



FAO Fisheries and Aquaculture Climate Change Publications

Table of Contents

Global Strategies and Knowledge on Climate Change and Fisheries and Aquaculture	1
Understanding Vulnerability Climate Change in Fisheries and Aquaculture.....	12
Supporting Adaptation in Fisheries and Aquaculture	19
Regional and National Climate Change Priorities	25
Greenhouse gas emissions and mitigation potentials	39





Food and Agriculture Organization
of the United Nations

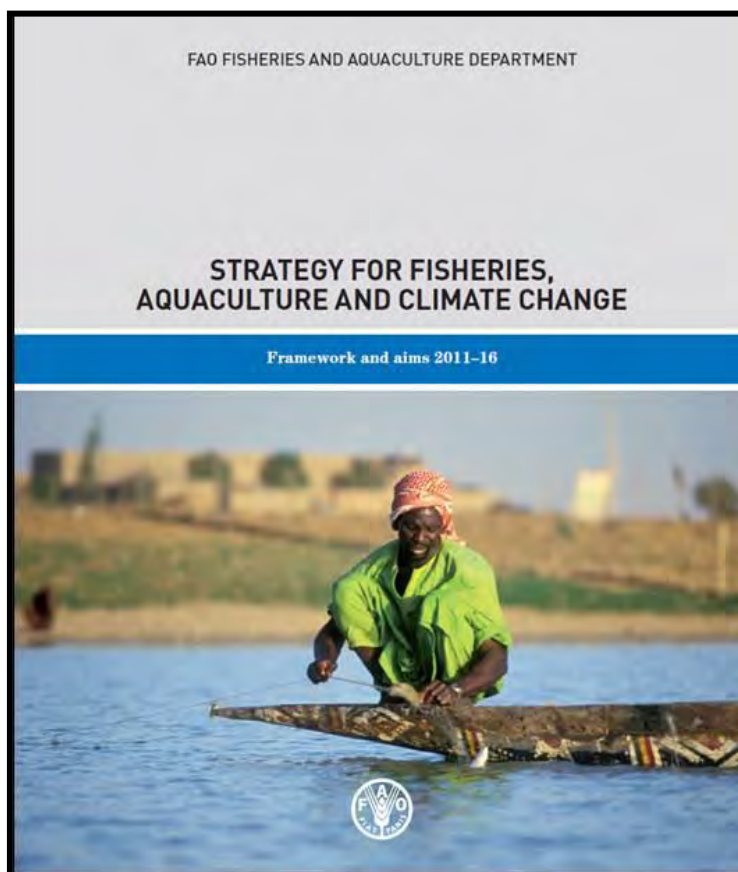
FAO Fisheries and Aquaculture Climate Change Publications

Global Strategies and Knowledge on Climate Change and Fisheries and Aquaculture



FAO Fisheries and Aquaculture Climate Change Publications

Fisheries and Aquaculture Department Climate Change Strategic Framework



The aim of this document is to provide the medium-term (2011–16) strategic framework defining the perspectives and objectives of the FAO Fisheries and Aquaculture Department with respect to climate change issues and development responses, and its coherence and operational effectiveness with respect to more localized delivery through regional and subregional offices. The **goal** of the program is to enable people, communities and States to meet their social and development objectives effectively while responding to the additional challenges imposed by climate change on fisheries and aquaculture. The **purpose** of the program is to support Member States and partners in mitigating, and adapting effectively to, the impacts of climate change for fisheries, aquaculture and aquatic ecosystems, through policy development, knowledge development and exchange, normative outputs, practical demonstrations, and capacity building.

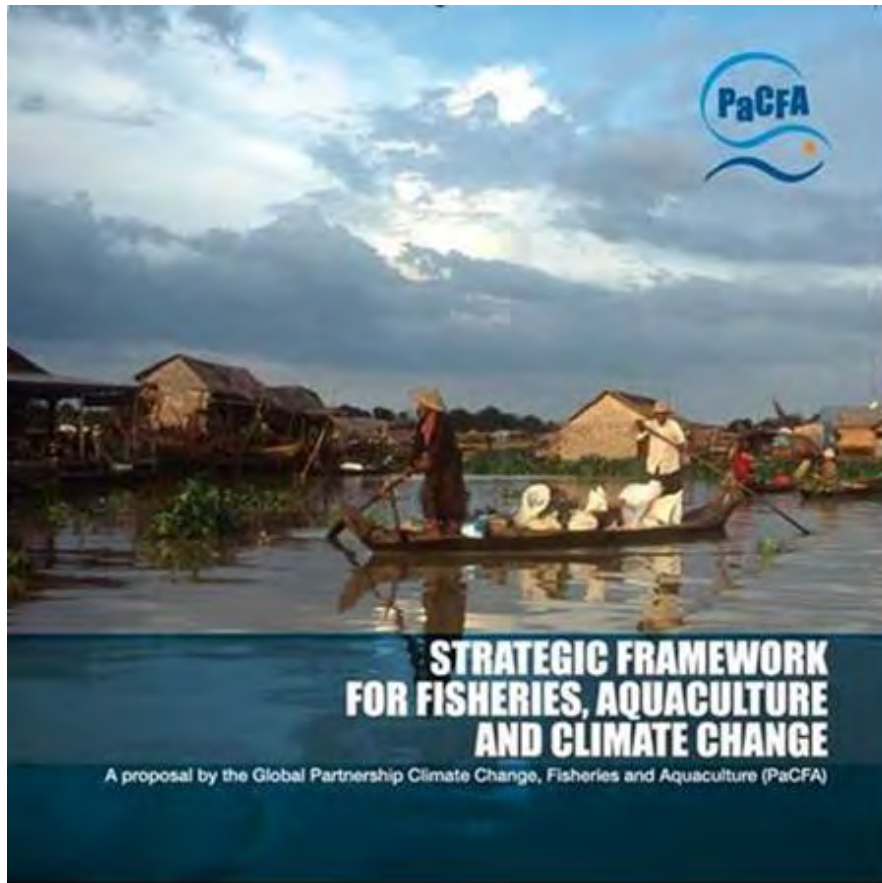
The PDF publication can be downloaded from the following url:

ftp://ftp.fao.org/fi/brochure/climate_change/strategy_fi_aq_climate/2011/climate_change_2011.pdf



FAO Fisheries and Aquaculture Climate Change Publications

Global Partnership for Climate, Fisheries and Aquaculture



This document has been prepared by the Global Partnership Climate Change, Fisheries and Aquaculture (PaCFA) to support the process of the United Nations Framework Convention on Climate Change (UNFCCC) in response to the need for concerted action on fisheries, aquaculture and climate change. It lays the groundwork for a coordinated response from the fisheries and aquaculture sector to climate change, notably through a strategic approach to maintain or enhance the health and resilience of global oceans and waters, and strengthening the capacity of dependent people and communities, integrating these closely into broader development strategies. PaCFA is a voluntary global level initiative among international organizations and sector bodies with a common concern for climate change interactions with global waters and living resources and their social and economic consequences. PaCFA members share a commitment to raising awareness of the vital importance of these issues, developing effective tools and management approaches to address them, and building international development support to implement change and bring about lasting positive outcomes. An immediate aim is to highlight key issues to alert and inform decision makers and climate change negotiators at UNFCCC meetings. From this, global, national and local responses can be formulated and implemented for adaptation and mitigation in aquatic ecosystems and for fisheries and aquaculture and in national and local responses to climate change.

*The PDF publication can be downloaded from the following url:
ftp://ftp.fao.org/FI/brochure/climate_change/pacfa/pacfa.pdf*



FAO Fisheries and Aquaculture Climate Change Publications

Global overview of Climate Change implications for fisheries and aquaculture, from impacts to adaptation and mitigation



An overview of the current scientific knowledge available on climate change implications for fisheries and aquaculture is provided through three technical papers that were presented and discussed during the Expert Workshop on Climate Change Implications for Fisheries and Aquaculture (Rome, 7–9 April 2008). A summary of the workshop outcomes as well as key messages on impacts of climate change on aquatic ecosystems and on fisheries- and aquaculture-based livelihoods are provided in the introduction of this Technical Paper. The first paper reviews the physical and ecological impacts of climate change relevant to marine and inland capture fisheries and aquaculture. The paper begins with a review of the physical impacts of climate change on marine and freshwater systems and then connects these changes with observed effects on fish production processes. It also outlines a series of scenarios of climate change impacts on fish production and ecosystems through case studies in different regions and ecosystems. The second paper tackles the consequences of climate change impacts on fisheries and their dependent communities. It analyses the exposure, sensitivity and vulnerability of fisheries to climate change and presents examples of adaptive mechanisms currently used in the sector. The contribution of fisheries to greenhouse gas emissions is addressed and examples of mitigation strategies are given. The role of public policy and institutions in promoting climate change adaptation and mitigation is also explored. Finally, the third paper addresses the impacts of climate change on aquaculture. It provides an overview of the current food fish and aquaculture production and a synthesis of existing studies on climate change effects on aquaculture and fisheries. The paper focuses on the direct and indirect impacts of climate change on aquaculture, in terms of biodiversity, fish disease and fishmeal. Contribution of aquaculture to climate change is addressed (carbon emission and carbon sequestration), as well as possible adaptation and mitigation measures that could be implemented.

Cochrane, K.; De Young, C.; Soto, D.; Bahri, T. (eds). **Climate change implications for fisheries and aquaculture: overview of current scientific knowledge**. FAO Fisheries and Aquaculture Technical Paper. No. 530. Rome, FAO. 2009. 212p.

