WorldFish
CENTER

Climate change and fisheries: vulnerability and adaptation in Cambodia

CLIMATE CHANGE AND FISHERIES:
VULNERABILITY AND ADAPTATION IN CAMBODIA

KEY MESSAGES

- Cambodia is highly vulnerable to the effects of climate change on fisheries, which supply livelihoods for millions and up to 80% of all animal protein in the diet.
- Hydrological variation in the Mekong Basin induced by climate change may amplify an emerging boom-and-bust cycle of fish catches, with banner years followed by years of shortage.
- Changes in fishery production are likely to have the greatest impact on the people most dependent on fisheries, whose poverty, marginalization and lack of livelihood alternatives leave them ill-equipped to cope.
- Fisheries must be taken into consideration in adaptation planning to ensure that adaptation measures in other sectors, such as irrigation and hydroelectric projects, do not inadvertently undermine fishery sustainability.
- Building fisher communities' capacity to adapt to immediate environmental change, partly by diversifying livelihoods and improving access to natural resources, goes hand-in-hand with improving their long-term capacity to adapt to climate change.
- As fisheries and aquaculture can compensate for other adaptation problems, such as the loss of low-lying farmland, conserving wild fisheries and enhancing aquaculture should be considered twin strategies of adaptation to climate change.

Climate Change and Fisheries

Rising concentrations of greenhouse gases in the atmosphere are causing global climate change. In the coming decades, global average temperatures will increase, rainfall patterns will change, extreme weather events will become more severe, sea levels will rise and numerous other environmental changes will occur (IPCC 2007). Agriculture will be affected, with impacts on food security. Fisheries and aquaculture will also feel the heat.

Climate change may directly affect fishery production along many pathways. Fish reproduction, growth and migration patterns are all affected by temperature, rainfall and hydrology (Ficke et al. 2007). Changes in these parameters will therefore shift patterns of species abundance and availability. Saltwater intrusion caused by rising sea levels may threaten freshwater fisheries while, at the same time, creating opportunities for catching and cultivating high-value brackish or marine species (WorldFish Center 2007). Changes in precipitation will affect seasonal flooding patterns that drive inland fish production. While greater wet-season flooding may boost production in some inland fisheries, drier dry seasons may threaten stocks of both wild and cultured fish.

Fish in Cambodia

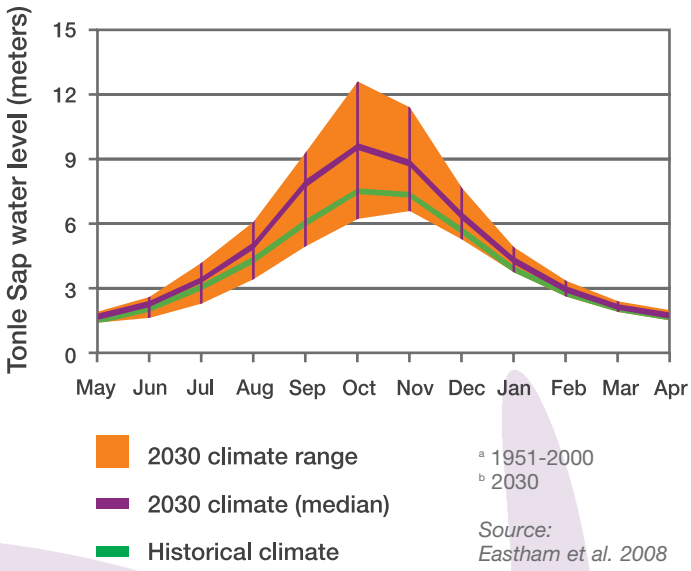
Fisheries are critical to human well-being in Cambodia, where fish provide up to 80% of all animal protein in the diet (Hortle 2007). Capture fisheries and aquaculture contribute about 10% of Cambodia's gross domestic product and are even more important in terms of local livelihoods. Fishing and related activities are the primary sources of income for about one third of the people living around Tonle Sap and a secondary source of income for half of those who live around Cambodia's great lake (Baran 2005).

