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Report of the

FAO/PaCFA EXPERT WORKSHOP ON ASSESSING CLIMATE CHANGE VULNERABILITY IN FISHERIES AND AQUACULTURE: AVAILABLE METHODOLOGIES AND THEIR RELEVANCE FOR THE SECTOR

Windhoek, Namibia, 8–10 April 2013

PaCFA
Global Partnership Climate, Fisheries and Aquaculture

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PREPARATION OF THIS DOCUMENT

This is the report of the global Expert Workshop on Assessing Climate Change Vulnerability in Fisheries and Aquaculture: Available Methodologies and their Relevance for the Sector, which was convened by the FAO Fisheries and Aquaculture Department Climate Change Working Group and the Global Partnership on Climate, Fisheries and Aquaculture (PaCFA) in Windhoek, Namibia, from 8 to 10 April 2013. The workshop was hosted by the Benguela Current Commission.

The report was prepared by Cécile Brugère, Consultant, FAO Fisheries and Aquaculture Department, and Cassandra De Young, Fisheries Planning Analyst, Policy and Economics Division, FAO Fisheries and Aquaculture Department, Rome, Italy. Support for this workshop was provided by the Government of Japan under the project "Fisheries management and marine conservation within a changing ecosystem context (GCP/INT/253/JPN)" and by the Government of Norway under the project "Climate Change, Fisheries and Aquaculture: testing a suite of methods for understanding vulnerability, improving adaptability and enabling mitigation (GCP/GLO/322/NOR)".

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ABSTRACT

The purpose of the global Expert Workshop on Assessing Climate Change Vulnerability in Fisheries and Aquaculture: Available Methodologies and their Relevance for the Sector was to review latest stages in research on, and the application of, climate variability and change vulnerability methodologies. It also provided an opportunity to begin a common reflection on what role these methodologies can have in planning policies and strategies to best cope with climate change impacts on fisheries and aquaculture. Making the link between expert advice and practical use of vulnerability methodologies from around the globe set the scene for fruitful discussions on how to make the best use of the existing information, how to prioritize the filling of gaps and how to develop a common understanding on the effectiveness of such knowledge in relation to policy and management actions and programmes. As vulnerability methodologies are a function of different factors (vulnerability of what and of whom to what), the workshop required experts from across the natural and social sciences disciplines and from both inland and marine capture fisheries and aquaculture. These examined current methodologies for conducting vulnerability assessments and provided best practices on how to develop and undertake a vulnerability assessment for incorporation into the design of adaptation programmes in fisheries and aquaculture in the face of climate change.

CONTENTS

ANNEXES

ABBREVIATIONS AND ACRONYMS

AC	adaptive capacity
ARCC	Mekong Adaptation and Resilience to Climate Change
BCC	Benguela Current Commission
BCLME	Benguela Current Large Marine Ecosystem
CAM	Climate Adaptation and Mitigation
CANARI	Caribbean Natural Resources Institute
CARICOM	Caribbean Community and Common Market
CDM	Comprehensive Disaster Management
CEDMA	Caribbean Emergency Disaster Management Agency
CRiSTAL	Community-based Risk Screening Tool – Adaptation and Livelihoods
E	exposure
EAA	ecosystem approach to aquaculture
EAF	ecosystem approach to fisheries
EEZ	exclusive economic zone
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
LDCF	Least Developed Countries Fund
P3DM	participatory three-dimensional modelling
PaCFA	Global Partnership for Climate, Fisheries and Aquaculture
PI	potential impact
PICTs	Pacific island countries and territories
PROVIA	Programme of Research on Climate Change Vulnerability, Impacts and Adaptation
S	sensitivity
SCCF	Special Climate Change Fund
SEES	socio-economic-ecological systems
SLA	sustainable livelihoods approach
UNESCO	United Nations Economic, Social and Cultural Organization
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USFA	Undersecretariat for Fisheries and Aquaculture (Chile)
V	vulnerability
VIA	vulnerability, impacts and adaptation
WMO	World Meteorological Organization

1. OPENING OF THE WORKSHOP

Mr Hashali Hamukuaya, Executive Secretary of Benguela Current Commission (BCC), welcomed the participants and opened the expert workshop. He provided an overview of the BCC, highlighting that the Convention between Angola, Namibia and South Africa had been formally signed on 18 March 2013 with the objective of promoting a coordinated regional approach to the long-term conservation, protection, rehabilitation, enhancement and sustainable use of the Benguela Current Large Marine Ecosystem (BCLME), in order to provide economic, environmental and social benefits in its riparian countries. Mr Hamukuya stressed the high productivity and variability of the BCLME, and trends associated with climate change and regime shifts, such as significant sea surface temperature warming, sea-level rise and shifts of pelagic fish species out of traditional fishing grounds. He noted that a number of projects funded by Norway were being implemented in the region. The full project proposal under elaboration for funding by the Global Environment Facility (GEF) Least Developed Countries Fund (LDCF) and Special Climate Change Fund (SCCF) complement these initiatives by increasing resilience and decreasing vulnerability of fisheries and aquaculture to climate change in the three countries.

In her welcoming address, Ms Cassandra De Young, FAO, thanked the BCC for its organizational support in the preparation of the workshop, and Norway and Japan for their financial support. She reminded participants that the meeting was an initiative of the Global Partnership for Climate, Fisheries and Aquaculture (PaCFA)[1] to provide the opportunity for key experts to examine existing climate change vulnerability methodologies and identify their relevance for understanding vulnerabilities specific to the fisheries and aquaculture sector. She provided a brief history of the PACFA, an informal partnership created at the initiative of FAO, WorldFish Center and the World Bank comprising 22 organizations, and its role in: furthering understanding of the impacts of climate change; supporting adaptation and greenhouse gas (GHG) mitigation efforts within the sector; advocating for the inclusion of fisheries and aquaculture in global, regional and national climate discussions; and facilitating collaboration with partners in project development. She also reminded participants about the functioning of “expert workshops”.

1.1 Introduction of participants

The participants introduced themselves (see Annex 1). Ms Nicole Leotaud acted as chair of the workshop, and Ms Cassandra De Young and Ms Cécile Brugère, FAO, as rapporteurs. Mood collectors and meeting reflectors were also chosen to report informally in plenary on progress and general reflections at the beginning of each day of the workshop.

1.2 Overview of workshop objectives and expected outputs

Ms Cassandra De Young noted that the fisheries and aquaculture sector was a relative latecomer to the formal discussion of climate variability and change vulnerability when compared with other sectors, such as agriculture and health. Vulnerability is a complex issue, whose assessment in the context of fisheries and aquaculture bears linkages with existing approaches such as the sustainable livelihoods approach (SLA), the ecosystem approach to fisheries and aquaculture (EAF/EAA), disaster risk management and many others. Issues of scale, uncertainty in determining causal relationships among climate and other drivers as well as in future projections of change and assessment methodologies render understanding of the issues underlying vulnerability more difficult and, hence, might not provide sufficient information for effective adaptation planning.

[1] See www.climatefish.org

In this context, the objective of the workshop was to review the latest stages in the research on climate variability and change vulnerability methodologies and to begin a common reflection on what role these methodologies could have in planning policies and strategies to cope best with climate change impacts on fisheries and aquaculture.

Although the prime focus of the workshop was on vulnerability to climate change, the broader remit of this issue (i.e. vulnerability to multiple drivers of change within the sector) was acknowledged. The agenda was reviewed and agreed upon (Annex 2). It was recognized that some flexibility would be allowed in order to enhance the flow and richness of the discussions.

2. OVERVIEW OF VULNERABILITY ASSESSMENT METHODOLOGIES

Based on the background document prepared ahead of the workshop, Ms Cécile Brugère presented an overview of the range of vulnerability assessment methodologies that have been used, and of the conceptual perspectives and frameworks in which they are anchored (i.e. risk–hazard, political economy/ecology, resilience, outcome and contextual vulnerability), which are summarized in Annex 3. Her presentation highlighted the dichotomy between methodologies stemming from the study of biophysical systems and the study of human/institutional systems, and reviewed their application to fisheries and aquaculture in comparison with other sectors. These disciplinary roots would then play a predominate role in the determination of how a given vulnerability framework is defined and which methodologies are used to collect, analyse and disseminate relevant information. Based on a review of vulnerability assessment experiences, Ms Brugère concluded that the Intergovernmental Panel on Climate Change (IPCC) definition of vulnerability,[2] and its roots in risk and linear impact pathway analyses, has provided a basis for most of the vulnerability assessments within the sector as well as in other sectors. Its application has primarily been quantitative, using predictive climatic modelling or secondary sourced-developed indicators (i.e. "top-down" methodologies) applied to the characterization of vulnerability of natural resources. However, more recent applications of the original IPCC framework have evolved towards more integrated social-ecological frameworks of vulnerability with attempts to combine "top-down" modelling information with more participatory and perceptions based information.[3]

The plenary discussion that followed raised a number of general issues related to the nature of available methodologies and the place of climate change among other drivers of change and vulnerability. In terms of methodologies, the wealth of experiences at field level and of information available in grey literature was acknowledged as an important contribution to vulnerability knowledge, although often inadequately accounted for in the scientific literature. In relation to this, the need to integrate and ground local knowledge and bottom-up approaches in science was further highlighted. The usefulness of providing a set of principles for "good vulnerability assessment practices" versus the development of methodological toolboxes to guide assessments was debated.