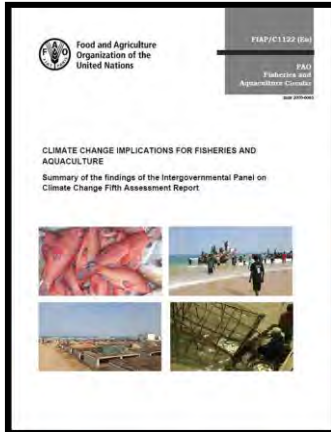
The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/012/i0994e/i0994e00.htm>





FAO Fisheries and Aquaculture Climate Change Publications

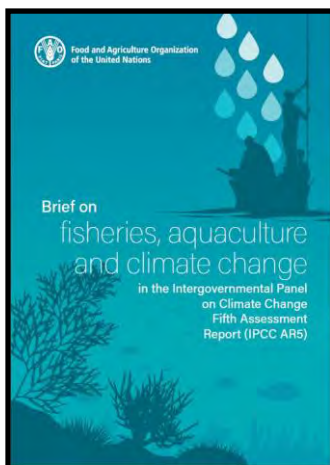
Summary of IPCC AR5 reports from a fisheries and aquaculture perspective



This report aims to facilitate the use of the Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC AR5) by those concerned with the fisheries and aquaculture sector and their dependent communities. The extensive information within the AR5 is condensed from the fisheries and aquaculture perspective, and guiding links to the relevant IPCC documents facilitating further investigation are provided. The report moves from the chemical and physical changes already observed and forecasted within the aquatic systems (inland and marine), to the implications of these changes for fisheries and aquaculture production systems. The AR5 is then reviewed for knowledge on the effects, vulnerabilities and adaptation options within the sector and its dependent communities at the continent and regional scales. The report concludes with a review of knowledge gaps from the fisheries and aquaculture perspective that would support further IPCC efforts.

FAO. 2016. Climate change implications for fisheries and aquaculture: Summary of the findings of the Intergovernmental Panel on Climate Change Fifth Assessment Report, by Anika Seggel and Cassandra De Young. FAO Fisheries and Aquaculture Circular No. 1122. Rome, Italy.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-i5707e.pdf>



THE FAO Fisheries and Aquaculture Department has prepared this Brief on Fisheries, Aquaculture and Climate Change in the AR5 to provide an entry point to the vast AR5 content specifically for those interested in the fisheries and aquaculture sector and its dependent communities who are directly and indirectly affected by climate change and variability. This brief synthesizes the Intergovernmental Panel on Climate Change Fifth Assessment Report's (AR5) important knowledge on how climate change is already manifesting itself through the aquatic systems, what the future changes may be and their predicted impacts on food and livelihood security, marine and inland fisheries and aquaculture systems, and overviews AR5's information on implications of climate change and variability for capture fisheries, aquaculture and dependent communities in eight regions: Africa, Asia, Australasia, Central and South America, Europe, North America, Small Island States and Polar Regions. In this

context, adaptation options suggested by the AR5 will be outlined for each. It concludes with a review of knowledge gaps from the fisheries and aquaculture perspective that could benefit from further IPCC efforts.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-i5871e.pdf>



FAO Fisheries and Aquaculture Climate Change Publications

Global overview of Climate Change implications for food security



By adopting the sustainable development goals, the world has committed to ending hunger, achieving food security and improving nutrition by 2030. But climate change is already undermining the livelihoods and food security of the most vulnerable populations. Ensuring food security and good nutrition in the face of climate change is among the most daunting challenges facing humankind.

The report *Climate change and food security: risks and responses* brings together evidence from the Intergovernmental Panel on Climate Change (IPCC), updated by the latest evidence and scientific findings as well as by results from experience on the ground, on the impacts of climate change on food security and nutrition. It shows how a cascade of impacts from ecosystems to livelihoods interacts with a series of vulnerabilities, undermining food security and nutrition, especially of the most vulnerable populations. The report presents ways to adapt, to reduce vulnerabilities

and to build resilience to climate change. It shows the importance of acting now to address climate change, to ensure food security and good nutrition for all, now and in the future.

FAO. 2016. Climate change and food security: risks and responses. Rome, FAO. 98p

The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-i5188e.pdf>



FAO Fisheries and Aquaculture Climate Change Publications

Global expert workshop on CC implications for fisheries and aquaculture, from impacts to adaptation and mitigation



This Expert Workshop was convened to identify and review the key issues of climate change in relation to fisheries and aquaculture, from the physical changes, the impacts of those on aquatic resources and ecosystems and how these ecological impacts translate into human dimensions of coping and adapting within fisheries and aquaculture. Three comprehensive background documents formed the basis of the technical discussions. The Workshop also evaluated policy options and activities at the international, regional and national levels that can help minimize negative impacts of climate change, improve on mitigation and prevention, and maintain and build adaptive capacity to climate change. The impetus for the Workshop emerged from recommendations of the twenty-seventh session of COFI (2007) as well as to the need to provide inputs into the FAO High-Level Conference on World Food Security: the Challenges of Climate Change and Bioenergy, held in Rome from 3 to 5 June 2008.

FAO. Report of the FAO Expert Workshop on Climate Change Implications for Fisheries and Aquaculture. Rome, Italy, 7–9 April 2008. FAO Fisheries Report. No. 870. Rome, FAO. 2008. 32p

The PDF publication can be downloaded from the following url:

<http://www.fao.org/docrep/011/i0203e/i0203e00.pdf>





FAO Fisheries and Aquaculture Climate Change Publications

Fisheries and Aquaculture in the Climate-smart Agriculture Sourcebook



There has been a rapid uptake of the term Climate-Smart Agriculture (CSA) by the international community, national entities and local institutions, in the past years. However, implementing this approach is challenging, partly due to a lack of tools and experience. Climate-smart interventions are highly location-specific and knowledge-intensive. Considerable efforts are required to develop the knowledge and capacities to make CSA a reality. The purpose of the sourcebook is to further elaborate the concept of CSA and demonstrate its potential, as well as its limitations. This sourcebook is a reference tool for planners, practitioners and policy makers working in agriculture, forestry and fisheries at national and subnational levels, dealing with the effects of climate change.

FAO. 2013. Climate-smart Agriculture Sourcebook. Rome, FAO. 557pp.

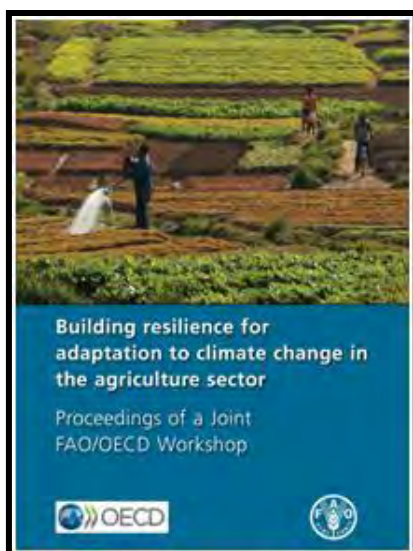
The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/018/i3325e/i3325e00.htm>





FAO Fisheries and Aquaculture Climate Change Publications

An FI&AQ chapter in Proceedings from a Joint FAO/OECD Workshop on building resilience



Globally, climatic conditions are increasingly variable, and the intensity of their effects stronger. As climate change brings new uncertainties, risks and changes to already existing risks, one of the most efficient ways for agriculture to adapt is increasing its resilience. In April 2012, the joint FAO/OECD Workshop on “Building Resilience for Adaptation to Climate Change in the Agriculture Sector” was held to address these issues in different agro-ecological and socio-economic contexts, and to illustrate how building resilience is critical to adapting to climate change. The various sessions of the Workshop questioned the notion of resilience from very different angles, confronting concepts, specific risk management strategies, case studies and national policies, from different perspectives – biophysical, economic, or social and institutional – and at various scales, from farm and household to national and global. This publication is a compilation of the papers presented at the Workshop, and the Workshop Summary.

Meybeck, A., Lankoski, J., Redfern, S., Azzu N., Gitz, V. (eds.). **Building Resilience for Adaptation to Climate Change in the Agriculture Sector. Proceedings of a Joint FAO/OECD Workshop.** 23–24 April 2012. Rome, FAO. 2012. 346pp.

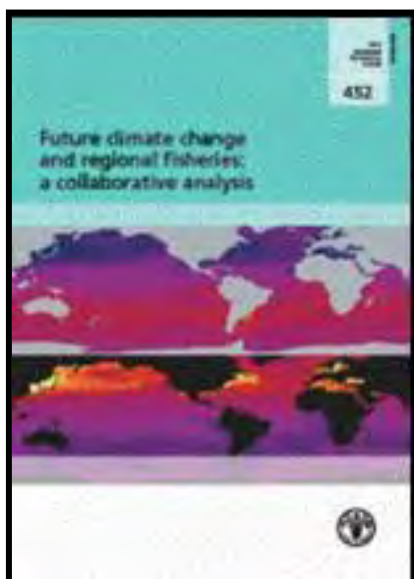
The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/017/i3084e/i3084e.pdf>





FAO Fisheries and Aquaculture Climate Change Publications

Overview of interacting physical climatic and ecological processes that play critical roles in maintaining Earth's ecological support systems, particularly those related to fish and fisheries



First, issues of Global Change versus Global Warming are discussed. The larger perspective is presented of earth as a warm, wet planet, that experiences frequent cold periods via climate history graphics of Earth's recent million years of climate variation, from paleoclimate research. The hydrological cycle is described, and its relevance to fisheries is made clear. Climate-related dynamics have had serious consequences in evolution of species, society and fisheries variability. Both production variabilities and changes in vulnerability due to constant dynamics of ocean motion affects are described. The records available for major fisheries are interpreted as we understand them from a century of in-depth research and analysis of various proxies, in particular, bioindicators. The history of climate as it relates to fisheries is addressed. The various spatial and temporal scales that are reflected in fisheries responses are described in an attempt to isolate weather from climate, or other events. Regional ecological responses to climate change are reviewed. Examples are given for the main ocean ecosystems, as defined by seasonal thermal properties. Synchrony and systematic

transitions are discussed. Several forecast approaches are described, and their similar conclusions merged to provide a realistic expectation over the next few decades, and beyond. Likely impacts are ranked by fishery system type, and coping measures identified, where they are known, emphasizing the role of humans in habitat protection and maintenance of options.

