Precision Fishery Management Framework Based on Fisheries Management Area

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Abstract. Implementing precision fisheries management is a challenge for fisheries governance. Precision fisheries management might depend on the availability of data, area, carrying capacity, utilization, labor, industrial capacity, and fish consumption of the community. For Indonesia, the Fisheries Management Areas (FMAs) approach could become the basis for traceability and measurability of precision fisheries management. To ensure its effectiveness, the design of precision fisheries management must be started with the development of a logical framework, which then serves as a foundation for a further management design. This paper aims to present a management framework for precision fisheries management based on Fisheries Management Area. The framework covers sub sector in fisheries including capture fisheries, aquaculture, fish processing, and conservation activities. Meanwhile, supervision is the cornerstone that will oversee the implementation of all the fisheries sub sector. The framework shows that spatial-based data is one of the determinants in the efficacy of precision fisheries management.

1. Introduction

The establishment of the Ministry of Marine Affairs and Fisheries (MMAF) was expected that the marine and fisheries sector could contribute up to 10 billion dollars per year or equivalent to 10 percent of Indonesian state budgets. However, 20 years since its establishment, this target has not been able to be properly achieved. Even, declared by Bappenas [1], around 6.2 billion dollars in 2020 is become unlikely due to the impact of Covid19. Difficulties in formulating a just and responsible fisheries development mechanism are claimed as the causes. Importantly, the lack of available data to adequately manage the sector. For instance, the fish stock of 12.5 million tons [2], the potential stock of lobster larvae (refs), the absence of salt balance (refs), number of fishers (refs), fisher welfare (refs), the need for employment (refs), as well as estimates of the carrying capacity and capacity of fishery businesses that are not measured properly (refs). Possible investment uncertainty is also affected by the fish stock data. For instance, the 2017 estimate by Ministerial Decree No. 50 of 2017 is deemed incomplete. The fish stock data is the basis for various implementing policies, the benchmark for licensing, and evaluating business progress. For this reason, the concept of precision fisheries management is promoted, which is driven by the use of precision data to optimize benefits, while allocating a suitable amount of resources to implementation management.

The development of precision fishery is essential to escape from the trap of long-term pseudo development and avoid uncertainty management [3]. To achieve this, several actions must be
in place including improving fisheries data (i.e. catch data, cultivation area, number of processors, and salt requirements), revisiting non-accommodative policies (i.e. presidential regulation on salt, differences in fisheries criteria in several Laws, government coordination in port asset and data management), strengthening work systems that required continuous data collection (i.e. fish landing data), assessing carrying capacity of aquaculture areas and synchronizing coastal and marine spatial plan (RZWP3K) between provinces, recalculating potential manpower for all fisheries sub-sector, and adapting digital technology into operational management (i.e. fishery data collection).

To implement precision fisheries governance, a framework is needed as a theoretical basis for the development. This study aims to formulate a precision fisheries framework in the fishing, aquaculture, processing, and conservation subsectors.

2. METHODOLOGY

2.1. Time and Procedure
The research was conducted during 2020. The data collected were qualitative and quantitative data, both primary and secondary, including through online and offline FGDs with target groups. The data then is screened and used to design a framework through a logical analysis approach. All the frameworks developed also take into account various issues and problems in the fisheries sector, including the issue of implementing the Fisheries Management Area approach.

2.2. Data analysis
The analysis was carried out in two stages. The first stage involved the formulation of information from the data collected through FGDs and observations on key fisheries issues. The second stage focused on the formulation of precision fisheries frameworks on the fisheries sub-sectors: capture fisheries, aquaculture, processing industry, and conservation. The analysis carried out is using the LFA (logical frameworks analysis) approach Baccarini [4], which is to formulate a model of the relationship between the stages and processes in the management of capture fisheries, aquaculture, processing, and conservation. The designed framework is presented in the form of a flowchart starting from data, spatial information, implementation, and output of income schemes in the fisheries economy.

3. RESULT AND DISCUSSION

3.1. Capture Fisheries Framework
Precision fisheries management framework for capture fisheries is started from precise fishery stock data and information. The estimated national fish stock of 12.5 million tons (accumulation from 11 FMAs is used for a simple iteration) is served as the basis for developing capture fisheries. The framework includes stock information in FMA-i which then becomes an aggregate of national fish stocks (Figure 1). In general, the framework includes three fishery business groups, the small-scale fisheries/SSF, the medium-scale fisheries/ MSF, and the large-scale fisheries/ LSF. These three groups have been accommodated in the grand scheme of national fisheries actors.
Three important chains must be considered in capture fisheries. The first is in the data collection process at fish auction sites (TPI), distribution of catch, labor, production value, and income as well as economic growth. Second, in the production process, there is a mechanism for managing state revenues, followed by the auction process [5]. Third, the processing system is mapped in the MSME business system, crabs, blue swimming crabs, lobsters, and large industries. In all these systems, the need for labor, the value and volume of production, the income of fishermen, and the welfare of fishermen are depicted. A precise TPIs data collection system will provide accurate estimates of production, income, fishermen’s welfare, and income that can be managed by the state. Its means that a successful market development also depends on auction-real data information [6].

