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Assessing Vulnerability of Coastal Fisheries in the Philippines to Climate Change Impacts: Tool for Understanding Resilience of Fisheries (VA-TURF)[1]

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Photo by Thandar Soe

The tool for understanding resilience of fisheries (VA-TURF) is a practical and cost-effective tool for assessing the climate change vulnerability of coastal fisheries in the tropics (Mamauag, Aliño, Martinez, Muallil, Doctor, Dizon, Geronimo, Panga, and Cabral 2013). Developed by local marine scientists at the Marine Science Institute of the University of the Philippines Diliman, VA-TURF aims to identify vulnerable fishing communities and demonstrates how to link vulnerability assessment results to climate change adaptation. The results are inputs to drafting of action plans towards reducing vulnerability.

Key Features

The spatial unit of analysis of VA-TURF is the *barangay* or village. Hence, the target end-users of this tool are the local stakeholders such as the local government units, the *barangay* captain, and the *Bantay Dagat* (Sea Patrol). Meanwhile, the climate change hazards considered are the waves, storm surge, and sea surface temperature (SST).

One of the advantages of using VA-TURF is that the required data is accessible or easily generated. Moreover, the analysis, which involves scoring and ranking, is devoid of complicated mathematical equations. In addition, assessment is highly participatory that allows validation of results and decision-making for local adaptation strategies.

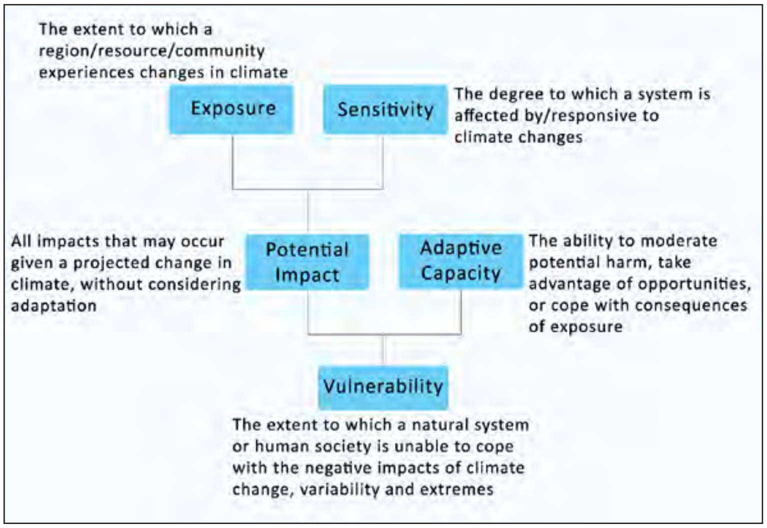
VA-TURF Framework

VA-TURF follows the vulnerability framework of the Intergovernmental Panel on Climate Change (IPCC) (Figure 1) with the following components: exposure, sensitivity, potential impact, adaptive capacity, and vulnerability.

Also based on the IPCC framework, VA-TURF has three major components (Mamauag et al. 2013):

1. ***Fisheries***. VA-TURF examines the type of fisheries in the area. This aspect focuses on top gears used and their dominant catches, fishing effort and its distribution in the area, and the frequency of occurrence of

Figure 1. IPCC vulnerability framework



recruits important in the population dynamics of the fishery and historical patterns.

2. ***Reef ecosystem features***. The life history, characteristics, and behaviors of target species are important biological features that provide insights to vulnerability of fisheries. Hence, the ecological significance of the reef system is emphasized considering the interaction among species within the habitat. Vulnerability of the reef ecosystem may be measured based on extent of habitats, presence of adjacent habitats and species composition.

3. ***Socio-economic attributes***. Measures of socio-economic vulnerability of the fishing community include population size, level of dependence on fisheries, annual household income from fishing, number of fishermen having other sources of income, and their annual household income derived from other sources.

