



WorldFish



Workshop Report 2011-09

Envisioning 2050: Climate Change, Aquaculture and Fisheries in West Africa

Dakar, Senegal 14-16th April 2010

Summary

This report presents the activities and results of the workshop *Envisioning 2050: Climate Change, Aquaculture and Fisheries in West Africa*. The objectives of the workshop were to discuss critical issues and uncertainties faced by the fisheries and aquaculture sector in Ghana, Senegal and Mauritania, build sectoral scenarios for 2050 and discuss the implication of these scenarios in the context of climate change for the countries and the region. During the workshop participants were introduced to scenario-building methodologies, identified drivers of change and ranked them according to their importance and levels of uncertainty. Participants then constructed four consistent scenarios for 2050 for each country. The scenarios raised several questions including: Can aquaculture address both national food security and macroeconomic growth? Should regional trade be promoted or access to global markets prioritised? How will climate change affect fishery resources, especially small pelagic fish like sardines, which are an important export commodity for Senegal and Mauritania?

Participants also assessed the implications of the different scenarios in terms of climate change and research and development in the fisheries and aquaculture sector. It was agreed that a regional or sub-regional effort is needed to better integrate scientific knowledge and to put into place coherent fisheries policies. Additionally, a better understanding of the impacts of climate change on the sector is needed, with for instance, the development of coupled climate-fisheries models for major commercial fisheries in the region. Participants unanimously agreed that strategic planning and foresight studies methodologies should be widely disseminated. Indeed the opportunity for reflective and creative thinking was recognised as an important part of planning - especially adaptation planning - to climate change.

Finally, the workshop provided a rare opportunity to include in a foresight study, art projects by youth on the future of the fisheries sector and the coasts as an exhibition and discussion theme ("Visions of the Future: What is African Youth telling us about our Ocean?"). Empowering youth on climate change issues and integrating their needs into adaptation planning is essential as they will be the ones most affected by future developments.

The workshop organisers gratefully acknowledge financial assistance from Canada's International Development Research Centre (IDRC), the German Federal Ministry for Economic Cooperation and Development (BMZ), the German Technical Cooperation (GTZ), and QUEST-Fish, a project funded by the United Kingdom's National Environmental Research Council (NERC). We would particularly like to thank the Climate Change Adaptation in Africa (CCAA)/IDRC program for kindly providing the necessary financial support to make participation at this regional workshop possible. The assistance of Dr. Aliou Sall and Mr. Ibrahima Seck with providing local arrangements and the cooperation of Hotel Ocean (Yoff) is also gratefully acknowledged.

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1. Introduction

The workshop *Envisioning 2050: Climate Change, Fisheries and Aquaculture* was held in Dakar, Senegal and is part of the project “What futures for fisheries production systems in West Africa? Development of scenarios for adaptation to climate change” conducted by the WorldFish Center and the Leibniz Center for Marine Tropical Ecology. The aim of the project is to build future scenarios for Ghana, Senegal and Mauritania fisheries to identify how the sector in these countries is likely to respond to future changes under different climate change, population change, trade patterns, economic and policy scenarios.

The objectives of the workshop were to:

1. Discuss critical issues and uncertainties faced by the fisheries and aquaculture sector in Ghana, Senegal and Mauritania identified in an internet survey that participants were invited to fill out prior to the event;
2. Build scenarios for 2050;
3. Discuss the implications of these scenarios in the context of climate change for the countries and the region.

The workshop was co-organised by the WorldFish Center (WFC, Penang, Malaysia) and the Leibniz Center for Tropical Marine Ecology (ZMT, Bremen, Germany). Workshop participants included 17 experts from governments, non-governmental organizations (NGOs), research institutes and universities (Annex 6.2). In addition before and during the workshop, the WorldFish Center teamed up with the *Mundus Maris* initiative, a NGO that mobilises science and the arts to encourage young people to work towards sustaining healthy oceans and coasts. WorldFish commissioned art created by a Senegalese youth group on the topic “Visions of the future: What are young Africans telling us?” Through their paintings and presentations during the workshop, four high school students from the Senegalese fishing village of Kayar voiced their concerns about the future of their coastal community. The four students were mentored by the renowned contemporary Senegalese artist Samba Laye Diop and supervised by Abibou Diop, Director of the secondary school CEM Kayar, and Dr. Aliou Sall, the local coordinator of the *Mundus Maris* initiative.

2. Workshop activities

The workshop took place over two and a half days from April 14th through April 16th, 2010. It was officially inaugurated by Nathalie Beaulieu from the IDRC Climate Change Adaptation in Africa (CCAA) program who welcomed the participants to Senegal and highlighted the work of IDRC/CCAA, particularly its concern on the importance of fisheries in the region and the role scenarios can play in the development of adaptation strategies and policies. The project team then clarified the context and goals for the workshop and gave a presentation on scenarios (Box 1). This was followed by three keynote presentations on the fisheries and aquaculture sectors of the participating countries.

Box 1 What are scenarios?

Scenarios are not forecasts or predictions, but rather plausible descriptions of how the future may develop, based on a coherent and internally consistent set of assumptions about key relationships and driving forces. They are useful tools to estimate future socio-economic conditions, accounting for the multiple external drivers a system is or will be exposed to. There are three modes of thinking about the future - **predictive, explorative and normative**. The **predictive** type of scenario attempts to get an indication of what will happen by trying to find the most likely development in the future (close to forecasting, “If trends continue what would the future look like?”). **Normative** scenarios involve taking normative (desirable) goals into account and exploring the paths leading to these goals (“What do we want the future to be?”). In this project we employed the **explorative** scenarios, characterised by the openness to several possible events and different developments. They challenge conventional assumptions and deal with high levels of uncertainty and ambiguity (“What could the future be?”). They are useful when addressing the considerable uncertainty about future trajectories in complex systems and are instruments of reflexivity and learning. The idea is to achieve proactive and informed strategic planning.

ENVISIONING 2050: CLIMATE CHANGE, AQUACULTURE AND FISHERIES IN WEST AFRICA

Preliminary results of the internet surveys administered to 28 experts were then presented. Through open-ended questions the surveys asked to identify main drivers of change in the fisheries and aquaculture sector for 2050; and the answers were codified.

Participants were divided into country teams. The country teams discussed the results of the survey in order to:

- Assess whether the codes used by the project team were appropriate;
- Re-assess the ranking of the drivers in terms of importance and uncertainty.

This modified Delphi approach¹ allows experts through a series of rounds to yield some kind of consensus and shared understanding of the issues at stake. Day one of the workshop ended with a “process meeting” that drew some of the participants together to review how activities were carried out during the day and to identify areas needing adjustments that could improve sessions on the following day.

