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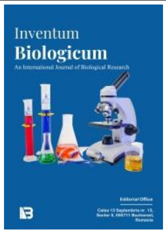

Review paper

Mangrove Guardian: A Toolkit for Eco-DRR in Coastal Disaster Prevention

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ABSTRACT

The Ecosystem-based Disaster Risk Reduction (Eco-DRR) Framework focuses on managing, restoring, and conserving the environment for the purpose of integration in the Disaster Risk Reduction (DRR) program. The leaders and managers around the world utilized the intrinsic services provided by the ecosystem as reinforcement to reduce the impact of disaster brought by natural hazards. However, in spite of their significance in superseding disastrous natural events and policies protecting them, anthropogenic activities continually exploit the resources of the environment for development. This turns out that the challenge of this approach in DRR program is the insufficiency of techniques to measure and describe the intervention done by a specific ecosystem to reduce the damage of natural hazards and for humans to realize its importance.

1. Introduction

Ecosystem-based Disaster Risk Reduction (Eco-DRR) is a solution that recognizes the ability of the environment to minimize the adverse impact of natural hazards. This strategy is a part of the Ecosystem-based Solution that deals with the action of reducing the impact of climate change and disasters through the proper management, restoration and conservation of the environment. Various countries initiate Eco-DRR and legal implementations relative to the approach. Researches are being conducted to ensure the effectiveness of every project intended for this strategy. However, challenges in the implementation of environmental protection to supp-ort the concept of EcoDRR are massive instead of declining the degradation. Hence, humanity has to understand their relevance in the ecological balance. Several studies show that many developing countries already have environmental policies, legal frameworks and economic instruments that are considered highly sophisticated by international standards yet still confronted with deterioration of environmental conditions (Huber et al., 1998). The major challenges faced by these countries are not only the lack of a legal and economic environment protection framework, but also the lack of public part-

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-icipation in pro-environmental behavior. People are aware that ecosystems of the environment support the resiliency of all the biotic and a biotic factors from the impact of natural hazards. They understand that these biomes provide numerous ecosystem services that secure lives and properties against natural disasters. Despite this knowledge regarding the importance of the environment in buffering natural hazards, anthropogenic activities continue to degrade the ecosphere for development.

Eco-DRR existing frameworks focus on the management, restoration and conservation of the environment. Projects and policies protecting the ecosystems are the priorities of the participating nations (Estrella & Saalismaa, 2013). This is in consideration of the fundamentals of the Ecosystem-based approach on which DRR is a driver that provides good quality healthy environment and appropriate measures to safeguard and rehabilitate the ecosphere (Prieur, 2012). An example of these projects is the Reducing Emissions from Deforestation and Land Degradation (REDD+) mechanism which provides incentives to countries reversing their loss of forest carbon. The participants are paid to follow the REDD+ mechanism in response to the emission reduction of the project (Epple et al., 2011).

The above situation is just one of the copious projects under this kind of Ecosystem-based approach. There are many strategies implemented to meet the concept of an Ecosystem-based approach, particularly for DRR. However, the scheme of implementation focuses only on the fortification of the environment; this only encompasses the idea of restoring and conserving the environment through sound management. Actions undertaken by the manager and other players in discussing environmental issues are the projects that help mitigate the depletion of ecosystems. Limited data show the efficiency of ecosystem services that support the concept of Eco-DRR. Usually, the available data to measure the effectiveness of the ecosystems are acquired through the valuation method which focuses mainly on the monetary value. However, environmental issues differ qualitatively from individualistic consumer choices on commodities creating discrepancies in the results of the approach. In the end, the capacities and features of a certain ecosystem are not specifically discussed by the valuation method. There is a lack of elaboration on how a particular ecosystem works to assist their networks (McCauley, 2006; Vatn, 2005; Sagoff, 1998; Taylor, 1992).

A spectrum of figures to describe the importance of the ecosystem services specifically intended for Disaster Risk Reduction (DRR) must be provided. Consequently, accomplishments in the implementation of Eco-DRR projects recorded for local and international dissemination are general in manner. Often, data being gathered for the reporting are a summary of services provided by a particular ecosystem reinforcing Eco-DRR concept. The discussion of a milestone for the different environmental projects is usually in narrative writing. There's a deficit in translating knowledge and data on Ecosystem-based approaches into measurable run-through. Systematic learning on the impacts and effectiveness of the environment is more easily understood if the variables are more revealing (CBD, 2016). To describe the value of the ecosystems, there should be a systematic accounting method of the different services that they rendered, showing historical trends of Eco-DRR accomplishments. This provides a different method that will serve as a tool for measuring the preventive capacity of ecosystem services in dealing with natural hazards.

