Assessing vulnerability to climate change at multiple scales: to what purpose and how?

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Outline

1. Vulnerability analysis – what is it used for and where did it come from?

2. VA frameworks in the climate change arena – IPCC

3. Example applications at global, regional and national scales

4. Challenges and recent trends in vulnerability analysis

5. Links to adaptation and mitigation actions

Defining vulnerability

"Vulnerability is the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt" (Adger, 2006)

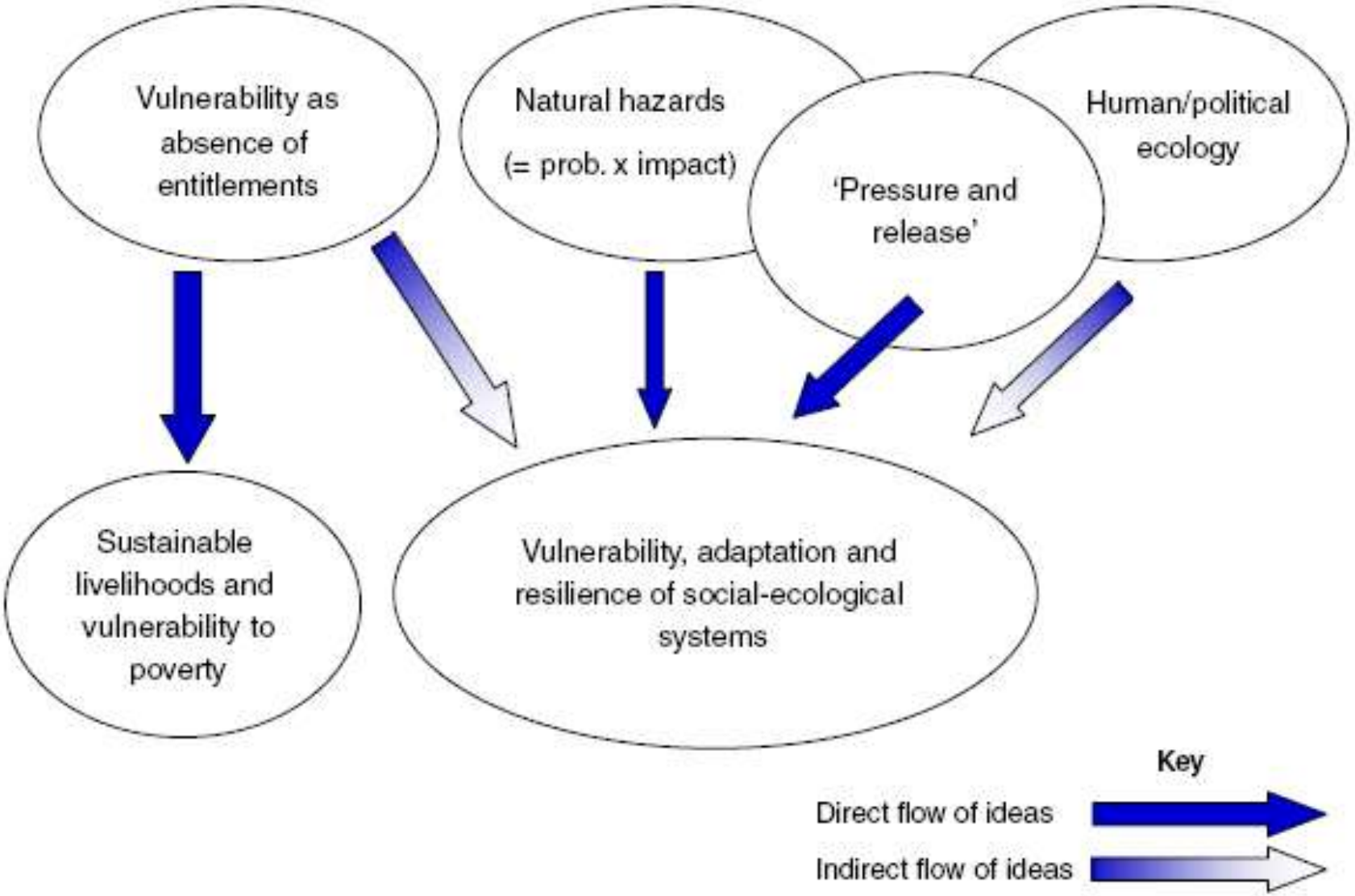


Fig. 1. Traditions in vulnerability research and their evolution.

Vulnerability of what (or whom) to what?

