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

Cassandra De Young (FAO), Cécile Brugère (FAO consultant), Tarub Bahri (FAO)

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Outline

- *Why do a vulnerability assessment (VA)?*
- *How are different groups approaching VA?*
- *The IPCC VA framework*
- *Examples of VA in fisheries*
- *Concluding thougths*

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Why do a vulnerability assessment?

Vulnerability analysis → 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?

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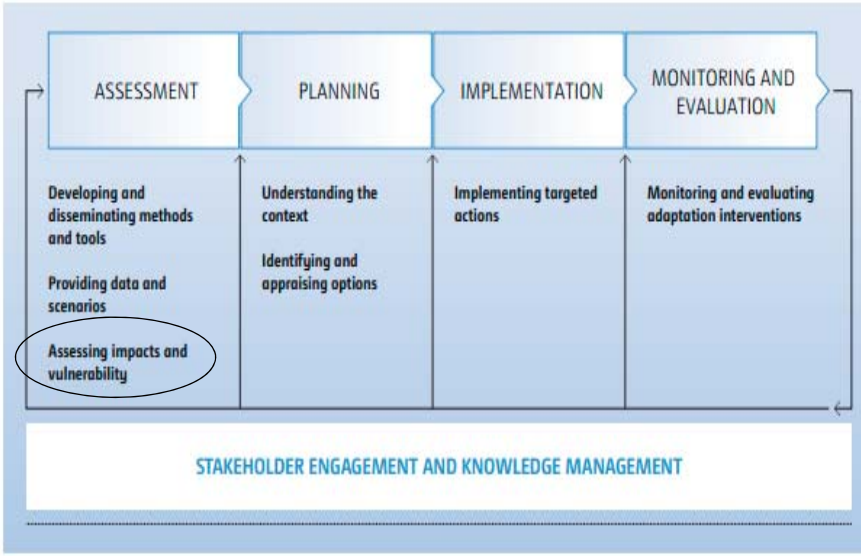

UNFCCC, 2011

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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

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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

Eakin and Luers, 2006

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

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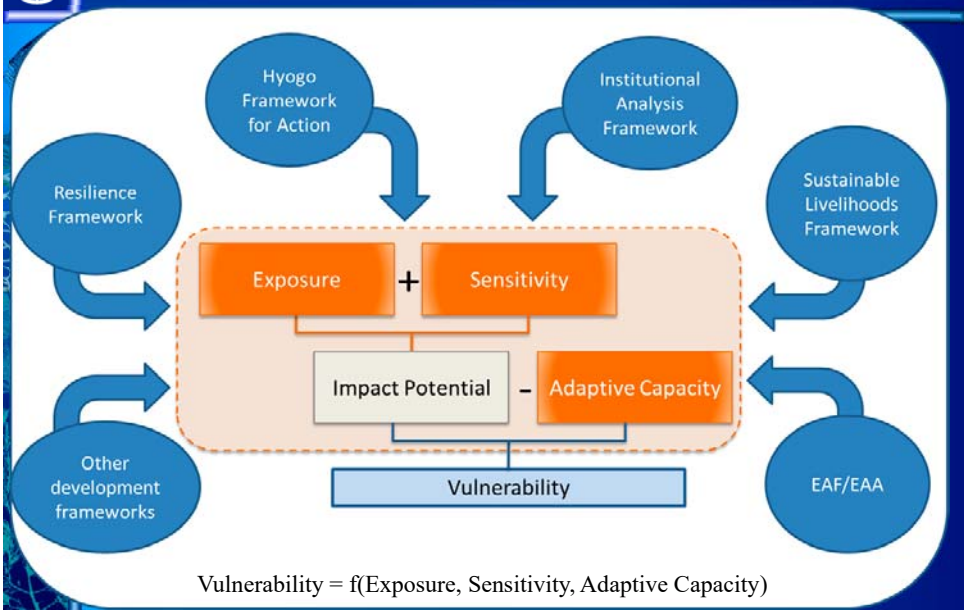
O'Brien et al., 2004, 2007

The IPCC generic VA framework



Vulnerability = f(Exposure, Sensitivity, Adaptive Capacity)

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Adapted from IPCC, 2001

Some examples of VA in fisheries and aquaculture

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Example 1 Allison, et al. 2005, 2009

Vulnerability Question:

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

Purpose of assessment:

Awareness raising

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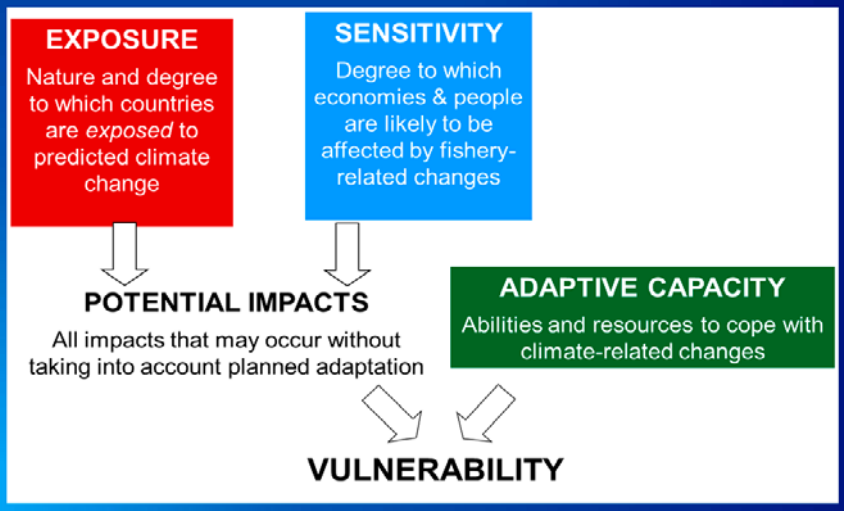
VA Framework



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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 combinations

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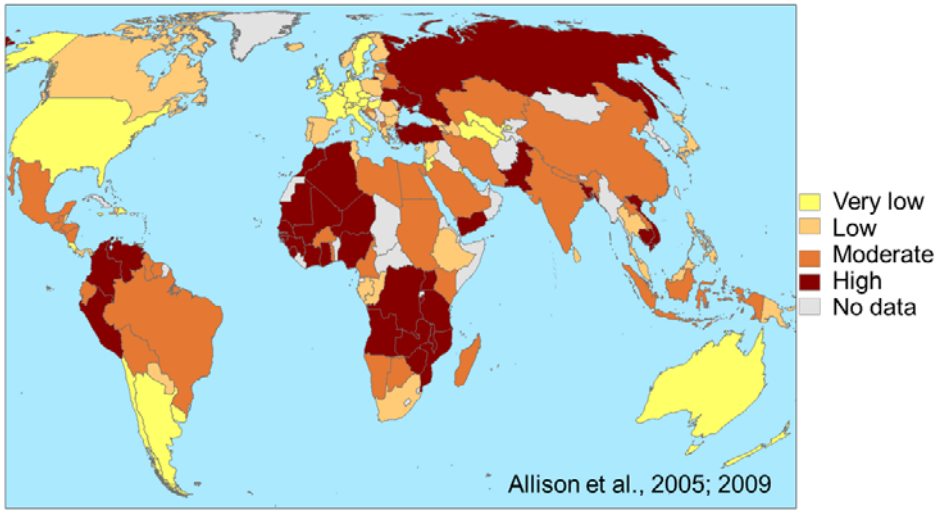
Graphical presentation of relative vulnerabilities



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Example 2: Cinner et al, 2013

Vulnerability Question:

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

Purpose of assessment:

Methodological advancement

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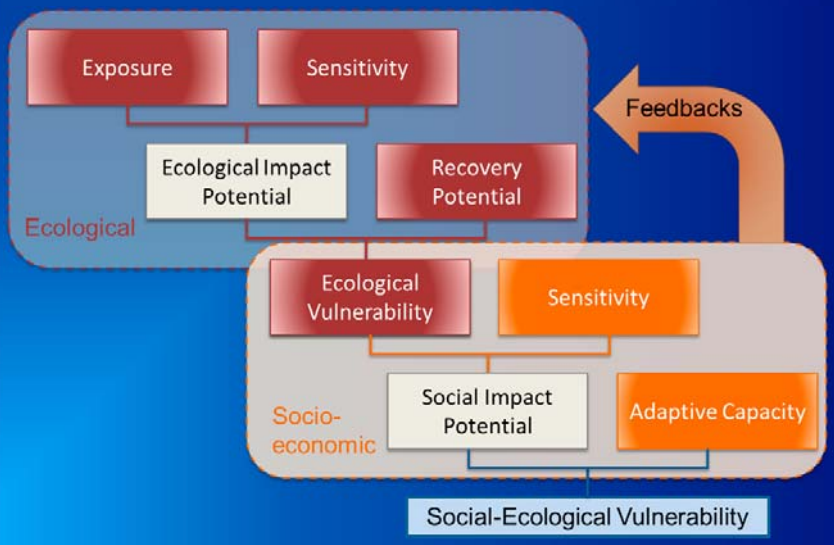
Ecological V nested in Socio-economic V



Adapted from Marshall et al. (2010).

