

January 2014



**CENTRAL ASIAN AND CAUCASUS REGIONAL
FISHERIES AND AQUACULTURE COMMISSION**



TECHNICAL ADVISORY COMMITTEE (TAC)
Second Session
Bishkek, Kyrgyzstan, 21-23 April 2014
CLIMATE CHANGE

INTRODUCTION

1. This document aims to provide basic background information to TAC in its effort to generate scientific and technical advice on climate change, focusing key global and regional issues and challenges as well as likely regional optional mitigation measures for adapting to climate change. This document should be read in conjunction with the 5-year work programme of the CACFish (CACFish:TAC2/2014/Inf.3).

2. The implications of climate change for global fisheries and aquaculture were explored at the FAO Expert Workshop on Climate Change Implications for Fisheries and Aquaculture, held from 7 to 9 April 2008 in Rome, Italy (Cochrane et al. 2009). The workshop was convened to provide participants at the High-Level Conference on World Food Security: the Challenges of Climate Change and Bioenergy, held at FAO headquarters in Rome from 3 to 5 June 2008, with a coherent and high-quality understanding of the climate change issues impacting on fisheries and aquaculture.

3. The following major conclusions arising from the workshop summarize the general biological and ecological issues and impacts relevant to fisheries and aquaculture development that are expected to result from global climate change:

- Climate change is a compounding threat to the sustainability of capture fisheries and aquaculture development. Impacts occur as a result of both gradual warming and associated physical changes, as well as from frequency, intensity and location of extreme events (cyclones, flooding, etc.), and take place in the context of other global socio-economic pressures on natural resources.

- Climate change is modifying the distribution of marine and freshwater species. In general, warm-water species are being displaced towards the poles and are experiencing changes in the size and productivity of their habitats.
- In a warmed world, ecosystem productivity is likely to be reduced in most tropical and subtropical oceans, seas and lakes and increased in high latitudes.
- Increased temperatures will affect fish physiological processes; resulting in both positive and negative effects on fisheries and aquaculture systems depending on the region and latitude.
- Climate change is already affecting the seasonality of particular biological processes, altering marine and freshwater food webs, with unpredictable consequences for fish production.
- Risks of species invasions and the spread of vector-borne diseases are likely to increase.
- Differential warming between land and oceans and between polar and tropical regions will affect the intensity, frequency and seasonality of climate patterns (e.g. El Nino) and extreme weather events (e.g. flooding, droughts and storms). These events will impact the stability of related marine and freshwater resources.
- Sea-level rise, glacial melting, ocean acidification and changes in precipitation, groundwater and river flows will significantly affect coral reefs, wetlands, rivers, lakes and estuaries, requiring adaptive measures to exploit opportunities and minimize impacts on fisheries and aquaculture systems.

4. These biological and ecological changes resulting from climate change will lead to the following impacts on the fisheries and aquaculture sectors and the communities that depend on them:

- Changes in distribution, species composition and habitats will require changes in fishing practices and aquaculture operations, as well as in the location of landing, farming and processing facilities.
- Extreme events will impact on infrastructure, ranging from landing and farming sites to post-harvest facilities and transport routes. They will also affect safety at sea and settlements, with communities living in low-lying areas at particular risk.
- Water stress and competition for water resources will affect aquaculture operations and inland fisheries production, and are likely to increase conflicts among waterdependent activities.
- Livelihood strategies will have to be modified, for example, with changes in fishers migration patterns due to changes in timing of fishing activities.
- Reduced livelihood options inside and outside the fishery sector will force occupational changes and may increase social pressures. Livelihood diversification is an established means of risk transfer and reduction in the face of shocks, but reduced options for diversification will negatively affect livelihood outcomes.
- There are particular gender dimensions, including competition for resource access, risk from extreme events and occupational change in areas such as markets, distribution and processing, in which women currently play a significant role.
- The implications of climate change affect the four dimensions of food security:

- *availability* of aquatic foods will vary through changes in habitats, stocks and species distributions;
- *stability* of supply will be impacted by changes in seasonality, increased variance in ecosystem productivity and increased supply variability and risks;
- *access* to aquatic foods will be affected by changes in livelihoods and catching or farming opportunities; and
- *utilization* of aquatic products will also be impacted and, for example, some societies and communities will need to adjust to species not traditionally consumed.

