Scientific advice for fisheries management in West Africa in the context of global change

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Chapter 9

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Abstract

The chapter presents the process of scientific advice on fisheries in West African countries. Based on a survey among researchers, experts, and managers, it reveals that there are weaknesses within the research institutes regarding institutional and human resources, which may lead to negative impacts on their functioning and the quality of their products. Concerning the administration of users of the advice, there are problems relating to the weakness of human resources and also the lack of clear frameworks for fisheries sector policies and for decision-making processes. The work also highlights the absence of a mechanism enabling the promotion of scientific information to the professionals. It finally appears that there is a need for improvement of the transmission and clarity of the scientific advice. In the context of global change affecting fisheries, the improvement of scientific advice is essential.

Keywords: Fisheries management, scientific advice, West Africa, Sub-Regional Fisheries Commission, Institutional frameworks, fisheries adaptation

Introduction

Despite biologically very rich waters, West African countries today are facing the challenge of resource scarcity. The intensification of fishing effort and chronic illegal fishing practices has progressively eroded marine ecosystems. The current situation shows that public policies implemented to regulate fisheries have failed. That raises questions, on one side, of the applicability of the measures taken to regulate fishery access, and on the other, of the intellectual and scientific basis of the decisions taken. The first question refers to the implementation and follow-up of management measures as well as fishermen's compliance with them. The second, which is the subject of this chapter, deals with the quality and the format of the scientific information necessary to the formulation of fishery management measures.

World Fisheries: A Social-Ecological Analysis, First Edition. Edited by Ommer, Perry, Cochrane and Cury.

Following the logic that the better the information is, the better the subsequent decisions are, improvement in knowledge of fish stocks should be synonymous with increased reliability of the diagnoses of marine resources exploitation, and hence of the ability to ensure that policy responses, in the form of management measures, are appropriate for the given natural, economic, social, and political contexts. The West African report (Bâ, 2007) demonstrates such a logic and shows that an increase in information, while necessary, is not sufficient to constitute a secure basis for fishery management. It is the formulation of knowledge, in the form of scientific advice, which is crucial, despite its value being underestimated until now. More especially it is the quality of information and its manner of transmission that is the key to success in fishery management. In 2004, the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) joint working group considered another factor often missing in scientific advice: risk analysis. The group defined "scientific advice" as the "conclusion of a skilled evaluation taking account of the scientific evidence including uncertainties" with the purpose being to "help risk managers, policy-makers and others in decision-making" (WHO/FAO, 2004).

In West Africa, the concomitant increase in the volume of information produced by research centers and the administrative structures for making decisions has not materialized in a harmonious meeting of research and administration. Researchers still do not understand why their work is not taken into account by managers, while managers do not see why research institutes cannot develop clear and pertinent scientific advice. Due to the importance of this problem, the research programmes ECOST and ISTAM,[1] for which the management of fisheries is central, undertook a joint evaluation of the relevance of scientific advice in West Africa. The main expected outcome of the study was the identification of major stakes that surround fishery advice from the scientific and management perspectives; the identification of the most suitable actions for the reinforcement of the research centers in charge of the formulation of the scientific advice was also anticipated.

The first part of this chapter presents the context for the West African fisheries in terms of the main organizations involved in fishery management and fishery policy. The second part explains the methodology used to tackle the problems in scientific advice. The third part lays out the main results, and the fourth part discusses these findings. The conclusion highlights the main points that need immediate attention and indicates which need further investigation.

West African context

With a coastline extending more than 3,000 km, and a continental shelf of almost 170,000 km^2, Cape Verde, Gambia, Guinea, Guinea-Bissau, Mauritania, and Senegal are located in one of the best fishing zones of the world. Coastal upwelling involves the wind-driven movement of dense, cooler, nutrient-rich water towards the ocean surface, replacing the warmer nutrient-depleted surface water, and creates a marine environment of great ecological richness. Fish are abundant and for 20 years their capture has constituted an essential element in the growth and economic development of several of these States, which are classified among the least advanced countries (LDC). Fishing could help some of them mitigate the constant fall of the incomes resulting from agricultural cash crops (Morand

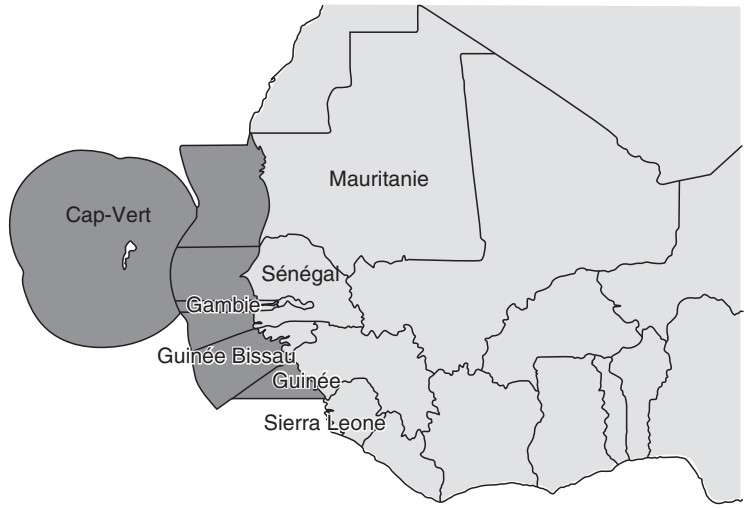

Fig. 9.1 States that are members of the Sub-Regional Fisheries Commission.

et al., 2005) and thus alleviate weak and unstable domestic growth. With a total sales turnover of almost 1 billion US dollars (in 2006), the fishing sector already provides public receipts as well as helping to restore the balance of payments in these countries. Moreover, more than 200,000 jobs are provided by the harvest sub-sector, along with a further over one million in the post-harvest sub-sector (downloading, processing, fish trade, marketing).

