

Review

Implementing a unified methodology for fisheries management (UMFM) in fresh water in Morocco

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The ecosystem approach for fisheries management in fresh water is based on the application of appropriate methodologies and tools to promote sustainable production of goods and services with least possible environmental impact and the highest possible economic and social yield. In this paper, we develop a unified methodology for fisheries management (UMFM) in fresh water in Morocco in order to better plan, organize, manage the sector in a manner that provides sustainable goods and services and contributes to human well-being and equity for all relevant stakeholders. The UMFM Framework describes the various activities required for the implementation of the ecosystem approach to fisheries, developed by integrating, as appropriate, 29 processes involved around six knowledge areas. Some lead to specific fisheries objectives, such as fisheries, marketing, and quality management. Others provide methods to achieve the objectives, such as those related to stakeholders, research and risk management. These processes are logically grouped into four iterative steps: Scoping and diagnostic process group, planning process group, implementing process group and monitoring and controlling process group. This framework, developed from the best practices, will increase the chances to ensure sustainable fisheries, and which best meet the needs of recreational and commercial fishers, or of fishers and non-consumptive users of the resource.

Key words: Methodology, process, Moroccan reservoirs, fisheries management, ecosystem approach to fisheries.

INTRODUCTION

Fishing in fresh water holds an important place in the rural area in Morocco. The continental aquaculture is based on the extensive aquaculture in reservoirs. Actually, 128 reservoirs are being exploited in Morocco.

Historically, Morocco has taken a policy of introducing exotic freshwater fishes to enrich the natural fish resources. Currently, there are 16 exotic fish existing in

the Moroccan freshwater according to Azeroual et al. (2000). The use of exotic fish is a characteristic feature of inland fisheries and freshwater aquaculture development in Morocco.

In most reservoirs, the main stocked species are black bass *Micropterus salmoides*, pike *Esox lucius*, silver carp *Hypophthalmichthys molitrix* and common carp *Cyprinus*

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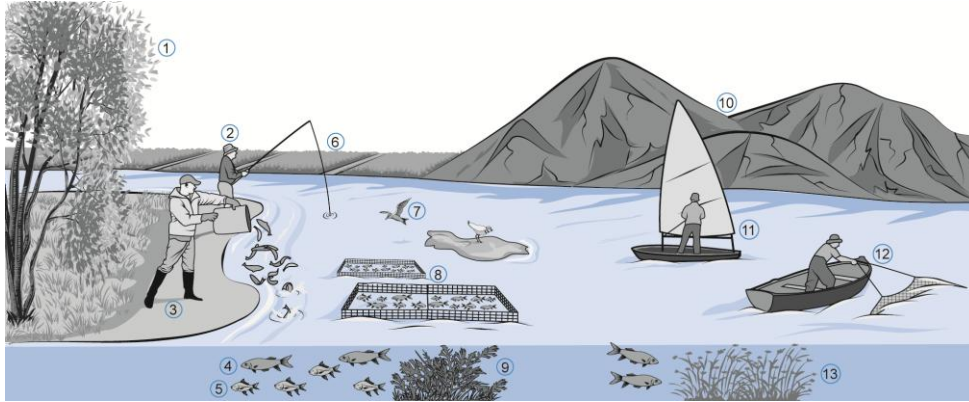


Figure 1. Illustration of the complexity of fresh water ecosystem management: 1, Forest; 2, recreational fisheries; 3, Fish stocking; 4, predatory species; 5, herbivorous species; 6, Agriculture; 7, habitat migratory bird; 8, aquaculture; 9, eutrophication; 10, soil erosion; 11, tourism; 12, commercial fisheries; 13, fish habitat.

carpio. The stocking densities used and the species ratio of the seed stock vary according to the trophic status and the size of the reservoir.

