

Vulnerability assessments in fisheries social-ecological systems: some experiences in their development and implementation for adaptation planning

Results of a PaCFA workshop

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BCC regional project development inception workshop on building resilience in Benguela Fisheries and Aquaculture

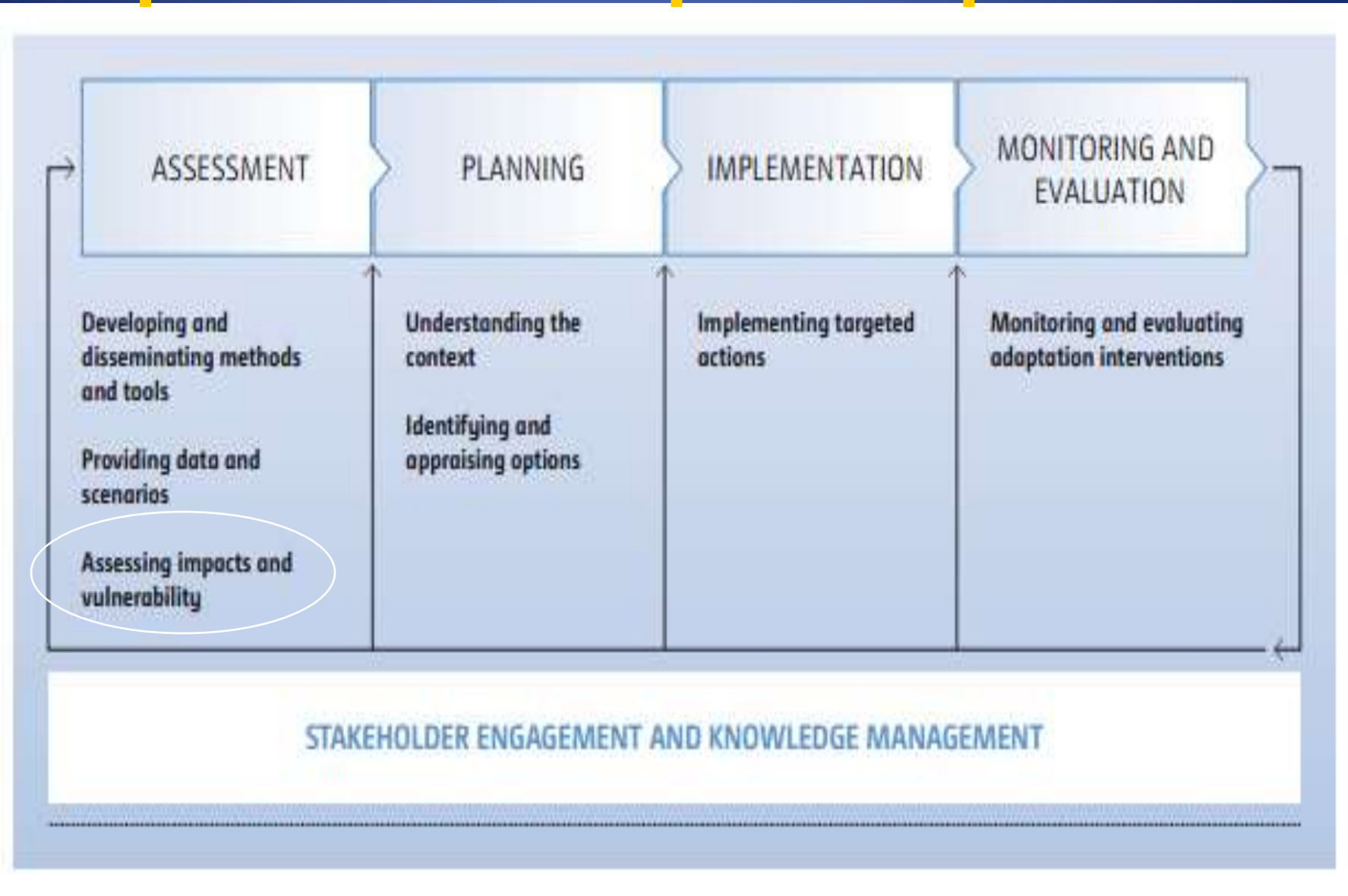
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Outline

- *Why do a vulnerability assessment?*
- *How are different groups approaching VA?*
- *The IPCC VA framework*
- *Some examples of VA in fisheries*
- *Some good VA principles and steps*
- *Some concluding thoughts*

As part of an adaptation process



Why do a vulnerability assessment?

The main purpose of vulnerability analysis is to improve targeting and effectiveness of adaptation actions:

- Who are the vulnerable people\species and how can their vulnerability be reduced?
- Where are the vulnerable ecosystems? Can their capacity to adapt be supported by resource management?
- Where will the economic consequences of vulnerability of fishery systems be felt most? How can we plan to minimize those consequences?
- Where will climate change create new opportunities and bring benefits? For whom?

Vulnerability of what-whom to what?

