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# THE INNOVATION OF VULNERABLE FISHERIES USING ECOSYSTEM-BASED FISHERY MANAGEMENT APPROACH: A TEST CASE IN KARIMUNJAWA ECOSYSTEM, CENTRAL JAVA, INDONESIA

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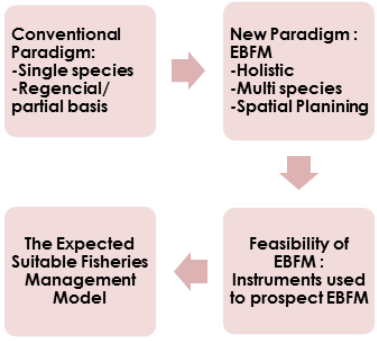
## Graphical abstract




## Abstract

The sustainability of marine ecosystem has become a major concern the government; however, the implementation of sustainability-based fisheries management has not been fully carried out and well controlled. Therefore, having a concept of ecosystem-based fisheries management (EBFM) is essential in protecting it preserved. The aim of this study was to analyze the implementation of EBFM in Karimunjawa ecosystem, Central Java, Indonesia. The analysis of this study was based on the primary data collected from fishermen and stakeholders using in-depth interviews, and the secondary data gathered from stakeholders of Karimunjawa documentation. Meta-analysis with triangulation was invoked in this study. The result showed that the vulnerability of marine ecosystem, particularly fisheries' resource in the pilot project is in progress. The conventional approach has not yet succeeded in managing fisheries' resource in terms of sustainability attributes. Moreover, the EBFM has not yet proven to be a suitable approach for some reasons; although, this concept is very promising in encouraging a new paradigm for sustainable management in Indonesia with a protocol concept. This initial finding needs to be furthered in order to explore other aspects of development.

*Keywords*: Central Java, ecosystem, fisheries, management



## 1.0 INTRODUCTION

As open-access resources, marine ecosystem has been utilized to its limit to be recovered. Both traditional fishermen and modern fishery companies exploit it that lead in the destruction of the resource. Realizing of its negative impact, many countries have been implementing fishery management scheme as it is assumed that natural resources or ecosystem is under controlled by human [1–3]. The behavior of ecosystem is becoming vulnerable and hardly can be predicted [4]. Therefore, in 2009, the Ministry of Fishery and Marine Affairs of Indonesia issued a regulation regarding the minimum size of fish captured. However, as a result of an ineffective policy and enforcements, Indonesian fisheries have faced depletion [5]. Learning from both national and international experiences, an alternative approach to reform conventional fishery management needs to be introduced [6].

Indonesia, as a maritime country with approximately 17 504 islands, has implemented decentralization policy that brings positive and negative implication. The decentralization system of Indonesia provides local government an authority to issue a policy within its

jurisdiction. The government authority entitles resource management for land, sea and air in some extend of exploration, conservation, spatial administration and law enforcement [7]. As a results, many of regencies or municipality have been trying to exploit their resource to a maximum limit. This is one of the most demerits of decentralization system, in which fisheries management is influenced vest–interest. Moreover, the implementation fisheries management policy is incomplete resulted in the local government policy, to some extends, creates problems. For example, the problem in fishery management in Central Java is mostly caused by conflict in resource utilization and exploitation that lead to resource degradation. Most conflicts arise because of excessive fishing as population and economic motivations increase [8-9].

In fisheries, the conflicts among stakeholders often take place in the context of allocation or access rights to the limited resources for diverging economic and social motivations or even multiple socio economic factors, such as institutional and market failures. Conflicts among stakeholders might be caused by gear use, landing site use or market behavior, and they are rooted in more complex institutional issues such as cultural differences and political power struggles [10]. Conflicts arise when the many dynamic interactions among natural resources, humans and institutions contradict each other because of the underlying differences in priorities pursued by various fishery players.

Furthermore, the conflict can be categorized into two types; conflicts among human/ stakeholders (user-user conflicts); and conflicts between human and the marine environment (user-environment conflicts; such as aquaculture development, mangrove clearing). For example : (i) large vs. smalls–cale fishers over rights and access to designated zones by type of fishery and use of light luring and modern fishing gears by large-scale fishers; (ii) rivalry between resident smalls–cale vs. migrant large-scale fishers over legitimacy of access and destruction of gears; (iii) Fishers vs. government authorities over lack of proper management and enforcement, overlapping of functions and weak institutional structure at various levels; (iv) fishery and other sectors such as tourism, navigation/ docking, sand quarrying and mariculture over varying use of aquatic resources [11]. The impact of the conflict, if not well manage, may lead to the destruction of the marine ecosystem.

Governance of fisheries and coastal resources has shifted the responsibility and authority for the management of fisheries and coastal resources from a centralized to decentralized agency; from central to local government. Governance regimes, such as community-based fisheries management (CBFM) and co-management, put emphasize on stakeholders' participation and empowerment in order to improve the effectiveness of resource management. Meanwhile, in Indonesia, there has been a similar growing emphasis on governance but, due to the small size of the country and weak local government arrangements, there has been less emphasis on decentralization and CBFM [12]. Instead, national co-management institutions and authority delegate it to non-governmental organizations (NGOs) are more prominent in stewardship [13].

CBFM have several strength such as: (i) locating the rights and responsibilities of management with the people closest to the system, potentially increasing responsiveness to local needs in line with their local culture; (ii)spending low cost of transaction, because it is managed by community's way and tradition; (iii) creating cohesiveness among individuals in the community through active participation.

On the other hand, CBFM have disabilities to resolve the intercommunity conflict, low capacity of communities to run organisations and deal with administrative demands, and inflexibility of rights. As a results, It is difficult to achieve the economics scale. CBFM will be difficult to achieve the economic scale. Therefore, CBFM will be properly work if the community structure is simple, well educated, and having a high level of awareness about environment. Moreover, CBFM will be adopted properly if the area covered is not widely spread, clear, and limited by geographical boundaries [14].

Essentially, CBFM is a core part of co-management; although, co-management has such advantages over CBFM. The advantages are promoting a more participatory decision making process at local level by enganging community members in protecting their local resource, leading to a greater compliance if local communities have been able to incorporate their preferences into policies [15], being more efficient if it utilizes comparative advantages in the allocation of tasks between government and communities [16]. These advantages resulted that certain tasks (such as monitoring other resource users, enforcement) can be done easily and cheaply at the local level. However, transaction costs of co-management might be higher if community capacity to support the co-management system is little, due to weak community institutions, poor leadership, and/or high levels of conflict.

Therefore, a new paradigm of protocol concept to manage marine ecosystem including fishery resources, which cover the unity of ecosystem as the fishery resources are in the coastal and sea regions [17], should be introduced. This new paradigm underlies the shift of fishery management from conventional fishery management to marine ecosystem management. The conventional management is conducted based on the need for data intensive, biological assessment of the status of resources, and selected reference points [18]; while, the marine ecosystems management is developed based on accounting for effects on other parts of the ecosystem in which a fishery is embedded, recognizing the broader economic and social interests of stakeholders, and accounting to a much larger extent for institutional, political, cultural and social objectives [19].

The new paradigm approach called EBFM shifts the management concept from fisheries sector specific to ecosystem-based approaches that encompass the

entire aquatic resource systems. This approach covers not only both human and natural but also multiple sectors activities on land and water. For examples; CBFM serves individuals or groups an exclusive or preferential access to specific fishery resources and allows community (not just the resource users) to manage their own fisheries; co-management gives community together with government to manage fishery, and the sustainable livelihood approach, in which people, particularly the poor, is the center of development [20].