The fishing products of the West African coastal countries are exported to large exterior markets: increasing amounts of small pelagic fish feed the populations of the West African interior, while demersal fishes and mollusks are exported to the Asian markets. In addition, some shrimp and demersal fishes are exported to Europe from the coastal nations (i.e., Mauritania and Senegal), which have agreements between processing plants and European importers (Fig. 9.1). During the last 20 years, major changes in commercial trade flows reflect the demographic, economic, and institutional changes that have affected markets worldwide and put pressure on West African fisheries.

In the late 1970s, Mauritania, Cape Verde, Senegal, Gambia, Guinea Bissau, and Guinea combined their efforts to better manage fisheries, and created a regional body that could handle fishery policy at the regional level. The Sub-Regional Fisheries Commission (SRFC), born in 1985, has also had, since 2004, Sierra Leone as a member. The main objective of the SRFC is to strengthen cooperation between Member States. The SRFC therefore seeks to harmonize national fishing policies and improve fishery management. It also fights illegal fishing by giving, for example, member States the right to pursue illegal fishing vessels in adjacent waters. Fishing agreements are also at the heart of the SRFC. Bilateral agreements exist between SRFC countries and the EU but, until now, these agreements have been signed on a country-by-country basis, but among its future goals the SRFC seeks to establish a concerted regional system of fishing agreement negotiations, and to define, in the short term, minimal conditions of access to EEZs for all types of fishing.

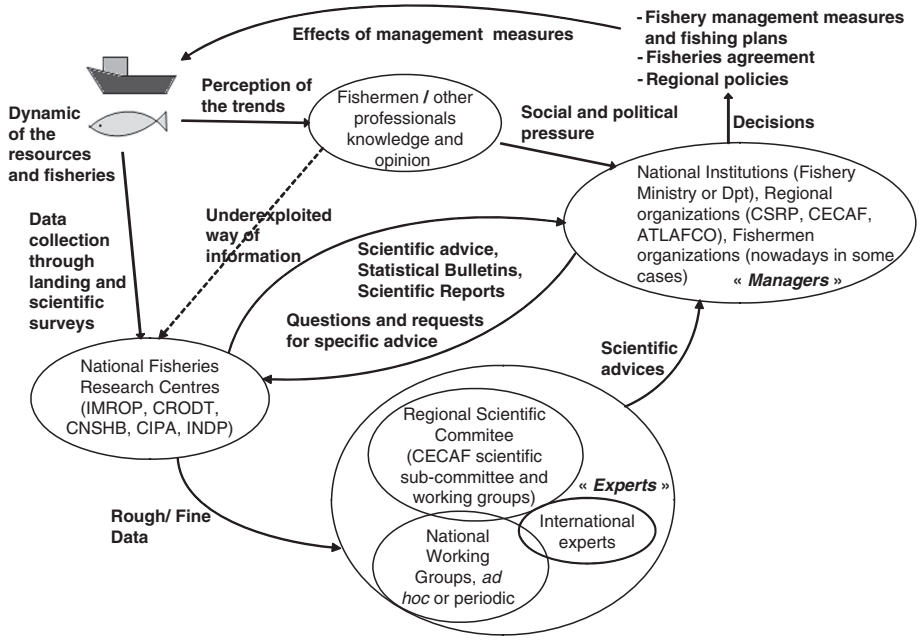

Fig. 9.2 An overview of the scientific information and advice network in the Sub-Regional Fisheries Commission region.

At both the national and the regional level, then, scientific advice for fishery management is sought as a support for management and policy decisions. The structure of the scientific information and advice network in the SRFC region has traditionally functioned through interrelationships between three main institutional bodies: research institutes, national fisheries ministries, and regional institutions (Fig. 9.2). In Gambia and Sierra Leone, only two distinct institutions exist since the research department is part of the Ministry of Fishery, while in Senegal, Mauritania, Cape Verde, Guinea, and Guinea Bissau, research institutes[2] are independent bodies. The institutes aim to produce data for fishery management purposes, so one of their main tasks is the collection of basic data through surveys (landings and sea exercises), which they then process and analyse, and subsequently write reports for the attention of the management authorities. Some research centers produce periodical statistical bulletins.