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[2] "Vulnerability is a function of the sensitivity of a system to changes in climate (the degree to which a system will respond to a given change in climate, including beneficial and harmful effects), adaptive capacity (the degree to which adjustments in practices, processes, or structures can moderate or offset the potential for damage or take advantage of opportunities created by a given change in climate), and the degree of exposure of the system to climatic hazards" (IPCC. 2001. *Climate Change 2001: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Third Assessment Report of the IPCC. [also available at www.grida.no/publications/other/ipcc_tar/]).

[3] See Barsley, W., De Young, C. & Brugère, C. 2013. *Vulnerability assessment methodologies: an annotated bibliography for climate change and the fisheries and aquaculture sector*. FAO Fisheries and Aquaculture Circular No. 1083. Rome, FAO.(also available at www.fao.org/docrep/018/i3315e/i3315e.pdf).

From a comment on the necessity to define the boundaries of the system under study and to be clear on the vulnerability questions to be asked, issues of scale and complexity were discussed. It was pointed out that donor-funding priorities for climate change might run the risk of diverting attention away from potentially more significant drivers of change. From this statement, there was overall agreement that focusing solely on climate change could lead to missing overriding drivers of change and factors of vulnerability. There was general recognition that climate change was typically an amplifier of underlying vulnerability as well as a potential source of vulnerability. There was also agreement that a broad understanding of the multiple drivers of change affecting a system and the role climate change played as an amplifier or underlying driver would assist in determining whether a climate-change-specific vulnerability assessment was warranted.

3. VULNERABILITY ASSESSMENT CASE STUDY PRESENTATIONS

Twelve case study presentations (available in Annex 4) were made and discussed during the course of the first day of the workshop in order to illustrate the range of vulnerability assessment experiences as well as the processes undertaken in the implementation of the assessment (e.g. which methods were chosen and why, how approaches were integrated, and how issues of scales were dealt with).

1) PROVIA guidance on assessing climate change vulnerability, impacts and adaptation

Ms Katharine Vincent, representing an international author team from the Stockholm Environment Institute in Stockholm and Oxford, Global Climate Forum, SYKE – the Finnish Environment Institute, Norwegian University of Life Sciences, and Kulima Integrated Development Solutions, introduced the aims and structure of the PROVIA[4] (Programme of Research on Climate Change Vulnerability Impacts and Adaptation) Guidance on Assessing Climate Change Vulnerability, Impacts and Adaptation (VIA). PROVIA is an international programme hosted by the United Nations Environment Programme (UNEP) and managed by UNEP, the United Nations Economic, Social and Cultural Organization (UNESCO) and the World Meteorological Organization (WMO) that has four themes of activity. These are: developing an international research agenda, providing advice and scientific information (including as support under the Nairobi Work Programme), communication with the research community (including supporting biennial international adaptation conferences, the most recent of which was in 2012 in Arizona, the United States of America, the next of which will be in 2014 in Fortaleza, Brazil), and guidance and assessment tools. The aim of this fourth theme is to improve the robustness and rigour of climate change VIA assessments, with the particular intention that this will be of use to parties to the United Nations Framework Convention on Climate Change (UNFCCC) as they prepare their national adaptation plans.

The guidance documentation – currently in its final stages of revision – provides methodological guidance on assessing climate change VIA and on implementing, monitoring and evaluating adaptation (updating the previous IPCC technical guidelines on VIA, published in 1994). It attempts a novel approach to integrating various existing methods into a coherent framework. Based around the "Adaptation Learning Cycle" (involving five steps: identifying vulnerability and impacts; identifying adaptation options; appraising adaptation options; planning and implementing adaptation; and monitoring and evaluation), the guidance presents multiple entry points for decision-makers, ensuring applicability regardless of their particular interests. In particular, the process of VIA is outlined from two perspectives: one focusing on the task in question (and using various decision-trees to guide progress through that task); and the other (complementary) focusing on the methods that may be applicable at each stage.

[4] www.provia-climatechange.org

Given the audience and interests of the PaCFA programme, this presentation focuses on the tasks and methods for identifying vulnerability and impacts (and pays relatively less attention to identifying, appraising and monitoring and evaluating adaptation options).

2. A framework for vulnerabilities in the Caribbean

Mr Ricardo Yearwood, of the Caribbean Emergency Disaster Management Agency (CEDMA),[5] introduced the regional framework for disaster management promoted by CEDMA in the Caribbean and the specific vulnerabilities of fisheries and aquaculture in this part of the world. CDEMA, originally called Caribbean Disaster Emergency Response Agency, was established in 1991 through an Agreement of the Heads of Government of the Caribbean Community, and it is currently responsible for 16 Participating States. The Caribbean is a region highly exposed to natural and anthropogenic hazards. Significant components of the natural environment to consider in understanding the vulnerability of the CDEMA Participating States include: corals, seagrass beds, fishing grounds, sandy beaches, salt ponds, forests, wetlands, rivers, etc. In the context of disasters, these are of particular concern for social and economic development. Developed in the past decade, the Comprehensive Disaster Management (CDM) strategy aims to foster regional sustainable development through strengthening of regional-, national- and community-level capacity for the mitigation, management and coordinated response to natural and anthropological hazards, and the effects of climate change. As well as cutting across all phases of the disaster management cycle and encompassing all sectors of the economy, it involves risk reduction and management and integrates vulnerability assessments in the development planning process. In its first phase of implementation (2007–2012), the CDM strategy proved an effective mechanism and programme for the management and sharing of CDM knowledge for decision-making. It has led to the mainstreaming of comprehensive disaster management at national levels and its incorporation into key sectors of national economies (including tourism, health, education, infrastructure, planning and agriculture) and has enhanced community resilience in CDEMA States and/or territories to mitigate and respond to the adverse effects of climate variability and change and disasters. The implementation of complementary studies on the determination of poverty levels in fishing communities in the Caribbean Community and Common Market (CARICOM) area is useful to inform national disaster priorities, identify suitable planning models and implement alternative livelihood and poverty alleviation programs in these communities.

***3) Assessing vulnerability to climate change at multiple scales: to what purpose and* how?**

Mr Eddie Allison, of WorldFish Center,[6] Malaysia, and the University of East Anglia,[7] the United Kingdom of Great Britain and Northern Ireland, examined some of the numerous attempts to use the IPCC "exposure, sensitivity, adaptive capacity" framework to assess the relative vulnerability of different people, places, economies and production systems to various facets of climate change in the fisheries sector. The overall aim of most of these efforts is to identify relative vulnerabilities so that adaptation efforts can be focused and prioritized according to relative need. However, these assessments are often limited to particular sectors and are often not very specific about the vulnerability of whom to what. Moreover, they are not always closely linked to adaptation processes. Bottom-up, participatory assessments of vulnerability are an alternative to these top-down indicator-based approaches. However, perceptions of climate variability – both absolute and relative to other risks and stresses – are shaped by public discourses on climate change and respond to political agendas. Thus, they may not always provide a reliable guide for action either, as recent analyses of regional fisheries management organizations' responses to the climate change agenda have shown. The

[5] www.cdema.org
[6] www.worldfishcenter.org
[7] www.uea.ac.uk/international-development

presentation concluded with recommendations to combine top-down and bottom-up assessments, keep such assessments simple, and avoid undue preoccupation with refining the vulnerability analysis. Many climate-change adaptations are "no regrets" and thus a capacity to anticipate and act on change is fundamental, whether the stresses come from climate change or other sources. Thus, investing in systems of governance that are responsive and flexible to change is as important as producing improved climate change projections and vulnerability analyses. Since the development, by the IPCC in 2001, of an approach to assess relative climate change vulnerability, there have been numerous attempts to use its "exposure, sensitivity, adaptive capacity" framework to assess the relative vulnerability of different people, places, economies and production systems to various facets of climate change.