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

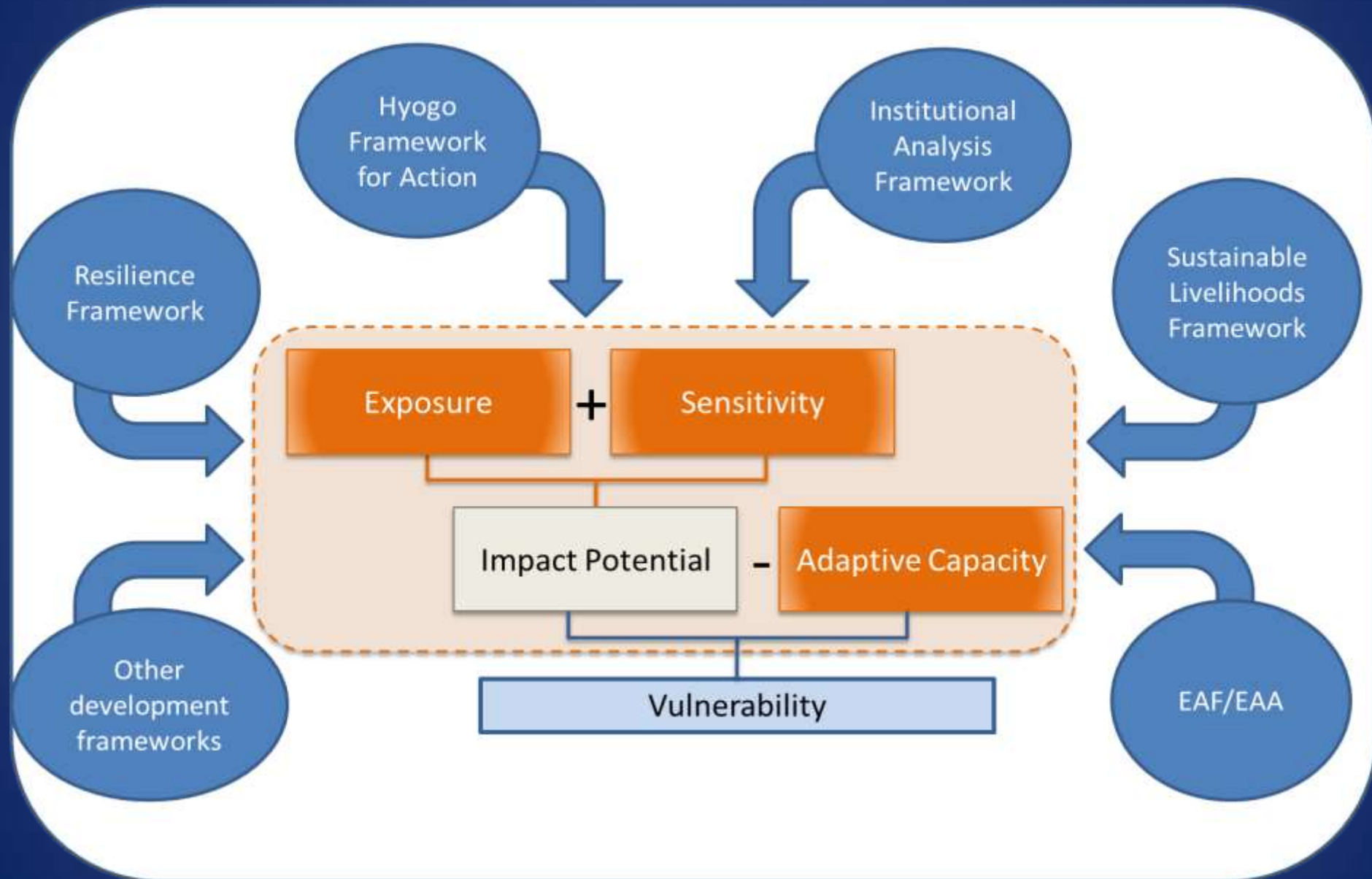
Different schools of thought/perspectives

	Risk/hazard	Political economy/ecology	Resilience
Key focal questions	What are the hazards? What are the impacts? Where and when?	How are people and places affected differently? What explains differential capacities to cope and adapt? What are the causes and consequences of differential susceptibility?	Why and how do systems change? What is the capacity to respond to change? What are the underlying processes that control the ability to cope and adapt?
Key attributes	Exposure, sensitivity	Capacity, sensitivity, exposure	Thresholds of change, reorganization, capacity to learn and adapt
System (unit of exposure)	Places, sectors, activities, regions	Individuals, households, social groups, communities, livelihoods	Ecosystems, coupled human-environmental system
Scale	Regional, global	Local, regional, global	Landscapes, ecoregions, multiple scales

Different Disciplines

	Outcome vulnerability	Contextual vulnerability
Root problem	Climate change	Social vulnerability
Policy context	CC mitigation, compensation, technical adaptation	Social adaptation, sustainable development
Vulnerability and adaptive capacity	Adaptive capacity determines vulnerability	Vulnerability determines adaptive capacity
Starting point of analysis	Scenarios of future climate hazards	Current vulnerability to climatic stimuli
Main discipline	Natural sciences	Social sciences
Meaning of vulnerability	Expected net damage for a given level of global climate change	Susceptibility to climate change and variability as determined by socio-econ factors

