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# What I learned during my one-year sabbatical at USAID

米国国際開発庁での1年間サバティカル休暇で学んだレッスン

John Bower

ジョン バウアー



**USAID**  
FROM THE AMERICAN PEOPLE

**United States Agency for  
International Development**  
米国国際開発庁



**Japan International  
Cooperation Agency**  
国際協力機構



Climate change

気候変動





# Environmental changes

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Ocean warming  
海洋温暖化

Sea level rise  
海面上昇

Ocean acidification  
海洋の酸性化

# Environmental changes

## Impacts (影響)

Ocean warming  
海洋温暖化

Poleward shifts in plankton and fished species  
プランクトンと魚類の極地へのシフト

Changes in timing of phytoplankton blooms  
植物プランクトンの]大繁殖のタイミングの変化

Changing zooplankton composition  
動物プランクトンの組成の変化

Sea level rise  
海面上昇

Loss of coastal habitat  
沿岸生息地の喪失

Saline intrusion into freshwater habitats  
淡水の生息地に塩水侵入

Ocean acidification  
海洋の酸性化

Negative effects on calciferous animals  
石灰動物に悪影響

## Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change

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### Abstract

Previous projection of climate change impacts on global food supply focuses solely on production from terrestrial biomes, ignoring the large contribution of animal protein from marine capture fisheries. Here, we project changes in global catch potential for 1066 species of exploited marine fish and invertebrates from 2005 to 2055 under climate change scenarios. We show that climate change may lead to large-scale redistribution of global catch potential, with an average of 30–70% increase in high-latitude regions and a drop of up to 40% in the tropics. Moreover, maximum catch potential declines considerably in the southward margins of semienclosed seas while it increases in poleward tips of continental shelf margins. Such changes are most apparent in the Pacific Ocean. Among the 20 most important fishing Exclusive Economic Zone (EEZ) regions in terms of their total landings, EEZ regions with the highest increase in catch potential by 2055 include Norway, Greenland, the United States (Alaska) and Russia (Asia). On the contrary, EEZ regions with the biggest loss in maximum catch potential include Indonesia, the United States (excluding Alaska and Hawaii), Chile and China. Many highly impacted regions, particularly those in the tropics, are socioeconomically vulnerable to these changes. Thus, our results indicate the need to develop adaptation policy that could minimize climate change impacts through fisheries. The study also provides information that may be useful to evaluate fisheries management options under climate change.

**Keywords:** catch, climate change, fisheries, global, marine, redistribution

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### Introduction

Climate change is likely to affect the goods and services provided by ecosystems and its impacts on provisioning services such as food supply will have direct implication for the welfare of human society (e.g. Arfaoui *et al.*, 2005; Easterling *et al.*, 2007; Batistola & Napier, 2009). In terrestrial systems, using empirical and simulation modelling, food-crop production is projected to be negatively affected under the more intensive CO<sub>2</sub> emission scenarios, with most severe impacts projected for low-latitude

regions (e.g. Parry *et al.*, 2004, 2005; Fischer *et al.*, 2005; Easterling *et al.*, 2007). Similar projections for pastures and livestock production have also been made (Easterling *et al.*, 2007). Although such projections are uncertain, they allow analysis of potential socioeconomic vulnerability impacts on global food security and benefits and costs of climate change. In the marine biome, projections of climate change impacts on fisheries focus largely on a few species, regional climate variability and regime shifts, or qualitative intenseness of potential changes (e.g. Labeyrie, 2003; Lebedev *et al.*, 2005; Roessig *et al.*, 2004; Déniro *et al.*, 2005; Brandt, 2007). Despite the large contribution of marine capture fisheries to global animal protein supply (Pauly *et al.*, 2002; Food and Agriculture Organization (FAO), 2008), a global-scale projection of climate change impacts on marine fisheries is lacking.