Fishery enhancement, through stocking, is carried out for a number of purposes: To increase fish food production, to increase depleted stocks, to fight against eutrophication for improving water quality and to develop recreational fisheries (De Silva, 2003). However, the complexity of ecosystems and the multitude services provided has given rise to several problems and constraints observed in Moroccan reservoirs associated with non-integrated management approach to fisheries management with other components of the ecosystem or with other relevant sectors (Figure 1). These issues are summarized as follows: (i) Conflict and competition between fish farmers, commercial and recreational fishers, or between fisheries and other uses of inland waters such as agriculture, tourism; (ii) Degradation of water quality by eutrophication due to the enrichment of water by nutrients or by pollution from agriculture, pesticides and fertilizers (losses from agriculture, soil erosion; (iii) Selective fishing for predatory species (piscivorous species) with high market value such as largemouth black bass *Micropterus salmoides* pike *Esox lucius*, pike-perch *Sander lucioperca* causing an ecological disturbance induced by the abundance of herbivorous species such as cyprinids species; (iv) Limited skill capacity: The sector suffers from lack of human resources with the appropriate technical skills; (v) Difficult access to market: Lack of preservation, cooling systems; (vi) Strong reliance on natural resources, especially in poor rural communities; (vii) Many stakeholders are involved in the use of reservoirs, and, there is a need to mitigate different interests among the stakeholders; (viii) Some reservoirs have biological and ecological interest and constitute an important habitat for wintering bird community. The management of these fishing areas must also provide habitat of migratory birds.

The aim of this paper is to develop a unified methodology for freshwater fisheries management in Morocco, that can be used by fisheries managers to better plan, organize, manage the sector in a manner that provides sustainable goods and services and contributes to human well-being and equity for all relevant stakeholders.

OBJECTIVES AND SCOPE

According to PMBoK® (PMI, 2004), a methodology is “a body of practices, procedures, and rules used by those who work in a discipline or engage in an inquiry; a set of working methods. The unified methodology for fisheries management (UMFM) is a set of guidelines or principles that can be tailored and applied to a specific situation. In fisheries environment, these guidelines might be a list of things to do.

The UMFM is a structured approach for managing fisheries in fresh water, adapted from standards the Project Management Body of Knowledge (PMBoK®), developed by the Project Management Institute (PMI, 2004, 2008, 2013) and consists of a set of processes, with each process having clearly defined their inputs and outputs. A process is a set of actions and activities in relation to each other, put together in order to reach a predefined set of products, services or results (ISO, 9001:2008).

The UMFM revolved around a number of inter-related guiding concepts; principles described in The FAO Technical Guidelines on the ecosystem approach to fisheries (FAO, 2003). The Principles of relevance to an ecosystem approach to fisheries are (i) Avoiding overfishing; (ii) Ensuring reversibility and rebuilding; (iii) Minimizing fisheries impact; (iv) Considering species interactions; (v) Ensuring compatibility; (vi) Applying the precautionary approach; (vii) Improving human well-being and equity; (viii) Allocating user rights; (ix) Promoting

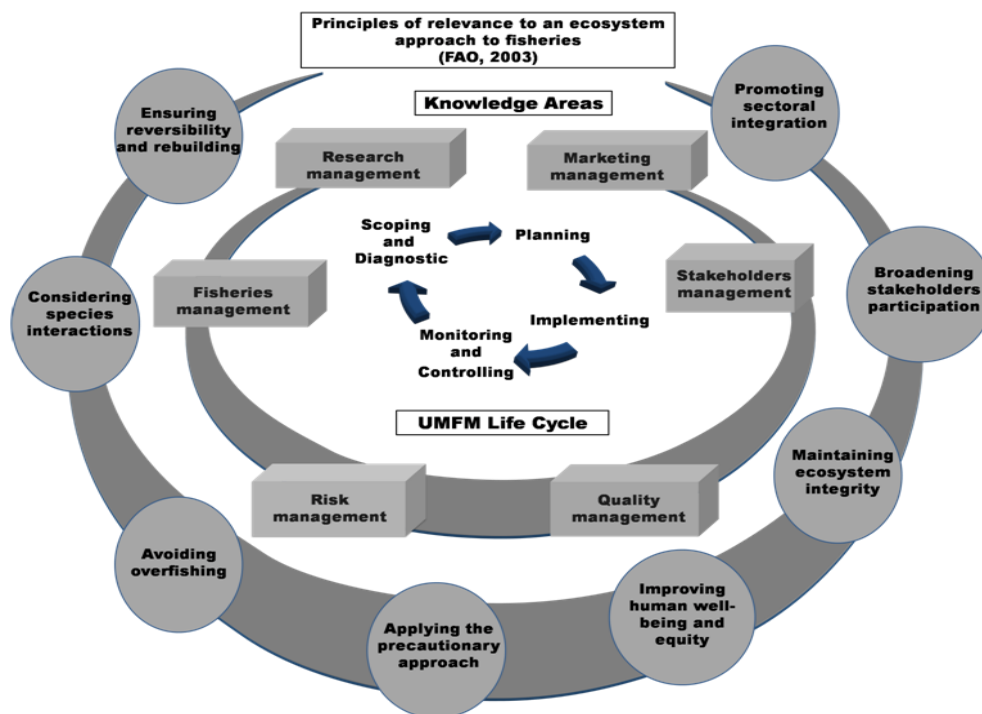


Figure 2. The UMFM framework.