Fishery management bodies are mainly formed, at the national level, by the ministry or the department of fisheries, depending on whether or not that fishery stands alone.[3] In some cases, such as Mauritania and Senegal, they are formed by fishers' organizations, which are nowadays involved in the fishery management process. At the regional level, the principal organization is the SRFC and to a lesser extent the Fishery Committee for the Eastern Central Atlantic[4] (CECAF) and the Ministerial Conference on Fisheries Cooperation among African States Bordering the Atlantic Ocean (ATLAFCO). The CECAF, as an advisory body, promotes the sustainable utilization of the living marine resources within the West Africa area of competence, through the proper management and development of fisheries and fishing operations. Since its creation in 1967, the CECAF has also encouraged the development of a rational utilization of fishery resources, assisted in establishing basis

for regulatory measures, and encouraged training. More recently, it has also looked at the strength of regional fishery governance in West Africa.

The ATLAFCO[5] plays a political role in West Africa but at a lower level than the SRFC, since it is more political than practical. Another regional layer can be added with the Economic Community of West African States[6] (ECOWAS) and the New Partnership for Africa's Development (NEPAD). ECOWAS is the organization responsible for the implementation of the new Economic partnership agreement[7] with the EU, where fish exports rules and tariffs are very sensitive issues. The NEPAD seeks to develop an integrated socio-economic development framework for Africa, in which the fishery plays a significant role. For these two organizations, the fishery is a cornerstone of development, due to its importance in the economy of West African countries. It therefore needs both ecological and economic advice for initiating appropriate development and trade policies.

Specific working groups or committees of experts, both at national and regional levels, carry out more detailed data analysis than is done in national research centers, and these experts also produce more sophisticated diagnoses of problems. Such groups or committees are composed of both national and international experts (national researchers, international experts, members of international organizations such as FAO, OECD, World Bank, etc.). For instance, working groups of the scientific sub-committee of CECAF (small pelagics, demersal species, and artisanal fisheries) meet on a regular basis: they are irreplaceable, given the information they provide on fish stocks at regional level. Generally, committees of experts provide scientific advice through their reports on the status of fish stocks, fishing effort, and degree of effort control that has to be implemented when necessary. These reports constitute, in most cases, the main information support of scientific advice.

Method

The best way to study fishery advice is to undertake a survey that involves scientists (national and international), public managers, and also fishermen's representatives when the latter are involved in management bodies. The ECOST/ISTAM survey, carried out in 2006 and 2007, did this. It assessed the efficiency of scientific advice in the West African fishery context, examining (at both national and regional levels) the contribution of scientific advice to fishery management. Stakeholders involved in the process of providing information and influencing public decisions were asked to give their opinion on the quality and implementation of scientific advice, so what was really assessed was the degree of satisfaction and non-satisfaction of the persons surveyed regarding scientific advice. Questions about the relationship between research and administration asked:

- To what extent is scientific advice actually used to support decisions in fisheries management?
- What are your perceptions regarding main causes of an observed low level of use of scientific advice?
- According to stakeholders, what can be done to improve the quality of scientific advice and its use in the decision-making process?

The survey was supported by a questionnaire subdivided into four different parts (specific questions asked depended on the category in which various actors[8] belonged). The first part contained general questions asked of everyone in the survey, such as: What solutions do you suggest that will improve scientific advice? The three other parts include more specific sets of questions targeted at different categories of informants:

- Directors or heads of fisheries research teams (in national research centers) were asked questions orientated around the scientific production of the research team such as: What is the number of researchers, engineers, and technicians involved? What are the main difficulties encountered in maintaining your research teams?
- International and regional experts with experience of scientific advice were asked questions focused on the efficiency of scientific advice and its use in the West African context, such as: How do you appraise the use of the results of scientific and technical research for fisheries management in general, and for the CECAF region in particular?
- Public Managers were asked questions targeted at an assessment of scientific advice and ways to improve its use, such as: How do you assess the role of scientific advice in the decisions that you have to take concerning the management of fishing activities?

Of the 65 questionnaires distributed by email, 51 were completed by 28 experts, 15 managers, and 8 research directors. Since most of the questions were open, allowing free-flowing answers, a re-codification was done after receipt of the completed questionnaires in order to undertake a quantitative analysis of the results. Before conducting that analysis, an inventory of the information collected was made. The responses to each question were classified by theme, thus enabling a classification of the qualitative information that had been captured, and then the information was codified, using themes or key words. For example, for the question relating to the process of the communication of scientific advice, a response such as "Contact between researchers and professionals" was classified in the category "Direct responses" for this question. Then the proportion of the different categories of responses was calculated, and the results graphed. The sum of that proportion could be more than 100% of the number of categories, because it was possible to show several responses; conversely it could be less than 100%, because no arbitrary value was assigned when information on a question was lacking.

ECOST/ISTAM survey results

Scientific advice: content and processes

Most of the themes covered by scientific advice related to the biology and exploitation level of the resource (60% of answers). The main aspects mentioned were: the structure and functioning of the marine ecosystems; the composition of the catches; the exploitation of demersal resources; the overexploitation of fish stocks; and the mean length and weight of catches. The socio-economic theme had many fewer responses than did those in the natural sciences, being only about 25% of the responses received. The advice dealt mainly with conflicts between the small-scale and industrial fisheries, the characteristics of small-scale fishery communities, and return on investments. Only a few recommendations directly addressed management issues by mentioning technical measures such as the types of licenses, fishing gears, fishing areas, and biological assessment (15%). As a result, scientific advice in the SRFC region is strongly focused on resource assessment.