3.2. Mariculture Framework

In the mariculture system, FMAs-based management becomes very important benchmark for developing the business. In the coastal and marine zoning plan, mariculture areas are usually allocated. The extent of area that is suitable for mariculture in zoning plan is used to determine production capacity. By using the average production approach, the carrying capacity of production can be estimated (Figure 2). Using the same approach, quantity of essential input, such as seed, feed, labor, technology needs can be precisely calculated, and thus helping the mariculture business to be more efficient. These analysis are consolidated into FMAs level, and becomes basis for measuring the carrying capacity of the FMAs through mariculture sector.
Based on data from the Directorate of Aquaculture, the total mariculture area is 12,636,104 ha, with potential production of 12,505,367 tons per year (Figure 3). For each FMA, the area that has been developed for mariculture, and potential, unused for mariculture activity must be determined. Such unused area can be allocated for investment to generate jobs, and linked with calculation of market demands (i.e. hotels, restaurants, and retailers). Further spatial-based calculations will be able to determine production levels, and industrial development, investment needs, market needs, and other potential gaps such technological investment. Intelligent technology adaptations in mariculture are increasingly being used to increase production efficiency [7]. Krom et al [8] stated that the automatic system is increasingly practiced in mariculture.

**Figure 2.** Framework of mariculture business

**Figure 3.** The potency of mariculture are in each WPP in Indonesia (DJBP, 2020)
3.3. Processing Industry Framework

Processing industry capacity is closely related to the capture fisheries and mariculture production. Total production is the total potential of raw materials for processed by MSMEs, and by large scale fisheries facility, including fresh product (Figure 4). This processed product will then be distributed to local and global markets. The source of revenue for each value chain is part of the economic value of processing, and recorded as part of the economic distribution in the processing industry.

![Figure 4. Framework of fish processing industry](image)

Based on size of potential stocks from capture fisheries, it can supported as many as 3500 processing industries including tuna and tuna-like species from RFMO waters. In the framework, the raw materials from mariculture will be very decisive in increasing industrial capacity. Thus, mariculture should be the backbone for further industrialization in the fisheries sector. Fore et al [9] noted that precision aquaculture and mariculture production contribute to increasing the availability of raw materials for the processing industry. Yonvitner et al [10] distributed the number of industries that can be supported or production carrying capacity for processing raw materials by FMAs (Figure 5).
3.4. Conservation Framework

In the coastal and marine zoning plan, marine conservation areas are generally divided into 3 zones, the core, buffer and utilization zones. In the core zone, economic potential through research can still be developed, while in the buffer zone, ecotourism and research activities are some of the options. In the utilization zone, utilization is possible through capture fisheries and mariculture. These three types of zone can be calculated to determine potential contribution to the carrying capacity of production (Figure 6). If within 23.34 million ha of the total conservation area, 15% is the core zone, then the core zone area can reach 3.5 million ha. Likewise, if 20% is a utilization zone, the area can reach 4.7 million ha. Meanwhile, the utilization zone area reaches 15.2 million ha (65%) of the total marine conservation area. Thus, the economic carrying capacity of the three zones can be calculated as the economic carrying capacity of the conservation area.

Figure 5. Fish processing capacity based on capture fisheries in each wpp Indonesia
The potential of conservation areas as research is an economic potential that has not been fully explored. For instance, biodiversity can be sourced as raw materials for the biotechnology industry. The progress of the future biotechnology industry is one indicator of the progress of development and the benefits of marine conservation areas. Likewise, the existence of diversity as a commodity and is part of economic transactions through research and the biotechnology industry. Sala et al. state the enhancement of local fisheries, increased tourism, and maintenance of ecosystem services as part of commoditized on conservation business model on marine protected area.

3.5. Integrated Framework
Integrated framework is focused on integrating management of capture fisheries, mariculture, processing industry, and conservation as part of a comprehensive management process. The linkage model is all determined and mapped using data, either spatial data, production data, labor, and state revenues (Figure 7).
Figure 7. Integrated framework of fisheries management governance based on WPP management

The integration of the designed framework will show how planning, production, investment and welfare industry is link each other. However, to ensure that the system is working and in determining the effectiveness of the framework, surveillance and control must be in place. The integrated model also must includes consideration of population dynamics and socio-ecological systems including community participation [13]. The development of precision fisheries is an effort to maintain a balance between productivity (i.e. fishing, aquaculture, food supply), and ecosystem integrity which is widely promoted through the blue economy concept [14]. Precision fisheries management will assist fishery managers, in estimating revenue and economic contribution of the fishery economy, and designing development that will generate optimum benefit to the welfare of fishers, fish farmers, processors, as well as state revenue for long-term.

4. CONCLUSION
Precision fisheries management framework integrate whole management aspects from planning, implementation, surveillance, to evaluation, as well all subsectors in fisheries from capture, mariculture, conservation and processing. For Indonesia, the Fisheries Management Area approach could become the basis for traceability and measurability of precision fisheries management.

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