Sharp, G.D. Future climate change and regional fisheries: a collaborative analysis. FAO Fisheries Technical Paper. No. 452. Rome, FAO. 2003. 75p.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/006/Y5028E/Y5028E00.HTM>





FAO Fisheries and Aquaculture Climate Change Publications

Forecasted impacts of climate change on commercial fish species based on predictive-modeling



The main objective of the study was to develop a predictive model based on the observable correlation between well-known climate indices and fish production, and forecast the dynamics of the main commercial fish stocks for 5-15 years ahead. Populations of the most commercially important Atlantic and Pacific fish species - Atlantic and Pacific herring, Atlantic cod, European, South African, Peruvian, Japanese and Californian sardine, South African and Peruvian anchovy, Pacific salmon, Alaska pollock, Chilean jack mackerel and some others - undergo long-term simultaneous oscillations. Total catch of these species accounts for about 50% of total fish harvest over Atlantic and Pacific. It was found that the dynamics of global air surface temperature anomaly (dT), although in correlation with the long-term dynamics of marine fish production, is of poor predictive significance because of high inter-annual variability and a long-term trend. The Atmospheric Circulation Index (ACI), characterizing the dominant direction of air mass transport, is less variable and in closer correlation with the long-term fluctuations of the main commercial stocks ($r = 0.70-0.90$). Spectral analysis of the time series of dT, ACI and Length Of

Day (LOD) estimated from direct observations (110-150 years) showed a clear 55-65 year periodicity. Spectral analysis of the reconstructed time series of the air surface temperatures for the last 1500 years suggested the similar (55-60 year) periodicity. Analysis of 1600 years long reconstructed time series of sardine and anchovy biomass in Californian upwelling also revealed a regular 50-70 years fluctuation. Spectral analysis of the catch statistics of main commercial species for the last 50-100 years also showed cyclical fluctuations of about 55-years. These relationships were used as a basis for a stochastic model intended to forecast the long-term fluctuations of catches of the 12 major commercial species for up to 30 years ahead. According to model calculations, the total catch of Atlantic and Pacific herring, Atlantic cod, South African sardine, and Peruvian and Japanese anchovy for the period 2000-2015 will increase by approximately two million tons, and then decrease. During the same period, the total catch of Japanese, Peruvian, Californian and European sardine, Pacific salmon, Alaska pollock and Chilean jack mackerel is predicted to decrease by about four million tons, and then increase. In the next 15 years, total catch of main commercial species in the North Pacific is predicted to decline by 1.5 -2 million tons, while in the North Atlantic it is predicted to increase by about 1.7 -2 million tons. The probable scenario of climate and biota changes for next 50-60 years is considered.

Klyashtorin, L.B. Climate change and long-term fluctuations of commercial catches: the possibility of forecasting. FAO Fisheries Technical Paper. No. 410. Rome, FAO. 2001. 86p

The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/005/y2787e/y2787e00.htm>





Food and Agriculture Organization
of the United Nations

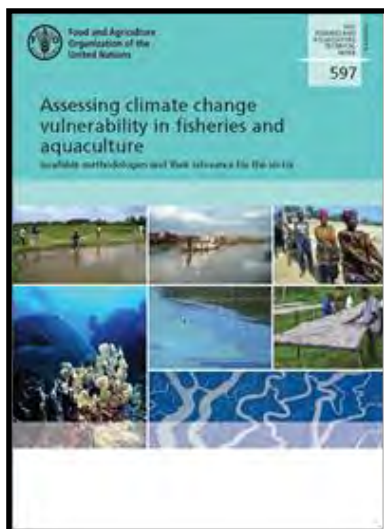
FAO Fisheries and Aquaculture Climate Change Publications

Understanding Vulnerability Climate Change in Fisheries and Aquaculture



FAO Fisheries and Aquaculture Climate Change Publications

Vulnerability assessment methodologies and their relevance to fisheries and aquaculture



From relatively limited and narrow uses two decades ago, the concept of vulnerability has emerged as a key dimension of the development debate. Be it in relation to climate change, disasters, globalization and economic development, and social–ecological system changes more generally, vulnerability is a complex and multifaceted concept that has attracted the attention of scholars and development practitioners from all disciplines. The many interpretations of vulnerability and its many scales (e.g. individual, community, ecosystem, countries, continents) and fields of application have led to a wide array of propositions regarding ways and means by which vulnerability could be studied, characterized, understood, and acted upon. This multiplication of approaches and methodologies of assessment has enabled new insights into the causes and consequences of vulnerability, but has also caused some confusion among practitioners and led to the voicing of a need for clarification and guidance on how best to approach the study of vulnerability. This publication provides

an overview of vulnerability assessment concepts and methodologies. It sheds light on the different vulnerability assessment methodologies that have been developed, and on how these are conditioned by the disciplinary traditions from which they have emerged. It also analyses how these methodologies have been applied in the context of fisheries and aquaculture, with illustrative examples of their application. A series of practical steps to assess vulnerability in the fisheries and aquaculture sector is proposed in order to support climate change specialists working with communities dependent on fisheries and aquaculture, as well as fisheries and aquaculture practitioners wishing to incorporate adaptation planning into the sector's management and development.

Brugère, C and De Young, C. 2015. Assessing climate change vulnerability in fisheries and aquaculture: Available methodologies and their relevance for the sector. FAO Fisheries and Aquaculture Technical Paper No. 597. Rome, Italy. 86 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-i5109e.pdf>



FAO Fisheries and Aquaculture Climate Change Publications

Community-based vulnerability assessment in the Benguela Current Large Marine Ecosystem's fishing-dependent communities



Climate change is considered one of the most critical challenges facing the planet and humankind. It poses a key threat to marine ecosystems and fisheries resources as well as communities that depend on these systems for food and livelihoods. Understanding the vulnerability of these socio-ecological systems to climate change, and their capacity to adapt, has become the focus of several climate change and fisheries projects and programmes in recent years and, increasingly, researchers and practitioners recognise that actions supporting adaptive capacity building have to be grounded in local needs and experiences and thus vulnerability assessments should be participatory and inclusive. A good understanding of local vulnerabilities, including local perceptions of the multiple drivers of change, historic and customary adaptation strategies, and existing capacity within local institutions and amongst individuals, should be used as building blocks for strengthening resilience and identifying appropriate adaptation strategies. Participatory vulnerability assessment is an approach that facilitates

better understanding of the extent to which a socio-ecological system (e.g. coastal fishery system) is susceptible to various socio-ecological changes (including the effects of climate change) and the system's capacity to cope with and adapt to these changes from the viewpoint of the local communities. This analysis will help countries, partner agencies and their staff, researchers and fisheries professionals in understanding how to define and measure vulnerability within complex fisheries systems, using perceptions-based approaches within fishing communities in the Benguela Current region (Angola, Namibia, South Africa) as an example. Ultimately, the scope of this work is to improve resilience of fisheries systems and dependent communities to multiple drivers of change including climate change and ocean acidification.

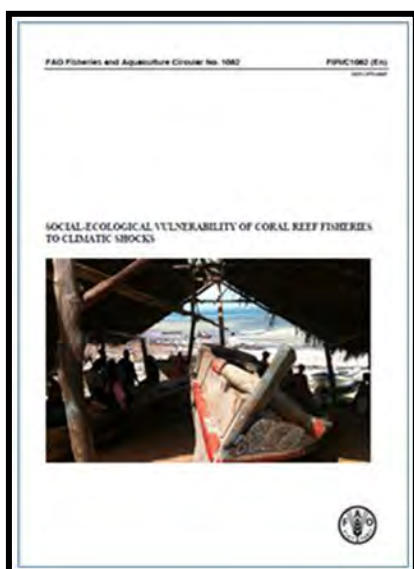
Raemaekers, S. & Sowman, M. 2015. Community-level socio-ecological vulnerability assessments in the Benguela Current Large Marine Ecosystem. FAO Fisheries and Aquaculture Circular No. 1110. Rome, FAO. 120 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-i5026e.pdf>



FAO Fisheries and Aquaculture Climate Change Publications

Understanding social-ecological vulnerability of coral reef fisheries to climatic shocks



This circular examines the vulnerability of coral reef social-ecological communities to one effect of climate change, coral bleaching. The objective was to develop and test in Kenya a community-level vulnerability assessment approach that incorporated both ecological and socio-economic dimensions of vulnerability in order to target and guide interventions to reduce vulnerability. In addition to a range of direct threats such as siltation, overfishing and coral disease, coral reefs are now threatened by climate change. Climate impacts on coral reefs and associated fisheries include: increasing seawater temperatures; changes in water chemistry (acidification); changes in seasonality; and increased severity and frequency of storms, which affect coral reef ecosystems as well as fisheries activities and infrastructure. Coral bleaching and associated coral mortality as a result of high seawater temperatures is one of the most striking impacts of climate change that has been observed to date. As warming trends

continue, the frequency and severity of bleaching episodes are predicted to increase with potentially fundamental impacts on the world's coral reefs and on the fisheries and livelihoods that depend on them. The analysis presented in this circular combined ecological vulnerability (social exposure), social sensitivity and social adaptive capacity into an index of social-ecological vulnerability to coral bleaching. All three components of vulnerability varied across the sites and contributed to the variation in social-ecological vulnerability. Comparison over time showed that adaptive capacity and sensitivity indices increased from 2008 until 2012 owing to increases in community infrastructure and availability of credit. Disaggregated analysis of how adaptive capacity and sensitivity varied between different segments of society identified the young, migrants and those who do not participate in decision-making as having both higher sensitivity and lower adaptive capacity and, hence, as being the most vulnerable to changes in the productivity of reef fisheries.

Cinner, J., McClanahan, T., Wamukota, A., Darling, E., Humphries, A., Hicks, C., Huchery, C., Marshall, N., Hempson, T., Graham, N., Bodin, Ö., Daw, T. & Allison, E. 2013. Social-ecological vulnerability of coral reef fisheries to climatic shocks. FAO Fisheries and Aquaculture Circular No. 1082. Rome, FAO. 63 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/018/ap972e/ap972e.pdf>





FAO Fisheries and Aquaculture Climate Change Publications

Global Expert Workshop on Assessing Climate Change Vulnerability in Fisheries and Aquaculture: Available Methodologies and their Relevance for the Sector



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 programs. 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 programs in fisheries and aquaculture in the face of climate change.

FAO. 2013. 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. FAO Fisheries and Aquaculture Report No. 1047. Rome. 29 pp.