EBFM is capable of accommodating and balancing various needs and desires of community. EBFM put emphasis on managing ecosystems, living marine resources, habitats, diverse community's objectives, the estimation needs for future generations, and the utilization of goods and services provided by marine ecosystems [21]. Moreover, EBFM provides orientation toward precautionary management of risk and uncertainties as well as plan for trends or changes over time in the fished ecosystem; therefore, the goal of EBFM is to assess and to manage the impacts of ecological, social, and impact of outcome associated with fishing activities in the ecosystem [22–23].

Furthermore, the implementation of EBFM must follow regional planning process that requires participation of local governments and stakeholders in the framework of an integration planning and management across provinces. The Government needs to be aware of a proper planning and management under circumstances of vulnerable fisheries with the influence of climate change at the same time; so that, the management will be able to accommodate regional–based structuring large–scale fisheries ecosystems, and encourage the preparation and implementation of fisheries spatial planning [24-26].

EBFM, according to Ecosystem Principles Advisory Panel (EPAP), covers at least four major aspects. Those are the interaction between the target species with predators, competitors and prey species; the influence of season and weather on the biological and ecological fish; the interaction between fish and their habitat; and the impact of fishing on fish stocks and their habitat, particularly, how to catch the species that have an impact on other species in the ecosystem. Meanwhile, the National Research Council of the USA (NRC) identifies the role of human as a component of ecosystems as well as the direct users. NRC also differentiated between ecosystems and the ecosystem users and stated that the ultimate goal is to maintain the integrity of EBFM and ecosystem sustainability. Planning of EBFM is very relevant to the sustainable development strategy as it will be able to ensure the ecological processes in fisheries, biological diversity, and survival for the entire population of native species [27, 28].

EBFM often involves ''scaling up'' management, for example, from single-species fisheries management to management of multi-species assemblages; from looking at isolated drivers of change to considering all environmental and human impacts; from design of individual protected areas to planning protected area networks; from conservation of a fragment of habitat to comprehensive spatial management [30]. Issues of scale include what is the appropriate scale of the marine ecosystem for fisheries management purposes [31] and scaling-up from other management arrangements [32, 33] such as community-based management to an ecosystem scale.

One of the challenges of EBFM is to fashion ways to ensure that the actions of the coastal and fisheries institutions at each level of government are harmonized with one to another and consistent with agreed EBFM goals and policies [34]. Therefore, management decisions matched to the spatial scale of the ecosystem, to the programs for monitoring all desired ecosystem attributes, and to the relevant management authorities are likely to be more successful in achieving ecosystem objectives.

Meanwhile, Issues in establishing governance arrangements for EBFM include not only the appropriate scale, but also boundaries and type of management for a marine ecosystem [35, 36]. Marine resources are usually managed at a political jurisdiction level rather than an ecosystem level. The questions are how to establish the appropriate type of governance arrangement—central, co-management, community-based—to manage the ecosystem and how to develop governance arrangements at the appropriate scale that addresses political, social/customary, and ecosystem needs for management.

Having identified the problem, the need of a new approach to maintain and manage marine ecosystem in Central Java coastal environment, the aim of this study was to analyze the implementation of EBFM in Karimunjawa Ecosystem, Central Java, Indonesia.

## 2.0 METHOD

Central Java was selected for this study due to a number of actions taken by the government to improve fisheries and coastal resource management through legislative reforms, as well as innovative projects and programs. While the policy conducted by government were not specifically undertaken for EBFM, the activities undertaken and the outcomes produced provide lessons that are important in developing governance arrangements for EBFM [12].

Primary data were collected through site visit to each regency and in-depth interview with key-informants associated with the projects in each regency such as National Economic Development Agency regional staff, provincial and municipal officials, management council, university staff, and non governmental organizations. The key informants were asked a series of questions about the governance and institutional arrangements in the regencies including history, sctructure, problems and opportunities, and lessons learned. Meanwhile the

secondary data were obtained through documentation of socioeconomic, resource, and ecological taken from Fisheries Statistical Project Reports and Department of Marine and Fisheries Document Database.

The research was carried out in Jepara, Pati, and Rembang Regency for these regencies fulfill three criteria: availability of good secondary data on governance arrangements; representative location and marine ecosystem; and the governance structure had been developed. Karimunjawa Ecosystem offered a unique opportunity to evaluate the development and implementation of fisheries and coastal resource governance arrangements at an ecosystem scale and to learn from the experience to improve fisheries management.

The data collected were analyzed using meta-analysis. Meta-analysis is one of quantitative approach that uses numbers and statistical methods to organize and dig up as much information as possible from the data obtained comprehensively [37]. Meta-analysis in this study was used to describe the evaluation of conventional fisheries management model and explore the success level of the new approach paradigm. The evaluation was measured using conventional scale of 1-10 with three categories (1-3 is bad; 4-6 is fairly; 7-10 is good) based on Rapid Appraisal of Fisheries Management Systems (RAFMS) indicator.

RAFMS was applied as its main conceptual is based on a method known as institutional analysis and development. Institutional analysis focuses on institutional arrangements, the set of rights and rules by which a group of fishers and the government organize resource governance, management and use in collective action situations. As such, RAFMS can quickly diagnose the elements of the existing fisheries management system and make a tentative evaluation of how such a system operates and performs. Six sets of attributes are relevant for the RAFMS. Fisher/community institutional and organizational arrangements attributes (Group IV), that define the sets of rights that fishers possess in relation to the fishery and the rules that define what action they can take in utilizing the fishery. The biophysical attributes (Group I), which pertain to both terrestrial and marine environments, are important determinants of the biological productivity and sustainability of fisheries resources. The market attributes (Group II) focus on the supply–demand relationships for marine products. Resource problems are often market based. The attributes of stakeholders, e.g. fishers, fishers family, fish traders, processors and money lenders, in the fishery refer to the social, cultural and economic conditions and characteristics that affect their incentives to cooperate with and contribute to management (Group III). Group V is composed of attributes for institutional and organizational arrangements external to the community. Group VI are exogenous attributes which are mainly external factors beyond the control of the local, and at times, the national levels [38].

Triangulation is a series of generating and verifying data for the given set of relevant attributes under examination. The "truth" is approached through the rapid buildup of diverse information rather than via statistical replication. This data will then be generated through actual field data gathering and reconfirmed or ascertained during the community validation. Meanwhile, in-depth interview is one of the means for triangulation procedure. In-depth interview or unstructured interview is a qualitative method of analysis conducted through a confidential and secure conversation to elicit holistic information [39]. In-depth interview in this study was employed to determine the prospect of EBFM in Karimunjawa Ecosystem and the reconstruction of EBFM model dan how to implement the set-up of EBFM. In-depth interview was carried out with key person from related agencies in fisheries sector such as committee of Indonesian Marine and Fisheries Socio Economics Research Network (IMFISERN), Research Centre for Fisheries Management and Conservation of Fish Resources (P4KSI), provincial and regional officials, and representative of local community. After that, interview transcripts visualized in diagrams and tables [40]. The governance arrangements establish by legislation and programs to gain insights into success and failure of these arrangements [41].

