Small is beautiful: Marine small-scale fisheries catches from the South-West Maluku Regency

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Abstract. The fisheries data supplied by fisheries agency have served as the primary tool for regional fisheries statistics. However, it is recognized these data are incomplete and often underestimate actual catches, particularly for small-scale fisheries. There is no widely accepted definition of small-scale fisheries or global data on number of small-scale fishers and their catches. This study reconstructed total marine catches from 1980 to 2015 for South-west Maluku (MBD) regency, by applying an established catch construction approach utilizing all available quantitative and qualitative data, combined with assumption-based estimations and interpolations. As newly established regency since 2009, there is lack of fisheries data available which is needed for fisheries management. Fishers' knowledge is important information taken from to construct long-term fisheries data. Estimated total fish withdrawal from MBD waters was 86,849.66 tonnes during 1980 – 2015, dominated by pelagic fishes. Consistency of estimated total removal and total landings at MBD regency play important role in small-scale fisheries management and this method of visualizing the history of fishery from poor-data condition might be an optimistic effort.

1. Introduction

Nearshore fisheries in the tropical developing countries provide the main source of animal protein which food security remains a pressing issue [2]. With general definition of small-scale fisheries (SSF): those that work from shore or small boats in coastal and inland water [1], these fisheries make important but poorly quantified contribution to national and regional economies and development of millions people [21]. [8] Predicted that 200 million people might depend on SSF and related activities. As a consequence, illegal practices in small-scale fishing methods can be very destructive, such as dynamite and cyanide fishing cannot be avoided (e.g. in South East Asia [19] and Africa [22]). Thus, overfishing can occur with small-scale fisheries [24], and assessment of these fisheries is urgently needed.

Many studies of small-scale fisheries have been conducted, but many problems appeared at first sight. [17] Showed that the disadvantages of SSF by their physical, socio-economic, political and cultural remoteness from urban centers positioned them further to the marginalization. Communities of small-scale fishing in the developing countries mostly located further from political power which then usually receives far less support e.g. from government [7]. Their lacking landing sites and infrastructure create difficulties to market access. Further, small-scale fisheries are distinctively different between countries or even regional, and each fishery is unique [7]. The SSF conditions result less amount of research and data collection efforts compared than large-scale fisheries. Many catches

for the SSF are not estimated by fisheries agencies [27]. Hence, an attempt to counter the marginalization of SSF by retroactively estimate catches is needed such conducted by [26].

It is widely recognized that catch statistics are crucial to fisheries management. Incomplete catch statistics are not an issue only for developing countries, but also for developed countries with sufficient human and financial resources to maintain recent statistics [27]. Although the catch statistics routinely collected and published in most countries, deficiency in numerous ways is still occurred [28]. The focus of reported data has been primarily on commercial harvest and has not covered shore-based fisheries [26]. Therefore, SSF has large contribution to the deficiency in fisheries statistic due to its marginalization. Here, we report on work undertaken for the South-West Maluku regency to account for unreported catches.

South-west Maluku (MBD) regency is archipelago regency consisted of 17 subdistricts located at 3 groups of islands. Marine area covers 63,775 km2 or 88.06% of the total area (Fig.1). The regency was recently established in 2009 after regional division from a subdistrict belonged to Southeast-west Maluku (MTB) Regency. The regency of MTB was also as regional division from South-east Maluku (Malra) regency in the year of 2004. Therefore, statistical fisheries data from new regencies is available in short time-series. Domestic fisheries divided into two sectors, small boat-based fisheries and shore-based fisheries; Catch data for both fisheries have been estimated by fisheries department, but the data were likely incomplete because the commercial and noncommercial catches have never been thought to be reported.