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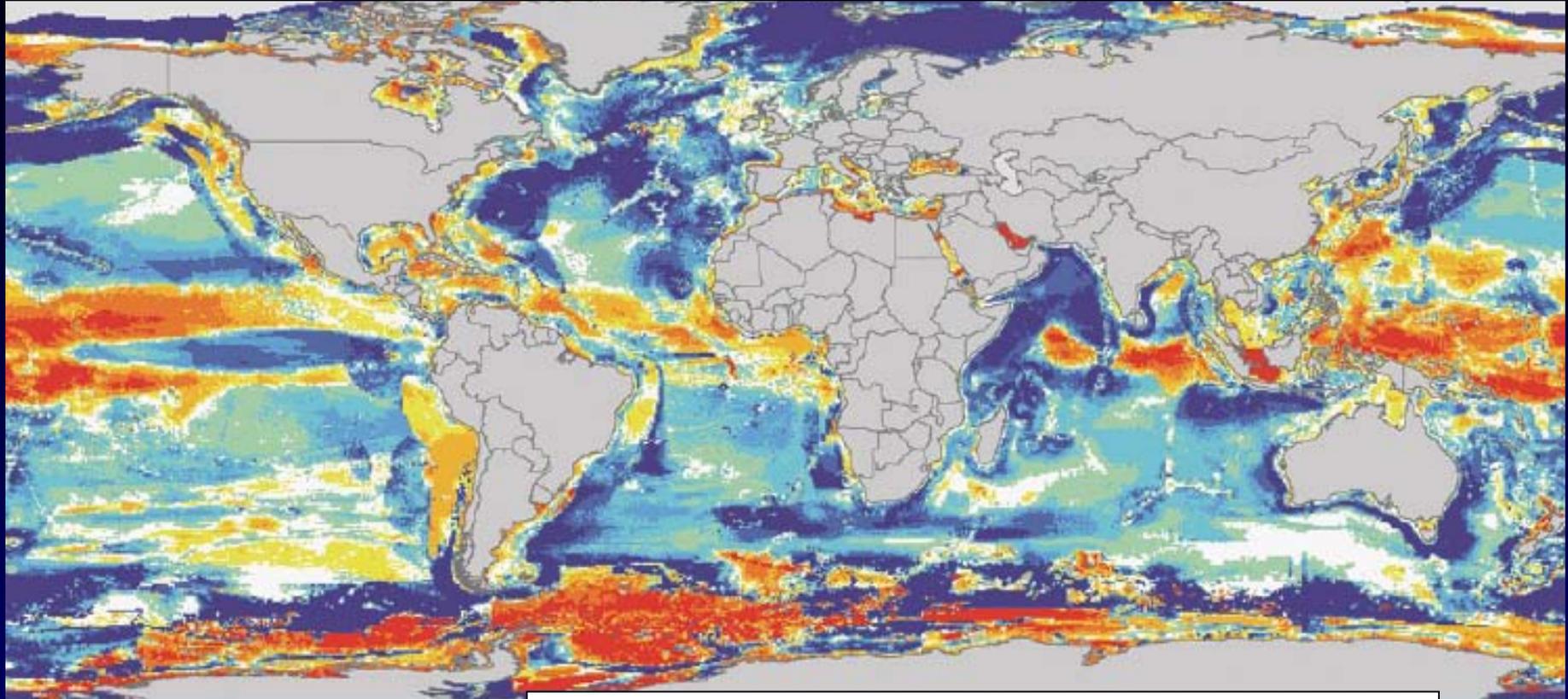
# Used several models to predict future changes in maximum fisheries potential (最大漁獲量の可能性)

Predict large regional changes in potential catch:

- in high-latitude (高緯度) regions: 30–70% increase
- in the tropics (熱帯地方): a drop of up to 40%

FIGURE 1. CHANGE IN MAXIMUM CATCH POTENTIAL FROM 2005 TO 2055 under the

2005年から2055年までの最大漁獲量の可能性を変更



Change in Catch Potential (% relative to 2005)

漁獲量の可能性を変更 (2005年に比例)

