FAO FISHERIES AND AQUACULTURE TECHNICAL PAPER

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Towards integrated assessment and advice in small-scale fisheries

Principles and processes

WorldFish CENTER

FAO FIAT PANIS

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Main photo: Fishers in the Sundarbans of Bangladesh; courtesy of G. de Graaf, FAO FishCode STF Project.
Left inset: A small-scale fisheries landing site in Kayar, Senegal; courtesy of G. de Graaf, FAO FishCode STF Project.
Right inset: Consultation of fishers at West Point, Monrovia, Liberia, by officials from the Bureau of National Fisheries; courtesy of F. Marttin, FAO FishCode STF Project.

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Prepared by

Serge M. Garcia
FAO Consultant
Rome, Italy

Edward H. Allison
WorldFish Center
Malaysia

Neil Andrew
WorldFish Center
Malaysia

Christophe Béné
WorldFish Center
Egypt

Gabriella Bianchi
FAO Fisheries and Aquaculture Department
Rome, Italy

Gertjan de Graaf
FAO Fisheries and Aquaculture Department
Rome, Italy

Daniela Kalikoski
FAO Fisheries and Aquaculture Department
Rome, Italy

Robin Mahon
Centre for Resource Management and Environmental Studies
Barbados

Lobo Orensanz
Centro Nacional Patagonico
Argentina

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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Preparation of this document

Conventional assessment frameworks do not provide an adequate basis for informed management decisions and development planning of the small-scale fisheries (SSF) subsector. Normative management frameworks and approaches have been developed as an evolution of conventional fisheries management, such as the FAO Code of Conduct for Responsible Fisheries and the ecosystem approach to fisheries (EAF). Yet, the assessment frameworks required to operationalize these alternative management approaches have not been fully developed, at least for small-scale fisheries.

The integrated assessment and advisory (IAA) framework presented in this publication begins to address this need. The document presents the conceptual basis of the IAA process, introduces the framework and situates the assessment within the broader planning and management cycle. The IAA framework presented here results from the synergistic efforts of the Food and Agriculture Organization of the United Nations (FAO) and the WorldFish Center (WFC), with collaboration from individuals leading both research and practical assessment and management programmes related to SSF. The document results from the May 2007 working group. A "zero draft" was based on the contributions of all participants. The compilation of the outputs and drafting of this report were led by Serge M. Garcia (FAO) and Edward H. Allison (WFC). Recognizing the complexity, multiple potential approaches and a diversity of perspectives, feedback and empirical testing of this framework by the many experienced researchers and practitioners interested and working in SSF are invited.

Abstract

The document presents the principles and processes for integrated assessment and advice in small-scale fisheries. The first chapter discusses failures of conventional assessment and management approaches. Chapter 2 presents the conceptual origins and principles of integrated assessment of small-scale fisheries. The framework is then introduced and places the assessment within the broader planning and management cycle. The final chapter discusses the implementation of the IAA framework.

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Allison, Edward (School of Development Studies, University of East Anglia, United Kingdom and WorldFish Center, Malaysia); Andrew, Neil (WorldFish Center, Malaysia); Arthur, Robert (MRAG Ltd, United Kingdom and WorldFish Center, Malaysia); Baran, Eric (WorldFish Center, Cambodia); Béné, Chris (WorldFish Center, Egypt); Bensch, Alexis (FAO, Italy); Bianchi, Gabriella (FAO, Italy); Bjoru, Kirsten (Norwegian Agency for Development Cooperation, Norway), Charles, Anthony (Finance and Management Science, St Mary's University, Canada), Davy, Brian (International Development Research Centre, Canada), de Graaf, Gertjan (FAO, Italy); Evans, Louisa (WorldFish Center, Malaysia), Fletcher, Rick (Western Australia Fisheries, Australia); Garcia, Serge (FAO, Italy); Gomez, Edgardo (Marine Science Institute, University of the Philippines, Philippines); Hall, Steve (WorldFish Center, Malaysia); Hjörleifsson, Einar (UN University, Marine Research Institute, Iceland); Horemans, Benoit (FAO, Gabon); Hoshino, Eriko (World Bank, United States of America); Jul-Larsen, Eyolf (Christian Michelsen Institute, Norway); Kalikoski, Daniela (FAO, Italy); Kelleher, Kieran (World Bank, United States of America); Kurien, John (Centre for Development Studies, India); Leemans, Ingrid (International Foundation for Science, Sweden); Mahon, Robin (Centre for Resource Management and Environmental Studies, University of the West Indies, Barbados); Marrul, Simão (Ministério do Meio Ambiente, Brazíl); Mees, Chris (MRAG Ltd, United Kingdom); Neto, José Dias (General Coordination for Fisheries, Brazil); Nguyen Khoa, Sophie (International Irrigation Management Institute, Sri Lanka); Orensanz, Lobo (Centro Nacional Patagonico, Argentina); Parma, Ana (Centro Nacional Patagonico, Argentina); Petralli, Nila (FAO, Italy); Pírez, Laura (Swedish Board of Fisheries, Sweden); Ratner, Blake (WorldFish Center, Cambodia); Reynolds, Eric (FAO, Italy); Sholtz, Uwe (German Agency for Technical Cooperation, Germany); Siar, Susanna (FAO, Italy); Staples, Derek (FAO, Thailand); Strømme, Tore (Institute of Marine Research, Norway); Sugiyama, Shunji (FAO, Italy); Supongpan, Mara (Department of Fisheries, Thailand); Tomasson, Tumi (UN University, Iceland); Townsley, Philip (IMM Ltd, Italy); Vasconcellos, Marcelo (FAO, Italy); Willmann, Rolf (FAO, Italy).

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Foreword

When the accumulation of perceived failures significantly exceeds the perceived utility of management, the legitimacy and conceptual coherence of that management institution are weakened to the point where they are vulnerable to challenge and open to fundamental change.

(Finlayson and McCay, 2000)

Conventional fisheries assessment does not provide an adequate basis for informed management decisions and development planning in the small-scale subsector. Current assessment methods and procedures have failed to maintain legitimacy as they lack conceptual coherence and often neglect to incorporate important aspects of the fishery system.

This document introduces an assessment and advisory framework for small-scale fisheries (SSF) that it is proposed will inform policy and management more effectively. The framework builds on approaches that have evolved over the last thirty years. It emphasizes participation of a diversity of stakeholders, incorporates elements of the fishery system beyond the catching process, acknowledges the need to understand the social and economic system as well as the ecological one and aims to support an adaptive style of management. The conceptual underpinning of the new framework is that of building resilience of fishery social-ecological systems.

The framework emerges from a stream of activities in FAO and the WorldFish Center focusing on SSF, their specific characteristics, their various forms of management and their evolution in a rapidly changing global and fishery environment. It stems from the realization that, overall, SSF have been neglected both by fisheries management and in national development planning. As a result, these fisheries are characterized by overexploitation of coastal and inland fishery resources and neglect or marginalization of fishing communities' needs for social, judicial and financial services. This neglect arises, at least in part, from an under-estimation and consequent under-appreciation of the economic value and contribution of SSF to broader societal well-being.

The need for a more integrated assessment and advisory (IAA) framework was first identified by the fourth session of the FAO Advisory Committee on Fishery Research (ACFR) in 2002) and its 2003 Working Party on Small-scale Fisheries. The importance of the SSF sector to food security and poverty alleviation has also been recognized explicitly in the last three sessions of the FAO Committee on Fisheries (COFI) in 2003, 2005 and 2007. Specifically, COFI members recognized that there was a need for a better understanding of the nature, extent and causes of vulnerability and poverty among small-scale fishworkers and to improve the information base and monitoring approaches for determining the contribution of the sector to the alleviation of these conditions. The research agenda proposed at COFI 25, following the ACFR proposals, marked an important re-emphasis within FAO member countries towards effective governance and development strategies for SSF. In response, guidelines on enhancing the contribution of small-scale fisheries to poverty alleviation and food security were developed (FAO, 2007).

Agreement to develop an integrated assessment framework, presented here, within both FAO and WorldFish Center work programmes, originated from an informal brainstorming session at the WorldFish Center, Penang, Malaysia (2004). A more formal workshop was organized jointly by the WorldFish Center and FAO through the FishCode project on Status and Trends in Capture Fisheries (FAO FishCode STF) in September 2005 in Rome. This involved a larger community of scientists from developed and developing countries, with the view to elaborating a project concept. The workshop identified existing gaps and weaknesses in methods, identified some potential approaches and developed a roadmap to examine ways of dealing efficiently with what is an inherently complex, multidimensional and multidisciplinary problem. The project concept note outlined the various phases of the development of the framework, the distribution of roles among partners and the likely outcomes. Commitment to the development of the IAA was strengthened by the WorldFish Center's focus on capture fisheries and the building of resilient SSF to enhance their contribution to poverty reduction (WorldFish Center Medium Term Plan, 2006–2009). The FAO FishCode STF project followed up on the recommendations of the workshop, raised funds and organized a small working group in May 2007.

This document results from the May 2007 working group. A "zero draft" was based on the contribution of all participants. The compilation of the outputs and drafting of this report were led by Serge M. Garcia (FAO) and Edward H. Allison (WorldFish Center). Recognizing the complexity, multiple potential approaches and a diversity of perspectives, we invite feedback from and empirical testing of this framework by the many experienced researchers and practitioners interested and working in SSF.

The IAA framework presented here results, therefore, from the synergistic efforts of FAO and the WorldFish Center, with collaboration from individuals leading both research and practical assessment and management programmes related to SSF. Together, we have endeavoured to articulate and integrate multiple potential approaches and methods, which we propose are sufficiently generic and versatile to be widely applicable, yet specific enough to be effective in problem-solving in complex situations. The IAA incorporates a wide range of contemporary thinking in natural resource management, fisheries management and ecosystem governance in a conceptually coherent manner and, therefore, aims to garner legitimacy as an effective alternative to conventional assessment and management of SSF, so instigating the required "fundamental change".

Serge M. Garcia
Director (retired)
Fisheries and Aquaculture Management Division
FAO Fisheries and Aquaculture Department

Edward H. Allison
Director Policy, Economics &
Social Science
WorldFish Center

Abbreviations

ACFR	FAO Advisory Committee on Fisheries Research
CBD	Convention on Biological Diversity
CCA	Causal chain analysis
CCRF	FAO Code of Conduct for Responsible Fisheries
CGIAR	Consultative Group on International Agricultural Research
COFI	FAO Committee on Fisheries
EAF	Ecosystem approach to fisheries
EIA	Environmental impact assessment
FAO	Food and Agriculture Organization of the United Nations
FAO FishCode STF	FAO FishCode project on Status and Trends in Capture Fisheries
FAO SFLP	FAO Sustainable Fisheries Livelihoods Programme
GDP	Gross domestic product
GIS	Geographical Information System
HACCP	Hazard Analysis and Critical Control Point
IAA	Integrated assessment and advisory
ICAD	Integrated conservation and development
ICES	International Council for the Exploration of the Sea
IDRC	International Development Research Centre
ILO	International Labour Organization
ISO	International Organization for Standardization
LEK	Local ecological knowledge
LRP	Limit reference point
M&E	Monitoring and evaluation
MPA	Marine protected area
MSC	Marine Stewardship Council
MSE	Management Strategy Evaluation
NGO	Non-governmental organization
OMP	Operational management procedures
PRA	Participatory rural appraisal
RRA	Rapid rural appraisal
SD	Sustainable development
SSF	Small-scale fisheries
TAC	Total allowable catch
TEK	Traditional ecological knowledge
TEV	Total economic value
ThRP	Threshold reference point

TRP	Target reference point
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
WCED	World Commission on Environment and Development
WFC	WorldFish Center
WSSD	World Summit on Sustainable Development

Executive summary

Conventional assessment frameworks do not provide an adequate basis for informed management decisions and development planning of the small-scale fisheries (SSF) subsector. Normative management frameworks and approaches have been developed as an evolution of conventional fisheries management, such as the FAO Code of Conduct for Responsible Fisheries (1995) and the ecosystem approach to fisheries (EAF). Yet, the assessment frameworks required to operationalize these alternative management approaches have not been fully developed, at least for small-scale fisheries. The integrated assessment and advisory (IAA) framework presented here begins to addresses this need. This document presents the conceptual basis of the IAA process, introduces the framework and places the assessment within the broader planning and management cycle.

CONCEPTUAL ORIGINS OF THE FRAMEWORK

The IAA process is based on over thirty years of thinking in fisheries management, natural resource management, ecological governance and alternative development. Principles of participation, integration, transparency, versatility and adaptability underlie the framework. At the same time, insight from adaptive dynamics ecology, institutional analysis, rights-based approaches, rural development and macroeconomics inform its structure. The diverse conceptual origins of the framework mean that it more fully addresses the inadequacies of conventional assessments and other relatively limited frameworks, although, importantly, these may continue to play a role within the structures of this integrated process. In particular, the IAA process emphasizes and provides tools for understanding the complexity and interlinkages that characterize SSF as social-ecological systems, as well as highlighting the vulnerability of SSF to external drivers and the contribution of SSF to multidimensional local, national and global lifestyles. The historical neglect of these complexities is apparent in widely acknowledged management failures and fisheries collapses. SSF are experiencing problems of economic and social displacement and marginalization, resource depletion, poverty and food insecurity resulting in widespread economic, social and cultural stress. The IAA aims to provide a mechanism to better inform more effective and legitimate management of these fisheries within the context of uncertainty and global change. The IAA will also improve our understanding of SSF and the variety of issues that affect them.

INTEGRATED ASSESSMENT AND ADVISORY PROCESS

The IAA framework is intended for those who need assessment for decision-making for SSF management, including policy-makers, managers, fishing communities, industry representatives and non-governmental organizations (NGOs) or those who supply such assessments, including academics, government scientists, consultants, industry analysts and investors and donor agencies. It is demand-driven, in response to both strategic and operational planning and/or problem resolution.

It is also process-oriented. The logical steps through the IAA process are presented, moving from an initial scoping exercise, through comprehensive assessment and formulation of advice, to decision-making for management. A monitoring and evaluation process is a fundamental component. Although these are presented as discrete steps or processes, continuous feedbacks characterize the entire process. The most important feature of the IAA framework is the close linkage between the diagnostic process (scoping and assessment) and the advisory and decision-making process. This is characteristic of an adaptive management approach that responds flexibly to external drivers, opportunities and constraints – be they institutional political, climatic, ecological or economic.

Assessment and advisory processes are not distinct, mutually-exclusive activities, and it is expected that IAA activities at multiple spatial and geographical scales, on different and overlapping issues and within strategic and operational management arenas, will occur simultaneously.

Finally, the IAA framework is non-prescriptive. It combines historical, comparative and experimental approaches. It uses qualitative and quantitative methods and is fundamentally concerned with integrative modes of enquiry and multiple sources of evidence. It is about building integrated knowledge and applying this knowledge. This is essential for assessments within SSF (particularly in developing countries) where the resources and capacity available and the cost of the assessment relative to the fishery will differ among and within nations and the SSF subsector.

THE PLANNING AND MANAGEMENT CONTEXT

The IAA process does not deal directly with policy and management. It does position the assessment process within the broader planning and management arena to show the links between the assessment phases and the decision-making process for management. The framework intends to be applicable for both long-term policy review or development planning and short-to-medium-term management agendas. It is also appropriate for recurrent, routine management, crisis or issue-based management and conflict resolution.

IMPLEMENTATION

This document presents the IAA framework and is the first step in a process of evolution through broader peer review, new contributions and empirical testing. This stage of IAA development is an important step in a continuing collaborative effort that will lead to a legitimate conceptual framework for integration of assessment, advice and decision-making in SSF. The next step is to present a range of approaches, methodologies and tools to choose from, depending on the particular context in which the IAA is implemented. Indirect outcomes should include a better awareness of SSF and their contribution to food security and poverty alleviation, a clearer vision of the role and future for resilient, sustainable and legitimate SSF, the emergence of multidisciplinary teams and collaborative and participatory relationships among different stakeholders and an interdisciplinary knowledge base on SSF, including a large number of case studies and best practices.

In practice, simplifications of the ideal IAA process might be unavoidable but it will be important to maintain its spirit of integration. Pilot testing of the IAA process will be fundamentally important. Up-scaling an IAA from a local project to the entire sector will be challenging, but rapidly reaching efficiency in the process will be essential to convince decision-makers and stakeholders of the value of the system.

Once the IAA framework is established, a number of operational issues will arise, such as: (i) coping with the chronic deficit of formal scientific data for SSF, compensating as much as possible with local knowledge; (ii) integrating assessment and advice across time, space and institutional scales; (iii) institutionalizing adaptive social learning, ensuring fairness and sustainability; (iv) determining and using indicators in the assessment as well as the monitoring and evaluation (M&E) processes; (v) ensuring rapid responses to demands despite the added institutional costs of integration and participation; (vi) optimizing participation at a point where the costs do not outweigh the benefits; (vii) progressive capacity building through training, social learning and development of the collaboration networks; (viii) establishing an auditing system for the IAA process to maintain checks and balances; (ix) developing the background research needed on socio economic and institutional issues but also on resources; and (x) finding the right level of complexity in the assessments and in the administration of the sector in order to deal with the complexity of SSF.

1. Purpose of the framework

This introductory chapter argues for and justifies the need for a novel and integrated assessment and advisory (IAA) framework. It details why such an approach is particularly important for small-scale fisheries (SSF) in developing countries.

FAILURE OF CONVENTIONAL ASSESSMENT AND MANAGEMENT APPROACHES

Coastal and inland fisheries are complex, dynamic social-ecological systems with interactions between scales of operation (small- and large-scale, artisanal and industrial) and among different interest groups. Conventional approaches to management typically reflect those used in large-scale fisheries management, which assumes a simplistic and predictable relationship between the productive capacity of the resource (defined stock of single fish species) and the extractive capacity of a homogenous fishing fleet. Management aims to control this relationship through input or output regulations in order to maintain the stock in an optimal productive state. Conventional approaches are still pervasive in practice. Yet, current approaches to fisheries management have, in many cases, moved beyond "classical" fisheries science to account for more than one species, some level of interaction between different resource users and integration of economic and ecological components of the system. Yet, other components of the system, such as the structures and interactions within the social subsystem, remain relatively unaccounted for. Representations of fishery systems continue to be dangerously simplistic. They often fail to account fully for the *complexity of ecological interactions*, including functional relations in the resource pool, the *range of environmental disturbance*, such as habitat degradation and climate change, *external drivers*, for instance global markets or perverse economic incentives, *local socio-economic issues*, such as livelihood constraints or multiple perspectives, values and knowledge, and *institutional constraints*, including inappropriate rights systems, quasi-exclusive sectoral approaches and ineffective administration systems (see Garcia and Grainger, 1997 and Mace, 1997 for reviews). It is difficult to assess to what extent these factors contribute to fisheries management failures individually. Yet, in combination, neglecting to account for these issues has led to the failure of most fishery management systems. As a result, a more comprehensive approach to governing fisheries is strongly advocated (Garcia and Charles, 2007).

WHY FOCUS ON SMALL-SCALE FISHERIES?

SSF widely experience resource depletion, poor economic performance (manifested as poverty in fishing-dependent communities), food and/or nutritional insecurity among vulnerable people and social and cultural stress (Andrew *et al*., 2007; Béné, 2006). These issues are particularly acute in the developing world as a result of fewer alternatives for development and the absence of social safety nets. Yet, historically, SSF have received relatively little attention within both international and national agendas. It is contended that both the assessment and management of SSF require increased effort in understanding and developing processes, mechanisms and methods that are more attuned to the issues faced by SSF.[1] This document explicitly and exclusively refers to SSF, although the framework is likely to raise some important issues for other fisheries subsectors. Moreover, efforts are primarily towards the "tropical majority" of small-

[1] This does not advocate simply conducting smaller or more inexpensive versions of conventional assessments.

BOX 1
Defining small-scale fisheries

Attempts to define and categorize SSF have diverted, delayed and perhaps even stalled attempts to develop new approaches to improving their management. Allison and Ellis (2001, page 377) accept that the term "small-scale" is fundamentally relativist and opt for the imprecise definition: "those [fisheries] operating from the shore or from small fishing vessels in coastal or inland waters", while FAO (2006) and Béné, Macfadayen and Allison (2007) adopt the lengthier FAO definition (FAO, 2005). Johnson (2006) offered a definition based on two dimensions: social organization of production and operations in time and space (see table below). The glossary in this document contains definitions of artisanal and small-scale fisheries largely derived from Johnson's perspective

Characteristics of small-scale fisheries

Fisheries-related characteristics	Categories		
	Small-scale		Large-scale
	Subsistence	Domestic commodity production	Industrial
Social organization			
Socio-economic			
Nature of fishing unit	Individuals and community based groups usually linked by ties of social reciprocity	Small groups, with some specialization and some division of labour, importance of household and community	Small and larger groups; higher specialization and division of labour
Nature of work	Part-time, multioccupational; catch shared	<---------------------------->	Usually full-time, professional; greater prevalence of wage-labour or salaries
Disposal of catch and market integration	Primarily household consumption but some local barter and sale	Household consumption and sale to local, national and international markets	Sale primarily to mass markets
Processing of catch	Mostly direct consumption	<---------------------------->	Mostly processed, including large quantities of fishmeal for non-human consumption
Ownership	Individual or group ownership and operation; occasional absentee ownership	Usually owned by senior operator, or operators jointly: some absentee ownership	Concentration of ownership, often by non-operators; often ownership is corporate
Investments	Capital investment low, although often high investment of labour time	Low-to-medium capital investment, large proportion borne by other than operator	Capital investment high, large proportion borne by other than operator
Operator/owner's income level	N/A or minimal	Low or medium	Often high
Knowledge and technology	Premium on skill and local knowledge	Highest diversity of target species and techniques; thus high skill and knowledge needs	Skill and experience important, but supported by high technology
Craft	None or small and non-motorized	Small with low power engines	High power engines
Gear	Often hand-made and operator assembled; mainly non-mechanical.	Many machine-made components, often operator assembled, high diversity of gear types; manual and mechanized gears	Assembled by other, low diversity of gear types; electronics and automation
Catch capacity	Very low to low	Low to medium	Large to vast
Management			
Fisheries authority	Local community or kin-based	Regional community, or kin-based, with few scientists/managers	Comprehensive in scope, science driven; many scientists/managers
Management units	A great many small units	Usually many small units	One or few large units
Rules	Customary	Customary and State	Usually State regulated
Fisheries data collection	Often none due to difficulty of data collection	Difficult due to features of fisheries and authorities	Relatively straightforward but depends on authority's capacity
Space and time			
Fishing bases	Highly dispersed	Dispersed	Concentrated
Fishing location	On or adjacent to shore	Relatively near shore	Exploits all marine areas
Fishing duration	Few hours	Few hours or few days	Few days to months
Seasonality	Seasonal	Extended seasons due to more robust crafts and gear	Ability to withstand rough weather and to go to the fish; all but eliminates climate related seasons

On aggregate, the long-term trend has been for global fisheries to shift to the right direction, but this trend is neither inevitable nor irreversible

Source: reproduced from Johnson, 2006.

BOX 2

Small-scale fisheries: a human development perspective

Small-scale fisheries in the poorest developing countries are simultaneously centres of dynamic economic activity and deep human insecurity. Emerging, scattered research findings (summarized in Andrew *et al.*, 2007) suggest that the income of fishworkers (fishers, processors and traders) may exceed the average rural wage labour rate, but seldom exceeds national poverty lines substantively, except where fishworkers own their own fishing gear and boats. Their income also supports ancillary industries and brings the monetary economy to otherwise remote areas. However, higher incomes do not always translate into greater security and better living conditions. Fishing incomes are highly variable and fishers and their dependents often face an unpromising institutional, economic and biophysical environment. They are often found to be socially and politically marginalized, to lack access to basic infrastructure (transportation, housing) and to social (health, education) and judicial services; they may be prey to rent-seeking officials and arbitrary and punitive forms of taxation. Their status is often that of migrants or ethnic minorities with respect to land-owning elites, so their social capital and bargaining power with officialdom may also be limited. They also live in environments that are highly exposed to physical risks from extreme climate events (storms, floods, droughts) and, in the case of inland fisheries, to water-borne disease vectors. As if this were not enough, the future of a fishery is often in the hands of upstream water-resource users, or competing users of coastal zones. These high vulnerabilities undermine their capacity and incentives to engage in participatory forms of resource management (FAO SFLP, 2005). Managing SSF in developing-country contexts is clearly more than an attempt at resource management alone. It is also an endeavour in social and economic development and so belongs to the wider class of problems and challenges in integrating resource conservation with poverty reduction – or integrated conservation and development (ICAD).

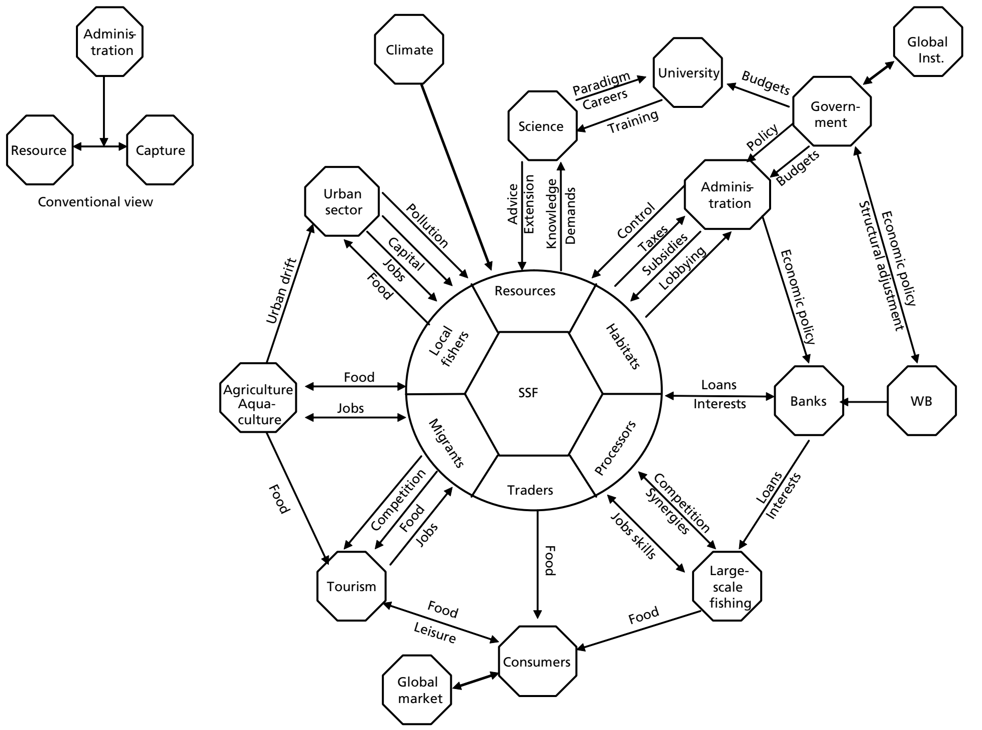
Source: Brown and Wyckoff-Baird, 1994; Brown, 2002; Berkes, 2004.

scale fisheries and towards the fisheries of countries with low gross domestic product (GDP) and human development indices, where many fishworkers and fisherfolk live in poverty.