*The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/018/i3357e/i3357e.pdf>*





FAO Fisheries and Aquaculture Climate Change Publications

Report of the Regional Workshop on Assessing Climate Change Vulnerability in Benguela Fisheries and Aquaculture



The purpose of the Benguela Current Large Marine Ecosystem Regional Workshop on Assessing Climate Change Vulnerability in Fisheries and Aquaculture was to present an initial review of the biophysical and biological implications of climate variability and change on the region's fisheries; review the latest stages in research on and application of climate variability and change vulnerability methodologies and discuss their appropriateness to the region's adaptation planning needs; identify key elements of vulnerability for the region, including climate-related drivers of change and adaptive capacities along the entire fisheries and aquaculture value chains. Making the link between expert advice and practical use of vulnerability methodologies from around the globe with fisheries representatives from the region set the scene for fruitful discussions on how to develop vulnerability frameworks appropriate to the region, making the best use of existing information and evaluating means to collect needed information, particularly concerning social and economic vulnerability of the

region's fisheries and aquaculture.

FAO. 2013. FAO/BCC Regional Workshop on Assessing Climate Change Vulnerability in Benguela Fisheries and Aquaculture, Windhoek, Namibia, 11–13 April 2013. FAO Fisheries and Aquaculture Report. No. 1051. Rome. 66 pp.

*The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/018/i3389e/i3389e.pdf>*



FAO Fisheries and Aquaculture Climate Change Publications

An annotated bibliography on vulnerability assessment methodologies



This paper presents a comprehensive annotated bibliography of the most contemporary and seminal vulnerability methodologies from over the past decade, focusing particularly on vulnerability to climate change in the fisheries and aquaculture sector. The bibliography was developed as a background paper for an international expert workshop in Namibia in 2013 on climate change vulnerability methodologies, coordinated by FAO. A significant degree of confusion and debate surrounds vulnerability assessments and the methods through which vulnerability should be measured in order to provide an accurate assessment that can feed into effective policies and strategies for adaptation and vulnerability reduction. A clear and structured approach is presented in the annotated bibliography by dividing the paper into seven main sections: reviews, frameworks, drivers of change, scale, fishery and farming ecosystem, species and vessels, and special considerations. A comprehensive range of vulnerability methodologies has been incorporated in the annotated bibliography, crossing a multitude of scales, approaches and

disciplines. The paper identifies a number of important connections and links within the literature on vulnerability – developed through the use of subsections and by cross-referencing throughout the bibliography – further assisting in the clarification of vulnerability methodologies.

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. 43 pp.

The PDF publication can be downloaded from the following url:

<http://www.fao.org/3/a-i3315e.pdf>





Food and Agriculture Organization
of the United Nations

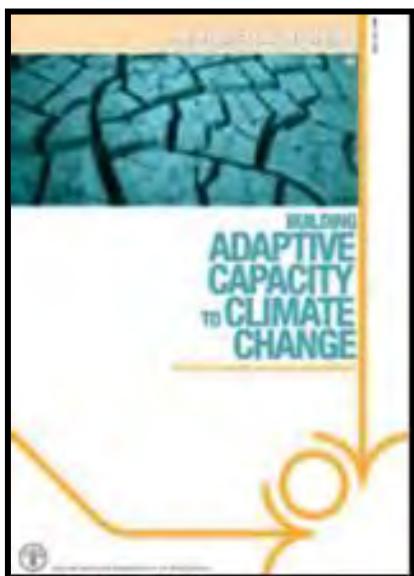
FAO Fisheries and Aquaculture Climate Change Publications

Supporting Adaptation in Fisheries and Aquaculture



FAO Fisheries and Aquaculture Climate Change Publications

Policy brief to support adaptive capacities to climate change



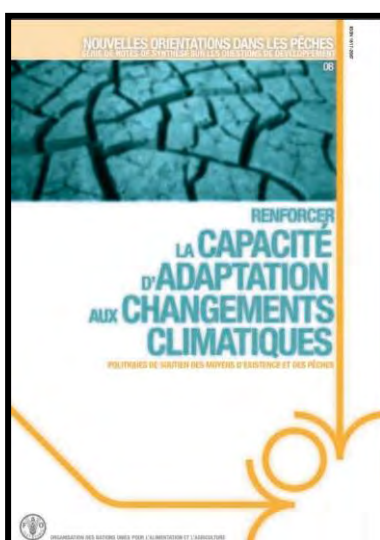
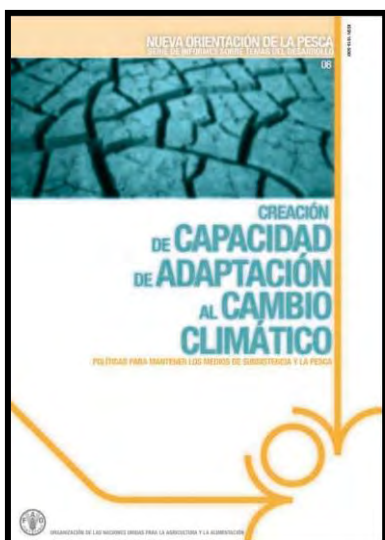
Fisheries ecosystems and fishing-based livelihoods are subject to a range of climate-related variability, from extreme weather events, floods and droughts, through changes in aquatic ecosystem structure and productivity, to changing patterns and abundance of fish stocks. Resource users and managers face continued challenges in responding to this variability. Human-induced climate change, which is likely to increase the frequency and magnitude of variability as well as potentially causing major shifts in ocean system productivity and surface freshwater availability, is going to make adaptation more difficult and costlier. There is increasing concern that, although climate outcomes cannot be precisely predicted, the shift in probability towards greater climate challenge is becoming clearer. Unless changes can be anticipated and brought rationally into local, national and international coping response, many of the world's development aims will be gravely compromised. This brief outlines our present state of knowledge on climate change and its links to fisheries. It presents a global analysis of the vulnerability of economies to possible climate-related changes in fisheries and

proposes policy responses to mitigate potential impacts, developed from existing coping and adaptation strategies.

FAO. 2007. Building adaptive capacity to climate change. Policies to sustain livelihoods and fisheries. New Directions in Fisheries – A Series of Policy Briefs on Development Issues. No. 08. Rome. 16 pp.

The PDF publication can be downloaded from the following url:

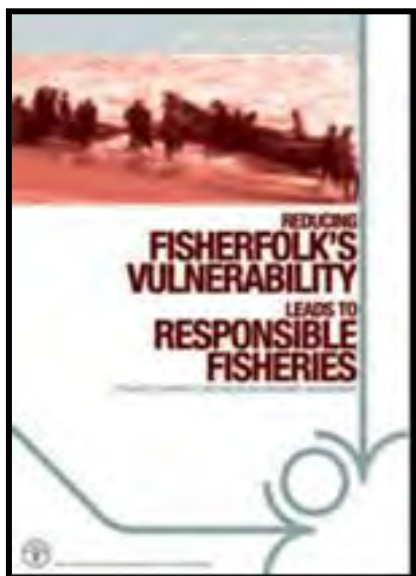
<http://www.fao.org/docrep/010/a1115e/a1115e00.pdf>





FAO Fisheries and Aquaculture Climate Change Publications

Policy brief to reduce fisherfolk's vulnerability

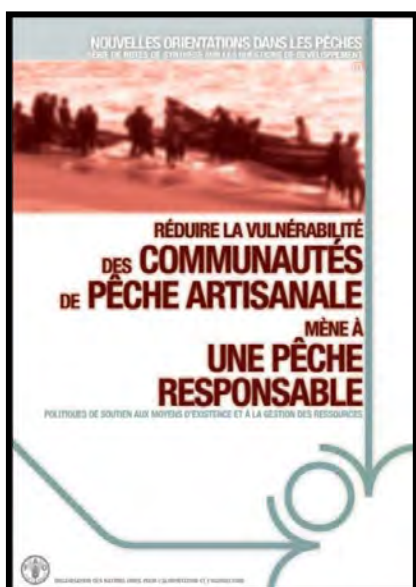


The aim of this policy brief is to 1) Highlight the different ways in which small scale fisheries currently contribute to poverty alleviation and food security, with a focus on West Africa. Propose that decreasing people's vulnerability and marginalization are key ways of reducing poverty among fishing-dependent people without putting additional pressure on fully- or over- exploited fishery resources; 2) Show that diminishing fisherfolk's vulnerability and marginalization will increase their incentives and capacity to participate in resource management; 3) Emphasize that reducing fisherfolk's vulnerability and supporting their social inclusion will help to enhance the flow of benefits from fisheries and increase the sector's contribution to pro-poor economic growth at local, national and regional levels; and 4) Outline response strategies and recommendations for national governments, donor and international organizations, and policy-makers in fisheries.

FAO. 2006. Reducing fisherfolk's vulnerability leads to responsible fisheries. Policies to support livelihoods and resource management. New Directions in Fisheries – A Series of Policy Briefs on Development Issues. No. 01. Rome. 12 pp.

The PDF publication can be downloaded from the following url:

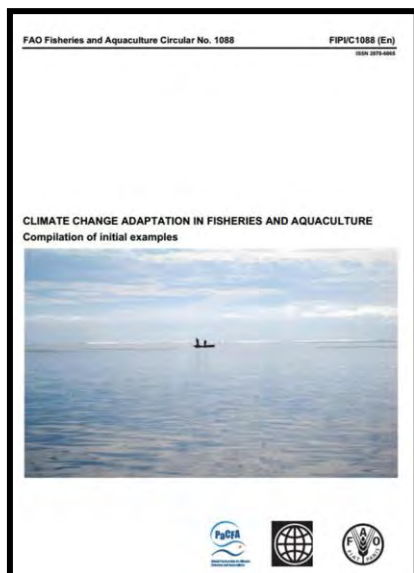
<ftp://ftp.fao.org/docrep/fao/012/a0228e/a0228e00.pdf>





FAO Fisheries and Aquaculture Climate Change Publications

Fisheries and aquaculture climate change adaptation examples



This circular contains a selection of current and recent climate change adaptation activities and measures in the fisheries and aquaculture sector. These examples provide an overview of the types of adaptation activities and programmes rather than a comprehensive review of adaptation activities addressing fisheries and/or aquaculture. Some of the highlighted activities are specifically targeted at addressing climate change impacts in fisheries or aquaculture, and others address related areas (e.g. coastal management and capacity building activities) that also have benefits for fisheries or aquaculture. In addition to specific examples, the publication provides an overview of climate change impacts on global fisheries and aquaculture and potential adaptation and mitigation strategies. Descriptions for 26 current or recent activities and programmes focused specifically on or benefiting fisheries and/or aquaculture (and other sectors if relevant), primarily in developing countries, highlight the diversity of potential adaptation actions at the local to regional scales. This

circular is intended to provide a starting point for planners, policy-makers and practitioners who are involved in sectors related to fisheries and aquaculture around the globe.

