Current status of the small-scale fisheries and its resources at Peukan Bada coastal area in Aceh Province, Indonesia

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Abstract. The coastal region around the world is in response to the significant change from the environment impacted by natural and anthropogenic sources. Such significant change could be observed in the coastal region where it had been experienced a natural disaster, climate change, and social-economic shift locally and regionally. The Peukan Bada coastal area in Aceh Province has experienced all of these features; thus, studying this region will give a new perspective and highlight the status of the small-scale fisheries and their governing marine-fisheries resources. In this study, we conducted the Rapid Appraisal of Fisheries Management System (RAFMS) to estimate the fisheries resources and their biological and physical attributes, market pattern, and main coastal problem facing by the community. The study found that the rapid and significant change of the fisheries resources and their biological and physical attributes as a result of a major natural disaster such as 26 December 2004 mega earthquake and tsunami, meanwhile a minor change to the market pattern was found changed in response to market demand, and major coastal problems are dominantly related to the community activities (anthropogenic) rather than resulted from natural event.

1. Introduction

Indonesia is an archipelago nation that hosts over 17,000 islands and has a coastline that stretches as long as ~50,000 km, claimed as the 3rd longest coastline in the world [1]. A distinct difference to the other coastline, at Indonesia, most of its region located at or in adjacent to the convergent plate boundary or the subduction zone [2], it was also found in a direct effect of the climate change such as sea-level rise which both act as the source of disaster as the natural pressure [3]. Furthermore, several strategic big cities as well as industries are neighboring, and or along the coastal region, hence, its contributions in social-economic and its dynamics gave an immense pressure to the coastal region and marine resources, respectively act as the anthropogenic pressure [4].

Aceh coastal region is among the few regions that had experienced significant pressure from natural and anthropogenic sources [3,5]. On the natural pressure, it is heavily impacted by the mega earthquake
and tsunami disaster on 26 December 2004 [6], while anthropogenic source comprises of the high density in fishing activities close to the coastal region [7]. Recent studies by [7] indicate that the northern waters of Aceh, i.e. Peukan Bada coastal and its offshore region are shown to have the highest density of fishing activities.

Figure 1. The study area is shown in Aceh Province at the northwestern tip of the Indonesia archipelago (map in the background on the top). (a) The Aceh Province and the subdistrict political boundary are shown with a black solid line, while the red-colored region indicates the Aceh Besar sub-district. The blue rectangle on the upper left corner indicates the spatial location in b. (b) The study sites are shown by the red-colored area with text, i.e., Lam Teungoh and Lam Awee. The Aceh province capital is shown by the star symbol with the label Banda Aceh, while the location of Ocean Fisheries Port Lampulo (OFPL) is shown in the black dot. The green and blue shapes indicate the fishing ground location during the northeast and southwest monsoon, respectively. The orange shape indicates the near coast Fish Aggregating Devices (FADs) locations, and the brown shape indicates the location of manta and sharks were caught. The X cyan-colored symbols indicate the location of coral reefs where the fishermen usually went fishing.

Several factors may have contributed to the anthropogenic high pressure being given particularly to the Peukan Bada coastal and its offshore region, i.e. the abundances locations of the most optimum sea surface temperature (SST) where the fish was caught [8], located in between two water region (northern and western) hence the fishing activities were active throughout all monsoon season [5] and semi-closed water with myriad islands resulted in a low ocean current velocity as well as smaller wave height [9,10]. Actually, the fishermen resided along the Peukan Bada coastal area are small scale fisher. They are the most vulnerable group facing the abrupt shift in the pressure by the natural and anthropogenic sources. Therefore, this study tries to highlight the recent status of the small-scale fisheries and its resources at Peukan Bada coastal area, which will give a new perspective and highlight the status of the small-scale fisheries and their governing marine-fisheries resources.

2. Material and Methods
2.1 Study sites
The study sites are located at two villages, i.e., 1. Lam Awee and 2. Lam Tengoh, in Peukan Bada subdistrict of Aceh Besar as it is shown in Figure 1. These sites were chosen because of the large number of small-scale fishermen reside in these villages, besides adequate fishing facilities for the small-scale fisher are present, such as fish landing base, fish auction market and fishing gear repairing stations are present.

2.2 Data collection

The procedure to perform the Rapid Appraisal of Fisheries Management System (RAFMS) was clearly described in [11,12] that characterized by its cost-effective, easy to generate information, intense participation of the concerned stakeholders, and promote actual results for managers and politicians [5,6,13]. The overall step in RAFMS is by performing (1) Literature review, (2) Probing a survey, (3) Appraisal/data gathering, and (4) Validation by the concerned communities [11]. A total of 7 days was needed to perform the RAFMS at each village.

2.3 Respondent participation

The respondents were chosen purposively to best cover the whole part of the fisheries management system in the study sites; thus, it is a combination of coastal stakeholders such as Panglima Laot (traditional institution for fishermen), fishermen, fisheries trades, local sellers, and coastal residents. A total of 28 respondents participated in the data gathering and validations, regardless of the indirect respondent involved during the appraisal and validation.