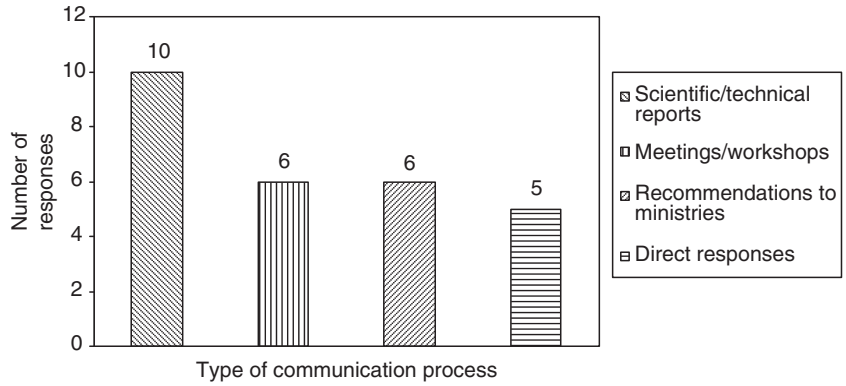

Fig. 9.3 The process of elaborating on, and diffusing, scientific advice within the Sub-Regional Fisheries Commission member States.

Regarding the way the scientific advice is processed, the survey revealed that, despite the fact that country frameworks and channels of communication exist, about 40% of the respondents were not aware of such a formal dissemination framework. Scientists mainly use scientific or technical reports to give advice (Fig. 9.3), but there are also other processes in place such as meetings and workshops, recommendations to Ministries, and direct responses to requests from manager. This last is interesting: it implies that researchers and managers do interact with each other, with actors in the sector directly making a specific request to the scientist, prompting a "direct response". In Mauritania for example, scientific advice is often transmitted in response to a request made by the government. If the advice is not clear, a specialist is invited to the Ministry to clarify the scientific information provided. In the same country new means of transmission of scientific advice through the participation of scientists in TV and radio programs is under development.

Beside regular processes, initiatives are also taken by research institutions themselves. Such initiatives are strongly supported by managers, because they give them a capacity to anticipate problems. For instance, one of the informants stated that:

> Scientific advice can correspond to a demand explicitly formulated by an actor in the sector. But it can also (ideally) be the result of an internal action of the research institute that demonstrates its capacity to anticipate problems. It therefore gains credibility.

However, the problem is that management initiatives are all too often taken without prior dialog with all possible involved actors.

Use and non-use of scientific advice and its implications

Is scientific advice taken into account in decision-making? The survey looked at the perceptions of experts regarding the use of their advice by managers in the fisheries sector. More than half of the experts surveyed thought that scientific advice was not (or not very much) taken into account by managers. This is shown in Fig. 9.4.

The reasons why scientific advice does not receive proper attention do not lie in the fact that managers think such advice unimportant: 40% of them said that scientific advice plays

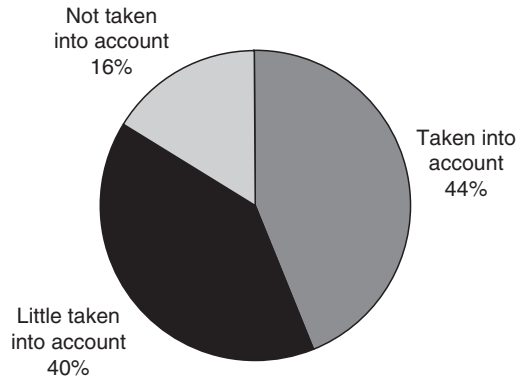

Fig. 9.4 Perception of experts on the use of scientific advice by managers.

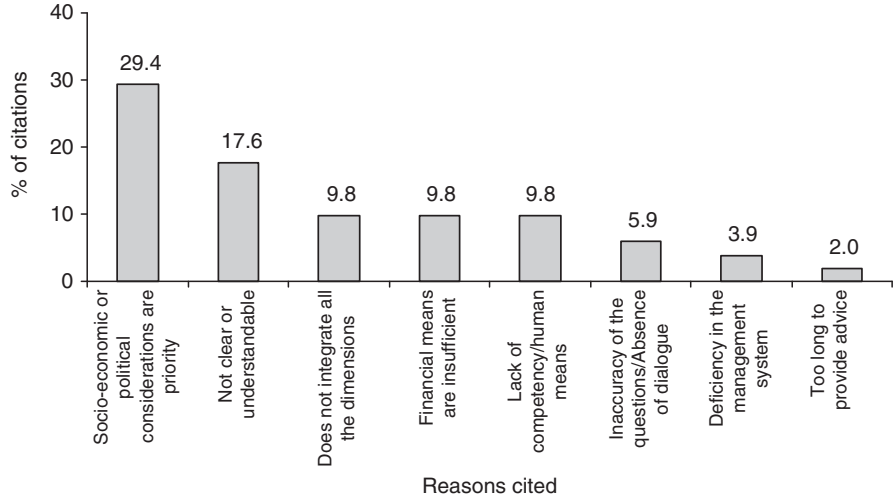

Fig. 9.5 Responses on the reasons why scientific advice is not taken into account within the Sub-Regional Fisheries Commission. Note: The sum of the proportion can be greater than 100% because it was possible to provide several responses. It can also be less than 100% because we have not assigned an arbitrary value when information on a question was lacking.

an important role in their decision-making process, while 65% considered its role to be very important. One manager wrote that "Scientific advice is important for the correct exercise of our job, and we are aware of that." The recent management plan for octopus and shrimp fisheries in Mauritania, for instance, explicitly refers to the results of a European research cooperation project (INCO-Cephalopods) on resource use and management (Failler, 2002) and to two international scientific working group meetings held in Mauritania in 1998 and 2002. Thus, scientific advice can be taken on board by managers when making fishery management plans. The survey showed that the main reasons why scientific advice is sometimes not taken into account are as shown in Fig. 9.5.