sectoral integration; (x) Broadening stakeholders participation, and (xi) Maintaining ecosystem integrity. Closely linked to this guiding concepts and principles of the ecosystem approach to fisheries six knowledge areas are identified in the UMFM (Figure 2). Some lead to specific fisheries objectives, such as fisheries, marketing, and quality management. Others provide methods to achieve the objectives, such as those related to stakeholders, research and risk management.

Fisheries management

This is the integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of resources and formulation and implementation, with enforcement as necessary, of regulations or rules which govern fisheries activities in order to ensure the continued productivity of the resources and the accomplishment of other fisheries objectives (FAO, 1995).

Quality management

This includes all activities of the overall management function that determine the quality policy, objectives and responsibilities and implement them by means such as quality planning, quality assurance and quality control (PMI, 2013). The quality management goes well beyond

satisfying the needs of the recreational fishermen, or ensuring the safety and quality of commercial fishing products.

Risk management

This includes processes ensuring that each risk is properly identified, documented, categorized, and resolved within the fisheries environment. It refers to the culture, processes and structures that are directed towards the effective management of potential opportunities and adverse effects (Cooper et al., 2005).

Marketing management

This consists to analyze, plan, implement, coordinate, and control programs involving the conception, pricing, promotion, and distribution of products, services, and ideas designed to create and maintain beneficial exchanges that satisfy individual and organizational objectives (Boyd et al., 1998). This concerns mainly the sale of fishery products, promotion of recreational fishing and tourism development related to fishing