The mangrove ecosystem can be used as case scenario to describe the capacities of the environment in reducing the impact of natural hazards. Measuring their Eco-DRR value is beneficial in policy-making and conservation program, and strengthening the Disaster Risk Reduction (DRR) program of a particular coastal community. Eventually, the evaluation scheme of the mangrove ecosystem in terms of Eco-DRR draws out a tool that can be used to create baseline data regarding their abilities to halt coastal natural hazards.

Mangroves are salt-tolerant trees, also called halophytes, and are adapted to live in harsh coastal conditions. They contain a complex salt filtration system and complex root system to cope with saltwater immersion and wave action (Giri et al., 2010). Aside from its capacity to withstand salinity, mangroves have pneumatophores that capture organic materials, roots designed for fish spawning grounds, and intact zonation pattern and numerous species that compliment other biotic factors. Also, this ecosystem buffers hurricanes and tsunamis; harbors masses of floral and faunal biodiversity; provides variety of products in coastal settlements such as food, fuel and building equipment; and provides indirect use value such as water filtration, coastal erosion mitigation and community storm protection (Alongi, 2009). These ecosystems supply trapped nutrients to neighboring habitats in their roots including sea grass and coral reef. As much as 75% of all tropical commercial fish species spend a portion of their life cycle in mangroves. In addition, these shrubs are part of some indigenous culture considering native mangrove extracts for wood, thatch, medications and colors. They are appreciated for ecotourism and as fishing ground for poachers of fish and shellfish. Because of the enormous quantity of carbon sequestration, mangrove forests are significant tropical latitude carbon sinks (Nellemann et al., 2009). They provide the biotic environment within the coastal and intertidal habitat with a broad spectrum of ecological services.

Due to multiple anthropogenic activities, mangrove populations have experienced annual losses worldwide between 0.16 and 0.39 percent over the past two centuries. Extraction, degradation, and failure in the succession process are the critical problems of mangroves (Hamilton & Casey, 2016). Human activities such as wood extraction, aquaculture, housing development, and charcoal production exacerbate the world's mangrove forests without realizing the disadvantages of such actions. Furthermore, natural causes such as temperature, rainfall, typhoons and rising sea level are important variables that threaten the mangrove's biodiversity and ecological equilibrium (Soares, 2009). These scenarios demonstrate how these occurrences decrease the mangrove population and alter their biological process.

In 1920, 400,000 – 500,000 hectares of mangroves covered the Philippines but decreased to 120,000 hectares in 1994. Over-exploitation by coastal residents, conversion of mangrove areas to agricultural lands, salt lakes, industry and settlements caused this depletion (Garcia et al., 2013). Mangrove evaluation is needed to define species composition of current mangrove structures with an emphasis on species classification for conservation issues. This is important to determine the output of the vegetation stand in order to comprehend the dynamics of organic matter and nutrients cycling in mangroves especially the activity of carbon sequestration. Reliable biomass manufacturing data will serve as an important basis for intervention programs such as initiatives for forest restoration and rehabilitation. In addition, awareness of the structure of species and the variety of current mangrove structures could serve as a basis for the design of an efficient strategy for managing natural resources.

2. Discussion

According to the report of IUCN (2014b), the CBD Strategic Plan for Biodiversity focuses its program on restoring the natural habitats. Moreover, conservation of areas utilized for agriculture, aquaculture and forestry are given priority. Policies are implemented for the protection of coral reef and other ecosystems. Based on the report of UN (2015), the Sustainable Development Goals focused on providing resilient communities through the restoration and protection of water-related ecosystems including mountains, forests, wetlands, rivers, aquifers and lakes. This also includes resilient agricultural practices that increase productivity and maintain ecosystem. Furthermore, (Sudmeier-Rieux, 2013) described that the UNFCCC Cancun Adaptation Framework developed and implemented national adaptation plans as a means of identifying medium and long-term adaptation. In addition, Sendai Framework works in the restoration, conservation and protection of the ecosystems in combating the effects of climate change. Meanwhile, according to the study of(Renaud et al. 2016), the Paris Agreement supports the enhancement of the sinks and reservoirs of the greenhouse gases identified during the convention of this agreement. In addition, IUCN (2014a), the UNCCD focuses solely on measuring the progress of the land ecosystem (IPCC, 2014; Kauffman & Donato, 2012; Schöngart et al., 2011). Based on the report of The Sustainable Development Report (2019), the Ramsar Convention Resolutions incorporate Disaster Risk Management and Climate Change Adaptation into development and planning policies at all levels of government including vulnerability analysis, poverty reduction strategies and natural resource management plans (including land-use and water-use plans) and sectors as well as multi-sectoral policies and plans. On the other hand, Policy Brief is the most typical approach in implementing the DRR programs and provides interest merely in the planning process (US Geological Survey, 2012; Krueger & Casey, 2000).