Shelton, C. 2014. Climate Change Adaptation in Fisheries and Aquaculture. FAO Fisheries and Aquaculture Circular C1088. Roma, FAO. 34 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/019/i3569e/i3569e.pdf>



FAO Fisheries and Aquaculture Climate Change Publications

Manual on the development of participatory environmental monitoring systems



Este documento describe el proceso para diseñar un sistema de monitoreo ambiental integrado en el Estero Real, Chinandega, Nicaragua entre el 2012 y 2014, tendiente a prevenir los efectos del cambio climático en las comunidades pesqueras y acuícolas más vulnerables y poner en práctica un sistema de alerta temprana ante las amenazas climáticas y otras asociadas a cambio climático. Se describe en forma especial la metodología que se utilizó para diseñar el manual incluyendo los estudios de procesos biofísicos necesarios para determinar estaciones de muestreo, frecuencia de muestreo y métodos de muestreo y análisis. También se incluyen las consultas ciudadanas y a los grupos interesados en la decisión de las amenazas más importantes y como estas se pueden abordar a través de variables y parámetros indicadores. El proceso también aborda la inclusión de alerta temprana para pescadores y acuicultores generada a través de la información colectada en el monitoreo ambiental integrado. El documento incluye además el manual de

monitoreo ambiental resultante comprendiendo los pasos y etapas del monitoreo, el procesamiento y análisis de los datos y la divulgación de los resultados. El proceso de elaboración del manual y el manual mismo pueden ser usados como ejemplos para replicar en otras localidades y situaciones para mejorar la capacidad de adaptación en la pesca y la acuicultura al cambio climático y otras amenazas ambientales. El trabajo técnico y desarrollo del proceso y manual estuvieron a cargo de los expertos del Instituto CIDEA de la Universidad Centro Americana con el apoyo de INPESCA, MARENA, INETER y MAGFOR, y con la cooperación técnica y apoyo de FAO.

FAO. 2016. Desarrollo de un sistema de monitoreo ambiental para mejorar la prevención y capacidad de adaptación al cambio climático de las comunidades pesqueras y acuícolas: caso de estudio estero real Nicaragua. FAO Fisheries and Aquaculture Circular No. 1112. Rome, Italy.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-i5509s.pdf>



FAO Fisheries and Aquaculture Climate Change Publications

Review of fisheries and aquaculture in National Adaptation Programs of Action



The main purpose of this review is to support least-developed countries (LDC), development partners and donors in planning and implementing climate change adaptation actions for the fisheries and aquaculture sector. In particular, it is aimed at the LDCs eligible for support from the Least Developed Countries Fund (LDCF) (operated by the Global Environment Facility [GEF]), the GEF and its Agencies and the United Nations Framework Convention on Climate Change (UNFCCC) LDC Expert Group (LEG). This desk study analyses the existing national adaptation programmes of action (NAPAs) of LDCs to identify why and in what ways the sector has been identified as needing priority adaptation action and how this prioritization has transferred into actual projects through the LDCF. The report: familiarizes fisheries and aquaculture decision-makers in LDCs with the NAPA process and the means for NAPA implementation; reviews country priorities vis-à-vis the fisheries and aquaculture sector; and provides those in the climate change arena with an understanding of the particular needs and vulnerabilities of the sector. The ultimate goal of the circular is to

promote the inclusion of a traditionally under-represented but potentially highly vulnerable sector in the planning and implementation of climate change adaptation strategies.

Vadacchino, L.; De Young, C.; Brown, D. The fisheries and aquaculture sector in national adaptation programmes of action: importance, vulnerabilities and priorities. FAO Fisheries and Aquaculture Circular. No. 1064. Rome, FAO. 2011. 60 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/014/i2173e/i2173e.pdf>





Food and Agriculture Organization
of the United Nations

FAO Fisheries and Aquaculture Climate Change Publications

Regional and National Climate Change Priorities



FAO Fisheries and Aquaculture Climate Change Publications

Workshop on Climate Change, Disasters and Crises in the Fisheries and Aquaculture Sector in Southern and Eastern Africa



The purpose of the regional Workshop on Climate Change, Disasters and Crises in the Fisheries and Aquaculture Sector in Southern and Eastern Africa was to determine the gaps in adaptation and disaster risk management strategies, policies and activities that aim to assist fishers, fish farmers, fish workers and the communities they live in to improve their resilience to the impacts of disasters and climate change, and to identify ways to address these gaps based on the experience of the participants. The workshop was the second of two; the first focused on West and Central Africa. Together, they form part of the consultative process of Component C of the NEPAD-FAO Fish Programme (NFFP). The workshop addressed three main questions with respect to the fisheries and aquaculture sector and the impacts of disasters and climate change:

- what are the effects and vulnerabilities of climate change and disasters to the sector?
- what has the sector done to adapt (and what can we learn from this)?

– what else can be done (and how) to reduce vulnerability and strengthen resilience, and how do we prioritize action to adapt to climate change and strengthen resilience?

The workshop recommended disaster risk reduction and adaptation actions at the local, national and regional levels based on practical experiences and examples of actions that have worked, or not worked, in the past. The workshop outputs will be used to complement the mapping and gap-analysis paper that will, in turn, contribute to a work plan for Component C of the NFFP. The combined findings of this workshop and the mapping and gap analysis will be well placed to feed into the pan-African process of elaborating a comprehensive fisheries reform strategy and ensuring that climate change and disaster impacts are addressed for the fisheries and aquaculture sector.

FAO. 2014. Report of the FAO/NEPAD Workshop on Climate Change, Disasters and Crises in the Fisheries and Aquaculture Sector in Southern and Eastern Africa, Maputo, Mozambique, 22 to 24 April 2013. Rapport de l'Atelier FAO/NEPAD sur le changement climatique, les catastrophes et les crises dans le secteur des pêches et de l'aquaculture en Afrique australe et orientale, Maputo, Mozambique, 22-24 avril 2013. FAO Fisheries and Aquaculture Report/FAO Rapport sur les pêches et l'aquaculture No. 1055. Rome. 86 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-i3843b/index.html>



FAO Fisheries and Aquaculture Climate Change Publications

Workshop on Climate Change, Disasters and Crises in the Fisheries and Aquaculture Sector in West and Central Africa



The purpose of the regional Workshop on Climate Change, Disasters and Crises in the Fisheries and Aquaculture Sector in West and Central Africa was to contribute to a process that is currently under way to determine the gaps in adaptation and disaster risk management strategies, policies and activities that aim to assist fishers, fish farmers, fish workers and the communities they live in to improve their resilience to the impacts of disasters and climate change, and to identify areas to address these gaps based on the experience of the participants. The workshop was the first of two; the second will focus on Southern and Eastern Africa. Together, they form part of the consultative process of Component C of the NEPAD-FAO Fish Programme (NFFP). The workshop addressed three main questions in respect to the fisheries and aquaculture sector and the impacts of disasters and climate change: (i) what are the impacts on and the vulnerabilities of the sector; (ii) how has the sector adapted and what can be learned from this; and (iii) what else can be done (and how) to reduce vulnerability and strengthen resilience? The

workshop recommended adaptation actions at the local, national and regional levels based on practical experiences and examples of actions that have worked or not in the past. The workshop outputs will be used to complement the mapping and gap-analysis paper towards a work plan for Component C of the NFFP. The combined findings of this workshop, the forthcoming one for Southern and Eastern Africa and the mapping and gap analysis will be well placed to feed into the pan-African process of elaborating a comprehensive fisheries reform strategy and ensuring that climate change and disaster impacts are addressed for the fisheries and aquaculture sector.

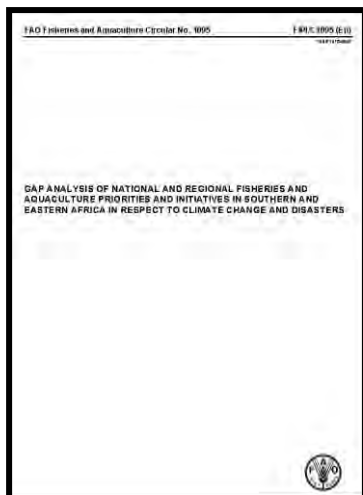
FAO. 2014. Report of the FAO/NEPAD Workshop on Climate Change, Disasters and Crises in the Fisheries and Aquaculture Sector in West and Central Africa, Accra, Ghana, 1–2 November 2012. FAO Fisheries and Aquaculture Circular No. 1037. Rome, FAO. 84 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/019/i3239b/i3239b.pdf>



FAO Fisheries and Aquaculture Climate Change Publications

Gap analysis of national and regional fisheries and aquaculture priorities and initiatives in Southern and Eastern Africa in respect to climate change and disasters



The objective of the study was to identify regional and national gaps and opportunities to reduce the vulnerability of the sector to impacts from climate change and increase the resilience of fisheries and aquaculture livelihoods to disasters. The identification of gaps and opportunities were made through a combination of a survey, website searches and reviews of documents – including policies, strategies or agreements – that contain fisheries/aquaculture and climate change adaptation (CCA)/disaster risk management (DRM) aspects. Identified national and regional priorities were compared to actions in place and thus gaps were identified. A total of 24 countries, 16 of which are least developed countries (LDCs), were considered for Southern and Eastern Africa. A regional workshop on climate change, disasters and crises in the fisheries and aquaculture sector in Southern and Eastern Africa was held in Maputo, Mozambique on 22–24 April 2013 to provide input into the gap analysis process and provide recommendations for addressing

climate change adaptation and disaster risk management in fisheries and aquaculture. Overall, 39 gaps or recommendations were identified. These are presented in respect to the four areas of adaptation and disaster risk management action, namely: strengthened governance to address disasters and climate change impacts affecting fisheries and aquaculture; addressing and reducing underlying risks through prevention and adaptation measures; managing effective response and improving preparedness for disasters and climate change; and improved early warning systems and availability of information.