The great majority of respondents mentioned political issues as the main reason for any lack of consideration of scientific advice. For instance, one manager stated that: "The

results of the research are generally not applied by the managers because of the existence of other dimensions that are not strictly scientific but political, social, economic and institutional". Another manager asserted: "The use of the research results is, and will remain, for a long time, secondary as regards socio-economic and political obligations". It was also said that there is a "too big influence of the politics compared to the technical aspects" and that scientific advice is not clearly expressed, resulting in managers being unable to interpret and understand it. This means that there is both an issue with the format and contents of scientific advice and that there is also a crucial lack of communication between research institutions and government services. One respondent said that "Sometimes, the scientific advice is not very clear or very explicit", while others complained about the "inappropriate translation/presentation of the results in words/forms understandable by the managers" and the "lack of legibility of the results".

A third reason (10% of the answers) is that scientific advice does not integrate all necessary dimensions/aspects of the fisheries (social, economic), if the advice is to be considered in the decision-making process. This is a direct consequence of experts focusing primarily on resource assessment. According to one expert surveyed, the research results do not respond to the managers' expectations as "they are too 'biologists', not accompanied with economic impact analysis". The fourth and the fifth reasons relate to financial resources and the competence of the managers. Indeed, according to their responses, managers sometimes do not use scientific advice because there are insufficient financial resources to concretely integrate them into the management process. Moreover, according to some experts, managers are not sufficiently competent to be able to utilize the results of the research and translate them into management measures. On the other hand, 50% of the experts surveyed (some of them researchers) said that the information and results provided by research are not satisfactory and cannot support or produce good scientific advice. Here, the weakness or insufficiency of available scientific data and subsequent usable results with which to achieve good management regimes are indicated. Hence, the degree of efficiency of the national research centers has to be addressed as a possible upstream cause of the fact that scientific advice is not reliable/relevant enough to be taken into account.

Survey results revealed that the research institutions have weaknesses with respect to human, technical, and financial resources. They showed that the lack of competence involved economic, social, and legal aspects of the work, as well as marine ecology. Furthermore, research team leaders maintained that they had difficulties in supporting their research teams. When asked why they encountered such difficulties, they answered that it was mainly due to weakness of salaries and other benefits (65% of the responses), the functioning of the institute (50%), and insecurity of employment (40%). Indeed there is no attempt to provide motivation of the personnel and salaries are low. This means that some researchers are compelled to hold several jobs at the same time, or to leave the institute when they are presented with a good alternative employment opportunity. According to the survey, when scientists leave, they mainly turn to private consultancy (37.5%), national development programs (37.5%), international programs (25%), and international organizations (25%). Such a situation is clearly a major cause of the lack of complete and reliable data, of the insufficiency of scientific results, and of their non-availability in a timely manner (Bâ, 2007).

Improvement of the quality of scientific advice and its use in the decision process

What are the criteria (Fig. 9.6) by which scientific advice may be considered to be really useful? Experts in the sector were asked this and most of them answered that relevance and applicability were the first criteria to meet (43% of the responses). Indeed, managers will not be able to use the advice if it is not relevant to the management measures in place. However, it may be relevant, but not applicable, and this will lead to disregarding the advice.

One respondent, for example, said, "When they are of interest, the results of the research are often confused, little operational…" But expert respondents also mentioned that managers need to express their priorities clearly, and formulate their questions appropriately, if they are to get advice that is both relevant and applicable.

Respondents offered some solutions (Fig. 9.7) for improvement of scientific advice. Sixty-three percent of them suggested that, as a priority, sensitization programs, training of researchers, and strengthening of institutional capacities should be developed and implemented. When research leaders were asked which area should be focused on to strengthen the capacity of institutions and personnel in order to produce reliable scientific advice, they responded that the biology/ecology/fishery research team has to be excellent and management needs have to be correctly understood by the researchers (75% of the responses). Thus, the skill of scientists offering such advice should be recognized in order to improve the whole process. The research leaders surveyed also observed that it is very important for researchers to really understand the socio-economic and legal aspects of fisheries (38%); they added that research personnel need to be motivated and should benefit from their work (38%). This would help to improve the availability of timely advice.