The second day of the workshop started with the country teams finalising the selection of drivers of change and identifying two critical drivers (highest importance and uncertainty) to form the scenario logic (also known as “cross”), the framework that defines the four possible futures. The teams presented and discussed their respective results in the plenary. They resumed their group work to flesh out the four scenario “story lines”, with guiding questions provided to assist them. As in the first day, the workshop ended with a “process meeting”.

Day three began with teams completing their scenario story lines. They then undertook a modified backcasting. The concept of backcasting involves the identification of a particular scenario and understanding: “What do we need to do today to reach successful outcomes and avoid negative ones?” The exercise involved:

- Choosing one scenario with a regional dimension;
- Analysing in this scenario two drivers: 1) climate change and variability and 2) research and development/technology;
- Identifying which policies at the regional level in the short and long term related to these two drivers could enhance the positive elements in the chosen scenarios and attenuate the negative ones.

Each team presented their results and a discussion ensued. The workshop discussion ended with final comments from the project team. The Kayar students then presented a painting they undertook during the workshop highlighting four issues that affected their coastal community.

¹ Under a traditional approach, Delphi participants remain anonymous, all communication is done in writing and usually more than two rounds are undertaken. Here possible bias due to group interaction is acknowledged.

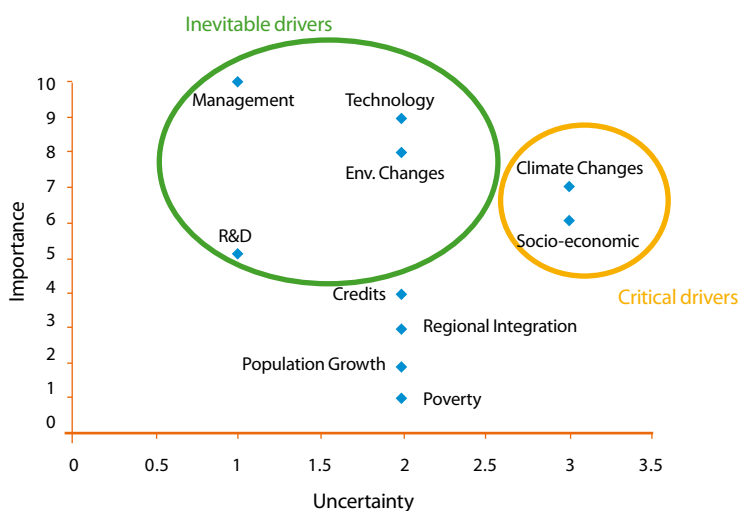
3. Workshop results

3.1 Ghana scenarios

3.1.1 Drivers of change

Drivers identified through the survey and their new rankings are presented in Figure 1. Inevitable drivers are drivers that have an important impact and require management attention but are less uncertain. Critical drivers have a high uncertainty and high importance, and are those used to create the scenario cross. Indeed it is the combination between uncertainty and importance that warrant strategic planning. Two critical drivers were identified: “climate change” and “socio-economic”. Climate change (including climate variability) refers mainly to changes in upwelling in the Gulf of Guinea resulting in changes in species migratory patterns and survival of certain aquatic species. Socio-economic refers to expanding or recessing economies, commercial and industrial development, market development and infrastructure, changes in social, human development, cultural (values, consumer preferences) and economic systems (markets).

Figure 1: Driving forces according to their importance and uncertainty for Ghana



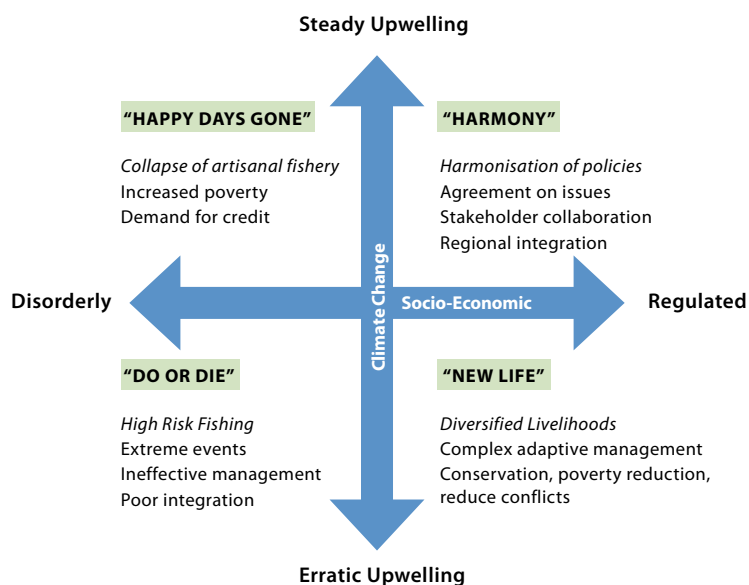
Inevitable drivers are drivers that have an important impact and require management attention but are less uncertain. The experts feel that these drivers are not outside the influence of a decision-making process and their direction of change can in the short term be altered.

3.1.2 Scenarios logic and storyline

In Figure 2 the four-cell matrix defining the boundaries of the scenarios is presented. The vertical axis signifies that upwelling could in the future evolve in two directions: a “steady upwelling” defined as an environment where upwelling patterns in the gulf of Guinea are similar to the present or easily predictable with models. “Erratic upwelling” refers to unstable upwelling patterns leading to unpredictable changes in abundance, composition and distribution of species. Coastal upwellings are wind-driven masses of cold nutrient rich waters replacing nutrient poor surface warm waters; and if reduced or altered may seriously affect the fisheries sector.

The horizontal axis is used to consider two extremes in socio-economic development: one where formal and informal institutions are not regulating society, more specifically the fisheries sector, and one where rules and norms are in place, enforced and effective. Once the boundaries of the scenarios were identified the group gave titles to the scenarios and developed four story lines.

Figure 2: Ghana scenarios



Scenario 1 “Harmony”: Harmonisation of policies

The scenario starts from a strong desire to apply a multi-sectorial and participatory approach to fisheries management. In the past, conflicting policies have resulted in widespread degradation of aquatic environments and illegal fishing gear has been widely used. In this scenario stakeholders participate in decision making, and agencies collaborate. For instance, an inventory of national policies governing natural resources is created to inform planning and management thereby increasing synergies and avoiding conflict between sectors. In terms of research and development data is readily available to implement ex-ante strategies to adapt to changes. Fisheries resources are spatially mobile, not bounded by national jurisdiction. Bilateral and regional structures and processes are promoted, especially in terms of monitoring, transboundary data collection and sharing, and technological transfer. Behaviours of other drivers in this scenario are presented in Table 1.