- *Vulnerability of people* – individuals, social groups, households, communities, provinces, nations
- *Vulnerability of human activities* – agriculture, fishing, tourism, transport, habitation etc.
- *Vulnerability of places* – low-lying coasts, enclosed seas, deltas, coral reefs
- *Vulnerability to particular stressors/hazards*: natural disasters, global environmental change, change in general

IPCC Vulnerability analysis framework

(Allison et al. 2009 derived from IPCC 2001)

EXPOSURE

Nature and degree to which countries are *exposed* to predicted climate change

SENSITIVITY

Degree to which economies & people are likely to be affected by fishery-related changes

POTENTIAL IMPACTS

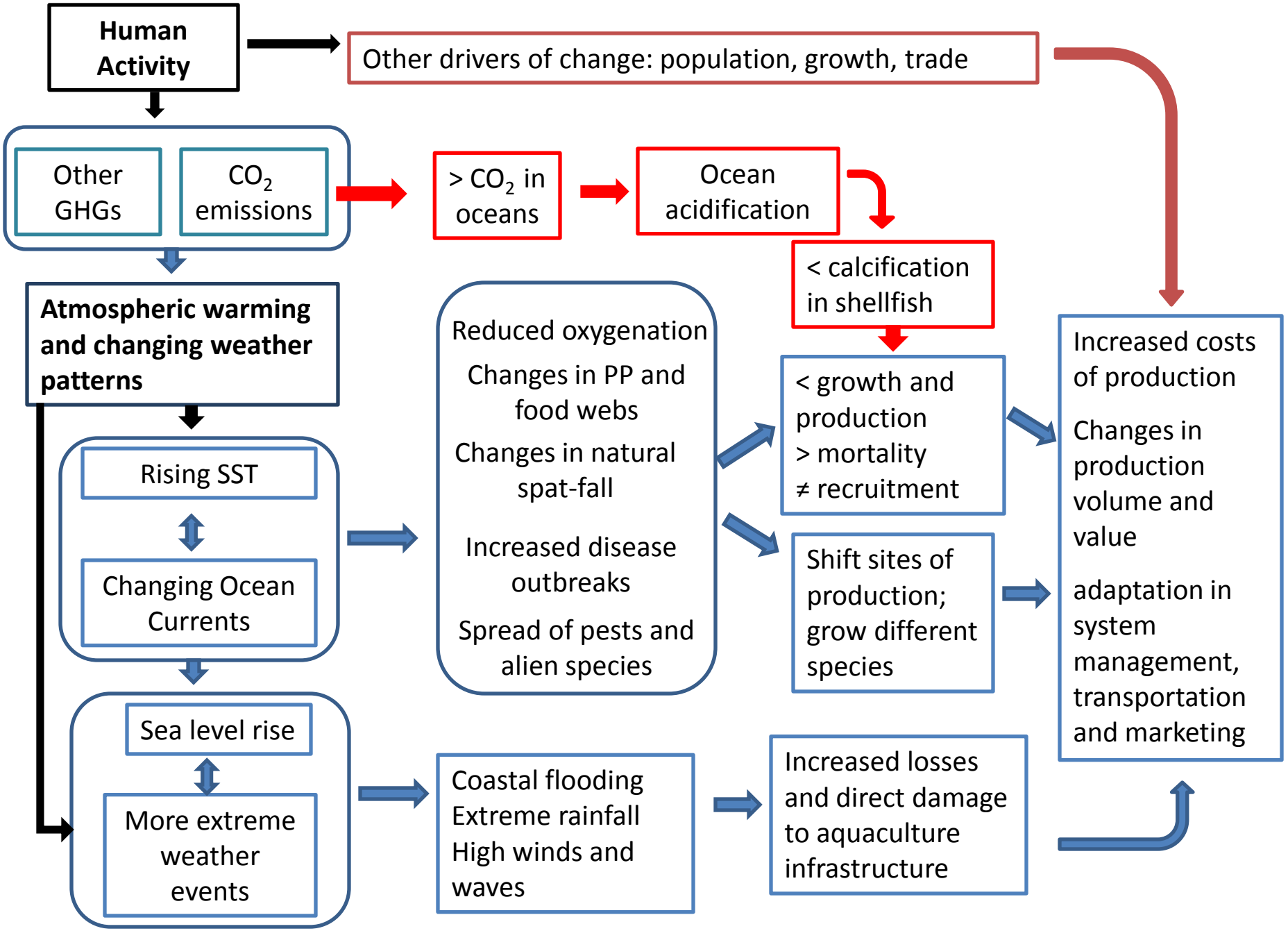
All impacts that may occur without taking into account planned adaptation

ADAPTIVE CAPACITY

Abilities and resources to cope with climate-related changes

VULNERABILITY

Multiple pathways of impact: climate change and mollusc aquaculture (Allison et al., 2011)



Components of vulnerability: data sources and methods

Exposure

- 2050 surface temperatures (HadCM3 model, 2 scenarios)

Sensitivity (Fisheries dependency – marine and inland)

- Landings and contribution of fisheries to employment, exports and dietary protein (FAO, World Bank)