Fisheries data collection in Indonesia has always been constrained by numerous issues leading to incomplete surveys. Because the marine fisheries area covers 5.1 million km^2 archipelago waters, including Exclusive Economic Zone, illegal fishing cannot be avoided. The standard statistical system has been introduced since April 1976 for the marine fishery [23], but excluding standard of data collection. Collection of basic data is the responsibility of the Central Bureau of Statistics while the Directorate General of fisheries of Indonesia collects and release fisheries statistics in the Fisheries Statistical reports [18]. The conduct of production survey is supported by insufficient numbers of enumerators which some of them has non-fisheries background [11]. Reduction numbers of auction levy in some regions, while some have none, making it difficult for data collectors to monitor and report the fish landed [11]. As Indonesia has continuously improved capacity and system of its data and fishery statistic, data verification and validation is needed.

The purpose of our study was to assemble available information and data on catches of the small-scale fisheries. The aim was to derive estimates of likely total removal of marine resources for the 1980-2016 period, as an initiative to construct a new 'road map' for small-scale fisheries, where they are put at the front and center of research and management interest, instead of remaining at the margin.

2. Methodology

2.1. Approaches
Successful reconstruction for marine fisheries catches has been conducted in other regions [26-27]. Here, we follow the conceptual framework and approach outlined by these studies to reconstruct marine fisheries catches for South-west Maluku regency. The catch reconstruction approach utilized here consists of six general steps based on [27]:

1. Identification of existing reported catch time series provided by Fisheries and Marine Affair Department and Central Bureau of Statistics from Maluku province
2. Identification of time periods, gears, trips, population, and fish consumption per-capita.
3. Search for available information sources through literature searches and consultation aiming to explain the changes in time series and to supply the missing catch data
4. Development of data anchor points in times for missing data items and their expansion to regencies catch estimates
5. Interpolation for time periods between data anchor points for per-capita consumption rates
6. Estimation on final total catch time series estimates for total catch, combining reported catches and interpolated.

We collected other information from fishers by conducting semi-structured interviews and focus discussion groups. Semi-structured interviews with closed and open questions put to fishers in face-to-face were conducted from April to June 2017. This assessment allows familiarisation with fishing methods, fishing grounds, concerns as well as local culture. We also randomly sampled the fishers from coastal villages based on the gear used and age of fisher. In total, 40 fishers were interviewed. Fishers were guided with books of fish to identify the local names of fish they caught. Personal interviews with fishers can gather large amounts of information regarding fishing practices [16]. The questionnaire was grouped in four sections: personal information including experience and property; knowledge of activities changes at the surrounding coastal areas, efforts and catch currently and in the past.

Figure 1. South-west Maluku regency islands located in the eastern Indonesia

2.2. Population Resources

1980-2015: We used human population statistic reported in the book of *Maluku in Numbers*.
1980, 1990, 1992-1996, 2011-2015: From *South-west Maluku in Numbers*, we used human population in the regency as the anchor points. To expand the population data, extrapolation was made by rationing between province and regency for this period. The ratio was fluctuated without showing any trend (level off). Thus, we assume that the ratio is constant and the average of these ratios was used to interpolate some human population between those periods.

2.3. Artisanal Fisheries

1980-2015: We used total marine catches reported for Maluku province and South-east Maluku regency in fisheries statistical annual reports. For South-east-west Maluku (MTB) regency, the available time-series data is 2004-2015, while for South-west Maluku (MBD) regency is 1996 and 2011-2015. Fisheries growth pattern for all regions is used to grow a model for reconstruction long-term time-series catches data for South-west Maluku regency.

2011-2015: Effort time-series data reported for MBD regency including boats, gears and trips, are used to descript the fisheries as small-scale fisheries and to explore possible approach to be used for interpolation.

2.4. Fish consumption per-capita

1993, 1996, 2000, 2003, 2006-2015: The available time-series in the book of *Maluku in Numbers*. Based on the fisher interviews, catches are commercially sold to fulfill local demands. No discard reported. Thus, we assumed that total catch for small-scale fisheries is the reflection fish consumption per-capita (gr day^{-1}) by using human population data.

