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Comparing different small-scale tuna fishery suppliers: a case study on trolling line and pole and line in Southeast Sulawesi, Indonesia

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Abstract. Tuna is one of the most important fish resources in Southeast Sulawesi. Most of tuna production from this area is supplied by small-scale fishery such as trolling line and pole and line, both is line fishery that operated in different ways. This research intended to compare trolling line and pole and line as tuna supplier, especially in terms of product form, length as well as the number of supply line. We used a combination of observation and semi-structured interviews with stakeholder in fisher village, market, and fishing port in Buton, Buton Utara, Wakatobi, and Baubau. Tuna supplied by pole and line ranges below 9 kg per individual and grading by "no grade," whereas tuna supplied by trolling line had a wide range of size and grade. Length of supply lines is relatively on average, yet capacity and fleet flexibility lead to a different number of supply line for each fishery.
Key Words: Tuna supplier, trolling line, pole and line.

Introduction. Tuna is one of the most valuable fish products in the world. Many of Pacific countries gained foreign exchange from these resources (Barclay & Cartright 2007). Tuna (including skipjack) was the second fish commodity export from Indonesia with the value of 15.08% of total fish export value (KKP 2014). As the global demands rise, tuna become more potential as an export commodity. Unfortunately, small-scale fisheries has limited access to take advantage from these opportunities because the variety of export requirements, including quality and products traceability (Tindall 2009; Ponte 2012). Meanwhile, fishery structure of most developing countries, especially African countries and Asia (including Indonesia), is generally still dominated by small-scale fisheries (FAO 2014a).

FAO emphasized the important role of small-scale fisheries in meeting the world food needs, poverty eradication, equitable development, and sustainable resource utilization (Béné 2006; FAO 2014b; FAO 2015a). Béné (2006) also mention about the role of small-scale fishery in cultural diversity. Small-scale fisheries contribute about half of global fish catches (FAO 2015a) and provide extensive employment to around 37 million people, of whom around 90% are in Asia (FAO 2015b).

Recently, by the development of technology, small-scale fishery has been able to reach deeper waters far from shore (Weber 1994). In certain areas, even small-scale fishery is also used to capture oceanic species such as tuna (*Thunnus spp.*). This practice occurs for example in Indonesian archipelago where predominant type of fishing gear used in some areas to catch and supply tuna was fishing fleet with capacity less than 10 GT (Alimina 2005; Hermawan 2012).

This research was carried out on small scale tuna fisheries in Indonesia, particularly in southern waters of Southeast Sulawesi between the Banda Sea and Flores Sea. Tuna from this area commonly supplied by small-scale fishery such as trolling line (TL) and pole and line (PL), whereas fishing base mainly located in Buton, Buton Utara, Wakatobi, and Baubau.

TL is one type of line fishing (von Brandt 2005) that is operated on sea surface or water column by towing the line with natural or artificial lures. Total number of TL vessel in Buton, Buton Utara, Wakatobi, and Baubau districs was 2,779 units or approximately 52.18% of the TL total numbers in Southeast Sulawesi Province (DKP Sultra 2013). The TL vessels are generally made from wood with capacity less than 2 GT. PL is also a type of line fishing (von Brandt 2005) that are characterized by the use of barbless hook and operated on sea surface. In the research area, PL was only existed in Baubau with total number of 28 units or approximately 15.05 % of the total numbers in the province (DKP Sultra 2013). The PL vessels, in general, are made from fiber with 6 GT in capacity.

Differ from common agricultural and aquaculture system, capture fishery is more volatile (Murray & Fofana 2002). Amount, size, and product quality mostly depend on the nature of fish resources, fishing gear or methods, as well as processing technology. Fishing gear or methods and its dimension at least determined fish species, size, and quality of the catch (Noija et al 2014; Rizwan et al 2014). This research aims to compare the differentiation of TL and PL as tuna supplier, especially in term of product material and supply line which sources tuna from both fisheries.

Material and Method. Research area covered four regencies in Southeast Sulawesi southern waters (5°00'-6°30'S and 122°00'-124°00'E) *i.e.* Buton, Buton Utara (Butur), Wakatobi, and Baubau (Figure 1). This area is surrounded by Banda and Flores sea, that are two of tuna fishing grounds in Indonesia.