## 3.0 RESULTS AND DISCUSSION

### 3.1 Evaluation of Conventional Approach

Figure 1 illustrates comparison about conventional management and EBFM approach. In general EBFM is better than co–management and CBFM for all attribute. The conventional fisheries management (CBFM and Co-Management) models are evaluated by RAFMS attributes. The results showed that the conventional management approach at the level of "fairly" for all attributes. However, the co-management is still better than the CBFM in market attributes; biological, physical and technical attributes; external institutional arrangements; and exogenous factors. Meanwhile, CBFM is better than the co-management for the characteristic of community and community institutional arrangements attributes. EBFM is on a "good" scale for exogenous factor; biological, physical, and technical; and external institutional arrangements attributes.

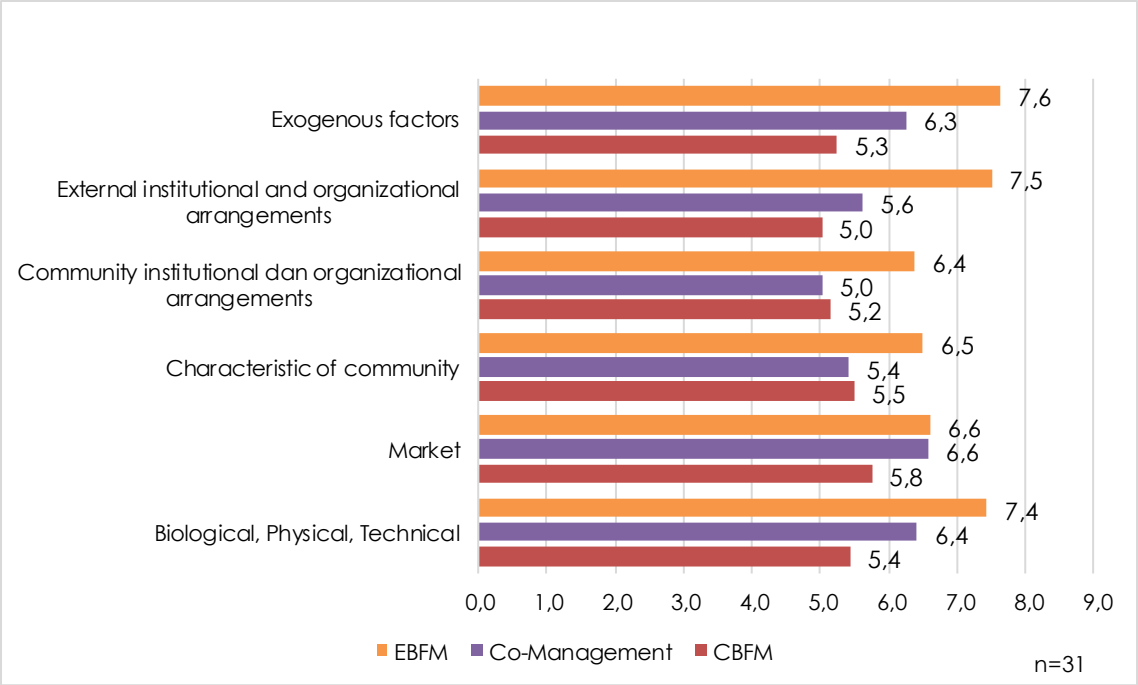



**Figure 1** Evaluation of conventional fisheries management vs EBFM

Community institutional arrangements attribute (Group IV) in the study area are defined by authority relationships that specify who decides what in relation to whom. Co-management is the worst model to implement it. Nevertheless evaluation of EBFM in this attribute also in "fairly" scale. Problems and constraints over resource use most often originate in the biological and physical attributes (Group I) of the resource and in the harvesting technology used. The nature of interaction among fishers is commonly structured by the biophysical and technological environment of the fishery. EBFM have "good" scale compared with conventional models for the status of fish stocks (species harvested and the fishing technology in use) and the state of resource exploitation. Market attributes (price, structure and stability) can affect the incentives for resource use activities, effort levels and compliance with rules. Both of conventional and EBFM has "fairly" scale in attributes related to market operations and functions, and to fisher and fish trader relationships (Group II). Both conventional and EBFM approach in terms of characteristic of community attributes (Group III) has "fairly" scale in religious affiliation, traditions and customs, sources of livelihood, the degree of community heterogeneity or homogeneity, individual behavior, and asset ownership. In external institutional attributes (Group V) shows that EBFM is the best proposed model for the processes of policymaking, legislation, governance and law enforcement that authorize and support community–level institutional and organizational arrangements at the national, regional, district or municipal levels. There may be nested, multiple layers of organizations at different political and administrative levels. For the last attributes, exogenous attribute, EBFM is also in "good" scale. These evaluation indicate how well the management system is functioning through its resiliency or capacity to accommodate sudden changes (for example: typhoons, civil unrest, political elections and inflation). It is summarized in Figure 1.

The prospect of EBFM is assessed more detailed through sustainability indicator based on RAFMS attribute. These attributes consist of five attributes (ecological, economic, ethical, social, and technology). Figure 2 illustrates a sustainability score carried out for attribute. In ecological evaluation, percentage of target catch has the greatest influence on sustainability, while no single attribute among the rest of the attribute stands out the influence. In economic aspects, subsidy, which provided to support the fishery, has the lowest influence on sustainability and price of fisheries product has the highest influence for sustainability. In social aspect, households in fishing in the community has the highest influence, while the direct fisher influence on actual fishery regulation has the lowest influence on sustainability. In technological aspect, the use of Fish Aggregating Devices (FADs) has the highest influence on sustainability. Discard and waste of fish has the highest influence on sustainability in ethical aspects, while attempts to mitigate fisheries induced ecosystem change has a lowest influence on sustainability