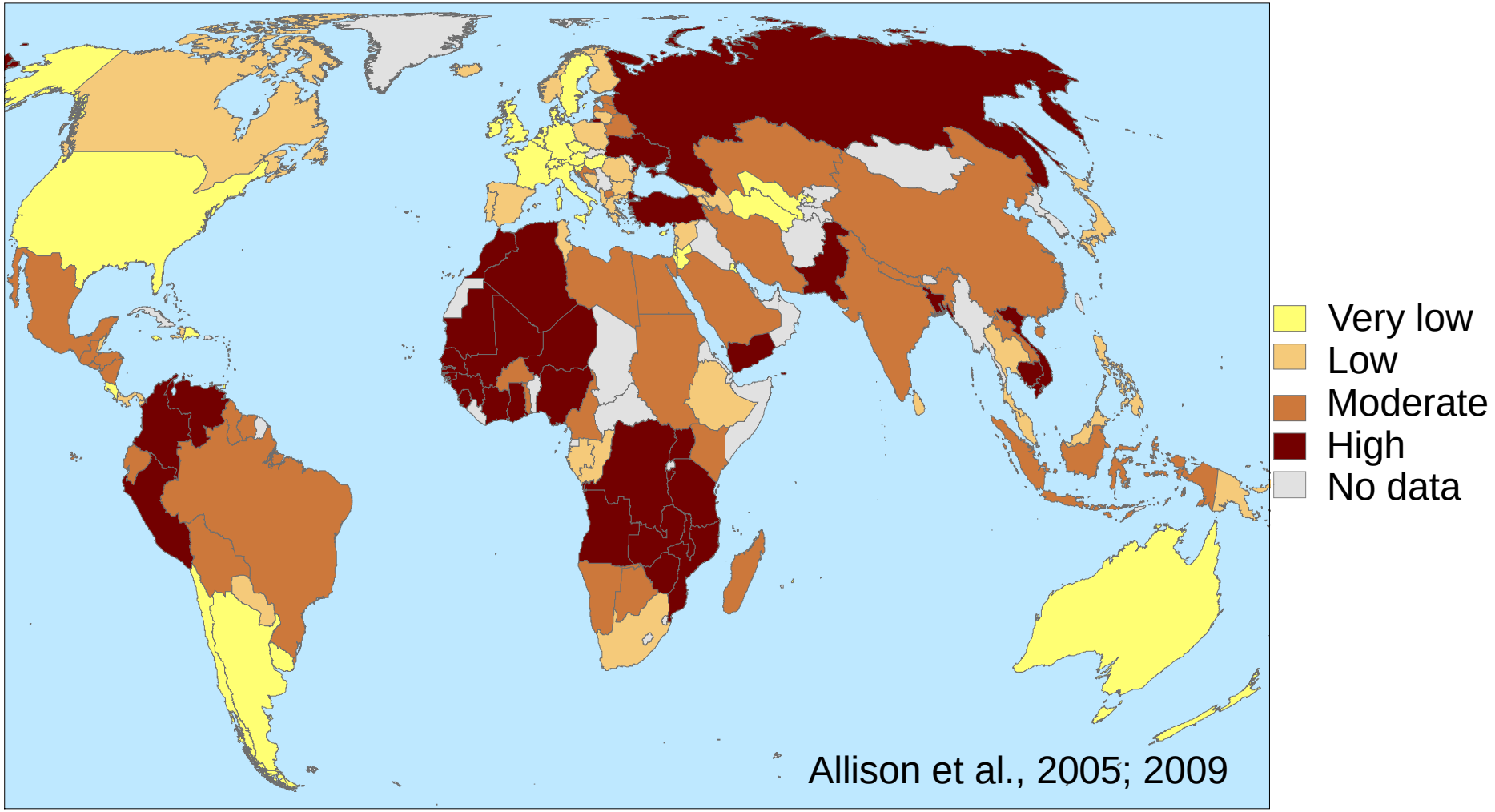
Adaptive capacity

- Human development indices (health, education, governance, and economy size)

Vulnerability

- 132 nations
- Robust to different methods of weighting and combination

Vulnerability index – Global



Relative vulnerability of national economies to any potential change in their fisheries resulting from climate change

2/3 of most vulnerable are Least Developed Countries

Fisheries and aquaculture policy

Climate adaptation and mitigation policy

Oceans Day at Copenhagen

The Importance of Oceans, Coasts, and Small Island Developing States in the Climate Regime

