recognized as an indicator target or a limit reference point, in case the performance falls below the reference limit, actions to improve performance have to be taken, following the management responses outlined in each management plan.

The ECOFISHMAN project considers that fisheries outcome targets and associated indicators are classified in four dimensions: ecological, economic, social and governance. The four main dimensions of a fishery are associated with different criteria that represent those properties that will be affected by the process of sustainability. Therefore a well-designed operational system has to be in place in each region for the collection and monitoring of required performance indicators for each management plan. Selected performance indicators require compilation, processing, analysis and assessment of data from a number of sources.

A high number of existing candidate biological, social, legal and economic indicators for a Responsive Fisheries Management System (RFMS) were first reviewed and proposed by ECOFISHMAN experts of these different areas of expertise. In order to screen and check those indicators against specific, measurable, achievable, realistic and time bound (SMART) properties, a scientific framework was adopted. For this purpose only scientific experts were considered in the scoring procedure to ensure that could be efficiently and used as adequate combined variables and functions to describe the processes involved in the management objective. The management objectives were simultaneously and interactively being defined and discussed with stakeholders at the several steps of the management plans.

Since no significant differences were found between the experts background, the relative importance of each criteria was assumed the same. Hence it was possible to compute a final score for each indicator defined as the sum of the matrix products of (equivalent) criteria weights by scores. A subsequent analysis was performed to eliminate redundant indicators with comparable properties. Exploratory analysis across all indicators revealed association between 3 *criteria groups* on which indicators were evaluated: (1) Sensitivity/Responsiveness/Specificity; (2) Concreteness/Cost/Measurement; (3) Theoretical basis/Public awareness/Historical data.

These new performance indicators are a combination of ecological, economic, social and legal indicators. Each performance indicator is measured against an outcome target or limit reference point. Limit reference levels represent the minimum acceptable level of fishery performance. The OTs can be recognized as the indicator target or limit reference point, if performance falls below the reference limit, measures to improve performance must be developed, following the management responses outlined in each management plan. Stakeholders were consulted and interviewed regarding the management principles, goals and objectives as well as the output targets linking WP2 to WP7 & WP5. Social scientists (WP7) associated with other scientists closely related to each of case study fisheries, were responsible for the operational organization of stakeholder's interaction meetings as one of the first steps to engage and involve stakeholders in the new RFMS system. These Open Dialogue Workshops included interactive stakeholder's sub-group and in-depth debate on the user's suggestions for specific objectives and associated indicators in fisheries management.

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1. ECOFISHMAN FRAMEWORK

As stated in the proposal: *Task 2.4 includes identification, evaluation and, if needed, development of ecological, biological, social, legal and economic/ governance indicators relevant for an indicator framework to support a new RFMS. The development work will be based on typical system development methodology. The first step will include defining the requirements on the indicators (to rationally measure the status of the defined outcome targets). The second step includes coarse, higher level description of the indicators to be developed (system description). Final step is the actual (technical) implementation of the system description into a rational indicator, designed to measure the status of its relevant outcome target. The development of indicators will also be approached by interactive and adaptive feedback processes. This is needed to ensure principles for sustainable governance. The developed indicators will be included in the work on indicator visualisation in WP3. The indicators will be used when designing the new RFMS (WP4). Application of these new indicators, which may be multidimensional, in the simulated case studies enables us to test their applicability in practice in WP5 and evaluate the robustness and usefulness of them.*