Stakeholder management

This consists of developing an appropriate engagement

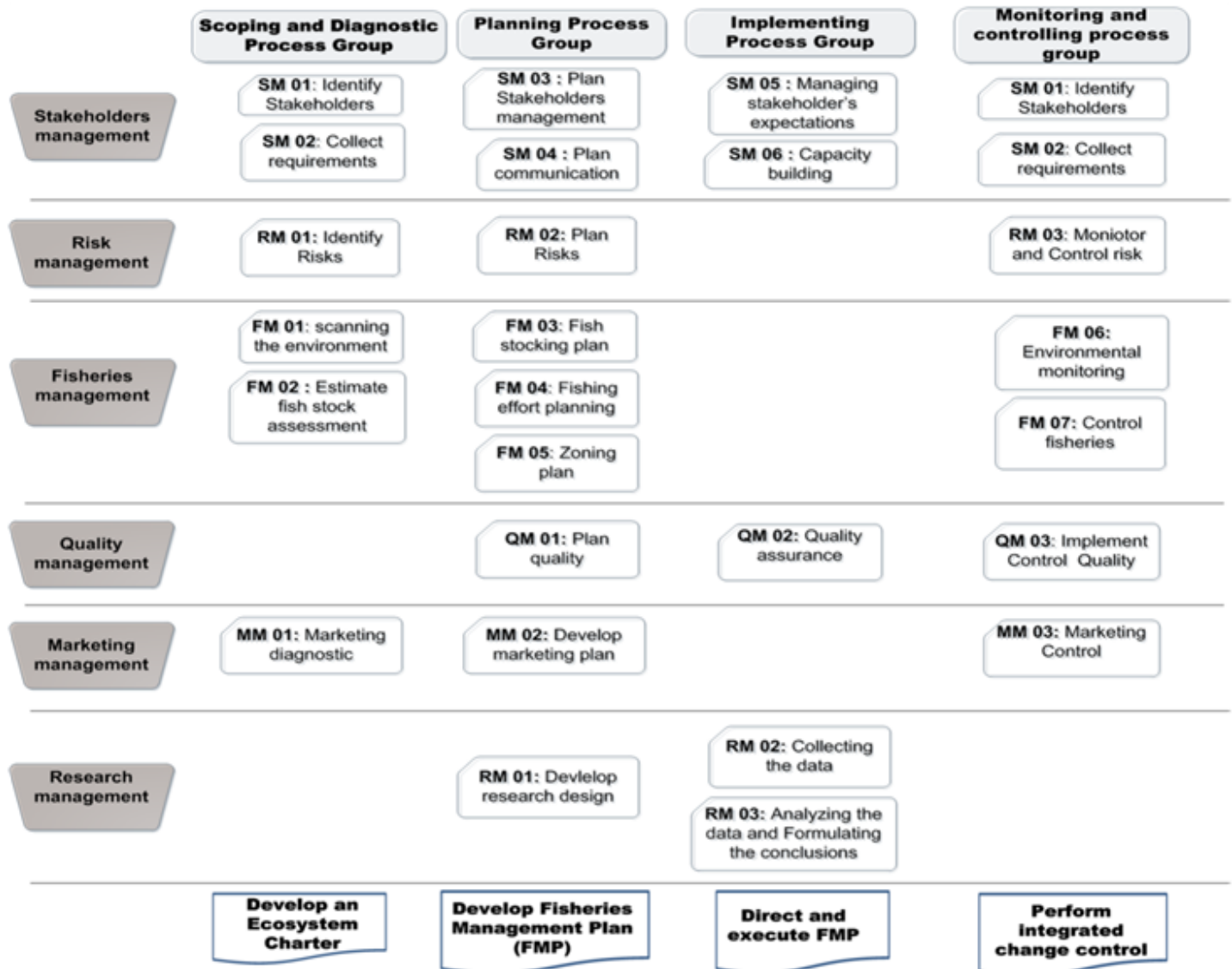


Figure 3. Outline view of the UFM process.

strategy to ensure that the needs and expectations of important stakeholders are understood and managed. It aims to identify all stakeholders, plan Stakeholder management, manage Stakeholder engagement and control Stakeholder Engagement (PMI, 2013).

Research management

This describes the processes involved to generate new knowledge by collecting information, analyzing the results, and communicating the findings and their implications. It consists to develop a research plan, execute the research plan, assure collaborative research partnerships and increase the use of research results by fisheries managers.

The methodology is a cyclic process which is initiated with the Scoping and diagnostic stage. It comprises of four stages, and consists of various tools, techniques and methods underlying the process.

THE UFM CONCEPTUAL FRAMEWORK

The UFM is the application of knowledge, skills, and tools techniques for fisheries management. It provides uniform guidelines to ensure that all interventions in fresh water are conducted rigorously, and with coherence. This framework, developed from the best practices, will increase the chances to ensure sustainable fisheries, and which best meet the needs of recreational and commercial fishers, or of fishers and non-consumptive