December 14, 2009

8:00 to 22:00

Venue: European Environment Agency, Copenhagen

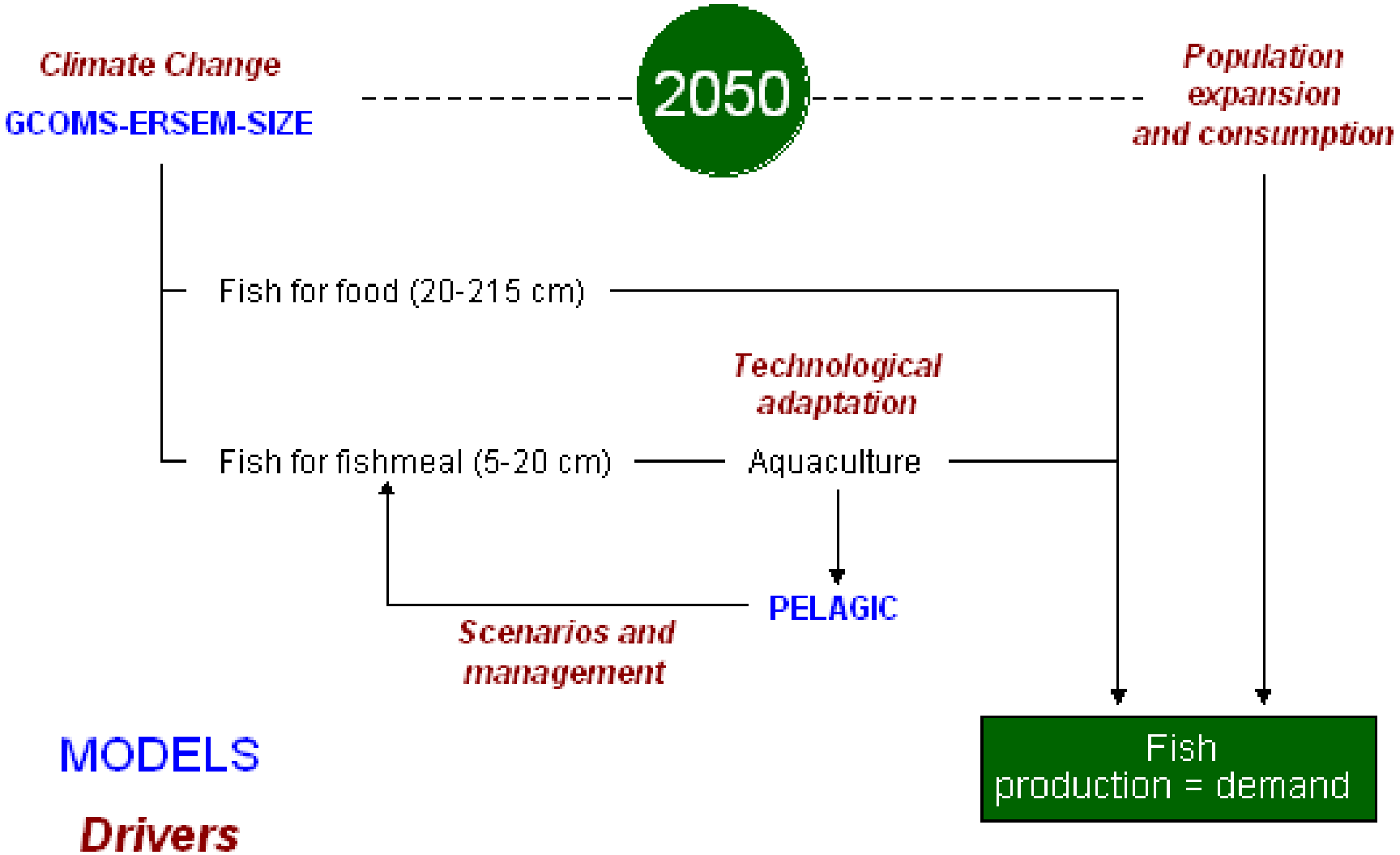
Featuring H.S.H. Prince Albert II of Monaco
Indonesian Minister Dr. Fadel Muhammad
Grenada's UN Ambassador Dr. Dessima Williams
US NOAA Administrator Dr. Jane Lubchenco
and other World Leaders

Can current and anticipated demands for fish and seafood be met in a changing climate?