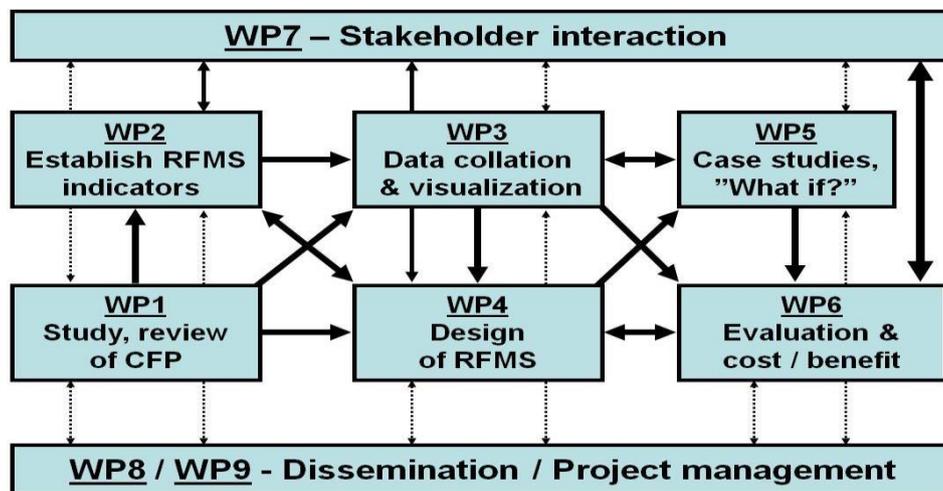


Figure 1-1 - Interactions between the EcoFishMan WP2, WP3, WP4 and WP5.

According to EcoFishMan glossary:

Responsive fisheries management system (RFMS) is a term generated for use in the EcoFishMan project and it is used to refer to the new system that we are proposing to develop. The RFMS is an adaptive management system that is results –based and ecosystem based. The RFMS attempts to reduce micro-management by involving stakeholders and has the capacity to include, or not, elements of rights-based management and co-management, as appropriate, (Source EcoFishMan,DoW).

The context of application of the RFMS is complex, mixed-fisheries and multi-stakeholder, fishery sectors with the intrinsic ecological, economic and social dimensions, as found in the EU-Common Fisheries Policy (CFP) area.

The basic aims of European Fisheries Policy (CFP) are as cited below:

- *The Common Fisheries Policy shall ensure exploitation of living aquatic resources that provides sustainable economic environmental and social conditions (Council Regulation (EC) nr. 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy).*
- *...no conflict between ecological, economic and social objectives in the long term... Ecological sustainability is therefore a basic premise for the economic and social future of European fisheries (Green Paper, p.9)*



Recommendations for RFMS potential indicators, to be used by policy makers, scientists and stakeholders in general

To develop the proposed RFMS is necessary to make use of an adaptive management called Results Based Management (RBM). A system opposed to the top-down, micromanagement system currently in place. This new approach is specifically adapted to be implemented in the fisheries sector by region, under the new CFP framework. A results based management (RBM) allows:

To define an acceptable impact and leaving to resource users to identify the means to meet the requirements and to document the effectiveness of the means, and ultimately achieve the requirements (Source: EcoFisMan glossary DoW).

2. RESPONSIVE FISHERIES MANAGEMENT INDICATORS

Fisheries outcome targets and associated indicators can be classified in four dimensions: ecological, economic, social and governance. As outlined in the ECOFISHMAN proposal, ecological indicators measure the trends in the state of the environment and ecological functions, economic indicators measure the state of the human component in activities that increase conventional gross national product and trends in production accounts and economic growth, social indicators measure the human dimensions focusing on communities, household demographics and their wellbeing, and governance indicators measure the performance of rules and institutions, of the mechanism and processes to articulate interest, and of the interactions and roles of the state, civil society and private sector in fisheries management. The four main dimensions of a fishery are associated with different criteria that represent those properties that will be affected by the process of sustainability.

A well designed operational system has to be in place in each region for the collection and monitoring of the required performance indicators for each management plan. Selected performance indicators require compilation, processing, analysis and assessment of data from a number of sources. For the most part, ecological - based indicators are computed from either vessel activity information (e.g. effort, landings, discards, biomass) and from available stock assessment information. On the other end Socio-economic-based indicators are mainly obtained from both socio-economic and financial reports, such as audit reports, subsidies information or specific protocol certifications (e.g. trainee certificate, fishing permits).