Consistent with the IPCC framework, the VA-TURF framework indicates that vulnerability (V) is a function of exposure (E), sensitivity (S), and adaptive capacity (AC). Each of the major components—fisheries, reef ecosystem features, and socio-economic attributes—incorporates variables necessary to evaluate sensitivity and adaptive capacity. Exposure information, on the other hand, is derived from the wave exposure model (WeMo). Climate hazards, particularly waves, storm surge, and SST are considered. Figure 2 shows the vulnerability assessment framework of VA-TURF.

Evaluating Coastal Vulnerability

To evaluate the coastal fisheries vulnerability, the sensitivities and adaptive capacities of the fisheries, reef ecosystem, and socio-economic components of the coastal fisheries ecosystem are initially scored.

A numerical scale of 1 to 5 is used to score the sensitivity and adaptive capacity variables, with 1 to 2 pertaining to low, 3 to 4 as medium, and 5 as high. The two-point scale for low and medium provides a definitive delineation between them in the scoring process. Consensus of participants on the scoring process should be based on the relative value of each criterion in relation to the threshold values set by the tool. The numerical values of the sensitivity and adaptive capacity variables in each component were added and translated into a rank system wherein the point class intervals correspond to low, medium, or high. Since it depends on the total number of criteria considered in each sensitivity and adaptive capacity variable, the point class interval for each rank varies.

The possible point class intervals and corresponding rank classifications are presented in Table 1.

The sensitivities are then integrated to the exposure variable (wave exposure, E) to derive measures of potential impacts (PI) of climate change on the three ecosystem components. To obtain the vulnerability measure for

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Figure 2. Vulnerability assessment framework of VA-TURF (Source: Mamauag et al. 2013)

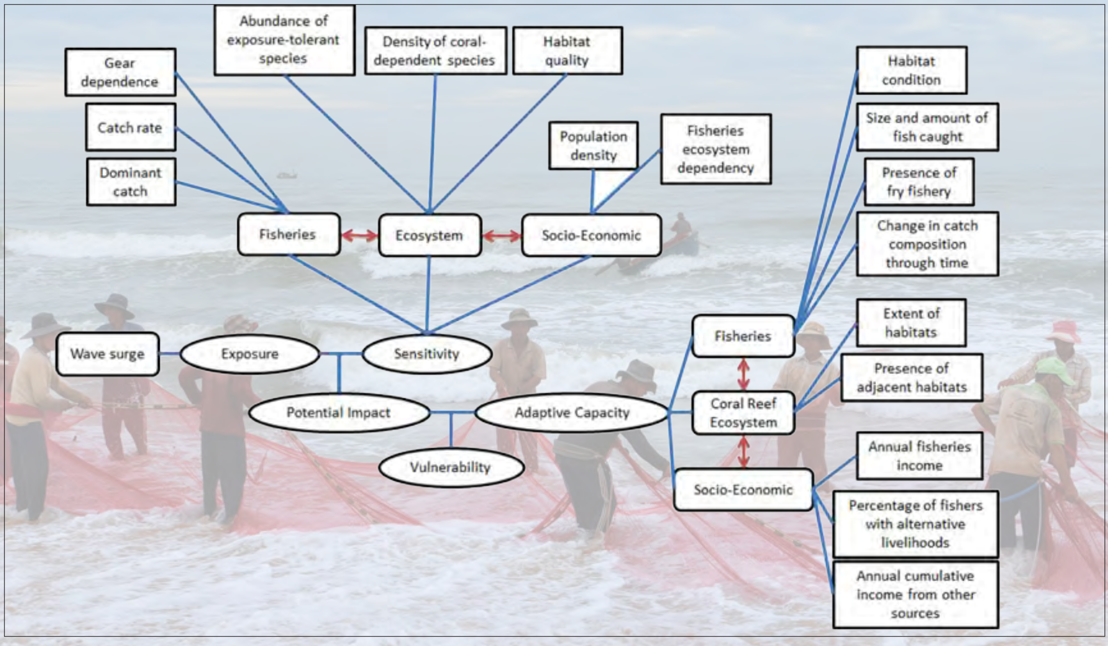

Figure 3. Rubric for deriving coastal fishery ecosystem vulnerabilities (Source: Mamauag et al. 2013)