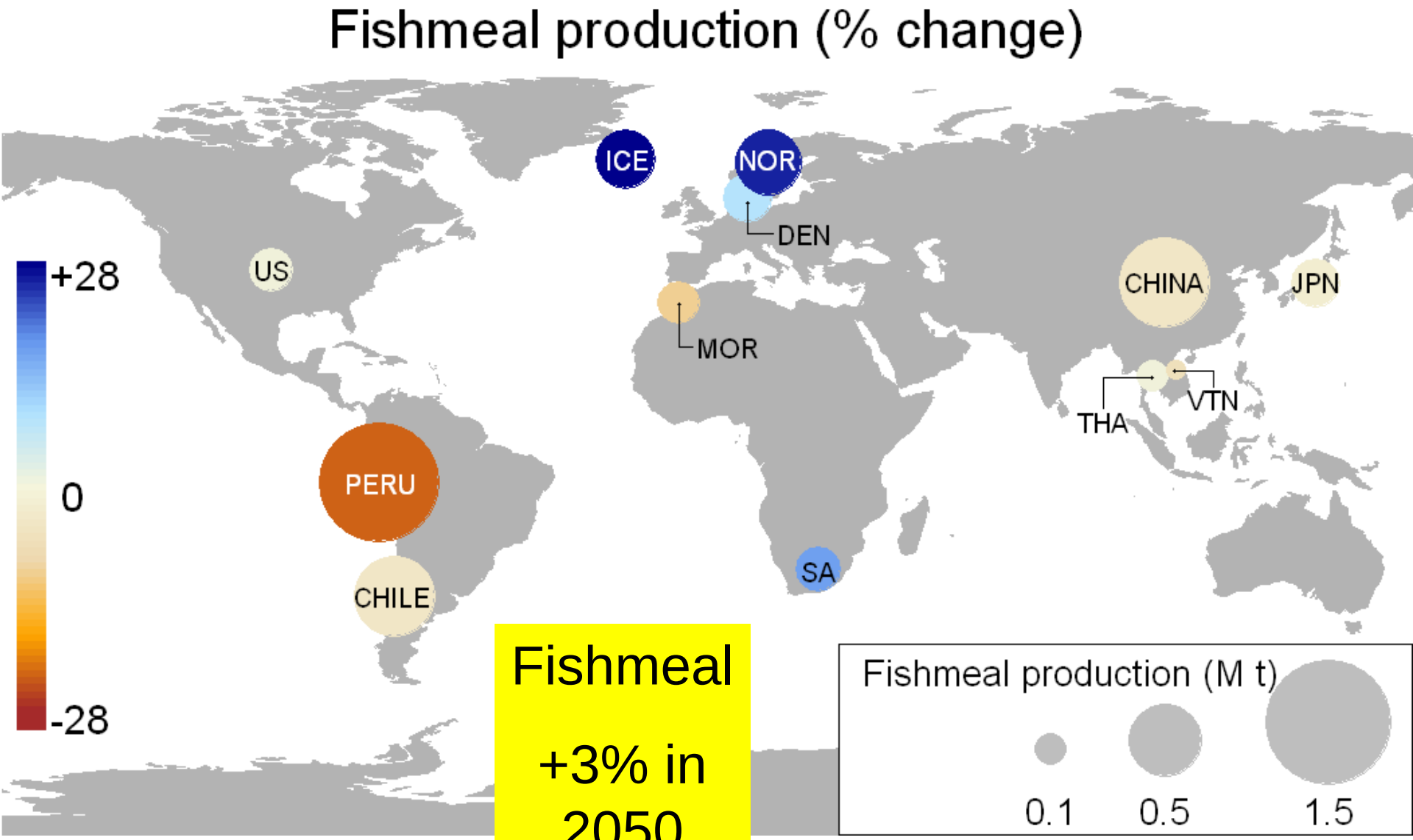
- World population to increase to 9.3 Billion by 2050
- Fish provides protein, minerals and vitamins (17kg/cap/yr)
- Marine capture fisheries close to maximum capacity
- Aquaculture growing faster than population in the last 30 years, specially in Asia

Modelling framework

20 countries with LMEs producing 80% of global catch



Climate change and reduction fisheries



Fishmeal

+3% in 2050

Conclusions of the study

- *CC and marine fisheries* ~ Food fish production +6.5%, Fishmeal +3% by 2050
- *Aquaculture:* Likely to produce enough fish to maintain and increase current consumption if recent trends in feed technology continue. FIFO would need to reduce to 50% of current.
- *Capture fisheries:* management efficiency also required to secure fish for direct consumption and for feed (likely).
- Aquaculture impacts could be transferred from fisheries to terrestrial commodities (e.g soya).
- A potential impacts study, rather than a vulnerability analysis (similar to most in fishery sector, e.g. Cheung et al., 2009; 2010)

Merino *et al* (2012) Can aquaculture meet global seafood demand in changing climate? *Global Environmental Change* 22

Vulnerability analysis: country scale/province - Vietnam

EXPOSURE (E)
Sea level rise: % of province area flooded
Temperature rise: Avg temperature increase relative to 1980-99
Rainfall change: Annual rainfall change relative to 1980-99
Coastal extreme events: Aquaculture area damaged, due to storms & typhoons 1989-2008
Floods: Aquaculture area damaged by floods, 1989-2008

DEPENDENCY (D)
Direct livelihood: % hh engaged in aquaculture
Indirect employment: employees in fishery enterprises as % of total enterprise employees
Macro-economics: Fish output as % of country GDP; seafood export processing facilities
Food security: Per capita annual fish & shrimp consumption

ADAPTIVE CAPACITY (AC)
Poverty: % of population below poverty line; % of hh monthly food expenditure spent on fish & shrimp
Infrastructure: Telephone lines per 100 people; # of hospital beds per 1000 people
Education: Graduates of 2o education as % of total candidates
Disaster response to CC: # of disaster management programs; DRM investments in construction projects; DRM investments in non-construction projects
Social capital: share of fishery cooperatives as % of national total
Education: % of fishery employees with education