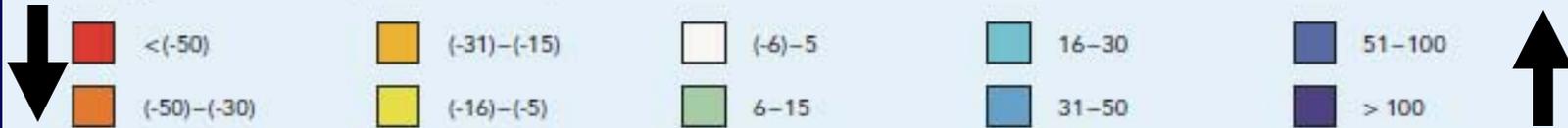
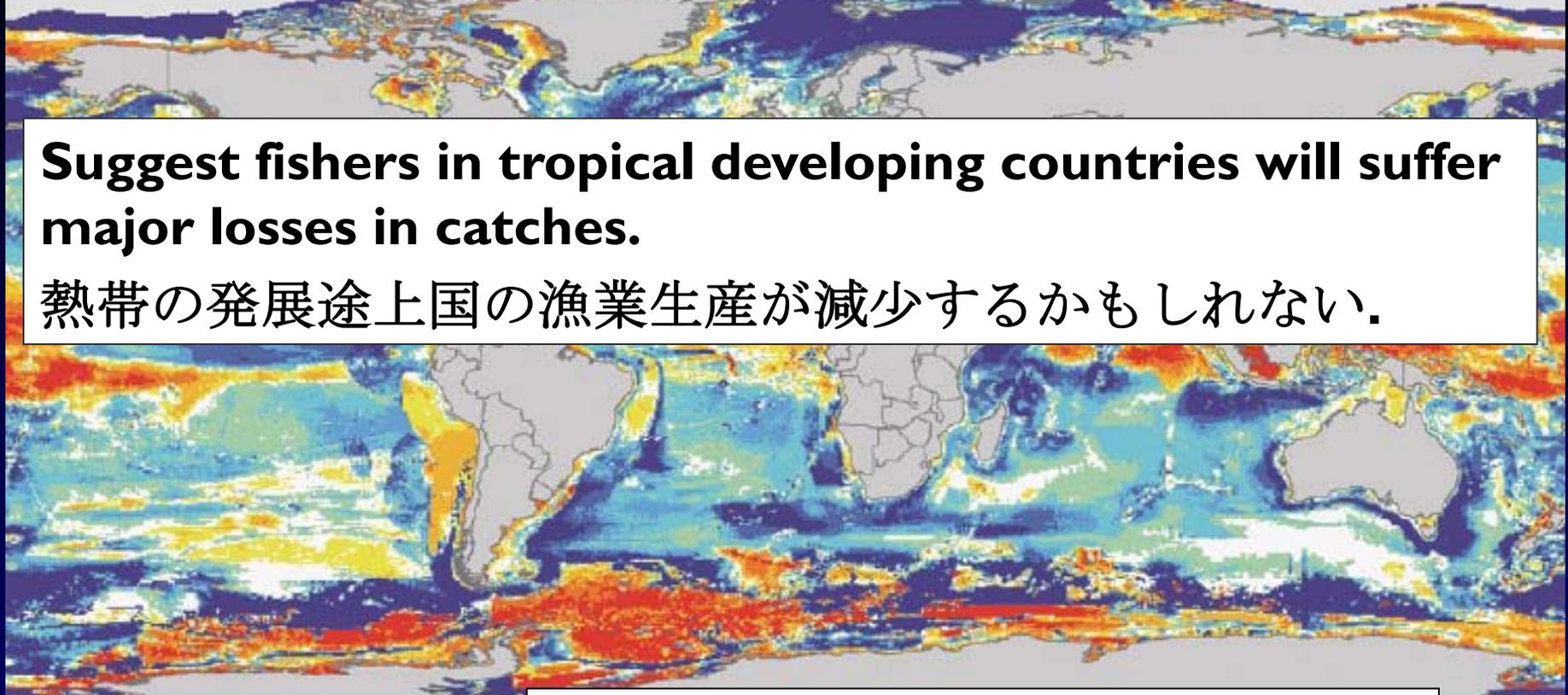


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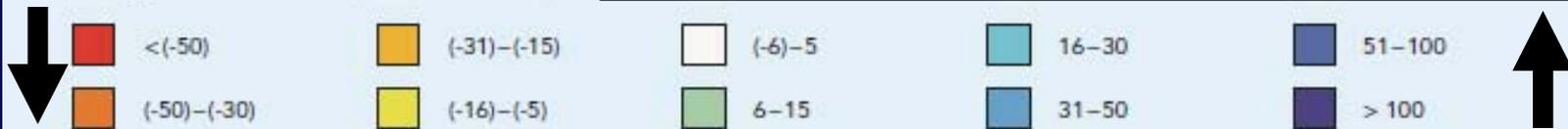
**Suggest fishers in tropical developing countries will suffer major losses in catches.**