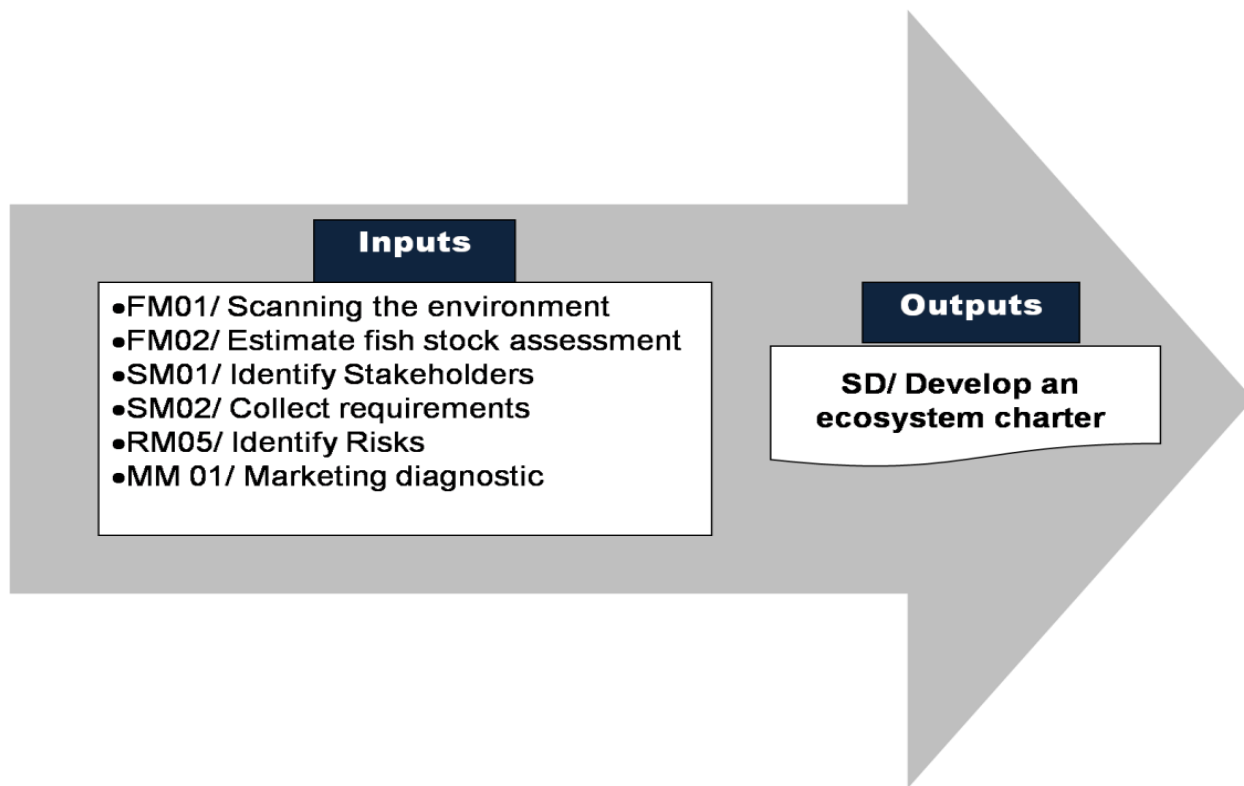


Figure 4. Developed ecosystem charter: Inputs and outputs.

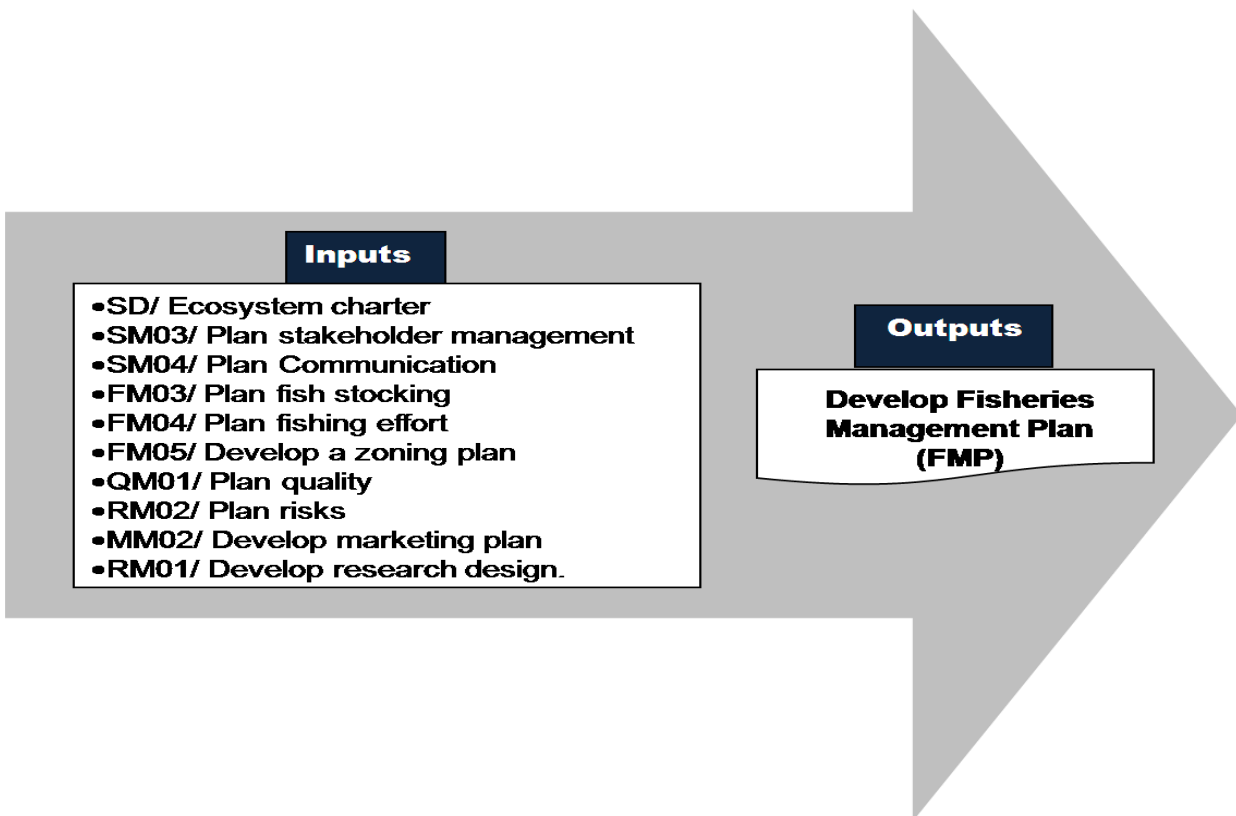


Figure 5. Developed fisheries management plan: Inputs and outputs.

users of the resource.