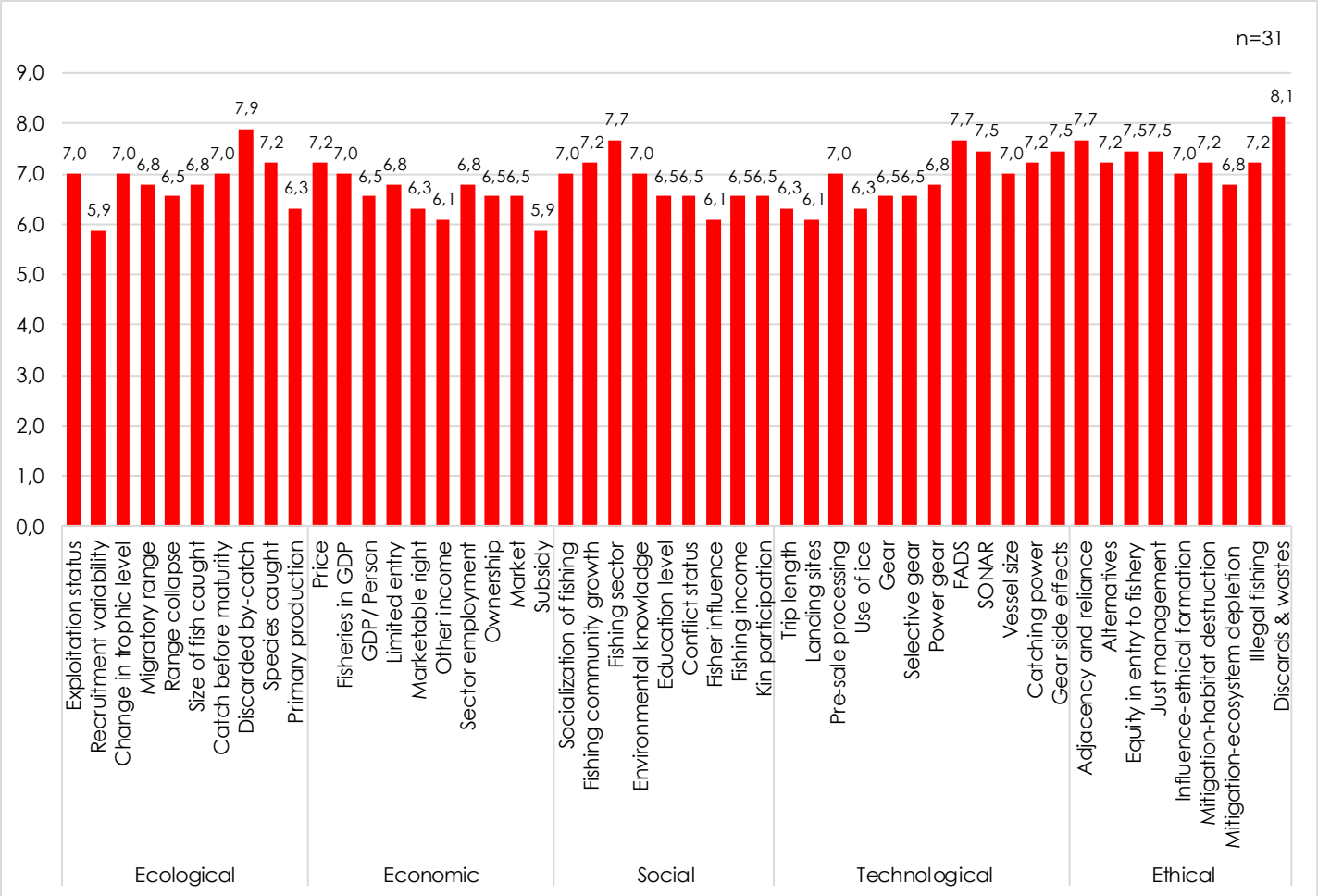



**Figure 2** Sustainability attributes for evaluation EBFM concept

Current interest reflects dissatisfaction with conventional fisheries management, which often have failed to meet societal goals for sustainable use of marine resources and protection of biological diversity and productivity. Overfishing represents one of the most challenging problems in marine conservation. In Java Sea 44 % of the fish stocks are now fully exploited and 25 % are overexploited and clearly in need of urgent management resources.

Fisheries resource is changing in line with the change in ecosystem and human activity. In accordance to this condition, need new fisheries management scheme since the conventional models perhaps no longer suitable with this current situation. The sustainable fishery will shoulder the life of fishers and other related stakeholders. In the existence of climate change and a shift of human's life style which tends need for higher demand for fisheries products, therefore indeed need to find out the suitable fisheries management on the basis of ecosystem approach.

EBFM for the management of fish resources may be one alternative method for the management of fish resources is a complex ecosystem. As a means of monitoring the ecosystem, EBFM then equipped with ecological indicators to measure changes in the ecosystem including humans. Planning is very relevant to the sustainable development strategy. It will be able to ensure the ecological processes, marine biological diversity, and survival for the entire population.

### 3.2 Implementation of EBFM

Data obtained through in–depth interview with key–persons in the fisheries sector indicated that in the early stage of its implementation, EBFM is hardly to be practiced since understanding and responsibility among stakeholders to achieve a target of sustainability in fisheries resource management has not been achieved. At this stage, EBFM has not been popular yet among officers in-charge for resource management working in the government agencies in Indonesia. Nevertheless, according to the key persons, EBFM inspires the spirits to sustain fisheries resource as it might become an alternative scheme for resolving fisheries management problems in Indonesia.

Previous studies claim that EBFM is an extension of the conventional fisheries management paradigm that improves their implementation and reinforcement to ecological relevance [25-27, 37]. Figure 3 illustrates schematically the elements (and links) considered under conventional fisheries management approach, and the extension required.

Figure 3 summarizes that elements in dotted and italic lines represent elements added to EBFM, while elements in black and bold specify conventional approach. A substantial part of EBFM implementation is a well–trodden area for which sophisticated instruments and experience are available. Other ecological considerations about direct and indirect consequences of fisheries, as well as ecosystem service to human use must also be dealt with it. In this sense, it is assumed that the fishery sector and its governance can evolve as required without a more costly revolution.