Climate Change in Cambodia

Climate change is occurring now. The average temperature in Cambodia has increased since 1960 by 0.8°C, and with it the frequency of unusually hot days and nights has increased as well (McSweeney et al. 2008). A further 0.3-0.6°C increase is expected by 2025 (MOE 2002). Alternative estimates put the expected warming at 0.7-2.7°C by the 2060s (McSweeney et al. 2008).[1] Temperature increases will be more severe from December to June.

All climate change models agree that rainfall in Cambodia will increase, but the magnitude of change is uncertain.

Figure 1: Historical[a] and future[b] seasonal fluctuation in the Tonle Sap water level



[a] 1951-2000
[b] 2030

Source: Eastham et al. 2008

Table 1: Overview of climate change effects in Cambodia

Factor	Change predicted	Trend [a]	Remark
Temperature	+0.3° to +0.6° by 2025	→	
Rainfall in wet season	+3% to +35%	→	Direction of change certain, but magnitude uncertain
Rainfall in dry season	No change or decrease	↘	
Extreme events	More frequent and more intense	→	Extreme events = floods, drought, storms
Runoff	+21%	→	Higher sediment load in water, impact on fishery productivity
Tonle Sap level in rainy season	+2.3 meters	→	Increased rainfall in wet season will raise flood levels
Tonle Sap level in dry season	+0.1 meter	→	

[a] The thickness of arrows indicates the degree of certainty in findings.

Estimates of the increase vary from as little as 3% to as much as 35% (ICEM 2009). Models predict that the increase in rainfall will occur during the wet season, bringing more flooding, and that precipitation in the dry season will be unchanged or lower (Eastham et al. 2008).[1] Rainfall is expected to increase more in the lowlands than in the

[1] Climate change predictions vary because they are based on a variety of development scenarios. The range of estimates includes predictions for scenarios with low emissions, high emissions, and in between. Each scenario also includes various assumptions about population growth, technological development, economic growth and energy sources. Variability among scenarios accounts for the typically wide error margin in predictions. A second layer of uncertainty results from ecological feedbacks in the system. Uncertainty further increases with the complexity of the system and as predictions move farther along ecological and social processes.

highlands, with precipitation and flooding increasing predominantly in the central agricultural plains, which are already vulnerable to flooding and drought.

Climate change will bring more extreme weather events such as storms, heat waves, droughts and floods. Damage from intense cyclones has increased significantly in Cambodia in recent decades (Cruz et al. 2007) and may worsen.

Implications for Cambodian Fisheries

Runoff throughout the Mekong Basin is expected to increase by 21% by 2030 (Eastham et al. 2008). This will intensify sediment loading in Cambodia's rivers, lakes and wetlands, with higher nutrient levels boosting fishery productivity. However, this effect may be offset by sediment retention behind the many dams that are likely to be constructed upstream.