熱帯の発展途上国の漁業生産が減少するかもしれない。



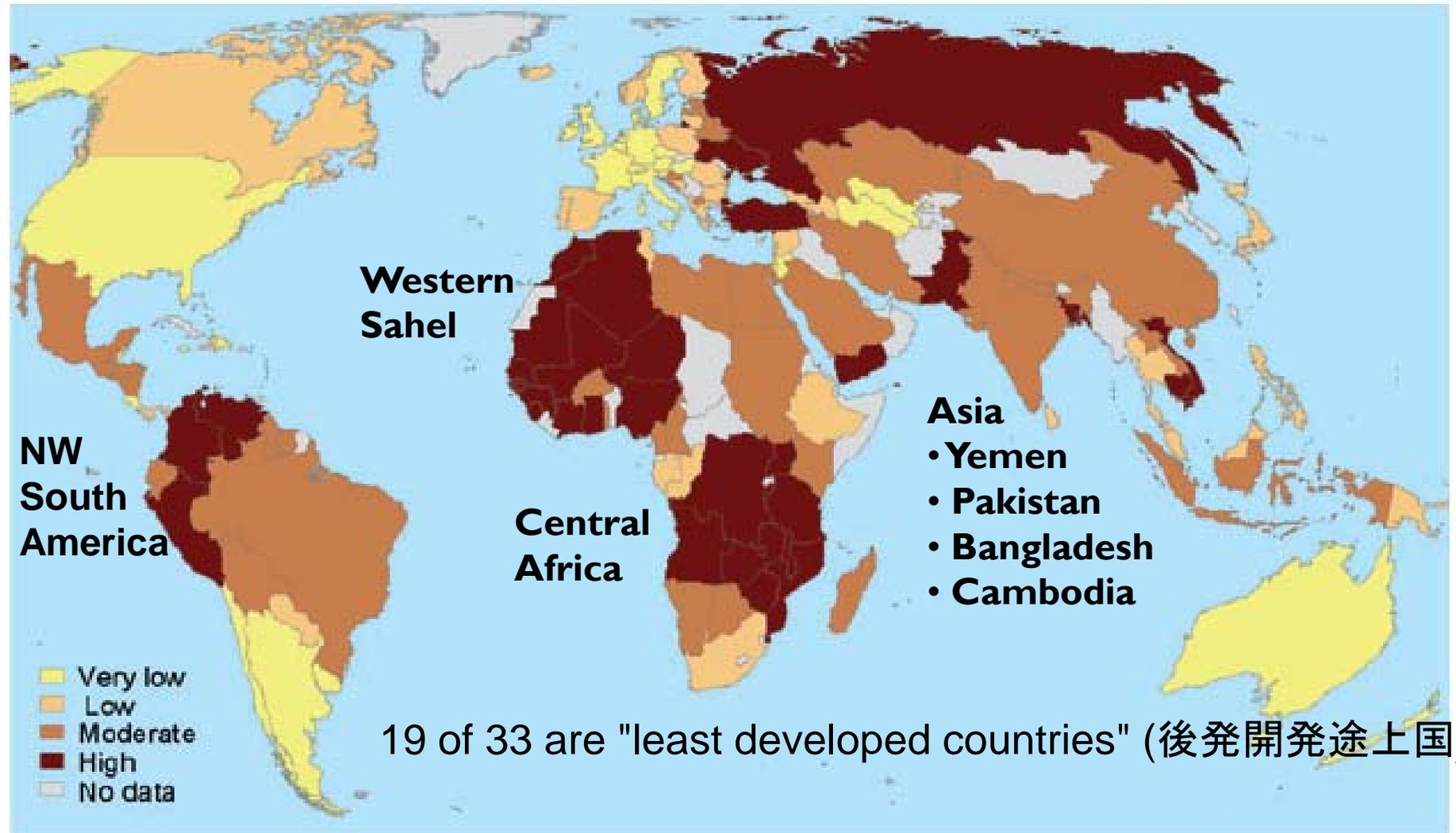
漁獲量の可能性を変更 (2005年に比例)