The IPCC generic VA framework

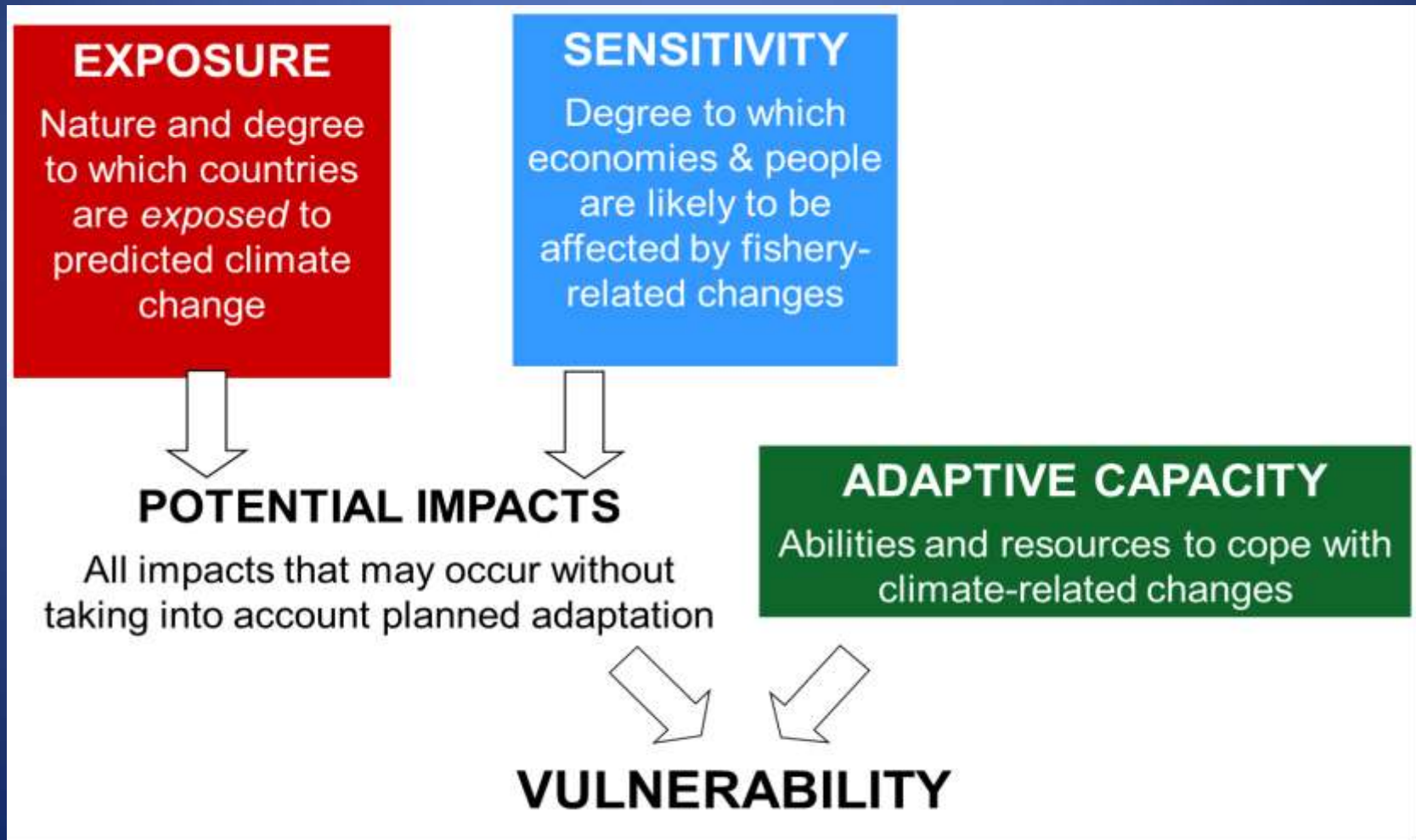


3 examples of VA in marine fisheries
and 1 in aquaculture

Example 1. Allison, et al. 2005, 2009

Vulnerability Question:

How are national economies vulnerable to potential climate change impacts arising through their fisheries?



Data 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)