4) Assessing vulnerability in developing countries' fishing communities – some methodological considerations

The presentation by Mr Chris Béné, from the Institute of Development Studies[8] in the United Kingdom of Great Britain and Northern Ireland, drew on a series of vulnerability and resilience assessments conducted through action research in several coastal and inland small-scale fishing communities in developing countries. The objective of these assessments was to understand better the various sources of vulnerabilities affecting these fish-dependent communities and also the factors influencing the ability of their members to respond to these threats. A series of principles (rather than a rigid framework) structures the approach. First, there is the recognition that both vulnerability and resilience are not merely objective concepts but instead have strong subjective (and therefore social and cultural) dimensions. In particular, people will engage in mitigation and adaptation initiatives only if/when they perceive that they are vulnerable. Therefore, understanding the subjective dimension of vulnerability of communities is a critical initial step in developing or strengthening their abilities and/or willingness to engage in adaptive initiatives. Second, emphasis was placed on the multidimensional nature of vulnerability (its "multistressor" nature, so prevalent in the context of developing countries' rural communities). Therefore, it is not presumed that the main sources of threat are systematically or directly linked to fishing activities – even if it is recognized that fishing may be a particularly risky occupation. Rather, the community is guided through a participatory and integrated "360 degree diagnosis" process,[9] with the aim of identifying the various sources of shocks and stresses affecting the community's members at different scales. Finally, this participatory assessment process offers the opportunity for the community to construct, alter and improve its understanding/perception of its own vulnerability and, subsequently, to identify some direct and actionable entry points for resilience interventions.

5) Qualitative vulnerability assessment: Case of coastal fishing households, Tanzania

Mr Robert Katikiro, from the Leibniz Center for Tropical Marine Ecology[10] in Bremen, Germany, reported on the use of qualitative methods to assess vulnerability of fishing households to climate change impacts, with a particular focus on vulnerability in relation to locally perceived short-term seasonal risks. The vulnerability assessment undertaken was a part of a project "Linking reef fisheries and livelihoods of coastal households in Mtwara district, southern Tanzania" and this presentation outlined the vulnerability assessment for Msimbati village in the Mtwara district. Vulnerability is considered not only by meteorological hazards but also by a series of dynamical processes involving sociocultural, economic and political processes. Therefore, this project adopted vulnerability as a concept with many perspectives on what it represents. Various methods were employed to assess the

[8] www.ids.ac.uk

[9] Integrated multistressor and/or multi-impact vulnerability scanning of people and livelihoods, institutions and governments, natural systems and external drivers.

[10] www.zmt-bremen.de/en/

vulnerability and existing adaptive capacity to climate change impacts, including the Community-based Risk Screening Tool – Adaptation and Livelihoods (CRiSTAL)[11] decision support tool, interviews with appropriate participatory rural appraisal exercises and local knowledge, and transect walks. This approach allowed validation of the results through data triangulation. The vulnerability assessment took the form of narrative-based procedures, especially in focus group discussions, which aimed at arguing on what and how participants perceived as hazards to their livelihoods. The assessment procedures conducted focused on describing the different interpretations of the vulnerability phenomena, identifying key multipliers and empowering them, and providing platforms for exchange and communication between interest groups. The use of CRiSTAL identified strong winds, floods, drought and sea-level rise as the major hazards. The likely impacts of these hazards on livelihoods of fishing households included decline in fish catch, destruction of houses and property, loss of income, rise in crime events, shoreline erosion, and saline intrusion in traditionally used freshwater wells. Existing coping strategies were identified, including modifying fishing gear and vessels to manoeuvre with climate variability, opting non-fishing activities, doing nothing, and changing fishing-hour patterns. Alternate coping strategies were also explored based on the influence of hazards on fisheries stocks/resources and on opportunities and challenges that were explored during the workshop. With fishing households, a qualitative assessment approach offered more context-based answers to "who and what is vulnerable?" The methodological challenges of qualitative assessment are evidenced by this study; thus, a qualitative approach is not enough to answer accurately the multidimensional aspects of vulnerability in fishing households.

6) Social-ecological vulnerability of coral reef fisheries to climate change

Ms Cindy Huchery, on behalf of Mr Josh Cinner and her colleagues at James Cook University[12] in Australia, presented a study that piloted a modified version of the vulnerability framework used by the IPCC. Specifically, this framework was advanced by considering how ecological and social elements of vulnerability are linked. The combination of ecological exposure, ecological sensitivity and recovery potential were considered as determinants of the ecological vulnerability of a site, which in turn can be considered as the exposure experienced by the social system. Social vulnerability is then understood as a combination of this exposure plus social sensitivity and social adaptive capacity. A quantitative approach was used to evaluate climate change impacts (specifically coral bleaching) in well-studied Kenyan coral reef fisheries. The modified framework was operationalized by developing and testing community-level indicators to build each of the social-ecological vulnerability components. The method provides a useful holistic diagnostic approach that can help identify where critical sources of vulnerability lie, and it should have broad application to other social-ecological systems.

7) Calculating 'vulnerability' when resources are enhanced by climate change

Mr Eddie Allison, on behalf of Mr Johann Bell of the Secretariat of the Pacific Community[13] in New Caledonia, described a variation on the estimation of potential impacts (PI) and the use of adaptive capacity (AC) to estimate the relative vulnerability of several Pacific island countries and territories (PICTs) to the projected redistribution of skipjack tuna, and the contributions that industrial fishing and processing operations for this fish make to national economies. Traditionally, previous studies have compared relative vulnerability among countries, the potential impact (PI) of climate change has been calculated by adding indices for exposure and sensitivity. Vulnerability (V) is then estimated by relating PI to an index of adaptive capacity (AC). Because these studies have generally focused on the negative impacts

[11] See www.iisd.org/cristaltool/
[12] www.coralcoe.org.au
[13] www.spc.int

of climate change, vulnerability has often been calculated as V = PI × (1 – AC) to minimize vulnerability in countries with high adaptive capacity. In this study, the authors used the projected percentage changes in catches of skipjack tuna within the exclusive economic zone (EEZ) of a PICT, relative to the 20-year average catch for 1980–2000, as the index of exposure (E). Depending on the location of the EEZ, E is either positive or negative. To estimate sensitivity (S), the average percentage contributions of the skipjack tuna fishery to government revenue and gross domestic product (GDP) was used. The value for PI was then estimated by multiplying E by S. This recognized the vital importance of contributions to the economies of some PICTs, and suppressed high scores that would have occurred for PICTs where catches of skipjack are projected to increase substantially, but where they currently contribute little to the economy. The value for PI was positive for PICTs expected to have a larger biomass of skipjack tuna in their EEZ in the future and negative those where biomass is projected to decrease. Adaptive capacity was calculated by combined indices for health, education, governance and the size of the economy – on the assumption that PICTs with higher levels of human and economic development are in a better position to undertake planned adaptation. Vulnerability was then estimated in two different ways. In PICTs, where the skipjack fishery is projected to decrease, AC was inverted (1 – AC) so that the PICT with the greatest adaptive capacity had reduced vulnerability to lower catches of tuna. For PICTs where skipjack catches are projected to increase, the adaptive capacity index was retained as calculated to reflect the likelihood that the PICT with the greatest adaptive capacity would be more capable of maximizing benefits from the increased resource. The assessment of the effects of climate change on the contributions of skipjack tuna to the economies of PICTs raises the question about the use of the term “vulnerability”. While it is appropriate for resources expected to be adversely affected by climate change, consideration needs to be given to how best to describe the results of applying the IPCC framework where resources are projected to increase.

8) Fisherfolk perspectives of vulnerability: Climate and policy intertwine in small-scale fisheries in Southern Brazil

Mr Denis Hellebrandt (University of East Anglia, the United Kingdom of Great Britain and Northern Ireland[14]) and Patrizia Abdallah (Universidade Federal do Rio Grande, Brazil[15]) presented evidence of how the vulnerability of fisherfolk is affected by the combined impact of climate variability and fisheries policy. The argument is framed by a critical perspective on the relationship between fisheries and poverty, and links to literature, which emphasize how policies that minimize fishers’ exposure and susceptibility to shocks may be more relevant than initiatives seeking to maximize wealth generation in small-scale fisheries. This study was carried out in the Patos Lagoon estuary in southern Brazil. Fisheries governance in the area is based on comanagement, which has set regulations controlling season closure, gear type and minimum fish and shellfish size. Both quantitative and qualitative methods, including surveys, participant observation and in-depth interviews, were used. Three categories of inter-related hazards emerged from the analysis: (i) overcapacity was associated with incentives from credit supporting new entrants and increased use of bottom trawling; (ii) climate variability was related to coupled rainfall and wind patterns, with direct effect on target abundance and range – its high impact was explained by non-compliance with regulations, a result of the mismatch between rigid formal rules and fishing strategies adapted to uncertain climatic and ecological conditions; and (iii) pressure on estuarine stocks was linked to the virtually absent control over the excessive fishing capacity of the industrial coastal fleet. These patterns were independently confirmed by the different methods applied. These findings resonate with other studies that stress how vulnerability is determined by the compounded effect of ecosystem and policy processes.