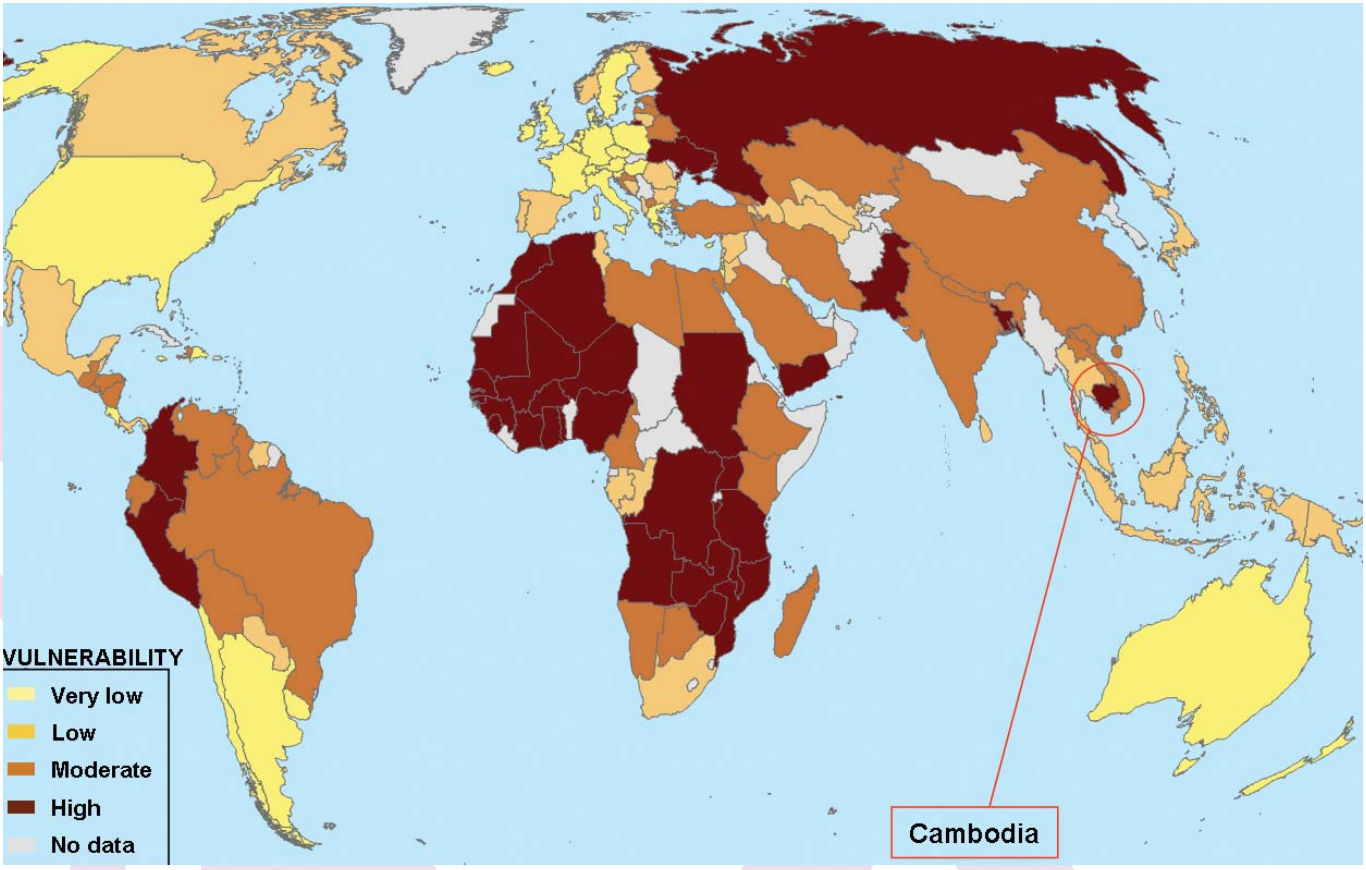
By 2030, climate change may raise the wet season flood level of the Tonle Sap lake by 2.3 meters (Eastham et al. 2008), extending feeding grounds and encouraging fish production. On the other hand, dams to be developed in the Mekong Basin will store water during the moonsoon and thus will decrease wet season flood levels. The net result of these two processes is unknown.

It is similarly difficult to predict the specific effects of climate change on fish species composition and abundance in Cambodia. Patterns of change in fertility, recruitment, nutrition and growth will depend on both species and interactions between species. Some of the 500 or so Cambodian freshwater species will thrive in a changed climate, while others may die out (Johnston et al. 2009). An assessment is needed of climate change effects on the commercially dominant species that comprise the bulk of the catch.