The importance of using inventory approach in assessing the content of wildlife and plants within the mangrove ecosystem is very practical. This simply discusses the efficiency of mangrove ecosystem in supplying the needs of the fringing flora and fauna.

The mangroves serve as a support system that remarkably reinforces the conservation and protection of other biotic components associated to them. On the other hand, the collected data from the inventory help policymakers to come up with a novel approach in protecting this ecosystem. The status of abundance and richness of flora and fauna in the mangrove area serves as basis to enhance policies reinforcing this ecosystem (Long & Johnson, 2000).

The study can freely discuss the interpretation regarding the collective thoughts of the participants based on the weight of their scores given to each of the attributes. There were items that can be regarded to have a high or low score based on the learned knowledge of the participants. This helped to discuss the inference in the difference of the scores for each attribute. Moreover, this helps to justify the value of the Eco-DRR services of mangroves in a shared manner essential for relevant presentation of the importance of the mangroves in the coastal zone, policy making and planning. The social assessment strategy used in this study can provide details to the different frameworks that support the existing Eco-DRR frameworks and policies for DRRM policy enhancement and programs.

This only means that the mangroves provide a relaxing climate because they sequester the carbon materials near them that might be converted in to a greenhouse gas that cause extreme heat in the surface of the planet. In addition, mangroves oxygen release made their ecosystem to have a circulating fresh air through the process of photosynthesis. Meanwhile, some respondents also stated that they observed different species of animals, both terrestrial and marine lurking in the mangrove ecosystem of the study site. These were non-numerical data from the interviews and based on the observation of the community people near the mangroves. Still, they justify the results of the inventory of flora and fauna. The said inventory was a quantitative approach in acquiring the richness of biodiversity and population per species of living organisms in the study site. The respondents during the interview did not mention the number of species and species of animals in the mangroves but their statements supported the data analysis from the inventory. This is by means of the illustration of animals they have seen in the studied ecosystem. Furthermore, some examples of direct statements from the qualitative approach that backed up the quantitative data analysis is the ability of mangroves to act as barrier against the flood. The community people witnessed the flood buffering capacity of the mangroves. They mentioned that the roots, trunks and branches of the mangroves caused the velocity of the flood water to diminish. The quantitative results provided a computation of the estimates of the reduced velocity of the running water entering the mangrove ecosystem. The same idea goes also in describing the tidal wave and tsunami energy reduction done by the mangroves. Lastly, the prevention of coastal erosion was observed in the study through the use of Sediment Pins and remote sensed images. These methods of data collection are in numerical form. Moreover, based on the qualitative data collection, the respondents saw that mangroves trapped the sediment in their roots. The accumulated sediments in the roots were transferred in the beach through tide shift. The statement of the participants regarding the sediment capture of mangroves supported the use of technique in measuring the sediments accrued in the mangroves through the use of sediment pins.

3. Eco-DRR Assessment Tool for Mangrove Ecosystem Services

Most of the Ecological Assessment results of the formulated tool provides numerical data and requires controlled procedure during data collection. On the other hand, the Social Assessment particularly the qualitative data collection approach, created a non-numerical information that addressed the perceptions, experiences and own knowledge of the participants regarding the subject of the study. Both of these assessment techniques are effective in supporting the purpose of the formulated assessment tool for Eco-DRR to provide measures of the disaster reduction of the mangrove ecosystem. Specifically, the procedure in collecting the live biomass, is the primary requirement of computing the Carbon Stock or Sequestration, Carbon Dioxide Equivalent, and Net Oxygen Release of the mangrove ecosystem.

4. Conclusion and Recommendation

The tools provided a spectrum of figures to justify the importance of mangroves in reducing the risks of natural hazards in the coastal areas. Through the use of common ecological and social assessment tool, the study helps in filling the gap of the lack of approach in measuring the DRR capacities of mangroves as reviewed from the past written accounts and literature. Further study regarding the used of the different tools in describing the relevance of mangrove to disaster risk reduction must be done. There should be an updated knowledge regarding future trends of understanding mangrove ecosystem in terms of their interventions for coastal hazards.

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