Black: Generic; Red: CC related; Blue: aquaculture sector

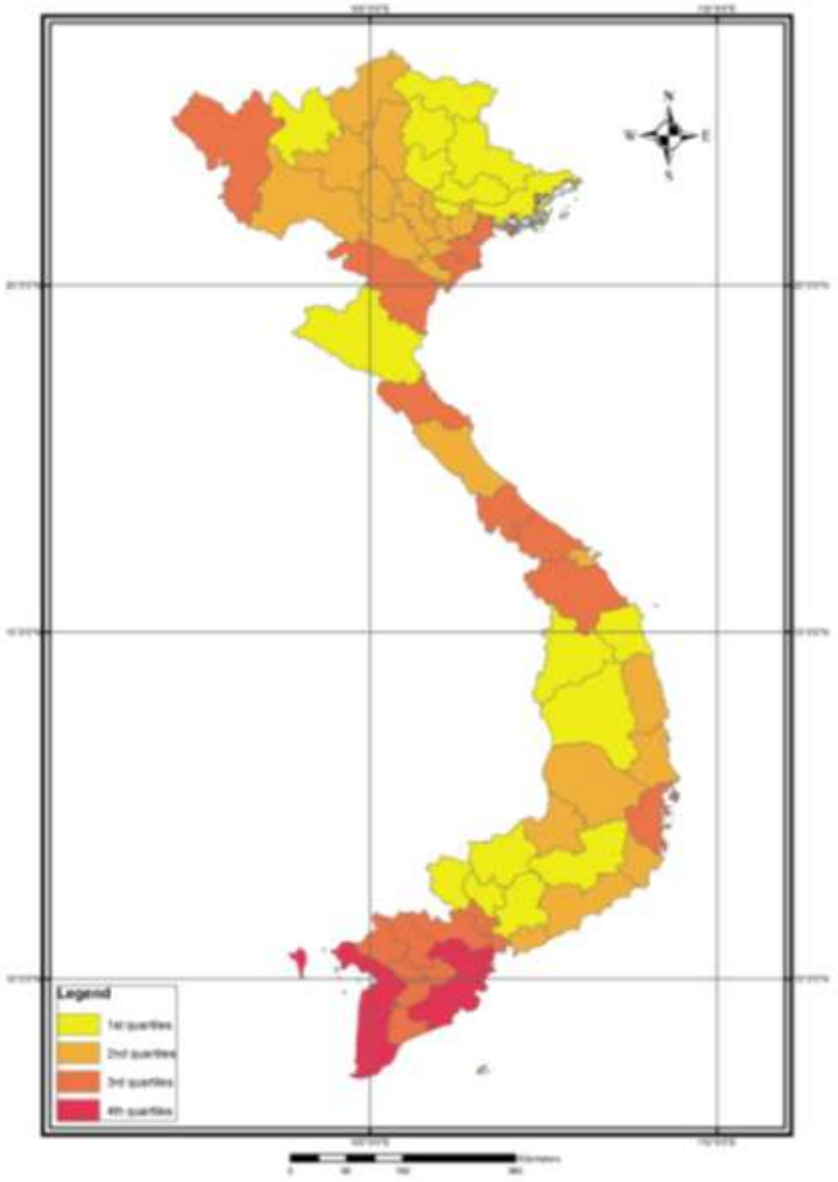
POTENTIAL IMPACTS (PI)
- impacts that will occur without adaptation

PI = f(E,D)

VULNERABILITY
-the nature & extent of losses incurred by the aquaculture sector due to CC

V = f(PI, AC)

Vulnerability indices by Province, Vietnam



Provinces most vulnerable to climate-induced changes in the aquaculture sector are in the Mekong Delta, Red River Delta and Central Province

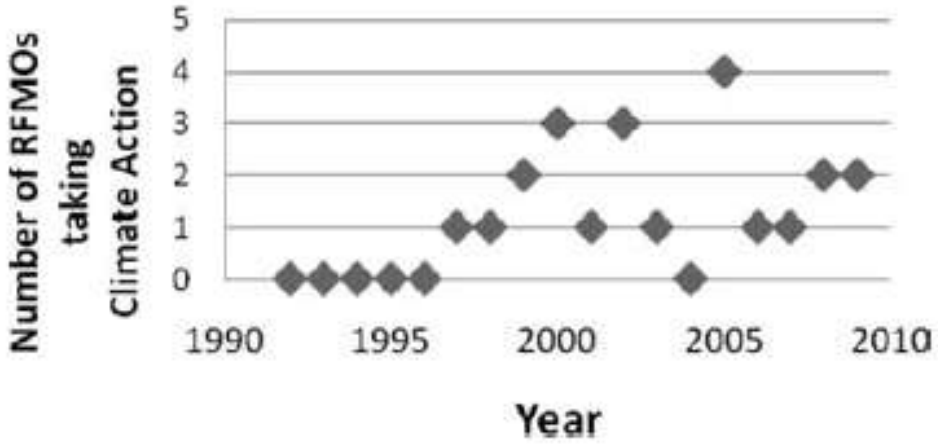
Badjeck et al., 2012. WorldFish Center

Some trends in vulnerability analysis

- More detailed analysis of single impact pathways (e.g. fisheries production, acidification, flooding and drought)
- Regional downscaling of climate models enabling analysis at scales relevant to action
- Resolution/separation of biophysical and social/economic impact
- Climate change in context - Simultaneous analysis of multiple stressors or drivers of change (globalization, urbanization, food security etc)
- Bottom up- analysis: what can vulnerable people do and what have they done already to adapt? Focus on decision-making capacities and political feasibility
- Global/regional /cross-sectoral analysis: informing NAPAs and other large-scale adaptation responses; identifying mitigation potentials
- Political ecology/political economy of climate change responses

Vulnerable when politically and financially convenient?