Table 1: Evolution of driving forces in “Harmony” scenario

Drivers	Fisheries	Aquaculture
Management	Very effective	Sustainable
Technology	Broadly accepted	Improved production
Environmental Changes	Conservation	Cleaner production
Climate Change	More mitigation	Currently not known
Socio Economic	Improved market	Regulated market
Research & Development	Reliable data	Reliable data
Credits	Readily available	Readily available
Regional Integration	Enhanced coordination	Information sharing/ replication of best practices
Population Growth	Reduce pressure	None
Poverty	Reduced	Reduced

Scenario 2 “New Life”: *Diversified livelihoods*

Due to an erratic upwelling, capture fisheries can no longer provide sustainable livelihoods. Diversification is needed, and immediate strategies are required to build communities’ adaptive capacity to climate change. Policies should focus on the needs of people most affected by climate change impacts, and aim to improve their resilience in the long term. Because the livelihoods of Ghanaians who live along the coastal areas and around lake Volta is tied to the fisheries sector, which may experience significant declines during erratic upwelling and changes in rainfall patterns, people opt to switch to a new life that will involve non-fishing activities. Diversified livelihoods, for instance the development of aquaculture (Table 2), have positive impacts such as reduced conflicts among resource users, conservation benefits and improved fisheries management practices. If well addressed, diversification may boost poverty reduction strategies, for example through activities which can be accessed by women.

Table 2: Evolution of driving forces in “New Life” scenario

Drivers	Fisheries	Aquaculture
Management	Complex	Intersectoral
Environmental Changes	Conservation	Increase pollution
Research & Development	Shift R&D investment from fisheries to aquaculture	Increase in R&D
Credits	More demand	More demand
Regional Integration	Enhanced coordination	Information sharing/replication of best practices
Population Growth	Reduce pressure	None
Poverty	Reduced	Reduced

Scenario 3 “Do or Die”: *High risk fishing*

Climate change and increased climate variability will bring higher sea levels, more intensive extreme events and is likely to increase the strength of winds. The number of risks faced by the fisheries industry in Ghana will increase; resulting in fewer fishing activities and many losses such as capsizing of fishing vessels, gear damage and even deaths caused by accidents. Fishing activities will be impacted severely. Under such conditions, it will be difficult to enforce the regulations and rules governing fisheries; therefore investment will decrease and the speed of environmental degradation will increase. Some fisherfolk with modern gears will “weather the storm” while the majority will quit fishing.

Table 3: Evolution of driving forces in the ‘Do or Die’ scenario

Drivers	Fisheries	Aquaculture
Management	Not effective	Increased interest
Technology	Illegal methods	Improve
Environmental Changes	Degraded	Reaching carrying capacity
Credits	Little investment	More investment
Regional Integration	Poor	Better
Population Growth	Reduce pressure	None
Poverty	More	

Scenario 4 “Happy days are gone”: Collapse of artisanal fisheries

The fishery of Ghana is seasonal in nature and it is closely associated with upwelling. During the period of steady upwelling, spawning and recruitment of fish stocks will be enhanced resulting in higher abundance and availability of fish stocks, especially pelagic ones such as sardinella. Fishing effort increases, leading to excessive fishing pressure that may cause fisheries to collapse. The livelihoods of dependent communities will therefore be severely impacted, as a result poverty will increase; and there will also be an increased demand for credits to venture into other fields, or even for daily sustenance. In this scenario, fish consumption will decrease and price of fish will likely increase, leading to food insecurity, fish being an inexpensive source of protein.

Table 4: Evolution of driving forces in the ‘Happy days are gone’ scenario

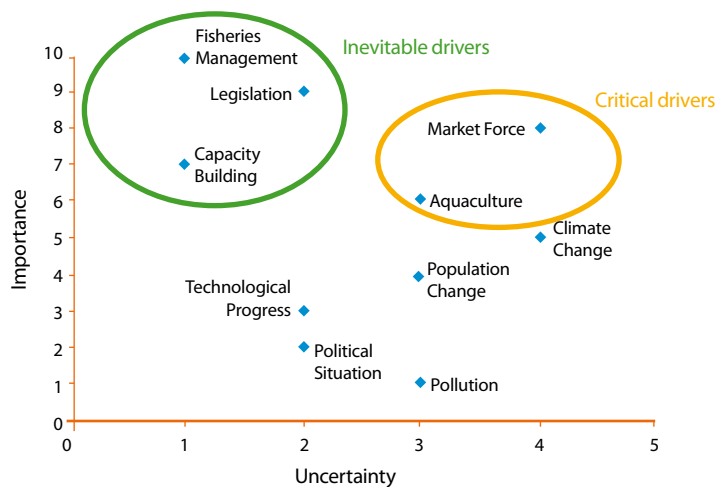
Drivers	Fisheries	Aquaculture
Management	Ineffective measures	Poor promotion
Technology	Increase	Increase
Environmental Changes	Reduced climate change but increased fishing effort leading to depletion of stocks	Increase pollution
Research & Development	Increase	Increase
Credits		Increased access
Regional Integration	Collaboration needed	Information sharing/ replication of best practices
Poverty	More	Reduced

3.2 Senegal scenarios

3.2.1 Drivers of change

Like in the other groups, the top ten drivers were selected based on their perceived importance and uncertainty (Figure 3). Aquaculture development and market forces qualified as the most critical drivers for the scenario-building exercise.

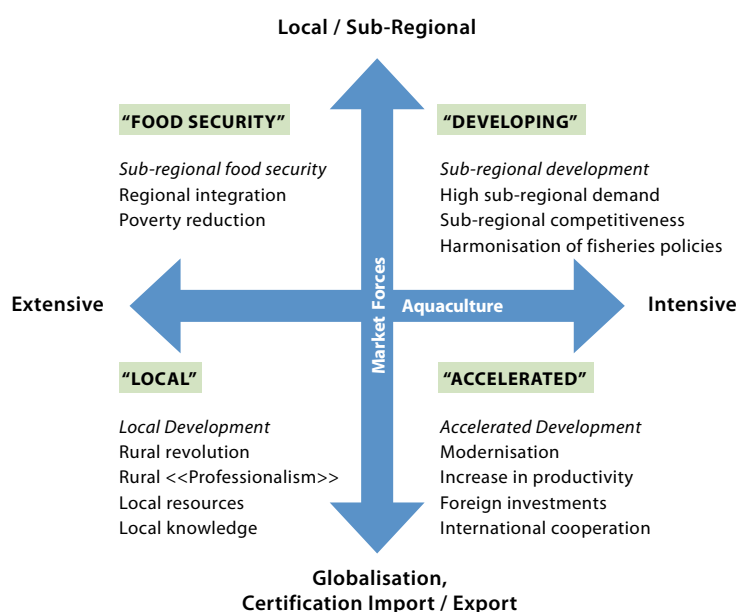
Figure 3: Driving forces according to their importance and uncertainty for Senegal



3.2.2 Scenarios logic and storyline

To build their scenarios, the Senegalese group decided to focus on “market forces” and “aquaculture” (development) as the two main drivers. This was translated into two axes of a scenario cross, of which they first distinguished between a globally oriented development and a region-centered and/or local approach to development. This axis thus represents different approaches to development, one rather export-oriented and geared largely to global markets, the other aiming more at regional integration and markets and focusing more on local needs. Unsurprisingly, these different approaches led to some differences in opinion during the discussions. The second, less contentious axis concerning aquaculture development goes from an extensive “village” approach to aquaculture on one side, to a modern, intensive high input aquaculture on the other (Figure 4). As in the other groups, once the boundaries of the scenarios were identified, the group gave titles to the scenario and developed four story lines.