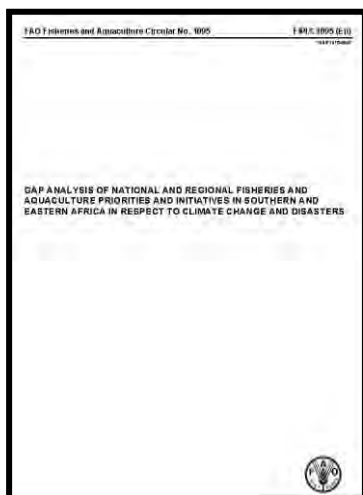
Davies, S., Sheridan, S., Hjort, A. and Boyer, H. 2014. Gap analysis of national and regional fisheries and aquaculture priorities and initiatives in Southern and Eastern Africa in respect to climate change and disasters. FAO Fisheries and Aquaculture Circular No. 1095. Rome, FAO. 100 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-i3756e.pdf>



FAO Fisheries and Aquaculture Climate Change Publications

Gap analysis of national and regional fisheries and aquaculture priorities and initiatives in Western and Central Africa in respect to climate change and disasters



The objective of the study was to identify regional and national gaps and opportunities to reduce the vulnerability of the sector to impacts from climate change and increase the resilience of fisheries and aquaculture livelihoods to disasters. The identification of gaps and opportunities were made through a combination of a survey, website searches and reviews of documents – including policies and strategies – that contain fisheries/aquaculture and climate change adaptation (CCA)/disaster risk management (DRM) aspects. Identified national and regional priorities were compared to actions in place and thus gaps were identified. A total of 23 countries, 16 of which are least developed countries (LDCs), were considered for Western and Central Africa. A regional workshop on climate change, disasters and crises in the fisheries and aquaculture sector in Western and Central Africa was held in Accra, Ghana on 1–2 November 2012 to provide input into the gap analysis process and provide recommendations for addressing climate

change adaptation and disaster risk management in fisheries and aquaculture. Overall, 27 gaps or recommendations were identified. These are presented in Chapter 4, with reference to their source and in respect to the four areas of adaptation and disaster risk management action, namely: strengthened governance to address disasters and climate change impacts affecting fisheries and aquaculture; addressing and reducing underlying risks through prevention and adaptation measures; managing effective response and improving preparedness for disasters and climate change; and improved early warning systems and availability of information..

Davies, S., Sheridan, S., Hjort, A. and Boyer, H. 2014. Gap analysis of national and regional fisheries and aquaculture priorities and initiatives in Southern and Eastern Africa in respect to climate change and disasters. FAO Fisheries and Aquaculture Circular No. 1094. Rome, FAO. 107 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-i3753e.pdf>



FAO Fisheries and Aquaculture Climate Change Publications

Proceedings on disaster risk management and priority adaptations to climate change and for CARICOM and Caribbean fisheries and aquaculture



Fisheries and aquaculture are important to the lives and livelihoods of people in the Caribbean region for quality animal protein, essential fatty acids, vitamins and minerals, food security and income (personal and national). People involved in the sector are, however, vulnerable to climate change and disasters including hurricanes, floods, earthquakes and disease outbreaks. The regional workshop on the Formulation of a strategy, action plan and programme proposal on disaster risk management and climate change adaptation in fisheries and aquaculture in the CARICOM and Wider Caribbean Region was held in Kingston, Jamaica, from 10 to 12 December 2012. The workshop brought together 65 local, national and regional stakeholders involved in fisheries, aquaculture, disaster risk management (DRM) and climate change adaptation (CCA), including the Caribbean Regional Fisheries Mechanism (CRFM), the Western Central Atlantic Fishery Commission (WECAFC), the Caribbean Disaster Emergency Management Agency (CDEMA) and

the Caribbean Community Climate Change Centre (CCCCC). Workshop discussions largely focused on reviewing and refining three documents prepared for the workshop: an assessment study on the impact of climate change and disasters on the fisheries and aquaculture sector in the CARICOM region; a strategy and action plan for integrating DRM and CCA into fisheries and aquaculture (as well as the reverse); and a results-based programme proposal. These proceedings include the report of the regional workshop and an assessment study on the impact of climate change and disasters on the fisheries and aquaculture sector in the CARICOM region. The strategy, action plan and programme proposals are published as separate documents. The workshop recommended that the strategy, action plan and programme proposal be finalized and implemented to strengthen regional and national cooperation and develop capacity in addressing climate change impacts and disasters in fisheries and aquaculture.

McConney, P., Charlery, J., Pena, M., Phillips, T., Van Anrooy, R., Poulain, F., Bahri, T. 2015. Disaster risk management and climate change adaptation in the CARICOM and wider Caribbean region – Formulating a strategy, action plan and programme for fisheries and aquaculture. Regional workshop 10–12 December 2012, Kingston, Jamaica. FAO Fisheries and Aquaculture Proceedings. No. 35. Rome. 123 pp.

*The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-i4369e.pdf>*



FAO Fisheries and Aquaculture Climate Change Publications

Proceedings on priority adaptations to climate change for Latin American fisheries and aquaculture



Estas Actas reúnen casos de estudio y las deliberaciones de un taller regional de expertos que llevó a cabo del 5 al 7 de octubre de 2011, en el Centro de Investigación Oceanográfica en el Pacífico Sur Oriental (COPAS) de la Universidad de Concepción, Concepción, Chile. El taller tuvo como principal objetivo ofrecer una perspectiva regional inicial para América Latina sobre los posibles impactos y potencial de adaptación al cambio climático en la pesca y la acuicultura, además de discutir y acordar recomendaciones regionales para fortalecer la adaptación a nivel nacional y local y fortalecer la colaboración regional. En la reunión se presentaron y discutieron tres casos de estudio provenientes de ambientes diversos; uno en una zona costera tropical, el Golfo de Fonseca en Centro América (Nicaragua, Honduras y El Salvador), el segundo en la provincia de Loreto cubriendo una parte del Alto Amazonas en Perú representando las aguas continentales y el tercero dividido en dos capítulos representando la situación de los ambientes marinos asociados a la corriente de Humboldt y la Patagonia. Adicionalmente se presentó un estudio sobre la vulnerabilidad de las costas de América latina y el Caribe. El Taller permitió además recoger

otras experiencias de países y de cuencas en la región para ofrecer un panorama de diagnóstico preliminar más completo. Las presentaciones y discusiones dejaron en evidencia que el cambio climático presenta una amenaza para la pesca y la acuicultura. El taller recomendó mejorar la preparación y adaptación a la variabilidad climática como una estrategia que recogería más apoyo entre los grupos interesados y las instituciones puesto que es una necesidad que se percibe como inmediata, sin embargo los fenómenos y tendencias de largo plazo no deben desconocerse. Es necesario lograr mayor coordinación entre las instituciones que lideran las actividades de cambio climático, ubicadas usualmente en los ministerios o unidades de medio ambiente, con los ministerios e instituciones del sector pesca. El taller también recomendó incrementar la integración y el empoderamiento de las entidades con incidencia en el tema dentro del sector acuícola y pesquero, y generar una mayor integración con otros organismos relevantes (por ejemplo seguridad alimentaria, prevención de riesgo de desastres). Se requiere además incrementar los esfuerzos para difundir y concientizar sobre los potenciales efectos del cambio climático y requerimientos de adaptación a niveles locales (comunidades de pescadores y acuicultores) incluyendo a las mujeres y grupos minoritarios.

Soto, D y Quiñones, R. 2013. Cambio climático, pesca y acuicultura en América Latina: Potenciales impactos y desafíos para la adaptación. Taller FAO/Centro de Investigación Oceanográfica en el Pacífico Sur Oriental (COPAS), Universidad de Concepción, Concepción, Chile. FAO Actas de Pesca y Acuicultura. No. 29. Roma, FAO. 335 pp.

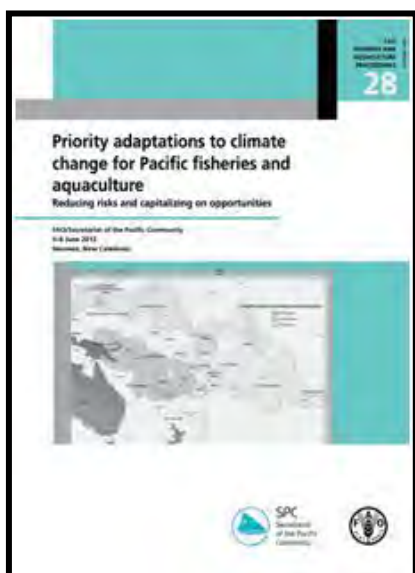
The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/018/i3356s/i3356s.pdf>





FAO Fisheries and Aquaculture Climate Change Publications

Proceedings on priority adaptations to climate change for Pacific fisheries and aquaculture



This publication includes: (i) a summary of the technical presentations provided on the implications of climate change for Pacific fisheries and aquaculture; and (ii) the outcomes of discussions by participants on the priority adaptations that Pacific island countries and territories (PICTs) can implement to reduce risks and take advantage of opportunities. The Workshop was hosted by Secretariat of the Pacific Community (SPC) as the culmination of 3.5 years of work to assess the vulnerability of Pacific fisheries and aquaculture to climate change. It also formed part of a series of climate change awareness-raising and adaptation planning workshops around the globe financed through a Japanese-funded, and FAO-implemented, project “Climate Change, Fisheries and Aquaculture: Understanding the Consequences as a Basis for Planning and Implementing Suitable Responses and Adaptation Strategies” (GCP/INT/253/JPN). The technical presentations and range of possible adaptations and supporting policies presented were based on SPC publications. Discussions focused on priority

adaptations for economic development and government revenue, food security and sustainable livelihoods for Melanesian, Micronesian and Polynesian nations. The adaptations identified reflect the different fisheries participation rates and importance of fish to economic development and as a source of local food and income in these different regions. The Workshop discussions recommended immediate action by all PICTs to manage fisheries resources sustainably now and into the future, to establish systems to minimize impacts of various drivers facing the sector now and from future climate change, and to capitalize on opportunities. Cooperation between PICTs and partnerships among governments, regional and international organizations and communities were highlighted as important ways to implement effective adaptation.

