



**WorldFish**  
C E N T E R

## Fisheries and aquaculture can provide solutions to cope with climate change

### KEY MESSAGES

- Significance of fisheries and aquaculture. Fish provides nutritious food, fishing and fish farming generate income and employment to millions of poor people, and trade in fishery products contributes to poverty reduction and national economic growth in many developing nations.
- Nature of the climate change threat. Global warming affects aquatic ecosystems and their fishery productivity. Fisheries and aquaculture are also threatened by the secondary effects of warming: changes in ocean currents, precipitation that affects lake levels and river flows, and increasing storminess and extreme floods and droughts. This makes living near water and catching or farming fish more hazardous than it is already.
- The need to adapt to climate change. Greater climate variability and uncertainty complicate the task of governing fisheries and expanding aquaculture sustainably. Fish can provide opportunities to adapt to climate change by, for example, integrating aquaculture and agriculture, which can help farmers cope with drought while boosting profits and household nutrition. Fisheries management must move from seeking to maximize yield to increasing adaptive capacity. Research is needed to find innovative ways to further improve the existing adaptability of fishers and aquaculturists.

Climate change has moved to front and center of the world's environmental agenda, and rightly so. Because fisheries production depends so heavily on climate this brief shows how WorldFish is working with partners to help nations deal with impending change.

A major new study by the Intergovernmental Panel on Climate Change (IPCC Fourth Assessment) concludes that:

- In the low latitudes of the tropics, many wet areas will get wetter and dry areas, drier, aggravating drought and flood tendencies.
- Weather events will become more extreme, creating more variability in water supplies that drive agricultural and hydrological systems.
- Rising water temperatures may reduce the upwelling of food supplies that fish in upper water layers depend

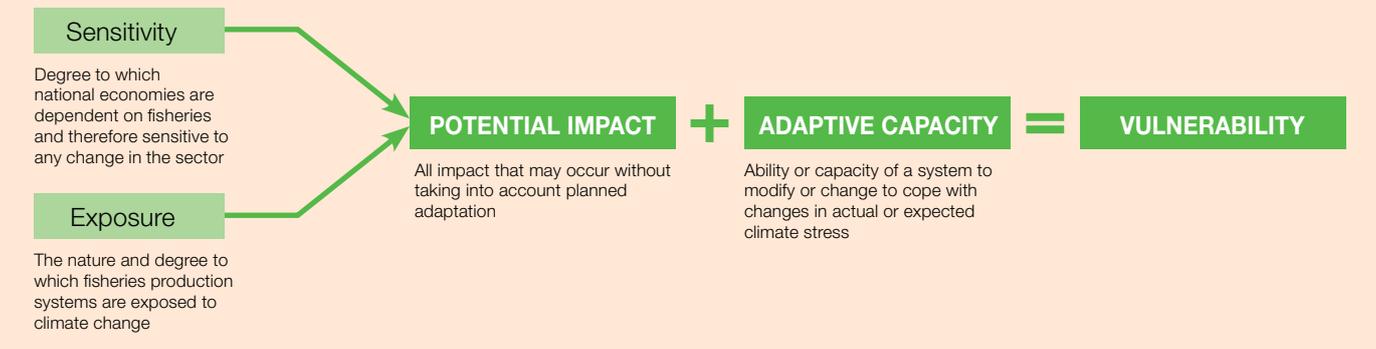
on, and increased carbon dioxide in the atmosphere will increase the acidity of water bodies, adversely affecting shellfish and coral reefs.

- Coastal areas and islands will be especially hard-hit by rising sea levels and more intensive oceanic storms such as typhoons or hurricanes.