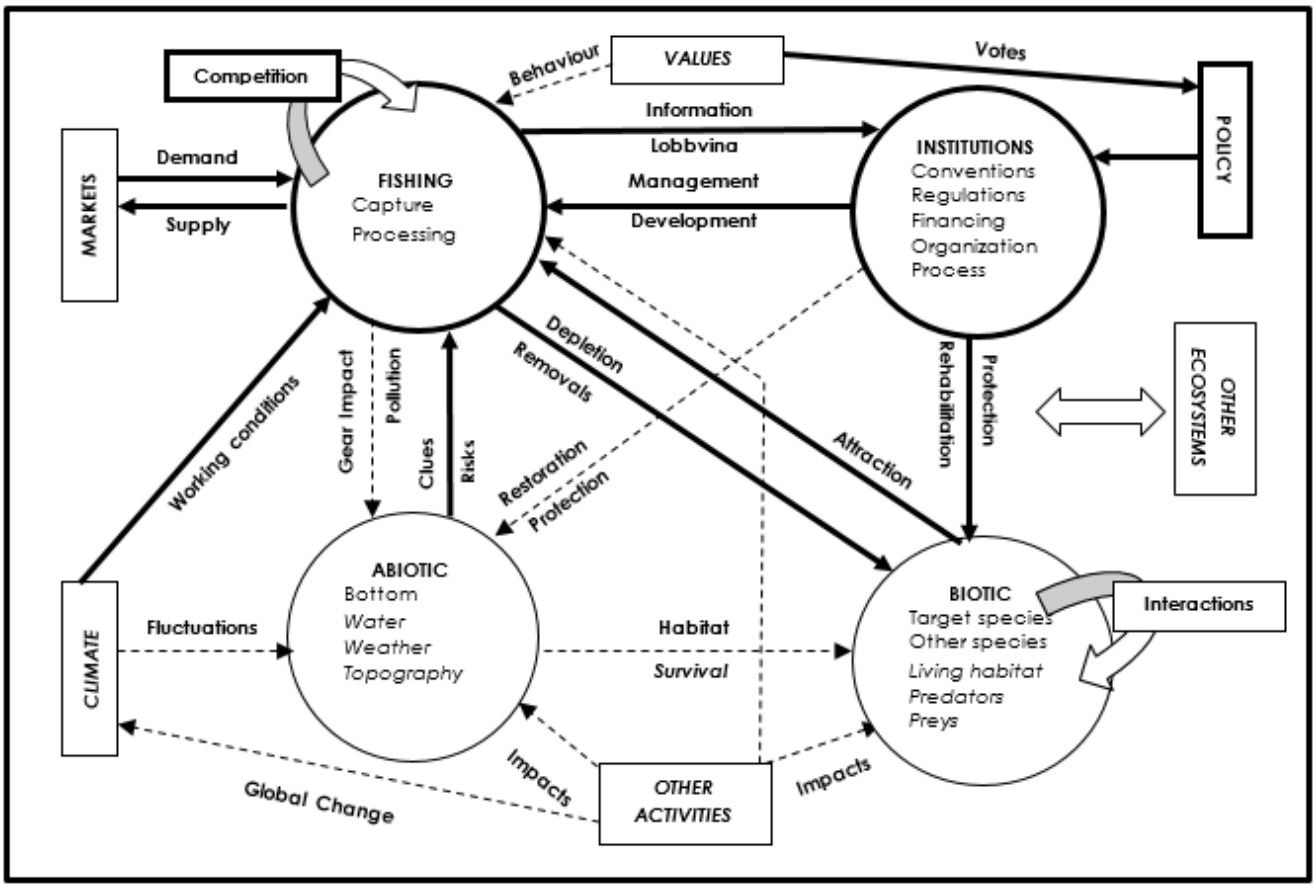



**Figure 3** Ecosystem components and interactions by EBFM

Having been tested, the result showed that the "extension" strategy has serious constraints faced by most fisheries agencies that can be resolved by implementing the existing institutional infrastructures (staff, laws and regulations, mechanisms, control and surveillance systems, etc.) and improving them as required. Furthermore, political will and industry's cooperation should be available in order to deal with the problems of the changes at a rate deemed acceptable by society. In the process, the socio-economic situation of fishers and related industries and the lack of alternative employment will be as much of a challenge as ever.

The implementation of EBFM requires a nested set of processes at regional, national, and local levels by interconnecting policies, strategies, and plans. While the main conceptual steps may be similar for all levels, the focus, scope, means, and approaches may be different. Therefore, the implementation requires top-down guidance and decisions to develop an enabling institutional environment (through decentralization), within which the lower-level processes can develop. Figure 4 summarizes implementation of EBFM that requires a policy and an operational management plan.

Figure 4 can be explained that, first, the policy defines the main orientations of fisheries and the high-level conceptual goals and constraints, connecting fisheries management to sector-development planning, integrating socio–economic and environmental considerations. Second, the policy also articulates the relations between national, local, and

sectoral processes and responsibilities, organizing the interaction between them, so establishing the framework for conflict resolution and decision. Then, it identifies the institutions involved, and outlines oversight mechanisms and information flow. Finally, the policy needs to deal with allocation and user rights, clarifying existing and future allocation instruments, as well as conflict-management mechanisms.

Meanwhile, the management plan, first, specifies expected outputs and outcomes and looks for overall performance. Second, it identifies indicators and reference values corresponding to the main objectives and constraints, through a process of interaction among the main stakeholders. Third, it provides feedback and adaptation as better information is obtained. It is important to be noted that poor communication is a common problem in conventional management, therefore effective information management is indeed a sine qua non in an EBFM. The participation of stakeholders requires an effective system to manage and distribute information.

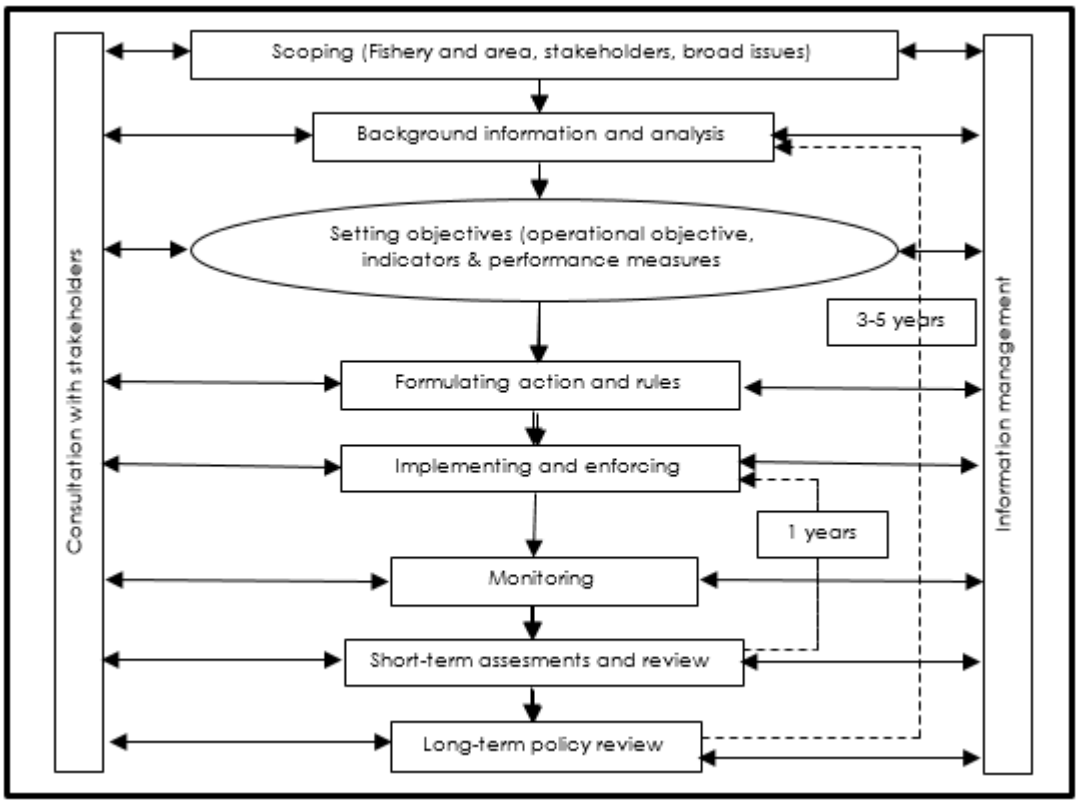



**Figure 4** Proposed institutional arrangement for EBFM implementation

In order to implement the policy and the operational management plan, reinforcement is needed, especially when responsibilities are decentralized for implementing EBFM. As a result, developing better institutions; developing mechanisms for integrated planning; establishing functional interconnections between administrations dealing with fisheries and environment within the ecosystem boundaries; establishing negotiations of multiple stakeholders; harmonizing legislation and regulations; establishing effective conflict management processes; ensuring decentralization, participation, and transparency are needed. As a supporting system to the implementation, research for development is needed to be developed to improve data collection, integrated analysis and communication, developing a better understanding of the ecosystem's functioning, evaluate policy and management options, and identifying trade–offs, ensure the use of appropriate assessment methodologies (including management performance and risk assessment), and identifying relevant indicators and reference points. Moreover, human resource development should also be improved by doing training administrative staff, observers on board fishing vessels, enforcement officers, scientists and advisers, and fishers in order to optimize their interaction in the participatory processes [42].

Another finding was that the cost of EBFM implementation is a perennial issue. To deal with it a tax on products could be imposed in commercial fisheries in exchange for the right to fish; however this would not seem appropriate for many small-scale fisheries. Therefore, cost may be reduced through devolution of responsibilities and co–management, self–management, and mobilization of social pressure

to improve compliance, although this decision may require additional costs to improve local implementation capacity, coordination, and control.

Realistic time frame of the implementation of EBFM in full scheme is about 10 yr. The advantages generated will be the elimination of destructive fishing practices; the establishment of networks of MPAs; the adoption of time/area closures for the protection of nursery grounds; the adoption of coastal land–use and watershed planning; and the integration into marine and coastal area management.