Small-scale fisheries (gear technologist tradition) or artisanal fisheries (socio-economist tradition) generally emphasize smaller technologies and household- or family-based social units, respectively, compared with larger-scale and industrial or company-based fisheries. Importantly, SSF incorporate both subsistence and commercial fisheries. Purely subsistence fisheries are extremely rare, even in developing countries where a share of harvest is often bartered for other goods and services.

Compared with large-scale fisheries, which are often relatively distinct, SSF are more difficult to isolate. Wilson and Delaney (2005) stress that SSF are social units with porous boundaries that individual fishers can cross, unconsciously or deliberately blurring the divide between the various individual fisheries operating from a community. SSF are also relatively more diverse in terms of people, gears and resources and the processing and market activities more diffuse and informal. Effective SSF can create wealth, contribute to economic development, enhance social stability in rural and peri-urban areas, improve nutrition and food security and provide social safety nets for the poorest (Heck, Béné and Reyes-Gaskin, 2007). However, their vulnerability in the context of globalization, modernization and increasing pressure on resources means it is difficult for States and managers to resolve conflicting ecological, economic, political and social trade-offs in order to balance sustainability, productivity,

FIGURE 1
The small-scale fisheries subsystem and selected relations with its environment



Source: reproduced from Garcia and Reveret, 1991.

equity and social justice objectives (Smith, Pauly and Mines, 1983; Panayotou, 1988; Bailey and Jentoft, 1990). As early as the beginning of the 1990s Garcia and Reveret (1991) introduced a figure representing the key components of the SSF subsystem (see Figure 1), to try to focus attention on these external drivers. It is important that the wider community, researchers and practitioners recognize these multiple components and, by extension, appreciate the need for an integrated process for understanding, assessing and advising on these interactions and trade-offs, which will differ according to the context of the SSF.

The relatively high rate of failure of management interventions has already been stressed and analysed through the *Study of International Fisheries and Aquatic Research* (World Bank/UNDP/CEC/FAO, 1992). The challenges to effective management are particularly acute in SSF. One response[2] is this initiative to develop an integrated framework for assessment and provision of advice on management. There are numerous recurrent or emerging issues that affect SSF (Box 3), which clearly demonstrate the need for a broad, integrative framework of assessment to inform management of SSF.

There is thus increasing recognition that establishing appropriate pro-poor governance and better adapted strategies and institutions for fisheries management, which might include rights-based approaches, co-management regimes, fishing capacity reduction strategies and the support for diversified livelihoods, is central to improving the contribution of fisheries to poverty alleviation and food security (Béné,

[2] Other responses include a re-examination of the causes of poverty in fisheries (e.g. Béné, 2003), the recognition of the significance of vulnerability (e.g. FAO SFLP, 2005), the recognition of the need for new strategies for poverty reduction, a review of the potential role of fishery research and of the conditions and approaches to improved governance (Mahon, McConney and Roy, 2008).

BOX 3

Issues in the management of small-scale fisheries as articulated by the International Collective in Support of Fishworkers

1. Fisheries management: protection of the SSF areas of operation from encroachment by industrial fisheries; elaboration of appropriate management regimes; fishing rights and the impacts of incentive systems, (e.g. quotas) on artisanal fishing communities; economic and other types of incentives; economic sustainability of fisheries operations (e.g. responsible modernization of gear, improved fuel efficiency and materials for boat building); banning destructive fishing practices; problems of coastal pollution, particularly from land-based sources; cross-border conflict between countries and communities.
2. Labour and social security: implications of international trade laws (from the International Labour Organization [ILO]) and other relevant instruments (e.g. human rights) on social security for small-scale fishworkers.
3. Access to land and sea resources: privatization of coastal zones leading to land alienation of coastal fishing communities.
4. Trade: impact of trade on small-scale fishworkers; ecolabelling initiatives and their implications for small-scale fisheries.
5. Aquaculture: appropriate forms of small-scale aquaculture that benefit wider communities and particularly women in these communities; aquaculture forms that can benefit fishing communities; unsustainable aquaculture practices.
6. Other concerns: advocacy (visibility of fishworker struggles); awareness building of rights and responsibilities among communities; increased visibility of women's roles in the fisheries and addressing gender-related welfare-disparities; strengthening of organizations; participatory research that draws on indigenous knowledge; migration of fishworkers and problems faced by migrant fishers; fisheries agreements and their implications for small-scale fisheries.

Source: ICSF, 2006.

Macfadayen and Allison, 2007). In addition, the commitments made by governments at their highest levels in the United Nations Convention on the Law of the Sea (UNCLOS), 1982, the United Nations Conference on Environment and Development (UNCED), 1992, the Convention on Biological Diversity (CBD), 1992, the Code of Conduct for Responsible Fisheries (CCRF), 1995, the Millennium Declaration and Development Goals, 200), the Reykjavik Conference, 2001 and the World Summit on Sustainable Development (WSSD), 2002 call for a broader, more comprehensive and more environmentally conscious approach to fisheries development and management. Modern strategies need to be knowledge-based, combining the best scientific information available with all other relevant sources of reliable knowledge in highly participatory decision-making systems.

SSF representatives generally have a poor capacity to lobby and as a result are relatively more at risk from misinformed governmental policy. Fisheries management, in particular SSF management, is often characterized by a lack of understanding and information, both of the state of different system components and of the expected outcomes of policy and management action. However, it is acknowledged that improved knowledge on SSF alone will not be sufficient to reverse their present situation and that fundamental changes in governance and institutional arrangements are also required and are already progressively happening in many countries. Decision-making in the context of incomplete knowledge and associated risk-taking are inherent challenges in SSF management. At the same time, improved knowledge used in appropriate decision-making processes is expected to assist governments, subsector managers and stakeholders in accelerating and optimizing positive change. Nevertheless, taking a comprehensive view of SSF, recognizing that they are (and operate within) very complex social-ecological systems (Berkes and Folke, 2000) raises significant information and assessment challenges. Beneath a superficial homogeneity in general characteristics, SSF demonstrate a bewildering diversity of dynamics and social and institutional settings that emerge from the interaction between the rich mosaics of cultures and ecosystems. In addition, SSF communities have developed strong relationships with other sectors of activity in the rural and peri-urban domains, which are essential to their own resilience and important to that of these domains. These relationships need to be understood and management systems that accommodate or strengthen them are needed (Ellis and Allison, 2004). Socio-cultural and ethical issues around values, equity, justice, rights and responsibilities are particularly relevant in SSF. Despite a wide recognition of this problem, there remains no unifying set of principles nor agreed structure for such a necessary approach, which integrates conceptual and methodological thinking from the natural and social sciences. Researchers, managers, policy-makers, donor agencies, fishworkers' organizations and NGOs are faced with an unrewarding clutter of theories, methods and heterogeneous case studies. This does not meet management needs. This document addresses one aspect of this by developing a conceptually comprehensive assessment and advisory framework that borrows from contemporary thinking and operationalizes ideas within the context of SSF.

WHAT THE FRAMEWORK OFFERS

The starting assumption is that a common framework for IAA will improve how SSF are managed and so will secure their future in changing policy and climatic contexts. The IAA is both conceptual and operational offering both a "mind frame" and a typology of approaches and tools applicable to SSF worldwide. Its intellectual foundations are made explicit in the following chapter. As such, the IAA framework contributes is many ways:

1. It intends to increase the understanding of policy-makers and their scientific and technical advisers about the characteristics of small-scale fisheries and the issues that confront them.
2. It aims to contribute to the empowerment of the communities concerned through developing an approach that puts the mechanisms of decision-making and knowledge-generation in their own hands.
3. It aims to enlarge the scope of policy and practical intervention in support of a more resilient SSF social-ecological system by broadening the analysis of the fishery system to encompass relevant aspects of its wider context.

The IAA is demand-oriented. While it might be useful as a basis for undertaking academic studies in SSF, it is primarily intended to be used for assessments in response to specific demand originating from government (policy- and decision-makers, fishery managers), fishery and coastal communities, NGOs and civil society organizations. Such demand may be of a strategic or operational nature (e.g. related respectively to policy development or problem-solving), a one-off instantaneous activity or a regular management practice.

The process needed to satisfy the types of demand listed above, providing a reliable assessment and the most appropriate advice, can be demanding for most research institutions, particularly in the developing world. However, IAA can, in principle, be undertaken within a wide range of budgets and human capacities. The process can be simplified while still following the principles, depending on the complexity of the issue, the value of the fishery, the potential risk of management failure, the resources and time available and the capacity of the stakeholders and managers involved in the IAA framework. The assessors need, however, to remind themselves that simplifications have consequences, in terms of cost but also in terms of benefits.

Recognizing the diversity of possible demands and the varieties of methods available, the framework *is* process-oriented. Recognizing that specific responses cannot be provided at this level of generalization, it proposes processes through which such responses can be obtained.

The IAA process serves to respond to questions such as:

1. Why is an assessment needed (to clarify the demand)?
2. Who asked for it?
3. Who should be invited to participate?
4. What sort of assessment is needed?
5. What sort of advice is expected?
6. When is the response needed?
7. What is the management context/capacity?

The framework proposes a unifying, multidisciplinary, non-prescriptive architecture for IAA to be used for the governance of responsible small-scale fisheries. This capitalizes on opportunities arising through the growing acceptance of interdisciplinarity, multiple perspectives, values and knowledge and participation and more democratic processes of action. Integrating these conceptual ideals in an operational framework enables policy-makers and managers to cope better with the complexities and dynamics of SSF.

TARGET AUDIENCE

The IAA framework aims to facilitate deeper understanding, more appropriate assessment and effective processes of advice and decision-making for SSF. It is therefore, intended for policy-makers, managers, subsector leaders, NGOs and fishing communities. It is also targeted towards individuals or organizations providing assessments, such as academics, scientists working for governments, environmental and development NGOs, industry analysts and investors, donor agencies, advisers and consultants.

Implementation of the IAA process should be driven by societal demand. The timing and expected outcome of the assessment are important considerations. The timing is imposed by the circumstances (e.g. recurrent planning or emergency issue) and the outcome should be a response to a specific set of questions that have serious consequences for the resource and the people.

EXPECTED OUTCOMES

The aim of this collaborative process is to develop a comprehensive and legitimate conceptual framework that will be adopted by researchers and practitioners interested in and managing fisheries. The framework should enable a degree of flexibility, autonomy and versatility while still effectively guiding assessments of a diverse spectrum of SSF. The IAA framework aims to replace the conventional approach to fisheries assessment founded on "classical" fisheries science, in those cases when there is a need to deal with SSF in all its dimensions. It also aims to provide guidelines that improve on ad-hoc descriptive methods of assessment and the associated reactive and piece-meal approach to addressing the SSF sector's needs, problems and opportunities that characterize most government fisheries departments in developing countries.

The IAA framework aims to raise awareness of the complexity and interconnected nature of the fisheries system in itself as well as its position within wider processes. The importance of SSF in contributing to food security and poverty alleviation is stressed and it is expected that the IAA framework, in action, should emphasize these contributions for those that implement it. Implementation and experimentation with the framework are also expected to build understanding of SSF in general. This will occur through the accumulation of interdisciplinary knowledge on SSF, case-study examples and best practice in their management.

The complexity of SSF and the need to account for it is likely to make comprehensive understanding and assessment difficult. Experience, capacity building and accumulative use of the framework should, however, optimize its contribution to decision-making for management. The framework does not deal explicitly with capacity building but recognizes that it is an essential component for the success of its application. A number of initiatives are ongoing and will certainly be undertaken in the future for capacity building, at the manager, adviser and assessor levels, and it is hoped that the framework will help in developing a national capacity to assess and manage small-scale fisheries better in a participatory mode.

STRUCTURE OF THE DOCUMENT

This chapter justifies the need for an improved means of assessing fishery social-ecological systems, in particular small-scale fisheries. Chapter 2 highlights the conceptual background and fundamental principles underpinning the new IAA framework. Chapter 3 then introduces the framework itself and details the sequential steps and feedback processes that define the approach. The IAA process is then placed within the planning and management cycle utilized by most bureaucracies in one form or another (Chapter 4). Finally, Chapter 5 deals with a number of cross-cutting issues affecting framework implementation and concludes with the expected way forward in testing, refining, disseminating and operationalizing this approach. References and annexed information follow.

2. Contextualizing the framework

This chapter aims to convey the conceptual origins of the IAA framework, to show how it incorporates contemporary thinking in natural resource management, fisheries management and ecosystem governance. It introduces the fundamental principles on which the IAA framework is based in order to justify and enable integration of these ideas in the operational IAA framework, which is then presented in Chapter 3.

CONCEPTUAL ORIGINS

Management of SSF can be improved by an assessment and advice process that better recognizes and understands the complexities, interactions and dynamism of these systems. While some progress has been made in going beyond single-species "classical" fishery science, subsequent approaches do not fully appreciate and integrate the breadth of conceptual work on alternatives. Moreover, management frameworks that highlight these issues, such as FAO's Code of Conduct for Responsible Fisheries (CCRF) and the associated ecosystem approach to fisheries (EAF), as well as more general sustainable development (SD) approaches, are not specifically tailored to SSF. The IAA framework seeks to operate within these overarching normative frameworks to provide a basis for developing operational tools for managers of SSF. Further, this framework provides an approach to SSF assessment that is versatile enough to be relevant for SSF where the value of the fishery is too small relative to the cost of conventional approaches.

Inspired by work in sustainability and management science, the IAA process adopts a systems approach that recognizes SSF as interacting social and natural systems (Holling 1978; Walters, 1986; Gunderson, Holling and Light, 1995; Holling, Berkes and Folke, 2000; Charles, 2001). A systems approach is strongly interdisciplinary. It combines historical, comparative and experimental approaches, it uses qualitative and quantitative methods and it is fundamentally concerned with integrative modes of inquiry and multiple sources of evidence. A systems approach also engages with issues of uncertainty, surprise and threshold effects, and recognizes the importance of cross-scale interactions. A management system is, therefore, expected to cope with multiple perspectives, scales of action and composite effects of change and so needs to be experimental, flexible and adaptive. Rights-based approaches are also central to the principles and processes developed for the IAA framework.

Integrated analyses in cognate disciplines and areas of enquiry, including integrated river-basin management, integrated coastal zone management, integrated rural development, integrated conservation and development, interactive governance and common property resource management, are also adopted and the methodological tools that populate these frameworks borrowed. The theories and conceptual background of the IAA framework are summarized in Table 1. Many of these theories and concepts are themselves interrelated. It is beyond the scope of this document to review all the literature and ideas behind them, but it would be remiss not to acknowledge their influence on our thinking.

Finally, assessment frameworks that have been used to understand specific aspects of a complex system are incorporated. These are not supplanted by the framework presented here but can be used within the IAA process where appropriate. They include conventional stock assessment, environmental impact assessment (EIA), qualitative and quantitative risk analysis and management, rural livelihood assessments and approaches used for understanding and coordinating macroeconomic development (globalization of trade, poverty reduction strategies, pro-poor growth).

TABLE 1
Theoretical and conceptual origins of the IAA framework

Theoretical and conceptual basis	Selected references
Adaptive-dynamics ecology and systems theory	
Integrated social-ecological systems thinking	Gallopin 2002; Garcia and Charles, 2007
Adaptive management	Folke, Berkes and Colding, 2000; Walker *et al*., 2004; Folke, 2006
Social adaptive learning	Holling, 1978; Walters, 1980, 1986
Non-equilibrium ecology	Berkes and Folke, 2000; Charles, 2001; Hilborn and Walters, 1992
Institutional analysis	
Common-property and collective action	Wade, 1987; Berkes, 1989; Ostrom, 1990; Berkes and Folke, 1998; Ostrom *et al*., 1999; Jentoft and McCay, 2003; Berkes, 2005
Institutions and power	Agrawal, 2003, 2005; Scott, 1998; Oakerson, 1992; Ostrom, 2005
Collaborative approaches	
Participation and deliberative inclusionary processes	Brown, Tompkins and Adger, 2001; Francis and Torell, 2004; Raakjaer-Nielson, 2003; Wilson, Raakjaer and Degnbol, 2006
Multiple knowledge systems	Agrawal, 1995; Blaikie *et al*., 1997; Scott, 1998
Interactive governance	Hersoug, Jentoft and Degnbol, 2006; Bavinck *et al*., 2005; Mahon, McConney and Roy, 2008
Integrated management	
Integrated conservation and development	Brown, 2002; Berkes, 2004
Integrated coastal zone management	
Vulnerability	
Risks, hazards, exposure, sensitivity and adaptive capacity, resilience, human security and social and environmental justice	Capak, 1993
Macroeconomic growth theories of development	
Modernization, structural adjustment, pro-poor growth, food entitlements and food security, poverty reduction, decentralization, strengthening civil society, human rights, wellbeing, development as freedom	Sen, 1999; Corbridge, 2002; Jomo and Fine, 2005; Stiglitz 2006
Rural development theory	
Farming systems analysis, integrated rural development, capitals and capabilities, sustainable livelihoods, participation and empowerment and rights-based approaches, use of local or indigenous technical knowledge	Ellis and Biggs, 2001; Fafchamps, 2003
Rights-based and entitlements approaches	
These ideas underlie many of the approaches above.	

The IAA framework intends to act as a precursor to effective management. This document does not explicitly deal with management structures but develops a process through which challenges and opportunities for management, characteristic of a particular SSF at a particular time, are identified and negotiated. The framework intends to build integrated knowledge in support of responsible SSF management. The IAA process presented here guides the incorporation of multiple conceptual principles expected within IAA implementation. These principles are elaborated below.

FUNDAMENTAL PRINCIPLES

Recent international codes and standards in fisheries, science, good governance and equitable and sustainable development provide a number of principles upon which the IAA framework has been built. Listed as thematic headings, they include the following.

1. Principles of integration
2. Principles of collaboration
3. Principles of transparency and accountability
4. Principles of versatility
5. Principles of adaptability
6. Principles of sustainability

BOX 4

The ecosystem approach to fisheries

During the past decade the concept of an ecosystem approach to fisheries (sometimes also referred to as ecosystem-based fisheries management or ecosystem-based management) has been increasingly used in policy statements by fisheries' management and environmental agencies, both governmental and non-governmental, at the national and international levels. At the same time, there has been widespread confusion regarding what an ecosystem approach actually entails. Perceptions and use of the expression have been very different, ranging from the idea of the need to base management of human activities on a detailed understanding of ecosystem structure and functioning to the perception that the use of marine protected areas (MPAs) is synonymous with EAF. Notwithstanding good progress in many localities, this confusion has significantly hindered progress towards implementation of the approach.

According to FAO (2003),

An ecosystem approach to fisheries strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries.

The above definition clearly addresses both human and ecological well-being and merges two paradigms – that of protecting and conserving ecosystem structure and functioning and that of fisheries management – that focus on providing food, income and livelihoods for humans. In fact, the application of EAF represents the ultimate effort to implement sustainable development in fisheries, to be achieved through democratic and transparent practices that take account of diverse societal interests and allow participation of stakeholders in the planning and decision-making processes. Issues of sustainability are also linked to the principle of intergenerational equity, also a fundamental principle of EAF (FAO, 2003).

The *FAO Technical guidelines on the ecosytem approach to fisheries* (FAO, 2003) provide a framework for planning and managing fisheries in a way that is consistent with EAF, recognizing the need to consider the wider (ecosystem) context, including the ecological, social and institutional dimensions of the fishery system.

The EAF-based planning process consists largely of examining existing or developing fisheries to identify key priority issues to be dealt with by management in order to be consistent with an ecosystem approach. As the process unfolds, high-level policy goals, which are often too general to be useful in day-today management, are translated into operational objectives and decision rules for actual implementation. A fundamental step in this process is the formal identification with stakeholders of the priority issues to be considered for management, e.g. through a qualitative or quantitative risk analysis (depending on the information available).

The planning process unfolds in a structured way, with reference to three major dimensions of sustainable development, – namely: ecological and social well-being, and the "ability to achieve", which depends on fishery governance capacity as well as drivers external to the fisheries systems.

The process also should be applied in a participatory way, such that it is able to draw upon informal and traditional knowledge and to combine, in a balance that will depend on the type of fisheries and social conditions involved, bottom-up with top-down approaches.

Subsequent steps in the process engage practical challenges of how management can actually deal with the agreed priority issues, including the setting of operational objectives (i.e. targets), determination of the most appropriate management tools, and assessment of costs and benefits of alternative management options.

The EAF-based planning process stands in marked contrast to conventional fisheries management approaches because it is holistic in orientation: it attends to issues and concerns across all dimensions of a fisheries system, and it calls for wide stakeholder participation.

Sources: FAO, 2003; Bianchi, Cochrane and Vasconcellos, in press.

While the framework itself aims to enable some flexibility, autonomy and creativity on the part of those implementing the IAA process, the above principles should underpin the various choices made. These include the selection of methods of assessment, the process of their application, the interpretation of findings, the identification of options and the elaboration of advice.

Principles of integration

Shared visions and values

The IAA process aims to develop a vision shared among the stakeholders – a mental model of the facts, issues and solutions – as well as a common set of values and principles as a necessary condition for them to act accordingly. It is important, from the onset, through the scoping and assessment phases, to establish whether common understanding exists of threats, opportunities and objectives of the fishery and the SSF subsector. If this is not the case, it will be necessary to develop a common understanding of the state of the system, its key components with their relationships and dynamics, the roots of the problem and its history and possible solutions. A shared vision is not a prerequisite for action but, where it does not exist, it should be sought as an outcome of the IAA process. The ideal consensus might only emerge fully during the IAA process and possibly only after repeated IAA interventions. For this reason, constructing shared visions and values is an objective of every intervention. This requires formalizing a modus operandi that is multistakeholder, interdisciplinary, participatory (inclusive) and integrates different sources of knowledge, accounting for differing perceptions and values. Tools for conflict resolution and consensus building may be required.

Multiple forms of knowledge

Fishery science and management have co-evolved for more than a century, but as the demand for advice increased in complexity, the incremental process of involvement of additional disciplines led to very segmented visions of the sector. Disciplinary “domains” have tended to remain mutually exclusive, narrowly preoccupied with their respective specializations. Thus, in rough outline, the following viewpoints have come to prevail.

1. Resources: the domain of the fishery biologist
2. Technology: the domain of the gear technologist and engineer
3. Markets: the domain of the economist
4. Environment: the domain of the ecologist
5. Stakeholders and society: the domain of the sociologist
6. Institutions: the domain of fishery administrators, lawyers and political scientists

In contrast, the IAA process should be an integrated undertaking requiring the interaction of knowledge from many domains, whether this is of scientists and bureaucrats trained in different disciplines within the natural and social sciences, or stakeholders with differing experience and perspectives. It aims to move beyond "multidisciplinarity", towards "interdisciplinarity" or "transdisciplinarity". The framework therefore encourages, collaboration between disciplines and between technical specialists and those with other forms of knowledge (experiential, local, traditional, etc.). This facilitates the elaboration of the synoptic assessments necessary for multidimensional advice. This will be better enabled through time by the emergence of a new breed of scientist, manager and/or collaborative team with the capacity to and appreciation for undertaking such comprehensive, interdisciplinary assessments.

The framework recognizes both the potential and the challenge of achieving interdisciplinary science and advisory support. The standard process of data collection, data analysis, diagnosis, advice, monitoring and evaluation offers various steps at which to start integrating across disciplines. Conventionally, the process may have involved only a few potentially useful disciplines with the synthesis expected at the decision-making level (leaving to the manager the impossible task of blending the various disciplinary advices). It would be more effective if integration occurred earlier on in the process, resulting in integrated advice and information for the stakeholders. This is the minimum requirement for such an integrated assessment. Yet, it is also possible to integrate disciplines earlier, for instance at the level of the analysis and diagnosis (e.g. if hybrid, multidisciplinary models are available) and even at the data collection level, to achieve economies of scale. The appropriate level of confluence of the disciplines cannot be easily prescribed and will depend on the context, the scientific capacity available and the institutions in place, which may or may not enable the process.

It is important throughout processes of knowledge integration to maintain scientific rigour. Rigour does not equate with quantification but relates to respect for agreed enquiry protocols and transparency about assumptions, for example. The UNCLOS requirement for the "best scientific information available" states that assessments should be policy-relevant, rigorous, accurate, precise, documented, verifiable, comprehensive, understandable for recipients and timely. Rigour and quality of qualitative methods highlight criteria such as credibility, transferability, dependability and confirmability (UNEP, 2005). Assessments must also be cost effective. This is particularly so in the resource-poor settings characteristic of many SSF. The need to meet timing requirements and operate within limited resources may lead to trade-offs, however – for example, between timeliness and comprehensiveness or precision. Precision and rigour are not the same, however; it is possible to be rigorous in reporting high levels of uncertainty and in using existing information to best effect.

The uncertainty inherent in resource systems and their assessment can be addressed by broadening perspectives, as is encouraged through the IAA process, from:

- resources to the ecosystem, including people;
- single to multiple disciplines;
- assessing stocks to assessing fisheries, subsectors and cross-sectoral issues;
- dealing with management *sensu stricto* to dealing with the whole range of decision-making, from management to policy development and planning; and
- using exclusively scientific conclusions to using a broad range of information from different origins.

Again, the extent to which broader perspectives can be achieved and integrated with an IAA process cannot be prescribed. It will depend, *inter alia*, on: (i) the type of question faced; (ii) the data; (iii) the "client"; and (iv) the research capacity, among other issues. Importantly, the way the assessment is carried out is central to the success and sustainability of outcomes. Thus, the concept of "rigour" (although seldom articulated as such) in the human part of the IAA process places emphasis, in addition to scientific rigour, on effective participation of target groups in problem identification and solving, on building institutional capacity and on stakeholder ownership of the development process.

Beyond the integration of disciplines and analytical and conceptual approaches within the natural and social sciences, the value of local knowledge is increasingly recognized in the broader natural resource management and development literature:

> *The knowledge of local people…has a comparative strength with what is local and observable by eye, changes over time and matters to people. It has been undervalued and neglected. But recognizing and empowering it should not lead to an opposite neglect of scientific knowledge ... the key is to know whether, where and how the two types of knowledge can be combined, with modern sciences as servant not master and serving not those who are central, rich and powerful, but those who are peripheral, poor and weak, so that all gain.*
>
> (Chambers , 1997, page 205)

The IAA framework for SSF requires the combination of scientific, interdisciplinary knowledge with various forms of "non-scientific" local (indigenous or traditional) knowledge.[3] This document refers to the validation of local knowledge – meaning the differentiation of collective knowledge and group perspectives from individual or elite interests. The IAA process encourages consideration and integration of multiple perspectives, values, experiences and knowledge of both a scientific and 'non-scientific' nature. It is appreciated that the "non-scientific" too can influence decision-making processes and the development of understanding, shared values, legitimacy and appropriate collective action. In practice, there may not be a sharp distinction between "local" and "scientific" knowledge. Scientists sometimes use a kind of "folk knowledge" similar to that used by small-scale fishworkers – they use "rules of thumb", "gut feelings" and rapid observations and experience to make judgments that, because they are "experts" are judged to be "scientific". This process is even formalized as "expert elicitation" and used to inform major global policy processes, such as the likelihood of catastrophic "tipping points" in future climate change, including the melting of the polar ice caps or the loss of the Amazon rainforest (Schellnhuber *et al.,* 2006). Similarly, local knowledge may in fact have multiple sources, with fishworkers now acquiring data through radio programmes, discussion with scientifically-trained extension agents and multiple other pathways of knowledge diffusion. In agricultural development, such "multiple sources of innovation" models of knowledge diffusion have largely supplanted the dichotomous view of knowledge as being either "traditional" or "scientific" (Biggs, 1990). It is increasingly recognized that in the event of a contradiction between collective local knowledge and scientific knowledge, it cannot be assumed that the scientific knowledge is *de facto* correct. For this reason, the IAA framework encourages a view that engages with multiple sources and types of knowledge.