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Methods– ecological vulnerability

Ecological exposure – based on 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

Susceptibility of fish community to population declines associated with coral habitat loss from bleaching

- Using species-specific climate vulnerability index

Ecological Recovery Potential

5 indicators for corals, 6 indicators for fish species

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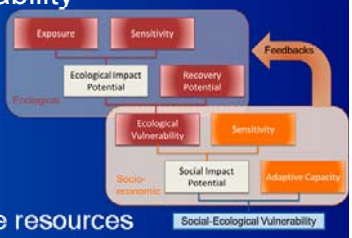
Methods- Social vulnerability

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

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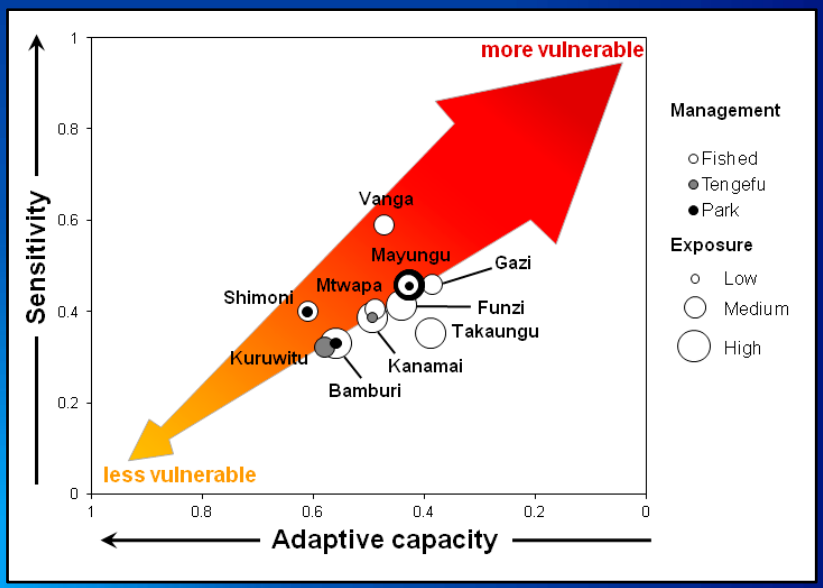
Social-ecological vulnerability evaluated for 10 Kenyan communities



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Example 3 Raemaekers and Sowman (2015)

Vulnerability Question:

What are the socio-ecological vulnerabilities of fisheries dependent communities in relation to climate change and environmental variability, including impacts of other sector activities that may exacerbate vulnerability?

Purpose of assessment:

Community adaptation planning

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Vulnerability Framework

Vulnerability was defined as the extent to which a socio-ecological system (coastal fishery system) is susceptible to various socio-ecological changes (including the effects of climate change) and the system's capacity to adapt to and cope with these changes and effects from the viewpoint of local communities.

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Data and methods

In each community, using participatory assessment tools, a profile and map of the socio-ecological system were drawn up, perceptions on threats from all sources were identified, and vulnerabilities were assessed in terms of geographical location, fishery, and post-harvest activities as well as the different groups affected such as children, women groups, and institutions.

Coping and adaptation mechanisms were then discussed, and key adaptation options were highlighted. This rapid assessment was done during a two-day workshop consisting of several dedicated plenary discussions, group exercises and key informant interviews or focus group meetings

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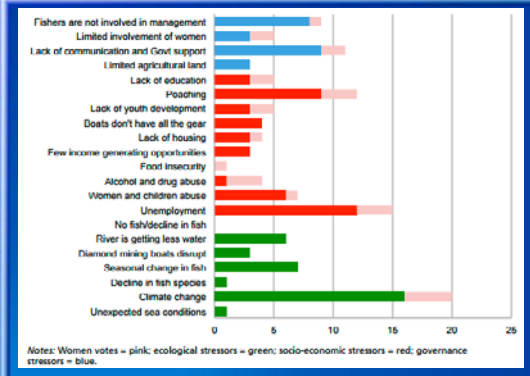
Results



Notes: Women votes = pink; ecological stressors = green; socio-economic stressors = red; governance stressors = blue.

