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Seagrass – Mangrove Ecosystems: Bioshield against Biodiversity Loss and Impacts of Local and Global Change along Indo-Pacific Coasts

1. Description of activities and collaborating partner institution

With regard to environmental change and mitigation, coastal management have been heavily focused on coral reef protection. Increasing works have been taking place on mangrove conservation, but there are only few that deals with seagrass ecosystems. Project "Seagrass – Mangrove Ecosystems: Bioshield against Biodiversity Loss and Impacts of Local and Global Change along Indo-Pacific Coasts" was conducted to demonstrate that seagrass bed and mangrove forest as an interlinked system serve as natural "bioshield", sustaining system goods and services against local and global human and natural stressors. The project was conducted as collaboration among: (i) University of the Philippines; (ii) James Cook University Australia; (iii) Anna University, India; (iv) Research Center for Oceanography, LIPI, Indonesia; (v) Saitama University, Japan; (vi) Kyoto University, Japan; and (vii) The University of Tokyo, Japan.

Studies on seagrass are very few compared to mangrove. Whereas, seagrass can function to stabilize the sea bottom. Without seagrass, the sea bottoms are vulnerable to strong wave action from currents and storms. The extensive root system in seagrasses, which extends both vertically and horizontally, helps stabilize the bottom in the same way land grasses prevent soil erosion.

Through this project, field and laboratory activities were conducted to gather data on area, distribution and community structure of seagrasses and mangroves, status, and composition of biodiversity. Simulation of impacts on ecosystem services was also conducted by developing models that synthesise data on trophic dynamics, water quality, stable isotopes, carbon fluxes and ecohydrology.

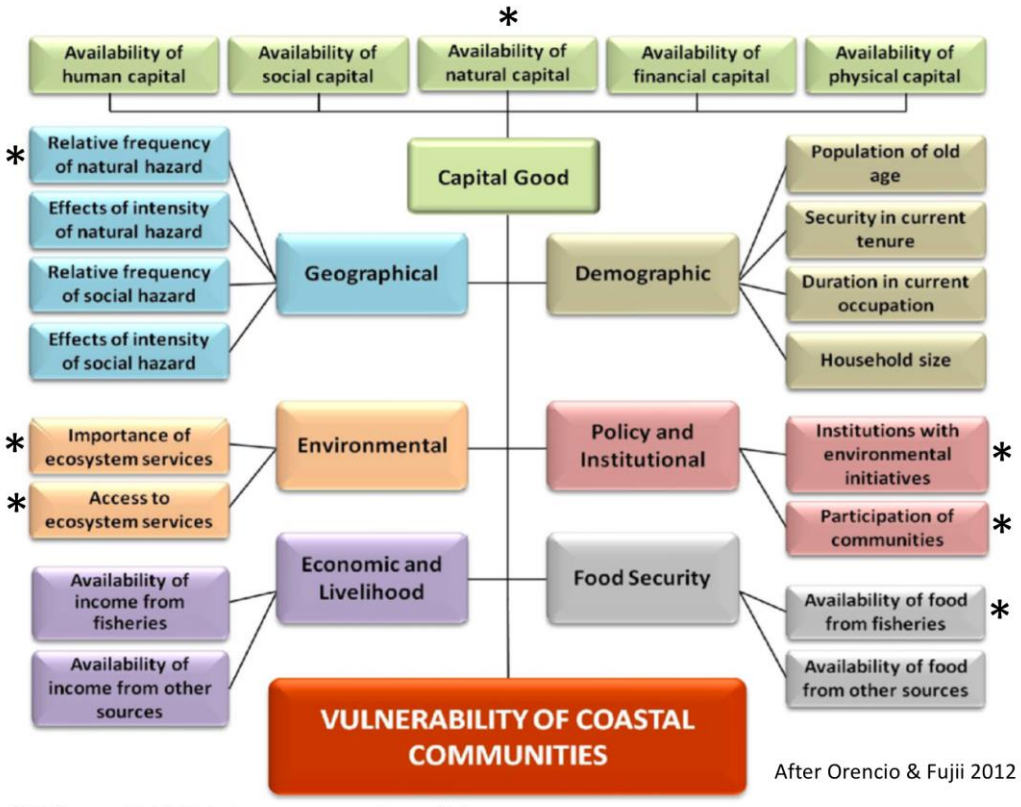
2. Key results

a) The project contributed to the formulation and implementation of programmes and projects on preparedness and response to natural hazards and disasters, which are a legal requirement for all municipalities in the Philippines since the country was struck by the devastating Typhoon Haiyan in 2013. Particularly, the project supported:

   ① *Planning and design of conservation zoning plan for Mayo Bay.* One of the critical issues in

the development of the coastal area of Mati, Philippines, is the proliferation of many unsustainable practices associated with the booming tourism industry. After persistent campaigning, the project team, in collaboration with the Davao Oriental State College of Science & Technology (DOSCST), local NGO caretaker and Local Government Units designed a zoning plan of the Mayo Bay in the Philippines, to conserve the rich biodiversity of its coastal and terrestrial protected areas. The scientific evidences resulted from the project were translated into educational and advocacy materials.

② *Provide inputs to the Coastal Community Vulnerability Index (CCVI).* Scientific results from the project were synthesised and analysed in the context of a Coastal Community Vulnerability Index (CCVI) for input to the local disaster risk reduction and management plans. The project contributed to 7 sub-factors to be considered for full accounting of the index, which include: (i) availability of seagrass and mangrove ecosystems; (ii) relative frequency of natural hazards; (iii) importance of seagrass and mangrove ecosystems services; (iv) access to seagrass and mangrove ecosystems services; (v) availability of food from seagrass beds and mangroves; (vi) community participation; and (vii) existent of institutions with environmental initiatives.

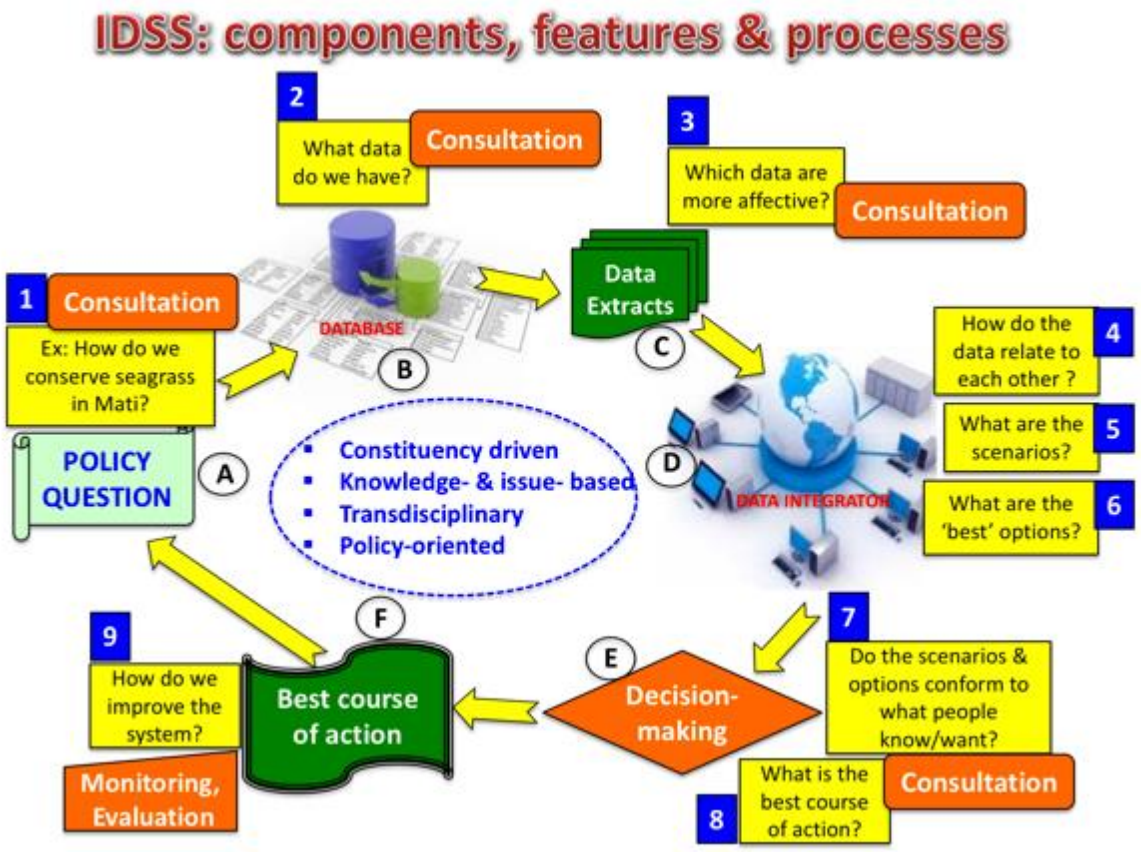


* Where SMBP data were most useful

③ *Provide scientific input to the development of Land Use Plan of Abuyog, Leyte, Philippines.*