Another major solution cited (33%) was to increase the collaboration between research and fisheries professionals. According to the responses, such collaboration can be achieved

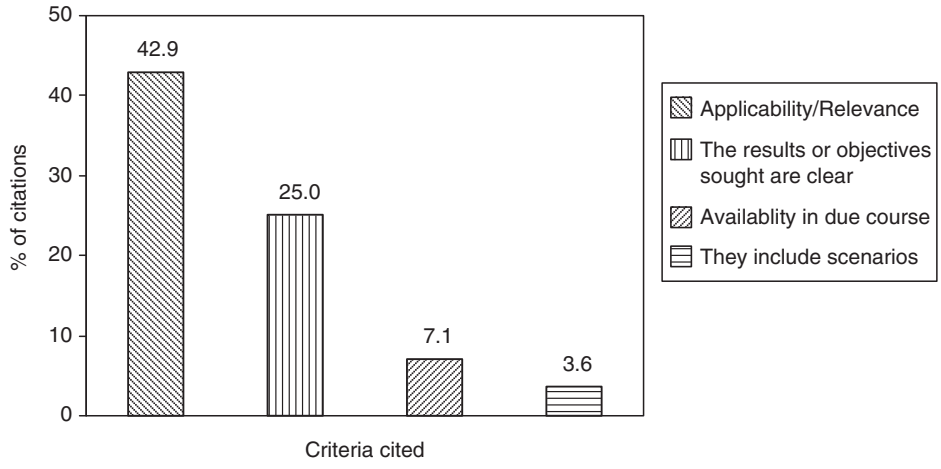

Fig. 9.6 Criteria for the usefulness of scientific advice.

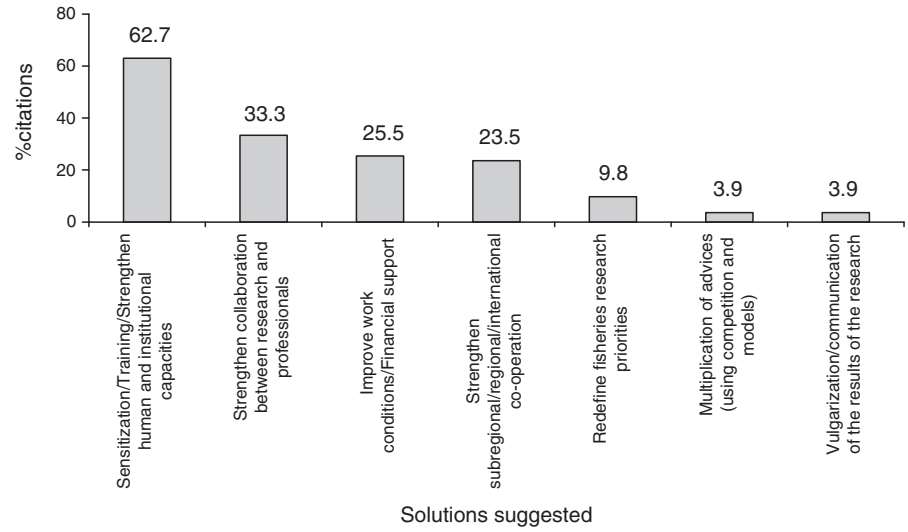

Fig. 9.7 Suggestions to improve scientific advice.

through the development of programs aimed at bringing together the providers and the users of scientific advice. For example, workshops and meetings, dialog, and communication between managers and scientists can increase the likelihood of managers' expectations being taken into account, while translation of scientific research results into understandable and applicable advice is also essential. Finally, an important suggestion was the strengthening of regional and international cooperation; this was also seen as a priority. Experts suggested that the Sub Regional Fisheries Commission (the sub-regional entity dealing with fishery resources) has to be strengthened, leading to better cooperation between the member countries.

Discussion

According to the survey, West African countries are aware that scientific advice is important, since they commit themselves, through their national fisheries structures, to be part of and to implement programs aiming at improving the dissemination of scientific information. However, the results of the survey show that, in the SRFC region, scientific advice is not sufficiently taken into account for two main reasons. The first is that other "political" considerations are placed in the foreground, leaving aspects related to the state of the fishery resource as a second priority. The second reason is that advice suffers from some intrinsic weaknesses due to:

1. difficulties encountered by research centers in producing the basic data on which the advice would rely; and
2. inadequacies in communication of the needs formulated by the managers and the results of the research.

The first reason confirms the statement of Daw and Gray (2004) that:

> the translation of scientific discovery into practical policies is often slow and incomplete, as many other political, social, and economic factors come into play. We can see such a pattern in fisheries science and policy, where the lack of effective management has contributed to a crisis in world fisheries.

Indeed, in most of these countries, socio-economic and political considerations are treated as priorities. Lobbying and political behavior are privileged over other considerations. Therefore, neither experts nor researchers are to blame in this case. In Europe, such situations are also found, as fishing lobbies force a process of fisheries management more focused on politics than on the sustainability of stocks; scientific advice is used for political objectives, not in relation to good fisheries management (Daw and Gray, 2004).
Science should play an important role in fisheries management. This is the case in Mexico for example, where in order to solve the problem of how to manage over-exploited fisheries (particularly reduce fishing mortality), scientific-based decisions were integrated into fisheries management and a new fishery policy was designed. Thus, the maximum allowable effort was defined and calculated, giving fishing managers appropriate criteria with which to decide on the issuing of permits, licenses, and concessions, all of which have an impact on fishing effort (Hernandez and Kempton, 2003). Marriott (1997) examines the institutional reform in fisheries that developing countries need to undertake if they are to better manage fisheries resources and to take better decisions. One of these proposed reforms suggests that the Minister of fisheries acts as the "resource manager" when taking decisions based upon advice from the professionals and managers. The minister is thus considered as directly or formally responsible for decisions of the ministry. He or she would also have to enhance the understanding of the role of policy-maker (minister who takes decisions) and the basis for making policy (specialists that suggest policy and actions), which is crucial to resource management policy.