3. Result and Discussion

3.1. Result
Fisheries statistical reports for MBD regency are available from 2011 (Table 1). Fishing boats in MBD regency is dominated by canoes. Inboard engines are occupied for under 10GTfishing boats. Fishing gears are mostly operated in traditional ways. Gillnets included drift gillnets, encircling gillnets, and bottom gillnets are mostly self-mended by fishers, as well as traditional traps made from bamboos. Line fishing included handlines, longlines and trolled lines is the most gear used. Tuna trolled line activities in the region provided tuna loin to support tuna industry outside the region. In 2013 and 2015, number of trolled lines increased about 4%. Lift nets activities in 2009 and purse seines in 2012 occupied more young people involved in the fisheries. Other gears used in the area include spear fishing, *bameti* or collecting marine organism during low tide, and other types of traditional small traps used occasionally. These general figures of MBD's fisheries convince us to assume that this fishery is categorized as small-scale fisheries.

Table 1. General figures of MBD's Fisheries in numbers. Boats (Can: canoes; W*s*: small wooden boat; W*m*: medium wooden boat; W*l*: large wooden boat; Out: outboard engine; In: inboard engine). Gears (Gn: gillnets; Line: line fishing; Ps: purse seines; Ln: lift nets; Oth: other gears)

Year	Catch	Fishers	Boats						Gears					
			Can	W*s*	W*m*	W*l*	Out	In	Gn	Line	Trap	Ps	Ln	Oth
1996	9,877.9	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	3,286.0	9,366	697	476	84	28	148	146	860	529	84	-	89	194
2012	8,638.0	9,564	698	476	84	28	162	146	860	548	84	14	89	194
2013	4,330.5	9,901	698	476	84	28	176	176	857	565	84	16	89	197
2014	8,653.0	10,004	698	476	84	28	189	150	857	579	84	18	89	194
2015	19,130.4	10,004	589	67	26	4	189	150	857	759	84	18	89	194

The result of interviews and focus group discussions brought some issues to reconstruct long-term time-series catch data. There was no change on fishers' catches or relatively stable fish production. They considered on marine resource demands which increased recently. Previously, these fisheries normally contribute food for household consumption, with small amount of catches for barter or trade. Fish are easy to be caught due to abundantly existed. Nowadays, fishing effort should be expanded following the increase of demands. They are considered commercial fisheries, as catches are landed and sold either by fishers or their family members at the market or through middlemen. Lift nets and purse seine are recently operated in MBD's water. The using of fish aggregation device (*rumpon*) concentrates pelagic fishes and enlarges the catch of purse seine and lift nets. Fish price varies depending on number of catch; it might be lower than Rp. 2000, - (equal to 20 cents USD) per-kg. There is no cold storage available, fisher's self-storage their unsold fish with ice crunch. It is also reported that large ships (>30GT) captured and bought demersal fishes from Mdona Hyera sub-district.

Fish production in Maluku tends to increase annually except for the regencies (Fig. 2). Due to regional division occurred for Malra and MTB regencies, marine fish production dramatically drops in

the year of 2008. After all, the production increases gradually except for MBD which elevated significantly. There were some missing data for Maluku province and South-east Maluku regency catches, but for other two regencies little catch data series are available.