What strategies are working?	What supported is needed?
Local-level organizations (fisher cooperatives, associations)	Improved financial skills, networking, work ethics, collaboration among cooperatives, better governance
Improved fishing and post-harvest technologies (e.g. GPS, cooling pumps, engines)	Training to use and manage equipment, fisheries management plan, sea rescue unit for area
Improved stock monitoring	Better monitoring and management, safer boats, more research and information and feedback
Exploring new fishing grounds	Safer boats, better technology, more research with local fishers
Supplementary livelihoods (e.g. farming)	Explore and develop fish farming (abalone, mussels, kelp), access to better markets, whale watching
Working closely with NGOs, religious groups, universities and others	Counselling/mentoring, communication, training

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Example 4: ICEM (2013)

Vulnerability Question:

How are Lower Mekong River Basin aquaculture species and production systems vulnerable to predicted climate change impacts?

Purpose of assessment:

Science basis for adaptation planning

VA Framework:

IPCC applied to aquaculture

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Data and methods

Exposure – modelled 2050 predictions on temperatures, precipitation, water availability, drought, flooding, storms and flash flooding, sea-level rise, and increased salinity

Sensitivity – based on e.g. water quality requirements and tolerances; breeding; season; diet; current trends and threats

Expert judgement was used to examine exposure, sensitivity and adaptive capacity of selected aquaculture systems

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Results

System component or assets	Thread	Interpretation of threat	Exposure	Sensitivity	Impact level	Impact summary	Adaptive capacity	Vulnerability
		Written description of how the threat relates to the system component				*Written explanation of what the impact is, and why it was scored (high, med, low)*		
SEMI INTENSIVE POND POLYCULTURE OF TILAPIA, SILVER BARB AND CARPS	Increase in temperature	Maximum temperatures increases of up to 10% in the wet season. 5-7% during other seasons. Even higher relative changes in minimum temps 3-27%, highest in the cool season.	High	High	High	Reduced oxygen levels. Poorer water quality. Disease incidence. Reduced survival rate and growth of fish.	Low	High
	Increase in precipitation	Increased precipitation in the period March-December, highest in the months of Aug & Sept and Oct. Highest percentage increase in precipitation occurs in December (40%).	Medium	Low	Medium	Reduced water quality through turbidity. Reduced productivity of pond and growth of fish	High	Medium
	Decrease in precipitation	Decreases in precipitation are projected to occur duing the months of Jan & Feb, (although these are low rainfall months they are not the driest months).	Medium	Very high	High	Stagnation of pond water. Ammonia accumulation. Water column stratification. Potential die offs.	Very low	Very high
	Decrease in water availability	Reduced soil water availability in period Feb-May and Aug & Sept. The dry season decrease may affect stream water flows.	Low	Medium	Medium	Accumulation of wastes in pond. Poorer water quality. Capacity to fill ponds. Reduced survival and growth of stock.	Medium	Medium
	Increase in water availability	No negative effect.	-	-				
	Drought	Droughts (>60% of years for 6 months) resulting in poorer water quality, increased fishing pressure in refuge areas. Negative effects compounded by temperature increase.	Medium	Very high	High	Difficulty in maintaining pond water levels. Stratification. Reduced survival and growth of stock.	Low	High
	Flooding	No negative effects anticipated	High	Very high	Very high	Control of pond water levels. Maintenance of pond fertility. Loss of stock from pond.	Medium	Very high
	Storms and Flash floods	Increase in the number of days with daily precipitation above 100 mm, from 7-10 days. Increase in the highest single daily precipitation; 160 mm	Medium	Very high	High	Control of pond water. Maintenance of pond fertility in pond. Loss of stock from pond. Damage to pond infrastructure.	Low	High
	Sea level rise	n/a						
	Increasing salinity	n/a						

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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

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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)

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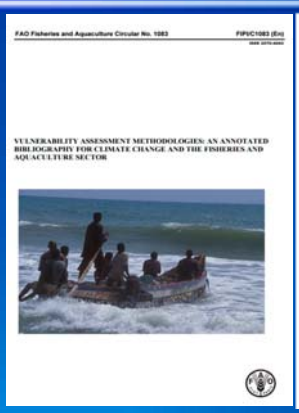
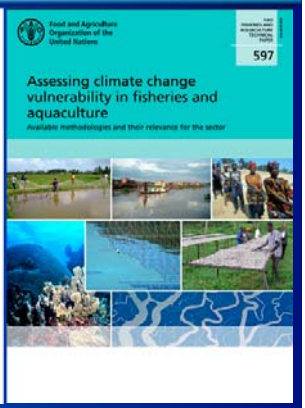
Results of a global expert workshop





FishAdapt conference will provide us with more examples!

THANK YOU

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