The survey revealed that national research centers do not have all the capacities required for the production of basic reliable data. The most relevant contemporary data and methods should be used to produce quality scientific advice (National Research Council, 2004), but the national research centers of the West African countries lack the institutional, human, and financial capacities for this. At the human level, the problems concern the number and competence of the researchers, especially given that the turnover of personnel may be high. In Mauritania, for example, according to the survey, for 8 researchers leaving the institute, only 3 will enter it. Some national research centers (i.e., the CNSHB in Guinea) have established criteria for assessing the results of the research; however, scientists still must be well trained, and competent. The lack of financial and institutional capacities within the research centers is linked to the fact that in general there is no real national policy and/or planning basis for the research, and there are also inequalities between the capacities of research institutions. Low level of competence may result in a delay in the study of alternative fishery regulatory systems, or of appropriate development policies, and may also harm the development of studies on the long-term effects of the fishery on renewable marine resources.

Chavance *et al*. (2007) have reported on difficulties in producing timelines and reliable data and said that these were related, among other things, to the diversity of the information

systems in place in terms of scales used and goals. This leads to problems of compatibility between the data they produce. If data are not reliable, this will in turn lead to the production of non-reliable scientific advice. It is also necessary that advice arrives in a timely manner in the current management process, in addition to being the best information available. Adequate research/scientific advice and fisheries management plans should be created in terms of usefulness and timeliness: scientific advice is useful in improving fisheries monitoring systems, but would be more useful if rapidly applied, resulting in a better and effective exploitation and management of fisheries resources, and risk assessment. Scientific advice should therefore be provided with little delay and in the appropriate format to help policy decisions.

It is also now clear that managers and scientists do not communicate with each other sufficiently, leading to a mismatch between the needs formulated by the managers and the results of the research. Thus, it should be noted that the relationship between the managers' expectations, priorities, and research results is not very clear, a point that has been the subject of discussions at the sub-regional level, although it does not seem to have been improved (Failler *et al*., 2002). Finally, advice that is not comprehensible to managers will simply be ignored or disregarded, resulting in, as Cardinale and Svedang (2008) state, the fact that even though there might be uncertainties in the assessment, the real problems of fisheries management are that advice is ignored.

What should be done? Although in countries of the South, especially West African countries, scientific information and advice is not explicitly called into question (like it can be in countries of the North), improvements in their production and use have been suggested. The main solution remains the strengthening of the capacity of scientists in the area of the state of the resource's related subjects, i.e., biology, fisheries science, hydrology, etc. Indeed the competence and knowledge of persons providing advice should be clear. At the sub-regional level, the SRFC can contribute to the improvement of the production of scientific advice, by playing an instrumental role in forging a better understanding of management issues through the promotion, within government and research institutions, of a global vision, a better appraisal of the opportunities of the fisheries sector, regulatory terms and conditions, and exchange of information and experience on issues related to the provision of scientific advice, management plans, monitoring, etc. At the national level, the improvement of scientific advice assumes that states invest mainly in the four following pillars (closely linked and complementary):

1. The information system, which must be integrated, consolidated, and composed of networks.
2. The stock evaluation and forecasting, and the economic modeling systems.
3. The system of fishery allocation.
4. The monitoring and control system.

This means that scientists, managers, and government's officials should sit together, strengthen collaboration and dialogue, as well as undertake a joint in depth analysis of the fisheries sector, identifying the elements to improve, and the real needs of the managers in terms of fisheries management. They should formulate adequate questions according to the objectives that have been established. One objective of "scientific advice/fisheries

management" is, among others, the identification of a suitable way to improve decision-making in terms of fisheries management and planning, while also meeting the priorities of governments in the development of the fisheries sector. This should lead to the best decisions regarding the sector. Such interaction is also necessary for the accurate identification of lessons to be learned from research results, for the identification of research priorities for improving scientific advice in fisheries management, and of problems to solve. Interaction with fishers is also important, as their knowledge is an important source of information. Local knowledge should be integrated and expanded in fisheries management as an input to scientists' and managers' knowledge, because fishers know the local areas. This local knowledge should be transmitted in a way that permits it to contribute appropriately to science and management (Maurstad, 2001). Applying co-management as a type of governance in fisheries may well enhance the effective and equitable participation of all stakeholders, including local communities of fishermen. However, for this to succeed, some processes should be taken into account, such as communication and the development of trust between partners as a prerequisite to the development of contractual agreements (Pomeroy and Berkes, 1997; Pomeroy *et al*., 2001).

