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The mobilization of science and technology fisheries innovations towards an ecosystem approach to fisheries management in the Coral Triangle and Southeast Asia

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ABSTRACT

Several regional fisheries and marine conservation organizations in the Coral Triangle (CT) and Southeast Asia have indicated their support for an ecosystem approach to fisheries management (EAFM). It is also likely that science and technology (S&T) innovations will play a role in the region for the purposes of filling gaps in fisheries data, enhancing the coordination of fisheries management efforts, and implementing and operationalizing an EAFM. Here, we outline the methodology and results of an expert-opinion survey designed to elucidate and prioritize the implementation of these S&T innovations. As a first step and case study, the survey presented here was conducted on U.S. government experts. The U.S. market is one of the world's largest importers of seafood, and therefore, in the framework of this study, is considered to be a stakeholder in the seafood supply chain that originates in the CT and Southeast Asia region. Results are discussed in terms of the data needs and principles of an EAFM, as well as current trends and contexts of the CT and Southeast Asia region. Next steps and recommendations are also provided on how S&T innovations can be implemented to enhance the cooperation and coordination of regional marine resource management efforts.

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1. Introduction

The Coral Triangle and Southeast Asia region is composed of a complex myriad of interwoven environmental, social, economic, and political contexts [14]. In order to sustainably manage the marine fisheries and biodiversity of this dynamic region, decision-makers must balance the multitude of objectives that arise from its diverse resource users. Several regional organizations, such as the Coral Triangle Initiative (CTI), Southeast Asian Fisheries Development Center (SEAFDEC), and Asia Pacific Fisheries Commission (APFIC), have recognized the ecosystem approach to fisheries management (EAFM) as a more inclusive and holistic approach to fisheries management [32]. By being inclusive of all stakeholders that benefit from and/or potentially impact fisheries and their supporting ecosystems, seeking their input during the earliest planning stages, and adapting management actions based on continued monitoring and reassessment, an EAFM is considered the preferred option and best practice for ensuring the long-term sustainability of fisheries and the marine ecosystem services provided to society [12,13].

Management plans in the region are already moving forward in the implementation of an EAFM. For example, some organizations, such as SEAFDEC have already begun the dissemination of EAFM trainings throughout the region [32]. Furthermore, the countries that border the Sulu Sulawesi Sea Large Marine Ecosystem - Indonesia, Malaysia, and the Philippines – have already developed a strategic plan that includes ecosystem-level priorities and indicators [37]. While progress has been made, in practice, national government agencies around the globe are still determining how

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best to implement such a multi-sector (across agencies), multi-scale (matched to both local and national management processes) initiative [30].

One of the challenges of moving towards an EAFM is that this approach explicitly broadens the scope of fisheries data collection beyond target species and into the realm of whole ecosystems, taking into consideration the biological, physical, and human components of the system that influence the productivity and sustainability of fisheries and the well-being of people. Science and technology (S&T) innovations, if mobilized properly, have the ability to optimize integrated data collections and disseminate high quality scientific information in a timely manner, thus enhancing the salience, credibility, and legitimacy of this information [3] and allowing for effective implementation of an EAFM.

For the Coral Triangle / Association of Southeast Asian Nations (CT/ASEAN) region in particular, S&T innovations have the potential to spur the region beyond simply embracing EAFM policy, and actually operationalizing one. For example, major data gaps exist for the region, especially in terms of the species composition of its fisheries catch [10]. Demographic information on the fishers themselves is also largely missing; small-scale (i.e., artisanal or subsistence) fishers are not currently represented by any regional organization, and thus engagement with this sector has been limited [31]. This is particularly worrying given the large and growing contribution of this sector to fisheries production in the region [25].

Furthermore, there is international interest in addressing illegal, unreported, and unregulated (IUU) fishing in the region. Recent evidence has suggested that a significant portion of wild-caught seafood imported into the U.S. (20-32% by weight, or over $1 billion worth) is made of illegal or unreported catches [34]. Therefore, as one of the world's largest importers of seafood, the U.S. market, in the framework of this study, is considered to be a stakeholder in the seafood supply chain that originates in the CT/ASEAN region. U.S. interest in the region is evidenced by their 5-year investment of over $40 million of technical and financial assistance to the Coral Triangle countries as part of the U.S. Coral Triangle Initiative Support Program [6]. More recently, this initiative has been expanded into the Oceans and Fisheries Partnership, focused on combatting IUU and mobilizing S&T innovations to enhance communication and seafood catch traceability in the region. Another international initiative, the recently signed Trans-Pacific Partnership trade agreement, includes the U.S. as well as several countries in the region as signatories and contains provisions to take collective action against overfishing and IUU.