### 3.3 Innovation of EBFM in Karimunjawa Ecosystem

Karimunjawa ecosystem in Central Java has been chosen as the pilot project of this study as Karimunjawa has implemented EBFM with its protocol concept. The protocol functions to coordinate resource utilization among users within the demarcation area of the ecosystem services. In the early–stage, the implementation of EBFM was supported by the central–provincial–regional governments as the major facilitator and the other stakeholders proportionately. In the province level, the Governor provided an instruction to the head of regencies/municipalities in setting up one body of fisheries management to regulate the resources which lies within one ecosystem. Meanwhile, the contribution to establish facilities and funding was shared by each member under the same protocol of EBFM. However, the sharing obligation among the member brought about obstacles in the implementation of the EBFM. Therefore, the protocol concept now is under–negotiation between the regencies or municipal government and the authority within the study area.

The protocol area of one ecosystem proposed by this study covers regencies of Jepara, Pati, and Rembang. In addition, Rembang regency is was initially selected as the most possible protocol for this fisheries management as it has the biggest fish landing in the region. Furthermore, the institutional set up for EBFM was composed of several agencies which have a hierarchy in national, provincial and regional levels. The lowest level of institutional set up played as the main actor of the executing agencies for the protocol of fisheries management. Indonesia Maritime Board, Indonesian Institute of Science, Board Planning, Ministry of Marine and Fisheries, Academician, and Non–government organization or other research institution supported the protocol board of the executing agencies in the selected regions.

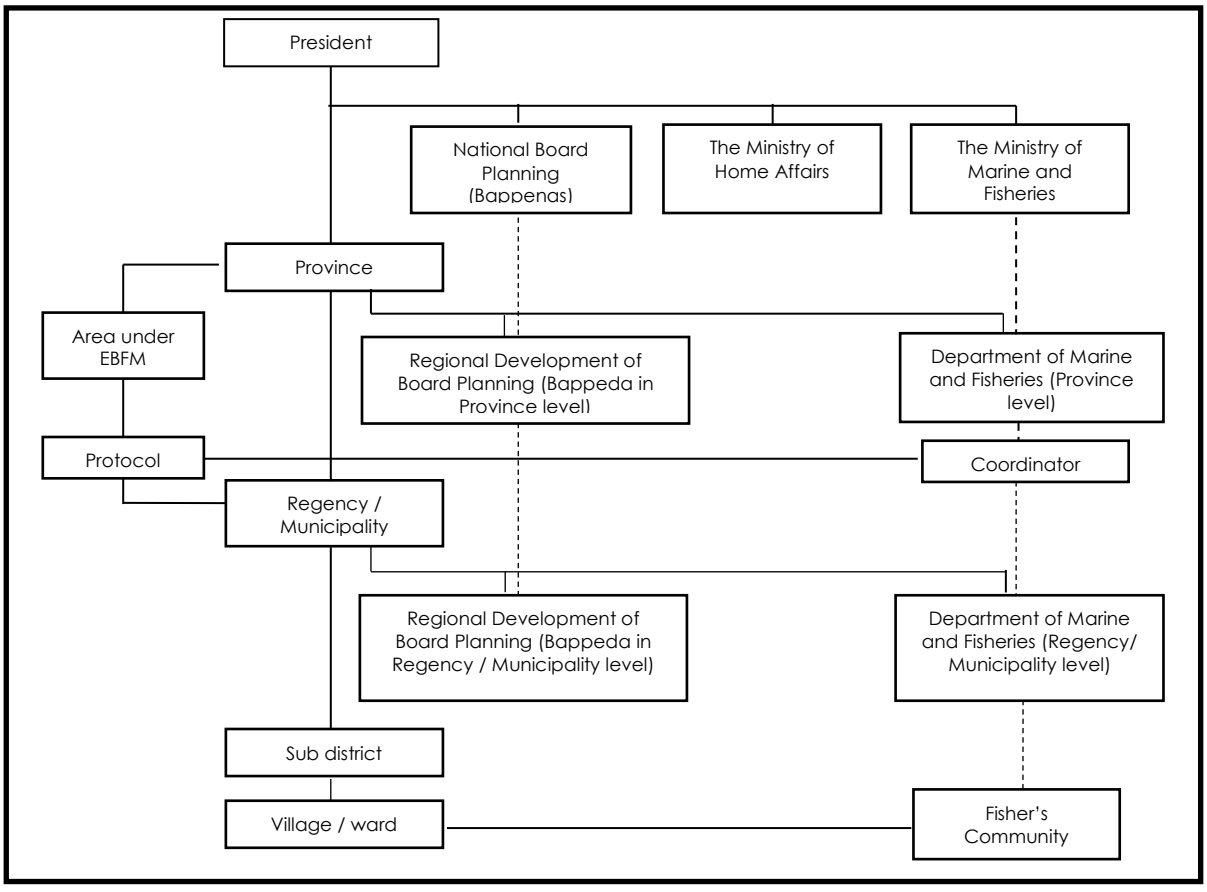



**Figure 5** Protocol concept in the implementation of EBFM

The executing agencies were responsible to manage the fisheries resource in the study area on the basis of ecosystem from planning to evaluation activities. The rule–in–used and the relevant regulations for EBFM set up of the institution were based on regulation No. 32/2004 (regional autonomy), regulation No. 27/2007 (the management of the coastal region and small islands), and regional regulation No. 9/2009 (the management of the coastal region and small islands in Central Java).

Central Java continues to innovating in fisheries management, showing leadership in developing and applying new approaches. Legislation and policies and experience learnt from projects have provided opportunities for innovation and cooperation and foundation for utilizing EBFM to manage the provinces near shore fisheries. Figure 5 visualizes the protocol concept in Central Java in implementing EBFM.

Many challenges existed during in implementation EBFM further, including a number of the initiatives project-based and a challenge for sustainability and continuity. Other challenges identified were: (i) regency executives had a political will to play an important role in coastal resource and fisheries management; (ii) technical capacity and level of awareness of the staff including training and cross visits were not developed; (iii) the mechanisms to ensure the sustainability and continuity during the three–year tenure of local government unit executives was not well developed; (iv) delineation of municipal waters was not clear; (v) support for enforcement was not well implemented; (vi) financial support from local governments for multi–jurisdictional management efforts was low; and (vii) addressing data/ information needs to support fisheries management has not been well developed.

Meanwhile, in the protocol concept, a formation of an assessment team formation for the ecosystem in the government level with local regulation should exist as shown in Figure 6. Figure 6 describes the proposed team to carry out the protocol concept of the Karimunjawa ecosystem. In order to implement the concept, the structure has two elements consisting of community and assessors. The community element consists of the public figure, fishermen and non-government organization. The community might be part of the habitat continuity team, stock assessment team, socio economic team, and food tenacity team. The community is responsible to socialize and implement the assessment result conducted by the assessors' element to the society. Meanwhile, the assessors' element functions to evaluate and monitor the work which consists of the representatives of stakeholders. Then the assessors will communicate the result to the community in their region. The team is a media between the central and the region government, so that the team will live in the protocol area under EBFM. Furthermore, for coordinating and supervising work of each team, the protocol area chosen based on the convention should be determined. The coordination with some institutions is requirement to make good policy which based on the scientific analysis, whereas the provincial marine and fisheries department conducts the work as its main duties and function.