Risk should not be neglected, especially in the context of global change in fishery systems and given the complexity and unpredictability of fisheries systems. Even if the use of scientific advice is improved, it still may not be taken into account if unpredictable external situations occur, such as strong seasonal climate variability (Failler and Samb, 2005). Scientific advice can often contribute to risk assessment, but the achievement of risk management (in response to scientific advice) depends on the relevance of the assessment and the uncertainties in that assessment, which can prevent the production of scientific advice in time or at all. Uncertainties can arise from difficulties in making predictions about complex systems (POST, 2004) and rapid and unpredictable changes in the sector (e.g., the proliferation of a species or rapid changes occurring in trade-circuits) can lead to uncontrolled situations. One useful way to improve the capacity of scientists to detect rapid changes is to keep an eye on the behavior of fishermen and other professional observations (Fig. 9.2), which should be continuously monitored by specific surveys. Nevertheless, it will remain difficult for scientists and experts to issue reliable advice in uncertain conditions, and so the precautionary principle (adopted by the EU) should also be invoked in some cases. In the UK, for example, the Interdepartmental Liaison Group on Risk Assessment (ILGRA) recommends the invocation of the precautionary principle when "the level of scientific uncertainty about the consequences or likelihood of the risk is such that the best available scientific advice cannot assess the risk with sufficient confidence to inform decision-making" (POST, 2004).

Conclusion

Inadequacies in the production of reliable scientific advice stem from weaknesses within the research structures that lack appropriate human, financial, and technical resources, as well as proper institutional frameworks for supporting policy decisions. However, even if clear and relevant, scientific advice is often not taken into account, because political factors play a major role that prevents advice from being applied to a specific fishery or resource.

There is a crucial need to equip national research centers with a strong institutional framework and the financial resources to support their activities. The training of personnel is very important, and dialog between the research community and public managers is a prerequisite for improvement of the production and use of scientific advice, especially when facing global changes in fishery systems. This collaboration should be strengthened through regular meetings as they appear to be the best available way to produce clear advice that meets the managers' expectations and approximates realities in the field. Collaboration at an upper level (sub-regional, international) through the SRFC and its members should be encouraged and enhanced.

These findings highlight the difficulty of achieving fishery management entirely based on upper/governmental institutions: in such a framework, the information-decision cycle is very long and its maintenance is cost heavy. The low reactivity of such information-decision networks may prevent them from efficiently supporting fisheries' adaptation to future environmental and market changes and thus mitigating negative impacts that may follow from this. Nevertheless and fortunately, fisheries management plans now starting to be put in place in Mauritania (for cephalopods and shrimps fisheries) and in Senegal (for deep shrimps trawlers) appear to be an interesting way of moving forward, because they operate at the level of specific fisheries rather than at the national level. This may increase timeliness and the relevance of the scientific information. Furthermore, new players in scientific information production, such as universities, NGOs like WWF or the World Conservation Union (IUCN), or the Fondation du Banc d'Arguin, may also help to change things as they have strong connections with professionals and local actors, and are not driven by political considerations.

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Endnotes

1. ECOST: Ecosystems, Societies, Consilience, Precautionary principle: Development of an assessment method of the societal cost for best fishing practices and efficient public policies (http://www.ecostproject.org); ISTAM: Improve Scientific and Technical Advices for Fisheries Management (http://www.istam-project.org).
2. • Institut Mauritanien de Recherches Océanographiques et des Pêches (IMROP), Mauritania;
   • Institut National de Développement des Pêches (INDP), Cape Verde;
   • Centre de Recherches Océanographiques de Dakar Thiaroye (CRODT), Senegal;

- Centre de Recherche Appliquée sur les Pêches (CIPA), Guinea Bissau;
- Centre National des Sciences Halieutiques de Boussoura (CNSHB), Guinea.

3. Like in Gambia where fishery is associated with natural resources and environment or in Guinea with aquaculture, or in Senegal with Maritime transports.
4. The Fishery Committee for the Eastern Central Atlantic (CECAF) was established in 1967 by a FAO Resolution under Article VI of FAO Constitution. It is an advisory body integrated in the FAO organization and has no specific administration or budget. Its transformation into a Fisheries Commission under Article XIV of FAO Constitution, with an autonomous budget is currently under examination. The Area of competence is the Eastern Central Atlantic between Cape Spartel and the Congo River. The main functions of CECAF are to:
   - promote programs of development for the rational utilization of fishery resources
   - assist in establishing basis for regulatory measures
   - encourage training.
5. Established in 1989, ATLAFCO, the Ministerial Conference on Fisheries Cooperation among African States Bordering the Atlantic Ocean comprises more than 20 countries; Morocco ensures Permanent Secretary. The objectives are to:
   - promote active and structured co-operation in the management and the development of fisheries in the region;
   - stimulate all the national economic sectors on the basis of direct and induced effects which can result from the exploitation of fisheries resources;
   - develop, coordinate and harmonize their efforts and their capacities in order to preserve, exploit, valorize fisheries resources;
   - strengthen solidarity with regard to the African States without littoral and of the States of the region that are geographically handicapped.

   See www. http://www.atlafco.org/
6. For more information: http://www.ecowas.int/
7. It replaces bilateral agreements of one ACP country with EU under the Cotonou agreement.
8. Available at www.ecostproject.org (under WP10 section).

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