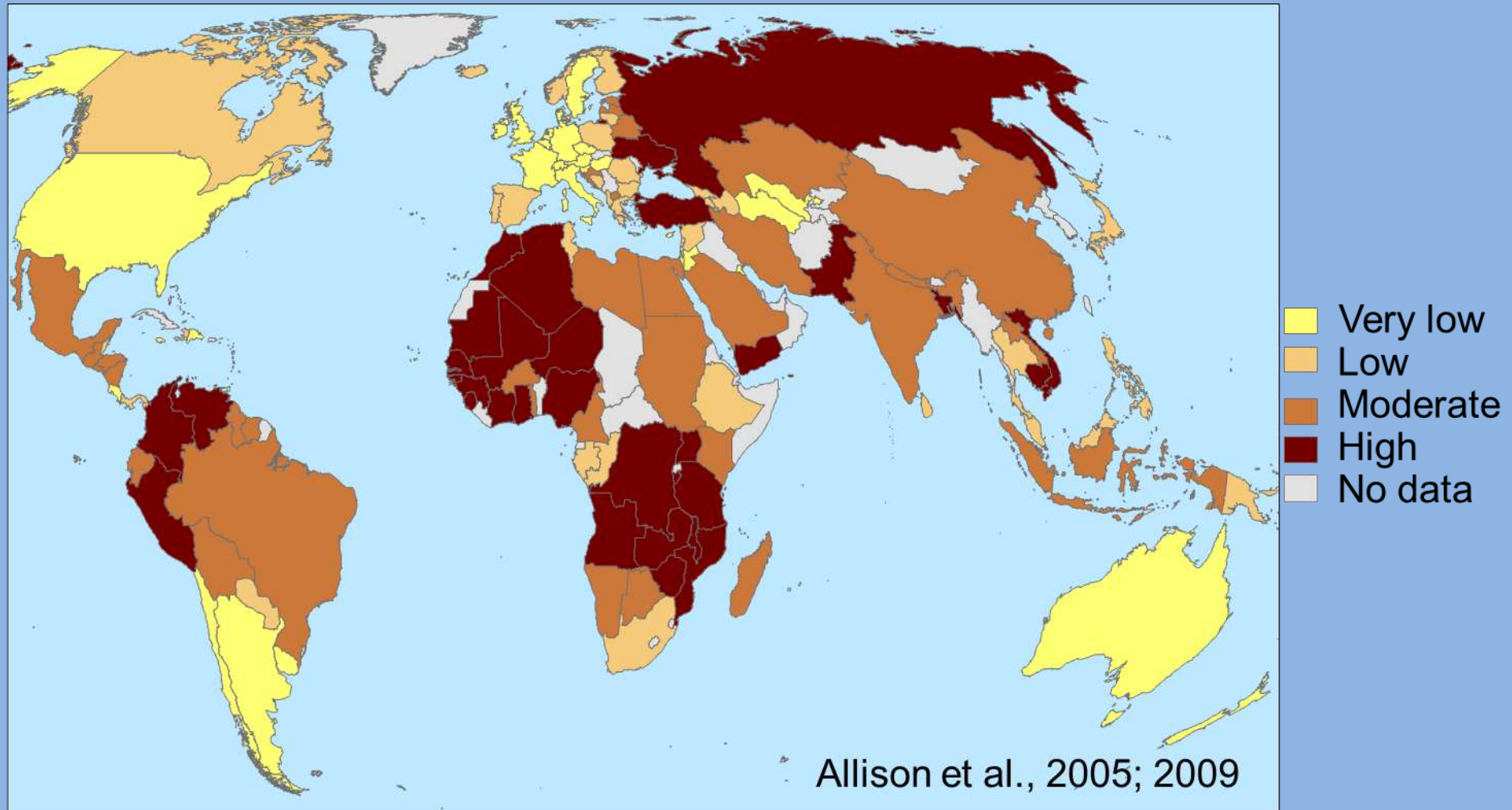
Adaptive capacity

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

Vulnerability = E + S - AC

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

Graphical presentation of relative vulnerabilities

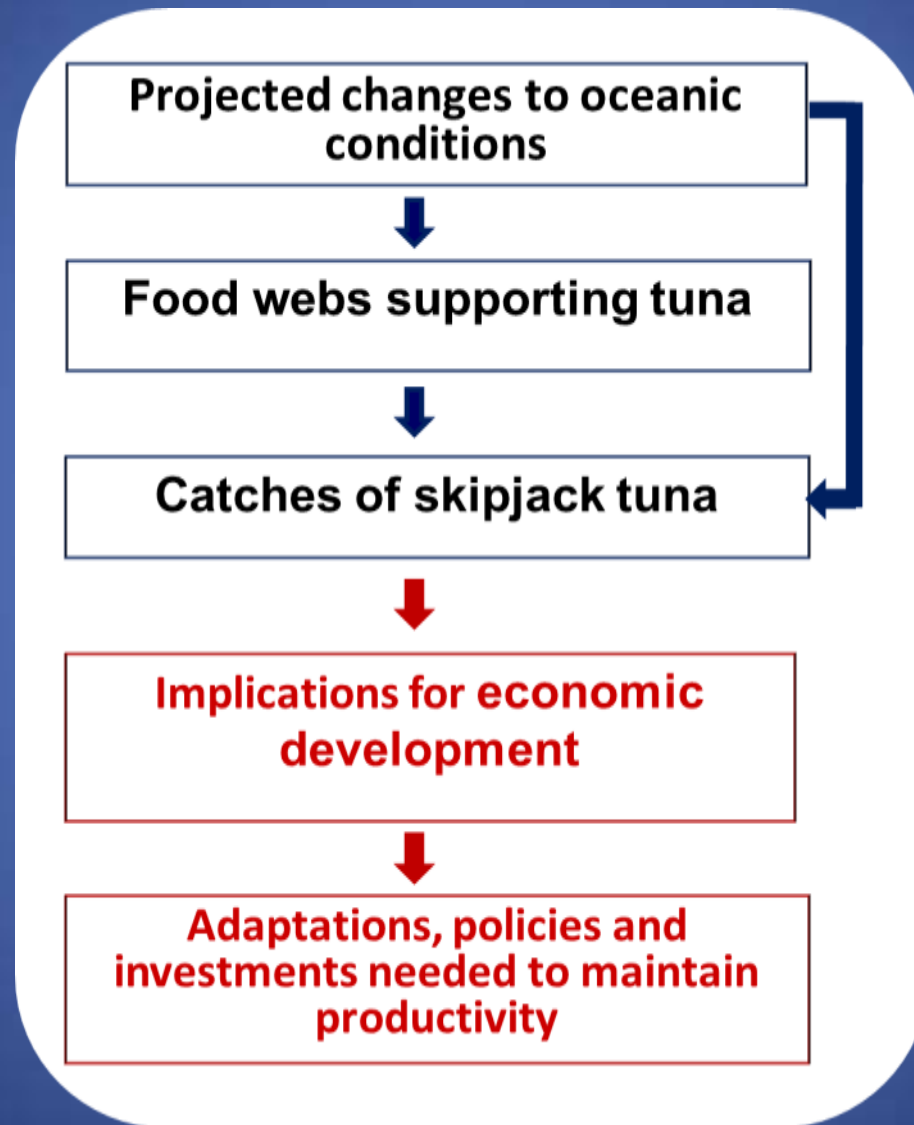


Example 2: Bell et al, 2012

Vulnerability Question:

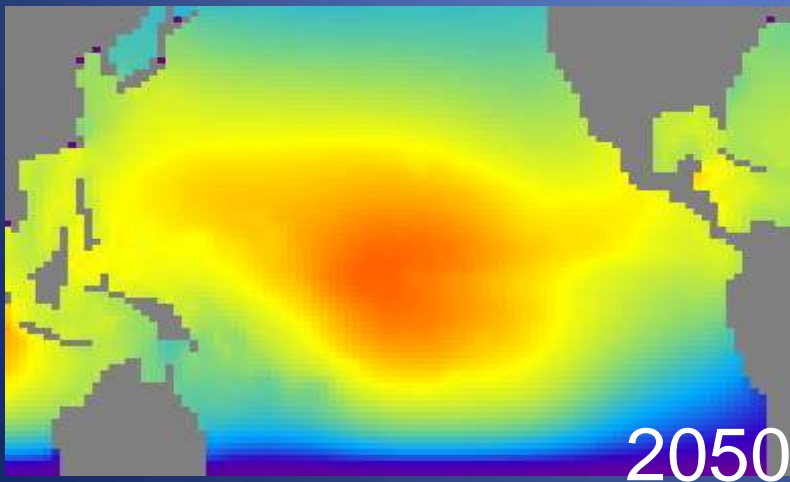
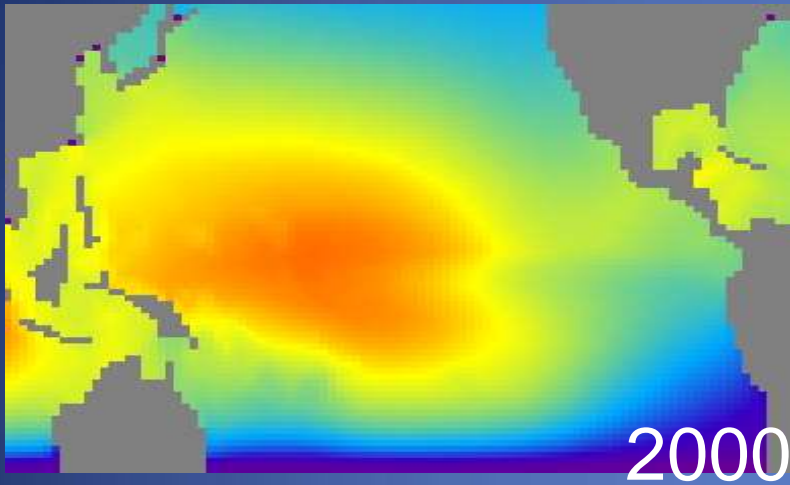
How are Pacific SIDS economies vulnerable to CC through potential changes in tuna fisheries?

Approach used



Projected effects on skipjack tuna

A2 emissions scenario



Redistribution east due to:

- Increases in sea surface temperature in eastern Pacific
- Shift of prime feeding areas to the east

Expected benefits of losses (% change from 1999-2008 period)

PICTs	1999–2008		2035		2050		2100	
	L	U	L	U	L	U	L	U
Government revenue								
FSM	6	12	+1	+2	0	+1	-1	-2
Kiribati	30	50	+11	+18	+13	+21	+7	+12
Nauru	10	25	+2	+6	+2	+5	0	0
Palau	2.5	3.2	+0.2	+0.3	0	+0.1	-0.7	-0.9
Tokelau	2	15	+1	+9	+1	+10	+1	+9
Tuvalu	10	25	+4	+9	+4	+10	+2	+6
GDP								
American Samoa	20	25	+3	+6	+2	+4	-1	-2
Marshall Islands	10	25	+2	+6	+2	+6	+1	+2
PNG	1.5	4	0	+0.1	-0.2	-0.4	-0.4	-1.2
Solomon Islands	2	5	+0.1	+0.2	-0.1	-0.3	-0.3	-0.8

Data and methods

Potential impact = Exposure x Sensitivity (PI = E x S)

Exposure estimated from projected change in tuna catch

Sensitivity estimated as average contribution to gov't revenue and GDP

Adaptive capacity (AC) estimated from four indices – health, education, governance and the size of the economy

Vulnerability

In PICTs where contributions from tuna expected to decrease or increase:

Vulnerability = PI x (1-AC) or = PI x AC

Comparative benefits and vulnerabilities

proj. changes in industrial catches of skipjack tuna under A2

PICT	2035	2050	2100
PNG	+ Very low	- Very low	- Very low
Solomon Islands	+ Very low	- Very low	- Low
FSM	+ Low	+ Very low	- Low
Kiribati	+ Very high	+ Very high	+ Very high
Marshall Islands	+ Low	+ Low	+ Low
Nauru	+ Moderate	+ Moderate	- Very low
Palau	+ Very low	+ Very low	- Very low
Tokelau	+ High	+ High	+ Very high