[14] www.uea.ac.uk/international-development
[15] www.sacc-hd.furg.br/

9) Vulnerability to climate change in Chilean aquaculture and fisheries: results and findings

Mr Exequiel González Poblete, from the School of Marine Sciences at the Pontificia Universidad Católica de Valparaíso[16], in collaboration with Mr Ricardo Norambuena and Ms Carolina Alarcón from the Universidad de Concepción in Chile, presented three studies that have been used by the Chilean Undersecretariat for Fisheries and Aquaculture (USFA) to determine fisheries and aquaculture vulnerability to climate change and promote the nation's adaptive capacity to climate change impacts.

The first study,[17] on the vulnerability of Chilean capture fisheries, used the IPCC's exposure, sensitivity and adaptive capacity components of vulnerability. It identified a number of physical and anthropogenic stressors to estimate the exposure of the Humboldt Current System, and deducted the level of sensitivity of the Chilean fisheries under analysis based on the known and predicted future status of the fishery. The determination of the adaptive capacity of the Chilean fisheries sector relied on the analysis of the 1997–2002 crisis experienced by the Chilean jack mackerel fisheries. The authors concluded that there was a relevant adaptive capacity to changes in biomass levels in the pelagic central-south fishery of Chile and that the adaptive capacity to climate change was directly related to fisheries sustainable management efforts.

The second study[18] estimated the vulnerability of Chilean aquaculture, considering it both as the whole sector and subdivided it into four main aquaculture types (salmon, seaweed [*Gracilaria*], Chilean blue mussel and northern scallops). Vulnerability analyses used two of the IPCC emission scenarios. The study identified environmental stressors to determine the level of exposure and economic indicators as proxies for sensitivity. Determination of the adaptive capacity of the country was based on national information regarding the relative importance of the Chilean economy in the international arena (GDP), life expectancy, educational attainment and governance. Although results suggested that the Chilean economy and country had a low level of vulnerability to climate change through the potential effects of climate change on its aquaculture activity, they did not allow the actual level of vulnerability of the aquaculture activity itself to be determined. This calls for caution in the use of the findings of such studies for policy development. In the case of Chile, experience shows that aquaculture activities not characterized as vulnerable under this method (seaweed and mussels) are in fact those most constrained by contextual conditions (e.g. oligopsonistic market structures, poverty) and among the most vulnerable.

The objective of the third study[19] was to propose a methodological approach and action plan to cope with the impacts of climate change on Chilean fisheries and aquaculture. The study adopted a socio-economic-ecological systems (SEES) approach, considering interactions between the ecological and the socio-economic systems, their linked vulnerability to climate change and the human dependence on natural resources and the environment. The proposed

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[16] www.ucv.cl

[17] Quiñones, R., Salgado, H., Montecinos, A., Dresdner, J. y Venegas, M. 2012. *Evaluación de potenciales impactos y reducción de la vulnerabilidad de la pesca al cambio climático: el caso de las pesquerías de la zona centro-sur de Chile*. Concepción, Chile, Centro de Investigación Oceanográfica en el Pacífico Sur Oriental (COPAS), Universidad de Concepción, Subsecretaría de Pesca y Acuicultura de Chile y FAO.

[18] González E., Norambuena, R., Molina, R. y Thomas, F. 2011. *Evaluación de potenciales impactos y reducción de la vulnerabilidad de la pesca y la acuicultura al cambio climático, estudio de caso: acuicultura Chile*. Valparaíso, Chile, Escuela de Ciencias del Mar, Pontificia Universidad Católica de Valparaíso, Subsecretaría de Pesca y Acuicultura de Chile y FAO.

[19] Cubillos, L., Alarcón, C., Norambuena, R., Quiñones, R. y Pantoja, S. 2012. *Propuesta metodológica y plan de acción para abordar los impactos del cambio climático en el sector pesca y acuicultura en Chile*. ID4728-40-LE11. Informe Programa Copas Sur-Austral y Subsecretaria de Pesca y Acuicultura.

methodology included both direct and indirect components of vulnerability and their effects on the five dimensions of the SEES, namely: ecological, socio-economic, technological, institutional and ethical. It applied a quali-quantitative scale of impacts (0 = nil, 1 = low, 2 = medium and 3 = high) and relied on a participatory process eliciting available information and expert knowledge and experience (scientific and local-traditional) to determine the degree of exposure, sensitivity and adaptive capacity.

From a methodological point of view, key lessons learned from these experiences include: (i) the chosen approach needs to adjust the definition of time, spatial and social scales with the central objectives of the assessment and of adaptation; and (ii) a sound vulnerability assessment needs to: (a) rescue traditional and local community knowledge, (b) recognize the value of past stakeholder experience in adaptation processes, and (c) ensure timely, effective and efficient transfer of all knowledge and information (traditional-local, scientific) to local communities.

10) Vulnerability assessment of Mekong capture fisheries and aquaculture

Mr Rick Gregory, on behalf of the United States Agency for International Development (USAID) and the Mekong Adaptation and Resilience to Climate Change (ARCC) project,[20] presented a vulnerability assessment of the Mekong capture fisheries and aquaculture. Capture fisheries and aquaculture form an integral part of the culture, food and livelihoods of inhabitants of the Mekong Delta, but the compounding threat of climate change will challenge traditional and contemporary ways of life. The ARCC Climate Adaptation and Mitigation (CAM) Fisheries Vulnerability Assessment allowed for a systematic appraisal of the threats and impacts on species (in the context of fisheries) and production systems (in the context of aquaculture), in selected ecoregions of the Mekong Delta, based on 2050 projections of new weather patterns and climate conditions. Selected fish species were selected as indicators of the sensitivity of hot-spots for fisheries and aquaculture to future projects of changes in climate. The largest single threat to the diversity and productivity of the Mekong's fisheries was identified as the alteration of river morphology caused by physical structures (dams), although it was difficult to isolate climate change "signals" among other causes of vulnerability. Fishing and farming communities of the delta have traditionally been very resilient, but climate change will test the limits of the capacity of Mekong people to produce food and generate incomes.

11) Development of methodology for assessing vulnerability and developing adaptation strategies for small-scale aqua-farmers in Asia

Mr Patrick White, of AKVAPLAN – NIVA As in Tromso, Norway, [21] presented the vulnerability assessment approach that had been piloted in context of the NORAD-funded Aqua-Climate project[22] on the strengthening of adaptive capacities to the impacts of climate change in resource-poor small-scale aquaculture and aquatic-resources-dependent sector in the South and Southeast Asian Region. The main goal of the Aqua-Climate project was to identify and demonstrate the potential of integrated adaptation strategies to sustain small-scale aquatic farming systems under different climate change impact scenarios. It is one of the first and the most extensive on-site study that has been carried out in the region so far and has explicitly focused on communities and individual farmers' capacities to adapt to the impacts of climate change. The project focused on five case studies that are important from a livelihood and/or food security perspective: catfish farming in the Mekong Delta of Viet Nam; milkfish farming in the Philippines; low-intensity shrimp farming in India; improved extensive shrimp farming in Viet Nam; and culture-based fisheries in seasonal

[20] www.mekongarcc.net
[21] www.akvaplan.niva.no
[22] www.enaca.org

reservoirs in Sri Lanka. One of the most important outputs of the project was to develop generic methodology to assessing vulnerability and developing adaptation strategies. The following methodologies were undertaken: focus group meetings, seasonal and crop calendars, stakeholder workshops and panels, risk assessment, stakeholder and institutional mapping and analysis, life cycle analysis, and policy analysis. Data and information so gathered enabled the researchers to map farmer perceptions of climate change, conduct socio-economic analyses and develop climate change scenarios for the case study areas. This showed that all of these systems are at substantial risk from climate change owing to impacts such as sea-level rise, saline intrusion into freshwater reaches of river systems, changes in rainfall patterns and more frequent storms and other extreme events. Major deliverables of the project include adaptation strategies for each farming system and a series of technical and policy briefs and extension materials separately targeting policy-makers, scientists and farmer groups that can be used as decision-making tools by the case study partner countries and other interested groups in the region.