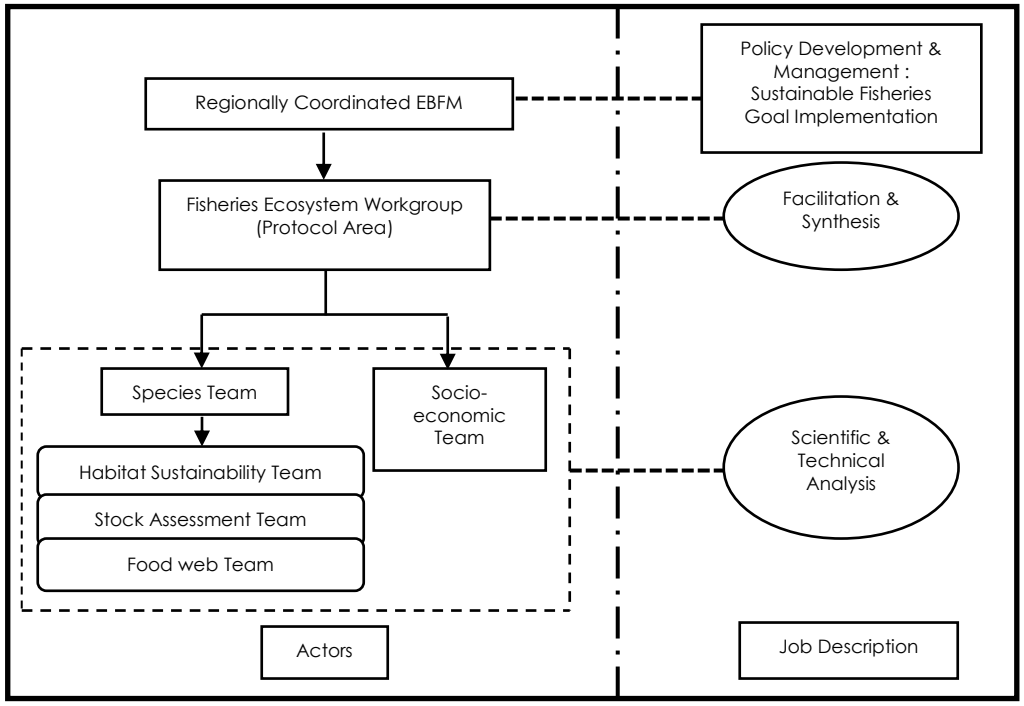



**Figure 6** Proposed team of protocol concept EBFM

EBFM identifies the necessary collaboration and establishes the mechanisms for interaction. To do it, EBFM requires an integrated planning; institutional development; risk assessment, management, and communication; valuation of environmental assets; and preserving local culture wisdom. The EBFM outlines the implementation pathway and approaches, for instance specifying the approaches required dealing with precaution, participation, monitoring, reporting, and performance assessment, as well as the resources required. A central difficulty lies in defining the group of genuine stakeholders, finding an appropriate compromise between representation of the largest possible range of interests and the need to keep interaction costs manageable. Focus Group Discussion (FGD) with key persons was conducted to outline the further action plan for establishing institutional arrangement (Governance, Academician, and Users) for EBFM. Transcription of FGD has been made and the synthesis is summarized in Table 1.

**Table 1** Action plan of EBFM in pilot project

| No | Stakeholders | Action Plan |
|---|---|---|
| 1 | Policy Makers | • identify the main operational objectives<br>• allocate resources through appropriate systems of rights<br>• identify the proper set of stakeholders and resolve the thorny issue of exclusion in an equitable manner<br>• lobby to reduce coastal pollution and degradation<br>• improve the image of fisheries governance<br>• maintain capture fisheries production while reducing environmental impact |
| 2 | Academician | • identify effective and feasible measures<br>• advise on boundaries that make both ecological and institutional sense<br>• elaborate a conceptual equivalent to maximum sustainable yield for ecosystems<br>• identify a parsimonious set of ecosystem indicators and associated reference values<br>• credibly assess ecological risks<br>• develop rehabilitation strategies<br>• elaborate affordable transition pathways<br>• integrate social sciences |
| 3 | Fishers Community | • face the challenge of capacity reduction<br>• adopt more environment–friendly gear and practices<br>• lobby for fishing rights<br>• preserving local/ culture wisdom |

## 4.0 CONCLUSIONS

Today's management ranges broadly from free and open access with little or no regulations enforced, to fairly sophisticated rights-based management systems, including consideration of the impacts on non-target species. The implementation of EBFM is still in its very first stage that involves many challenges for both the stakeholders and the government; however, it might represent the only opportunity for fisheries to become responsible and sustainable.

The progress of the implementation of EBFM is being made; although, more effort is needed, to develop more specific regulations regarding individual species, gears, practices, and habitats, and to adopt a more integrated approach, simultaneously addressing rights and responsibilities, allocation and equity, resource conservation, and environmental protection in a transparent framework. Performance assessment and public information are not yet as part of the routine as they should be.

Proposed approach by protocol concept has been presented "clustering" of multiple local government units to be able to operate and manage fisheries resources at ecosystem scales. The experience and innovation of EBFM concept from Central Java seem to be applicable to other regions where decentralization of fisheries management has occurred.

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## References

[1] FAO Fisheries Department. 2003. *The State of World Fisheries and Aquaculture*. Rome: FAO.
[2] FAO Fisheries Department. 1995. *The Code of Conduct for Responsible Fisheries*. Rome: FAO.
[3] Conra, J. M. and C. W. Clark. 1987. *Natural Resource Economics, Notes and Problem*. New York: Cambridge University Press.
[4] Bundy. 2001. Fishing on Ecosystems: The Interplay of Fishing and Predation in New Foundland Labrador. *Canadian Journal of Fisheries and Aquatic Science*. 58: 1153–1167.