Incorporating local knowledge and different perceptions may provide useful information for creating working hypotheses, structuring models or scouting for options. It is also necessary for the construction of shared visions and values and so will play an important role in the negotiation and, therefore, in the practical outcome of the IAA process.

Principles of collaboration

The IAA framework should be highly participatory. Active participation of stakeholders and other knowledge holders is essential for the application of many of these principles and for ensuring ownership by the community, relevance of the issues and legitimacy of the responses. It helps in empowering the actors, mobilizing people, building-up consensus, improving the knowledge base and identifying expectations and perceptions. The mechanisms put in place in a participative assessment may become useful for other more decision-oriented processes, facilitating decentralization and devolution of responsibilities. Participation contributes to adequate problem formulation and effective solution-finding, facilitating conflict resolution and reducing social and economic risk. It increases equity and transparency, facilitating public scrutiny and auditing. It is also a means necessary to improve scientific understanding and transform it into a broader societal understanding that will inform people's decisions and willingnessness to comply or not to particular courses of action. The concept of participation and its nuances and ramifications are explored in Annex 2.

The degree of participation required for an effective process depends on the nature of the issues to be dealt with. Decisions about a food-safety norm may require less stakeholder participation (and non-scientific intervention) than decisions on where to site a marine protected area or on the introduction of territorial use rights.

[3] This issue is both sensitive and controversial and even hedges on the ideological. It is examined in more detail in the section *Stakeholders' roles*.

Active participation is in line with the requirements of the 1990 Arusha Declaration[4] and 1998 Aarhus Convention[5]. In IAA, the assessment constituency and the management constituency may overlap significantly, even given that stakeholders may have different roles in the two interconnected processes. Fishworkers, for example, will be contributors in the assessment process as well as negotiators or deciders in the advisory and decision-making processes.

An important consideration for the application of participatory integrated assessments is that organizers, in the design and preparation of any application, should honestly reveal the potentially diverging interests, conflicting views and possible hidden agendas of expected participants. With this and a skilful moderator, these problems can be managed if identified ahead of time and contingency measures are taken. The key is to prevent the evolution of hostile attitudes towards the participatory process itself. Meticulous preparation can turn this risk into an opportunity by creating group dynamics that transform initial tensions into creativity (Toth, 2001).

Principles of transparency and accountability

The assessment should be transparent, i.e. processes, data, methods, processes, results and interpretations should be documented and easily available. This is particularly important when dealing with uncertainty and multiple sources of knowledge. It also requires a formal recognition of roles and responsibilities in the process. Dissent and concerns should be particularly documented if set aside, with information on the reason for discarding. Together with active participation, transparency and accountability contribute to credibility, legitimacy and trust.

Principles of versatility

By definition, assessments of complex systems should not pretend to be universal (i.e. they are strongly contextual). Nevertheless, the IAA framework can be employed under a variety of management/policy contexts and by any organization. There are a number of governance, economic and research approaches that are available to guide the design of management structures and processes. These vary in their prioritization of different objectives, including collaboration (co-management, community-based management), integration (integrated zone management, integrated conservation-development projects), rights (property rights, human rights) and sustainability (sustainable ecosystem approach, sustainable livelihood approach). In any given country, the institutional architecture of management may differ among, subsectors and individual projects. The IAA framework is designed to be appropriate for assessment and decision-making processes in the entire spectrum of management and policy contexts from sector to individual project. As such, the assessment process is independent from the current management or policy frame.

Indeed, IAA is expected to update and improve the current management or policy frame. The framework can, therefore, be implemented by a range of individuals and

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[4] The 1990 Arusha Declaration on Popular Participation in Development was founded on the notion that sustainable development could only be achieved through the full participation of the intended beneficiaries of the development process (Sharp, 1995). It followed from recognition that development projects designed and implemented without the full involvement of the intended beneficiaries have a high failure rate.

[5] The United Nations Economic Commission for Europe Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (in short, the Aarhus Convention) was signed in 1998 and entered into force in 2001. It recognizes citizen's rights to information, participation and justice and aims to promote greater accountability and transparency in environmental management matters. The pillars of the convention are: (i) greater public access to public environmental information; (ii) opportunity for people to express opinions and concerns on environmental matters and ensure that they are accounted for in decision-making; and (iii) public access to review procedures when those rights have been breached and, in some cases, the possibility to challenge violations of environmental law.

organizations, including government agencies, academic institutions, the private sector, local communities or NGOs. To enable this, the IAA process is adequately generic and adaptable to particular contexts. This principle raises three important challenges. First, the term SSF hides a wide range of very different situations in which similar assessment processes and methods might successfully be used but for which generalization of management prescriptions would be dangerous. Second, the whole IAA framework itself, with its approaches to knowledge development, uncertainty, participation and empowerment, is deeply embedded and informed by a range of theories regarding structures and interrelationships in the natural and human subsystems. It is forward-thinking and innovative but based on relatively well-established principles. It is, however, difficult to envisage how it might be used in situations where such concepts might not yet be accepted, e.g. where some of its underlying principles and values, such as the principles of democratic governance, are not yet adopted and implemented. In such areas, emerging ideas relating to resilience-building, empowerment for self-organization, etc. might be a way to enable evolution in the more appropriate directions. Third, the concept of co-evolution of science (or knowledge building) and management, implies that initially similar IAA systems, applied to different situations in an adaptive mode, may evolve differently. Starting from a common framework, evolutionary pathways might diverge.

The IAA framework can thus be employed to increase understanding of problems and issues and clarify pathways to solutions, in many different contexts: in data-poor as well as data-rich situations, whether high or low assessment capacity is available, in a problem-oriented as well as strategic planning mode, in a short-term as well as a long-term perspective, for dealing with local to global issues and under a variety of governance regimes. To achieve this versatility, the framework encompasses a range of qualitative and quantitative approaches of varying cost and difficulty of application. It proposes sophisticated analyses as well as rapid appraisals. It combines scientific knowledge with collective local knowledge. It overcomes shortcomings through iteration and social learning.

Multiple scales of enquiry

The connections between spatial scales (global, national and local levels) have been revealed through research, management practice, industry and market mechanisms and trends in human development. Research has indicated the importance of international and regional programmes and mentoring sources that have progressively replaced colonial research. It is recognized that management practice is subject to the obligations generated at all levels by the international instruments agreed at the highest political levels, often without a clear analysis of their implications at the lower levels. Industry and market mechanisms and norms continue to develop at the global level with the power to disadvantage or eliminate those who cannot adapt (the Hazard Analysis and Critical Control Point [HACCP] system, the International Organization for Standardization [ISO], the Marine Stewardship Council [MSC], etc.). Finally, trends in human development include increased labour mobility, such as movements of people between fisheries and from fisheries into other sectors of the economy. The IAA framework, therefore, needs to be versatile enough to account for cross-scale interactions. It considers the fishery (and the fishery sector) as a complex whole even when the assessment is concerned with a specific issue affecting only part of that whole. The need to deal with cross-scale effects is important, *inter alia,* for looking at:

- transboundary impacts, whether imported (external drivers) or exported (externalities) from the studied subsystem;
- strategic (long-term) implications of operational measures and vice versa;
- interactions between governance systems, at intersectoral level and across jurisdictional scales (from local to global).

Dealing with multiple scales is obviously a challenge as, with finite assessment resources, this will inevitably involve a trade-off between the operational (local) and the strategic (contextual) scales. It will be neither possible nor useful to assess both to the same extent. Part of the solution of the dilemma is in the demand itself. If the initial question is a broad strategic one (e.g. what might be the impact of ecolabelling, or territorial rights in the national SSF sector?) then the focus will be strategic, but some representative case studies, at local level, will be used as "ground truthing". If, on the contrary, the question is local (e.g. conflict with an expanding neighbouring fleet or newly introduced gear), the solution is to focus on the local issue, but open a rapid assessment of the potential consequences of the solutions proposed in terms of, for instance, compatibility with national legislation and the national constitution, possible "domino effects" on other fisheries out of the area, etc. In general, a dual track will be advisable, combining parallel assessments of the global and partial assessment, with the balance between the two being fixed by the nature of the initial request (i.e. the entry point).

In brief, while the scale at which assessment is made is largely imposed by the demand, the framework calls for looking at all relevant scales with an appropriate weighting (in terms of importance, detail, cost of the analyses) depending on the particular issue and context.

As stressed by Lebel (2006), scales are not politically neutral. The capacities and interests of the different stakeholders vary greatly with scale. The fleet scale (as opposed to vessel scale) is preferred by industry for confidentiality. The scale at which a coherent assessment can be made (because of data density or model limitations) may not be the most pertinent scale for operational management. Power holders prefer the scale (local, national or global) at which they can influence the outcomes. The implication is that integrated assessment and advice will need to find the best scale combination or compromise for the issue and mix of stakeholders concerned.[6]

Principles of adaptability

Addressing complexity and uncertainty

Acknowledging the complexity of social-ecological systems, including SSF, has various implications:

- loss of universality (reduced transferability of experience);
- increased uncertainty;
- multiple and scale-dependent points of view and cross-scale issues;
- non-linearity of relations between components;
- non-applicability of equilibrium and reversibility concepts;
- delayed responses to action;
- remote control and feedbacks;
- possibility of unexpected evolution (surprises) and of self-organization; and
- risk of organizational failure if thresholds are reached

Under these conditions, the risk of ineffective action is high. The IAA framework must therefore accept complexity, knowledge limitations and an element of uncertainty. In line with the precautionary approach to fisheries, the IAA process will identify and explicitly assess the consequences of uncertainty on the robustness of the advice. The assessment should be repeated with a frequency dependent on the level of risk. Such risk should be explicitly assessed, for example using qualitative or quantitative participative risk assessment procedures. It should specifically look for potential errors in model structure and interconnections, unexpected effects of external drivers or internal feed-back loops. It should ensure that risk is duly communicated to managers and stakeholders and progressively reduced through adaptive learning processes.

[6] Fanning *et al.* (2007) elaborate extensively on scale issues and linkages, largely in response to SSF governance issues.

The complex, even chaotic, behaviour of fish stocks led Wilson *et al.* (1994) to suggest that there could never be sufficient information to manage fisheries on a numerical basis. Instead of controlling "how many' fish are caught (e.g. by specifying total allowable catches [TACs]), they suggested that the best alternative was to develop fishing restraints that affect "how, when and where, fish are caught", to ensure that core ecosystem functions that support fisheries productivity are preserved. Wilson *et al.* (1994) reviewed examples of what they termed "parametric management" from fisheries around the world and suggested that many "traditional" management systems that had successfully sustained fisheries were based on such parametric controls, which include protection of spawning and nursery areas, limited access, closed seasons and size limits. These management measures are often based on local or indigenous knowledge (Ruddle, 1994).

A modern extension to the idea of addressing the inherent uncertainty of fisheries systems and implementing the precautionary principle in fisheries management is the development of networks of marine reserves (e.g. Lauck *et al.*, 1998). Here is a management tool that does not depend on numerical fisheries stock assessment to balance conservation and resource extraction. Their use as a management tool does, however, require a wider assessment process, which encompasses many of the principles and processes outlined in this document.

Thus, in a context of high uncertainty, assessment advice should provide clear indications about directions, which are robust to uncertainty, as opposed to dubious predictions about targets. Participative elaboration of long-term scenarios should be preferred to model-based equilibrium models. Sources of variability, such as "decadal" cycles and recruitment levels, should be studied to improve short-term forecasting.

Complexity should be taken into account with all its implications, maintaining a balance between two dangerous extremes: the illusory facility of oversimplification and the unnecessary burden of over complication (Holling, 2000; Garcia and Charles, 2007).

Adaptability, flexibility and information asymmetries

SSF, particularly in a developing country context, present a particular management challenge. In many cases, even if governments had sufficient understanding of the complex and dynamic ecological, social and economic factors affecting aquatic resources to devise rules (which they do not), it would still be difficult and costly to enforce them (e.g. Baird, 1996). For this reason, more collaborative approaches (e.g. co-management) may be required whereby authority and responsibility are shared among a diversity of stakeholders (e.g. Berkes *et al.*, 2001; Garaway and Arthur, 2004). Experience indicates that while fishers often have a wealth of time and place knowledge, they often have less understanding about the dynamics and biological limits of the fishery (e.g. Anderson and Mees, 1999). On the other hand, external agencies and researchers often have an understanding of some of the larger scale biophysical, political, economic and social processes and factors affecting the fishery, but lack knowledge of the specifics (Garaway *et al.*, 2006). The framework addresses information imbalances, with stakeholders learning from each other in order that management and policy decisions are built upon a common understanding among all stakeholders.

The complex and dynamic nature of SSF has led also to an emerging interest in applying the principles of adaptive management within a co-management setting, bringing together multiple stakeholders to participate in the management process, using management as an experiment from which all stakeholders learn (e.g. Garaway and Arthur, 2004; Olsson, Folke and Berkes, 2004; Armitage, Berkes and Doubleday, 2007; Armitage *et al.*, in press). In complex, dynamic systems, while some uncertainties can potentially be addressed prior to identifying a management strategy, others, such as the response of key variables to change, cannot. Adaptive management recognizes this and seeks to identify appropriate policies and management strategies through processes of experimentation aimed at reducing key uncertainties (Rondinelli, 1993; Lee, 1993; Holling, 1987; Walters, 1986). In this way management can be used to learn more about the resource system at the same time as it is being managed, with management actions subsequently being refined based on learning. Experimentation may be of two types, both based on examining variation in management actions and outcomes temporally or spatially.

Variation in management may come about through naturally occurring variation in the systems (allowing passive experimentation), e.g. comparing the outcomes from different protected area policies in different locations. Alternatively it may come about through deliberate changes to management actions to create variation (as active experimentation) and "probe" the fishery system (Charles, 1998). In terms of learning, active experimentation, where the variation and contrast in treatments are more controlled, is likely to produce results more quickly (Peterman and McAllister, 1993; McAllister, Peterman and Gillis, 1992; Collie and Walters, 1991; Sainsbury, 1988) but is much less applicable to the human aspects of the system (Garaway and Arthur, 2004).

An important element of complexity and uncertainty perspectives is the idea of social-ecological system resilience (as an inherent system property), which infers resilience of valued ecosystems (not resources) and reduced vulnerability of communities supported by them. Enabling the accumulation of resilience within SSF, with the minimum input of public resources, is a primary aim of management. The IAA process therefore addresses uncertainty, vulnerability and risk in the context of resilience as a system outcome.

Principles of sustainability

The task of IAA assessment is to assist decision-makers and stakeholders in their efforts to achieve sustainability despite changing requirements and environments. There are numerous definitions of sustainability (e.g. World Commission on Environment and Development [WCED], FAO) and the Code of Conduct for Responsible Fisheries lays down the fundamental implications in each area of activity of the fishing sector (catching, processing, trade, management, etc.). The definition of sustainability is relevant for assessment inasmuch as it indicates the broad direction in which SSF should be guided when assessing impact and alternative options. For the purpose of this framework, it is agreed that sustainability requires both the well-being of people and the health of the ecosystem and stresses with Berkes and Folke (2000) that sustainability implies not challenging ecological thresholds that will negatively affect ecological and social systems. Other evaluative criteria for assessing performance and options could include efficiency (in terms of Pareto-optimality) and equity (Oakerson, 1992), as well as poverty alleviation, empowerment of disadvantaged groups and food and livelihood security. One difficulty is that while there is some agreement on ecological sustainability criteria, there is less agreement on economic criteria and even less agreement on social and cultural criteria (Berkes and Folke, 2000, page 21).

As with many complex and value-laden processes, overprescription is counterproductive. It suffices to distinguish four broad principal components of sustainability (e.g. Charles, 1994):

1. Ecological sustainability – dynamic maintenance (and *a priori* rebuilding) of the resource base so as not to foreclose future options for its use.
2. Socio-economic sustainability – the maintenance and positive evolution of livelihood-related benefits from the resource, for those who depend on it.
3. Community sustainability – the ability of groups of people to maintain social structures that enable equitable sharing of livelihood benefits from resource use.
4. Institutional sustainability – the maintenance of suitable financial, administrative and organizational capability in the long term.

SYNTHESIS

This chapter has provided the conceptual background of the IAA framework. The framework benefits from the development of new conceptual and analytical tools in ecosystem governance, fisheries management, natural resource management and alternative development. From these, fundamental principles have been identified, which informed both the design of the IAA process and should continue to inform its implementation. The IAA framework is presented in the following chapter.

3. Presenting the framework

This chapter introduces the IAA framework, guides the reader through the core processes and highlights the range of issues that need to be considered. The chapter also presents a range of potential approaches and methodologies that might be used throughout the assessment and advice process in order to enable autonomy, creativity and flexibility of the individuals or teams undertaking such activities. It is important to recognize here that, while the presentation of the framework follows a relatively linear mode, in practice the process should be reflexive, adaptive and continuous.

OVERALL FRAMEWORK

Assessments that support decision-making processes for management must be demand-led, timely and appropriate to the questions asked or problems identified by policy-makers, managers or stakeholders. The advice should prioritize issues, construct and inform on alternative choices and suggest means of achieving appropriate action, making explicit the trade-offs involved. Legitimacy and consensus are achieved through participatory and transparent processes. They are further supported by the implementation of a monitoring protocol providing feedback information for adaptive learning. To be fully comprehensive, assessments should carefully consider the relevant scales and boundaries of resources, ecosystems, communities and institutions. They must capture information both historic and current, intra- and intersectoral, recognizing the multiple dimensions of sustainable livelihoods.

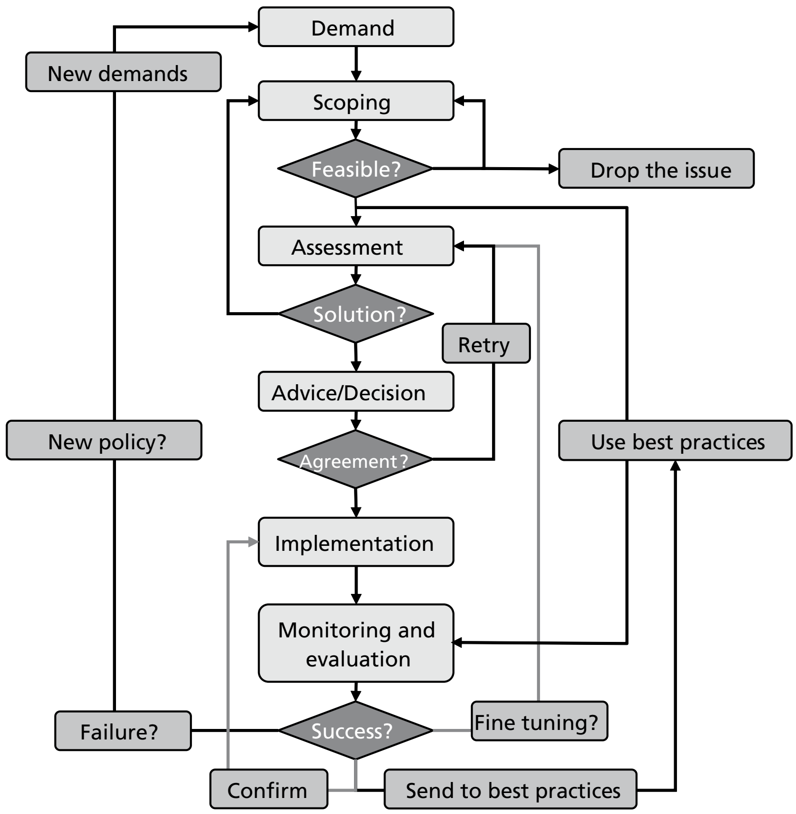
A general process of participatory assessment for decision-making can be conceptualized as a double loop with feedback connections, which is usually subdivided, partly arbitrarily, into discrete steps for the sake of convenience (see Figure 2). Examples can be found in most methodological publications (e.g. Brown, Tompkins and Adger, 2001 and Walmsley, Howard and Medley, 2005).

The general assessment cycle is largely independent of the type of assessment – strategic, operational or problem-focused – and includes the following steps:

1. **Preparation of the assessment.** Also referred to as framing, scoping, preliminary appraisal or pre-assessment, this step aims at providing the preliminary information on: (a) the fishery, management and other relevant contexts; (b) the issues at stake; (c) the objectives and constraints already identified; (d) the information sources potentially available; (e) the competencies needed and potential partners; (f) the communication channels available, etc.
2. **Assessment process *sensu stricto*.** During this phase, the approach and methods to be used are selected, the data needed are collected and the analyses undertaken. The options available are identified and analysed before presentation to the "clients" (e.g. decision-makers at central or community levels). The expected outcomes of the various options are specified to the fullest extent possible. Uncertainties are identified and their potential consequences assessed *ex ante*. The term "**diagnosis**" has been suggested, which combines pre-assessment and assessment and is linked explicitly to subsequent management action (Andrew *et al*., 2007).
3. **Use of the assessment outputs.** The results of the assessment, and in particular the options available and their implications, are communicated to the stakeholders and decision-makers and analysed before selection in the advisory and decision-making processes. While fishers and other stakeholders are involved in both processes, as contributors of knowledge and as negotiating parties, the role of science is usually (but not always) limited to the advisory phase. The expected

FIGURE 2

Flow diagram of a general integrated assessment and advisory process



outcomes of the various options are specified to inform the negotiation process. Other communications, e.g. with the media, will strongly depend on the political context in which the assessment takes place.

4. **Monitoring and *ex-post* evaluation**. In order to assess the quality of the assessment itself, to gain new and better information and to check the performance of the implementation, a monitoring programme should be set up. The information it will collect (e.g. in relation to a set of indicators) will be used for an *ex-post* evaluation. Its results may lead to the pursuit or modification of the action.

In an environment characterized by large uncertainties in the natural and human subsystems, assessments need to be regularly revisited in order to check their continued relevance and validity as well as the performance of the assessment process. This requires the institutionalization of feedback loops at appropriate time scales.

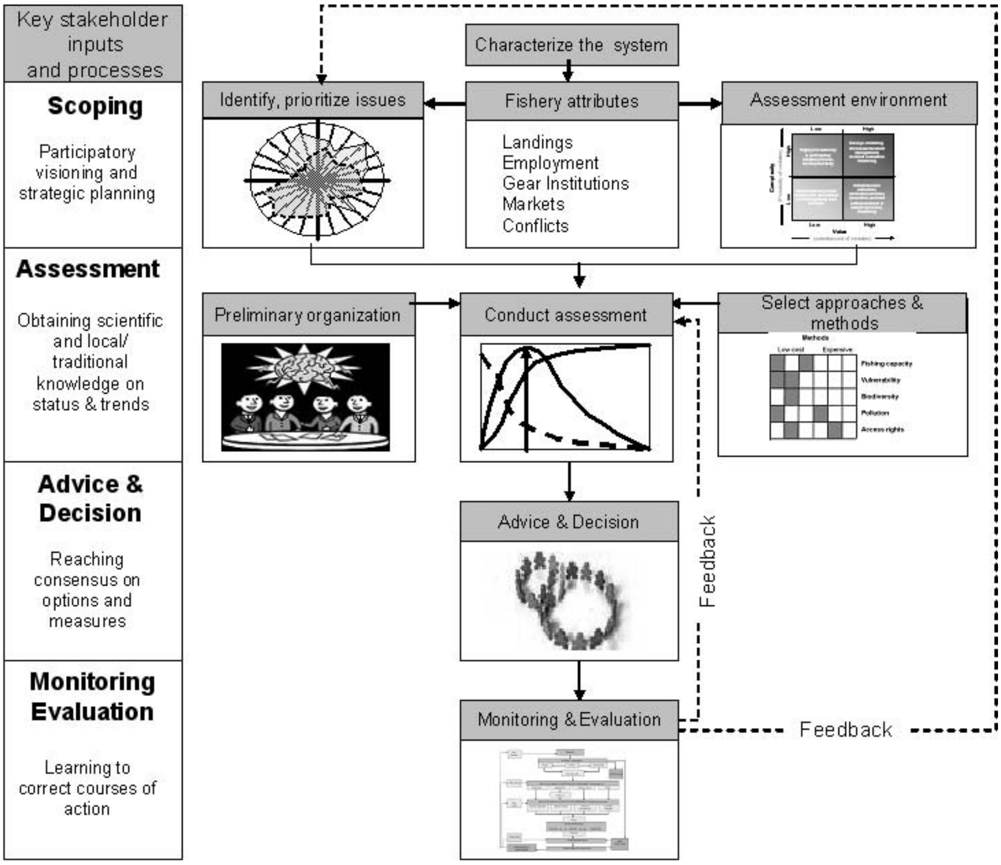
The remainder of the chapter will introduce and discuss the different phases of the IAA framework. The progressive phases of the process are represented diagrammatically in Figure 3.

SCOPING PHASE

The scoping phase is, in many respects, a rapid version of the assessment itself, progressing through similar steps for orientation and logistical purposes. The domains to be covered will depend on the specific demand for assessment but are likely to include the resource, the community and their environment (taken in the broader sense). It is at this level that, among other issues:

- The stakeholders' willingness to participate in the assessment is ascertained and stimulated.

FIGURE 3
The progressive phases of the integrated assessment and advisory process



- The question to be assessed, as posed by the management authority or by stakeholders, is specified or reformulated.
- First perceptions are gained as to whether a diagnosis and a possible compromise/ response can be found.
- Working hypotheses are formulated, which the assessment itself can test.

Descriptions of different assessment processes in the literature diverge slightly as to the amount of new information generated during this phase as opposed to simply collecting and articulating existing knowledge. The scoping phase is useful in analysing threats, opportunities and constraints faced by the fishery, in general and in relation to the specific demand.

This phase is important to obtain a preliminary identification of the key parameters of the assessment, for example: (i) system boundaries (e.g. geographical, ecological, institutional and political); (ii) system dimensions (e.g. ecological, techno-economic, socio-cultural and institutional) and their relative importance; (iii) system components, such as sectors involved, people concerned, type of resources, types of fisheries, operational institutions; (iv) Interactions, e.g. between dimensions, relations of authority, trade flows, conflicts, alliances; (v) respective roles of stakeholders concerns, including decision-makers (central or local), sources of knowledge (key informants), partners and facilitators; (vi) relevant time scales, e.g. from operational (seasonal, annual) to strategic (5–10 years); (vii) data availability (and data gaps) and sources of uncertainty, analytical approaches/methods potentially usable; (viii) participation capacity and optimal participation, i.e. comprehensive enough but not so large as to stall the process; (ix) potential obstacles to eliminate or circumvent; (x) value of the fishery (in economic and social terms; (xi) ecological threats, etc. The different steps to be followed in scoping an assessment will obviously differ according to context and specific conditions of the assessment. To begin with, the different steps that might constitute a scoping process include characterizing the system attributes, identifying and prioritizing issues and characterizing the assessment environment.