12) Participatory approaches to assessing vulnerability of natural resources and associated livelihoods to climate change in the Caribbean islands

Ms Nicole Leotaud, from the Caribbean Natural Resources Institute (CANARI) in Trinidad,[23] shared the experience of CANARI in the implementation of bottom-up, participatory approaches to the understanding of vulnerability in fisherfolk communities in the Caribbean. CANARI is a non-profit technical organization working across all of the islands of the Caribbean to facilitate and promote participatory natural resource management. As part of its work, CANARI uses various innovative participatory methods to engage fisherfolk and other resource users in rural communities in building resilience to the impacts of climate change and natural disasters. The methods used capture local knowledge on the impacts of climate change and adaptation actions being taken, build understanding and capacity, and engage fisherfolk and other resource users in the analysis of what the priorities are for action on the ground as well as the policy changes needed to build resilience. Innovative methods used include participatory video and participatory three-dimensional modelling (P3DM) as well as interviews, focus groups, peer exchanges, field visits, problem analysis and mapping. The recommendations from fisherfolk and other resource users are communicated to policy-makers and other stakeholders to build awareness and influence policy.

3.1 Discussions

A number of recurrent themes emerged from the discussions held in plenary after each presentation.

- The amplifying effects of climate change and variability on already vulnerable people and the system they depend upon: the existence of multiple impact pathways was evident throughout the examples presented as well as the ability to understand single impact pathways in some cases.
- The purpose of climate change vulnerability assessments – for what and for whom: this has not only a decisive influence on the delimitation of the remit of an assessment, but also conditions the incorporation of stakeholders' perceptions and the coproduction of knowledge.
- The selection of a mix of relevant methodologies and their careful implementation: the most suitable methods will be dependent on the objective and scale of the assessment, and methods should be selected and implemented to minimize the influence that any preconceptions of the assessment implementers and researchers could exert on communities and study findings.

[23] www.canari.org

- The potential (or "likely") existence of both losers and winners of climate change at different levels.
- The potential impacts of adaptation and GHG mitigation actions within other sectors on the fisheries and aquaculture sector and the benefits of cross-sectoral approaches.

Issues of particular relevance to vulnerability assessments were also flagged:

- In relation to methodologies: **flexibility** in the choice of vulnerability assessment framework and methodologies; **optimal use** of a combination of methods grounded in "hard" sciences on the one hand and purely participatory on the other; **replicability** of methods, especially when applied to the investigation of the vulnerability context, which tend to rely more extensively on participatory and perception methodologies; **scale** of implementation of the methods; and **complementarity** of methodologies with one another to support integrated approaches, understanding the strengths and weaknesses and biases of any given methodology.
- In relation to vulnerability studies: agreement on **purpose** as a conditioning factor for the entire assessment; establishing the **information** available and needed; **comparability** of study findings; **capacity building** throughout the stakeholder network, from the assessment team to political leaders (potential users of study findings); evaluation of the **costs and benefits** of action and non-action options and of **lessons learned** from documenting the history of adaptation within the given context.
- The need not to lose sight of the bigger vulnerability picture when the chosen vulnerability assessment framework focuses on particular elements of the bigger picture.
- The complexity of linking long-term projections and needs with short-term perceptions and vulnerabilities.
- The complexity and often incompatibility of existing vulnerability frameworks, the need to use language, vocabulary and other communication means appropriate to the context and meaningful to the stakeholders.[24]
- A desire to consolidate methodological advances to this point while noting that the methodological advances will continue.
-

4. DEFINING PRINCIPLES AND GUIDING STEPS FOR VULNERABILITY ASSESSMENTS

Vulnerability assessment principles and steps proposed in the second part of the background document were briefly outlined by Ms Cécile Brugère. Participants were then randomly split into groups to test them out and provide suggestions for improvements using fictitious case studies to ground their analysis. On the basis of this and of the plenary discussions that followed, a set of principles and a refined vulnerability assessment process were proposed as follows.

4.1 Principles for a "good" vulnerability assessment

A "good" vulnerability assessment should:

- be linked to concrete adaptation actions, leading to the achievement of societal objectives;

[24] This includes using vulnerability terms that hold the same meaning to each member of the vulnerability assessment team.

- acknowledge that climate change is typically one among many risks and drivers of change (it may be an amplifier of existing changes) and that its compounded effects may be difficult to single out from these other drivers, or to clearly quantify and predict;
- be based on an established and agreed-upon framework;
- use an approach that relies on established and robust methodologies (to ensure accountability and replicability), while allowing for uniqueness inherent to each context;
- consider combining and reconciling the strengths of top-down and bottom-up approaches;
- be based on best available scientific information (evidence-based data, objective, models) but also account for and/or include perceptions and/or subjective information from stakeholders);
- be a transparent process, acknowledging limitations and uncertainties as well as disciplinary biases;
- be aware that there may be winners and losers who need to be identified at different (time, geographical) scales;
- acknowledge the benefits and limitations of working at any particular scale and that vulnerability assessment findings might be limited to a predetermined scale deemed of relevance to the assessment itself;
- account for the different needs of end users and use context-relevant communication channels;
- be an iterative, participatory and multistakeholder process.

4.2 Proposed steps for a vulnerability assessment in fisheries and aquaculture

Below are proposed steps to assist vulnerability assessment practitioners support stakeholders in the development and application of a vulnerability assessment. The level of detail and language used in the process will depend on the information available, the stakeholders involved and the end users of the results.

Step 1: Why a vulnerability assessment? – assessment "warm-up"

This step enables defining the broad context within which the assessment will take place. It is essential to reflect and decide on why a vulnerability assessment is needed:

- Who is driving/requesting the assessment and why?
- Define the objective (or objectives) of the assessment: its immediate objective and links to longer-term/higher level goals. This implies distinguishing between the specific output (product) of the assessment and the outcomes (changes) the assessment will lead to.
- To what extent is the assessment anticipating (*ex ante*), reactive (*ex post*) or a mix of both?
- Who are going to be the users of the assessment? (direct and indirect users, at several possible levels)
- Who will undertake the vulnerability assessment? What is their expertise/disciplinary background?

Operational constraints also need to be identified:

- What issues need to be considered relating to the funding source for the assessment?
- Are there time constraints for the assessment?
- Are there financial and human constraints?

Step 2: Identify the system and drivers – "scoping" activity

This step enables an **initial** scoping of who/what is vulnerable to what and why, within the context determined under Step 1. It is **not** the assessment as such, but it should enable obtaining a broad picture of vulnerability to help define the scope, range and possible methods of the detailed vulnerability assessment to be undertaken.

a) Important things to consider:

- What is the specific system, sector or group at stake: socio-economic, biophysical, combined human–environmental?
- What are the major drivers of change in the system: climate change, economic, social, policies, micro/macro? A rapid analysis of impact pathways may be useful here and will provide the broad picture of changes in the system.
- What is the temporal scale to be considered: long term, short term, past history, projections?
- What is the spatial scale of the assessment: national, local, regional, ecological scales, combination of scales?
- Can some thresholds and/or tipping points be identified at this stage, i.e. up to what point can the system be and/or can people do what they do until change is unavoidable?
- Who are stakeholders to involve in the assessment? At this stage, a rapid stakeholder analysis, including considerations of their likely perceptions and of external stakeholders may be useful.

Examples of initial vulnerability questions and issues specific to fisheries and aquaculture are given in Box 1. At this point, future projections of climate and vulnerability are not necessarily required, as it is mostly "contextual" vulnerability (see Annex 3) that is focused upon.

Box 1
Example questions and issues specific to fisheries and aquaculture for use in a vulnerability scoping exercise

Understanding the *exposure* of the human and aquatic system to change: Identification of the biophysical changes expected over different time scales (annual, decade, century) and their impacts on the system under evaluation and the larger communities dependent on the system

- Review of any existing climatic, oceanographic, etc. models predicting biophysical changes and system (ecosystem) impacts within the context of other drivers of change on the system (e.g. pollution, irrigation, land use, other users of the aquatic system, fishing).
- Analysis of the various pathways to impacts on the fisheries/aquaculture system and communities within the context of other drivers of change (e.g. globalization, changes in markets, war, policies). For example, fisheries management, use of resources by other sectors, pollution, runoff all affect the fisheries resources and environments. Social, political and economic drivers are also impacting fisheries and their communities.
- It would help to know to what extent changes are climate change driven and, further down, how sensitive the system is to the various drivers.
- How likely are these changes to occur?
- If no formal information is available, opinion and perceptions would be useful.

Understanding the *sensitivity* of the human and aquatic system to change

- Description of the biological and ecological state of the resources in the system:
  - How sensitive are the ecosystem and fisheries species to changes in temperatures, sea level, salinity, precipitation, ocean circulation and other predicted impacts? What are the consequences to ecosystem well-being if the change comes about?
- Description of the social and economic contributions to, for example, food/nutrition security, livelihoods, employment, export earnings, social stability, and dependence of the relevant communities (local, regional, national) on the system:
  - How sensitive are these to changes in the various drivers, including climate change? What are the consequences to human well-being if the change comes about?