After the Super Typhoon Haiyan struck the municipality, a plan for disaster risk mitigation and adaptation mechanism of the communities were developed and the project focus on seagrass and mangrove ecosystem has been a major consideration in the formulation of the plan. The scientific evidence that the project provided was: (i) translated into information materials for the communities, particularly on the bioshield function of the ecosystems; (ii) used as materials for training on the basic methods of assessment, analysis and advocacy of seagrass and mangrove protection.

④ *Assist in the development of a framework for an Integrated Decision Support System (IDSS) to support and enhance local governance*. More than 29 Focus Group Discussions, workshops and training courses were organized to identify community vulnerabilities, enhance understanding and appreciation of the importance and services of the ecosystems and provide the framework of a decision support system to enhance governance.



a) On the scientific front, based on increasing sensitivity (decreasing resistance) to a combined effect of nutrients, clorophyll-a and siltation, the project proposes the following sequence of species for seagrass and mangrove reforestation:

Enhalus acoroides → *Thalassia hemprichii* → *Cymodocea rotundata* → *Halodule uninervis*

→ *Cleome serrulata* → *Halophila ovalis* → *Syringodium isoetifolium*

This recommendation would guide coastal developers and entrepreneurs on which species to utilize, conserve or remove. In addition, in terms of protection of the coasts from erosion and impacts of waves and wind, the species occurring first in the series is more desirable.

3. Lessons learned and good practices

Several lessons learned from the implementation of the project:

a) Increasing awareness and capacity building is an important aspect for environmental conservation. Choosing the right message and material is critical for effectiveness of awareness raising and capacity building. From the project, it is found that grey literature/materials are more useful to local stakeholders than journal publications, which are too technical, generally inaccessible or expensive to come by.

b) Involving local colleges and local NGOs implies opportunities for graduate studies and network expansion. Mentoring of students and NGOs activists will ensure that, after training, the critical aspects of the project will be continued. In addition, concerted efforts can be expected to create bigger impact.

4. Challenges and Future Potential Work

a) The project identified gaps in knowledge and conservation of seagrass and mangroves resources as follow:

- The area of seagrass beds and mangroves have not been documented well enough.
- Tolerance threshold of seagrass and mangroves to excess nutrients and siltation has not properly researched.
- Comprehensive monitoring system in aid of legislation has not been in place.
- Weak technical support infrastructure, small number of researchers trained in transdisciplinary coastal ecosystem studies.
- Poor public appreciation of seagrass and mangroves (Knowledge of services of seagrass beds to humans are lesser compared to mangroves)
- Low participation on environmental management activities caused by lack of exposure of the population as well as local municipalities to knowledge and information on ecosystems and environmental management due to lack of support from institutions (research or academics).

The above gaps could be considered for future research work on mangrove and seagrass

ecosystems.

b) Mono-specific plantation of R. stylosa has been massively supported financially and institutionally under mangrove reforestation programmes, particularly in the study area. While the research found that mono-specific plantation significantly reduces species richness and variety of mangrove vegetation. It is a challenge to increase awareness and understanding of the stakeholders involved in the programme in order to ensure proper conservation practice in place:
   - Utilisation of several and especially the indigenous and dominant species
   - Maintain sufficient space between trees for normal growth and create tidal creeks, in order to recover some of the key ecosystem characteristics and services of natural mangrove forests.

c) Future works on seagrass and mangroves should adopt the integrated approach and to include more targeted research on seagrass trophic systems, monitoring of environmental indicators that alert managers to early signs of eutrophication, remediation of existing eutrophic systems through nutrient reduction mechanisms and planning policies that identify and afford greater protection to ecologically important habitats such as seagrass.

d) Coastal management should place priority on enhancing remaining seagrass and mangroves, and recover areas in sheltered waters that were illegally converted to private ownership and convert them to mangroves and/or seagrass. This would improve the environment by recovering the ecosystem services of these vegetation including sequestering excess nutrients and fine sediment as well as providing refuge for wildlife

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Cairns, Australia