Characterizing system attributes

During this step, the available and relevant information will be identified and located regarding: the subsector, area, fishery (or fisheries), resources, competing activities, historical evolution, production and value statistics, markets, the institutional set-up, the preceding crises and the solutions applied, their fate and outcome, key local authorities and potential informants (knowledge holders). This information will help in forming an early judgement on the knowledge and institutional environment within which the assessment will need to take place.

Identifying and prioritizing issues

SSF systems have a very large number of relevant dimensions related to the human and natural subsystems and the current management or governance structure. The situation may also be characterized by a number of opportunities and threats that condition their present functioning and future trends. Some of the threats may be internal (institutional flaws), while others may stem from external drivers (e.g. climate; markets). External drivers have not been emphasized in conventional approaches to fisheries management. The scoping phase involves examining all the key dimensions of the system to identify the most relevant issues on which the detailed assessment should focus. The "entry points" for the assessment will usually depend on the way the issues materialize, e.g. the reason for a conflict or the need for the intervention.

A practical way to proceed is, starting from the entry point, to scan the issues at stake with the managers, the stakeholders and the assessment partners systematically (e.g. through interviews, literature, etc.), obtaining a comprehensive set of relevant and often interconnected issues, turning on the "issue radar" (Figure 4).

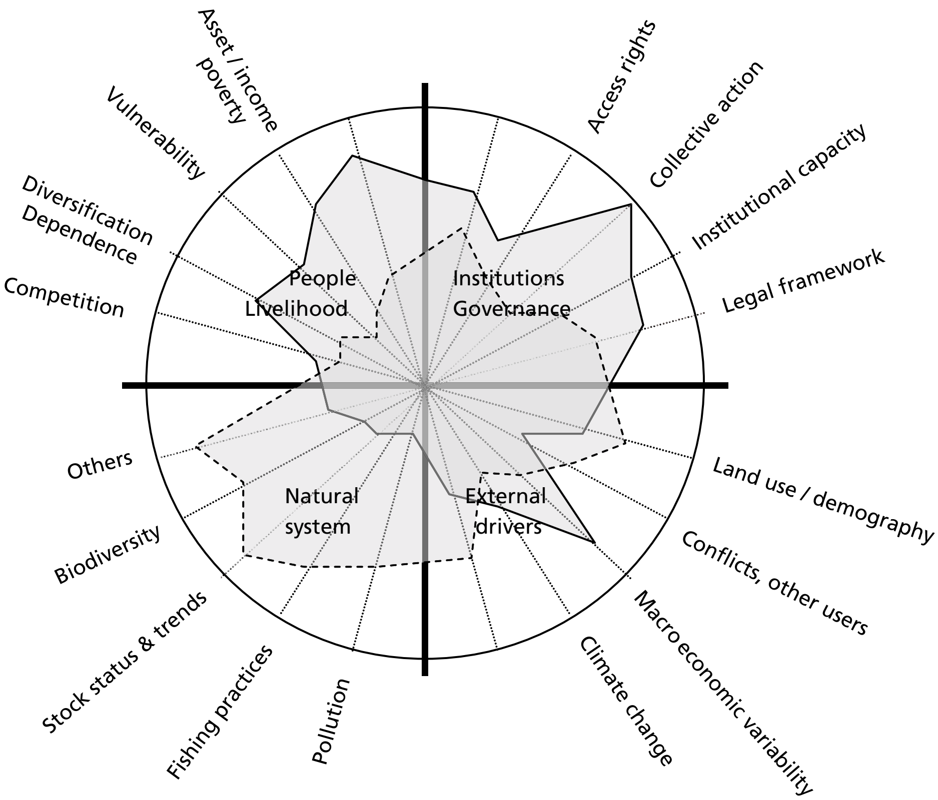
Having catalogued the issues, it will be necessary to determine their relative importance for the problem at stake. This initially will be done qualitatively (e.g. defining relevance as high, medium or low, for example, in relation to risk). Connecting the degree of relevance on each vector, a first indicative kite diagram of relevant issues will emerge. This will be a useful guide for the discussion with stakeholders as well as for identifying better what disciplines (i.e. partners) and approaches may be needed for the assessment. It is important to note that in order to conduct a full and comprehensive scoping exercise, all the issues represented in the diagram (and perhaps more) should be considered.

The holistic nature of this initial phase re-iterates the difference between conventional assessment and management approaches and more recent perspectives. It is emphasized that a comprehensive and holistic perspective can be adopted without getting mired in details and complexities. A simple, qualitative, ranked checklist developed from a stakeholder dialogue meeting that considers all four quarters of the issue radar is still going to be more useful to assessment and advice for SSF management than a very detailed fish population dynamics assessment survey that completely ignores an understanding of social and institutional issues.

Characterizing the assessment environment

During the scoping phase, identifying a common pathway for the assessment, among partners, with its time and financial implications, requires a set of criteria on which this decision can be based. It is argued that the most important criteria determining

FIGURE 4
Identifying relevant issues and their relative importance



The shaded areas represent two different fisheries; for the one with a dashed outline, ecological issues are prominent in the demand for assessment, while for the one with a solid outline, human development, livelihood and institutional issues are to the fore.

the level of investment in assessment are the fishery value and system complexity, with operational capacity (including governance and research capacity) playing a synergetic role (Figures 5 and 6). These elements are briefly discussed here.

Value

Common sense indicates that the cost of an assessment (and management) must be commensurate with the value of the fishery/sector to be assessed and in any case with the value of the benefit expected from the intervention. It is important to bear in mind that, especially in SSF, the value to be considered may go far beyond the measurable economic value of the fishery to include a range of social and cultural benefits that are difficult to measure. Nonetheless, assessing value at an earlier stage provides a guide to the kinds of approaches that are likely to be affordable for the fishery in question. From a purely economic perspective, the higher the value of the fishery, the higher the potential cost of a significant mistake (i.e. the higher the risk in economic terms) and the more investment is justified in informing and maintaining an effective management system. In a social-ecological system, however, the value of the system cannot be simply measured in conventional economic terms of use-values (e.g. value of the traded and exchanged goods and services provided). This is illustrated with reference to the total economic value (TEV) of wetland social-ecological systems (Figure 6).

While Figure 6 focuses on environmental goods and services, the total value of a fishery system is a highly composite variable that also includes, in the socio-economic system, employment and income multipliers associated with value-added along

FIGURE 5
Assessment approaches in relation to complexity and value of the fishery system

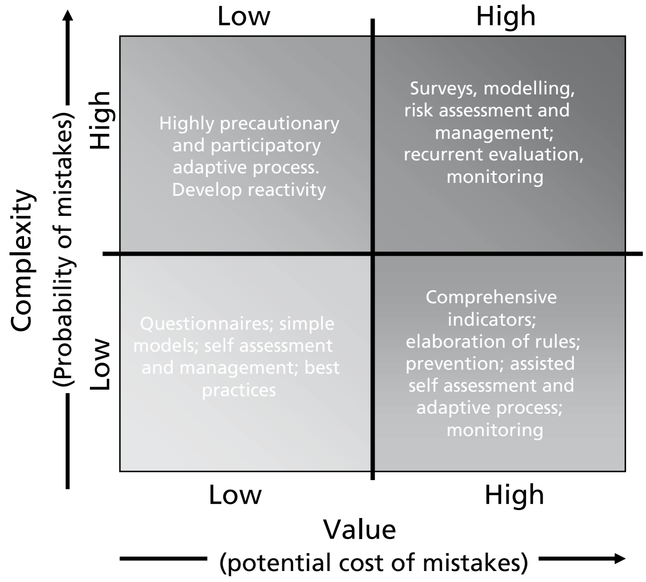
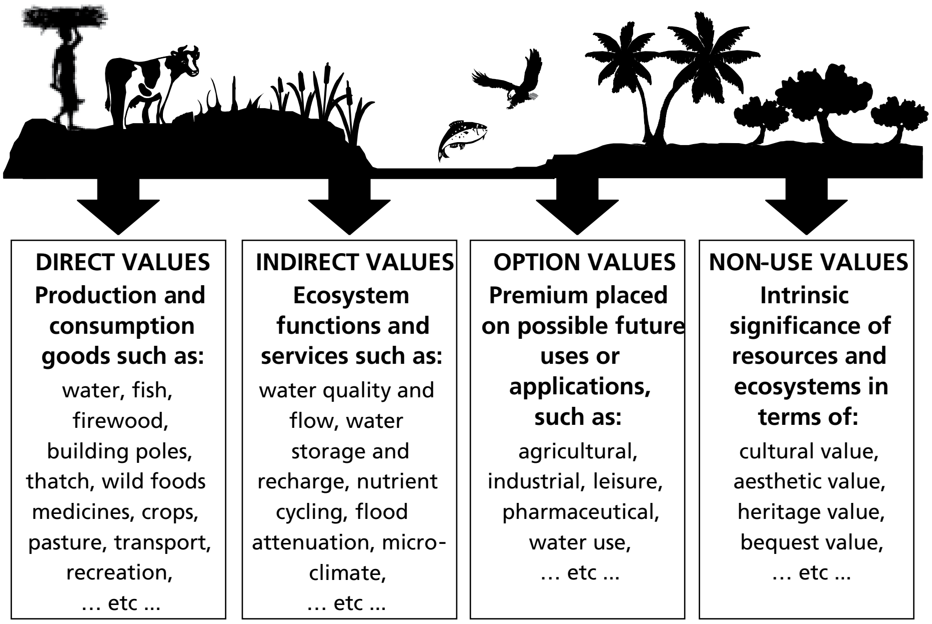


FIGURE 6
Total economic value of wetlands



Source: Emerton and Bos, 2004 after Barbier, 1997.

the market chain (FAO SFLP, 2006). It also includes the social value, as a safety net, or absorber of excess labour in times of employment shortage and its value in preventing food insecurity and the need for emergency aid assistance for at least some proportion of the landless poor. Fish and fisheries also have various cultural values: they contribute to our store of knowledge and understanding of ways of living and organizing ourselves; they play a prominent role in the visual culture of many countries; they are the source of symbols informing several major world religions; and, of course, they contribute to the culinary traditions and food cultures of many societies. These different categories of value (market, social, cultural, environmental) accrue to varying degrees to different stakeholders and at different scales in both time and space so they are difficult to identify. Further, once recognized, measuring them in a common currency is not easy, although various contingent valuation methods have been developed to do so and both environmental and social accounting are increasingly utilized to guide policy choices. In SSF, a simple proxy that captures some of these values is the number of households who depend directly and indirectly on the fishery for their livelihood.

The issue of value is further complicated by the fact that a fishery may have a low current value (e.g. as it is overfished) and a high potential value (e.g. if better managed). The potential value is probably a better indicator of what should be invested in managing the fishery in the long term, but current value may be the more realistic indicator of what could presently be spent. The value of a fishery might be high but the cost of the problem faced (and expected benefits of the intervention) might not justify the cost of the assessment and of the subsequent intervention (in cost/benefits terms). The economic value assigned to a particular fishery will depend on where the boundaries of analysis are drawn in each case. For example, a particular "fishery" (or "métier" in the sense of a boat/gear/species/season interaction) may have a limited economic value. However, the sum of the various "métiers" practised in a community is much higher. The value of the entire small-scale sector for an area would be even higher. The scale of valuation and assessment will be determined largely by the scale at which the dominant form of management is exercised, e.g. if most management decisions are taken at local community level, then that is the most appropriate scale for assessment. If management decisions are made on an ecosystem, coastal region or waterbody level, then that is the appropriate scale for assessment. In cases where there is little decentralization of management authority, larger, more aggregate scales of assessment may be used, as it is at that level that management actions will be implemented.

Complexity

Here, the term complexity relates both to the system to be studied and the assessment problem it raises. It includes aspects of both the system to be governed and the governing system which, in SSF, often overlap considerably (Bavinck *et al.*, 2005). The complexity of the system to be governed relates to the number of components, their interrelationships and their dynamics, such as: (i) the geographical spread; (ii) the number of species exploited and affected; (iii) the number of gear and boat types and hence of possible fishing strategies; (iv) the various types and combinations of livelihoods; (v) the variability (seasonal and interannual); (vi) the community heterogeneity; and (vii) the multiple-use coastal context. High complexity infers a wider information gap and higher levels of risk in making mistakes. Further, it is difficult to distinguish complexity and its effects from ambient noise or the effect of unaccounted factors. Holling (2000) proposes that "complexity may be in the eye of the beholder" and could relate more to our lack of understanding than to the number of components and relations identified. Nonetheless, in practice, the number of relevant components identified and their web of interactions will affect the choice of methods and the capacity to understand and produce a usable assessment. A key problem is balancing the level of complexity accounted for in order to achieve a realistic and accurate but still feasible assessment.

At the pre-assessment stage, complexity can be assessed against a simple checklist, for example:

1. Resources: does the fishery involve one or many species?

2. Ecosystem: is it pelagic or demersal? Simple or complex? Local or regional?
3. Stakeholders: Is there evidence of conflict and/or disagreement over management objectives and resource use? Is the fishery of significant value to groups beyond the fishers themselves (e.g. significant contributor to the economy, to nutritional security, cultural identity, etc.)?
4. Authority: Is the fishery under the jurisdiction of a sole formal or informal authority, or is responsibility shared among many (e.g. communities, private rights-holders, the State) such as common resources of transboundary stocks?
5. Technology: Does the fishery use multiple-gear types, or a single type? Does it involve one or multiple fleets?
6. Revenue streams: Do fishers or fishing households engage in other non-fishery related income-generating activities?

The responses will indicate how complex the fishery system is and, as a consequence, how "controllable" it might be. Some kind of complexity score can be set up and matched against the low/high scales in Figure 5.

Capacity

Operational capacity (e.g. financial, human and institutional) is another important criterion with obvious implications for the assessment strategy and process. Though not included explicitly in Figure 4, this criterion will, to some extent, be inversely related to complexity as the more complex the system, the less capable we will be to deal with it, under given conditions. Capacity is considered here in relative terms. Both capacity available and capacity deployment are important. It is important to know what capacity is available – for the assessment and implementation of advice – relative to each other. The lower the relative capacity (or the wider the capacity gap), the higher the risk of being unable to adequately tackle emerging issues. Every question to be resolved by an IAA necessarily raises the problem of capacity with its different components: the technical skills of the local experts available; the capacity to facilitate the participative process; the institutional competence (clarity of mandates) of the agencies involved; the data and time available for the assessment; and so on.

It is important to get a feeling for the capacity available versus what is needed at the level where the problem arises, whether locally (among fishers in the concerned community), or at national or regional levels. Capacity gaps may vary among disciplines and partners and it might be necessary to consider drawing on complementary external expertise.omplementary external expertise.

In the long term, the best way of closing the capacity gap is certainly to develop the national and local capacity in the deficient areas to a level commensurate with the value of the fishery. In the short term, however, the capacity gap determines the comprehensiveness, detail and reliability of the assessment and the level of precaution one will need to build in the proposed options. When the capacity gap is large, the options are: (i) to account for it in precautionary assessment and advice; (ii) to reduce it immediately, by bringing in external expertise when available; and (iii) to reduce it in the longer term adopting a capacity-building strategy. The choice among the three options is guided by the value of the fishery. However, it is also important to query whether the costs of the IAA process relative to outcomes/benefits warrant the use of capacity even where it is adequate.

There are various tools available for capacity assessment. The most relevant to a pre-assessment phase is institutional assessment, as implemented by the International Development Research Center (IDRC) as part of a process to strengthen the organizational capacity of its research partners (e.g. Morgan and Taschereau, 1996).

The scoping phase may conclude that it is inappropriate to proceed further with the assessment, for example for lack of consensus, excessively high levels of uncertainty, or a low value of the fishery or the benefit expected. While this may be an unfortunate conclusion, it is preferable to reach early in the process, before wasting precious resources. This does not always mean that nothing can be done to improve the fishery. In some cases the scoping will be a sufficient assessment to guide the direction of precautionary approaches, or those that increase capacity of stakeholders to address sustainability issues for themselves at lower costs. In some cases, the scoping may conclude that an assessment is feasible but not necessary, for example when there is already sufficient agreement among actors and a best practice solution is readily available (based on experience). In that case, it may be appropriate to proceed directly to the decision and implementation, building in the monitoring process. If the assessment appears indispensable and feasible with the means available, then the assessment phase can proceed. In reality, the distinction between scoping and assessment may not be clearly marked. Depending on the data and capacity available, some elements of the assessment may already start developing during the scoping phase. In addition, during the assessment itself, elements may emerge that require scoping before being fully assessed. It is important, however, within the IAA process to maintain synergy between the scoping and assessment phases of multiple components in order to keep all partners informed and optimize the assessment, e.g. realizing economies of scale.

ASSESSMENT PHASE

The assessment proceeds through different approaches, methods and tools (used here loosely but also referring to methodological categories nested in that order). Having conducted the scoping process and established the need for an assessment and the capacity available, the next phase proceeds first through an organizational mode.

Preliminary organization

Convening the assessment team

The assessment phase starts by building up of the assessment team, calling for: (i) the partners required to fulfil disciplinary requirements; (ii) key informants among stakeholders (users, managers and influential people); and (iii) other people with relevant knowledge but no stake in the process. This process is conducted with reference to the threats and opportunities identified in the "issue radar".

In putting together the assessment team, the following qualities are a consideration, in addition to the obvious and conventional disciplinary and technical skills:

- open-minded attitude and willingness to learn;
- gender balance;
- ethnic balance;
- local language skills; and
- organizational background.

There will also be a trade-off between establishing a small or large assessment team (assuming human resources are available) and between splitting, or not, the large group needed into smaller teams. The trade-off is between the ability to assess a large area faster or tackle a number of issues simultaneously and the inherent difficulties in managing a large composite team from different disciplines (Pomeroy and Rivera-Guieb, 2006).

Allocating roles and responsibility

Roles and responsibilities are jointly agreed based on the prioritization of different issues and the relative importance of different components within these issues. The leading role might be taken by the discipline most relevant to the issue at stake. It might also be taken (or supported) by a facilitator that will give the highest priority to the completion of an integrated assessment, smoothing any "friction" between disciplines. The leader (or facilitator) identifies and proposes roles and responsibilities and obtains agreement on the allocation of tasks and expected contributions. Specific roles will be given to selected stakeholders, with the usual caveats about full and diverse representation.

Developing shared visions and strategies

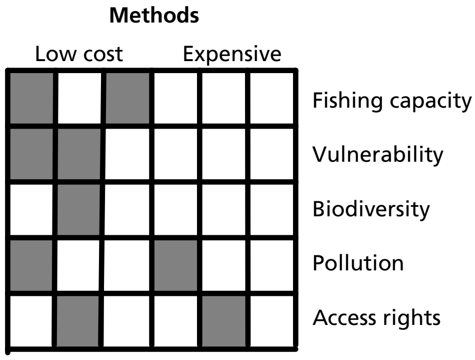
At this stage, the aim is to develop a shared vision and strategy for the assessment among those involved in the assessment process, building a common understanding on the nature of the problem and possible resolutions. This step should develop a common understanding of the relevant time and space frames to be used by the team (possibly allocating responsibilities and expectations across them) for a cross-scale assessment. This step involves also looking again, in more depth, at the "issue radar" given in Figure 4, confirming their relevance and relative priority. Efforts will be made to identify existing visions among stakeholders (including potential explanations), noting similarities and divergences. The common vision is, initially, the overlapping area between them. One key objective of the IAA will be to increase the overlap significantly as the various points of view converge. A variety of well-tested group process methodologies for developing a vision with a diverse group of stakeholders are available and the use of a facilitator[7] versed in these methods may produce a result that is consensual and that can be a strong foundation for moving forward.

Selecting approaches and methods

Once the team is established and responsibilities are allocated, the assessment work proceeds through a number of steps that are briefly described below. Based on the identification of key issues and the characterization of the assessment environment during the scoping phase, considerations for the disciplines, approaches and methods needed for the full assessment will start to emerge. Approaches are determined by the perceived complexity of the management issues, the resources and capacity available, the scale of application and the value of the fishery (see Figure 5). Depending on the degree of complexity and cost of the analyses to be conducted, directions might be different for the different areas of competence (e.g. resources, ecosystem, economics and institutions). Methodological specifications may be established first in broad terms, adding detail as the assessment progresses and the team is assembled.

At this point, experts from the various disciplines must identify the methods to be used, based on issues identified, data and competencies available, affordable costs, sophistication required, etc. (Figure 7). For low-value fisheries, for example, simple methods are required, using existing data, filling knowledge gaps from databases (e.g. Fishbase for biological parameters) and carefully selected case studies undertaken elsewhere on similar fisheries (with due caution – taking into account context effects). Learning will need to be low cost. Internet-based knowledge networks could be a good source of expertise.

FIGURE 7
Indicative matrix for identifying approaches and methods



Note: grey cells represent selected methods.

The diversity, severity and scale of issues will have implications for the selection of appropriate methodologies. Potentially useful methodologies, some of which are already used in fisheries, have been developed for other development sectors (e.g. agriculture, forestry, rural sector) or development frameworks (e.g. sustainable development, sustainable livelihoods) and their

[7] The facilitator's role is to assist in selecting the most appropriate methodology, planning the process and serving as a catalyst to help it along.

application to fisheries needs to be facilitated and promoted. For example, some participatory rural appraisal (PRA) tools used for the collection of social data and information have also begun to be used in the biological fields. Table 2 gives an indicative and limited selection of methods by domain of research, the intent of which is to show the range available compared to the very limited toolbox used in conventional assessment. As this framework matures through collaboration and testing, a more detailed catalogue will be developed indicating what these approaches and methods are and under which conditions they operate best and so on.

It would also be difficult to list all the tools that might be used in support of the various approaches listed above but, with the same intent, the following quantitative and qualitative tools can be mentioned: in-depth and informal, unstructured and semi-structured interview using open-ended questionnaires; participative mapping; transect walk; indicators; geographic information systems (GIS); desk research; stakeholders meetings; causal chain analysis (CCA); participant observation; group and focus group discussions; various ranking and scoring methods (pile sorts, Q-sorts)[8]; diagrams and other visual tools. More quantitative tools include: general and partial equilibrium models; multiagent models; and other models (macroeconomic, microeconomic, input–output, bio-economic). The use of qualitative methods may not be very typical in conventional stock assessment but their integration in multidimensional assessments becomes unavoidable.

While the process is made as transparent and objective as possible, the selection of the approach and the methods, in each assessment domain, implies reference to an explicit or implicit conceptual representation of the fishery (or conceptual framework) constructed from a body of theory (paradigm) and one's culture and experience. The conceptual (mental) models used by different knowledge holders (including stakeholders) are likely to be different. They will need to be clarified to and discussed by all team members, together with their basic assumptions. Clarification may concern:

- the criteria for selecting a particular method;
- the kind of information it uses, whether quantitative or qualitative;
- the kind of outputs it will bring (historical perspective, description of present state, trends and scenarios, alternative solutions) etc. and their relevance to the questions at stake; the robustness of these conclusions to uncertainty.

This process should clarify common understandings, or lack of, regarding the direction an IAA process is taking. Issues to consider in this part of the process could include an analysis of strengths and weaknesses of the given set-up, with its unavoidable shortages in data and resources. As a consequence, the expected synoptic output and single contributions to it could be outlined. Explicit judgement could be made about where to place emphasis in reducing uncertainty. The process of validating collective local knowledge should also be discussed as this is a sensitive and contested issue.

Conducting the assessment

Once the questions have been clarified, the team is in place (with external collaboration as required) and the methodological set-up has been determined, the assessment itself can take place. The expected outcomes of this phase include:

1. A definitive formulation of the question.
2. A clear statement of the objectives assigned to the assessment.
3. An updated report on status and trends in the area/sector/fishery, as appropriate.
4. A deeper understanding and clear expression of the issues at stake, e.g. the management problem, the conflicts, the policy formulation, the management plan.

[8] See Pomeroy and Rivera-Guieb (2006).

TABLE 2
Preliminary overview of methods used in the socio-economic and biological domain

	SOCIO-ECONOMIC DOMAIN		
	Fisheries only (incl. processing, etc.)	**Fisheries and related livelihood**	**Multisector**
Community	PRA (M) H/H survey (M) Stakeholder and gender analysis (M) Economic analysis (A) Socio-cultural analysis (A) Cost/Benefit Analysis (M)	SLA (A) PRA (M) Institutional Analysis and Development framework: IAD (A) H/H survey (M) Stakeholder and gender analysis (M) Economic analysis (A) Socio-cultural analysis (A) Cost/Benefit Analysis (M)	SLA (A) PRA (M) IAD (A) Stakeholder and gender analysis (M) Economic analysis (A) Cost/Benefit Analysis (M) Socio-cultural analysis (A)
Local admin unit	H/H survey (M) Stakeholder and gender analysis (M) Policy analysis (A) GIS (e.g. poverty map) (T) Economic analysis (A) Socio-cultural analysis (A)	H/H survey (M) Stakeholder and gender analysis (M) Policy analysis (A) GIS (e.g. poverty map) (T) Economic analysis (A) Socio-cultural analysis (A)	Stakeholder and gender analysis (M) Policy analysis (A) IAD (A) Economic analysis (A) Socio-cultural analysis (A)
Province/State	Economic analysis (A) H/H survey (M) Policy analysis (A) GIS (e.g. poverty map) (T)	Policy analysis (A) GIS (e.g. poverty map) (T) Economic analysis (A)	Policy analysis (A) IAD (A) Economic analysis (A)
Country	H/H survey (M) Policy analysis (A) GIS (e.g. poverty map) (T) Economic analysis (A)	Policy analysis (A) GIS (e.g. poverty map) (T) Economic analysis (A)	Policy analysis (A) IAD (A) Economic analysis (A)
Region	Policy analysis (A) GIS (e.g. poverty map) (T)	Policy analysis (A) GIS (e.g. poverty map) (T)	Policy analysis (A) IAD (A)
	BIOLOGICAL/ECOLOGICAL DOMAIN		
	Stock (single species)	**Multispecies**	**Ecosystem**
Community	Stock assessment (A) PRA (M)	PRA (M)	Ecosystem approach (A) PRA (M) Biodiversity assessment (M)
Local admin unit	Stock modelling (M) Stock assessment (A) PRA (M) GIS/RS (T)	Trophic analysis(A) Multispecies stock assessment (M) PRA (M) GIS/RS (T)	Ecosystem modelling (M) Ecosystem approach (A) PRA (M) GIS/RS (T) Environmental flow approach (A) Biodiversity assessment (M)
Province/State	Stock modelling (M) Stock assessment (A) GIS/RS (T)	Trophic analysis Multispecies stock assessment (M) GIS/RS (T)	Ecosystem modelling (M) Ecosystem approach (A) GIS/RS (T) Environmental flow approach (A) Climate/environment modelling (M) Biodiversity assessment (M)
Country	Stock modelling (M) Stock assessment (A) GIS/RS (T)	Trophic analysis Multispecies stock assessment (M) GIS/RS (T)	Ecosystem approach (A) GIS/RS (T) Environmental flow approach (A) Climate/environment modelling (M) Biodiversity assessment (M)
Region	Stock modelling (M) Stock assessment (A) GIS/RS (T)	Trophic analysis GIS/RS (T)	Ecosystem approach (A) GIS/RS (T) Environmental flow approach (A) Biodiversity assessment (M) Climate/environment modelling (M)

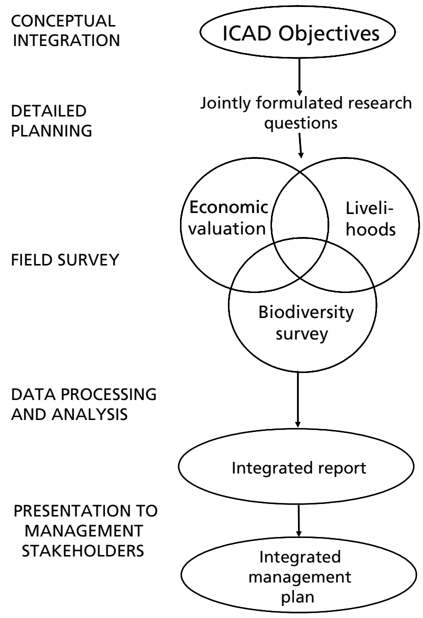
A: Approach
M: Method
T: Tool
Source: FAO, 2005a.