Axelrod, M. (2011) Climate change and global fisheries management: linking issues to save ecosystems or protect political interests? *Global Env. Politics* **11**(3): 64-84



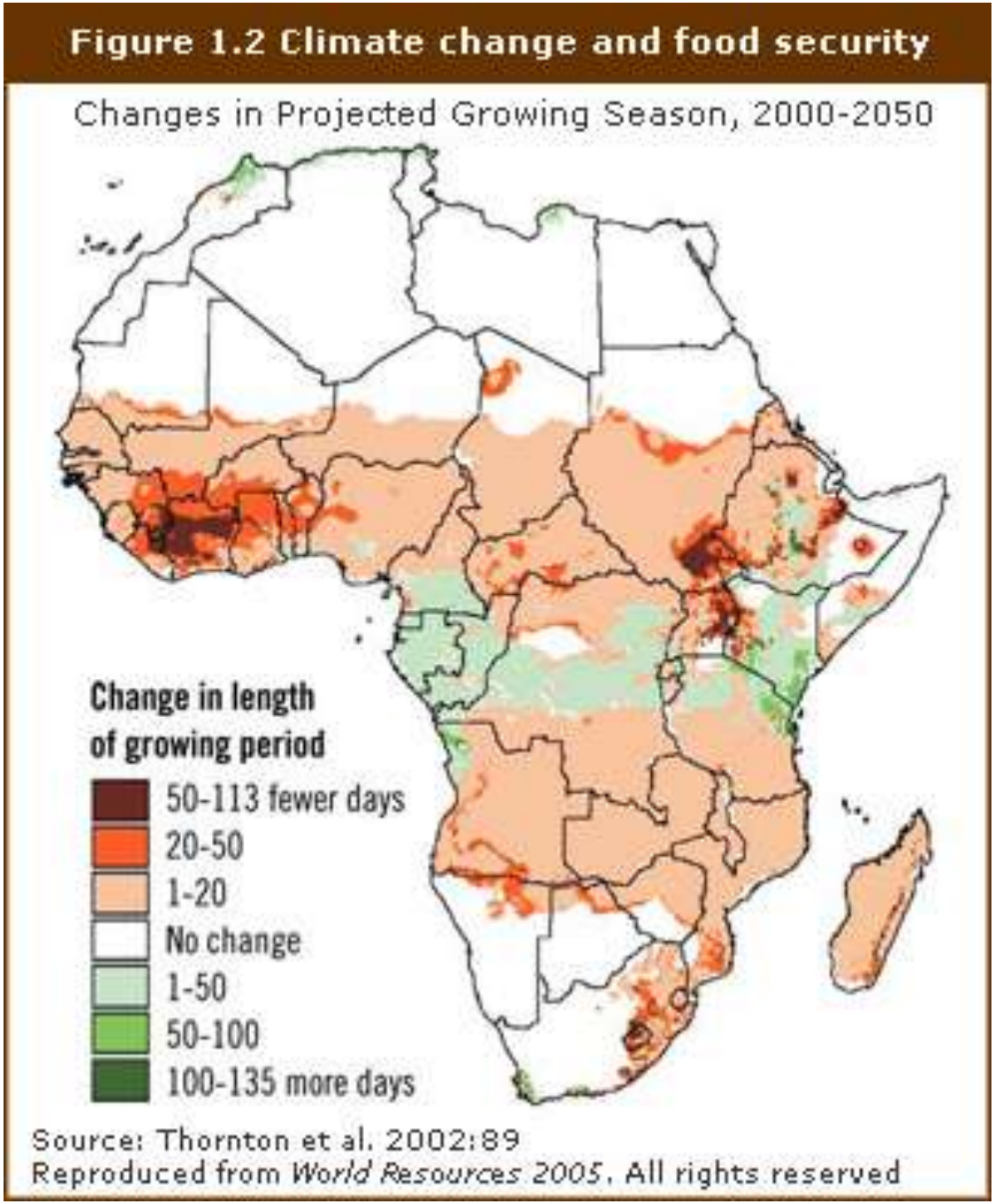
- RFMOs linking climate change to resource management is "bandwagoning …. to provide strategic cover for the pursuit of other political interests"
- More climate vulnerable countries are actually less likely to take action on climate change through RFMOs (1994-2009), due to overriding concern with setting catch limits and negotiating access agreements to their EEZs
- Major fishing nations, often with distant water fleets, push to adopt a climate change agenda ('more research') to distract from discussions about catch limits