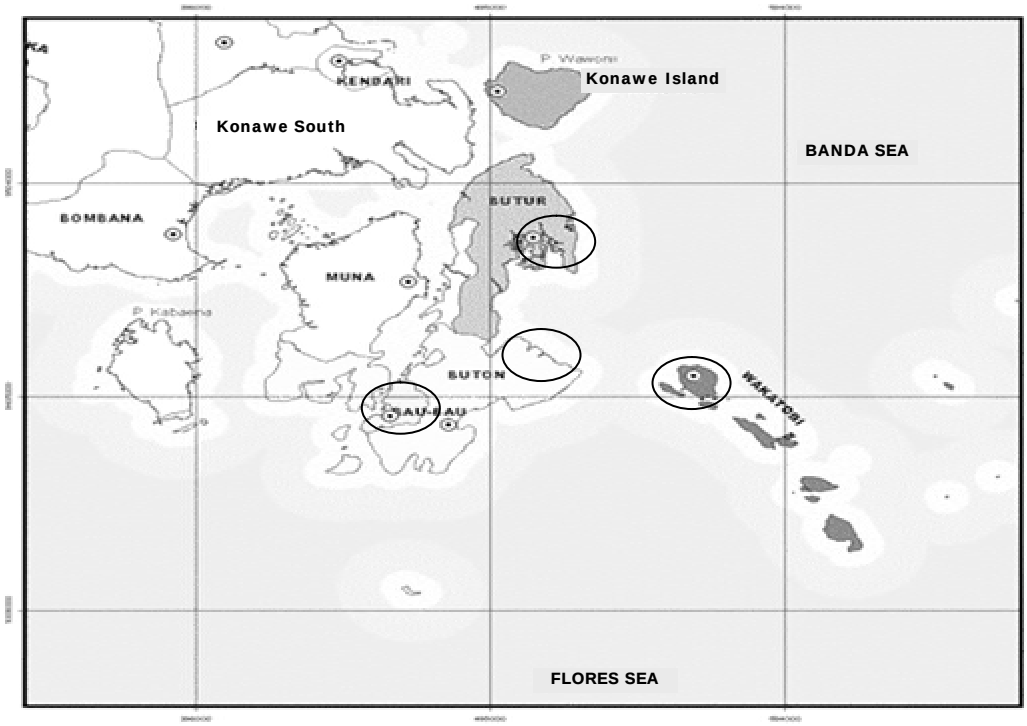

Figure 1. Location of the research area.

We used a combination of observation and semi-structured interviews with supplier (fisher of TL and PL), and producer (middleman, fish processor, retailer) in village, fishing port, and market. Snow ball sampling methods was used in interviews, where first chosen sample will lead to the next sample. Sample consisted of 7 PL fishers, 30 TL fishers, 4 middlemen, 5 retailers, and 3 processors. Additional data was supported by Fisheries Service (DKP) of Southeast Sulawesi Province.

Product material was analyzed by descriptive comparison between tuna that supplied by each TL and PL in terms of shape, weight, and prices. Length and number of supply line was modeled by using task dependency network (Walsh & Wellman 2000), which consist of good (product), supplier, producer, and consumer.

Results and Discussion

Statistics. Big tuna species in Southeast Sulawesi dominated by yellowfin tuna (*Thunnus albacares*) and big eye tuna (*Thunnus obesus*), with accounted composition by 86% and 14%. Tuna production from this area tends to growth at an annual average rate of 25.53% between 2001 and 2013. As first peak took place in 2005, tuna production jumped abruptly in next year (Figure 2). However, since 2007 tuna production recover gradually and achieved it second peak since 2012. To date, tuna occupied 4th place in fish commodity export from Southeast Sulawesi and about 13% of total export value (DKP Sultra 2013).

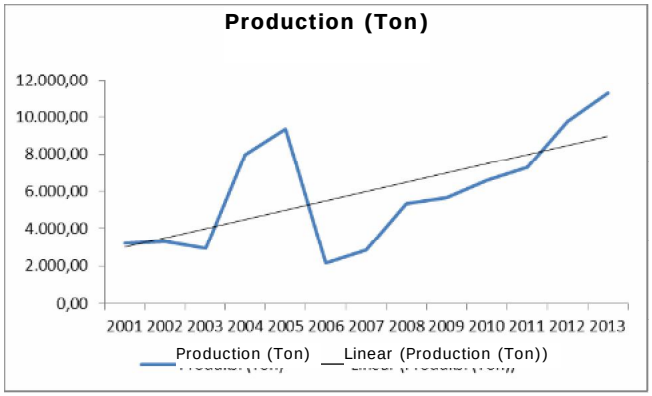

Figure 2. Tuna production from Southeast Sulawesi, 2001-2013 (DKP Sultra 2014).

Production. TL and PL may supply tuna in whole/round form or loins. Whole tuna is fresh tuna that has not undergone any treatment other than icing, whereas loins is tuna that fins, bones, head, and dark red meat has been removed. Tuna that is eligible for loins are whole tuna that weighing over 20 kg per individual, while tuna less than 20 kg per individual are generally sold in whole form. In tuna fishery in Ampenan (Nusa Tenggara, Indonesia), tuna weighing more than 20 kg was also consider as export-grade tuna (Pet et al 2012).