2.1 Screening of existing biological, social, legal and economic indicators for a RFMS

During earlier Tasks of WP2 a list of over 200 candidate indicators proposed by ECOFISHMAN experts of different areas of expertise were reviewed and listed. The proposed indicators were evaluated and expert judgment was used to assign each indicator a score in the nine Rice and Rochet (2005) proposed criteria's based on each criterion constituent considerations. To check if the proposed indicators have the required properties (see deliverable 2.1) to be used in the context of defined management objectives (WP7, WP5) only technical experts/advisors were considered in the scoring procedure. Since no significant differences were found between the experts background, the relative importance of each criteria was assumed the same. Hence it was possible to compute a final score for each indicator defined as the sum of the matrix products of (equivalent) criteria weights by scores. This methodology provided unique scores for each indicator. A subsequent analysis was performed to eliminate redundant indicators with comparable properties. See EcoFishMan deliverable 2.1 for details).

2.2 Scoring of biological, social, legal and economic indicators

To obtain general insights into the responses, patterns in the scores assigned by EcoFishMan experts were investigated at two levels. First, we explored potential differences in the scores according to each indicator subject (Ecological, Economic, Governance and Social). Second, we investigated how indicator's criteria and associated constituent considerations were evaluated relative to each other across all experts and indicator subject. The detailed results from this analysis are available in EcoFishMan deliverable 2.1 and in Mendes et al. (2012).

The main findings from the analysis were:

- (i) Economic and ecological-based indicators scored higher. Social and governance indicators scored lower in ranking most likely because the Rice and Rochet (2005) criteria's are adapted to ecological-based indicators. Several experts also mentioned not having sufficient background information to assign suitable scores to social and governance indicators.
- (ii) Scoring variability amongst criteria was lower in economic indicators; ecological and social indicators with higher variance across all criteria.
- (iii) Exploratory analysis across all indicators revealed association between 3 criteria groups on which indicators were evaluated: (1) Sensitivity/Responsiveness/Specificity; (2) Concreteness/Cost/Measurement; (3) Theoretical basis/Public awareness/Historical data

2.3 Guidelines for selecting indicators for a RFMS

During the scoring process, the relative importance of each criteria was assumed the same because only technical experts/advisors were considered in the scoring procedure. As the number of criteria is to a certain extent large and the property that a criterion is trying to capture often can be viewed from different perspectives, this methodology should be extended to different user groups. These include decision-makers, resource users and general audience which are likely to value the importance of the criteria differently. Whether the indicators are intended to merely inform discussion or to support decision making directly, each different study states that the properties and selection criteria need to be clearly specified to develop a good suite of indicators.

The important point is that indicators are a means to an end, *a priori* defined RFMS system characteristics that can provide feedback on progress towards management goals and objectives (Slocombe 1999).

The RFMS first step is to establish a set of relevant outcome targets¹, representing management goals for the fishery, or acceptable impacts. Afterwards, Indicators in the context of the EcoFishMan project are used: i) In the management plans (MPs) when outcome targets are set for each case study fishery, ii) used by the assessor to evaluate if the outcome targets in the MPs are met. It is simultaneously desirable to have the fewest possible number of indicators, while having all key system components covered by trustworthy indicators.

A summary list of potential associated ecological, economic, social and governance indicators to be used in accordance to fishery outcome targets are presented in Tables 1 and 2.

Table 2.1: Potential associated ecological indicators to RFMS outcome targets

Ecological indicators
1. Catch structure (time, space, species, length, etc)
2. Catch per unit of effort (time, space, species, length, etc)
3. Landings and discards (time space, species, gears, etc)
4. Biomass and abundance estimate of target species
5. Biomass and abundance estimate of non- target species
6. Exploitation rate/ Total mortality /Fishing mortality
7. Proportion of spawners per recruit (to obtain target and limit of F) in the population
8. Production ratio recruits per spawner in the stock
9. Mean and Maximum length in catch
10. Length distributions in relation to minimum landing size
11. Percentage of overexploited stocks in the area
12. Mean and Maximum weight of fish in population/community/ecosystem
13. Proportion of habitat type area not impacted by mobile bottom gears
14. Biodiversity indices in the area/ecosystem
15. Proportion of large fish in the area/ecosystem
16. Essential species habitats/ Change in area occupied by species/ /overlap with fishery areas
17. Mean trophic level of catch in the area/ecosystem
18. Ratios of pelagic forage fish versus predators /ratios of key trophic groups in the area/ecosystem
19. Fishery in Balance (FiB)
20. Primary production required to support fishery in the ecosystem

¹ An **outcome target** is a specific and measurable performance objective defined for a fishery on the basis of agreed and appropriately authorized general goals, standards and principles, as defined by the authorities based on policy objectives.