Coordinating enforcement efforts in the CT/ASEAN region, however, is complicated by the numerous countries, governing systems, ethnic and socio-economic groups, and industries that have the potential to clash over fishing rights and access [14,33]. S&T innovations that collect, integrate, and share information, may provide the credibility and validation needed to bring diverse stakeholders to the table. On the other hand, the implementation of S&T can be highly technical, jargon-laden, and inaccessible, and thus runs the risk of alienating non-scientific stakeholders. When implemented under the guiding principles of an EAFM, however, S&T innovations have the potential to not only help with data collection, surveillance, and enforcement in the region, but also with reaching out to groups that have largely been left out of the fisheries management process.

This paper outlines: (i) a survey that was developed to begin discussions on how S&T innovations could be used for sustainably managing trans-boundary (i.e., trans-national) fisheries in the CT/ASEAN region as well as the overall seafood supply chain leading into the U.S. market and (ii) the results of a pilot case study that focused on one set of stakeholders – i.e., the opinions of experts from the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), as well as several agencies within the U.S. Department of Interior (DOI). The results of the case study survey are discussed in terms of the data needs and principles of an EAFM, as well as current trends and contexts of the CT/ASEAN region. Due to the limited scope of this case study, however, the results presented here cannot be generalized to the needs and opinions of the CT/ASEAN region. The method outlined here should be conducted across multiple stakeholder groups, including fisheries scientists, managers, and fishermen throughout the CT/ASEAN region to spur discussions of how fisheries S&T could be coordinated and implemented on an international level.

2. The link between an ecosystem approach to fisheries management and science and technology innovations

A point of clarification should be made here to distinguish EAFM from EBFM, or ecosystem-based fisheries management. The U.S. NOAA uses distinct biological hierarchical levels to differentiate between EAFM and EBFM [22], with EAFM focused on single-species stocks and EBFM focused on multiple species, but with both models aimed at integrating wider ecosystem components. Given its international implications, this article instead employs the United Nations Food and Agriculture Organization's (FAO) definition of an EAFM [12]. While the FAO definition does not differentiate between single and multiple-species management, its emphasis on balancing ecological well-being and human well-being through good governance has already been adopted by several regional organizations in Southeast Asia and the Coral Triangle. Despite these nuanced definitions, it is important to shelter the implementation of an EAFM/EBFM from being “crippled with linguistic uncertainty” [28]. Thus, this report uses the term EAFM throughout, while recognizing that the common goal of both the FAO's EAFM and the U.S. NOAA's EBFM/EAFM is to move beyond single-species traditional fisheries management and that, in reality, there are aspects of both approaches that should be incorporated into the next generation of fisheries management plans [21].

It is also important to emphasize that while the data requirements for operationalizing an EAFM are broader and more comprehensive [16], they are not insurmountable. In fact, it is a myth that an EAFM can only be implemented in regions with a plethora of data [28]. Dispelling this myth is particularly important for implementing an EAFM in the CT/ASEAN region where data on fisheries and other physical and social components of the ecosystem may not be readily available. EAFMs can and should be implemented in data-poor situations, for example, by using traditional local knowledge and best available natural history information to define cautious policies at first (i.e., the precautionary principle), but with the flexibility to adapt these policies as new information becomes available [29]. In fact, fisheries managers from data poor regions are already developing ecosystem indicators and implementing a range of decision frameworks from qualitative to fully analytical [23,39].

3. Methodology

The survey's framework and questionnaire were developed with the guidance of S&T experts from throughout NOAA and DOI (i.e., the S&T core group). Among the core group's first task was to create a list of S&T innovations that could: (1) be implemented in the CT/ASEAN region in the next 5 years, and (2) address trans-boundary fisheries in the region. Using these criteria, a total of 21 S&T innovations were identified in our final list (Table 1), falling into three categories: (i) field-based or remote data acquisition, (ii)

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