Johnson, J., Bell, J. & De Young, C. 2013. Priority adaptations to climate change for Pacific fisheries and aquaculture: reducing risks and capitalizing on opportunities. FAO/Secretariat of the Pacific Community Workshop, 5–8 June 2012, Noumea, New Caledonia. FAO Fisheries and Aquaculture Proceedings No. 28. Rome, FAO. 109 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/017/i3159e/i3159e.pdf>





FAO Fisheries and Aquaculture Climate Change Publications

Proceedings on priority adaptations to climate change for Benguela Current fisheries



These Proceedings include the Report of, and the background papers prepared for, the Workshop on Climate Change Implications for Fisheries of the Benguela Current Region: Making the Best of Change. Presentation topics included: the regional biophysical features and decadal trends in the Benguela Current Large Marine Ecosystem (BCLME); national contexts of climate variability and change and fisheries; and a vulnerability assessment of the region's fisheries. Discussions largely focused on: aspects of developing a methodology for vulnerability assessment; definition of vulnerability in a fisheries context; potential climate change impacts on, and vulnerability levels of, the different fisheries in the region; and potential short- and medium-term adaptation actions. The Workshop recommended that a regional programme be developed with the aim of reducing vulnerability and increasing adaptive capacity of the social-ecological fisheries systems of the BCLME, primarily focusing on: establishing/improving national and regional interagency collaboration and communication to facilitate responses and action in relation to climate change; developing a

holistic and coherent methodology for vulnerability assessment of fisheries; developing and implementing pilot projects to develop and test anticipatory and responsive actions, providing for lesson learning/sharing and improvements.

De Young, C., Hjort, A., Sheridan, S. & Davies, S. Climate change implications for fisheries of the Benguela Current region – Making the best of change. FAO/Benguela Current Commission Workshop, 1–3 November 2011, Windhoek, Namibia. FAO Fisheries and Aquaculture Proceedings. No. 27. Rome, FAO. 2012. 125 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/017/i3053e/i3053e.pdf>





FAO Fisheries and Aquaculture Climate Change Publications

Proceedings on priority adaptations to climate change for Lake Chad Basin fishing communities



These Proceedings include (1) the report of and (2) the background paper prepared for the Workshop on climate change implications for fishing communities in the Lake Chad Basin: What have we learned and what can we do better? The Workshop was hosted by the Lake Chad Basin Commission (LCBC) from 18 to 20 November 2011, attended by the Lake Chad Basin countries of Cameroon, Central African Republic (CAR), Chad, Niger and Nigeria, and financed through a Japanese-funded, and Food and Agriculture Organization of the United Nations (FAO)-implemented, project component on Fisheries management and marine conservation within a changing ecosystem context (GCP/INT/253/JPN), in collaboration with LCBC. Presentation topics included: the hydrology of the Lake Chad region, national contexts of climate change and fisheries, identification and reduction of climate change vulnerability in the fisheries of the Lake Chad Basin and an overview of current projects on Lake Chad. Discussions largely focused on: hydrology and climate trends of the Lake Chad basin, national

perspectives on impacts and adaptations of climate change, current natural resources projects in the Lake Chad Basin and recommendations for actions to increase adaptability and resilience to be carried out. The Workshop recommended that there is more coordinated action and information sharing regarding natural resources, and increased cooperation between LCBC member State governments to support and strengthen existing political commitments in the Lake Chad Basin for effective aquatic resource use management to ensure sustainable development of land and aquatic based activities in the basin.

De Young, C.; Sheridan, S.; Davies, S.; Hjort, A. Climate Change implications for fishing communities in the Lake Chad Basin. FAO/Lake Chad Basin Commission Workshop, 18–20 November 2011, N'djamena, Chad. FAO Fisheries and Aquaculture Proceedings. No. 25. Rome, FAO. 2012. 84 pp.

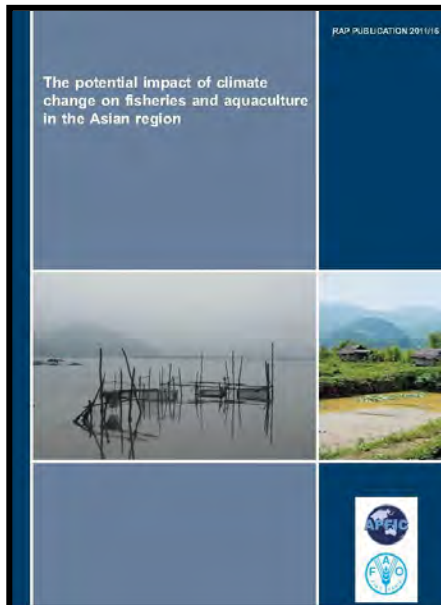
The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/017/i3037e/i3037e.pdf>





FAO Fisheries and Aquaculture Climate Change Publications

Potential impacts of climate change on fisheries and aquaculture in the Asian region



The impacts of climate change are likely to be far from uniform and it is expected that the Asian region will face very specific and locally variable challenges. Certain trends and impacts may be more pronounced in Asia (e.g. temperature increases are likely to be above the global norm in many parts of the region; a number of important river basins in Asia are threatened by further water stress; people in the region are likely to be disproportionately impacted by flooding; biodiversity loss will be greater in the tropics). Understanding the challenges and opportunities that climate change will pose to the fisheries sector in the Asian region will be crucial if governments hope to minimize negative impacts and buffer the impacts of climate change on some of the most vulnerable sections of society that are dependent on this sector. This document examines the significance of climate change for the fisheries sector in Asia and reviews what steps could be taken to minimize negative impacts as well as capitalize on potential opportunities. Drawing from the available literature some conclusions are

drawn regarding the: impact of climate change on Asia; implications of this to the fisheries sector in Asia; – significance of these findings to policy makers; and kind of action that should be taken to respond to potential challenges and opportunities

G. Sriskanthan and S. Funge-Smith. 2011. The potential impact of climate change on fisheries and aquaculture in the Asian region. RAP PUBLICATION 2011/16.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-ba0083e.pdf>



FAO Fisheries and Aquaculture Climate Change Publications

Proceedings on priority adaptations to climate change for fisheries and aquaculture in the Asia-Pacific region



Fisheries and aquaculture in Asia provide considerable trade, employment and food security and some of the densest rural populations of the world are found on coastlines and floodplains of the region. Impacts from climate change such as increasing ocean acidification, shifting fish distributions and more frequent cyclones may increase the negative impacts on capture fisheries which are already at their limits through over exploitation, coastal degradation and pollution. Productivity and viability in aquaculture operations are also expected to be negatively impacted by factors including higher sea water levels, flooding, increased competition for water resources and disease occurrence patterns. Climate change is expected to contribute to increasing disruptions to aquatic and coastal systems upon which many millions of Asian people depend and it is vital that governments in the region understand the risks, identify vulnerable systems and develop adaptive strategies. Increased policy attention and financial resources for climate change

adaptation and mitigation in the fisheries/aquaculture sector are urgently needed; and the marine fishery and aquaculture sectors need to be closely integrated into national climate change policies. It is therefore essential that the interactions between capture fisheries and aquaculture, along with other sectors such as agriculture and disaster management are integrated into the policy planning processes. This workshop report provides recommendations for member countries and partner organizations to take timely actions to address climate change issues related to the fisheries and aquaculture sectors. These cover the strengthening of climate change related policies for the fisheries and aquaculture sectors, the allocation of financial resources, the strengthening of governance and the use of integrated management approaches and monitoring tools. The workshop highlighted the involvement of all the relevant stakeholders in the fisheries and aquaculture sectors, especially the most vulnerable. These recommendations aim to strengthen the fisheries and aquaculture sectors in the Asia and the Pacific region by promoting better preparedness for climate related change.

FAO. APFIC/FAO Regional consultative workshop “Implications of climate change on fisheries and aquaculture: challenges for adaptation and mitigation in the Asia-Pacific Region” 24–26 May 2011, Kathmandu, Nepal. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication 2011/17, 52 pp.

The PDF publication can be downloaded from the following url:

<http://www.apfic.org/downloads/finish/49-climate-change/310-apfic-fao-regional-consultative-workshop-implications-of-climate-change-on-fisheries-and-aquaculture-challenges-for-adaptation-and-mitigation-in-the-asia-pacific-region.html>





FAO Fisheries and Aquaculture Climate Change Publications

Proceedings on adapting to climate change: the ecosystem approach to fisheries and aquaculture in the Near East and North Africa region



A workshop was held in December 2009 with Member Countries and with the purpose of: developing awareness among Member Countries and stakeholders of the need for the ecosystem approach to fisheries and aquaculture and of its implementation on the basis of the best available knowledge and information; strengthening capacity among the Near East and North Africa countries for planning and implementation of the ecosystem approach to fisheries and aquaculture; improving knowledge and awareness of the current and future implications of climate change for fisheries and aquaculture; and providing guidance on best practices for adaptive planning and management, and adaptive strategies in general, for coping with climate change.

Curtis, L.; Beveridge, M.C.M.; el-Gamal, A.R.; Mannini, P. (eds). *Adapting to climate change: the Ecosystem Approach to Fisheries and Aquaculture in the Near East and North Africa Region – Workshop Proceedings*. FAO Fisheries and Aquaculture Circular. No. 1066. Rome, FAO. 2011. 130p.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/014/i2146e/i2146e.pdf>





FAO Fisheries and Aquaculture Climate Change Publications

Report of the First Meeting of the Canary Current Large Marine Ecosystem Climate Change Working Group



The First Meeting of the Climate Change Working Group was held in Saly, Senegal from 11th to 13th of May 2011. The members of the working group had been nominated by the CCLME participating countries and partner institutions. The overall aim of the meeting was for the working group to agree on the outline of a document on climate change impacts and adaptation and mitigation strategies for the CCLME, to identify suitable potential project activities to address identified climate change issues, to assign responsibilities within the group and to agree on a work plan for the period 2011-2012 taking into consideration the expected date for the adoption of the TDA (November 2012). Two groups were formed in order to identify priority issues and their causes and recommended domains of intervention regarding climate change impacts on marine living resources; and on biodiversity, habitat and water quality in the CCLME area. The working groups defined a number of priority areas of intervention in need of additional funds. These focused on the need for improved observation systems; further analysis and modelling of existing data; vulnerability mapping in priority areas

for the CCLME; review and strengthening of National Adaptation Plans of Action (NAPAs) with regards to fisheries; and mangrove restoration / alternative energy sources. The meeting also agreed on a draft outline for the document on climate change impacts and adaptation and mitigation strategies for the CCLME as well as a 2011-2012 work plan for the working group with responsibilities assigned.