The re-estimation catch for small-scale fisheries for South-west Maluku regency indicated a substantially different pattern between commercial and subsistence catches (Fig. 3). Subsistence catches remained level off with slight fluctuation for the period 1980-2015. The estimated commercial catches for period 1980-1988 increased steadily and reached a peak in 1998 with 3-fold difference. In 1999, the catch decline to 6172.5t. In the period 2001-2005, the estimation tremendously elevated and reached more than 16 thousand tonnes but then followed by dramatic decline to 3286t in 2011. Another peak of 19 thousand tonnes was reached in 2015.
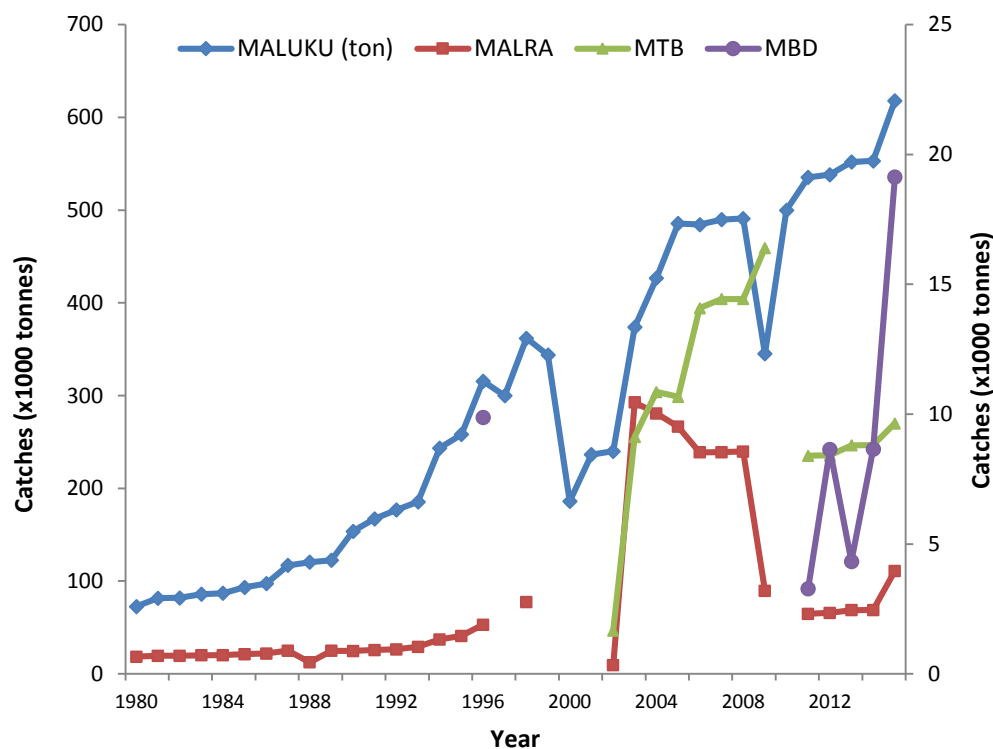

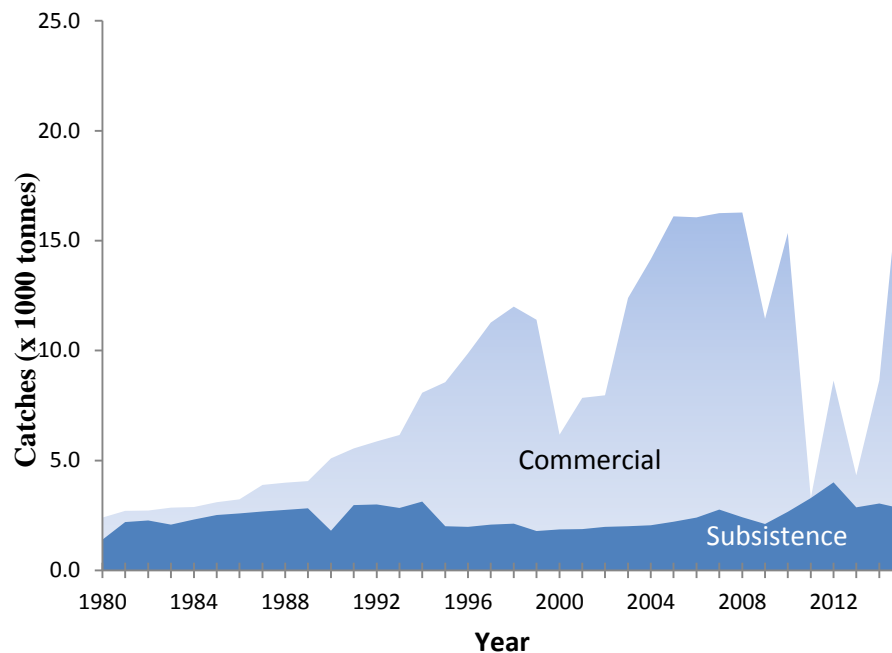**Figure 2.** Time-series catches from Fisheries Statistical reports from year 1980 – 2015

Figure 3. Long-term catch data of small-scale MBD's marine fisheries from 1980-2015 disaggregated into commercial catches (lightly shaded) and subsistence catches (dark shaded) levels.