Table 2.2: Potential associated economic indicators to RFMS outcome targets

Economic Indicators
1. Harvest /Catch/Landings
2. Harvest value
3. Employment in fisheries/vessel
4. Effort/ number of vessels
5. Fisheries contribution to GDP
6. Fisheries exports compared to value of total exports
7. Fishery net revenue
8. Profit
9. Economic performance
10. Income/average wage
11. Earning Before Interests, Taxes, Depreciation and Amortization (EBITDA)
12. Invested capital
13. Rate of return of investment (ROI)
14. Ratio of profit to sales
15. Index of catch stability
16. Fuel and catching efficiency
17. Subsidies per catch value and employment
18. Maximum Economic Yield
19. Global Sea food market performance
20. Carbon budget due to fishery activity

Table 2.3: Potential associated social indicators to RFMS outcome targets

Social indicators
1. Employment rate in fisheries
2. Demography
3. Income in fishing communities
4. Participation
5. Education/training
6. Maintenance of fishery traditions/culture
7. Minorities rights met
8. Number of accidents in fisheries activities
9. Social attractiveness/ acceptance
10. Number of people under poverty
11. Protein/consumption/quality
12. Certification
13. Account of social impact on management plan changes
14. Gender distribution in decision- making
15. Fixation of fishing communities
16. Proportion of younger people in fishery jobs.

Table 2.4: Potential associated governance indicators to RFMS outcome targets

Governance indicators
1. Compliance regime
2. Transparency and stakeholder participation ensured
3. Rate of quota taken
4. Existence of management plans
5. Capacity to manage
6. Existence of management body and decision making
7. Property rights
8. Protection of small scale fishing rights
9. Fisheries Policy Resources Index
10. Adequacy of enabling legislation
11. Inclusion of international laws in management plans
12. Sanctions
13. Level of quota exchange
14. Concentration of rights/level of resource conflict
15. Transparent enforcement rules
16. Overshooting TACs/quotas
17. Number of fisheries with certification
18. Legitimacy of fisheries management
19. Proportion of illegal under-reported and under regulated catches (IUU)
20. Code of conduct of responsible Fisheries acceptance

2.4 Management goals, management objective, management plan, outcome targets and associated performance indicators

According to Ecofishman , DoW Glossary:

- i. management goal is a higher order objective to which a management intervention is intended to contribute. This goal is derived from a management principle (OECD, 2011);
- ii. management objective is a purpose to be achieved within the overall principles of sustainable development encompassing all the dimensions and relevant criteria of sustainable development (FAO 1999);
- iii. management plan is a formal arrangement between a management authority and interested parties in the fishery; In the context of RFMS the development of a management plan is a delegated responsibility to fishery operators (FAO, 1999);
- iv. Outcome target (OT) are specific and measurable objectives with targets defined for a fishery on the basis of agreed and appropriately authorized general goals, standards and principles.
- v. performance indicators are associated to the outcome targets. They have to contain variables that describe well the process defined in the outcome target to be able to check if the outcome target is met.

These new performance indicators are a combination of ecological, economic, social and legal indicators. Each performance indicator is measured against a target or limit reference point. Limit reference levels represent the minimum acceptable level of fishery performance (Dixon and Sloan, 2007). Each elected performance indicator has to be related to a specific OT and to the high-end management goals and

objectives defined for each case study. The OTs can be recognized as the indicator target or limit reference point, if performance falls below the reference limit, measures to improve performance must be developed, following the management responses outlined in each management plan

As an example we present below a link with WP5 Management Plan for the Portuguese crustacean bottom trawl fishery (Table 2.5) where the Management goal is the sustainable exploitation of resources, the management objective sustainable harvesting of stocks and reduce discards. The outcome target is expressed as limits to attain the management objective and the associated performance indicator to measure if the outcome target is met.