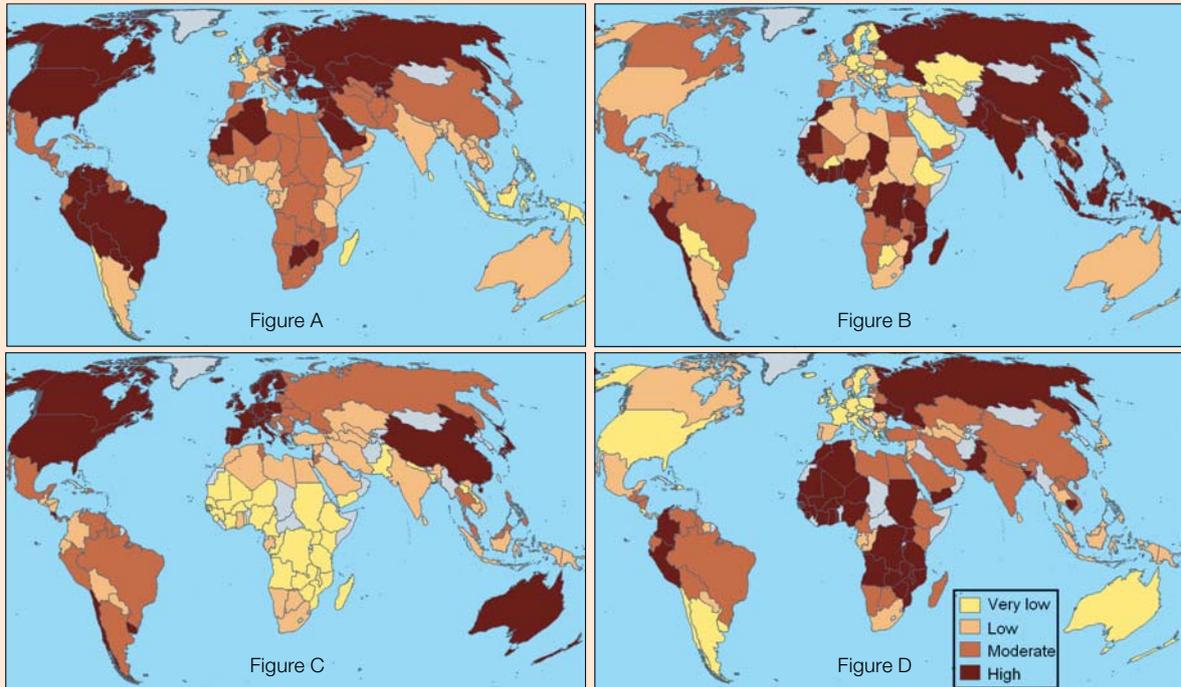
While many of these changes will severely undermine fisheries, some will deliver benefits. For example, with the right technologies and farming systems farmers can use flooded and saline areas no longer suitable for crops to cultivate fish. They can also use the water in reservoirs and ponds used for fish culture, to moderate the swings between drought and flood. Waste nutrients and water from such water bodies can help sustain crops during periods of drought, thereby increasing the resilience of the farming system.

## GLOBAL VULNERABILITY OF FISHERIES SYSTEMS TO CLIMATE CHANGE

Vulnerability to climate change is defined by the Intergovernmental Panel on Climate Change as a combination of the potential impact (sensitivity plus exposure) and adaptive capacity.



National exposure to climate change was measured as the average predicted surface air temperature in 2050. Sensitivity represented the national relative importance of fisheries and was a composite of: number of fishers, poverty (reciprocal of per capita GDP), fish export value as a proportion of total export value, size of fisheries employment sector, total catch and contribution of fish to daily protein intake. Adaptive capacity (resilience) was a composite of human development indices and economic performance, including: life expectancy, literacy rates, school attendance, size of economy, political stability and good governance, law, accountability and corruptibility.



In the figures above, the darker colours represent higher exposure to climate change (Figure A), higher sensitivity (Figure B), lower adaptive capacity (Figure C) and higher vulnerability (Figure D). West African and Central African fisheries form the bulk of the countries whose economies are most vulnerable to climate impacts on fisheries. Countries shaded in grey are those for which data are unavailable.

Source: Allison, E.H. et al. (2006). Effect of climate change on the sustainability of capture and enhancement fisheries important to the poor. DFID Fisheries Management Science Programme Project R4778J, UK. [www.fmsp.org.uk](http://www.fmsp.org.uk)

## IMPACTS ON PEOPLE

A recent study on the vulnerability of national economies and food systems to climate impacts on fisheries has revealed that African countries are most at risk. What makes them so vulnerable? The first reason is ecological — it is because many African countries are semi-arid with significant coastal or inland fisheries. This gives them high exposure to future increases in temperature and linked changes in rainfall, hydrology and coastal currents. The second reason is social — these countries also depend greatly on fish for protein, and have low capacity to adapt to change due to their comparatively small or weak economies and low human development indices. Countries in this category include Angola, Congo, Mauritania, Mali, Niger, Senegal and Sierra Leone. Other vulnerable African nations include Rift Valley countries such as Malawi, Mozambique and Uganda. Beyond Africa it is the Asian river dependent fishery nations including Bangladesh, Cambodia and Pakistan that are most at risk.

The often overlooked links between fisheries and agriculture also make the semi-arid areas of Africa vulnerable. In these areas the higher-potential agricultural zones are around lakes, swamps and river-floodplains. Here fisheries often provide both safety nets and capital to invest in agricultural inputs and livestock. If the fishery system is under stress, the potential of the other components of the ‘tri-economy’ is reduced. The system as a whole is resilient to local-scale perturbation, but with reduced rainfall stressing both fisheries and crop agriculture, that resilience could be threatened by climate change. So there is a case for not forgetting the fish in the wider discussion of adaptation and coping in these systems — and particularly fisheries of inland and near-shore waters.

## UNDERSTANDING, REDUCING AND COPING WITH VULNERABILITY

As well as national partners, WorldFish works closely with major economic and governance bodies at regional and continental levels. WorldFish advises the ASEAN economic community on fisheries issues, and has established vigorous partnerships with the African Union, NEPAD and FARA in Africa. The Center’s Fish-for-All initiative has catalyzed greater global visibility on fisheries issues, and this will ensure high-level attention to climate change-related fisheries needs and opportunities in the coming years.

Looking forward, WorldFish will play a key role by helping identify and focus the best of global science to further help developing countries understand and tackle the threats fisheries and aquaculture face. Our task is to work with farmers, scientists and policy makers to produce, synthesize and package scientific knowledge so that

together we improve our understanding of vulnerabilities, reduce them where possible, and cope with them where not.