Application of vulnerability analysis: Food security and poverty reduction

CCAFS Objectives

CLIMATE CHANGE AGRICULTURE AND FOOD SECURITY

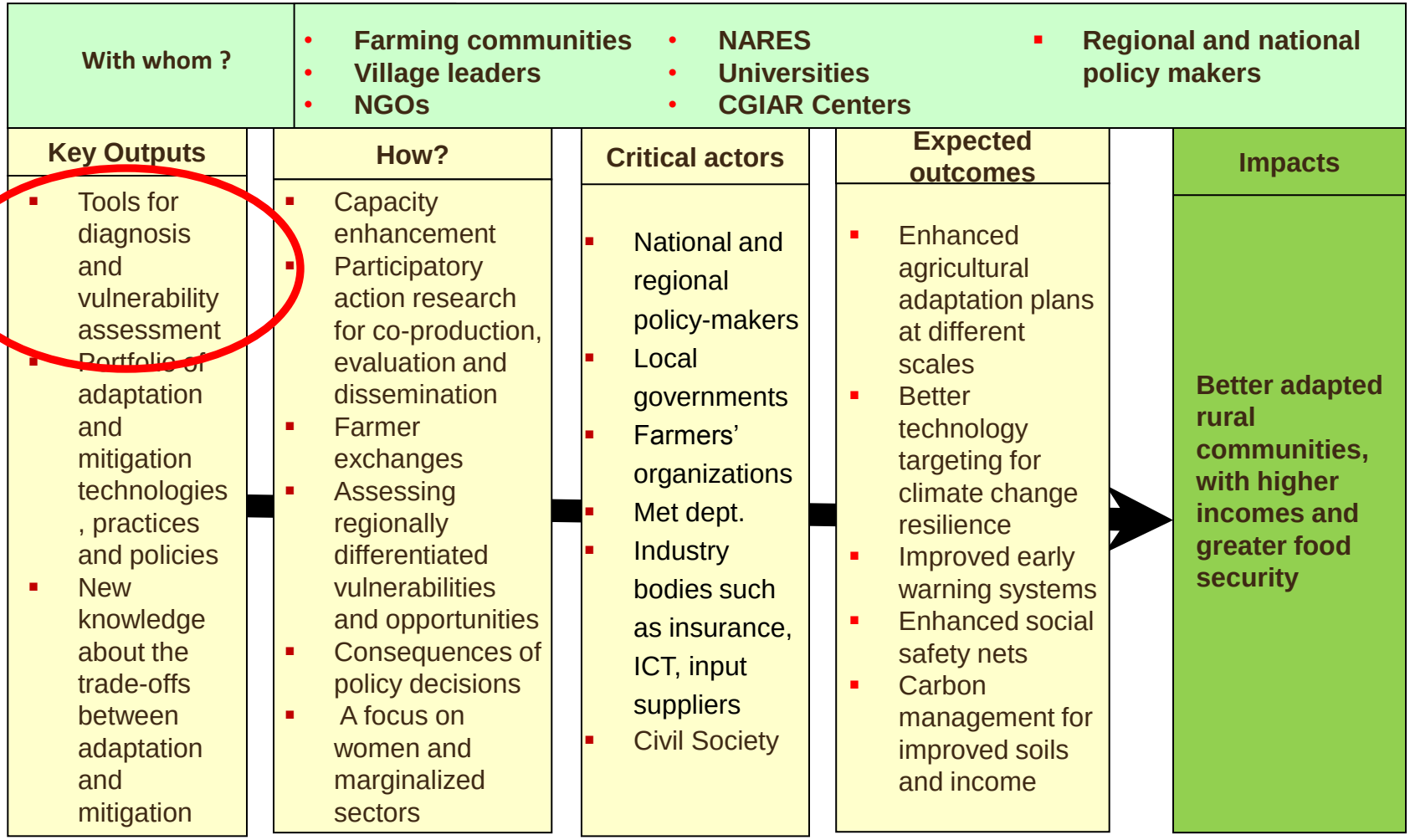
1. Identify and develop **pro-poor adaptation and mitigation practices, technologies and policies** for agriculture and food systems.
2. Support the inclusion of agricultural issues in **climate change policies**, and of climate issues in **agricultural policies**, at all levels.



Starting from climate risk exposure…

Regional Engagement for Integrated Agricultural Development:

Generic Impact Pathway



Synthesis

Combine top-down and bottom up analysis, keeping indicators simple, pathways of impact clearly defined and policy/practice objectives in focus

Many climate-change adaptations in fisheries are ‘no regrets’ actions and detailed VA to justify them may not be necessary

Ability to anticipate, plan for and react to change and surprise is required in all climate(and other) futures; supporting governance systems with these capacities is a higher priority than refining VAs