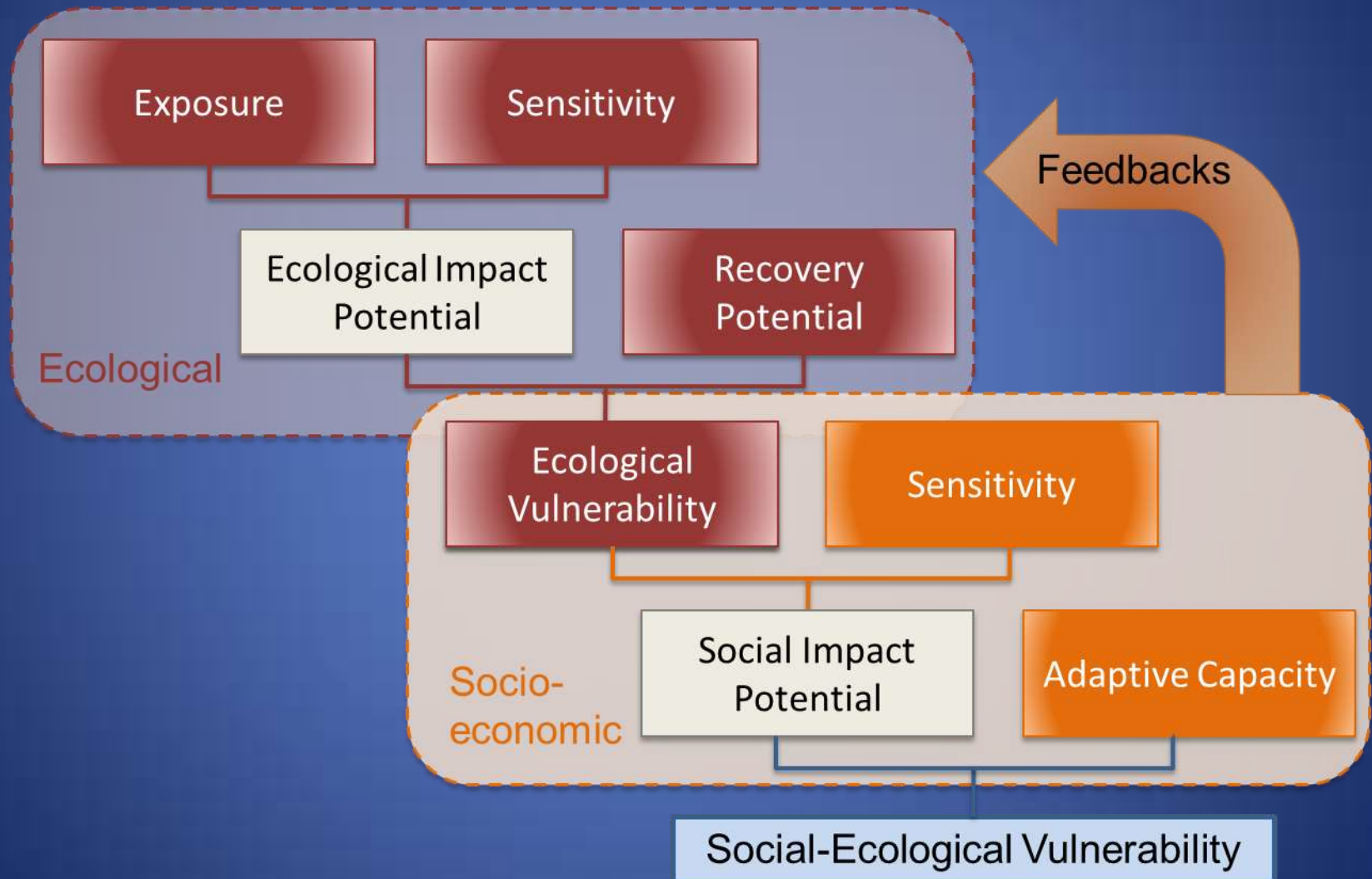
(+) benefit, (-) vulnerability to negative economic impacts

Example 3: Cinner et al, 2013

Vulnerability Question:

What is the Social-ecological vulnerability of coral reef fisheries to climate change?

Ecological V nested in Socio-economic V



Methods– ecological vulnerability

Ecological exposure – based on temp, currents, temperature, light, tidal variation, chlorophyll, water quality - Site-specific index of bleaching stress

Ecological Sensitivity – 2 indicators

- Susceptibility of coral community to bleaching
 - Using genus-specific bleaching sensitivity (McClanahan et al. 2007 MEPS)
- Susceptibility of fish community to population declines associated with coral habitat loss from bleaching
 - Using species-specific climate vulnerability index (Graham et al. 2011 Ecology Letters)

Ecological Recovery Potential

- 5 indicators for corals, 6 indicators for fish species

Methods- Social vulnerability

Social Exposure = Ecological Vulnerability

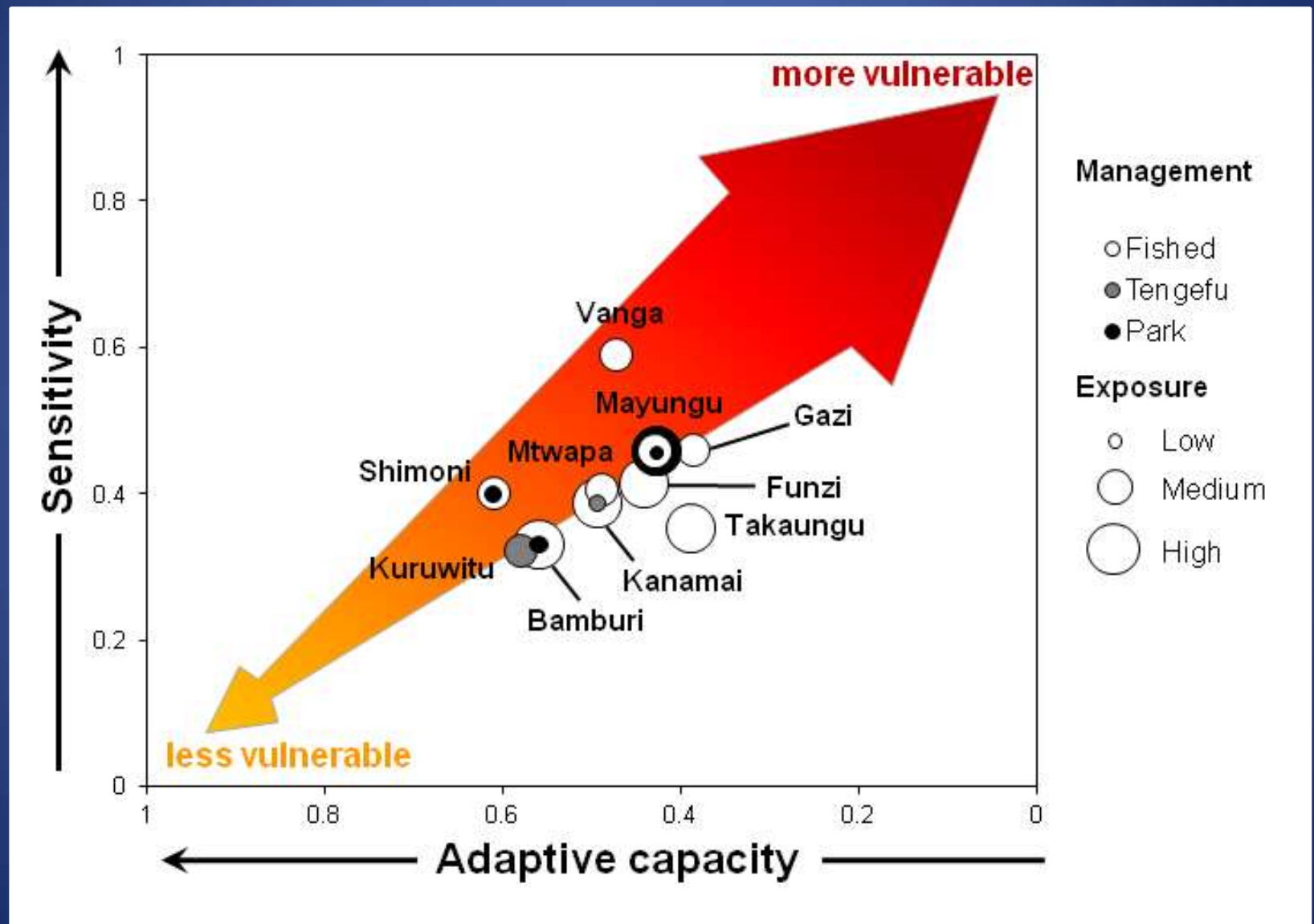
Social Sensitivity - 2 indicators:

- Livelihood sensitivity: dependence on marine resources
- Gear sensitivity: data on how susceptible the catch composition of different gears is to coral bleaching

Social adaptive capacity – 11 indicators:

- 1) Recognition of causal agents impacting marine resources
- 2) Access to credit
- 3) Occupational mobility
- 4) Occupational multiplicity
- 5) Social capital
- 6) Material assets
- 7) Technology
- 8) Infrastructure
- 9) Debt levels
- 10) Trust of community members, local leaders, police, etc
- 11) Capacity to anticipate change and to develop strategies to respond

Social-ecological vulnerability evaluated for 10 Kenyan communities



Example 4: Badjeck et al, 2012

Vulnerability Question:

How is the Vietnamese aquaculture sector vulnerable to climate change?

Data and methods

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

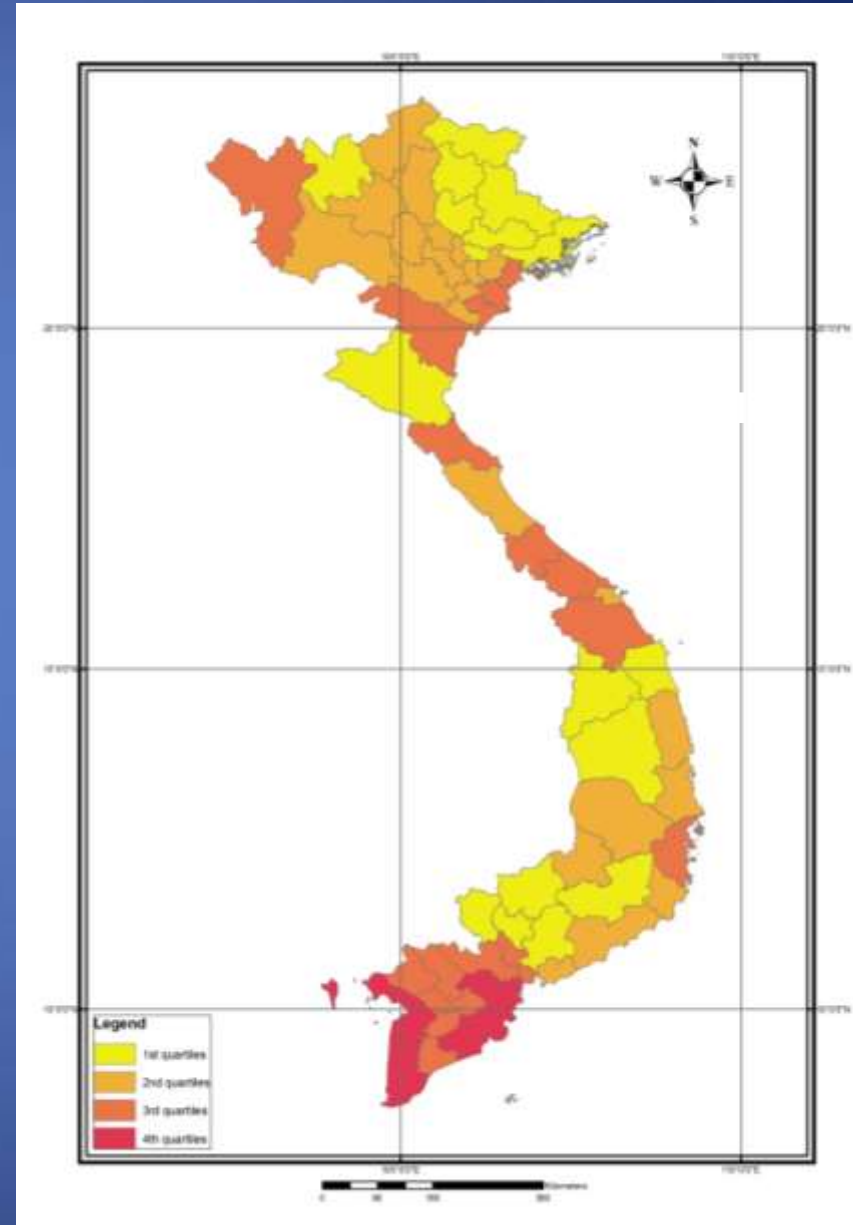
$$V = f(PI, AC)$$

Vulnerability of aquaculture in Vietnam

Dominated by coastal shrimp ponds and catfish (*Pangassius*) in Mekong Delta

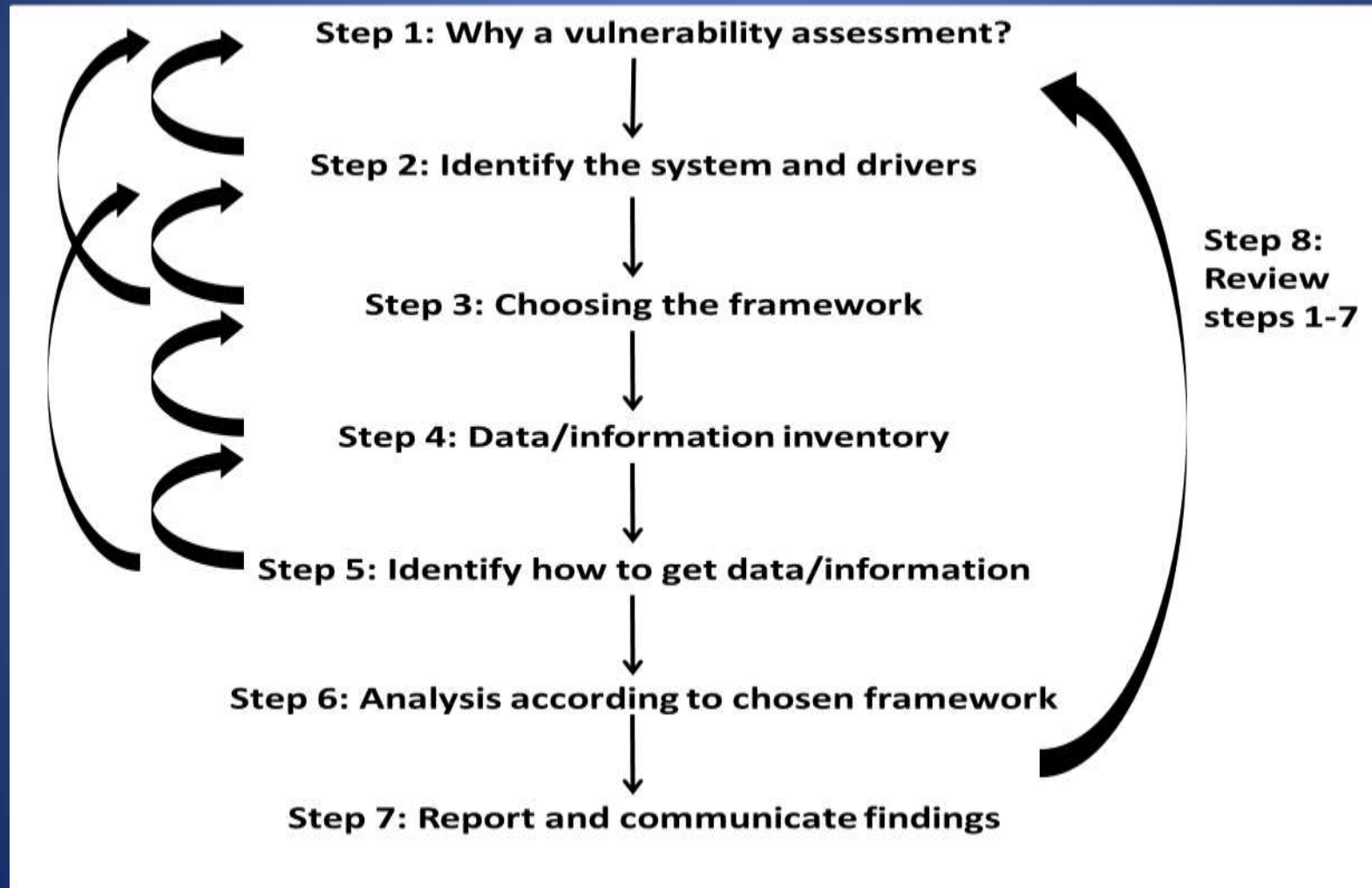
-Storms, sea level rise, temperature increase

Province Name	Region	Vulnerability Index
Sóc Trăng	Mekong River Delta	100.0
Cà Mau	Mekong River Delta	91.7
Kiên Giang	Mekong River Delta	87.3
Bến Tre	Mekong River Delta	77.9
Trà Vinh	Mekong River Delta	77.7
Tiền Giang	Mekong River Delta	76.7
Thái Bình	Red River Delta	69.7
Hà Tĩnh	North Central area & Central coastal area	61.6
Cần Thơ	Mekong River Delta	61.2
Bạc Liêu	Mekong River Delta	60.2



Additional results of PaCFA workshop

- Principles for a «good» vulnerability assessment
- 8 steps for a VA in FI&AQ



Some concluding thoughts

- A VA starts with the Vulnerability Questions needing to be answered
- The scale, approach and method of vulnerability analysis used should be determined by its purpose but will be influenced by resources, time, expertise and availability of data
- 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

- The IPCC «simple» model is evolving and gaining experience in FI&AQ
- Lots of learning to come (e.g. linking scales, mixing models and perceptions, better communicating to those who need to adapt)

THANK YOU