Recommendations for RFMS potential indicators, to be used by policy makers, scientists and stakeholders in general

Table 2.5: Management goal, management objective, outcome targets and associated performance indicators on the 10-year MP for the Portuguese Crustacean Bottom Trawl Fishery (case study 2).

Management goal	Management objective	Outcome target	Performance Indicator
<u>Sustainable exploitation of resources</u>	Sustainable harvesting of rose shrimp stock	Avg. yearly $I_{trigger} = 3.12 \text{ kg/h}^2$	CPUE index (landings/trawl effort)
	Sustainable harvesting of Norway lobster stock	$F \leq F_{0.1}$ $F_{0.1} = 0.2^3$ Avg. yearly $I_{trigger} = 3.21 \text{ kg/h}$	Fishing Mortality; CPUE index (landings/trawl effort)
	Improve knowledge of red shrimp and purple shrimp stocks	Report location of hauls, no. of hours and commercial size categories of related catch	logbook available (yes/no)
	Reduce discards	Avg. discard rate $\leq 50\%$ (5yrs) Avg. discard rate $\leq 25\%$ (following 5 yrs)	Discard rate (discards/landings)
<u>Fishing sector is operational</u>	Profitable and stable fishing industry	a) Each operator EBITDA ⁴ > 0	a) EBITDA
		b) 100% reduction in direct subsidies	b) Subsidies data
<u>Fishing sector contributing to settlement and employment</u>	Promote social stability	On board training opportunities for 25 new workers	Number of trainees
<u>Implementation of a RFMS</u>	Research framework for the development of the MP	All operators cooperate with a scientific institution	Operator compliance (yes/no)

² $I_{trigger}$ is a proxy for the MSY $B_{trigger}$. MSY $B_{trigger}$ should represent a stock size below which more conservative catch advice is needed to avoid impaired productivity.

³ $F_{0.1}$ is the fishing mortality rate corresponding to 10% of the slope of the yield-per-recruit curve at the origin (Gulland and Boerema, 1973).

⁴ Earnings Before Interest, Taxes, Depreciation, and Amortization.

3. STAKEHOLDERS CONSULTATIONS

Stakeholders' involvement is the core of the EcoFishMan project, both in terms of contents and process. They were consulted and interviewed regarding the management principles, goals and objectives as well as the output targets in WP7 & WP5. Social scientists (WP7) associated with the the other scientists closely related to each of case study fisheries, were responsible for the operational organization of stakeholder's interaction meetings as one of the first steps to engage and involve stakeholders in the new RFMS system. These Open Dialogue Workshops included interactive stakeholder's sub-group and in-depth debate on the user's suggestions for specific objectives and associated indicators in fisheries management. There was an intensive and productive debate among stakeholders and the main outline from these interactions were:

- (i) Outcome targets (OT)s are a key component of the RFMS.
- (ii) OT's must be reasonable and clearly defined, with the duties of stakeholders being transparent and acceptable; more than that, Management Plans must be feasible, achievable and efficient.
- (iii) Many OT's might just result in a new form of micro-management. They also explained that in order to achieve the OTs, it is necessary to have the possibility and capability to handle and affect the outcome targets by controlling their underlying factors.
- (iv) Some of the interactions have shown that it is really difficult for stakeholders to state concrete and measurable objectives for their fisheries. Even if they are experts with a long track on fisheries management, fishing activity or fisheries advice, defining OTs and associated indicators was a challenging task;
- (v) Nevertheless, there was some easiness to define ecological and biological OTs (similarities in current management systems);

An high number of existing indicators to be used in sustainable fishery management objectives were reviewed by the social, economic and ecological EcoFishman experts (see Deliverable 2.1). Therefore was necessary to use a scientific framework to screen and check these indicators against specific, measurable, achievable, realistic and time bound (SMART) properties. For this purpose only scientific experts were considered in the scoring procedure to ensure that could be efficiently and used as adequate combined variables and functions to describe the processes involved in the management objective. These management objectives were simultaneously and interactively being defined and discussed with stakeholders at the several levels of the management plans.

The process in the EcoFishMan project ensures that stakeholder's views, perceptions, knowledge and challenges are integrated in the successive definitions of the prototypes for the RFMS for the management plans.

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