5. The International Panel on Climate Change (IPCC) considers that climate change poses serious threats to Central Asia's environment and ecological and socio-economic systems, particularly because of the region's arid nature (IPCC 2007a,b,c,d). The following summarizes some of the major conclusions and projected impacts of climate change of relevance to fisheries and aquaculture in CAC countries as given in the 4th IPCC assessment report (IFAD undated):

- The complexity of precipitation changes, vegetation-climate feedback and direct physiological effects of CO₂ on vegetation present significant challenges for understanding and modelling climate change in such an arid region. However, there has been a general warming trend in Central Asia on the order of 1-2 C° since the beginning of the 20th century that might have a strong potential impact on the regional temperature and precipitation regimes and also on natural ecosystems, agricultural crops and human health.
- In Central Asia there is a high correlation and positive feedback loop between poverty and land degradation, aggravated by climate change. The impacts of climate change, land degradation and desertification will thus be felt by the poorest people living in rural areas.
- Coastal systems in CAC are under threat from pollution and development, resulting in the deterioration of fish populations in some countries. Coastal zones in the region are not projected to be significantly affected by sea-level changes resulting from climate change. A 50 m sea-level rise, 2.4 million emigrants and 1.8 billion USD/year in costs are projected in Central Asia.
- Fishery industries are important in some CAC countries, but over fishing and marine pollution have led to decreased catches. Recent evidence shows that the fishing sector in Central Asia is close to collapse, and that climate change will further exacerbate and accelerate this process, affecting mainly the rural poor.

6. A detailed review of climate change in Central Asia due to historical and present day human activities and to and global warming is presented by Lioubimtseva and Cole (2006), while brief reviews of the implications of climate change to individual Central Asian countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) are given in Zoi (2009). Neither of these documents mentions climate change implications to fisheries and aquaculture.

7. The CAC region is mostly arid and semi-arid and is dominated by grasslands, rangelands, deserts and some woodlands. Projections suggest considerable changes in desert and semi-desert vegetation due to a combination of green house gas (GHG)-related climate change and direct physiological CO₂ effects on vegetation.

- Grasslands, livestock and water resources are likely to be most vulnerable to climate change because they are located mostly in marginal areas.
- Water stresses are already a problem in many countries, and may be aggravated by climate change, since CAC countries do not yet have sufficient water infrastructure development.
- Glacial melt in the mountainous areas is expected to increase, increasing flows in some river systems for a few decades; however, this will be followed by a reduction in flow as the glaciers disappear, creating larger areas of arid, interior deserts in low- and mid-lying parts of the region. In the next 20 years the flow of the Amudarya River and some tributaries of Syrdaya and Zarafshan rivers may decrease by 25-30 percent.
- Projected precipitation increases are small, and temperatures and evaporation are expected to rise. Rapid development is threatening some water supplies through salinization and pollution, and expanding populations are increasing the demand for water. Because rainfall in the region is already low, severe water stresses, leading to further desertification, are expected, with rises in surface air temperature and depletion of soil moisture.
- Water storage and integrated water management are key to developing subregional adaptation strategies. These might include more efficient organization of water supply, treatment, and delivery systems for urban areas and, in arid Asia, increased use of groundwater. Measures to conserve or reuse water have already been implemented in some countries; such strategies may overcome some shortages, especially if they are widely adopted. Changes in cropping practices and improved irrigation practices could reduce water use significantly in some countries.

8. Climate change issues have a high level of uncertainty, and dealing with CC adaptation is dealing with these uncertainties; hence, there are many models and scenarios. CC stressors may affect fish community structure and wetland ecology and thus have impacts on the distribution and operational aspects of fisheries, including disease infestation and epidemics.

9. The Government of Turkey has recently published a national strategy (*Climate change strategy 2010-2020*, MEU undated) and a national action plan (*National climate change action plan 2011-2023*, MEU 2011). These broad policy and planning documents do not deal in detail with individual sectors. However, it identifies the projected impacts and vulnerable sectors, including projected impacts that include changes in river/basic regimes, diminishing surface waters, increasing scarcity of water for use, flood, coastal erosion, degrading of marine ecosystem, survival of migrating species, and reduced aqua-production, all of which may impact fisheries and aquaculture production.

10. Based on growing evidence, there is recognition that climate change would pose high risks to fisheries and aquaculture at global level. There are many reported cases, among others, of shifts in the spatial distribution of fish stocks; changes in fish biology (development, growth, maturation, spawning period and age, and mortality); alterations aquatic ecosystems and habitats, and altered productivity and food web structures, as a result of climate change impacts. In this context, TAC is expected to have a role in the determination of prioritized regional technical/scientific issues with regard to climate change, including likely adaptation options and associated actions, and identification of research needs and knowledge gaps to estimate the implications of climate change in CACFish Area. Key issues in dealing with the Climate Change Impacts on Fisheries and Aquaculture in Central Asia. The following are some of the issues and questions that TAC may want to

consider when making scientific recommendations to CACFish in relation to climate change impacts in fisheries and aquaculture:

- Is the current knowledge base on likely climate change impacts on fisheries and aquaculture in the CAC region and in the individual member countries adequate?
- Given that the impacts of climate change are expected to vary considerably with geographical location (latitude, elevation and existing environment), are the projected impacts of climate change on local aquatic ecosystems in individual CAC member countries adequately understood?
- What will be the likely socio-economic impacts of climate change on the fisheries and aquaculture sectors and those members of society dependent upon them?
- Have policy and planning documents been prepared at the national level for all CAC member countries? (i.e. broad level policy and planning documents)
- If such documents have been prepared (i.e. in the case of Turkey) have they been translated into detailed action plans for the fisheries and aquaculture sector?
- Is there a recent comprehensive review document (or documents) exploring the impacts of climate change on fisheries and aquaculture in the CAC region, the current state of preparedness by regional organizations, national and subnational governments and other relevant agencies, and outlining existing action plans and identifying strengths and weaknesses? For an example of such a document for the Asia Region (East, Southeast and South Asia), see Sriskanthan and Funge-Smith (2011).
- Is a regional climate change action plan for aquaculture and fisheries needed?
- Possible works of relevance to climate change impacts to be undertaken under the 5-year work programme of CACFish.

SUGGESTED ACTION FOR TAC

13. TAC is invited to examine the questions and issues raised in the Annex and to formulate technical/scientific advice for the consideration of CACFish related to possible actions that might be taken to better understand the probable impacts of climate change on the fisheries and aquaculture sectors of the CAC region and to identify ways to assist the sectors to adapt to these impacts.

REFERENCES

- Cochrane, K., De Young, C., Soto, D. & Bahri, T.** (eds). 2009. *Climate change implications for fisheries and aquaculture: overview of current scientific knowledge*. FAO Fisheries and Aquaculture Technical Paper No. 530. Rome, FAO. 212 pp. (available at: <http://www.uba.ar/cambioclimatico/download/i0944e.pdf>)
- FAO.** 2008. *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. 32 pp.
- IFAD.** *Climate change impacts - Central Asia. The Global Mechanism. United Nations Convention to Combat Desertification*. (available at: <http://www.ifad.org/events/apr09/impact/central.pdf>)
- IPCC.** 2007a. *Climate change 2007: the physical science basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor & H.L. Miller, eds. Cambridge and New York, Cambridge University Press, 996 pp. (available at: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html)
- IPCC.** 2007b. *Climate change 2007: impacts, adaptation and vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007. M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden & C.E. Hanson, eds. Cambridge and New York, Cambridge University Press, 976 pp. (available at: http://www.ipcc.ch/publications_and_data/ar4/wg2/en/contents.html).
- IPCC.** 2007c. *Climate change 2007: mitigation*. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. B. Metz, O.R. Davidson, P.R. Bosch, R. Dave & L.A. Meyer, eds. Cambridge and New York, Cambridge University Press (available at: http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg3_report_mitigation_of_climate_change.htm)
- IPCC.** 2007d. *Climate change 2007: Synthesis report*. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, R.K. Pachauri, & A. Reisinger, eds. Geneva, IPCC, 104 pp. (available at: http://www.ipcc.ch/publications_and_data/ar4/syr/en/contents.html) (<http://www.ifad.org/events/apr09/impact/central.pdf>)
- Lioubimtseva, E. & Cole, R.** 2006. Uncertainties of climate change in arid environments of Central Asia. *Reviews in Fisheries Science*, 14:29–49. (available at: <http://www.glerl.noaa.gov/seagrant/ClimateChangeWhiteboard/Resources/Uncertainty/climatech/lioubim06PR.pdf>)
- MEU.** Undated. *Republic of Turkey. Climate change strategy 2010-2020*. Ministry of Environment and Urbanization, Ankara, 30 pp. (available at: http://iklim.cob.gov.tr/iklim/Files/Stratejiler/%C4%B0DES_ENG.pdf) (broad national plan - no mention of fisheries or aquaculture).
- MEU.** 2011. *Republic of Turkey. National climate change action plan 2011-2023*. Ministry of Environment and Urbanization, Ankara, 176 pp. (available at: http://www.preventionweb.net/files/29675_turkeynationalclimatechangeactionpl.pdf)
- Sriskanthan, G. & Funge-Smith, S. J.** 2011. *The potential impact of climate change on fisheries and aquaculture in the Asian region*. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. RAP Publication 2011/16, 41 pp. (available at: <http://www.fao.org/docrep/015/ba0083e/ba0083e00.pdf>)
- Zoi.** 2009. *Climate change in Central Asia. A visual synthesis*. Zoi Environmental Network, 79 pp. (available at: http://www.preventionweb.net/files/12033_CCCAdec2009.pdf)

ANNEX I

Dealing with Climate Change Impacts on Fisheries and Aquaculture in Central Asia

Adapting to climate change

1. Projected climate change poses multiple additional risks to fishery-dependent communities that may limit the effectiveness of past adaptive strategies. Adaptation strategies will need to be context and location specific and to consider both short-term (e.g. increased frequency of severe events) and long-term (e.g. reduced productivity of aquatic ecosystems) impacts. All three levels of adaptation (community, national and regional) will clearly require and benefit from stronger capacity building, through awareness raising on climate change impacts on fisheries and aquaculture, promotion of general education and targeted initiatives in and outside the sector.