Evaluating the current *adaptive capacity* of the human and aquatic system

- Description of the resilience and adapting capabilities of the aquatic system, such as through indicators on biodiversity within the ecosystem, genetic diversity of species, biomass, age and size structures, water quality, amount of habitat destruction/rebuilding, proximity to threshold limits.
- Description of the adaptive capacity of the human economic–social system, such as:
  - The ability of institutions, communities and individuals to learn, use and store knowledge and experiences:
    - How is (market, climate, policy) information shared at the local level? National level?
    - What information is collected and how/when is it collected (e.g. research surveys, local knowledge surveys)?
    - How is this information used to assist management and manage uncertainty and change?
    - Et cetera.
  - Flexibility in decision making and problem solving:
    - Are adaptive, participatory, integrated approaches to management in place?
    - Et cetera.
  - Existence of power structures that are responsive, effective and consider the needs of all stakeholders:
    - Who is responsible for fisheries management?
    - Who is responsible for disaster risk management, general aquatic health, water management, coastal/lake/river/basin management?
    - Is it the same agency for the above items?
    - Do relevant plans exist and are they coordinated across institutions (e.g. does an integrated coastal management plan exist that incorporates disaster risk management)?
    - Who takes the decisions?
    - What are the consultation processes?
    - How is uncertainty built into the decision-making process?
    - Et cetera.
  - Existence of alternatives and access to services:
    - Are there social safety net systems in place (e.g. community-level insurance, shared recovery costs)?
    - Alternative livelihoods availability? Job mobility? Training?
    - Access to alternative markets?
    - Alternative sources of food and nutrition?
    - Access to public services (potable water, health systems, education)?

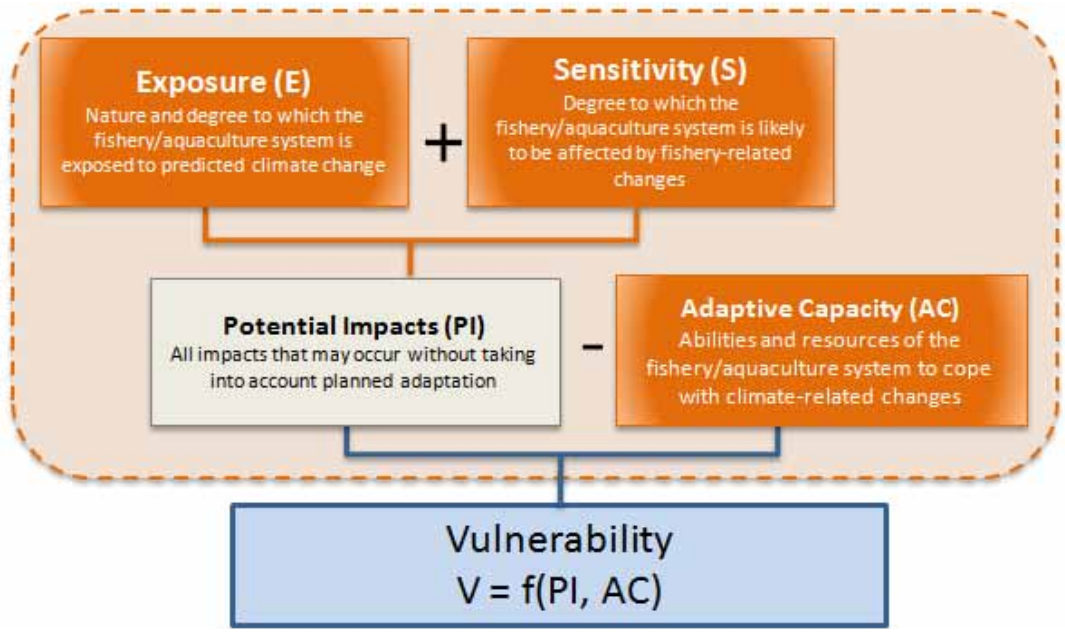
b) Methods to organize information from point 2.a)

Organizing the information gathered from point 2.a) will depend on the preferences of the stakeholders defining and working on the vulnerability assessment. Some possibilities include structuring information in:

- matrix/table form;
- decision trees;
- axis/gradients;
- maps;
- freely, in narratives;
- according to the five livelihood capitals (natural, physical, financial, social and human).

It may also be useful to organize the information according to the IPCC components of vulnerability (exposure, sensitivity, adaptive capacity – Figure 1) for different types of stakeholders, or scales (spatial and/or temporal).

Figure 1.
Generic IPCC vulnerability analysis framework for fisheries and aquaculture systems



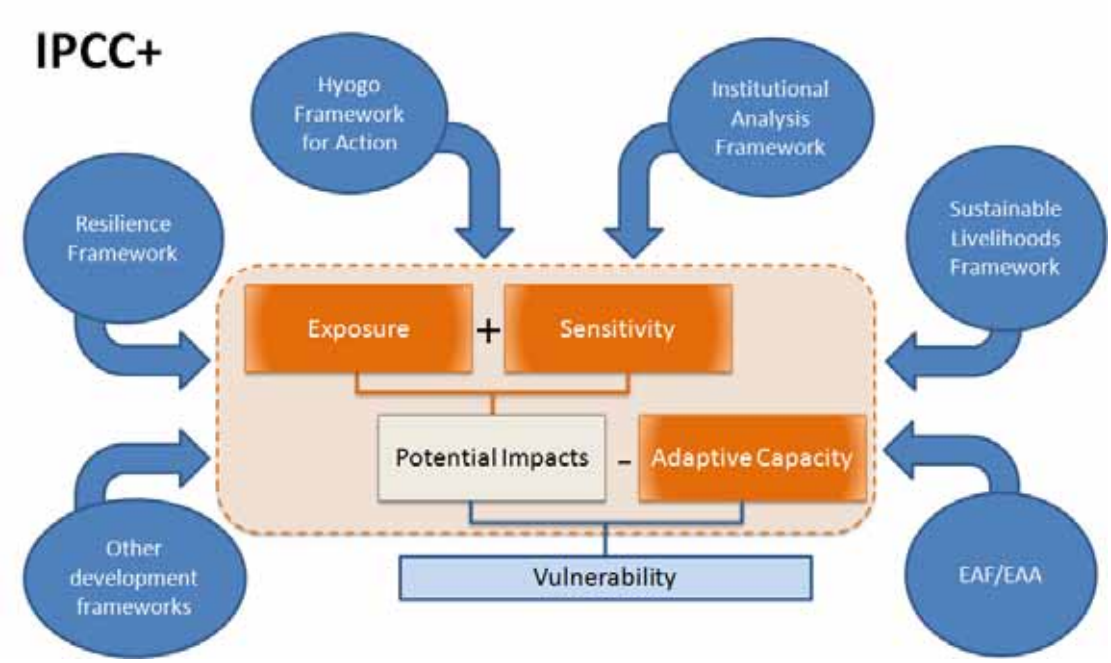
Source: Derived from IPCC. 2001. *Climate Change 2001: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Third Assessment Report of the IPCC. (also available at www.grida.no/publications/other/ipcc_tar/).

Step 3: Choosing a framework of analysis

From the broad picture and initial scoping of drivers and vulnerabilities drawn from Step 2, stakeholders will need to agree upon a particular framework for the vulnerability analysis. The choice of framework will depend on the questions to be asked by the vulnerability assessment, how and to whom the vulnerability assessment and its findings will be communicated, operational constraints and what people need and want from the vulnerability assessment.

As a starting point, consider using an "IPCC+" framework, i.e. a framework based on the IPCC definition and components but one that allows for drivers other than climate change to be considered. The IPCC+ framework can then be complemented by other relevant or appropriate frameworks, such as the Hyogo Disaster Risk Framework, the Sustainable Livelihoods Framework, the Resilience Framework and others to improve the basic IPCC framework (Figure 2). This enables not only acknowledgement of the existence and relevance of these other frameworks, but also the option to build a layer of complexity over the basic IPCC vulnerability components with complementary considerations and perspectives.

Figure 2.
Schematic representation of the place of non-climate specific frameworks to enrich the basic IPCC vulnerability framework



Step 4: Identify data/information needed to answer the vulnerability questions

Now that the questions to be answered by the vulnerability assessment have been established, depending on the purpose, the objective and the time, financial and human constraints of the vulnerability assessment, this step should establish which information and/or data are needed, which are already available and which need to be collected.

Depending on the various elements underlying the vulnerability questions, the assessment may consider using a mix of various types of data: qualitative, quantitative, primary (gathered at the source), secondary (derived from other sources) of any kind (e.g. scientific climatic, biological, socio-economic data, perceptions information).

This inventory of data/information can be organized according to the method used in Step 2.

Step 5: Identify how to obtain these data and information

There are many methodologies available for collecting data and information on the vulnerability components. The choice of methods will depend on issues such as the scale of the assessment and resource constraints, as well as whether participatory approaches or other approaches to collecting information are to be used.