2.4 Appraisal and validation

2.4.1 Appraisal. A set of questionary were set up by the interviewers about contextual variables relate to the fisheries and marine resources. The aim of each question to best explain the fisheries and marine resources on the study site. Table 1 indicates the variables, its attributes, and indicator in which being assessed.

| Attributes                      | Indicator                                                                 | Contextual Variable                                                                 |
|---------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| **Part I – Appraisal of the status of the marine and fisheries resources** |                                                                           |                                                                                     |
| Physical attributes             |                                                                           |                                                                                     |
| Resource usage                  |                                                                           |                                                                                     |
| Marine                          | 1. Indicator of the marine and fisheries resource with its perturbation.  |                                                                                     |
|                                 | 2. Spatial distribution of marine and fisheries resources correspond to the perturbation indicators. |                                                                                     |
| Coastal-land                    | 1. Significant land-use change and their progresses.                      |                                                                                     |
|                                 | 2. Major coastal-land utilization towards livelihood.                     |                                                                                     |
| Biology and habitat attributes  |                                                                           |                                                                                     |
| Coral reefs                     | 1. Spatial distribution of coral reef and its variance.                   |                                                                                     |
| Mangroves                       | 2. The diversity and abundances of caught coral fishes.                  |                                                                                     |
| Location and general condition  | 1. Spatial change of the mangrove ecosystems.                             |                                                                                     |
| Manta and shark                 | 2. Species and size of manta and shark that caught.                      |                                                                                     |
| **Part II – Market**            |                                                                           |                                                                                     |
Capture fisheries production and supply

1. Size and number of fishing fleet as well as gears.
2. Targeted fish production and marketing.

Fishing fleet, production capacity and market pattern

Part III - Other attributes

- Community institutions and fisheries management strategies
  1. Policy and management strategies on conservation.
  2. Policy and management strategies on marine and fisheries resources.

- Property rights
  1. Property right of land, house and fishing facilities.

- Alternative livelihood
  1. Alternative livelihood and their major aspects.

- Problems/issues
  1. Environmental change due to nature and resident activities.

In the course of the appraisal, the interviewer may ask about the spatial location of a particular attribute. In order to have a detailed record of the information given by the respondents, the interviewer might have asked the respondent to draw the location of answered location on a map, and other information directly written and or marked by the respondent is recorded.

2.4.2 Validation. The validation stage was the most important part of the RAFMS. It is a guarantee that the information collected and the initial analysis of the appraisal were realistic and acceptable. With the help from the Panglima Laot, a community assembly was managed to discuss the RAFMS findings. During the validation, in total there are 15 respondents participated at study sites.

3. Selected results and discussion

3.1 The rapid and significant change of the fisheries resources

There was a major change in the quantity and diversity of the capture fisheries production post the tsunami event of 26 December 2004, confirm the finding by [8]. The locations of the fishing ground as indicated in Figure 1b were identical before and after the tsunami event, however, the amount of catch was significantly reduced. The location of the fishing ground indicates in Figure 1b, confirming the fishing ground hotspot by [7] and the fishing pattern corresponds to the monsoonal system in this region confirms the study using RAFMS by [5]. This might be the result of overfishing, as the oceanographical properties of the sea surface temperature surrounding this region were not shown significant perturbation [3,8,14].

3.2 Market pattern

The market pattern performed by the fisheries trader and the local seller indicates that most of the fish landed were sold locally. In the case of the amount of fish caught in a surplus condition, the financer will direct the fishermen to land their catch in OFPL. For all cases, the arrangement between the financer, boat owner, and fishermen (skipper and crew) confirmed the study done by [6].

3.3 Problem and issues

The issues that is facing the community in the study sites is silting of access to the port. The appraisal found that during the lowest low tide, not even a rowboat could sail out of the port, and none of the returning boats were able to reach the port to landed their fish. This problem gave a lot of impact on their fishing activities and fisheries production. More time than they spend on to enter the port or fish landing base, the lower quality of catches they will get. That is the consequence of poor cold chain management done by the fishermen. Then, the rate of sedimentation, as well as the ocean current pattern, might play a major role [9,15]. The overall problem across a cartoon transect of the study site is shown in Figure 2.
Figure 2. A cartoon illustration of the transect at the study site is shown from the hill (left) to the marine/offshore (right) region. The listed problems and issues on the left correspond its location to the thick black line where it has been reported in the appraisal.

As it is indicated in Figure 2, most of the significant problems and issues are related to the disaster events, such as the tsunami 26 December 2004. From the six problems and issues that were listed, four of them are majorly impacted by the tsunami event, while another problem and issue are either due to the poor quality of port construction and or the oceanographic properties at this region, such as ocean current pattern and sedimentation. The other factors such as sanitation and waste are one of the key problems faced by the community from the anthropogenic source, which is lack of services from the government official to periodically pick up the waste and low self-awareness of good sanitation and waste management between the stakeholder and coastal residents.

4. Conclusion
The research reveals that the status of fisheries and marine resource at the study sites were highly impacted by the natural disaster, such as the tsunami event 26 December 2004. It resulted in significant perturbation to the capture fisheries production, which indicate a smaller amount of catch after the disaster event or a decreased capture fisheries production. The indication of overfishing is also considerable, since there was no significant change in fishing ground location throughout time. The market pattern follows the general practices among the Acehnese fishermen, and only in the situation of a surplus in fisheries production, the fishermen will sell their catch at the largest fishing port on the region (OFPL). The major coastal problem currently faced by the community is the sanitation and waste management. The government official should help the local resident providing waste management services as well as mentoring or assistance about waste management to the local residence.

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