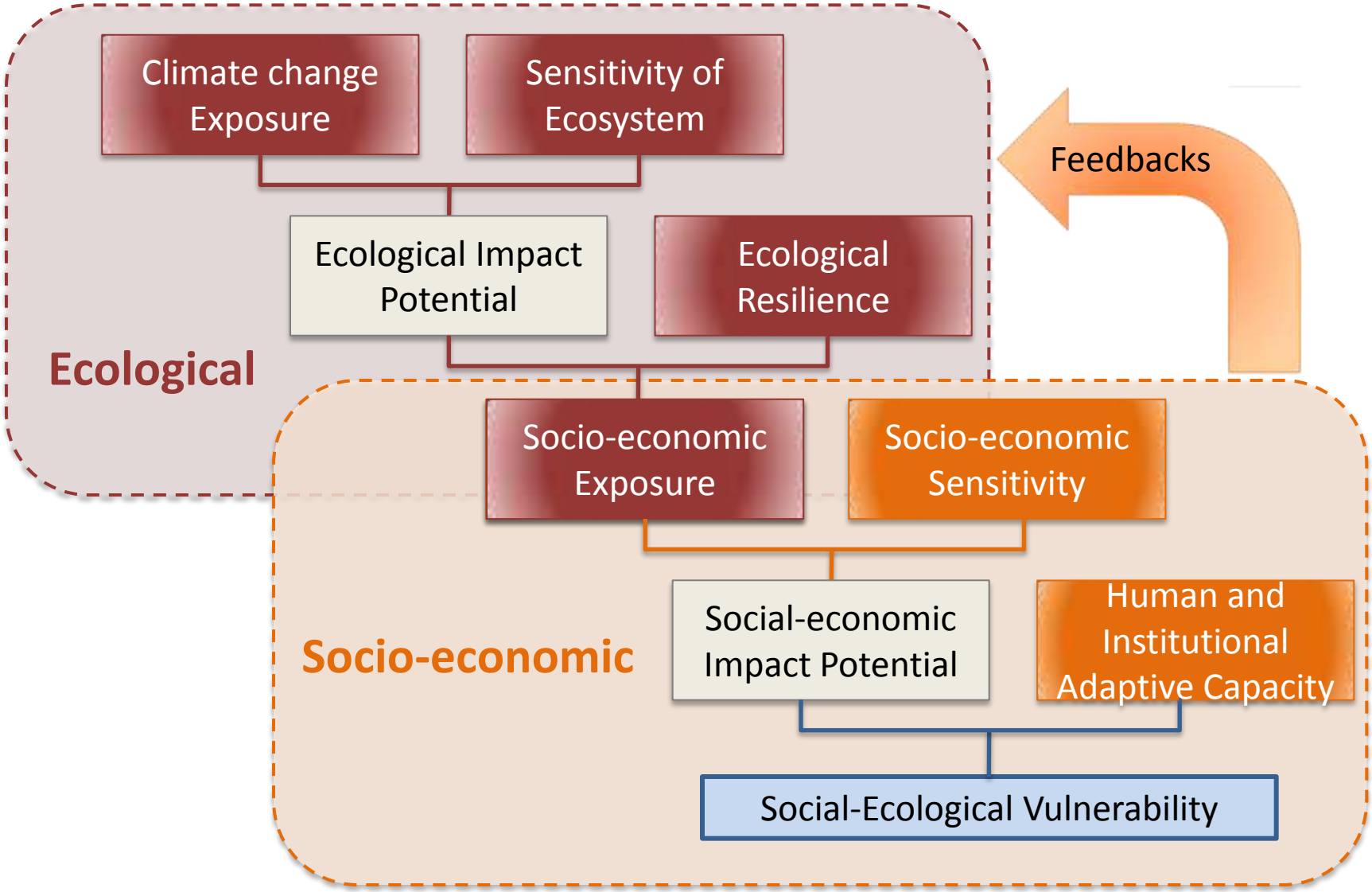
A potential framework for vulnerability analysis: Benguela current



Marshall et al., 2007; Cinner et al., in press

Ecological vulnerability: example variables

Climate change exposure	Sensitivity of Ecosystem	Ecological Resilience
Changes in SST	Changes in primary production	Probability of ecosystem recovery (e.g. from life-history theory)
Changes in wind, currents	Changes in fish species composition and distribution	Ecological response to stress reduction (e.g. reduced fishing pressure)
	Changes in fish biomass and production	
Local knowledge: observed changes in climate variables	Observed changes in habitats and species	Past environmental fluctuations and recoveries

Ecological Potential Impact = Climate Change Exposure + Ecological Sensitivity

= Climate-induced changes in production and biomass of commercially exploitable fish

This feeds into socio-economic vulnerability analysis as the exposure variable…

Socio-economic vulnerability : example variables

Socio-economic exposure	Sensitivity of socio-economic system	Adaptive capacity
Large-scale (national, regional) and "top down"		
Climate induced changes in fish catch (past, to 2030, to 2050)	Importance of fishery to national economy (GDP, exports)	Availability/access to alternative livelihoods
Changes in fishery governance regime	Importance of fishery to employment (inc. part time, subsistence)	Size and diversity of economy
	Importance of fishery to food system (per capita consumption relative to recommended levels)	Access to alternative sources of fish (aquaculture, imports) or other omega-3 and micronutrient rich protein sources
Small-scale (individual, household, community, sub-sector) and "bottom up"		
Risk Perceptions (community/local scale and sector and national)	Cultural/social preferences and dependencies on fishing	History of past adaptation to variability and change

Vulnerability = *f*(exposure, sensitivity, adaptive capacity)