Cambodian fish catches are increasingly made up of species such as *Henicorhynchus spp.* ("trey riel" in Khmer) that are considered unstable because their abundance is largely driven by the annual flood pattern, as they grow quickly and die young. This emerging boom-and-bust cycle may be amplified by the higher hydrological variability predicted with climate change, bringing very high year-to-year fluctuations in fish abundance, with years of high abundance followed by years of shortage.

Extreme weather events could further harm fish production in Cambodia by causing loss of aquaculture stock and destroying fishing and aquaculture infrastructure (Johnston et al. 2009). Changes in fishery production are likely to have the greatest impact on people who depend on fishing as their primary livelihood activity. As these people are often poorer and more marginal than those who own land and have other primary sources of income, the effects of climate change on fisheries will harm those least equipped to cope (Johnston et al. 2009).

Figure 2: Countries whose fisheries are most vulnerable to climate change



Source: Allison et al. 2009.

Issues for Local Adaptation Strategies

A recent global study classified Cambodia as highly vulnerable to the effects of climate change on fisheries (see Figure 2). These findings were based on assessments of Cambodia's dependence on fisheries, the magnitude of expected climate change in the country, and its adaptive capacity (Allison et al. 2009). This vulnerability makes it important that Cambodian fisheries receive the support necessary to adapt to and cope with climate change. Yet the current Cambodian National Adaptation Program of Action for climate change (NAPA) does not prioritize adaption planning for capture fisheries in lakes, rivers and wetlands, despite their importance to the national economy and their vulnerability to climate change (MOE 2006, TKK & SEA START RC 2009).

Infrastructure development upstream – which is a threat more immediate than climate change and whose effects will combine with those of climate change – calls for a response that includes investment in fishery forecasting and management in the context of changes in flow regime.

An ecosystem stressed by overfishing is more likely to collapse when subjected to climate change. Policies to prevent overfishing and ensure the sustainable use of fish stocks help build ecosystem resilience to climate change (WorldFish Center 2007).

A key to successful adaptation is diverse livelihoods. Livelihood diversity helps ensure that, if one economic option temporarily closes, people can resort to other options for making a living. Poverty reduction strategies that help diversify livelihoods and improve poor people's access to natural resources also help build adaptive capacity for climate change.

Fishing communities in Cambodia have coped with environmental variability for many years, developing strategies of adaptation to fluctuation. Understanding and supporting these adaptive strategies and removing barriers to adaptation are steps toward preparing fishery-dependent communities to cope with climate change.

Some adaptation strategies in other sectors may adversely affect fisheries. Hydropower dams and irrigation structures

can improve water management and availability in the dry season, but they can also block fish migrations and reduce fishery productivity (FAO 2009). It is therefore critical to take fisheries into consideration in adaptation planning, thereby ensuring that adaptation measures in one sector do not become counterproductive in another.

Fisheries and aquaculture can help solve other adaptation problems. As rising sea levels and increased flooding may render some existing farmland unsuitable for cropping, fish cultivation can provide alternative livelihoods and offset these losses. Further, water and nutrients from fishponds can improve farm productivity and sustain it under drought (WorldFish Center 2007). Conserving wild fisheries and enhancing aquaculture should be considered twin strategies of adaptation to climate change.

Conclusion

Most fisheries are highly variable by nature and subject to environmental change, including climate change. Hydropower dam construction, intensified fishing pressure and macroeconomic drivers are likely to affect Cambodian fisheries more immediately and visibly than climate change. Building fisher communities' capacity to adapt to these more immediate changes goes hand-in-hand with improving their capacity to adapt to climate change. A far-reaching strategy to improve adaptive capacity and strengthen resilience promises to reduce poverty and enhance food production now and in the years to come.

References

Allison EH, Perry AL, Badjeck MC, Neil Adger W, Brown K., Conway D, Halls AS, Pilling GM, Reynolds JD, Andrew NL, Dulvy NK. 2009. Vulnerability of national economies to the impacts of climate change on fisheries. Fish and Fisheries, 10(2):173-196.