Change in Catch Potential (% relative to 2005)



# Nations most vulnerable to climate-induced changes in fisheries

気候変化によって引き起こされる漁業の変化に脆弱性の国





# Summary of what I learned

Potential impacts from climate change on fisheries have large implications for **global food security** (世界食料安全保障)

People in the tropics and subtropics likely will suffer most because:

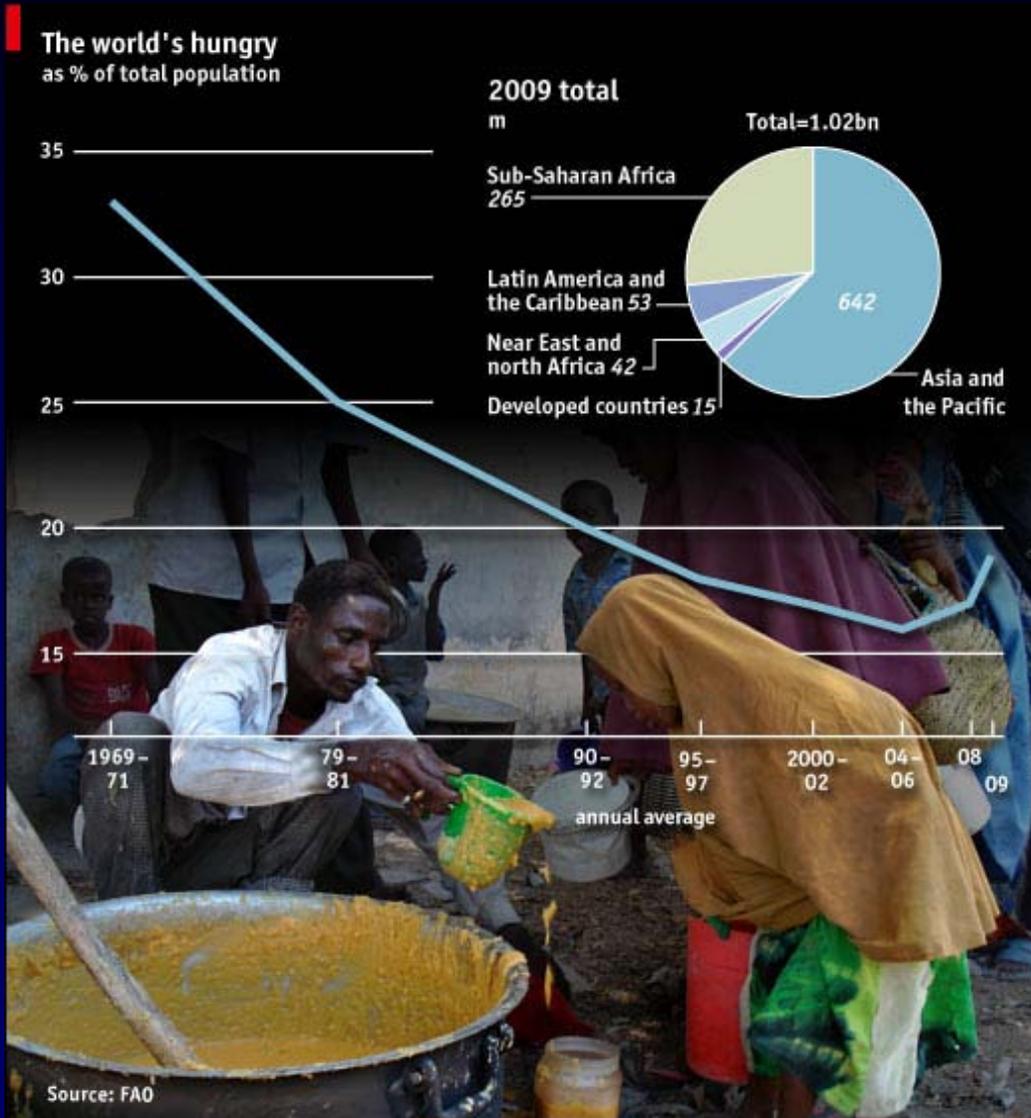
- 1) fish are important in their diets, and
- 2) they have limited capacity to develop other sources of income and food