5. A series of options for action, evaluated in economic, social and bio-ecological terms, in the short and long run, including the transition phase.

A key element of the assessment is that it should be, as far as possible, carried out in an integrated manner throughout, from scoping through to discussion of assessment findings with management stakeholders. As discussed earlier, the delicate issue is to decide what part of the assessment is carried out separately by each discipline, what part must be undertaken jointly and what procedure will be used to blend the various findings into a single whole to be communicated to the demanding authority.

This integration has been achieved, for example, in a wetlands assessment project, where the challenges of integrating livelihoods, economic valuation and biodiversity analysis to provide information on integrated wetland conservation and development have been addressed (Figure 8).

FIGURE 8
Schema for integration of disciplines reporting on integrated conservation and development (ICAD) assessment and planning in wetland sites



Source: Darwall *et al.*, 2007.

Validating the assessment – peer review

The peer review of the ongoing science build-up, e.g. through the process of formal academic publication, is different from peer review of the expertise provided and the options developed in a decision-making process. A broader view of peer review is to be taken in this latter case. The peer review is "extended" in the sense that it involves not only the scientific discipline peers but also the end-users themselves. The peer review is extended also inasmuch as it is both a substantial evaluation (assessing the data, methods and conclusions) and a procedural evaluation (assessing the degree of participation, adhesion to conclusions, etc.). If such a service would exist, the assessment could be certified as procedurally correct and substantially sound. Certification could be obtained from a competent company or developed by consensus-building. The peer review may be undertaken immediately, at the end of the integrated assessment, advice and decision-making process, or it could also be delayed to later on as more data become available. If the participation was equitable and led successfully to an agreed set of ranked options, it could be concluded that the extended peer review has indeed been taking place, integrated in the IAA process. If the assessment process is institutionalized, it is advisable to plan an external review of the whole process every few years, to check its outcomes and objectivity.

ADVISING AND DECISION-MAKING

Contrary to previous approaches, in an IAA, all stakeholders are well informed of and contribute to the advisory process as well as the subsequent decision-making and negotiation processes. Interactions between these phases are complex with bifurcations and feedback loops.

Advising

The most recent analyses of science – decision-making relations in fisheries (e.g. in Wilson and Delaney, 2005) clearly indicate the need for:

1. A shift of the focus of management advice and subsequent action from the resource (stock) to the fishery, i.e. from a biological to a bio-socio-technological dimension. Under an ecosystem approach to fisheries, the advice is expected to account not only for interactions within and between fisheries but also interactions within the ecosystem *sensu lato,* including the role of external drivers.
2. Advice that is not open to interpretation, a requirement that is more difficult to fulfill in a complex coastal, multiple use context. As information on complex systems can always be interpreted differently by changing the angle or the basic assumptions, this requirement implies that the interpretation must be

legitimized by the actors concerned through participation that generates a consensus regarding the advice that is offered even when there is a wide variety of options.

3. An examination of the impact/performance of existing measures before advising new ones, avoiding the accumulation of norms and measures that overcomplicates the regulatory landscape within which the sector operates.

A particular complexity of interdisciplinary advice required for SSF is the need to blend together considerations related to the natural system (elaborated by "hard" natural sciences) with those related to the social subsystems (elaborated by "soft" social sciences). In theory, considerations about nature can be quantified and objectively verified. Considerations about the social world, on the contrary, rely on a communicative system of shared meanings that can only be interpreted and never directly verified (Wilson and Delaney, 2005). These distinctions have also been shown for fishery systems by Garcia and Charles (2007). The differences between the two types of science, as described above, are obviously simplified. On the one hand, the "truth" established by so-called hard sciences tends to appear, in the long term, as partial and often transitory explanations. The more complex the subject of the study, the more likely this is to happen. On the other hand, some of the key findings of the social sciences are experimental and quantitative. In addition, "socially constructed" local knowledge is elaborated through fairly robust adaptive learning systems (Wilson and Delaney, 2005). The blending of all these forms of knowledge is in any case advisable, requiring:

- establishment of a proper mechanism for such blending in a decision-making environment so as to produce usable advice in the required time frame;
- establishment of an adaptive learning process through which the conventionally agreed blended knowledge can be complemented, tested and improved, e.g. through monitoring and evaluation; and
- maintenance of the needed flexibility in the system of institutions, norms and regulations to allow for change as required.

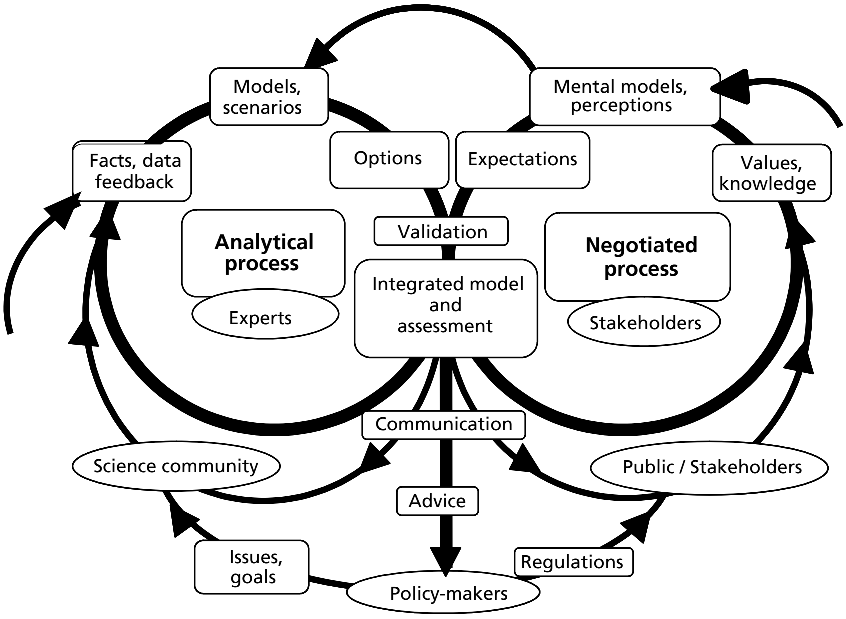
The assessment and its outcome must finally be evaluated – either by the authority that originally commissioned it or by an external entity called in for the purpose. This step involves both appraisal and decision. During the appraisal, the decision-maker develops insight about the various options available and the implications of each.

This last phase of the IAA process may take various forms, with different degrees of intervention of science and other stakeholders. It may involve the Minister alone (rarely), the minister and his/her advisers (often under lobbying pressure), or consensus-based decision-making through public for a (for example in the context of community-based management). For small-scale fisheries, the chances that decisions are successfully implemented will depend on the degree of transparency and stakeholder participation. The roles of stakeholders in this phase are different from the roles assumed during the course of the assessment. For example, stakeholders may play a role in positioning scientific information or other advice within a wider spectrum of other information, objectives and considerations (see Floistad, 1990).

The assessment must provide the distinct but connected advisory and decision phases (see Figure 9) with an understanding of the state of things and a set of possible options for action, with an analysis of their prospective implications in the short and longer terms. A scenario analysis would help in this respect. Comprehensible statements are essential. The assessment should also reflect the degree of gravity/urgency of the situation, e.g. being more directive in case of high risk. The options identified contain and identify explicitly the uncertainty in the assessment. The final outcome may or may not contain a recommendation as to the preferable option and the reasons for that.

Figure 9 provides a conceptual representation of the type of integrated assessment and decision-making process that could be used, in which careful knowledge

FIGURE 9
Integrated assessment and decision-making process



Sources: from Garcia and Charles, 2007. Adapted and redrawn from Pahl-Wostl, 2002.

integration, interdisciplinary alliance, active stakeholder participation and support for decision-making can take place in an integrated manner. It combines a rigorous scientific analytical subprocess and a participative negotiating subprocess. The participatory nature of the assessment legitimizes the options available and their evaluation, but attention must be paid to possible distortions owing to the proximity between the more objective and the more negotiated processes of advice and decision-making, respectively (see Floistad, 1990). The analytical subprocess uses facts, data and feedback information, within the current scientific paradigm, to generate a scientific understanding of the system. The negotiated subprocess, possibly facilitated by social scientists, provides inter alia an understanding of the functioning of institutions, values, perceptions, expectations, acceptable objectives and mental models to be considered in constructing the scientific model. It also mobilizes traditional knowledge to be integrated in the analytical process. Both processes contribute in an interactive mode to the elaboration and evaluation of the present situation, the identification, ex ante evaluation and ranking of implementation options and the elaboration of future scenarios. The same dual process monitors the evolution of the system during implementation and provides performance assessment as a basis for the adaptive management cycle.

The concept of a dual integrated process is not new to fisheries and may be prefigured by the processes used to elaborate operational management procedures (OMPs; Butterworth and Punt, 2003) and for management strategy evaluation (MSE; Fulton, Smith and Punt, 2005). It implies stronger levels of participation of stakeholders and social sciences in information-building, model conception and analysis of options. It implies a well-developed interface for integration of the respective assets of conventional fishery science, applied ecology and social sciences and provides a useful operational guideline for space-based integrated, cross-sectoral management. Its utility does, however, depend on whether the science-analysis is truly objective and free of the influence of informal mental models and perceptions and politicized viewpoints – for example between scientists who are also environmentalists and economists who are also advocates for social change. The policy-making process – including its advisory stages – can be highly politicized in complex systems (Sutton, 1999; Keeley and Scoones, 2000).

Decision-making

The IAA framework does not address the decision-making process *sensu stricto*. This process involves a specific set of actors, authorities, powers, constraints and objectives. Final decisions are made within policy frameworks that may extend well beyond the fishery sector and, *a fortiori*, the SSF sector.

The process is also different in different set-ups. In a top-down fishery management system, the minister may make the final decisions, while in a participatory set-up, that decision may be taken through an open and transparent system. It is obvious that the IAA framework makes a lot more sense if implemented in a participative, deliberative decision process and if it is embedded into a civic science approach (sensu O'Riordan and Stoll-Kleemann, 2002). Such an approach is a form of science that is deliberative, inclusive and participatory, and that recognizes the necessity of involving multi-stakeholder groups in society if fairer and more comprehensive decisions on natural resource management are to be made. For the fisheries sector, this would mean multistakeholder involvement in research and management. Participatory decision-making depends, however, on the existence of appropriate institutions that are based on a process of shared governance, where different groups in society are able to create their own pathways to the future (O'Riordan and Stoll-Kleemann, 2002).

Participation in the advisory process is extremely relevant as it creates outcomes that depend directly on the nature of the process. In this sense, the IAA recognizes the importance of institutions that aim to widen the process of decision-making by enabling participants to define problems from their perspectives and experiences and to seek solutions they regard as appropriate and suitable for their culture and aspirations. Outcomes so achieved, although perhaps not well liked, will tend to be accepted because the decision process was trusted and understood (O'Riordan and Stoll-Kleemann, 2002). In addition, while a consensual approach may sometimes lead to measures considered as clearly suboptimal from a strictly technical point of view, it has the potential to lead to better long-term performance (through the adaptive approach) because (or if) the steps on a difficult pathway are agreed by all the important stakeholders and implemented. On a similar note, in some cases high priority issues will be the ones for which data are not available and, therefore, negotiation will play a more important role than science. In such cases, precautionary principles will need to be employed while assessment and knowledge building can be done.

Information and communication

While communication and knowledge sharing has been a critical aspect throughout the assessment process, concentration here is on the communication of the assessment results and, leading into the next section, some implications for monitoring and evaluation. In the first place, it is important that in any communication of the results of the assessment there should be information about the uncertainties associated with it. Hoggarth *et al.* (2006) and Cochrane (2002) all provide useful advice relating to the presentation of information from stock assessments and Hoggarth *et al.*, (2006) also highlight some of the ways in which uncertainty can be communicated.

A key priority for communication activities is that information has to be generated and shared in an appropriate and timely fashion, allowing people to develop their own understanding and knowledge (Garaway and Arthur, 2004). In this respect, awareness of how information can best be shared, based on the knowledge, skills and experience of each target audience, is as important as the information itself. A useful principle therefore is to examine existing information flows – what methods different stakeholders already use – and start from there (Halls *et al,.* 2005). In achieving successful communication, developing trust and building mutual respect, the inclusion of different types of knowledge is challenging but essential. Where possible, the target audience should be engaged from the start and be involved throughout the assessment process. The barriers to communication, even within stakeholder groups, are many and go beyond issues of culture, translation, levels of education and terminology to include challenges posed by institutional and personal incentives and attitudes (e.g. Garaway *et al.,* 2006; Arthur and Garaway, 2006; Strigl, 2003).

In an adaptive learning process, the experience of Arthur and Garaway (2006) was that there is much to be gained if all stakeholders are involved in assessing or evaluating information or collaborate in generating it. They took an innovative "learning by doing" approach to information sharing in which, rather than being presented with the assessment results, the target audience was assisted to analyse some of the key data themselves and to discuss the implications of the findings (Arthur and Garaway, 2004). While time consuming, this approach often associated with "skills" training, ensured that those who needed to learn were doing so. This is important as it can be expected that when stakeholders understand the results, they can see their relevance and are more likely to be committed to the process. The results are then far more likely to be utilized than when decisions are imposed from the top (Bryan, 2004; Dalton, 2005; Faysse, 2006; Garaway and Esteban, 2003; Jentoft, 2000; Ribot, 2006; Rockloff and Lockie, 2006; Silva, 2006).

Greater participation and two-way communication by a range of stakeholder groups can greatly benefit the assessment process. While critical for accessing different knowledge types and for taking an interdisciplinary approach to fisheries systems, participation and communication can also help to improve the effectiveness and efficiency of data collection and the quality of the monitoring and evaluation systems (Arthur and Garaway, 2006; Halls *et al*., 2005). In developing countries, research and management take place in resource-poor and educationally-limited contexts. Without an emphasis on communication and participation, there is a very real risk that approaches will be unfamiliar to all the stakeholders and that key words, questions and concepts may become irrelevant or be misinterpreted. The likely result is poorly understood and executed designs that result in inaccurate or unreliable information (Arthur and Garaway, 2006). In addition, people are more likely to accept the results when they know where the information came from and had a hand in producing the answers.

MONITORING AND EVALUATION

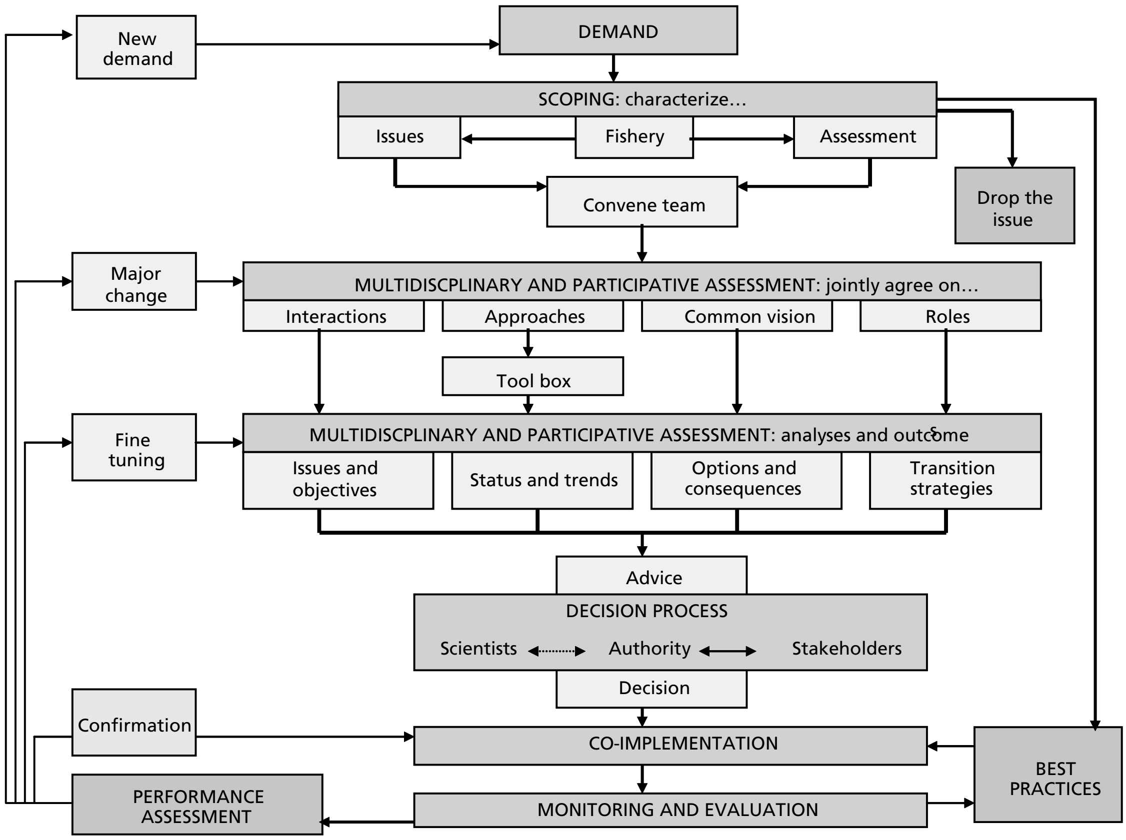
Monitoring and evaluation are critical components of adaptive learning and management performance assessment. They provide feedback information emerging from the application of available knowledge and the consequences of the new management actions. They are therefore critical to informing resilience-building adaptive management (Andrew *et al*., 2007). Thus, monitoring and evaluation should not be seen as a "before and after" process, but rather as a continuous, iterative and integral part of the IAA and adaptive management processes. Figure 10 pulls together in one single representation all the phases and steps provided for by the framework**.**

Purpose of monitoring and evaluation

In IAA, monitoring and evaluation (M&E) are integrated in the recurring assessment and decision-making process. They provide major feedback loops through which learning will increase and performance will improve. M&E are required to evaluate the IAA process in relation to its performance in the short term (operational, crisis solving) and in the long term (strategic, sustainable livelihoods). M&E are essential elements of the social learning process and the *sine qua non* condition of any effective adaptive

FIGURE 10

Complete integrated assessment and management process



approach. As for the assessment process itself, the M&E cost will have to be tailored to each situation and remain affordable (see next section).

- M&E in the short term: In this process, the assessment, advice and decision made to resolve a crisis, in terms of implementation and outcomes, are evaluated with the view to check their validity, to learn from experience and to improve the measures as required. The parameters for this evaluation are given by the initial objectives of the decision (e.g. translated into reference values) and the indicators regarding the resource and the fishery. This M&E process might be undertaken for a number of years depending on the resources concerned and the issue at stake. In practice, many decisions will need to be evaluated together. The cycle could go on indefinitely.
- M&E in the long term: In this process, undertaken every few years and ideally forever, the IAA process itself is evaluated in terms of its success rate, its efficiency, e.g. in achieving consensus, ability to find valid solutions and cost effectiveness, etc. This would include, from time to time, an evaluation of the M&E process itself and, in this case, will therefore need to involve external auditing. The parameters required imply that objectives are set for the IAA process (e.g. in terms of performance, cost, etc.) and that indicators are identified and collected.

The evaluation undertaken at this stage of the IAA cycle is undertaken *ex post* based on the data collected through monitoring. It follows and checks the validity of the *ex-ante* assessment undertaken during the initial phases of the IAA process or the preceding *ex-post* evaluation. In case of a recurring assessment, the *ex-post* evaluation of the past assessment phase and the *ex-ante* evaluation of the new assessment are confounded. Because of the cost involved in monitoring and evaluation, this part of the process can only be sustainable if there is a strong formal demand for performance-based governance.

Requirements for monitoring and evaluation

First of all, an M&E system requires a clear statement of objectives and expectations to be used as benchmarks. These objectives should be turned into indicators, and reference values for them identified where possible. These should cover both human and ecological well-being and could be quantitative or qualitative. The setting up (and institutionalization) of an ideal M&E system requires:

1. An agreed set of indicators determined for the purpose.
2. Enquirers, such as field enumerators or on-board observers for data collection and processing.
3. An integrated information system to store the data and make them available for analysis (e.g. databases connected to GIS).
4. Capacity to undertake recurrent analyses of such data to assess the stock and the sector.
5. Information support (e.g. through Internet) to feed the new information and knowledge back to the sector and the public, making the M&E process an instrument of transparency and oversight.
6. An authority specifically mandated for such oversight and auditing.

One of the key requirements for sustainable governance, however, is that it be affordable, e.g. viable at a cost commensurate to the revenues drawn from the fishery activities. As a consequence, the cost of the M&E process, as with the cost of the assessment itself, should be tailored to the value of the fishery. The costs of the above "ideal" system may scare off SSF managers from attempting any monitoring. This set of conditions can be short circuited. For example, if the "issue kites" from the scoping phase of the assessment are revisited with stakeholders periodically – in a group or individually – and their view of where thing are getting better or worse is recorded, that is a basic valid M&E process that does not require additional data collection.

While a thorough process would be advisable for an M&E of the SSF sector as a whole or in a large region, the ad hoc interventions undertaken in single fisheries or small communities will require simple procedures (that could be run by the community with minimal assistance) and simple data (that could be collected by the fishers themselves). In extreme cases, the M&E can be conceived as mainly or exclusively qualitative, e.g. largely based on questionnaires and discussions. An important point, however, is that without some reliable M&E process, the so-called adaptive approach is left entirely to informal processes, the capacity of which to face the rapidly changing context is more than dubious.

Indicators

The use of indicators as a means to monitor and assess progress in sustainable development was called for in 1992 UNCED Agenda 21, Chapter 40, as a basis for monitoring and decision-making at all levels and to contribute to self-regulating sustainability of integrated environment and development systems. Since then, indicators have become favourite instruments for monitoring, reporting and communicating progress in the process of implementation of the sustainable development framework (Bilharz and Moldan, 1995). Indicators and reference values have always been in use in fisheries management before their formal promotion in support of sustainable development and their formal use in management systems has been promoted by FAO (Garcia, 1997; FAO, 1999; Garcia and Staples, 2000). Indicators form an integral part of the implementation framework for the precautionary approach to fisheries (PAF) (Garcia, 1994; FAO, 1996; Garcia, 2000) and the ecosystem approach to fisheries (EAF) (Garcia *et al.*, 2003; FAO, 2003; Daan, Christensen and Cury, 2003; Garcia, 2008). The

BOX 5

Indicators, targets and reference points – definition and role

An indicator is *a variable, pointer, or index. Its fluctuation reveals the variations in key elements of a system. The position and trend of the indicator in relation to reference points or values indicate the present state and dynamics of the system. Indicators provide a bridge between objectives and action* (FAO, 1999). It is a *signal of processes, inputs, outputs, effects, results, outcomes, impacts, etc. that enable such phenomena to be judged or measured. Both qualitative and quantitative indicators are needed for management learning, policy review, monitoring and evaluation* (Choudhury and Jansen, 1999).

A reference point (or reference value) is a particular level of an indicator used as a benchmark for assessment and management performance. *It is an estimated value derived from an agreed scientific procedure and/or model, which corresponds to a specific state of the resource and of the fishery and that can be used as a guide for fisheries management. It indicates a particular state of a fishery indicator corresponding to a situation considered as desirable (target reference point, TRP) or undesirable and requiring immediate action (limit reference point, LRP and threshold reference point, ThRP)* (Garcia, 1997).

When reference values (and therefore objectives) cannot be expressed in quantitative terms, indicators could be interpreted in relation to reference directions (e.g. increased abundance; reduced discards; improved employment) as opposed to reference values. Indicators have a number of useful functions for small-scale fisheries assessment and management. As normative instruments (i.e. as standards), they can be used, for example, for attribution or not of a subsidy (when the latter is conditioned by, say, the level of revenue, or the overall value of the fishery) or to open or close a fishery (e.g. based on biomass levels). As instruments of quantification, they measure quantitatively (or qualitatively) the level of a criterion or of one of its components that can then be represented on a graph. As such they are considered important in monitoring and performance assessment. As instruments of communication, they intend to encapsulate the essence of a complex situation and convey a message (or performance, or risk) and can be used to inform the stakeholders as well as elements of mediation and dialogue, e.g. in a negotiation process. Finally, as a means of simplification, they aggregate the properties of complex components and systems into few aggregated or integrated variables. Simplification of complex systems and functions is a double-edged knife but it is central to communication. With all these functions, indicators can play a central role in evaluation and monitoring of SSF, provided they are affordable and agreed by stakeholders who understand their properties, the meaning of the changes, the factors behind such changes and the implications of these changes for action and are therefore willing to assist in their implementation.

development and maintenance of a system of indicators and reference values are central to the institutionalization of M&E as they formalize the demand and justification for collecting targeted information and providing a background scientific capacity for its routine analysis.

While the FAO Techical Guidelines on “Indicators for sustainable development of marine capture fisheries” (FAO, 1999) do refer to data-limited situations, integration of knowledge, use of rapid appraisal and capacity building (see the sections *Scoping phase* and *Advising and decision-making* of the Guidelines), their application, up to now, has focused on the development of quantitative indicators in both data-rich and high-capacity circumstances. It is recognized that designing a monitoring system for small-scale fisheries in resource-poor situations may require an approach, using qualitative indicators, that simply monitors a generalized system state and an indication of whether that state is moving in a societally-favoured or disfavoured direction.

Relevant indicators

The numerous indicators listed for use in fisheries (see FAO, 1999), whether referring to the resources, the sector or the governance system, are potentially relevant for SSF monitoring and assessment and the lists available are generally much too comprehensive for the means available to most SSF governance systems. The indicators of relevance for a particular evaluation programme obviously depend on the context, the nature of the fishery and, above all, on the question initially raised or problem to be solved, the solutions proposed and their expected outcome. However, the specific issues affecting SSF and the specific objectives retained for them imply giving particular attention to some of them relating for instance to sustainability, food security, poverty, empowerment, resilience, adaptability, vulnerability, livelihoods, etc. In addition to conventional fishery indicators, general indicators of human development will be particularly relevant for SSF, such as demography and level of education, nutrition and health. In small-scale fisheries, the main difficulty is likely to be in obtaining reliable indicators of the resources.