[5] Heazle, M. and J. G. Butcher. 2007. Fisheries Depletion and the State in Indonesia: Towards a Regional Regulatory Regime. *Marine Policy*. 31: 276–286.
[6] Coll, M., A. Santojanni, I. Palomera, S.Tudela and E. Arneri. 2007. An Ecological Model of the Northern and Central Adriatic Sea: Analysis of Ecosystem Structure and Fishing Impacts. *Journal of Marine Systems*. 67: 119–154
[7] Hutubessy, B. G., J. W. Mosse, P. A. M. van Zwieten and P. Hayward. 2014. Towards an Ecosystem Approach to Small Island Fisheries: A Preliminary Study of a Balanced Fishery in Kotania Bay (Seram Island, Indonesia). *Journal of Marine and Island Cultures*. 3: 98–105.
[8] Akhmad, F. and A. Zuzy. 2014. The Java Sea Small–Scale Fisheries in Changing Environment: Experiences from Indonesia. In Ann L. Shriver (ed). Economics of Fish Resources and Aquatic Ecosystems: Balancing Uses, Balancing Costs. *Proceedings of the Seventeenth Biennial Conference of the International Institute of Fisheries Economics & Trade*, July 7-11, 2014, International Institute of Fisheries Economics & Trade, Corvallis, Oregon, USA.
[9] Supriharyono. 2003. Does Marine Fishing Capture Decline in North Coast of Central Java? *Journal of Coastal Development*. 7(1): 11–19.
[10] Torell, M. and A. M. Salamanca. 2002. *Institutional Issues and Perspectives in the Management of Fisheries and Coastal Resources in Southeast Asia*. ICLARM Technical Report. Penang: ICLARM
[11] Salayo, N. D., M. Ahmed, K. Viswanathan and L. R. Garces. An Overview of Fisheries Conflicts in South and Southeast Asia. *Research Report NAGA WorldFish Center Quarterly*. 29(1&2): 11–20.
[12] Hutubessy, B. G. and J. W. Mosse. 2015. Ecosystem Approach to Fisheries Management in Indonesia: Review on Indicators and Reference Values. In Hady, H., H. Susanto and O. K. Radjasa (eds). *Procedia Environmental Sciences*. 23: 148–156.
[13] Viswanathan, K. K., J. R. Nielsen, P. Degnbol, M. Ahmed, M. Hara and N. M. R. Abdullah. 2003. *Fisheries Co–Management Policy Brief: Findings from a Worldwide Study*. Penang: Worldfish Center.
[14] Pomeroy, R. S. 1996. Community–Based and Co–Management Institutions for Sustainable Coastal Fisheries Management in Southeast Asia. *Ocean and Coastal Management*. 27(3): 143–162.
[15] Nielsen, J. R., P. Degnbol, K. K. Viswanathan, M. Ahmed, M. Hara and N. M. R. Abdullah. 2004. Fisheries Co–Management an Institutional Innovation? Lessons from Southeast Asia and southern Africa. *Marine Policy*. 28: 151–160.
[16] Carlsson, L. and F. Berkes. 2005. Co-Management: Concepts and Methodological Implications. *Journal of Environmental Management*. 75: 65–76.
[17] Pomeroy, R., B. Kimberly and M. Patrick. 2014. Marine Spatial Planning in Asia and the Caribbean: Application and Implications for Fisheries and Marine Resource Management. *Desenvolv. Meio Ambiente*. 32: 151–164.
[18] Pope, J. G., D. S. MacDonald, N. Daan, J. D. Reynolds and S. Jennings. 2000. Gauging the Impact of Fishing Mortality on Non–Target Species. *ICES Journal of Marine Science*. 57: 689–696.
[19] Pomeroy, R. R. Brainard, A. Heenan, M. Moews, J. Shackeroff and N. Armada. 2013. Coral Triangle Regional Ecosystem Approach to Fisheries Management (EAFM) Guidelines. *Ocean and Coastal Management*. 47: 429–447.
[20] Christie, P, L. F. David, T. W. Alan, E. O. Liza and J. William. 2007. Assessing the Feasibility of Ecosystem–Based Fisheries Management in Tropical Contexts. *Marine Policy*. 31: 239–250.
[21] Patrick, W. S. and S. L. Jason. 2015. Hidden in Plain Sight: Using Optimum Yield as a Policy Framework to Operationalize Ecosystem–Based Fisheries Management. *Marine Policy*. 62: 74–81.
[22] Pomeroy, R. J. Parks, R. Pollnac, T. Campson, E. Genio, C. Marlessy, *et al.* 2007. Fish Wars: Conflict and Collaboration in Fisheries Management in Southeast Asia. *Marine Policy*. 31(6): 645–656.
[23] Arkema, K. K., S. C. Abramson and B. M. Dewsbury. 2006. Marine Ecosystem–Based Management: from Characterisation to Implementation. *Frontiers in Ecology and the Environment*. 4(10): 525–532
[24] USA National Marine Fisheries Service.1999. Ecosystem Based Fishery Management: A Report to the Congress by the Ecosystem Principles Advisory Panel [Online]. From: http://www.nmfs.gov/sfa/reports.html. [Accessed on 23 June 2015].
[25] Garcia, S. M. and K. L. Cochrane. 2005. Ecosystem Approach to Fisheries: A Review of Implementation Guidelines. *ICES Journal of Marine Science*. 62: 311–318.
[26] Marasco, R. J., D. Goodman, C. B. Grimes, P. W. Lawson, A. E. Punt and T. J. Quinn. 2007. Ecosystem–Based Fisheries Management: Some Practical Suggestions. *Canadian Journal of Fisheries and Aquatic Science*. 64: 928–939.
[27] Gasalla, M. A. and W. Rossi. 2004. Contribution of Ecosystem Analysis to Investigate the Effects of Changes in Fishing Strategies in the South Brazil Coastal Ecosystem. *Ecological Modelling*. 172**:** 283–306.
[28] Metcalf, S. J, D. J. Gaughan and J. Shaw. 2009. *Conceptual Models for Ecosystem Based Fisheries Management (EBFM) in Western Australia*. Fisheries Research Report No. 194: 42. Western Australia: Department of Fisheries.
[29] Fletcher, W. J. 2008. *A Guide to Implementing an Ecosystem Approach to Fisheries Management (EAFM) for the Tuna Fisheries of the Western and Central Pacific Region*. Version 5 March 2008: 70. Honiara: Forum Fisheries Agency.
[30] Marine Ecosystems and Management (MEAM). 2008. Issues of Scale: Ensuring that EBM Works at All Levels, from Local to National and Beyond [Online]. From: https://meam.openchannels.org/news/meam. [Accessed on 30 Januari 2016].
[31] Wilson, J. Getting the Scale(s) Right in Ocean Fisheries Management: an Argument for Decentralized, Participatory Governance. In: Gray, T. (ed). *Participation in Fisheries Governance*. Berlin: Springer.
[32] Lovell C, A. Mondondo and P. Moriarty. 2002. The Question of Scale in Integrated Natural Resource Management. *Conservation Ecology*. 5(2): 25–35.
[33] Berkes F. 2006. From Community–Based Resource Management to Complex Systems: the Scale Issue and Marine Commons. *Ecology and Society*. 11(1): 45–53.
[34] Pikitch, E. K., C. Santora, E. A. Babcock, A. Bakul, R. Bofil, D. O. Conover, *et al*. 2004. Ecosystem–Based Fisheries Management. *Science*. 305: 346–347.
[35] Sardà, R., T. O'Higgins, R. Cormier, A. Diedrich and J. Tintore 2014. A Proposed Ecosystem–Based Management System for Marine Waters: Linking the Theory of Environmental Policy to the Practice of Environmental Management. *Ecology and Society*. 19(4): 51.
[36] Lynam, C. P. and M. Steven. 2015. How Will Fisheries Management Measures Contribute Towards the Attainment of Good Environmental Status for the North Sea ecosystem? *Global Ecology and Conservation*. 4:160–175.
[37] Pomeroy, R., M. Len Garces and S. Geronimo. 2009. Ecosystem–Based Fisheries Management in Small–Scale Tropical Marine Fisheries: Emerging Models of Governance Arrangements in the Philippines. *Marine Policy*. 34: 298–308.
[38] Pido, M., R. Pomeroy, L. R. Garces and B. C. Melvin. 1997. A Rapid Appraisal Approach to Evaluation of Community–Level Fisheries Management Systems: Framework and Field Application at Selected Coastal Fishing Villages in the Philippines and Indonesia. *Coastal Management*. 25: 183–204.

[39] Berry, R. 1999. Collecting Data by In–Depth Interviewing. Paper Presented at the British Educational Research Association Annual Conference, University of Sussex at Brighton [Online]. From: http://www.leeds.ac.uk/educol. [Accessed on 29 January 2016].
[40] Fletcher, W. J. 2005. The Application of Qualitative Risk Assessment Methodology to Priorities Issue for Fisheries Management. *Journal of Marine Science*. 62: 1576–1587.
[41] Metcalf, J. S. 2009. *Qualitative Modeling to Aid Ecosystem Analyses for Fisheries Management in a Data–Limited Situation*. Dissertation. Tasmania: University of Tasmania
[42] Food and Agriculture Organization (FAO). 2003. *The Ecosystem Approach to Fisheries*. FAO Technical Guidelines for Responsible Fisheries, vol. 4(2). Rome: FAO.