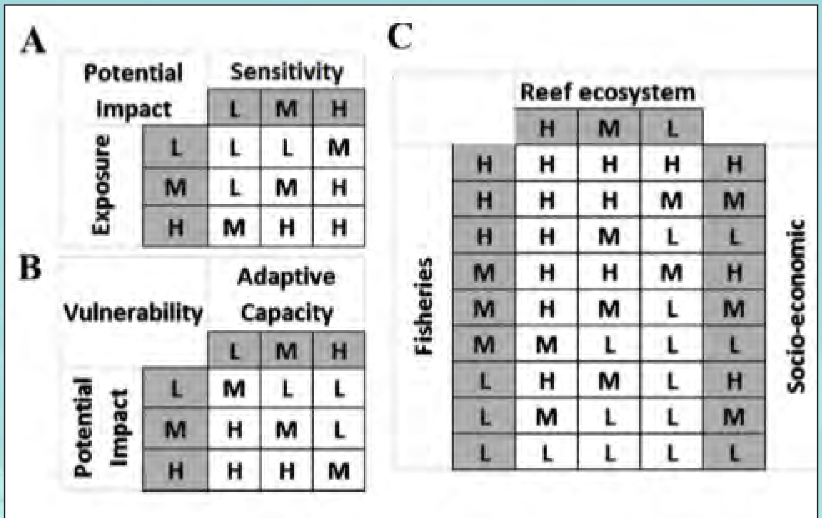

Table 1. Point class interval and corresponding rank classification for the sensitivity and adaptive capacity components of fisheries.

Fisheries Ecosystem	Number of Variables	Minimum Total Score Possible	Maximum Total Score Possible	Point Class Interval (score to rank system conversion)
Fisheries sensitivity	3	3	15	3-7 - Low (L) 8-11 - Medium (M) 12-15 - High (H)
Adaptive capacity	4	4	20	4-9 - Low (L) 10-15 - Medium (M) 16-20 - High (H)
Reef ecosystem sensitivity	3	3	15	3-7 - Low (L) 8-11 - Medium (M) 12-15 - High (H)
Adaptive capacity	2	2	10	2-4 - Low (L) 5-7 - Medium (M) 8-10 - High (H)
Socio-economics sensitivity	2	2	10	2-4 - Low (L) 5-7 - Medium (M) 8-10 - High (H)
Adaptive capacity	3	3	15	3-7 - Low (L) 8-11 - Medium (M) 12-15 - High (H)

Source: Mamauag et al. 2013

each component, cross-tabulation is used to combine the PI for each component with the corresponding adaptive capacity of the fisheries ecosystem. Meanwhile, the overall vulnerability index is computed by incorporating the vulnerability measure for the three components.

Figure 3 shows the rubric for deriving coastal fishery ecosystem vulnerabilities such as (1) potential impact from sensitivity and exposure, (2) vulnerability from adaptive capacity and potential impact, and (3) overall vulnerability from the individual vulnerabilities of the fisheries ecosystem components (L = low, M = medium, and H = high).

CASE STUDY: Boracay Island, Malay, Aklan

To date, VA-TURF has been applied to 14 municipalities in the Philippines to aid in the identification of their vulnerability status and formulation of site-specific adaptation strategies for fisheries sustainability in the context of climate change.

One of the municipalities assessed is Malay, Aklan where the world-famous Boracay Island is situated. It is a first class municipality attributed to the tourism activities in the area. Tourism is the primary source of income for the island barangays while agriculture (farming/fishing) prevails in the mainland barangays. The corresponding rank scores of the sampled coastal barangays and individual vulnerability of each component for each barangay and overall vulnerability of fisheries after the validation workshop are shown in Table 2.