Issues with indicators

The experience accumulated during the last 15 years with the use of indicators in fisheries points to a number of difficulties that need to be foreseen and resolved, including, in a SSF context: (i) the selection of relevant and affordable indicators for population and ecosystem indicators; (ii) the process of obtaining the data and calculating and interpreting of indicators; (iii) the assessment of uncertainty (signal/noise ratio); (iv) the development of decision rules stemming from the observation of indicators; (v) the long-term cost of monitoring; (vi) the difficulty of separating the effects of climate, habitat degradation/pollution and fishing; (vii) the frustrating quest for relevant pre-exploitation baseline information; (viii) the agreeable formulation of value judgments attached to specific indicators levels (e.g. what is acceptable?); (ix) the ranking of objectives and risks among stakeholders with different expectations and perceptions; (x) allocation of the burden of proof in a precautionary approach; and (xi) development of a risk assessment and management culture; all of this in a context of chronic limitation of data and research capacity.

Indicators appear, therefore, as a source of hope in a data-limited context, but can lead to incorrect action if they are misunderstood.

Indicators are also seen as a useful means of communication, able to encapsulate summaries of complex information in a few graphs. For the same reason as above, these very concise summaries can be very difficult to decrypt by the constituency. Indeed, it is usually recommended to distribute indicator summaries with reading keys and scientific commentaries to assist readers in their interpretation.

Indicators and local knowledge in SSF

The development of indicators that are scientifically valid, less complex than conventional models and agreeable to stakeholders would be an important step in improving management frameworks, not only in the developing world. For indicators to be accepted in SSF management they need to address directly SSF communities' local agendas and concerns. However, these concerns might not match the general management/sustainability concern of more strategic importance but of little relevance perhaps to the poor communities. An example of this is the need for catch statistics at aggregate level for global monitoring of the sector by FAO, while locally developing a monitoring system to quantify total catch may not be a high priority and people may be more interested in tracking trends in catch rates, profitability or exploited species composition, all of which are too context-specific and influenced by different factors (technology, changing markets, etc.) to be useful for comparative purposes.

SYNTHESIS

This chapter has presented the integrated assessment and advice process, elaborating on the different phases. It should again be noted that while the presentation of the assessment process is linear, the framework is characterized by continuous feedback loops and founded on principles of adaptability and reflexivity. The integrated assessment and advice process (Figure 3) is coupled with the policy/management cycle described in the following chapter. Connections between the two – in the form of transfer of knowledge, power and legitimacy – are likely to work best if the wheels are turning in same direction.

4. Situating the framework within the planning and management cycle

This chapter positions the IAA framework in broader processes of policy-making, development planning and operational management. It re-introduces general planning and management cycles and discusses the role of different individuals within assessment, planning and management processes. Finally, the importance of integrating the different phases of the IAA framework and incorporating this into the wider management process is emphasized.

THE POLICY AND MANAGEMENT CYCLE

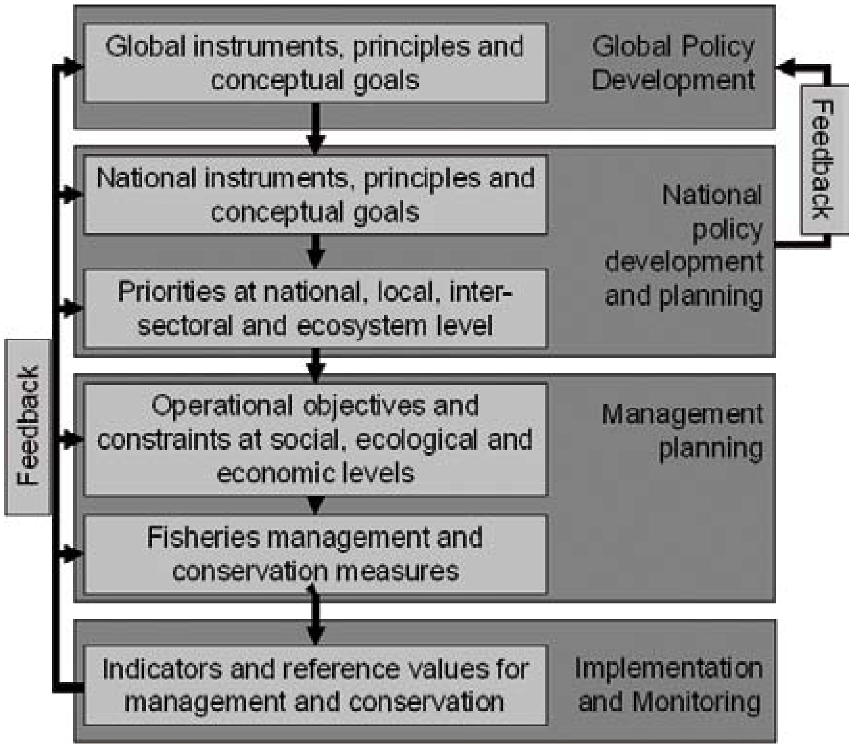
The integrated assessment of a SSF may be needed in support of short- to medium-term management or medium- to long-term planning for development or policy change.

Medium- to long-term planning involves either recurrent planning or the introduction of new initiatives and approaches. The first might involve, for example, the preparation of recurrent national economic development plans (five to ten years), which require a strategic assessment of the history of the fishery and performance of past planning strategies, a multidimensional profile of the SSF subsector, determination of the trajectory of the fishery and its status relative to other subsectors and identification, understanding and advice on constraints and opportunities for change. The second aspect of long-term planning might involve the introduction of a major change in the approach to developing SSF, which could occur as a result of broader contextual changes (e.g. a shift in government or donor policy) and also requires a strategic assessment.

Short- to medium-term management involves systematic planning and implementation of management initiatives as well as problem resolution in response to emerging issues. With regard to the first, which includes initial drafting or review of management plans occurring on a yearly or bi-annual timescale, the IAA process becomes both strategic and operational. It is strategic where it identifies suitable management approaches for the entire subsector, e.g. the EAF or the introduction of territorial fishing rights. It is operational when it deals with the elaboration of the management regime of a particular fishery, advising on specific measures designed for that fishery and type of resource with an *ex-ante* assessment of their impact. In both cases, the purpose of the assessment is to look at ways and means to translate national policy objectives into management objectives for the subsector and/or for specific fisheries, focusing on finer time and geographical scales. The recurrent assessment of management performance also belongs to this category of strategic assessments. Finally, resolution of emerging issues means that demand is associated with a particular issue, and time available for the assessment may be limited. These are short-term crisis-driven interventions. While the purpose of effective management is to avoid the emergence of crises, surprises are to be expected. It is also the reality that where management has been ineffective in the past, problem solving is often urgently required.

While presented above as distinct considerations, medium- to long-term planning and short- to medium-term planning are not mutually exclusive and there is considerable interaction and feedback between the different planning and management cycles. Connections between global and national policy development (i.e. at United

FIGURE 11
General policy and management cycle



Source: FAO, 1995.

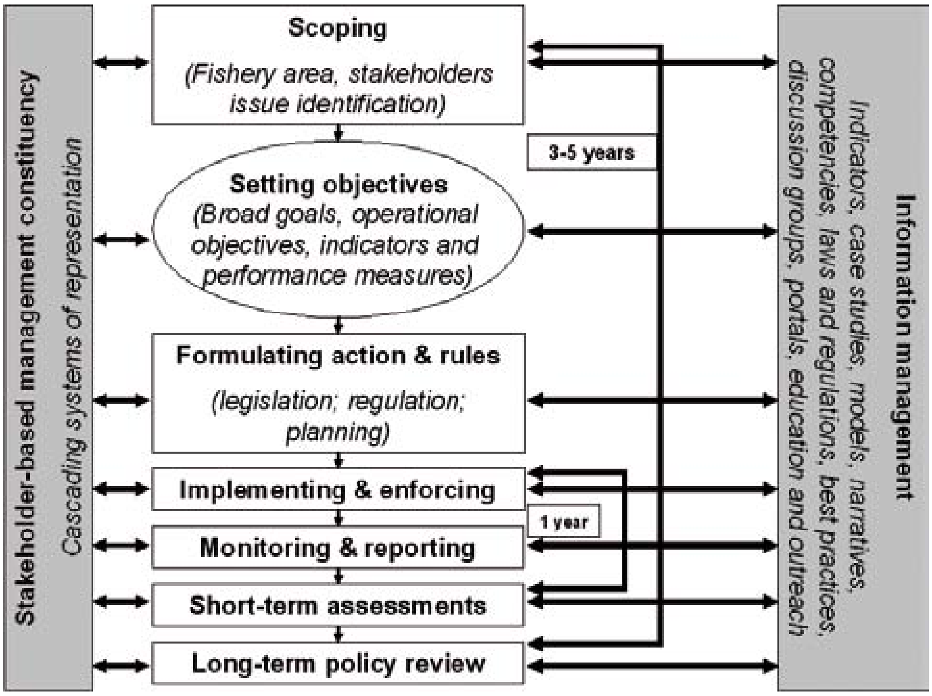
Nations or FAO levels) and between national policy development and management planning and implementation are important (a figure introduced by FAO in 1995 represents these connections – see Figure 11). Some form of assessment is needed at every step, e.g. to assist in selecting objectives and priorities, identify issues, assess likely consequences of different options, monitor implementation and assess performance. All feedback loops tend to involve some form of assessment. A more detailed representation of the management cycle (Figure 12) can be drawn in which the role of information (and stakeholder participation) can be reflected at every stage, from scoping the management plan through longer-term policy reviews (e.g. for performance assessment).

Conducting integrated assessment and advisory activities within the planning and management process, according to the fundamental principles outlined above (Chapter 2), is reliant on the interaction of a diversity of stakeholders. Defining different stakeholders and their roles in the assessment and advice process is important to maintain its effective and legitimate implementation. Further, the stakeholders involved and the roles they play will be different within different types of assessment so this feature of organization and integration will have considerable implications for the integrity of the process and its outcomes.

ROLES OF DIFFERENT STAKEHOLDERS

For an effective IAA process, it is important that the different actors concerned are aware of their respective roles and behave accordingly (Alverson, 1972; Jasanoff 1994). The actors involved in IAA are the key stakeholders, including: (i) the fishery management authority staff, decision-makers and advisers; (ii) the scientists and other components of the assessment group; (iii) the SSF communities or fishworkers in their

FIGURE 12
The management planning and implementation cycle



Source: FAO, 2003.

diversity; and (iv) the non-fishery stakeholders. non-governmental organizations, e.g. with interests in environmental or fishing sector matters, may play an important role in the IAA process. In the specific context of SSF in developing countries, a range of development-sector stakeholders are also implicated. Decisions on the location of schools and clinics, the power granted to local governments and the type of policies pursued for social protection and economic growth will all have implications for fishing communities. Stakeholders in these processes will include a wider range of governmental and non-governmental organizations, as well as traditional authorities and private-sector interests in other, potentially competing economic sectors. The roles of these potential stakeholders, particularly in relation to assessment and advice, are briefly specified below.

Who is the "manager"?

The "manager" is the entity or person charged with the authority and responsibility to manage the fisheries. Under current governance regimes, the ultimate authority is the State, which can delegate all of part of the authority and connected responsibilities to institutions below it and can comply with institutions beyond its jurisdiction (e.g. in regional and global governance regimes). The delegated authorities are accountable to the State, while States are accountable (usually voluntarily) in international law. While the term "manager" is thus used rather generally, it covers different realities in different countries. In some developed countries, a fishery manager is a single person in charge of managing a single fishery. In many developing countries, the responsibility is centralized and the "manager" is the Director of the Fisheries Department or even the Minister of Fisheries, whether at the national or provincial/state levels, e.g. in the case of many federal countries. With limited human resources, particularly in island countries, he/she may be "managing" the entire sector as a whole and at best a subsector, e.g. in the case of a person in charge of the whole small-scale fishery sector. SSF are rarely managed on a fishery-by-fishery basis. Instead, they tend to be managed on a geographical basis, for instance, by subregions or municipalities (as in the Philippines). In a co-management system, the manager responsibility is shared between the State and the community. In more devolved community-based management systems, the State remains ultimately responsible for the condition of the resources but all the management responsibilities might be devolved to the fishing or coastal community itself. Under an integrated coastal area management system, the authority might be the Minister for Planning, or Finance, or any coordinating agency specifically mandated. In a stakeholder-based management system, the "manager" is the stakeholder committee, accountable to the constituents it represents and is drawn from.

Who is the "assessor"?

In a conventional fishery management framework, the assessor is the scientist or group of scientists (usually fishery biologists) involved in undertaking the assessment,. In the more participatory management systems needed for SSF, the situation is more complex as the assessment may be conducted: (i) by a multidisciplinary team working in an integrated mode or (ii) with the active participation of the key stakeholders. The scientists may come from the national fishery research laboratory (depending on the Minister of Fisheries or the Minister of Science and Education) or from a university or research institute, or may be hired as consultants (e.g. in the Chilean artisanal fisheries). They may be contracted by the Ministry, a donor agency, a development bank, an environmental NGO or by the industry itself. In participative systems, stakeholders may therefore be involved both in the assessment and in the negotiation process leading to the decisions. In many traditional SSF, the "assessors" are the fishworkers themselves who develop an understanding of the system based on the collective wisdom inherited from the elders and their own experience.

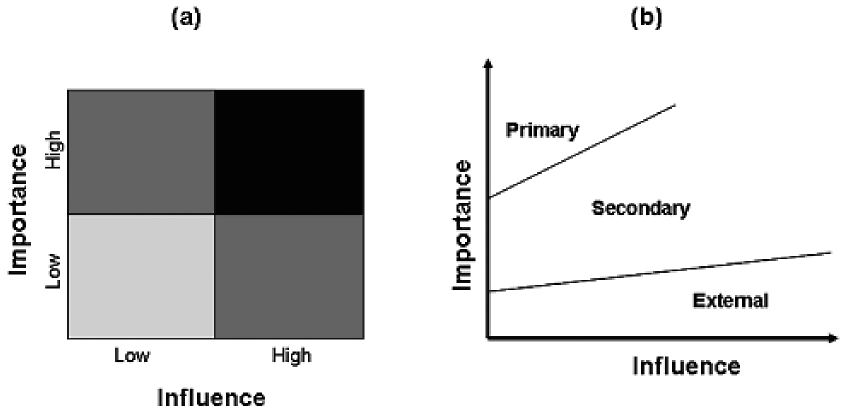
Usually, scientists assess and advise but do not have a role in the final decision-making process, in which other stakeholders and the authorities in charge negotiate over which implementation options among the ones elaborated through the IAA are most appropriate or acceptable. However, in some cases, the reality may be more complex. For example, the participation of scientists as stakeholders in the decision-making process might be useful in order to: (i) provide the explanations and clarifications other stakeholders may require during the final negotiation on the system "reality" or best scientific understanding; and (ii) assist in building consensus among groups of stakeholders with diverging understanding and objectives (Jasanoff, 2004). This is a role that social scientists may be comfortable with but which natural scientists are usually reluctant to play, concerned as they are, at least rhetorically, to keep the science process clear from political interference.

It is increasingly recognized that political processes and scientific ones are not as distinct as some natural scientists would like to believe. Conducting assessments in which scientists facilitate decision-making processes in addition to assessing and advising does not mean that rigour is necessarily jeopardized. Principles such as maintaining transparency and accountability, differentiating between collective knowledge and personal interests, and standardizing practices of reflexivity and adaptive learning can compensate where the line between assessors and participating stakeholders or decision-makers is less clear, as is likely the case in SSF in developing countries.

Who are the stakeholders?

The stakeholders are all those with a stake/role in decision-making. *All those affected, positively or negatively, by an activity, or the people who can influence the process of impact of an activity. Broadly defined, stakeholders in fishery regimes include fishermen, the fishing industry and institutions involved in the management system, all those who rely on fishery habitats for a living and those interested in conservation of fishery*

FIGURE 13
Common templates for the classification of the relative importance and influence of the different stakeholder groups



resources and habitats (compiled from Walmsley, Howard and Medley, 2005). It can be noted that in top-down management systems, there is a clear distinction between managers and other stakeholders. In fully devolved (bottom-up) management systems, the roles of managers and the other stakeholders overlap, as the latter also participate in the management process.

Wide stakeholder involvement is predicated in the context of the IAA framework. A key task then becomes that of managing the power relationships between stakeholders during the assessment process, so that the interests of primary stakeholders (fishworkers who may lack power) are not overridden by the powerful advocacy lobby of some external stakeholders, who may have the ability to muster impressive science-based analysis to support their position and thus influence the agenda of key government decision-makers (secondary stakeholders). Therefore, while there is much preoccupation with the technical integration of different knowledge systems, far more important is the way in which differential power is exercised in determining "whose reality counts" (Chambers, 1997). A stakeholder based assessment therefore requires careful attention to managing power relationships – a task requiring skilled facilitation and arbitration. Stakeholder participation in the assessment is likely to be more effective when the management itself also calls for their participation (Brown, Tompkins and Adger, 2001).

Various methods of classifying stakeholders have been proposed. The most common uses two criteria – influence and importance – to classify stakeholders into four categories (Figure 13a).

Brown, Tompkins and Adger (2001) develop a stakeholder analysis which defines importance as the degree to which the stakeholder is considered a focus of a decision to be made, while influence is presented as the level of power a stakeholder has to control the outcome of the decision-making processes or the decision itself. The level of influence stems from the power which stakeholders have to control, persuade or coerce others into making a decision and following a certain course of action. As Salancik and Pfeffer (1974) have said: "power may be tricky to define, but it is not difficult to recognize: [it is] the ability of those who possess it to bring about the outcomes they desire". Importance is often relational rather than absolute and can vary according to the objectives of the decision-makers. Groups or issues can also rise in importance under certain circumstances (Brown, Tompkins and Adger, 2001). A slight modification to this classification matrix uses the influence and importance criteria to classify stakeholders as primary, secondary and external (Figure 13b), where:

- **Primary stakeholders**: people directly affected by management – they are important beneficiaries of management but may have low influence, e.g. fisherfolk, migrants, fish traders
- **Secondary stakeholders**: people not directly affected by management, but directly involved in the process – may have high influence, e.g. traditional authorities, landlords, government officials, FAO fisheries field programme personnel.
- **External stakeholders**: not directly involved, but can be influential, e.g. fish consumers, scientists and conservation and development interests (national and international, such as FAO Fisheries and Aquaculture Department).

In their discussion on issues emanating from the use of a stakeholder approach in fisheries management, Mikalsen and Jentoft (2001) use a classification of *legitimacy*, *power* and *urgency* originally developed in a business studies context to suggest that stakeholders can be differentiated between: (i) groups that have a legal, moral or presumed claim (legitimacy); (ii) groups that are in position to influence decisions (power): and (iii) groups whose claims demand immediate attention from managers (urgency). Based on these criteria, stakeholders could be grouped in the following categories:

- **Definitive stakeholders**: groups or individuals whose demands and needs managers must attend to because they possess legitimacy, power and urgency, e.g. fisherfolk, fish processors, enforcement agencies.
- **Expectant stakeholders**: groups or individual that only possess two of the three attributes, e.g. local communities, environmental groups.
- **Latent stakeholders**: groups or individuals who possess only one of the attributes and to whom there is little incentive for the manager to respond to their claims until, for instance, they demonstrate legitimacy or acquire power (e.g. the media, future generations).

In a real world, however, experience shows that stakeholders having "only" power (political and financial) may be able to capture the attention of the managers and even control the system.

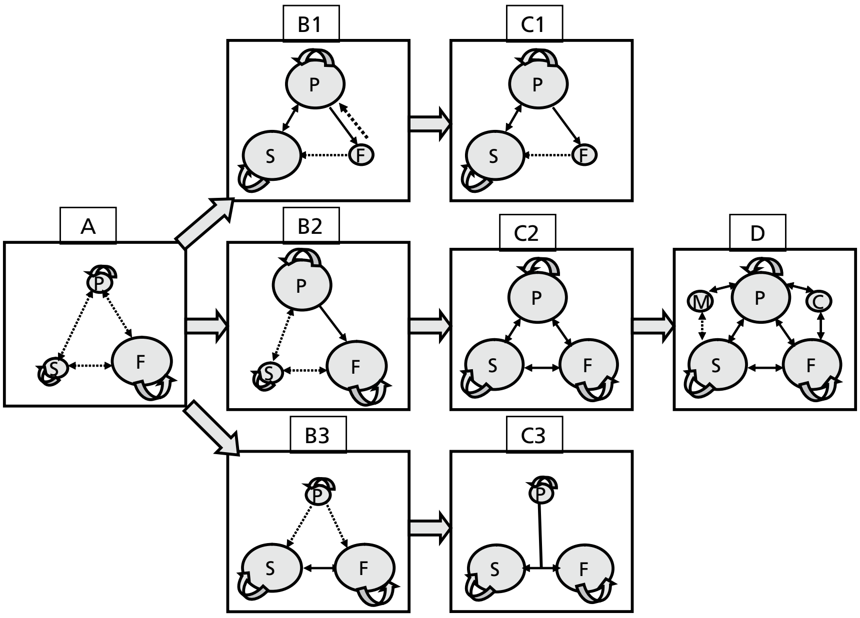
Understanding the different stakeholders in a SSF social-ecological system is important. When the demand for an assessment arises, either within strategic or operational contexts, the next step is to then assign roles and decide on the relative powers of the different stakeholders, which effectively represents the level of participation, interaction and collaboration that will define the IAA process. See Figure 14 for an overview of how different stakeholder relationships can be categorized.

It is essential for the sustainability of multistakeholder processes and effective IAA and management decision-making that stakeholders are aware of their different roles (at different scales in different cycles of assessment) and that they behave accordingly, working within the boundaries of their mandates and responsibilities (Alverson, 1972; Jasanoff, 1994), with transparency and accountability.

The boundary between the manager and other stakeholders is evolving rapidly as participatory management systems are put in place with part of the decision-making power being devolved to the stakeholders through appropriate institutions. Many of the decisions which, in any other sector, would belong to the industry and fishers (e.g. type and size of gear to use, area and season to fish, investment to make) are decided by the manager because of the vulnerability of the resource to overfishing and depletion and the conflict between the individual and collective interests. In devolved fishery systems, the manager tends to keep an oversight role (e.g. on stock sustainability), expressed by the imposition of norms, indicators and reference values, leaving operational details to the sector. That approach is certainly preferable for small-scale fisheries.

The boundary between scientists and other stakeholders in the development of scientific conclusions also depends on context. While in conventional fisheries management fishers are seen as data providers and decision implementers, in modern times the sector itself can commission scientific analyses, establish collaboration schemes with scientific institutions

FIGURE 14
Interaction between policy-makers or managers (P), scientists (S), fishworkers (F), media (M) and courts (C)



Notes:
The figure shows the configuration of relationships between policy/management (P), science (S) and fishworkers (F) that can evolve.

1. (A) may represent the system before the emergence of Nation States, when self-sufficient communities auto-generate their knowledge, rules and processes. Elements B1 to B3 represent three possible paths for the evolution of the system.
2. (B1) reflects the development of a strong government-science link in support of a top-down management system with an indirect role of fishworkers through lobbies.
3. (B2), on the contrary, reflects a situation in which a strong directive state develops a top- down, regulatory system (essentially for conflict resolution among fishworkers) with minimal scientific support. The sector provokes and influences the decisions through lobbying. Many fisheries around the world were managed in this way in the 1970s with little or no attention and lip service paid to science and conservation (Alverson, 1972). This is still the case for many large-scale fisheries in the developing world.
4. (B3) reflects a system in which strong links are established between science (often academic, non-governmental) and fishworkers in a situation of neglect or non-intervention from the State.
5. (C2) sees a balanced development of the three linkages and may reflect a true integrated knowledge-based management as seen for instance in the Northern prawn fishery of Australia.
6. (C3) would be an evolution of B3 in which the benevolent State limits its role explicitly to overseeing the relationship between F and S, making sure that it is informed by it.
7. (D) is the modern evolution of C2, with the emergence of a significant role for the media (M), advocacy and the courts (C), the latter becoming an instance for conflict resolution and an alternative path to conventional negotiations.

The types of decentralization likely to happen in SSF are best represented by elements A, B3 and C3.

and participate directly in the research and the interpretation, contributing also empirical or local knowledge. In order to investigate (or at least inform) the multiple dimensions of the system's likely response to potential measures, the scientists may feel compelled to straddle the boundary between science and policy, between what they can demonstrate and what they are convinced of. They may have to use participative research methods in which indemonstrable consequences of an action might be conventionally agreed as likely by all stakeholders. This situation is typical of decision-making under uncertainty. In such a process, most scientists would prefer to leave the full responsibility of the decision to the manager, voluntarily not constraining the decision. Many managers, on the contrary, would wish to get as "hard" and clear an advice as possible, particularly when political costs may be high, with a substantial part of the responsibility and risk being taken by scientists. However, under different circumstances, managers may want many options to select from based on their own perceptions or the lobbying and political pressures they are subjected to. In a fully participatory advisory process, the decision is jointly reached and the responsibility and liability are therefore shared.

THE INTEGRATIVE CHALLENGE

While the process of assessment and the choice of assessment procedures and methodologies are deliberately flexible, a key requirement of the IAA, as envisioned, is the need for integration on many levels. The process of assessment is as important to an effective and legitimate assessment and advice activity as the specific outcomes and recommendations. Interaction of actors, integration of knowledge, linkages between assessment and decision-making and merging of assessment outcomes from different time scales are essential components of the IAA proposed.

Integrating perspectives

Both the natural and social sciences have distinct but complementary contributions to make to the assessment process and the formulation of advice for decision-making (Jentoft, 2006). The IAA itself, as well as its embeddedness in the management and planning cycles, enables ongoing fusion of these disciplines, through holistic issue recognition, iterative and adaptive learning processes and feedback structures, and stakeholder interactions and participatory processes. Further integration of disciplinary perspectives occurs within a complex and dynamic environment, in which boundaries are blurred. The form that interdisciplinarity will take within the IAA process will be determined by the formal demand, practical questions, time schedules, deadlines, research positions and budgets that are agreed and allocated to achieve problem-oriented disciplinary integration.

Beyond different disciplinary perspectives, a consequence of fishery system complexity is that the same information may be interpreted differently by different stakeholders. Conversely, the same action may lead to different outcomes -- in different places or in the same place at different times. It is a requirement of managers that the assessment may not be open to multiple interpretations. However, in a multiple use, multistakeholder context, it is impossible to ensure that assessment outputs cannot be re-interpreted in a different manner. It is more precautionary to accept the fact that many causes may lead to the same effect and one factor may yield different results. In addition, in a multidimensional assessment, blending quantitative and qualitative information opens the way to re-interpretation or reformulation of the qualitative information, potentially affecting the conclusions. The solution to the dilemma for managers is not in ordering the scientists to elaborate iron-clad conclusions (artificially hiding part of the uncertainty), but in institutionalizing a highly participative, adaptive learning system. In such a system, it is important to recognize all possible interpretations that have been scientifically validated (possibly with some objectively determined degree of likelihood) and to consider them all when designing a potential response, hopefully robust, to the uncertainty. One of the elements of the response should indeed be to seek additional evidence in order to resolve the ambiguities as soon as possible. Resolution of differing interpretations and consensus on strategic decisions is ultimately necessary to maintain the spirit of partnership. It may be advantageous, in such cases, to have the scientists participating in the final stage of decision-making, where the ambiguity will need to be faced and the conclusions shown to be supported by the data and their analysis.