WorldFish and our partners can provide some of the required knowledge now, but we must also do new research. First we need more detailed analyses of the vulnerability of landscapes, agricultural and fishery systems to better target future investments in mitigation and adaptation. We need to develop better indices of vulnerability, improve our predictive models and provide vulnerability maps and other analyses at scales useful to policy makers. To build on the foundation provided by the IPCC’s global assessment, we must work at regional, national and river basin scales.

WorldFish has proved it can develop the types of knowledge products needed. For example, FishBase is the world’s most comprehensive and authoritative database on fish. It receives more than 30 million website hits per month, evidence of its usefulness in the identification and understanding of fish and their habitats. ReefBase documents 10,000 reefs in 40 countries, giving researchers, conservationists and managers a powerful tool for monitoring change and making management choices. ReefBase helped researchers assess the effects of the Asian tsunami on coastal fisheries and communities and to assess the potential impact of climate change on coral-reef fisheries.

The BayFish model is a set of decision support tools that are helping guide basin-wide decisions about water and land use in Cambodia’s Tonle Sap Lake zone, the most intensively fished lake in the world. BayFish forecasts the impacts of land and water management on fish production, helping managers to optimize the use of inland aquatic resources. Its use is now spreading across the Mekong River system in Cambodia and Vietnam and is an important tool for predicting the impacts of the floods that climate change may trigger.

## BUILDING THE CAPACITY TO ADAPT AND RESPOND

Assessing vulnerability is one thing, doing something about it is quite another. Our research must also lead to clear practical advice on reducing vulnerability and increasing resilience. And it must be advice that motivates people and institutions to act. To achieve this we must better understand how governments, fishing communities and fish farmers perceive risk and vulnerability, and respond to it in the face of threats such as climate change. We must also find ways to improve the governance and capacity of institutions that can help people adapt and provide policy advice that helps mainstream climate change adaptation into broader fisheries and rural development policy and law.

The effects of the Asian tsunami may unfortunately be an indicator of the disasters that lie ahead. To better cope with that event, WorldFish developed a Sustainable Coastal Livelihoods Framework that helps affected partners take an integrated, multi-sectoral view of rehabilitation. The Framework helps those affected to develop new livelihood alternatives to replace those the tsunami made untenable. Learning from that experience proved invaluable in responding quickly and effectively to the needs of Solomon Islanders when an earthquake and tsunami affected them in April 2007. The approach has proven to be effective in helping recovery after oil-spills and typhoons and should also serve communities well for responding to climate change-induced disasters.

## ADAPTING TECHNOLOGIES

Climate change will increase the potential for agriculture and aquaculture in some regions and reduce it in others. In either case, new or adapted technologies can help to fully exploit the possibilities. Aquaculture is an important means of diversifying and improving the productivity of farming systems and for improving food security in many regions, especially in Africa and Asia. Implemented properly, it can help conserve water and its potential to help farmers cope with climate change is enormous.

Because of their short generation time and large multiplication rate, fish can be quickly and efficiently selectively-bred to suit the new conditions and the likely increased prevalence of fish diseases that climate change will bring. WorldFish pioneered the modern science of tropical food fish breeding, creating faster growing and hardier strains of tilapia now used in thirteen countries.

Increased flooding may expand the number of seasonal ditches and pools available for cultivating fish. The extreme example of this is Bangladesh, which is thought by some to be turning from rice-bowl to fish-pond as the frequency and severity of flooding increases. WorldFish will apply the knowledge gained in helping the rural poor in Bangladesh utilize a million such water bodies for fish farming, an achievement that earned the World Food Prize in 2005. This experience will have wider applicability as coastal flood-plain zones expand around the world with rising sea levels.

Integrated aquaculture-agriculture (IAA) systems will aid coastal fisherfolk who lose, or need to diversify, their marine-based livelihoods because of climate change. It will also help farmers in coastal regions whose land will become unsuitable for crop production because of increased saltwater intrusion.

IAA will also be a key approach to improve water management and total-farm productivity in dry areas. WorldFish and partners have helped thousands in Asia

and Africa to adopt and adapt IAA to local conditions, using crop residues, tree leaves, and household food wastes to feed the fish, and recycling nutrient-rich pond water and sediments to feed their crops. Farmer to farmer dissemination of these practices has been high due to the simplicity and high impact of these systems. IAA improves the resilience of farming systems and could make a significant contribution to the reality of a green revolution for millions of small farmers.

## CONCLUSION

The IPCC tells us that climate change is unavoidable over the next century. It is poised to strike at the heart of the regions, ecosystems and people that are the focus of WorldFish's concern.

The recent Stern Review on the Economics of Climate Change concluded that "For fisheries, information on the likely impacts of climate change is very limited". The world community must step up its efforts and investments to fill this and other critical knowledge gaps to help make fisheries and aquaculture resilient and productive despite climate change. WorldFish and partners have shown that much can be done, and will remain at the forefront of efforts to meet this unprecedented challenge.

### Photo credit

Front top banner: Randall Brummett

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