Baran E. 2005. Cambodia inland fisheries: facts, figures, and context. Worldfish Center and Inland Fisheries Research and Development Institute. Phnom Penh, Cambodia.

Cruz RV, Harasawa H, Lal M, Wu S, Anokhin Y, Punsalmaa B. 2007. Asia. Pp. 469-506 in Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE (eds). Climate change 2007: Impacts, adaptation and vulnerability. Contribution of working group II to the fourth assessment report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.

Eastham J, Mpelasoka F, Mainuddin M, Ticehurst C, Dyce P, Hodgson G, Kirby M. 2008. Mekong River Basin water resources assessment: Impacts of climate change. Australian Commonwealth Scientific and Research Organization: Water for a healthy country national research flagship.

FAO. 2009. Fisheries and aquaculture in a changing climate. Food and Agriculture Organization, Rome, Italy.

Ficke AD, Myrick CA, Hansen LJ. 2007. Potential impacts of global climate change on freshwater fisheries. Reviews in Fish Biology and Fisheries, 17(4):581-613.

Hortle KG. 2007. Consumption and the yield of fish and other aquatic animals from the lower Mekong basin. MRC Technical Paper no. 16, Mekong River Commission, Vientiane, Lao PDR.

ICEM. 2009. Climate change adaptation in the Lower Mekong Basin countries. Regional synthesis report. International Center for Environmental Management, Hanoi, Vietnam, and Mekong River Commission, Vientiane, Lao PDR.

IPCC. 2007. 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. Pachauri RK, Reisinger A (eds). Intergovernmental Panel on Climate Change, Geneva, Switzerland.

Johnston R, Hoanh CT, Lacombe G, Noble A, Smakhtin V, Suhardiman D, Kam SP, Choo PS. 2009. Scoping study on natural resources and climate change in Southeast Asia with a focus on agriculture. Report prepared for the Swedish International Development Cooperation Agency. International Water Management Institute, Colombo, and WorldFish Center, Penang, Malaysia.

McSweeney C, New M, Lizcano G. 2008. Cambodia climate change profile. Oxford University, Oxford, UK. Available at http://country-profiles.geog.ox.ac.uk.

MOE. 2002. Cambodia's initial national communication to the United Nations Framework Convention on Climate Change. Ministry of Environment, Phnom Penh.

MOE. 2006. National adaptation programme of action to climate change. Ministry of Environment, Phnom Penh, Cambodia.

TKK, SEA START RC. (2009). Water and climate change in the Lower Mekong Basin: Diagnosis and recommendations for adaptation. Water and Development Research Group of Helsinki University of Technology and Southeast Asia START Regional Center of Chulalongkorn University. Water & Development Publications, Espoo, Finland.

WorldFish Center. 2007. Fisheries and aquaculture can provide solutions to cope with climate change. Issues brief. WorldFish Center, Penang, Malaysia.

Contact Details

The WorldFish Center
Jalan Batu Maung, Batu Maung,
11960 Bayan Lepas, Penang, MALAYSIA

Mail: P.O. Box 500, GPO 10670, Penang, MALAYSIA
Tel: (+60-4) 626 1606
Fax: (+60-4) 626 5530
E-mail: worldfishcenter@cgiar.org
Contact Person: Dr. Eric Baran
E-mail: e.baran@cgiar.org

Authors: E. Baran, N. Schwartz, Y. Kura
Photo Credit: A. Ribier, E. Baran, The WorldFish Center

Issues Brief No. 2008. The WorldFish Center. November 2009.

Design and layout: Scriptoria (www.scriptoria.co.uk)
Printed on 100% recycled paper

www.worldfishcenter.org

Reducing poverty and hunger by improving fisheries and aquaculture

© 2009 The WorldFish Center

All rights reserved. This brief may be reproduced without the permission of, but with acknowledgment to The WorldFish Center.

CGIAR

WorldFish CENTER