What is needed:

- 1) to identify these vulnerable countries, and
- 2) to include the fish sector in plans for helping them cope with climate change

# Chronically hungry people in the world

## 世界の慢性的に飢餓状態にある人々の数



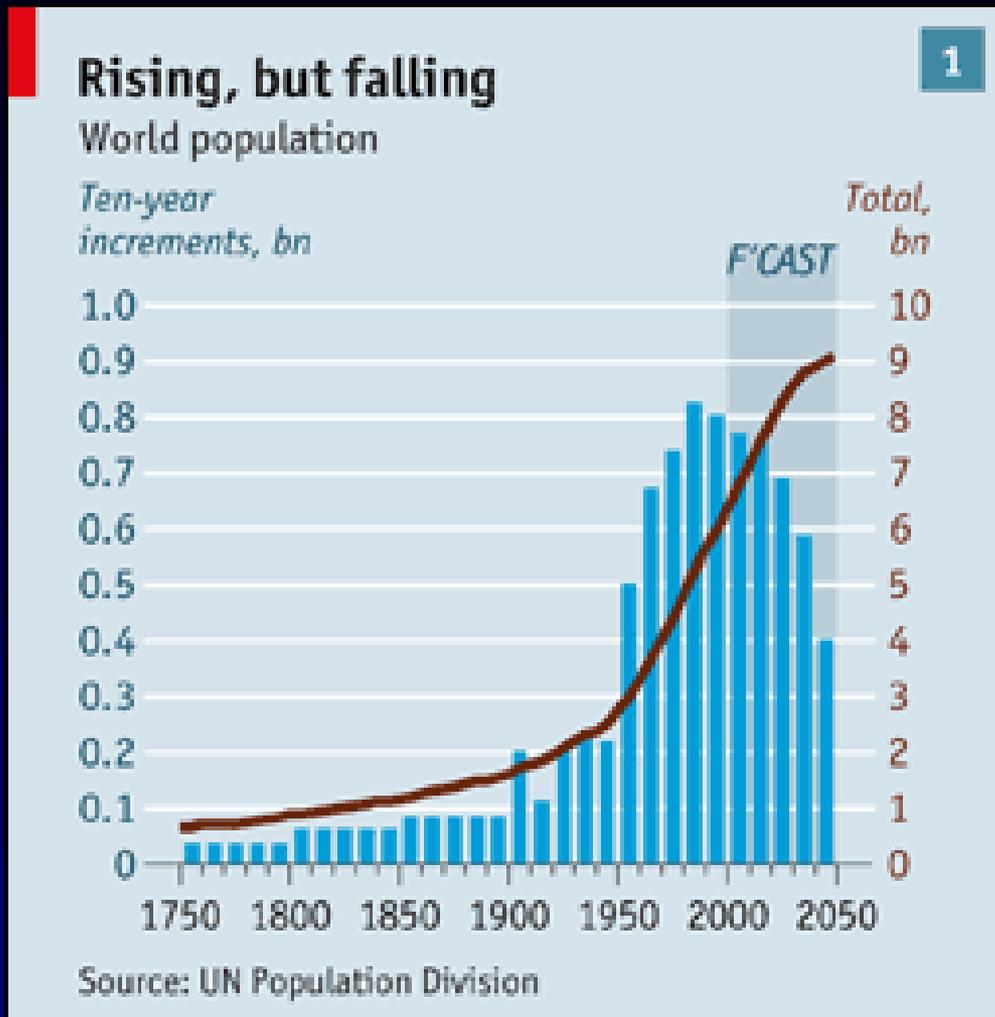
2008: 913 million  
9億1300万人



2009: 1.02 billion  
10億2000万人

(The Economist, 15 October 2009)

# 世界の人口



2009: 6.8 billion (68億)

2050: 9.1 billion (91億)

Global food output  
will have to increase  
**70% (FAO)**



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## **Climate Change Effects on Fish and Fisheries:**

**Forecasting Impacts, Assessing Ecosystem Responses, and Evaluating Management Strategies**