The UMFM framework describes the various activities required for the implementation of the ecosystem approach to fisheries, developed by integrating, as appropriate, 29 processes involved around these six knowledge areas. These 29 processes identified are logically grouped into four iterative steps (Figure 3).

Scoping and diagnostic process (SDP) group

This group of process addresses the full range of activities affecting the health of the reservoir ecosystem and strategic decisions about engaging stakeholders in the fisheries management. It leads to an understanding of the opportunities and threats relating to the fishing activities in order to define the goals and the targets to achieve.

FM01/ scan the environment

This process consists to describe all the components of the reservoir ecosystem and to identify the limiting factors and their impact on the functionality of the fish populations and the environment. The description of the fisheries interaction within the ecosystem requires identification of four components: (i) A biotic parameters, including target fish resources, associated and dependent species and the living habitat; (ii) An abiotic compartment, characterized by its topography, bottom types, water quality and local weather/climate; (iii) A human component fishery compartment, in which harvesting and processing activities take place, with a strong technological character, and (iv) Legal and policy framework comprising Fisheries legislation and policy.

FM02/ estimate fish stock assessment

This process consists to estimate the total biomass of the stock and how fishing effort and mortality are distributed (Gavin and John, 1999). The inputs to an assessment may be obtained (i) from biological surveys, using such means as trawls, acoustics, tagging studies and counting fences; (ii) from biological sampling, e.g. to determine the age and size composition of the catch; (iii) from historical stocking densities; (iv) from temporally and spatially disaggregated catch and fishing effort data; (v) from fisher's experience provided, meeting sharing, and individual interviews, and (vi) from any other means possible, such as information from outside the fishery sector (Saila and Gallucci, 1996).

SM01/ identify stakeholders

This process consists to identify all the person or

organizations that are directly or indirectly interested or affected by the fishery activities. The types of actors involved can be many and varied, including government agencies and ministries at various levels, local elected and traditional authorities, local communities, NGOs, businesses and corporations, etc.

Mapping stakeholders is an important reality check towards implementing the ecosystem approach as it will allow identifying interests, the degree of stakeholders' interest, and their difficulties and/or incentives, in "joining the fisheries management programs" (Vierros et al., 2006)

SM02/ Collect requirements

This is the process of defining and documenting the needs of stakeholders necessary to achieve the ecosystem fisheries management objectives and to develop a collective vision for the future of the fishery and the community.

RM01/ Identify risk

This process consists of identifying all the possible risk which may significantly impact goal achievement in fishery management, to determine their ranking or status in terms of type, impact and probability using statistical data based on the studies of past occurrences or 'known' scientific knowledge (Tingley et al., 2010).

MM01/ Marketing diagnostic

This process consists to identify market opportunities and threats related to the main goods and services generated by fishing activities, through data gathering, analysis, and reporting.

SDP / Develop an ecosystem charter

This process consists to produce a formal document which is a set of common principles to guide all actions in the reservoir (Figure 4). The stakeholders identified (Agencies, organizations and individuals) were invited to sign on, committing themselves to following the shared vision developed for fisheries management.

The ecosystem charter describes this common vision, contains the key objectives, benefits expected from the actions items, assumptions, and constraints. All these elements help define the scope to guide ecosystem management in the reservoir as that vision is pursued.

Planning process (PP) group

It consists of coordinating the development of the

subsidiary plans (PMI, 2008b) and incorporating them into the fisheries management plan.

SM03/Plan stakeholder management

This process consists to define the measures and actions that can be used to meet or exceed the needs and expectations of stakeholders or to resolve conflict situations for the purpose of involving them in fisheries resource management.

SM04/ Plan communication

This process consists setting up formal communication channels and decision-making relationships with stakeholders to inform them of the success of the planned activities for fisheries development, the benefits that have been realized and the effort and activities required to ensure a sustainable development.