Five out of six sampled barangays had low overall vulnerability which was mainly due to the low exposure and low ecosystem and socio-economic vulnerabilities. The only barangay that scored medium for overall vulnerability is Barangay Caticlan. The score is mainly attributed to the area's high exposure to the waves coupled with high reef ecosystem sensitivity and medium socio-economic sensitivity. Even though the remaining barangays have comparable scores with Caticlan, its high exposure to waves has rendered it more vulnerable to the effects of climate change. Barangays located on the

Photo by Antonio Mendoza

Table 2. Individual vulnerability of each component for each barangay and overall vulnerability of fisheries.

Barangay	Exposure	Sensitivity	Potential Impact	Adaptive Capacity	Vulnerability
1. Yapak					
Fisheries	Low	High	Medium	Medium	Medium
Ecosystem	Low	Medium	Low	High	Low
Socio-economic	Low	Medium	Low	High	Low
			OVERALL VULNERABILITY		***LOW***
2. Balabag					
Fisheries	Low	High	Medium	Medium	Medium
Ecosystem	Low	High	Medium	High	Low
Socio-economic	Low	Medium	Low	High	Low
			OVERALL VULNERABILITY		***LOW***
3. Manoc-manoc					
Fisheries	Low	Low	Low	Medium	Low
Ecosystem	Low	Medium	Low	High	Low
Socio-economic	Low	Medium	Low	High	Low
			OVERALL VULNERABILITY		***LOW***
4. Caticlan					
Fisheries	High	Low	Medium	Medium	Medium
Ecosystem	High	Medium	High	High	Medium
Socio-economic	High	Medium	High	High	Medium
			OVERALL VULNERABILITY		***MEDIUM***
5. Balusbos					
Fisheries	Low	Low	Low	Medium	Low
Ecosystem	Low	Medium	Low	Medium	Low
Socio-economic	Low	Medium	Low	High	Low
			OVERALL VULNERABILITY		***LOW***
6. Motag					
Fisheries	Low	Medium	Low	Medium	Low
Ecosystem	Low	Medium	Low	Medium	Low
Scio-economic	Low	Medium	Low	High	Low
			OVERALL VULNERABILITY		***LOW***

island (Yapak and Balabag) and mainland (Motag and Balusbos) differ in the fisheries sensitivities such that those located on the island have low catch rate and the catch is dominated by habitat-associated demersal species unlike in mainland barangays where they have medium catch rates dominated by mostly pelagic species. High socio-economic sensitivity in the municipality due to high population density was offset by the high socio-economic adaptive capacity in relation to the cumulative income from all other sources.

Results derived from the VA were used to formulate site-specific adaptation strategies considering the urgency of the threat and the capacity of the area to address such threats. The adaptation strategies formulated include: review of marine park ordinances and establishment of protected areas to include important adjacent habitats such as mangrove and seagrass, strengthening of enforcement in fisheries management, and proper zoning of the municipal waters to prevent marginalization of fisherfolks due to tourism activities in the area.

In summary, VA-TURF is a simple tool for non-scientists to use and apply in their community. Results from the assessment allow the identification of adaptation strategies to alleviate potential climate change impacts on fisheries. Consequently, vulnerability differences and adaptation measures can significantly shift the outcome of climate change impacts.

Photo by Kyaw Kyaw Winn

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Additional reference: Mamauag, S., P. Aliño, R. Martinez, R. Muallil, M. Doctor, E. Dizon, R. Geronimo, F. Panga, and R. Cabral. 2013. A framework for vulnerability assessment of coastal fisheries ecosystems to climate change — Tool for understanding resilience of fisheries (VA-TURF). Fisheries Research 147, pp. 381-393.

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