Some questions to consider include:

- How to obtain the missing data/information: reviews, secondary data (e.g. census), surveys, expert or stakeholder workshops, etc.?
- Who can collect it?
- Where/who from? (if available)
- Are present data, future projections, historical information included?

Links to guidance on information-gathering methodologies that could be adapted to the context of a vulnerability assessment include the online EAF Toolbox[25] and the list of process-oriented methodologies and information management tools for use in the implementation of the EAF.[26]

Step 6: Analysing the data/information within the chosen framework

This step is about analysing the collected data and information according to the framework chosen for the assessment. There are many methodologies available for pulling together the information on the vulnerability components, such as modelling-based (e.g. downscaling, modelling), indicator-based (computation of indices and indicators), and stakeholder-based (livelihood narratives, institutional analyses, etc.) methods. The choice between these methods will depend on the scale, the information collected and available, and the purpose of the assessment itself.

The results of this step should provide refined answers to the questions as to who and/or what is vulnerable to what (Step 2), as well as clearly point to the causes or reasons for vulnerability, i.e. answering why a system or people are unable to adapt and vulnerable, in such a way that recommendations and priorities for action become clear.

Step 7: Report and communicate findings

Depending on the objectives and users of the findings, this step considers how and in what forms the findings of the vulnerability assessment should be communicated for adaptation planning and used to influence decision processes.

It is essential at this step to decide upon target audiences and users and the most appropriate communication channels for these audiences.

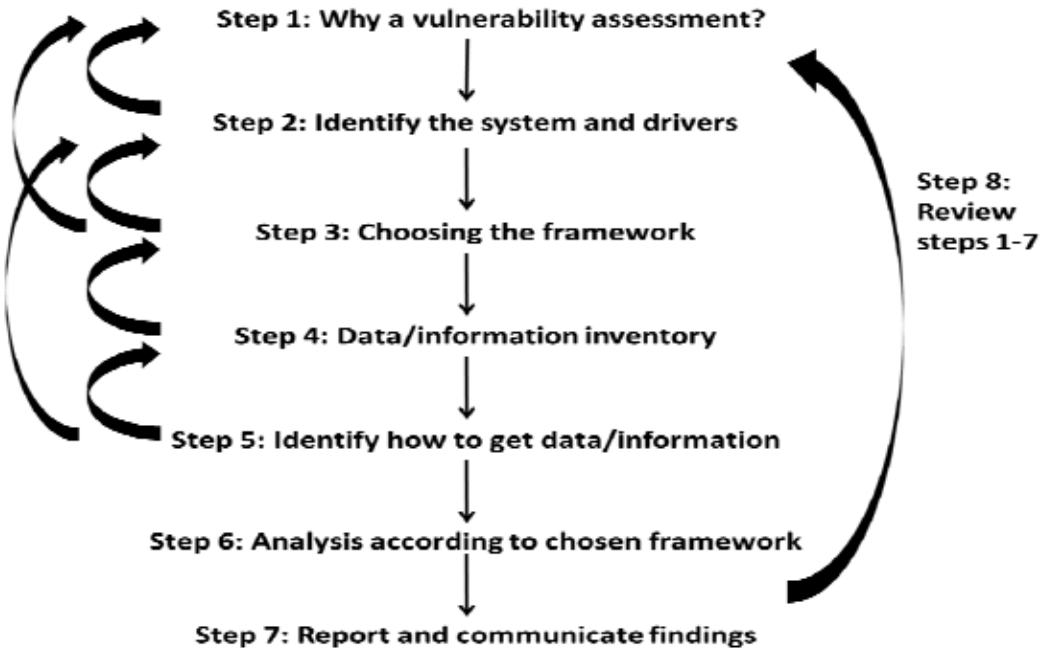
Step 8: Review Steps 1–7

As the vulnerability questions may evolve during the vulnerability assessment process (Steps 1–7), this step is to remind the assessor to review each step continuously along the way and make the necessary adjustments to the vulnerability assessment methodologies followed (Figure 3).

[25] www.fao.org/fishery/eaf-net/topic/166272/en

[26] De Young, C., Charles, A. & Hjort, A. 2008. *Human dimensions of the ecosystem approach to fisheries: an overview of context, concepts, tools and methods*. FAO Fisheries Technical Paper No. 489. Rome, FAO. 152 pp. (also available at www.fao.org/docrep/010/i0163e/i0163e00.htm).

Figure 3.
Proposed vulnerability assessment process



5. SUMMARY OF RECOMMENDATIONS AND CONCLUSIONS

5.1 Recommendations

The principles for vulnerability assessments and the process of assessment described above were agreed upon by workshop participants and deemed necessary to improve the quality, coherence and reliability of vulnerability assessment work in general and in the context of fisheries and aquaculture in particular. Therefore, these should be considered as a baseline for further refinement and development.

The preparation of specific outputs stemming from this workshop was also recommended:

- In the short term:
  - a policy brief summarizing the use of vulnerability assessments within an adaptation process, guiding principles and steps, and examples of their implementation and use;
  - a technical paper based on the background document that was prepared ahead of the workshop focusing on defining and implementing vulnerability frameworks for practitioners within the fisheries and aquaculture sector as well as those working with related issues, such as coastal zones and populations;
  - a journal article stemming from the theoretical discussions on vulnerability assessment frameworks and their relevance to fisheries and aquaculture.

- In the medium to long term:
  - detailed vulnerability assessment guidelines providing additional information for each step of the vulnerability assessment process, such as links to information, process tools, visualization tools and modelling tools to support vulnerability assessments in fisheries and aquaculture.

5.2 Concluding remarks

Ms De Young of FAO thanked the participants, on behalf of PaCFA, for their fully engaged concern for assisting the fisheries and aquaculture sector to understand impacts and vulnerabilities from climate change as well as other drivers faced by the sector. She thanked the BCC for hosting the event, Ms Nicole Leotard for her excellent chairing, and Ms Ariane Acqua for her support in handling travel arrangements. In addition, she thanked Ms Cécile Brugère and Mr William Barsley for their support in conceptualizing the workshop and providing valuable inputs leading to its success.

Mr Hashali Hamukuaya of the BCC thanked the experts for sharing their wealth of knowledge and experiences and assured the workshop participants that the results of the workshop would be applied in the adaptation project under development in the Benguela region. Mr Hamukuaya thanked FAO and PaCFA for their technical support and the Government of Japan and the Government of Norway for their financial support. Mr Hamukuaya then officially closed the meeting.

ANNEX 1

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ANNEX 2

Agenda

Day 1 – 8 April 2013	
9.00 – 10.30	Opening of the workshop • Welcome addresses – FAO and BCC Executive Director • Introductory remarks • Workshop objectives and agenda
10.30 – 11.00.	Coffee/tea
Session 1: Overview of Vulnerability Assessment Methodologies	
Objective: *Presentation of a review of vulnerability assessment methodologies*	
11.30 – 12.30	Results of a review of vulnerability assessment methodologies (Cécile Brugère) and discussions
12.30 – 14.00	Lunch
Session 2: Experiences in developing and undertaking vulnerability assessments	
Objective: *Participants will share their experiences in developing and undertaking vulnerability assessments*	
14.00 – 16.00	Case study presentations and discussions
16.00 – 16.15	Coffee/tea
16.15 – 17.00	Case study presentations and discussions
18.00 – 20.00	Cocktail
Day 2 – 9 April 2013	
Session 3: Understanding and refining the vulnerability assessment process	
Objective: *By way of case examples, working groups will undertake processes to define relevant vulnerability assessment frameworks for different contexts*	
8.30 – 9.00	Recap of previous day, Introduction to Day 2 Working Groups
9.00 – 9.30	Last case study presentation and discussion
9.30 – 10.00	Presentation of Vulnerability Assessment Framework Processes (Cécile Brugère)
10.00 – 10.15	Coffee/tea
10.15 – 13.00	Working Groups Session
13.00 – 14.00	Lunch
14.00 – 15.30	Working Groups Session (continue)
15.30 – 15.45	Coffee/tea
15.45 – 17.00	Presentation of Working Groups process (Step 1) and discussion

Day 3 – 10 April 2013	
Session 4: Understanding and refining the vulnerability assessment process (suite)	
Objective: *Discuss experiences of Working Groups with a view to propose a vulnerability assessment process applicable to fisheries and aquaculture*	
8.30 – 10.00	Presentation of Working Groups processes (Steps 1 to 6) and discussion
10.00 – 10.15	Coffee/tea
10.15 – 12.30	Plenary discussion on vulnerability assessment principles and steps
12.30 – 14.00	Lunch
Session 5: Guidance on Workshop Outputs	
Objective: *Discuss and plan next steps on workshop outputs to assist fisheries and aquaculture develop and implement vulnerability assessments*	
14.00 – 15.30	Discussion on types of outputs needed to assist the sector in developing and implementing vulnerability assessments
15.30 – 15.45	Coffee/tea
15.45 – 16.00	Closing Remarks

ANNEX 3

Summary of key perspectives on vulnerability

Contextual vulnerability: A state or condition of being moderated by existing inequalities in resource distribution and access, the control individuals exert over choices and opportunities and historical patterns of social domination and marginalization.[1] Opposed to outcome vulnerability.