QM01/ Plan quality

This process consists of identifying the requirements and / or quality standards applicable to the services generated by fish population, specially fisheries products and recreational fishing activities. The objectives are to satisfy the quality for recreational fisherman and to maintain high standards of fish quality and food safety and on maximizing value through efficient landing and sale operations.

FM03/ Plan fish stocking

This process consists defining a program of fish stocking activities, detailing the stocking density, the sources for procuring fry/fingerling, the size of fish stocked and timing of stockings. It is developed according to a number of factors including the species to be stocked, the size of the reservoir, the primary productivity in reservoir, fishing effort and previous success of stocking.

FM04 / Plan fishing effort

This process consists to set the annual fishing quotas and the number of fishing days for both the commercial and recreational fishing sectors. The objective is to promote the sustainable utilization of fisheries resources within the productive capacity of the reservoir.

FM05/ Develop a zoning plan

This process consists defining different space areas with defined activities permitted (related to tourism and recreation, commercial fishing and aquaculture), or prohibited from specified geographic areas. It is often

used to separate potentially conflicting activities and, also to fix protected spawning areas and to provide refuge for protected species, such as migratory bird.

RM02/ Plan risks

This process consists to identify measures and issues that need to be addressed to enhance opportunities and to reduce threats (Astles et al., 2006). It includes the assignment of responsibility for carrying out risk management options.

MM02/ Develop marketing plan

This process consists to describe the strategy that will be followed to promote all products and services generated by fishing activities in order to meet better the consumer's needs and expectations. This plan includes a statement of the products, targets for sales, distribution channels, promotional and advertising strategies.

RM01 / Develop research design

This process outlines research priorities and how they will be addressed. It lists specific research projects and identifies by whom, how, and when they will be completed (Graham et al., 2006).

PP/ Develop fishery management plan (FMP)

This process consists for documenting the actions necessary to the definition, and implementation of all subsidiary plans (Figure 5). The FMP becomes the main source of information on how planning, execution, monitoring and controlling, all the activities within the context of the ecosystem's approach to fisheries;

FMP is an iterative process that may be updated through the life cycle of the fisheries management. For example, the update may result from changes approved by the Integrated Change Control process.

Implementation process (IP) group

It includes the processes that are required to achieve and complete the activities identified in the fisheries management plan. This work will result in the accomplishment of the different objectives targeted as defined in the ecosystem charter.

SM05/ managing stakeholder's expectations

This process consists to communicate with stakeholders,

and work with them to meet their needs and address the major problems when they arise. It includes the implementation of the action plan defined for reaching consensus on the appropriate balance among competing interests.

SM06/Capacity building

This process consists to build fishing community capacity by facilitating the provision of training, technology transfer and access to information. Particular focus on creating skills through training in more effective ways for casting, appropriate techniques for handling, transporting and processing fish.

QM02/Quality assurance

This process consists of ensuring that specified standards or requirements have been achieved. The objective of quality assurance is the continual improvement of the products, services or processes identified in order to increase the efficiency and effectiveness and to enhance stakeholder satisfaction. Continuous process improvement provides an iterative means for improving the quality of all processes (PMI, 2008b).

ReM02/ Collect the data

This process consists to gather the necessary information (or data) to answer a research question, to identify the priority of research needs based on the identification of the problems faced by stakeholders, and to promote multidisciplinary participation in research by developing research networks that address the major research imperatives and opportunities in all domains affecting fisheries management.

ReM03/ Analyzing the data and formulating the conclusions

This process consists to analyze the data produced by researchers and to diffuse the results of research through formal and informal systems to include the fisheries managers, the decision and policy makers, fisheries community, researchers' networks, government agencies and ministries.

IP/ Direct and execute FMP

This process consists to execute the contents of the FMP.

Monitoring and controlling process (MCP) group

It includes the processes that are required to monitor, review and regulate the advancement of ongoing activities defined according to the FMP. It consists also of mastering changes and recommending preventive action in anticipation of potential problems. Monitoring includes status reporting, progress measurement and forecasting (PMI, 2008b). Continual measurement must be a key component in the establishment of process measures and performance targets.

FM06/ (Ecosystem) environmental monitoring

This process consists to describe the state of fisheries resources and fisheries activity and to assess trends regarding sustainable development objectives. A wider range of indicators will need to be used in monitoring the contribution of fisheries to sustainable development (assessing progress towards sustainable development), including indicators that reflect the broader ecological, social, economical and institutional objectives (FAO, 1999). Numerous studies on ecosystem indicators have been carried out (Fulton et al., 2005; Degnobol and Jarre, 2004; Jennings, 2005).