Figure 4: Senegal scenarios



Scenario 1 “Accelerated”: Accelerated development

This scenario was developed as a classical modernist development approach: high technology, market orientation and intensive production combine for a strong push in technology and growth. Substantial input in terms of education and training as well as a clear legislative framework to curb potential environmental problems is implemented. There is considerable pressure with regard to product standardisation and certification leading to new forms of competition in international markets.

Table 5: Evolution of driving forces in “Accelerated” scenario

Drivers	Fisheries & Aquaculture
Management	Need to strengthen management systems
Legislation	Legislative text adapted
Capacity Building	Targeted capacity program for aquaculture developed
Climate Change	Adaptation and mitigation strategies in place
Population Change	Conflict between land use change and population change - limited access to aquatic resources
Technological Progress	Adoption of selection methods Uptake of aquaculture production knowledge
Political situation	Strengthen democratic systems
Pollution	Early warning systems in place

Scenario 2 “Food security”: *Sub-regional food security*

A marked contrast in both dimensions is manifested in this scenario, which combines a political orientation towards local/regional markets with a rather decentralised, appropriate technological approach to aquaculture. The feasibility of such an approach was doubted by several members of the group, and even more so the desirability of such a combination. However, discussions highlighted that such an approach may be interesting in terms of poverty reduction in a rural setting.

Table 6: Evolution of driving forces in “Food security” scenario

Drivers	Fisheries & Aquaculture
Management	Promote and harmonise management framework at the sub-regional level
Legislation	Negotiation of tariff policies, promotion of traceability in aquatic goods Sub-regional technological transfer Regulation of fisherfolk migration to avoid conflicts Free movement of fisheries and aquaculture products Sub-regional cooperation based on reciprocal fisheries agreements
Capacity Building	Capacity building of fisherfolk regarding fisheries regulations Creation of consultation and cooperation agencies and development of their interrelations
Climate Change	Promoting transformation and awareness-raising campaigns for conservation
Population Change	Put into place monitoring and collection systems of production at the regional level to cope with increases in demand due to increased population and changing regional market
Technological Progress	Enhancement of added-value of local/regional products
Political situation	Organisation of sub-regional markets, fairs and exhibitions
Pollution	Stimulation of sub-regional program on mandatory Environmental Impact Assessment for every substantial project (dams, offshore oil exploitation, overflow canals, installation of agro-industrial complexes near water ways etc.)

Scenario 3 “Developing”: *Sub-regional development*

This scenario shows one possible “compromise” by combining high-tech, intensive aquaculture with economic development oriented at the sub-regional level. Substantial capacity building and awareness with regard to the potentially detrimental environmental effects of intensive aquaculture is occurring and a strong effort exists at the regional level to create the framework for harmonised regulations and regional market access. Some members argued that this approach would go well with the rising demand in fisheries products on a regional level.

Table 7: Evolution of driving forces in “Developing” scenario

Drivers	Fisheries & Aquaculture
Management	Improvement of production systems efficiency Improvement of extension systems Improvement of aquaculture sector
Legislation	Creation of political dialogue platforms in the sub-regions Harmonisation of fisheries regulations
Capacity Building	Design and implementation of sub-regional training programs on Best Management Practices in fisheries and aquaculture Increase awareness of FAO Code of Conduct for Responsible Fisheries and on the advantages of a sub-regional network on fisheries and aquaculture Revival and evaluation of community convention on free movement of individuals and goods
Climate Change	Assessment and modeling of climate change impacts on fisheries Dialogue on the challenges brought by climate change Design of sub-regional adaptation and mitigation strategies
Population Change	Design of private investment incentives (fiscal and customs)
Technological Progress	Disseminate and popularise modern fisheries and aquaculture equipment in the sub-region
Political situation	Promote sub-regional integration: free movement of individuals and goods, common market
Pollution	Creation of sub-regional agencies for monitoring and early warning on pollution risks linked with international agencies

Scenario 4 “Local”: *Local development and auto-sufficiency*

This last scenario was discussed very much in political terms and with regard to local self-determination and “grassroots” development. It was argued that this approach needed a true “rural revolution”, including the mobilisation of the local knowledge base and also rural education (and extension) to cope with the challenges of a decentralised, village-based production. The feasibility and potential strength of such a system remained contested. However it was agreed that it opened the view on the partial independence of the two axes.

Table 8: Evolution of driving forces in “Local” scenario

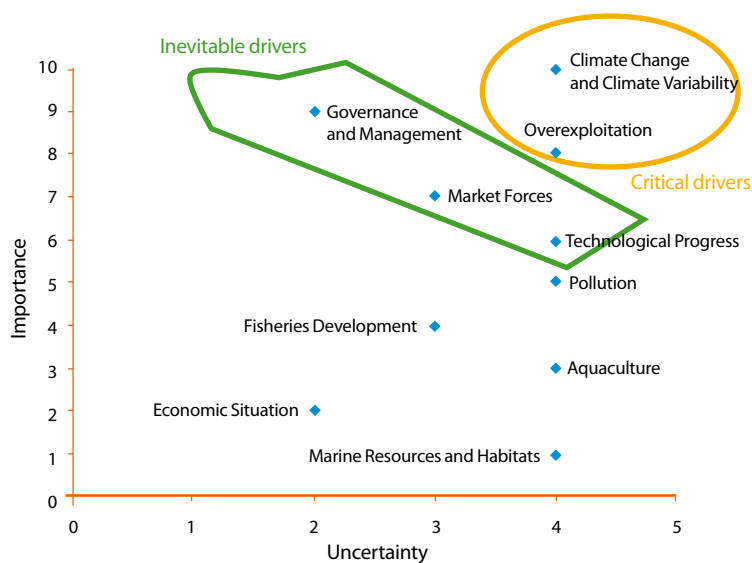
Drivers	Fisheries & Aquaculture
Management	Improvement of management systems Management plans Co-management
Legislation	Participatory elaboration of legislative texts Information, education and communication/popularisation of legislative texts
Capacity Building	Thematic capacity building programs developed
Climate Change	Awareness campaign on climate change Local strategies for adaptation and mitigation
Population Change	Land and property rights management according to local population’s needs
Technological Progress	Dissemination of integrated aquaculture agriculture techniques
Political situation	Local governance Rank and file democracy Equity in the exploitation of resources Civic education
Pollution	Local committees for early warning systems

3.3 Mauritania scenarios

3.3.1 Drivers of change

The group re-assessed extensively the initial clustering of drivers based on the surveys undertaken by the project team. For instance “governance and management” were merged into one driver; albeit participants agreed that “governance” referred more to the institutional framework and policy orientation, while “management” referred to the instruments used to implement policies. Based on importance and uncertainty the most critical drivers for the scenario building exercise were overexploitation of aquatic resources (including collapse of stocks and extinction); and climate change and climate variability (Figure 5).