3.2. Discussion

Without better attempts at accounting for historic extractions of living marine resources for all fisheries sectors, it is not possible to fully understand the formal and informal economic and cultural value of these resources or of the risks of overfishing or ecosystem degradation may represent to South-west Maluku regency [25, 27]. As new regency, exposing the existing resources including fisheries resources which aim to attract investors is a common political and economic intention. However, inaccurate projection or prediction of the available resources may lead to resource depletion after all. In the statistic report of MBD, marine catches dramatically increased in 2015 following extending of gears used. The re-estimation of catches of MBD's indicates two declines in catches of 50% in 1999. This decline might due social conflict occurred in Maluku causing investors fled out the region. During the regency establishment in 2009, when almost all sectors organized their adjustment, catches was recorded about 80% declined. Despite reasonable argues of fish production declined, catch fluctuation might indicate resource recovery after high exploitation. Continues decline and continues increase of fisheries production is an alarm of resource depletion or overfishing.

To support better data collection for SSF, sampling methods should be improved by applying some alternative approaches. The scattered character of SSF, particularly archipelago MBD regency, indicates that sample survey of selected major landing centers is insufficient to provide valid results. Frame survey might structure the information of number, characteristics and spatial distribution of vessels, gears, fishers, landing sites and fishing communities [9]. As a fisheries census [3], frame survey should be updated regularly, and its high cost becomes an obstacle to be conducted. Another alternative approach which is cheaper than frame survey is data collection through filling a simple logbook by fishers and boat owners on a voluntary basis or within co-management scheme [9]. Gathering fisher's knowledge through interviewing some fishers in more general activities [16] also performs beneficial results. The two later alternative approaches were applied in this study. We gathered complement information for the statistical fisheries reports. Since the reports focusing on the fisheries production and its values for export, it indicates that subsistence fisheries are perpetuating. We identified subsistence and commercial household. So, through estimation of total catches based on fish consumption data [20], we determined the subsistence catches.

The overall finding of our study is likely to be different than other reconstruction small-scale fisheries data have done before. At the country level, small-scale fisheries are exclusively classified as unreported data e.g. [5, 13-14, 25] and their catch estimation is added up to FAO fisheries reports. At regional level, we found small-scale fisheries production can be for commercial and subsistence. The subsistence fisheries comprised only 30% of the total production in the period 1990-2015. While before 1989, fish caught was mostly for consumption. We did not combine the fisheries reports and the subsistence; instead, we deducted those two to count the commercial fish production. Therefore, for further re-estimation catches at country level such as Indonesian archipelago, more evidence are needed to decide which estimation should be added as unreported small-scale fisheries.

Why small-scale fisheries is beautiful? We are confidence that small is beautiful: no take more than need and avoid discards. This is a simple economic understanding which impacts to ecosystem sustainability. Marginalization of SSF is associated with destructive fishing practices [19, 22], non-profit and dispersed to remote areas [6]. On the other hand, fishing practices of SSFs have been reported towards balance fisheries [30]: species or individuals are exploited by their productivity [10, 12]. Since small species naturally more abundance, balance harvesting would substantially increase yield than selectively captured large species [12, 15]. There would be a need to change human consumption patterns towards small fish instead of large. Small fish is more nutritious diet; most essential micronutrients such as calcium, iron, zinc, and vitamin A are concentrated in the part of small fish [4]. Since SSF comprised 85% of Indonesian fisheries focus on data collection, verification and validation should be prioritized.

Acknowledgement

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