FM07/ Control fisheries

This process consists to control the fishing level and the exploitation pattern applied to the stock for an adequate exploitation. The most common regulation measures to control fishing levels are the limitation of the number of fishing licenses, the limitation of the total fishing effort, the minimum size (or weight) of the landed individuals, the closed areas and periods for the protection of juveniles (Cadima, 2003).

RM03/ Monitor and control risk

This process consists to keep track of the identified risks, residual risks, and new risks. It also ensures the execution of risk response plans, and evaluates their effectiveness (PMI, 2008b).

QM03/ Implement quality control

This process consists of monitoring and recording the results of quality activities to identify and address errors and omissions in order to assess performance and recommend necessary changes.

MM03/ Marketing control

This process consists of measuring and evaluating the

results of marketing plan, and taking corrective actions to make sure objectives are being achieved (Kotler, 2003).

MCP/ Perform integrated change control

This process controls the approval and refusal of requests for change, determines when changes have occurred, influences factors that create changes and manages how and when the approved changes are applied (PMI, 2006a).

DISCUSSION

The UMFM is designed to implement the principles of the ecosystem approach to fisheries. It is axed around six knowledge areas and utilizing a set of 29 processes interrelated to one another.

Fisheries management includes seven main processes structured to avoid overfishing, to ensure reversibility and rebuilding, to consider species interactions, to promote sectoral integration and to minimize fisheries impact. Overfishing threatens both the biodiversity of inland waters and the ecosystem goods and services on which people rely. It is being driven by overcapacity and excess effort (Allan et al., 2005).

The fisheries management through the processes "Fish stocking plan (FM03)" and "zoning plan (FM05)" has as an objective to achieve stock rebuilding by habitat restoration and by fish stocking operations. The process control fisheries (FM07) consist of a monitoring system to measure catch, effort and catch rates.

The other objective of the process "Fish stocking plan (FM03)" is to set harvest levels of target species while maintaining the sustainability of other species in the ecosystem, which are connected with the target species through prey–predator relationships or other biological and environmental factors (Morishita, 2008).

Risk management involves explicit consideration of undesirable and potentially unacceptable outcomes and provides contingency and other plans to avoid or mitigate such outcomes. Undesirable or unacceptable outcomes include over-exploitation of resources, overdevelopment of harvesting capacity, loss of biodiversity, major physical disturbances of sensitive biotopes, or social or economic dislocations (Charles, 2001).

According to the precautionary approach, the main objectives of risk management are to avoid unacceptable or undesirable situations and to develop the adequate strategies and tools for dealing with the inherent problems of uncertainty, complexity and ambiguity (Stirling et al., 2004).

Stakeholder management includes 6 processes required to broaden stakeholder participation. Andrew et al. (2007) stress that humans must be considered within fishery ecosystems rather than apart from them. These

cooperative initiatives operate by offering a collective vision and a common set of goals and objectives that, in turn, weave together the various fisheries management programs.

The UMFM should also provide safeguards the socio-economic interests of fishers and other stakeholders, and improve human well-being and equity fisheries. The purpose of marketing and quality management is to improve quality to fisheries products or services and to maximize the value derived from the production that applies to all levels of the fishing and aquaculture sector in the reservoir in order to enable local key players (fishermen, fish farmers, processors, and project promoters) to achieve higher profit margins.

Research management includes the knowledge required to understand the methods, processes and instruments to be used in the five other knowledge areas. In this context the design, implementation, and assessment of the UMFM, require an integrated set of information and knowledge about the environmental, biological-ecological, technical, economic, social, legal, institutional, political, and cultural factors determining the performance of fishing activities and fisheries (Yáñez et al., 2011).

The six knowledge areas are on constant review and refinement improvements during the planning and controlling and monitoring phase. The objective is to integrate change management and to optimize the overall process of the UMFM.

CONCLUSION

The UMFM is an integration of the various management approaches or knowledge areas into a comprehensive and cohesive plan with the ecosystem approach to fisheries as its central framework. It is characterized with flexibility, adaptability, pro activity, responsiveness, and stakeholder centrality. This standardized methodology makes fisheries development more efficient and provides more certainty for stakeholders involving in Moroccan fresh water management. Moreover, it will enable fisheries managers and decision makers to apply the best practices in fisheries management in order to meet the economic, social and ecological policy goals.

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