Integrating knowledge

The principles of integration (Chapter 2) allude to the need to broaden perspectives for the IAA as well as for more effective and legitimate SSF management. The challenge is then to integrate the knowledge systems that inform broad perspectives in a way that maintains the integrity of the collective, integrated knowledge and the shared visions and values. Scientific rigour and integrity of knowledge are, among others, considered dependent upon effective participation of target-groups in problem identification and solving, on building institutional capacity and on stakeholder ownership of the development process.

BOX 6

Defining and using traditional and local ecological knowledge in fisheries

Traditional ecological knowledge (TEK, also known as local ecological knowledge or LEK)[1] refers to the cumulative body of knowledge, practice and beliefs, evolving by adaptive processes and passed down through generations by cultural transmission (Berkes, 1999; Neis and Felt, 2000). TEK contains empirical and conceptual aspects, is cumulative over generations and is dynamic, in that it changes in response to socio-economic, technological and other changes (Berkes, 1999). Berkes (1993) clarifies that traditional ecological knowledge differs from scientific ecological knowledge in a number of substantive ways: (i) TEK is mainly qualitative as opposed to quantitative; (ii) it has an intuitive component as opposed to being purely rational; (iii) it is holistic as opposed to reductionist; (iv) in TEK, mind and matter are considered together (as opposed to a separation of mind and matter); (v) it is moral (as opposed to supposedly value free); (vi) it is spiritual as opposed to mechanistic; (vii) it is based on empirical observation and accumulation of facts by trial and error as opposed to experimentation and systematic, deliberate accumulation of fact; (viii) it is based on data generated by the users themselves as opposed to that by a specialized cadre of researchers; and (ix) it is based on diachronic data, i.e. long time series on information on one locality as opposed to synchronic, i.e. short time series over a large area.

The field of TEK is grounded on a number of practical examples, as can be seen in a recent volume that contains an authoritative summary of the use and importance of fishers knowledge in fisheries assessment and management, and, in collaboration with scientists and managers, for advising on fisheries governance (see Haggan, Neis and Baird, 2007 for different examples worldwide).

There are already many initiatives towards complementary use of scientific and traditional local ecological knowledge around the world that seek to develop collaborative assessment of small-scale fisheries. Johannes (1981) details the biological/ecological evaluation of fisheries TEK in Oceania and volumes of selected studies of local-based marine resources management systems in Asia and the Pacific illustrate this topic (Johannes, 1989; Ruddle and Johannes, 1989; Freeman, Matsuda and Ruddle, 1991). In Brazil, studies have reported different aspects of fishers' knowledge, including their understanding of the environment of Pantanal wetlands (Calheiros, Seidl and Ferreira, 2000). Fishers in many coastal areas and in the Amazon river have a nomenclature system for fish species, usually classifying key species in a detailed way according to their ecology and behaviour. The use of fishers' knowledge in deciding about optimal fishing strategies of coastal islands (Begossi, 1992; 1996), in the management and assessment of fisheries in the Amazonian floodplain (Isaac, Ruffino and MCGrath, 1998; Castello, 2004), in coastal fisheries of northeastern Brazil (Cordell and McKean, 1992; Christensen et al., 1995) and in coastal lagoons in southern Brazil (Seixas and Berkes, 2003; Kalikoski and Vasconcellos, 2007) have been key for sustainable management of the resources.

[1] We refer here to all forms of knowledge available to SSF, whether based on well established tradition (also referred to as traditional knowledge or traditional ecological knowledge, TEK) or more recently acquired (also referred to as local ecological knowledge, LEK) (Berkes, Mahon and McConney 2001).

The successful application of the IAA framework and its use in planning and management cycles will be influenced by (i) the extent to which managers, assessors and stakeholders more generally appreciate the validity of each others' knowledge and understanding and (ii) by the extent to which collective knowledge and shared visions and values are developed and the different systems validated by other stakeholders.

To facilitate both these process a short review of the potential contributions of local knowledge is provided.

The findings of Wilson, Raakjaer and Degnbol (2006) in the small-scale fisheries they examined in Zambia and Viet Nam might be considered a useful proxy (to be checked in each case) of the type of issues affecting the use of fishers' knowledge:

1. Except for some key climatic factors (e.g. water levels or rainfall), traditional knowledge tends to be directly related to the geographical and time scale of the daily and seasonal operations of fisheries and rarely relates to the longer-term considerations of interest to fisheries management. The consensus emerging between fishers, in the various case studies, appeared to vary, depending on the subject, the place and the countries examined. There was good consensus among fishers in relation to fish abundance, size and species composition, the role of destructive fishing methods (and the need to ban them), the importance of juveniles and habitat for productivity. There was less agreement regarding the evolution of catch rates and very poor or no agreement at all when considering changes in water quality.
2. Fishers do not easily conceive the use of an indicator and many doubt that any observation today would tell anything about future catches, for instance.
3. Knowledge available with and interpretations of trends by older fishers may differ from those given by younger ones, indicating age-related differences in perceptions and interpretations. In addition, users of a wide range of small-scale gear had better ecological knowledge than those using large-scale gear.
4. Views of fishery officers and fishers could be very different, e.g. fishers may relate declining fish abundance to habitat degradation (or climate, in developed countries) while officers may relate it to overfishing. Differences relate to both the scale at which the fishery system is perceived (locally for fishers, more regionally for officers) and the nature of the drivers.
5. Disagreements about impacts of fishing and necessary management measures are often observed between subsectors of the SSF exploiting the same stock (shrimp) in the different areas (e.g. inshore versus offshore) but at different ages (e.g. juveniles versus adults) and with different gear (e.g. small versus large mesh size). This reflects a classical expression of conflict and competition in cases where management measures have an impact on the distribution of resources, opportunities and wealth.
6. Despite these divergences, the authors indicate that scope for agreement can be found, e.g. on local technical measures to be taken, but that traditional knowledge alone would be too weak to be used for the design of an effective management system.

As noted earlier, the situation and contexts of SSF vary greatly between and within countries and all generalizations are dangerous. In relation to item 6 above, for example, Mahon et al. (2003), working on a small and simple sea urchin fishery in Barbados, found that the fishers could devise a very reasonable management approach based on what they knew but did not have the capacity or authority to implement it.

Most quantitative scientists (whether biologists or economists) would likely agree that, in order to be utilized for a scientific enquiry and more specifically in a model, traditional knowledge on the functioning of nature (TEK or LEK), as well as on the social relationships within or between groups, the pertinence and efficiency of institutions, the economics of their industry, etc., needs to be validated. Wilson, Raakjaer and Degnbol (2006) indicate that this could be done by as follows:

- Checking (e.g. using consensus analysis) that it is really "traditional knowledge", i.e. a knowledge shared by the community or at least by the most knowledgeable elements of the community, in order to avoid taking a personal view of an informant.

- Looking for elements, facts, rules, informal models that could be used to verify and check the consistency of the knowledge.

Verification and consistency checks are intended to separate fact-based knowledge from myths, perceptions or values. The role of these latter in management is important, but their interference with factual analysis should be minimized. Scientific verification is made against available scientific theories, observations, models and literature. Social scientists can check coherence with general social theories, situations described elsewhere, etc., while overall conclusions are elaborated jointly by social and natural scientists.

Traditional knowledge can be identified through stakeholder interviews, using open-ended questionnaires, map drawing and/or historical timelines of climatic events or series (e.g. of changes in the fisheries). One can also collect stakeholders' statements about their own fisheries (alleged factual observations and assumed causal relationships). Such interviews may lead to the identification of candidate indicators that are meaningful to the stakeholders themselves.

Recent work by the International Council for the Exploration of the Sea (ICES) to cross-check the traditional understanding of fishers with the formal scientific findings of scientists using structured questionnaires, indicated a substantial agreement between the positions, sometimes after reformulation of the question. In many cases of apparent disagreement, it appeared that the difference was one of scale (e.g. the perception of local abundance trends in the short term by fishers did not match the longer-term trends of global abundance by scientists) (Prigent *et al.* 2007).

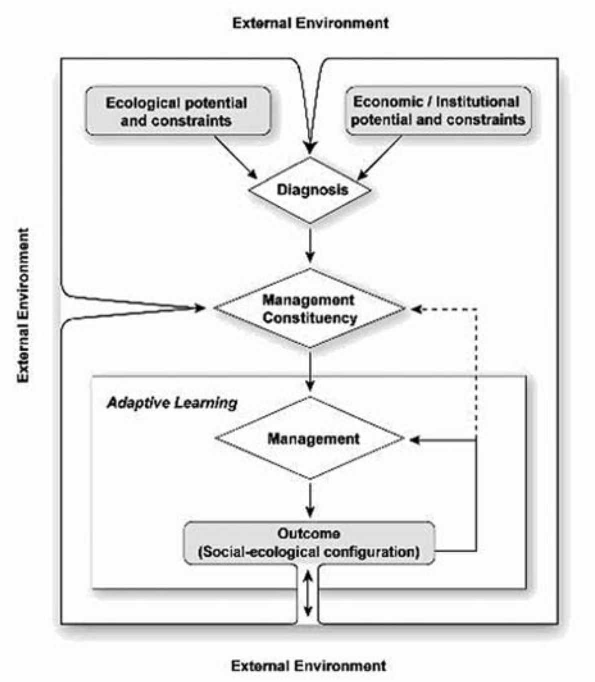
Effective integration of scientific and traditional knowledge requires active participation of stakeholders in the assessment process. In the preparatory phase, additional efforts should be made to identify the key stakeholders and establish channels of communication, ideally planning with them the following phases of the process. A stakeholders' analysis is added to identify formally stakeholders, their different interests, influence and potential role as well as their knowledge and perceptions about the fishery system and the issues at stake. Efforts are made to encourage their active participation in the whole process. The issue analysis is participative, looking for stakeholder confirmation or reformulation. The approach, models and methods used in the assessment are explained and discussed, along with their intended outcome and assumptions. During the main assessment phase, traditional knowledge is validated and integrated as appropriate. The results of the analyses are interpreted in a participative mode aiming at reaching a common understanding. The potential options available are jointly identified and analysed before results are presented to decision-makers (at central or community levels) and the broader stakeholders group.

Integrating scales

A major cause of fisheries management failure lies in the lack of coherence between management objectives selected and measures taken in the short term and development objectives adopted for the long term. It is therefore imperative to connect explicitly the assessments conducted at both scales, ideally nesting the short-term assessment in the longer-term one. On the long-term strategic time scale, the assessment may relate to the whole sector, a sub-sector, the sectoral development policy or governance, or the analysis of overall objectives, constraints and indicators. Its purpose might be planning, scenario development, management strategy development or performance assessment. On the short-term operational time scale, the assessment may relate to seasonal or annual management measures, in support of recurrent management schemes (fine tuning) or crisis resolution. The performance evaluation undertaken from time to time (e.g. in conjunction with medium-term planning) could be the occasion for establishing the longer-term, more strategic connections.

In highly complex systems, an analysis undertaken at the lower, operational level may be of little relevance for higher strategic levels of consideration (e.g. at cross-sectoral

FIGURE 15
General diagram for diagnosis and management of SSF



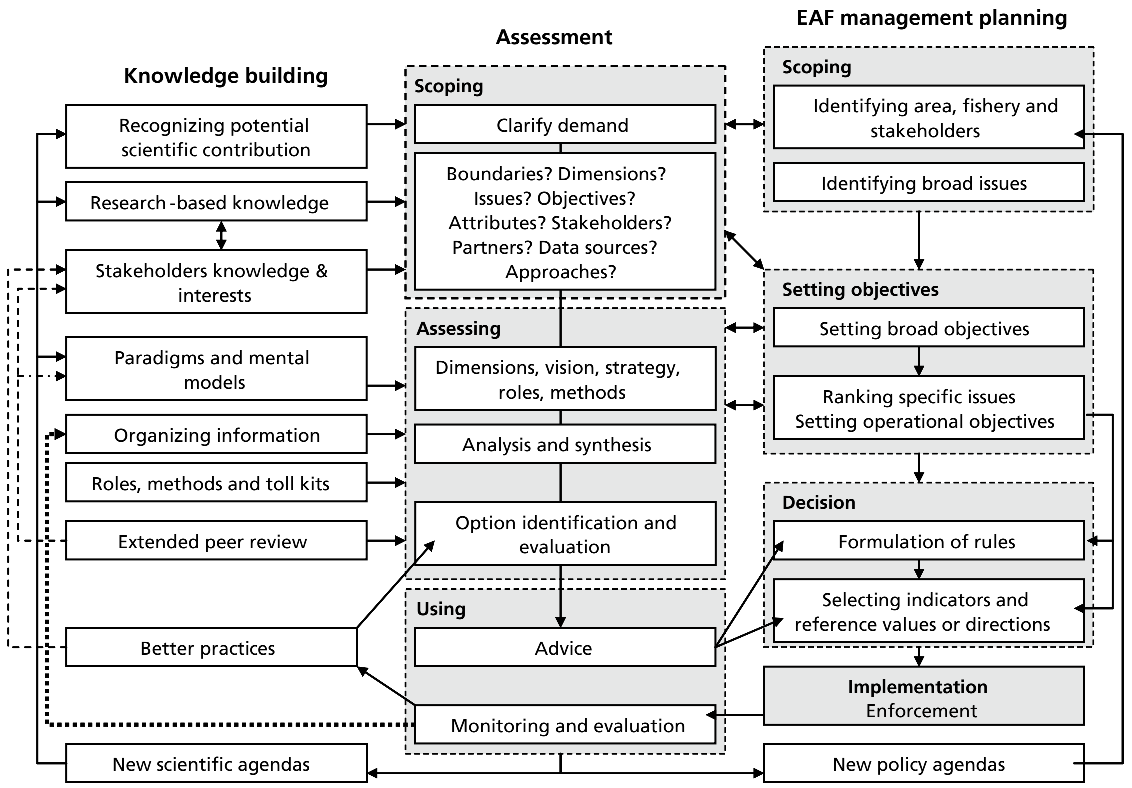
Source: from Andrew *et al.* 2007.

or national level). Conversely, strategic analyses undertaken at high level are very relevant in terms of understanding the global effects of the fisheries environment and for long-term scenario projections, but lose relevance and could be even dangerously inaccurate if their conclusions were extrapolated to the operational level. Efforts will therefore be needed to look for implications at all relevant levels, even though this might not be easy with the elements of information and within the time frame stipulated for the assessment.

Tools for integration

Collapsing some of the steps between assessment and management, Andrew et al. (2007) focus on the linkage between the enquiry (diagnostic) and decision-making process in an adaptive management approach (Figure 15). This representation highlights: (i) the role of external drivers (e.g. institutions, other policies, climate); (ii) the ecological and economic constraints

FIGURE 16
Integration of knowledge-building, assessment and policy management processes for an ecosystem approach to fisheries IAA



Source: adapted from Lebel, 2006.

to be accounted for in the diagnosis; (iii) the explicit connection between the diagnosis and the management constituency; (iv) the adaptive management concept (apparently limited to the short-term learning loop); and (v) the ultimate outcome of the process as a particular "social-ecological configuration" (sensu Berkes and Folke, 2000).

The close connection between knowledge building, assessment and policy/ management processes is also represented in much more detail in Figure 16. Three processes are identified: knowledge-building, assessment *sensu stricto* and management. The role of stakeholders is very clear in the assessment but is only implicit in the management box. The simplified connections (usually transfers of information, norms or rules) are indicated by arrows. This conceptual figure highlights the fact that science and policy interact in the various phases of the assessment process (scoping, assessing and using) and that information does not flow unidirectionally or linearly through these phases (as often assumed under conventional assessment) but emerges from convoluted interactions among scientists, policy-makers, stakeholders and the wider public that are continually reframing, reassessing and reusing the assessment (Lebel, 2006).

SYNTHESIS

This chapter has clarified the position the IAA process in the broader processes of policy-making, development planning and operational management. For the purpose, it stressed the strong connections between the policy, development planning and operational management cycles, operating on different space and time scales. It clarified also the role of the different types of stakeholders (fishers, scientists, managers, policy-makers, etc.) stressing the importance and challenge of the integration of points of view and requirements.

5. Towards implementation of the framework

This framework attempts to improve upon conventional assessment and normative management approaches and contemporary thinking by providing a set of flexible options for practical, operational steps to conducting IAA. A number of considerations have converged to provide the rationale and impetus for this initiative. First, the end of the twentieth century has been marked by a large-scale recognition of the poor state of fisheries, largely due to inadequate governance (including research or the provision of scientific support more generally). It has been progressively realized that, overall, SSF have been neglected both by fisheries management and in national development planning. This neglect stems, at least in part, from an underestimation and consequent under-appreciation of their economic value and contribution to broader societal well-being.

Second, underlining the first consideration, a new emphasis on SSF has been urged by the FAO Advisory Committee on Fishery Research (ACFR) in its 2002 and 2003 sessions, and by the FAO Committee on Fisheries in its last three sessions (2003–2007).

Third, if the general research framework for fisheries governance is far from adequate for large-scale fisheries (in particular because of the lack of appreciation for the systemic complexity of the sector), it is especially faulty with regard to SSF. Despite the new and dynamic focus on SSF governance, insufficient attention has been given to the assessment and advisory processes. Approaches and methods are available in the various streams of science engaged with SSF; but they tend to remain isolated in disciplinary silos, in part because of the lack of an agreed interdisciplinary framework. This document sets the first stage in developing a broad consensus on the elements of that framework. It is very much a work in progress, and refinement and clarification will take place as experience in testing approaches and embedding them in fishery governance systems progresses.

PROMOTING THE FRAMEWORK

Decision-makers will need to be convinced that an integrated assessment process is more appropriate and effective than conventional approaches. Raising awareness about the complexity of SSF, the failure rate of fisheries management and the mounting world trade requirements for sustainability (ecolabelling) are pushing national systems in that direction. A number of integrated development approaches (e.g. integrated conservation and development, sustainable livelihoods) or partnership approaches to management (e.g. co-management, community-based management) have been applied, though usually at project as distinct from sector level. The IAA framework has been elaborated to complement these endeavours, not to supplant them.

The success of the framework will be judged by its ability to improve the effectiveness of management actions in the world's small-scale fisheries. As such, the promotion of an IAA framework can best be regarded as a strategic initiative that will take many years to show a tangible impact on indicators of poverty reduction and responsible fisheries.

The relationship between the additional costs of an IAA process and its potential benefits will obviously be a central issue. The "costs" of formally establishing the process (human resources, means and institutional cooperation) may appear high (particularly in comparison with the nearly non-existent information systems used today for SSF in many places) and the expected benefits will need to be anticipated upfront and demonstrated as soon as possible, for example through pilot projects. Simplifications of the ideal IAA framework might be unavoidable when the SSF value is low but it will be important to maintain its spirit of integration and participation. In any case, the IAA process should generally be able to demonstrate the real value of the SSF sector, thus justifying itself.

IMPLEMENTING THE FRAMEWORK

The implementation of an IAA process requires the development of an enabling environment within which the different streams of information, presently developed separately in different institutions and processes, meet. However, developing an effective two-way participatory science–policy interface for strongly participative governance is a challenge (see Engels, 2005). Analysing informed, science-based decision-making processes and their outcomes in an environmental management arena characterized by high environmental risk, uncertainties and political stakes requires some navigation of scientific evidence, other knowledge perspectives and considerable social and political judgment (Jasanoff, 2004) on behalf of assessors, managers and stakeholders more generally. An effective process requires:

1. Agreement by scientific advisers involved in expert groups to consider traditional knowledge and to participate in the negotiating process leading to decisions, i.e. interacting within the advisory process and assisting in the decision-making process.[9]
2. A dual decision-making process: (i) among scientists within and between disciplines, to resolve scientific uncertainties or divergences that carry political weight and societal costs; and (ii) between policy-makers and stakeholders, including scientists, to decide on the best course of action. Such an integrated process would be ineffective in a context of scientific disagreements, disparate social and political values, or when occurring in an adversarial (judicial) context.
3. "Negotiation" of the boundaries between mandates: (i) around the scientific process to preserve the independence and objectivity necessary for the political acceptability of the advice; and (ii) around the decision-making process, through subsidiarity, devolution, etc. The first point is crucial in a system in which non-scientists and scientists are called to cooperate closely and where the risk for each of them to "cross the line" is high[10] and sometimes advisable. The second is important in a governance system where decision is devolved to lower levels while formal legal liability in relation to UNCLOS remains with the State.
4. Commitment of all actors to moderate their views towards an acceptable societal compromise/position. This requirement recognizes that free-riders or stakeholders with no willingness to reach agreement may stall the process.

Jasanoff notes in addition that the outcome of the process should be a state of knowledge that satisfies the test of scientific acceptability and supports reasoned decision-making, while assuring those exposed to risk that their interests have not been sacrificed to scientific uncertainty. The existence of a formal and transparent process of this type, in the long term, may produce scientifically robust knowledge (*sensu* Gibbons, 1999) and help maintain credible and relevant scientific excellence, while reducing the need for "underground" political pressure.

For some scientists involved in SSF assessment and management, this may sound excessive and it would be sufficient that the assessment process leads to an

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[9] This recognizes that final decisions are a matter of societal choice.

[10] With stakeholders tempted to interfere with scientific interpretation of facts and scientists tempted to play a role in objective setting or decision-making.

implementable decision with high probability of making things better. It is very hard to see, however, how such a high probability to make the right decision (the one that will make things better) can be obtained without the rigour of scientific analysis. Using a pure trial and error approach, taking only the consensus as the criterion as opposed to scientific validity implies accepting high (and non-assessed) risks for both the people and the resources.

WORKING ACROSS DISCIPLINES

Co-evolution of science and governance requires the simultaneous existence of a supply of science and a demand for governance. This implies that the policy-makers and managers request explicitly – and provide the conditions for – a more comprehensive form of advice. This also implies that the present purely operational horizon of management is complemented by a strategic one, with a more complete set of objectives, a multiscale and multistakeholder vision and a more democratic process. Finally, this implies a change in fishery research development policy, aiming at a closer collaboration if not integration between the social and biophysical sciences, e.g. changing the recruitment patterns in fishery research centres, providing incentives for interdisciplinary strategic analysis (to attract academics in the decision-making area) and to foster the joint development of comprehensive models (including agent-based simulation models and games). These changes do not need to happen all at once. Progressive changes are more pragmatic and more likely to be adopted, as shown in the countries where processes of this nature have already started to function.[11] A wide interdisciplinary collaboration around simulation platforms and integrated advisory processes may lead to the development of a transdiscipline (*sensu* Flinterman *et al.*, 2001) but the transition to that ideal will necessarily be pragmatic. The implications of integrated assessment for fisheries departments and how change might take place are discussed in more detail by Bavinck *et al.* (2005) and in the book, *Fish for life*, by Kooiman *et al.* (2004).

EMPOWERING STAKEHOLDERS

Because of the interconnectedness within and between ecosystems, the number of stakeholders potentially involved could be overwhelming. Stakeholders include researchers, managers and decision-makers, policy-makers, representative organizations (e.g. NGOs) and, obviously, end-users. A high level of participation of the latter is essential for a democratic process. User-centred simulations allow the end-users to participate actively in rerunning the simulations exploring differing scenarios, usually proceeding by iteration.

Funtowicz and Ravetz (1990) argued for participation in the process *of all those with a desire to participate in the resolution of the issue*, a proposal raising non-trivial problems of monetary and non-monetary interaction cost and effectiveness. A central problem is that of striking a balance between the broadest possible representation and affordable interaction costs. Once the stakeholders have been defined, it is important to define the roles that they are called (and are willing) to play (e.g. right holders, stewards, providers of data and traditional knowledge, scientific “assistants” in model development, or actors in a simulation game). As these roles are demanding, however, it is important to ensure that the stakeholders involved are motivated in order to maintain their commitment to the process.

HOW MUCH COMPLEXITY IS ENOUGH?

Chapter 1 illustrates the complicated structure of a SSF system with many interacting components (Figure 1). The large number of interactions between the components,

[11] For implications of integrated approaches for fisheries departments and for their evolution, refer to Bavinck *et al.* (2005) and Mahon, Bavinck and Roy (2005)

with non-linear positive and negative feedback controls (respectively amplifying or attenuating effects), not represented in the figure, create a high degree of complexity in a system, the understanding and control of which, as a consequence, can only be partial and dynamic. The successive adoption of the concepts of sustainable development, the precautionary approach and ecosystem approach since the early 1990s, signal a progressive recognition of the fact that fishery systems are complex social-ecological systems (*sensu* Berkes and Folke, 2000) and should be managed as such. There is an obvious gradient of increasing complexity from the open sea to the coastal zone, estuaries and deltas where so many SSF, large-scale fisheries, aquaculture systems, other economic industries and societal requirements interact. A similar gradient may exist between lowly populated mountains and coastal areas, lake shores or flood plains. This complexity, combined with the low capacity available for research and management, has sometimes led managers to question whether SSF can be managed at all (in the conventional sense, with State intervention) or should be left to themselves, implicitly accepting consequences as unavoidable.

However, Holling (1978, 1986, 2000) has underlined the difference between complication and complexity, stressing that highly complicated systems, in the end, might be driven less by the complex interactions between their components than by a few external drivers (e.g. demography, market, political stability), which should be the priority focus.

Finding the level of complexity beyond which the effort is counter-productive is a challenge (Garcia and Charles, 2007). The IAA system is highly integrative and participative but this has costs that can become prohibitive and stall decision-making mechanisms. Recognizing these difficulties and adding the problems hindering interdisciplinarity, how far should the integration process go? One could wonder (with Strand, 2003) to what extent the introduction of new embryonic approaches and instruments, the effectiveness of which is still to be fully tested, is preferable to continued use of the present well-tested approaches and methodologies, patching the system to mitigate its shortcomings. The losses in the present system, however, are sufficiently well established and the business-as-usual perspectives are so bleak that there seems to be little alternative to trying new approaches in SSF, some of which have been extensively tested in other fields.

One might argue that fisheries sustainability is a mature enough issue to be dealt with within shorter time frames. The issue is well established. Its causes have been abundantly described, analysed and agreed. A number of approaches to resolving the problem have already been tested under various conditions. A global scale agreement is available through the Code of Conduct for Responsible Fisheries. The ecosystem and precautionary approaches have already been adopted. However, resolution of the sustainability issue through such approaches at local, national and regional levels, where real decisions are made, is highly problematical. If the process is to be mounted in a strongly participative fashion, it would certainly require more time than a conventional assessment. As a consequence, an IAA process would probably be best suited for elaborating multiyear strategic frameworks for fisheries, within which the more operational management procedures would be implemented. Notwithstanding, many of the integrated features of IAA (interdisciplinarity and participation for example) will absolutely need to be implemented even in short-term crisis-based assessments.

COHERENCE WITH UNCLOS

The Convention requires that decisions be based on the best scientific evidence available – a requirement sometimes considered as an “elitist” mode of operation (Toth, 2003) as it may be interpreted as not using non-scientific (i.e. traditional) knowledge. Although a number of subsequent instruments, explicitly related to it, have added the requirement to include other forms of knowledge (particularly traditional knowledge) as a basis for decision-making, the fundamental requirement for the scientific nature of the information remains. As a consequence, while necessarily drifting towards a broader knowledge-building processes, the enquiry process will need to remain demonstrably scientific if a collapse of the decision-making process is to be avoided (Jasanoff, 2004).