Figure 5: Driving forces according to the importance and uncertainty for Mauritania

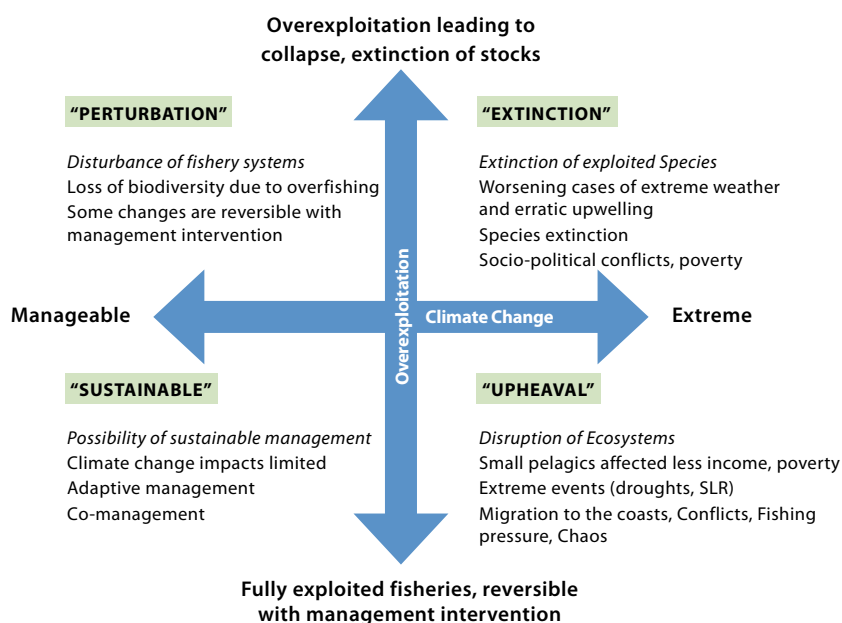


3.3.2 Scenarios logic and storyline

Overexploitation is conceptualised as the result of different types of management, a continuum from fully exploited fisheries, where management actions can still reverse trends, to overexploited ones, where commercial stocks collapse and management actions have failed (Figure 6, vertical axis). The horizontal axis represents different levels of climate change and climate variability, from slow onset resulting in small incremental changes that can be palliated by adaptation strategies to severe climate change and extreme events.

During discussions pessimism was rife amongst participants. Nevertheless the scenario logic and storyline development provided the opportunity to reflect on the type of changes and actions needed to avoid or minimise negative outcomes.

Figure 6: Mauritania scenarios



Scenario 1 “Perturbation”: *Disturbance of fishery systems*

“Disturbances” of the sector are mainly driven by anthropogenic factors, with little effect of climate change and climate variability on ecosystems. This future is characterised by high variability and uncertainty pertaining to the productivity of ecosystems due to severe overexploitation and collapse of main aquatic resources. This is compounded by an increase in pollution leading to a decrease in water quality, modification of habitats and loss of biodiversity (loss of demersal species), leading to widespread socio-economic impacts in the country. Action to reverse some of these tendencies is possible with the restoration of ecosystems, the adjustment of fishing capacity as well as through control and participatory monitoring of aquatic resources.

Table 9: Evolution of driving forces in “Perturbation” scenario

Drivers	Fisheries	Aquaculture
Marine Resources	Habitat degradation	Impact on shrimp and bivalve aquaculture
Economic Situation	Decrease in government budget envelope	Decrease in revenues
Aquaculture	Contributes to reducing fishing pressure	
Development/ Infrastructure	Overcapacity of the sector and increase in fishing effort	Increase investment in aquaculture necessary
Pollution	Changes in water quality and resources	Aquatic systems affected
Technological Change	Selective gear to reduce negative impacts	Control of rearing techniques (cage culture etc.), improvement in production
Market Forces	Increase in prices (insufficient supply) and breakdown of export sector	Greater demand leading to intensification
Governance and Management	Adaptive management: management plans (octopus, shark, shrimp etc.)	Develop water management policies

Scenario 2 “Extinction”: *Extinction of exploited species*

Compared to scenario 1, climate extremes are worsening (droughts, erratic upwellings) leading to the collapse of main commercial stocks, loss of biodiversity and a high level of poverty. This is compounded by the lack of systematic integration of a sustainable development approach in sectoral policies, leading to fish stock collapse and species extinctions. This is a significant impairment to poverty reduction and economic growth considering the critical role the sector plays in the national economy. Policy makers and the public sector are overwhelmed and have to deal with important social and political conflicts.

Table 10: Evolution of driving forces in “Extinction” scenario

Drivers	Fisheries	Aquaculture
Marine Resources		Water table drying out
Economic Situation	Fishing and affiliated activities are put to a halt => unemployment, social conflicts, reconversion etc.	Import and introduction of new species
Aquaculture	Investments transferred to the sector	
Development/ Infrastructure	Conflicts between users. Exploitation of new resources	Promotion of aquaculture
Pollution	Ecosystem deterioration (Emergency pollution management plans such as POLMAR in place)	Lower growth and yields
Technological Change	Selective techniques and no take zone necessary, fisherfolk capacity building needed	New areas developed, increase in animal production technologies
Market Forces	Low supply, dramatic price increase, food insecurity	Increase demand

Scenario 3 “Sustainable”: *Possibility of sustainable management*

Despite severe climate change, impacts and ensuing damages are limited due to the ability to successfully adapt to environmental changes, for instance through proactive aquatic resource management. Adaptive management is adopted: scarce resources are managed while maintaining fishing efficiency, equity, and protection of the environment. The perceptions and uncertainties of actors involved in the sector are taken into account and a portfolio of participatory management approaches, including co-management, are implemented. Despite adverse conditions, the sector can still remain sustainable and “ride out the storm”.