FAO. Report of the First Meeting of the Climate Change Working Group. 11-13 May 2011, Saly, Senegal. Protection of the Canary Current Large Marine Ecosystem Project (CCLME). 60 pp.

The PDF publication can be downloaded from the following url:

<http://www.canarycurrent.org/resources/publications/reports/climate-change-working-group-of-cclme/report-of-the-first-meeting-of-the-climate-change-working-group>



Food and Agriculture Organization
of the United Nations

FAO Fisheries and Aquaculture Climate Change Publications

Greenhouse gas emissions and mitigation potentials



FAO Fisheries and Aquaculture Climate Change Publications

Fuel and energy use in fisheries and aquaculture



The role of fuel and energy in the fisheries sector is an important yet so far little noted issue in natural resource, food and trade policy. While specific aspects of fuel use and cost have periodically concerned the fishing industry and its policy and management agents, the strategic issues of these have been relatively unquestioned until recently. However, in the midst of growing concern for rationalisation of fisheries management, for energy and greenhouse gas linkages in climate change mitigation, for competitive options for smaller scale producers, and for consumer appreciation of the environmental footprint of food choices, these issues deserve further exploration.

This review addresses the utilisation of fuel energy by the global fisheries industry. It explores the complete supply chain from aquatic raw materials to consumption, including capture fishing, aquaculture, post-harvest activities, distribution and retail presentation. This is the first such global overview, and although it has not been possible to set out complete and integrated value-chain perspectives, it provides initial data to demonstrate a range of critical characteristics and trends, with implications for sector development and relevant policy and strategic investment needs. As discussed more fully in the document, there are important interactions to consider in policy and practice, not just in ensuring the viability of the fisheries sector, but in linking energy cost with competition between capture fisheries and aquaculture, with choices of fishing methods or aquaculture systems, with implications for fishing effort, resource pressure and management strategies, and with the costs of making food available to consumers at all levels.

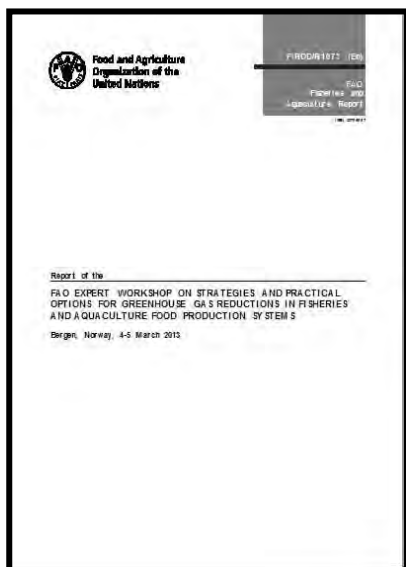
Muir, J.F. 2015. Fuel and energy use in the fisheries sector – Approaches, inventories and strategic implications. FAO Fisheries and Aquaculture Circular No. 1080. Rome, FAO. 86 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-i5092e.pdf>



FAO Fisheries and Aquaculture Climate Change Publications

Fisheries and aquaculture greenhouse gas mitigation potentials



This document contains the report of the Expert Workshop on Strategies and Practical Options for Greenhouse Gas Reductions in Fisheries and Aquaculture Food Production Systems, held in Bergen, Norway, 4-5 March 2013. The workshop was convened by the Director-General of the Food and Agriculture Organization of the United Nations, following a recommendation by the 29th session of the Committee on Fisheries (COFI) that FAO should provide Members with information on possible fishing industry contributions to climate change, and on ways to reduce the sector's reliance on, and consumption of, fossil fuels, respecting the principles embodied within the United Nations Framework Convention on Climate Change (UNFCCC). Financial and in-kind support for the Expert Workshop was provided by the Government of Norway, the FAO Regular Programme, Seafish, and other contributing participants.

FAO. 2015. Report of the Expert Workshop on Strategies and Practical Options for Greenhouse Gas Reductions in Fisheries and Aquaculture Food Production Systems. Bergen, Norway, 4-5 March 2013. FAO Fisheries And Aquaculture Report. No. R1073. Rome, FAO. 2014. 19 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/3/a-i4697e.pdf>



FAO Fisheries and Aquaculture Climate Change Publications

Report of the Expert Workshop on Greenhouse Gas Emissions Strategies and Methods in Seafood



This document contains the report of the Expert Workshop on Greenhouse Gas Emissions Strategies and Methods in Seafood held in Rome, Italy, from 23 to 25 January 2012. The Workshop was convened by the Director-General of the Food and Agriculture Organization of the United Nations, following a recommendation by the Twenty-ninth Session of the Committee on Fisheries that FAO should provide Members with information on possible fishing industry contributions to climate change, and on ways to reduce the sector's reliance on, and consumption of, fossil fuels, respecting the principles embodied within the United Nations Framework Convention on Climate Change. Financial and in-kind support for the Expert Workshop was provided by the Government of Norway, the FAO Regular Programme, Seafish, Dalhousie University and other contributing participants.

FAO. 2012. Report of the Expert Workshop on Greenhouse Gas Emissions Strategies and Methods in Seafood. Rome, 23–25 January 2012. FAO Fisheries and Aquaculture Report. No. 1011. Rome, FAO. 117 pp.

The PDF publication can be downloaded from the following url:
<http://www.fao.org/docrep/017/i3062e/i3062e00.htm>





FAO Fisheries and Aquaculture Climate Change Publications

A manual on fuel savings for small fishing vessels



The recent sharp increase in the price of fuel has had a major impact on the economics of operating fishing vessels. Fishing boat owners and operators struggle to meet this challenge and ask what measures can be taken to reduce the heavy burden of increased fuel cost. Litres of fuel required per tonne of fish landed varies widely depending on the fish species and fishing method used. Fuel saving methods have to be tailored to each fishing method and fishery. This manual aims to provide practical advice to fishing boat owners and crews, boatbuilders and boat designers and fisheries administrators on ways to reduce fuel costs. It focuses on small fishing boats measuring up to 16 m (50 ft) in length and operating at speeds of less than 10 knots. This covers the majority of the world's fishing boats. It also serves as a guide for those involved with fuel savings for small vessels used in support of aquaculture activities. The manual provides information to boat designers and boat builders on hull shape for low resistance and the selection of efficient propellers. The first chapters of this manual

deal with fuel saving measures that can be taken on existing boats without incurring major investment costs. The most effective measures include reducing boat service speed, keeping the hull and propeller free from underwater fouling and maintaining the boat engine. It also suggests that changing fishing methods can save fuel. The final chapters of this manual provide information regarding the fuel savings that are possible by changing from a 2-stroke outboard engine to a diesel engine, installing a diesel engine, and using sail. Selecting economic engine power on the basis of the waterline length and the weight of the boat is discussed. Advice is given on the choice of gear reduction ratio and of propeller related to service speed, service power and propeller rpm. Data are provided to assist with the design of a new fuel-efficient boat and the selection of an optimum propeller. The information contained in this manual is accompanied by many illustrations to make the main points more easily understood. Detailed background information is provided in the appendices. The appendices also contain blank tables that may be used to calculate potential fuel savings, cost of engine operation, the weight of a boat and the diameter and pitch of a propeller.

Gulbrandsen, O. 2012. Fuel savings for small fishing vessels – a manual. Rome, FAO. 57 pp.

The PDF publication can be downloaded from the following url:

<http://www.fao.org/docrep/017/i2461e/i2461e00.htm>





FAO Fisheries and Aquaculture Climate Change Publications

UN Rapid Assessment of Blue Carbon



Some 93% of the earth's carbon dioxide – 40Tt CO₂ – is stored in the oceans. In addition, oceans cycle about 90 Gt of CO₂ yr⁻¹, and remove over 30% of the carbon released to the atmosphere. Resilient aquatic ecosystems not only play a crucial role in binding carbon, they are also important to economic development, food security, social wellbeing and provide important buffers against pollution, and extreme weather events. Coastal zones are of particular importance, with obvious relations and importance to fisheries, aquaculture, livelihoods and settlements – over 60% of the world's population is settled in the coastal zone. For many coastal developing countries, the coastal zone is not only crucial for the wellbeing of their populations, it could also, as documented in this report, provide a highly valuable global resource for climate change mitigation if supported adequately. This report explores the potential for mitigating the impacts of climate change by improved management and protection of marine ecosystems and especially

the vegetated coastal habitat, or blue carbon sinks.

Nellemann, C., Corcoran, E., Duarte, C. M., Valdés, L., De Young, C., Fonseca, L., Grimsditch, G. (Eds). 2009. Blue Carbon. A Rapid Response Assessment. United Nations Environment Programme, GRID-Arendal.

The PDF publication can be downloaded from the following url:
<http://www.grida.no/publications/rr/blue-carbon/>



FAO Fisheries and Aquaculture Climate Change Publications

More coming soon!

FAO Workshop on Developing an Environmental Monitoring System to Strengthen Fisheries and Aquaculture Resilience and to Improve Early Warning in the Lower Mekong Basin. FAO Fisheries and Aquaculture Proceedings 45.

Assessing water availability and related economic social and nutritional contributions provided by inland capture fishery and aquaculture: an indicator-based framework. FAO Fisheries and Aquaculture Technical Paper No. 602.

Assessing water availability and related economic social and nutritional contributions provided by inland capture fisheries and aquaculture: an indicator-based framework - A compilation of water-related indicators in selected African and Asian countries. FAO Fisheries and Aquaculture Circular No. 1116.

Lessons learnt in water accounting: the fisheries and aquaculture perspective. FAO Fisheries and Aquaculture Technical paper No. 599. <http://www.fao.org/3/a-i5880e.pdf>

Fishing Vessel Energy Audit Pilot Project – Thailand. FAO Fisheries and Aquaculture Circular.