CHECKS AND BALANCES

Closely involving stakeholders in the complex exercise of fisheries assessments for decision-making has obvious advantages already mentioned, e.g. increased legitimacy, compliance, reduction of the danger of voluntary or inadvertent "manipulation" by industry, the central administration or the scientists. However, deep participation also reduces the opportunity of independent oversight, particularly of the overall performance of the IAA system itself. The solution to this dilemma may be in the introduction of additional checks through:

- repetition of the participative modelling (where relevant) and assessment exercise, at intervals, e.g. in line with the adaptive management principles, to detect mistakes or unexpected and undesirable changes; and
- use of additional peer review, e.g. by panels composed of both scientific and industry experts external to the IAA process.

CHRONIC INFORMATION DEFICIT

The scoping phase of the diagnostic or assessment process is most effective when data can be readily accessed. Data on small-scale fisheries are, however, notoriously patchy. The kind of basic information that many rural development economists and environmental managers take for granted when studying land-use change or response of crop yields to rainfall variation is simply not available at resolutions that differentiate fisheries from the wider agricultural economy (e.g. in demographic censuses, fishers are grouped with farmers in most countries). Similarly, national poverty surveys usually rely on some kind of random sampling procedure, so that it is very unlikely that any fishing-dependent communities are included

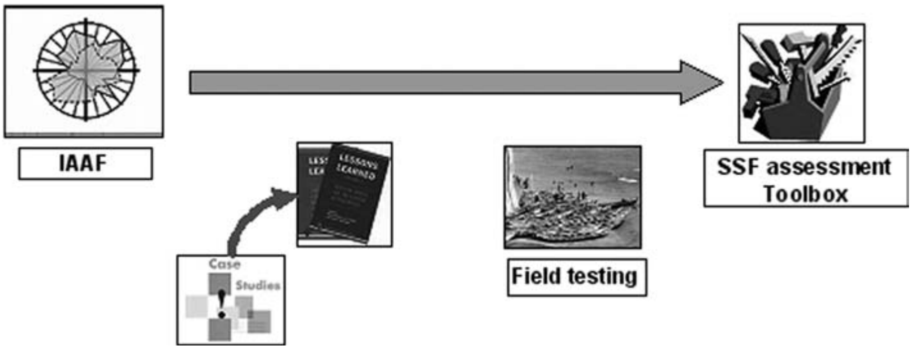
Some progress towards correcting the SSF information deficit has been made, however. Examples include (i) linking fishery statistical systems to the statistical systems used to generate national accounts in West Africa (Kebe and Tallec, 2006); (ii) work through the global FAO FishCode STF Project, which aims at improving information on status and trends in capture fisheries (www.fao.org/fi/fishcode-stf.htm); (iii) the FAO/WFC/World Bank "Big Numbers Project", which aims at highlighting the importance of small-scale fisheries in terms of their contributions to employment and food fish production, as well as the efficiency of their operations; and (iv) for marine fisheries, the "Sea Around Us" project, which is attempting to compile catch-effort statistics relating to the small-scale sector (www.seaaroundus.org).

TOWARDS IAA IMPLEMENTATION: NEXT STEPS

The present document represents a first step towards development of an IAA framework and a toolkit for its implementation. SSF researchers and practitioners need to be involved in consultation and empirical testing of the framework in order to carry this development forward. Next steps will be to synthesize the lessons learned on SSF assessment and awareness-raising through a series of case studies,[12] and to test the IAA framework in the field. On this basis, an assessment resource kit of methodologies, approaches and practical measures will be assembled for use (and further testing and refinement) by assessors, managers and stakeholders when designing and undertaking an IAA process for different small-scale fisheries (Figure 17)

[12] FAO started preparations to collect such case studies in May 2008.

FIGURE 17
Pathway of the development of a toolbox for the integrated assessment of SSF



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ANNEX 1
Glossary

Adaptive management	An iterative management approach in which management policies are treated as experiments from which managers can learn. It deals with unpredictable interactions between people and ecosystems as they co-evolve. It is an inductive approach to progressive knowledge accumulation and management optimization. Stimulating social and institutional learning, it emphasizes the importance of *feedbacks* in shaping policy (from Berkes and Folke, 2000). A management approach that explicitly recognizes the occurrence and potential consequences of uncertainties resulting from incomplete knowledge and adopts strategies and methods aimed explicitly at "learning by management", progressively reducing uncertainties and risk.
Adaptability	The ability to change (or be changed) to fit changed circumstances (Wikipedia, January, 2008*)*
Advocacy	Trying to influence public and political opinion to gain support for a particular change (Graham, 1971, p. 124)
Artisanal fisheries	A term of Latin origin with a socio-economic foundation. It tends to imply a simple, individual (self-employed) or family type of enterprise (as opposed to an industrial company), most often operated by the owner even though the vessels may sometimes belong to the fishmonger or some external investor, with the support of the household. The term has no obvious reference to size but tends to have the same connotation of relatively low levels of technology and this may not always be the case. See: *Small-scale fisheries*.
Assessment	An assessment is both *the action or an instance of assessing* and its result. *It is the process of gathering and documenting information* (appraisal is sometimes used as synonym but look at definition below) as well as *the amount assessed* (Webster online dictionary, http://www.m-w.com/dictionary/assessment, 2007). *It is the process of documenting, usually in measurable terms, knowledge, skills, attitudes and beliefs* (http://en.wikipedia.org, 2007). To form a *judgment about something (*a person, a situation, a patrimony) *based on an understanding* (Encarta, 2007). A judgment made by a scientist or scientific body on the state of a resource, a stock, a fishery (e.g. its size, potential, state, trend) usually for the purpose of passing advice for management (modified from Cooke, 1984). An assessment of a situation might be undertaken before (*ex-ante*), during (concurrent) or at the end/after (*ex-post*) of a project or an intervention. These phases are compressed when the assessment becomes recurrent and integral part of the decision-making process. See: *Appraisal; Baseline assessment; Conventional assessment; Integrated assessment; Pre-assessment*

Attribute An abstraction belonging to or characteristic of an entity. A construct whereby objects or individuals can be distinguished.

Appraisal A stage in formal decision methods (following the evaluation stage). The objective of the appraisal stage is for the decision-maker to develop insight into the decision and determine a clear course of action. Much of the insight developed in this stage results from exploring the implications of the formal decision model developed during the formulation stage (Wikipedia, June 2005)

Baseline assessment Provides the basis for future monitoring and performance assessment

Collaborative research *A relationship between equal partners in a research process. It usually involves a partnership between a traditional research institution like a university and one or more community partners* (Graham, 1971, p. 72). Collaborative research may improve credibility and legitimacy.

Criterion

1. In common dictionaries: a criterion is the ideal in terms of which something can be judged. A basis for comparison. A reference point. A benchmark against which other things can be evaluated.
2. In a sustainability indicators framework: a property of interest when considering the principle. In a complex system perspective, a criterion is a property of a component (in this case, the resource). In order to monitor the state of the resource base, for instance, it is necessary to monitor abundance, composition and variability. Criteria can therefore be considered as second order principles that add meaning and operational value to a principle without being a direct measure of performance (i.e. objectives cannot be expressed in terms of criteria). They also often provide the level at which indicators can be meaningfully aggregated, integrated.

Component A part that combines with other parts to found something bigger.

Conventional assessment Refers to the process of assessing resources from the Cartesian/Newtonian positivist and reductionist paradigm (assuming equilibrium, reversibility and predictability) using quantitative methods to advise centralized governments bureaucracies. It is distinguished from integrated assessment.

Conceptual framework A structure built from a set of concepts linked to a planned or existing system of methods, behaviors, functions, relationships and objects. A conceptual framework is used in research to outline possible courses of action or to present a preferred approach to a system analysis project. (Wikipedia, November 2007)

A conceptual framework for SSF assessment, therefore, articulates the ideas, concepts and mental images that are used to construct the operational framework. It is useful as a reference, or metaphor, for all the disciplines involved. If described in simple terms, it can also serve to articulate the interaction with other stakeholders.

See: *Operational framework*

Diagnosis Defined originally as the process used to recognize a condition by its outwards signs and symptoms using various diagnostic procedures (e.g. rapid assessment), it is taken now as including analysis of the causes of these symptoms (Wikipedia). The conclusion reached through these processes is called a *diagnosis*.

Dimension
1. The magnitude of something in a particular direction (e.g. length or width or height). One of three Cartesian coordinates that determine a position in space. A magnitude or extent.
2. The highest level subdivisions of a system. The classical (UN) sustainable development framework recognizes three dimensions: Pressure, State and Response and criteria and indicators will be identified in this typology.

Domain A knowledge area of interest. A territory over which rule or control is exercised. The set of values of the independent variable for which a function is defined (*range?).* A particular environment

Evaluation The act of ascertaining or fixing the value or worth of something. An appraisal of the value of something. A judgment (or a process leading to a judgment) on the quality, importance, amount or value of something (compiled from various dictionaries).

A stage in formal decision methods. The objective of the evaluation stage is to produce a formal recommendation (and its associated sensitivities) from a formal model of the decision situation *(*Wikipedia*).*

Ecological systems Refers usually to the natural environment (Berkes and Folke, 2000, p. 4). It includes the fishery resources, other resources, their habitat, the web of interrelationships and their general environment. Taken as synonym of ecosystem.

Ecosystem A system of complex interactions of populations between themselves and with their environment. The joint functioning and interaction of populations and environment in a functional unit of variable size. In modern use, conceived as comprising a natural and a human subsystem even though the boundaries between the two might be somewhat artificial. Berkes and Folke (2000) use the term social-ecological system.

Feedback In complex systems, *any behaviour that may reinforce (positive feedback) or modify (negative feedback) subsequent behaviour* (Berkes and Folke, 2000: 6)

Fisher A person who fishes. The term does not include those who process or market fish.

Fishworker Men, women, children and elders involved in harvesting, processing and marketing of fish (International Conference of Fishworkers and their Supporters held in Rome, 1984).

Fisherfolk The whole population associated with fish-related activity in a particular location. Also called fisherpeople.

Governance The activity or process of governing. A condition of ordered rule. Those people charged with the duty of governing. The manner, method, system by which a particular society is governed (McGlade, 1999). Governance is undertaken at strategic (policy) as well as operational (management) levels

Indicator

1. A *device for showing the operating condition of some system. A signal for attracting attention. A number or ratio (a value on a scale of measurement) derived from a series of observed facts. Can reveal relative changes as a function of time*.
2. In the sustainable development framework, variable attributes of the criteria that can be used to track the state (represent trends) of a system component and the degree of implementation of the principle, the performance of governance. Indicators are directly connected to operational objectives. They convey a simple, useful message but may aggregate more than one element of information. In relation to the criteria listed above, indicators could be: (i) biomass and catch rates (for abundance); (ii) species diversity and average trophic level (for composition); (iii) coefficient of variation of catch or biomass (for variability).

Indigenous knowledge *Local knowledge held by indigenous peoples, or unique to a given culture or society* (in Berkes and Folke, 2000, p. 4). Taken as a synonym of traditional knowledge and traditional ecological knowledge (TEK) although there is no reason to limit traditional knowledge to its ecological dimension.

Integrated *Not segregated. Resembling or formed (united,* blended) into a unified whole. Introduced into another entity* (example: an integrated assessment and advisory process or an integrated assessment and management process).

Integrated assessment An interdisciplinary process of synthesizing, interpreting and communicating knowledge from diverse scientific disciplines in order to provide relevant information to policy-makers on a specific decision problem (Toth, 2001)

The process of assessing whole and dynamic complex fishery systems in their environment using quantitative and qualitative methods to advise centralized and decentralized government bureaucracies as well as self-governing communities. For a development see Garcia, 2006.

See: *Conventional assessment.*

Integration *The act of combining into an integral whole.* The more integrated the representation, the closer to a system representation.

Interdisciplinarity A typical trait of holistic approaches in science and other fields. The act of drawing from two or more academic disciplines, integrating their insights in pursuit of a common goal and to develop a greater understanding of a single subject, or solutions to a single problem that is too complex or wide-ranging to be dealt with using the knowledge and methodology of just one discipline. Attacking a subject from various angles and methods, eventually cutting across disciplines and forming a new method for understanding of the subject. It may be seen as a remedy to the effects of excessive specialization. It draws its excellence from and feeds it back to the component disciplines.

Interdisciplinarity (cont.)	Examples of interdisciplinary fields are: nanotechnology, computer science, bioinformatics, ecological economics. Interdisciplinarity is sometimes understood as different from multidisciplinarity (in which many different disciplines examine simultaneously their respective objects and combine their conclusions) and transdisciplinarity (which becomes necessary when the concept or method cannot be understood from within a single discipline and requires the input of many disciplines to be understood and the boundaries between disciplines dissolves. Ethnography, is a transdiscipline, combining insights from psychology, philosophy, sociology (compiled from www.wikipedia.com).
Local knowledge	In the specific case of coastal communities, *the body of information developed by those with a local connection to the ocean, whether living by the sea or earning a living from the sea* (Graham, 1971).
Monitoring	To watch and check something (e.g. indicators, activities) carefully over a period of time, sometimes keeping a record of it, usually to check if changes fit with expectations. In fisheries, the observation of fishing activities by the fishery police (as part of the monitoring, control and surveillance [MCS] programme) to check compliance with regulations and provide emergency assistance.
Operational framework	The articulation of a process or series of actions for achieving a result (in this document, an integrated assessment). A framework ready to be used or being in effect or in operation (compiled from various dictionaries).
Participatory research	*A research approach in which local people decide on the research priorities and questions, collect and own information and decide on how it will be used*. (Graham 1971, p. 66). The term collaborative research is also used. See *Collaborative research*.
Pre-assessment	Equivalent to framing, scoping or preliminary appraisal (Chapter 3, section *Overall framework*), *it may be a process of collecting and generating fairly complex information.* In this document, however, a pre-assessment is a rapid assessment of the likely parameters of the assessment itself, before starting it, involving little or no computations and no generation of new knowledge. Its purpose is to help in optimizing the main assessment process. Parameters examined include: availability of data; institutional capacity; seriousness of the issue; scope for participation, etc.
Principle	The highest level of reference in the sustainable development framework. A principle is an expression of human wisdom. It is a statement conventionally taken as a fundamental "truth" or law as a basis for reasoning and action. It can be based on subjective arguments (e.g. ethics, values and traditions) as well as objective falsifiable ones (scientific knowledge). Agreed principles of relevance for fisheries can be found in the FAO Code of Conduct for Responsible Fisheries. They provide the justification for selecting criteria and indicators. They provide the basis for selection of high level conceptual objectives with which they are often confused.

Problem identification and analysis A process of isolating the issues contained within a larger policy issue *with the view to* defining a problem, analysing it root causes and identifying possible solutions to choose from (constructed from Graham, 1971, p. 121).

Resilience

1. *The ability to recover from (or to resist being affected by) some shock or disturbance* (www.wikipedia.com). *The buffer capacity or the ability of a system to absorb perturbations* (Holling *et al*., 1995) It reflects the capacity of a system to stay or return in its original steady state. *This traditional definition concentrates on stability near an equilibrium steady-state, where resistance to disturbance and speed of return to the equilibrium are used to measure resilience*.
2. *The measure of the amount of change or disruption that is required to transform a system from being maintained by one set of mutually reinforcing processes and structures to a different set of processes and structures (*www.wikipedia.com). *The magnitude of disturbance that can be absorbed before a system changes its structure by changing variables and processes that control behaviour* (Holling *et al*., 1995). This definition emphasizes conditions far from steady-states, where instabilities can flip a system into another regime of behaviour, i.e. to another stability domain.
3. Connected to (ii) the capacity for renewal of a social-ecological system in a dynamic environment, adapting to change so as to maintain or modify as appropriate essential functions (e.g. productivity, livelihoods). Connected to knowledge-building and the building of learning capabilities in institutions and organizations.

Small-scale fisheries A term of English origin with a technological foundation. It tends to imply the use of a relatively small size gear and vessel. The term has sometimes the added connotation of low levels of technology and capital investment per fisher although that may not always be the case. See: *Artisanal fisheries*.

Stakeholder Someone affected (positively or negatively) by an activity, or someone who can influence the process of impact of an activity. Broadly defined, stakeholders in fishery regimes include fishers, the fishing industry and institutions involved in the management system, all those who rely on fishery habitats for a living and those interested in conservation of fishery resources and habitats (taken from PARFISH, Walmsley, Howard and Medley, 2005)

Standard A criterion, indicators and reference value can become a standard when formally established and enforced by an authority and on the basis of which constraining action can be taken (modified from Garcia, 1997).

Surprise In complex systems behavior, an unexpected change. An outcome that differ from expectations not only quantitatively but qualitatively and may lead to a management crisis (Holling, 1986). A surprise may result from a yet uncovered emergent property of the system. It may also result from the brutal release of the unseen accumulation of minor ecological or social consequences of management under a triggering factor or beyond some tolerable threshold.

Threshold	The point where a system flips from one equilibrium to another (Berkes and Folke, 2000, p. 6). The level of an indicator at which the risk of the system to move out of the agreed limits is reached and action is needed (threshold reference point, Garcia, 1994).
Traditional knowledge	*A cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission {about the relationship of living beings (including humans) with one another in their environment}* (Berkes, 1999, p. 8). Also called traditional ecological knowledge (TEK). See also: *Indigenous knowledge; Local knowledge*.
Universal	*Of wide scope or applicability. Related to, affecting, or accepted by the whole world. Relating, affecting or including everyone in a group or situation. Used or understood by everyone. Applicable to all situations or purposes.*
Versatile	*Having a wide variety of skills. Able to move freely in all directions. Competent in many areas and able to turn with ease from one thing to another.* In fisheries, a useful property for an approach, method or model, allowing it to be easily used under various circumstances. Synonym: flexible.
Vulnerability	1. *Susceptibility to attack or/and injury*. A vulnerable ecosystem, species, fishery or human community can easily be modified and eventually damaged in terms of its composition, structure, functions and utility. 2. In fisheries, a multidimensional concept qualifying the relationship between SSF and their political, economic, social or natural environment. *Vulnerability research covers a complex, multidisciplinary field including development and poverty studies, public health, climate studies, security studies, engineering, geography, political ecology and disaster and risk management.* (www.wikipedia.com).
Verifiers	They are the elements to used calculate and/or verify the value of indicators and add meaning to them. They include the procedures needed to determine whether the conditions expected for the validity of the indicators are fulfilled. For catch rates, they would include catch and effort data as well as scientific survey data.

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ANNEX 2
Participation

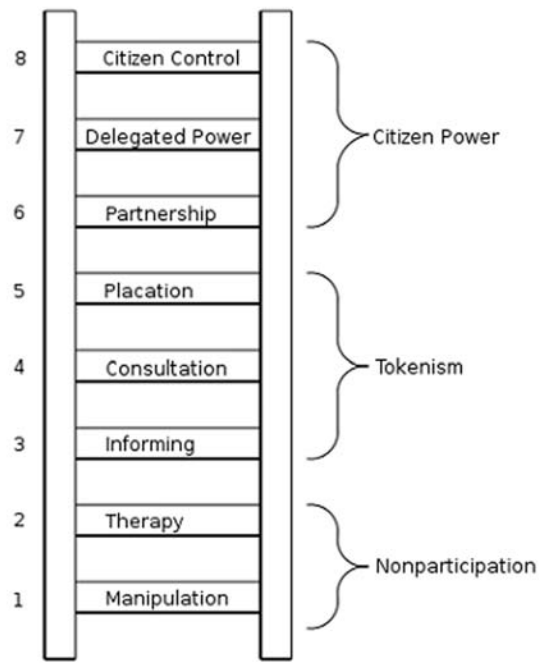
In the assessment as well as in the monitoring and evaluation processes, participation can provide an empirical check of the models used by scientists to represent the real world. It can also provide a check of the social acceptability of management options and of the legitimacy of their evaluation. In traditional systems' thinking, participation can therefore be seen as a control regulating the quality of the process of interaction between societal demand and scientific supply (Checkland, 1981).

The term "participation" covers a variety of decision-making and information-sharing arrangements. Arnstein's (1969) original "ladder of citizen participation" (Figure A2.1) illustrates the full range of decision-making arrangements found in practice, from those where citizens' needs are "cured" (or poverty "alleviated"), to situations where the people affected by projects and policies are those who make the decisions, with advisory input from external "experts".

To paraphrase Arnstein's (1969) own words: The bottom two rungs of the ladder describe levels of "non-participation" that have been contrived to substitute for genuine participation. Their real objective is not to enable people to participate in planning or conducting programmes, but to enable power holders to "educate" or "cure" the participants. Rungs 3 and 4 progress to levels of "tokenism" that allow the have-nots to hear (3) and to have a voice (4), but only under conditions where they lack the power to ensure that their views will be heeded by the powerful. When participation is restricted to these levels, there is no follow-through, no "muscle", hence no assurance of changing the status quo. Placation (rung 5) is simply a higher level tokenism because the ground rules allow have-nots to advise, but retain for the power-holders the continued right to decide.

Further up the ladder are levels of citizen power with increasing degrees of decision-making clout. Citizens can enter into a partnership (rung 6) that enables them to negotiate and engage in trade-offs with traditional power holders. At the top, under delegated power (rung 7) and with citizen control (rung 8), the directly-concerned citizens obtain the majority of decision-making seats, or full managerial power. It must be noted, however, that people in the lower rungs of participation have nonetheless some power of subverting what the powerful are attempting to achieve without their concern, either through non-compliance or circumventing the measures, ultimately affecting their outcomes. This is indeed one of the powerful reasons for promoting participation.

FIGURE A2.1
Ladder of participation



Although it is envisaged that the assessment framework is embedded within some form of power-sharing arrangement for resource

TABLE A2.1
A typology of participatory research and assessment with fishing communities

Type of participation	Main characteristics of research relationships
Induced or coerced	Scientists define the research or management agenda, fishworkers are paid or co-opted to participate
Extractive, passive or contractual	Scientists or extension agents define the research agenda, fishworkers provide data or resources for scientists to study.
Consultative	Fishworkers define the problem, researchers develop solutions
Collaborative	Fishworkers and scientists participate in different stages of the research
Collegiate	Scientists and fishworkers work together to strengthen both formal and informal knowledge systems.
Advisory	Fishworkers define their own problem-solving agendas. Scientists/ extension agents retain an 'on demand' advisory role.

Source: modified from Biggs, 1989 and Allison, 2002.

management, this cannot be considered a prescription in all cases and a prerequisite to the IAA process. The principles for "participatory research" are detailed in Table A2.1. Induced and extractive approaches prevail in much of the conventional rapid rural appraisal (RRA). While emerging from RRA, the participatory rural appraisal (PRA) prescribed for use in SSF, in line with the principles of this framework (Pido *et al*., 1997), corresponds more to consultative, collaborative and collegiate approaches. Advisory participation may be the most realistic alternative for assessments in situations where scientific capacity is absent or too expensive to mobilize. The difference between conventional and really participative assessment is illustrated in Table A2.1.

Many assessment activities claim to adopt participatory research approaches, such as PRA. The use of PRA tools implies "broad" participatory goals by enabling rural people to explore their own visions and solutions to environment and development problems. The aim is for local people to become creative analysts and performers of research, rather than passive or reactive respondents (Chambers, 1992), yet "doing a PRA" is frequently regarded as a rather simple way of generating a lot of information quickly. The simplicity of the techniques belies the more complex political and social context in which interactions between researchers and local people take place. Local people are often seen as all-too-willing participants without their own agendas. What they say is frequently regarded as a statement of fact, rather than a product of an encounter that is always set within relations of power (Cornwall, Guijt and Welbourn. 1993). Unless they are informed by a strong theoretical grounding in the social sciences and rigorous application of ethnographic research methodology, the "results" of PRA studies are likely to be of little use in informing policy and management. This should not be interpreted as discouraging the use of PRA tools, but as encouraging their more reflective and rigorous application.

Part of the problem with inappropriate use of PRA is that it is now virtually compulsory to use participatory research and development approaches. This has been called the "tyranny of participation" and does not consider the potential pitfalls of indiscriminate and inappropriate use of participatory techniques (Cooke and Kothari, 1998). PRA has become a banner under which all research that involves visiting villages or talking to local people is grouped. Use of PRA in this "extractive" way can be damaging. The tools of PRA are designed to elicit responses on peoples' problems, needs, hopes and aspirations. The "appraisal" is supposed to be only one part of a broader development process that "empowers" local people by enabling them to take some measure of control over the factors that affect their lives. If PRA exercises are not followed up by action to deal with identified problems and needs, expectations can be raised by researchers who lack the means – or even the intention – of fulfilling them. "PRA research" carried out in this manner poses significant ethical problems. The same could be said of application of this diagnostic framework if it is de-linked from subsequent management action.

TABLE A2.2
Differences between conventional and participatory research and assessment

	Conventional research	Participatory research
Purpose	To collect information for diagnosis, planning and evaluation	To empower local people to initiate action
Goals of approach	Predetermined, highly specified	Evolving, in flux
Approach	Objective, standardized, uniform, blueprint to test hypothesis, linear	Flexible, diverse, local adaptation, change is encouraged, iterative
Modes of operation	Extractive, distance from subject, focus on information generation,	Empowering, participatory, focus on human growth
Decision-making focus	External, centralized	Local people, with or without a facilitator
Methods and techniques	Highly structured focus, precision of measurement, statistical analysis (modelling)	Open-ended, visual, interactive, sorting, scoring, ranking, drawing
Researcher/facilitator role	Controller, manipulator, expert, dominant, objective	Catalyst, facilitator, visible initially, invisible later on
Role of local people	Sample, targets, respondents, passive, reactive	Generators of knowledge, active participants, creative
Ownership of results	Results owned and controlled by outsiders who may limit access to others	Results owned by local people, new knowledge resides in people
Output	Reports, publications, possible policy changes	Enhanced local action and capacity, local learning, cumulative effect on policy change, results may however not be recorded

Sources: Narayan, 1996 (from Pomeroy and Rivera-Guieb, 2006: Box 7.3).

Toth (2001) distinguishes two approaches to integrated assessment: mathematical modelling and participatory methods. However, the French school of integrated assessment has also developed participatory modelling (called Companion Modelling) in which stakeholders are directly involved in the design and use of multiagent models used for simulations as well as role games (see Bousquet and Lepage 2004; Gurung, Bousquet and Trébuil, 2006; and http://www.cirad.fr/ur/index.php/green_en/formations/jdr/jdr). A large array of participatory integrated assessment methods have been developed during the past few decades to satisfy the demand emerging from various segments of society (Toth, 2001).

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Conventional assessment frameworks do not provide an adequate basis for informed management decisions and development planning of the small-scale fisheries (SSF) subsector. Normative management frameworks and approaches have been developed as an evolution of conventional fisheries management, such as the 1995 FAO Code of Conduct for Responsible Fisheries and the ecosystem approach to fisheries. Yet, the assessment frameworks required to operationalize these alternative management approaches have not been fully developed, at least for SSF.

The integrated assessment and advisory (IAA) framework presented in this document begins to address this need. The document presents the conceptual basis of the IAA process, introduces the framework and places the assessment within the broader planning and management cycle. The IAA framework presented here results from the synergistic efforts of FAO and the WorldFish Center, with collaboration from individuals leading both research and practical assessment and management programmes related to SSF.

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