Table 11: Evolution of driving forces in “Sustainable” scenario

Drivers	Fisheries	Aquaculture
Marine Resources	Possible restoration of habitats (zoning, implement regulations)	Fight against invasive plant species and vector borne diseases
Economic Situation	Optimisation of social and economic benefit	Added value o agricultural products
Aquaculture	Stock enhancement activity	
Development/ Infrastructure	Integration in the wider economy (infrastructure, employment etc.)	Local development (employment)
Pollution	Prevention plans, environmental code revised and oil exploitation and pollution control integrated	Appropriate regulations
Technological Change	Renewable energy and valorization of ancient techniques like the use of sail	Hatcheries, retention basin and water bodies management
Market Forces	Quality products, eco-labeling, added value products	Increase supply (make up for decreases in fisheries)
Governance and Management	Integrate climate variability and change in legal norms and fisheries regulations. Implementation of fisheries code, sectoral strategy	Aquaculture norms and legislation in place that take into account climate variability and change

Scenario 4 “Upheaval”: *Disruption of Ecosystems*

Chaos induced by climate variability and change is pervasive: climatic disruptions such as droughts, floods, increase in temperature and sea level rise are worsening and will be rife over a long period of time. Additionally the ability to predict these changes is limited, creating further chaos. Inland areas are receiving even less rain, resulting in a massive population exodus to coastal zones: the coast is considered a refuge, a zone of ultimate “resort” and there is exponential pressure on all aquatic resources. In the ocean, trophic levels are changing, with the lowest trophic species with low or no commercial value dominating the fishery. Small pelagic fisheries will be greatly affected as they are extremely sensitive to environmental fluctuations. These species are the most affordable for the poorest of the population who will resort to fishing, increasing the fishing pressure. Despite this turmoil caused by climate change, society still tries to respond to these extreme environmental changes through adaptive management.

Table 12: Evolution of driving forces in “Upheaval” scenario

Drivers	Fisheries	Aquaculture
Marine Resources	Biomass of small pelagic species diminish, change in species migration patterns	No suitable sites available for aquaculture
Economic Situation	Drastic decrease in fiscal envelope, food insecurity, increase in unemployment	Decrease in aquaculture production leading to decrease in employment, increase in food insecurity
Aquaculture	Some investments in aquaculture	No suitable sites available for aquaculture (desertification)
Pollution	Increased fish mortality	Increased fish mortality
Technological Change	Reconversion of small pelagic fleet	Attempt to find more adaptive species to new severe environmental conditions
Market Forces	Collapse of the small pelagic sector, less demand	Increase in demand for aquaculture products

3.4 “Backcasting” through a regional perspective

The Ghanaian group chose the “Harmony” scenario to explore policy interventions to address climate change and promote research and development (R&D). They identified the development and implementation of a regional adaptation strategy crucial to tackle climate change (Table 13). The establishment of a regional legislative framework for fisheries and biodiversity conservation was also seen as important. R&D should focus on the design and implementation of a regional research institution acting as a repository for fisheries and climate related data.

Table 13: Policy intervention for “Harmony” scenario - Ghana

Driving force: Climate change and variability	
Short term (2010-2015)	Long term (2030)
Creation of an information database on climate change and fisheries for the West African region	Implementation of a regional adaptation strategy completed
Development of a regional climate change strategy	
Formulation of policies and unified laws for fishing and marine biodiversity conservation in the West African region	
Driving force: Research and development	
Short term (2010-2015)	Long term (2030)
West African regional body for fisheries research and documentation established and equipped with the aim of creating a reliable data base	Review and evaluation research on adaptation strategies

For Senegal the scenario “Food security: Sub-regional food security” was chosen by the country team. It was identified that in the short term (2010-2015) addressing climate change will mainly involve improving water resource management, including water conservation, pollution and multi-sectoral interaction (Table 14). Climate change should be mainstreamed with fisheries policy; and in order to achieve this sub-regional institutions and actors’ network should be strengthened. In terms of R&D, propositions included downscaling climate change models and coupling them with fisheries models as well as identifying fish species that could adapt to new environmental conditions. For the longer term the objective should be ecosystem restoration, for instance to increase the resilience of inland fisheries and aquaculture.

Table 14: Policy intervention for “Food security” scenario - Senegal

Driving force: Climate change and variability	
Short term (2010-2015)	Long term (2030)
Control, management of water resources Fight against non-native plant species	
Strengthening of sub-regional institutions Strengthening actors’ network Take into account environmental dimension in policy design and implementation	
Driving force: Research and development	
Short term (2010-2015)	Long term (2030)
Identify techniques to fight non-native plant species Identify fish species that can adapt to predicted changes	Ecosystem restoration
Modelling the scenarios Climate change adaptation strategies	

The Mauritania team chose the “Upheaval” scenario for the backcasting exercise. In the short term the participants identified the Sub-Regional Fisheries Commission in the region as a medium to increase cooperation and technological transfer related to climate change (Table 15). The hope was that in the longer term (2030), strengthening sub-regional cooperation would result into a stronger presence in international fora related to climate change. In terms of R&D, the integration of climate change issues in the education curricula was seen as a priority; and that by 2030 centres of excellence on fisheries and climate change would be up and running within the region.

Table 15: Policy intervention for “Upheaval” scenario

Driving force: Climate change and variability	
Short term (2010-2015)	Long term (2030)
With the Secretariat of the Sub-Regional Fisheries Commission (SRFC) promote fishing techniques that use renewable energy/increase efficiency Associate and increase partnership of countries that share small pelagic stocks (Western Sahara, Morocco and SRFC). Strengthen bilateral agreements	Actors in the region more involved in sub-regional and international climate negotiation (increase capacity building of actors and decision makers)
Driving force: Research and development	
Short term (2010)	Long term (2030)
Integrated climate change curricula at all education levels (from primary to postgraduate) Increase capacity building	Clusters of research centres, centres of excellence
Environmental education Coupled climate fisheries model developed in West Africa	Decision makers take into account science and research in their decision making process at the local, national and regional level

3.5 Youth, Art and the future

Located some 60 km north of Dakar, Kayar is the third-biggest fishing centre of Senegal. However artisanal fisheries have been experiencing a downturn due to decline in catches, mostly resulting from overfishing. Additionally, like in many coastal areas in Senegal, the region is also subject to sand extraction and deforestation, exacerbating coastal erosion, with accelerated sea level rise expected to increase existing coastal problems.

Four high school students from Kayar through paintings voiced their concerns about worsening deforestation in their communities, the lack of safety at sea and inundations. In one of the paintings prepared before the workshop, Masseck Dieng et Madické Kane explored the issues of inundation and the destruction of bridges in coastal zones (Figure 7). The painting aimed to raise authorities' awareness of these issues when planning future infrastructure development. "The message we want to share is that when we construct bridges we must be more careful," stated the artists.

During the workshop the four students Manga Ba, Masseck Dieng, Fallou Diop et Madické Kane created a four panel painting under the mentorship of Senegalese artist Samba Laye Diop (Figure 8). The students through their painting expressed the environmental degradation that is currently occurring in their community and it's implication for the future (Figure 9).

Figure 7: "Bridge under siege" by Masseck Dieng et Madické Kane. The bridge engulfed in huge waves highlights the need for coastal infrastructure to be carefully planned and constructed



Figure 8: Youth from the Senegalese fishing village undertaking a four-panel painting with Samba Laye Diop.



Figure 9: Youth from the Senegalese fishing village of Kayar explain to the experts a four-panel painting created during the workshop: their communities face deforestation, desertification, pollution and lack of safety at sea.