- Options to increase resilience and adaptability through improved fisheries and aquaculture management include the adoption as standard practice of adaptive and precautionary management. The ecosystem approaches to fisheries (EAF) and to aquaculture (EAA) should be adopted to increase the resilience of aquatic resources ecosystems, fisheries and aquaculture production systems, and aquatic resource-dependent communities.
- Aquaculture systems that are less or non-reliant on fishmeal and fish oil inputs (e.g. bivalves and macroalgae) have better scope for expansion than production systems dependent on capture fisheries commodities.
- Adaptation options also encompass diversification of livelihoods and promotion of aquaculture crop insurance in the face of potentially reduced or more variable yields.
- In the face of more frequent severe weather events, strategies for reducing vulnerabilities of fishing and fish farming communities have to address measures including: investment and capacity building on improved forecasting; early warning systems; safer harbours and landings; and safety at sea. More generally, adaptation strategies should promote disaster risk management, including disaster preparedness, and integrated coastal area management.
- National climate change adaptation and food security policies and programmes need to fully integrate the fisheries and aquaculture sector (and, if non-existent, should be drafted and enacted immediately). This will help ensure that potential climate change impacts will be integrated into broader national development (including infrastructure) planning.
- Adaptations by other sectors will have impacts on fisheries, in particular inland fisheries and aquaculture (e.g. irrigation infrastructure, dams, fertilizer use runoff), and will require carefully considered trade-offs or compromises. Interactions between food production systems could compound the effects of climate change on fisheries production systems but also offer opportunities. Aquaculture-based livelihoods could for example be promoted in the case of salination of deltaic areas leading to loss of agricultural land.

Options for enabling change

2. The following broad policy options and activities at the international, regional and national levels were identified by the FAO Expert Workshop on Climate Change Implications for Fisheries and Aquaculture (Cochrane et al. 2009) as having the potential to help to minimize the negative impacts of climate change, improve mitigation and prevention, and maintain and build adaptive capacity to climate change:

- *Developing the knowledge base:* Planning for uncertainty needs to take into account the greater possibility of unforeseen events, such as the increasing frequency of extreme weather events and other “surprises”. However, examples of past management practices under variability and extreme events can still provide useful lessons to design robust and responsive adaptation systems. Improved knowledge in a number of areas will be valuable, e.g. projections of future fish production level, detailed impact predictions on specific fisheries and aquaculture systems, improved tools for decision-making under uncertainty, and improved knowledge of who is or will be vulnerable with respect to climate change and food security impacts and how they can be addressed.
- *Policy, legal and implementation frameworks.* Addressing the potential complexities of climate change interactions and their possible impacts requires mainstreaming of cross-sectoral responses into governance frameworks. Action plans at the national level can have as their bases the Code of Conduct for Responsible Fisheries (CCRF) and related International Plans of Action (IPOAs), as well as appropriately linked policy and legal frameworks and management plans. Links will be required among national climate change adaptation policies and programmes as well as cross-sectoral policy frameworks such as those for food security, poverty reduction, emergency preparedness and others. The potential for spatial displacement of aquatic resources and people as a result of climate change impacts will require existing regional structures and processes to be strengthened or given more specific focus. Internationally, sectoral trade and competition issues are also likely to be impacted by climate change.
- *Capacity building: technical and organizational structures.* Policy-making and action planning in response to climate change involves not only the technically concerned agencies, such as departments responsible for fisheries, interior affairs, science, and education, but also those for national development planning and finance. These institutions, as well as community or political representatives at subnational and national level should also be identified to receive targeted information and capacity building. Partnerships also need to be built and strengthened among the public, private, civil society and non-governmental organization (NGO) sectors.
- *Enabling financial mechanisms: embodying food security concerns in existing and new financial mechanisms.* The full potential of existing financial mechanisms, such as insurance, at national and international levels will be needed to tackle the issue of climate change. Innovative approaches may also be needed to target financial instruments and to create effective incentives and disincentives. The public sector will have an important role in leveraging and integrating private-sector investment, interacting through market mechanisms to meet sectoral aims for climate change response and food security. Many of these approaches are new and will need to be tested in the sector.