Outcome vulnerability: The linear result of projected climate change impacts on a specific unit[2]. Opposed to Contextual vulnerability.

Political ecology perspective on vulnerability: Perspective that explores vulnerability with respect to broad processes of institutional and environmental change and that argues for a balanced consideration of both biophysical and social dynamics in decision-making. Like the political economy perspective, it focuses on the political dimension of vulnerability and highlights social inequalities and points of conflicts within societies.[3]

Political economy perspective on vulnerability: Perspective that emphasizes the sociopolitical, cultural and economic factors that together explain differential exposure to hazards, differential impacts and differential capacities to recover from past impacts and/or cope and adapt to future threats. Like the political ecology perspective, it focuses on the political dimension of vulnerability and highlights social inequalities and points of conflicts within societies.[4]

Resilience approach to vulnerability: Approach that gives a predominant weight to the implications of social and environmental change across the broader geographic space, reducing human activity to just one of the driving forces and humans themselves to only one of the affected species.[5]

Risk–hazard approach to vulnerability: Approach that uses a biophysical threat as point of departure and that describes, on a very broad scale: what a unit/system is vulnerable to, what consequences might be expected, and where and when those impacts might occur.[6]

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[1] Eakin, H. & Luers, A.L. 2006. Assessing the vulnerability of social-environmental systems. *Annual Review of Environment and Resources*, 31: 365–394.
[2] O'Brien, K., Eriksen, S., Nygaard, L.P. & Schjolden, A. 2007. Why different interpretations of vulnerability matter in climate change discourses. *Climate Policy*, 7(1): 73–88.
[3] De Young, C., Charles, A. & Hjort, A. 2008. *Human dimensions of the ecosystem approach to fisheries: an overview of context, concepts, tools and methods*. FAO Fisheries Technical Paper No. 489. Rome, FAO. 152 pp. (also available at www.fao.org/docrep/010/i0163e/i0163e00.htm).
[4] Ibid.
[5] Ibid.
[6] Ibid.

Perspective	Risk/hazard	Political economy/ecology	Resilience
Key focal questions	What are the hazards? What are the impacts? Where and when?	How are people and places affected differently? What explains differential capacities to cope and adapt? What are the causes and consequences of differential susceptibility?	Why and how do systems change? What is the capacity to respond to change? What are the underlying processes that control the ability to cope and adapt?
Key attributes	Exposure, sensitivity	Capacity, sensitivity, exposure	Thresholds of change, reorganization, capacity to learn and adapt
System (unit of exposure)	Places, sectors, activities, landscapes, regions	Individuals, households, social groups, communities, livelihoods	Ecosystems, coupled human-environmental system
Scale	Regional, global	Local, regional, global	Landscapes, eco-regions, multiple scales

Source: Eakin, H. & Luers, A.L. 2006. Assessing the vulnerability of social-environmental systems. *Annual Review of Environment and Resources*, 31: 365–394.

Perspective	Outcome vulnerability	Contextual vulnerability
Root problem	Climate change	Social vulnerability
Policy context	Climate change mitigation, compensation, technical adaptation	Social adaptation, sustainable development
Vulnerability and adaptive capacity	Adaptive capacity determines vulnerability	Vulnerability determines adaptive capacity
Starting point of analysis	Scenarios of future climate hazards	Current vulnerability to climatic stimuli
Main discipline	Natural sciences	Social sciences
Meaning of vulnerability	Expected net damage for a given level of global climate change	Susceptibility to climate change and variability as determined by socio-economic factors

Sources: O'Brien, K., Eriksen, S., Schjolen, A. & Nygaard, L. (2004). What's in a Word? Conflicting Interpretations of Vulnerability in Climate Change Research. CICERO Working Paper 2004:04. Oslo: Oslo University.

O'Brien, K., Eriksen, S., Nygaard, L.P. & Schjolden, A. 2007. Why different interpretations of vulnerability matter in climate change discourses. *Climate Policy*, 7(1): 73–88.

ANNEX 4

Case studies – PowerPoint presentations

1) **PROVIA Guidance on assessing climate change vulnerability, impacts and adaptation**
Katharine Vincent (Kulima Integrated Development Solutions, South Africa)
ftp://ftp.fao.org/FI/DOCUMENT/R1047/1_PROVIA.pdf

2) **A Framework for Vulnerabilities in the Caribbean**
Ricardo Yearwood (CDEMA)
ftp://ftp.fao.org/FI/DOCUMENT/R1047/2_Caribbean.pdf

3) **Assessing vulnerability to climate change at multiple scales: to what purpose and how?**
Eddie Allison (WorldFish Center, Malaysia and University of East Anglia, United Kingdom)
ftp://ftp.fao.org/FI/DOCUMENT/R1047/3_Multiple_scales.pdf

4) **Assessing vulnerability in developing countries' fishing communities – some methodological considerations**
Chris Béné (Institute of Development Studies, United Kingdom)
ftp://ftp.fao.org/FI/DOCUMENT/R1047/4_DevCountries_communities.pdf

5) **Qualitative vulnerability assessment: Case of coastal fishing households, Tanzania**
Robert Katikiro (Leibniz-Centre for Tropical Marine Ecology, Bremen-Germany/University of Bremen)
ftp://ftp.fao.org/FI/DOCUMENT/R1047/5_Tanzania.pdf

6) **Social-ecological vulnerability of coral reef fisheries to climate change**
Cindy Huchery and Josh Cinner (James Cook University, Australia)
ftp://ftp.fao.org/FI/DOCUMENT/R1047/6_Socio-ecological.pdf

7) **Calculating 'vulnerability' when resources are enhanced by climate change**
Johann Bell (Secretariat of the Pacific Community, New Caledonia) and Eddie Allison (WorldFish Center, Malaysia and University of East Anglia, United Kingdom)
ftp://ftp.fao.org/FI/DOCUMENT/R1047/7_Enhanced_resources.pdf

8) **Fisherfolk perspectives of vulnerability: Climate and policy intertwine in small-scale fisheries in Southern Brazil**
Denis Hellebrandt (University of East Anglia, United Kingdom) and Patrizia Abdallah (Universidade Federal do Rio Grande, Brazil)
ftp://ftp.fao.org/FI/DOCUMENT/R1047/8_Brazil.pdf

9) **Vulnerability to CC in Chilean Aquaculture and Fisheries: results and findings**
Exequiel Gonzalez (Universidad de Concepción, Chile)
ftp://ftp.fao.org/FI/DOCUMENT/R1047/9_Chile.pdf

10) **Vulnerability Assessment of Mekong Capture Fisheries & Aquaculture.**
Rick Gregory (ARCC)
ftp://ftp.fao.org/FI/DOCUMENT/R1047/10_Mekong.pdf

11) **Development of methodology for assessing vulnerability and developing adaptation strategies for small-scale aqua farmers in Asia**
Patrick White (AkvaPlan)
ftp://ftp.fao.org/FI/DOCUMENT/R1047/11_AsianAquaculture.pdf

12) **Participatory approaches to assessing vulnerability of natural resources and associated livelihoods in the Caribbean islands to climate change**
Nicole Leotaud (Caribbean Natural Resources Institute)
ftp://ftp.fao.org/FI/DOCUMENT/R1047/12_ParticipatoryCaribbean.pdf

The purpose of the global Expert Workshop on Assessing Climate Change Vulnerability in Fisheries and Aquaculture: Available Methodologies and their Relevance for the Sector was to review latest stages in research on, and the application of, climate variability and change vulnerability methodologies. It also provided an opportunity to begin a common reflection on what role these methodologies can have in planning policies and strategies to best cope with climate change impacts on fisheries and aquaculture. Making the link between expert advice and practical use of vulnerability methodologies from around the globe set the scene for fruitful discussions on how to make the best use of the existing information, how to prioritize the filling of gaps and how to develop a common understanding on the effectiveness of such knowledge in relation to policy and management actions and programmes. As vulnerability methodologies are a function of different factors (vulnerability of what and of whom to what), the workshop required experts from across the natural and social sciences disciplines and from both inland and marine capture fisheries and aquaculture. These examined current methodologies for conducting vulnerability assessments and provided best practices on how to develop and undertake a vulnerability assessment for incorporation into the design of adaptation programmes in fisheries and aquaculture in the face of climate change.