One of the objectives of scenarios is to evoke a mental and emotional response to plausible changes in the future, fostering lateral thinking. The storytelling function of a scenario process is in this sense similar to the storytelling function of art, where paintings can inform, shock and inspire. Art is also a tool of self-expression, where youth can share with others their vision of the world, the risks they face, etc. Youth can be agents of change in their communities, making their involvement in scenarios planning processes, where issues are identified, and adaptation planning necessary.

4. Discussion

During the workshop, it became obvious that while the developed scenarios differ quite substantially between the three countries, there are also important commonalities. Both aspects should be taken seriously. On the one hand, the situation in different West African countries may show major differences in terms of natural factors as well as key socio-economic trajectories, and reflect different perceptions of these changes. These differences may require highly specific adaptation measures in a sectoral and broader development perspective, some of which have been addressed in the scenarios on a national level.

On the other hand, there is clearly also substantial convergence and untapped potential of common interests across the region. A major issue mentioned in several scenarios was the importance of creating and implementing a suitable legal framework on national and regional levels. It was also repeatedly pointed out that adaptation to changing conditions in the future would require well-designed policies based on sufficient knowledge and reliable data. In this respect, participants emphasised an apparent lack of understanding and major knowledge gaps with regard to the specific dynamics of fish stocks and coastal communities affected by climate change. More capacity building efforts are needed to train scientists and decision-makers in the region on climate change, develop coupled climate and fisheries models, and establish regional climate science centers that have the necessary institutional capacities to support and inform climate change adaptation activities.

The issue of regional collaboration received considerable attention, acknowledging the fragmentary nature of existing approaches, in substantial as well as in geographical terms. Regional collaboration would take various forms such as developing platforms that could provide a space where scientists, decision makers and other stakeholders could share their knowledge and experience on climate change impacts and adaptation in the fisheries sector and engage in a process of mutual learning.

Early initiatives for adaptation were suggested as extremely important as opposed to a “see-and-wait strategy”. This issue was also discussed in relation to the growth in coastal tourism and the process of obtaining consent for infrastructure development on the coast.

The workshop participants highlighted that climate change is not integrated into aquaculture development plans, the latter being in its infancy in the region. The potential for aquaculture to address a decrease in capture fisheries and offer alternative employment was extensively discussed during the breakout sessions. While there was a clear enthusiasm for the development of this sector, it was noted that technological transfer (including strain and feeds adapted to local conditions), adaptive water management and capacity building are needed. Aquaculture development pathways are multiple, as shown in the Senegal scenarios: can aquaculture address both national food security and macroeconomic growth? Should regional trade be promoted or access to global markets prioritised? The benefits and trade-offs between these alternative scenarios should be analysed further in each country and at the regional level to inform policy and research.

The workshop was closed by the organisers with a short discussion on how to build future synergies through identification of areas of cooperation at sub-regional and regional levels. As a follow-up activity participants were asked to fill out a feedback from evaluating the workshop (Annex 3). The feedback had a dual purpose: to inform future scenario exercises and enable participants to reflect on their experience. Overall the workshop was successful in promoting future techniques/scenario methodologies amongst the participants. However the exercise did expose a lack of time to adequately absorb the methods and to reflect on the results as weaknesses. Details of the feedback are provided in Annex 3 in order for other scenarios exercises to benefit from this experience.

5. Next steps and recommendations

5.1 Next steps

Taking the scenarios forward

- Develop adaptation strategies to climate change that are internally consistent with each scenario
- The project team needs to identify drivers in each scenario that can be quantified and combined with climate-to-fish models developed within the QUEST_fish project. This project aims to elucidate how climate change will affect the potential production for global fisheries resources in the future and to estimate the added vulnerability of these effects on national and regional economies in fishery-dependent areas. For further information, please visit <http://web.pml.ac.uk/quest-fish/default.htm>

Disseminating methods

- Participants identified the development of a methodological brief on scenarios as a high priority. Foresight studies in the fisheries sector in Africa are still in their infancy and experts in the field are not exposed to scenario planning methodologies. The WorldFish Centre is in the process of developing such a brief
- Youth inclusion in scenario debates through art work proved an inspiring component of the workshop and should be further explored

5.2 Recommendation to Climate Change Adaptation in Africa (CCAA)/IDRC program / BMZ-GTZ regional activities

CCAA

- Uptake of the methodology in the CCAA/project project "Adapting Fishing Policy to Climate Change with the Aid of Scientific and Endogenous Knowledge (West Africa) led by the Network on Fishery Policies in West Africa (REPAO)
- Conduct a participatory backcasting exercise for all drivers in each scenario
- Develop local scenarios in each country and compare them with national level ones to understand cross-scale interactions
- Continue to integrate youth in fisheries sector development plans, formulation of adaptation strategies and more broadly strategic planning for the sector

BMZ/GTZ

- Broaden the regional participation to identify potential of coordinated action beyond the national level
- Integrate sectoral approaches into regional climate change adaptation projects
- Promote strategic planning and scenario use in the Sub-Regional Fisheries Commission
- Increase capacity of countries to develop the aquaculture sector through capacity building and technological transfer and "climate proof" this sector with appropriate water efficiency techniques promoted and used for inland aquaculture
- Understand the role of sub-regional trade versus exports to global markets in terms of food security and economic growth

Annexes

1. Workshop program

Day 1: Wednesday 14th April 2010

08:30 Registration

Opening session

09:00 Opening by guest of honor : IDRC representative

09:10 Welcome remarks and introduction to the ZMT/WorldFish-GTZ project

09:25 Background, objective and workshop guidelines

09:45 Ice-breaker – Workshop expectation (working groups)

10:15 *Coffee break & Group Photo*

Visions of the Future: What is African Youth telling us about our Ocean

10:45 School Project: Youth perspective on the future and climate change in Kayar Senegal

Framing our understanding : Fisheries and Aquaculture Sectors

11:15 Ghana Overview

11:30 Mauritania Overview

11:45 Senegal Overview

Drivers of change

12:00 Survey Results: main drivers of change

12:30 *Lunch*

13:30 In search of agreement : Ranking drivers of change (working groups)

15:30 *Coffee break*

Scenarios

15:45 Identify scenario logic (working groups)

17:45 Adjournment

Day 2: Thursday 15th April 2010

09:00 Presentation of scenario logic (20 minutes per group including discussion)

10:15 *Coffee break*

10:30 Building the storylines (*working groups*)

12:30 *Lunch*

13 :30 Building the storylines (*working groups*)

14:30 Presentation of storylines

15:30 *Coffee break*

15:45 "Backcasting": Identifying policy interventions

17:45 Adjournment

Day 3: Friday 16th April 2010

Climate Change

09:00 Finalising group works on backcasting

10:00 *Coffee break*

10:30 Plenary (*group presenting backcasting and discussions*)

11:30 Way forward and adjournment

12:00 *Lunch available*

2. Participants

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23	Manga Ba	CEM Kayar/ Project Ecole Mundus Maris		Senegal
24	Masseck Dieng	CEM Kayar/ Project Ecole Mundus Maris		Senegal
25	Fallou Diop	CEM Kayar/ Project Ecole Mundus Maris		Senegal
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3. Workshop feedback forms

Feedback from Ghana participants

<i>Question</i>	<i>Responses</i>
1. After the workshop do you think scenario exercises like this one are useful for the management of fisheries? For climate change adaptation?	<ol style="list-style-type: none"> 1. Yes, they are very useful especially for development of adaptation strategies 2. Yes, it serves as a reminder, precaution of actions, draws a pro-action agenda 3. Yes, scenarios are very useful for identifying how we perceive issues to be. When there are similarities in our scenarios, then we can start developing strategies that are not only more relevant but are also sub-regional. 4. Yes it was very useful; I have even started to use it to develop scenarios for other project areas like climate change and forestry. Indeed it is very wonderful.
2. This exercise helped you think about new aspects of the future you had not thought of previously?	<ol style="list-style-type: none"> 1. Yes, the market conditions are normally not factored into scientific studies. For me it was a nice reminder for consideration of this in our climate change, vulnerability and adaptation assessments. 2. Not in particular, it helps focus and give new dimensions as well 3. Yes, developing so many different scenarios was great! We got to think not only about the positives but also the more adverse effects 4. Yes, looking at the scenarios for Ghana it has made me reflect on actions and inactions and I have stronger convictions now.
3. What could be done to improve this workshop? We want you to help us improve this methodology for the next workshops	<ol style="list-style-type: none"> 1. Notification of participants at longer notice to ensure maximum participation of all relevant stakeholders. The Commission of fisheries was conspicuously absent 2. More time for educational training on what is expected with few examples (exercises). More attention given to translation using ear-phone for self responses and self follow up of the process 3. It was relaxed and not so hectic. We got to thrive at a good pace and the visit to the landing site was very insightful. To me every aspect of the workshop was well planned. Next time, more activities (outside the plenary) among participants to encourage experience sharing 4. Next time there should be more time for group works and interactions that may lead to better outcomes.

Feedback from Senegalese and Mauritanian participants

Overall participants found the seminar interesting. 90% of participants have acquired new and interesting knowledge. The organisers specifically asked participants what could be improved for future similar activities. The scenario methodology being new for most participants, they expressed the fact that more time should be devoted to a clear understanding of the methodology. For future scenario exercises this should be taken into account, with more time devoted to methods (extra half day) and a methodological brief developed prior to the workshop.

N°	Question 1: After this workshop, do you think scenario exercises like this one are useful for the management of fisheries? For climate change adaptation?	Question 2: Has this exercise helped you think about new aspects of the future you had not thought of previously?	Question 3: What could be done to improve this workshop? We want you to help us improve this methodology for the next workshops
R.1	Yes, Forewarned is forearmed. Anticipating the effects is a factor that improves adaptation to climate change and reduces impacts. That is why taking them into account is very useful if not indispensable for fisheries management.	Yes, The interaction of considered factors and their combined effects were not taken into account. Climate change appears as a diffused but sure threat that should be taken into account at all levels.	Increase the duration of the seminar so that we can better assimilate the approach on the one hand and better analyze the factors on the other hand.
R.2	In fact this type of exercise is quite useful because it allows us to adopt a prospective and wide approach by taking into account a set of natural and anthropogenic parameters and factors.	Perfect. Aquaculture development in Mauritania can take advantage of the experience from countries of the sub-region, namely Senegal.	More focused objectives and avoid scattered information in presentations. The target audience should be as homogenous as possible in terms of culture, language, socio-economic, economic and fisheries realities.
R.3	This type of exercise is indeed very useful as it allows us to see the levers on which we must act today to adapt to climate change.	Strongly agree. It allows me mainly to be aware of the dangers that threaten the future of fisheries in Senegal.	The devoted time was relatively short to treat properly all questions. Next time, separate rooms should be made available for working groups.
R.4	This seminar is a very important step to take among the countries of the sub-region for the sustainable management of living resources, taking into account the new concept of climate change. Moreover, if this exercise is implemented, it is sure that its results will lead to valuable solutions or ideas.	This exercise permitted us to harmonize ideas about sustainable management by taking into account climate change.	N/A
R.5	Of course, by taking into account the interactions of multiple driving forces.	Yes, especially on the influence of aquatic product markets on the evolution of fisheries.	Since this approach is quite new in fisheries management at the level of the sub-region, it would be important to organize a sub-regional seminar on the development of scenarios.

ENVISIONING 2050: CLIMATE CHANGE, AQUACULTURE AND FISHERIES IN WEST AFRICA

R.6	This exercise has been very useful for the management of resources in the context of climate change. To me, it is an efficient method that triggers thought on the many problems that may occur in the future. We can anticipate strategies that need to be put in place.	Yes, for example I did not think a lot about the aquaculture sector and the level of uncertainties that characterise it with regard to a globalised world. In short, this has allowed me to think about the different scenarios in the face of uncertain situations.	To me, this workshop is very interesting, but it needs to be improved by trying right at the beginning to better explain the methodology and certain concepts. This will allow participants to go straight to the point instead of devoting too much time at this level of the work. Participants also need to know the specific situation of each country. This will allow the different participants to be better equipped for their overall reflection at the sub-regional level.
R.7	In a context of uncertainties marked by visible impacts of climate change such as the decrease in rainfall, coastal erosion, decreasing resources, it is necessary to organise such workshops for a more fruitful exchange.	The different interventions were mainly cross-cutting. Nevertheless, they have allowed us to enrich our knowledge on species from the different countries. For example, species movements, the enthusiasm for aquaculture, etc.	We prefer from the beginning a clear explanation on the working groups. And we would gain a lot if it was easier to understand. The seminar went smoothly. We are asking for more.
R.8	Yes. If participants communicate with development actors of the fisheries sector in their respective countries, they would bring their know-how	Yes.	Sometimes we talked about going overtime; I think that to solve this problem, it would be good to have simultaneous translation.
R.9	This exercise is very instructive and allows us to project ourselves in the future to better manage the present; even if we know that many scenarios are highly uncertain.	In fact, sometimes this kind of exercise helps us discover aspects of the possible evolution of our environment.	This kind of group work is very interesting, but tedious. To improve these kinds of meetings and make them flourish, it would be important to devote the necessary time (duration of the group work), and put participants in the best possible logistic conditions (better per diem, support)
R.10	Yes. Reflection on the scenarios and policies /strategies.	No.	<ul style="list-style-type: none"> - Explain the methodology in detail and propose other methodologies - Time is too short; enough time should be devoted to workshop/group work. - Improve logistics (room) and increase the per diem





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