Based on fishers and middlemen's information, a whole single tuna could divided into 4 pieces of tuna loins which consists of 2 pieces belly loins that estimated ≈43% and 2 pieces dorsal loins that estimated ≈57%. Weight conversion of whole tuna to loins is around 40-60%, depend on "loiner" skill. Thus, if the weight of whole tuna is 20 kg, then the average weight of loins is about 10 kg which consists of approximately 5.7 kg dorsal loins and 4.3 kg belly loins.

Tuna loin was classified into 3 grade *i.e.* grade A, grade B, or grade C depend on weight and meat quality. Bright red meat tuna loins which was more than 3.5 kg per slice was considered as grade A, whereas "only" red meat tuna loins as grade B and the rest (2.5-3.4 kg per slice loins) as grade C. Tuna weighing less than 20 kg per individual was considered as "non-grade" (Table 1).

Fish grading determine the price. Prices comparisons in Table 1 refer to price of non-grade tuna (price index 1). Price index has been chosen for the price which can be very volatile. Prices index reveal that the higher the grade the higher the price, even grade A can reach a price more than 5 times higher than non-loin tuna.

Tuna supplied by PL was range below 9 kg per individual, whereas tuna supplied by TL has a wide range of sizes from a few pounds to more than 80 kg per individual. The relatively small size causes that tuna supplied by PL can only be sold in whole tuna form. Tuna supplied by TL can be sold in whole tuna form or loins, depend on it quality and weight. Since tuna loin has a good price, TL fisher tends to catch and supply tuna beyond 20 kg/individual. In terms of price, tuna supplied by TL has a chance to get a better price than PL.

Table 1

Grading and price comparison based on tuna weight and quality

Grade	*Weight*	*Quality*	*Price index*	*Supplier*
		Loins		
A	>3.5 kg/slice	Bright red meat	5.0	TL
B	≥3.5 kg/slice	Red meat	3.4	TL
C	2.5-3.4 kg/slice	-	2.1	TL
		Non loin		
Non-grade	10-19 kg/individual	-	1	TL
	1-9 kg/individual	-	0.9	TL/PL

TL - Trolling line, PL - Pole and line.

Length and number of supply line. Tuna supplied by TL propagate through 6 lines (Figure 3) *i.e*. Line I (fisher-middleman-interisland consumer), Line II (fisher-middleman-retailer-local consumer), Line III (fisher-retailer-local consumer), Line IV (fisher-middleman- processor-local consumer), Line V (fisher-processor-local consumer), and Line VI (fisher-local consumer).

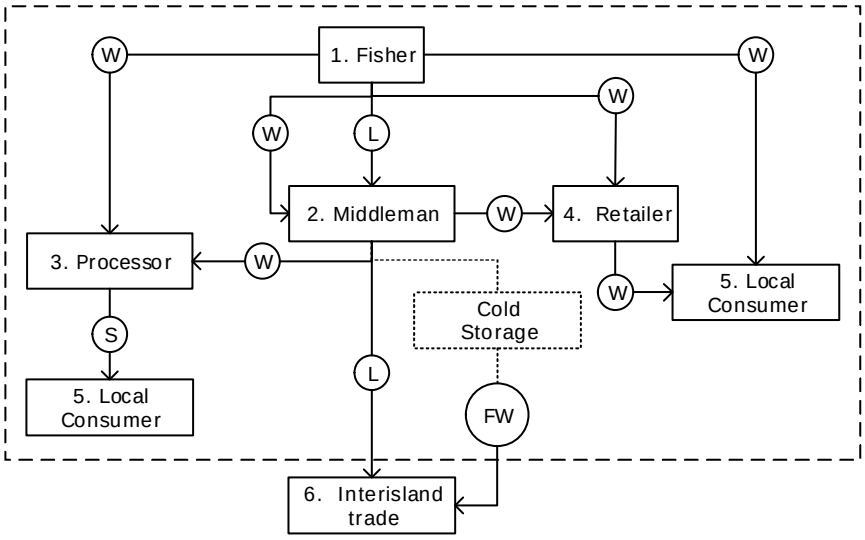

Figure 3. Tuna supply line which source is from trolling line fishery.

Tuna supplied by PL propagate through 4 lines (Figure 4) *i.e*. Line I (fisher-middleman-interisland consumer), Line II (fisher-middleman-retailer-local consumer), Line III (fisher-retailer-local consumer), and Line IV (fisher-middleman-processor-local consumer).

The longest line which involving 4 agent *i.e*. fisher, middleman, retailer/processor, and consumer appears in both fisheries. However, the shortest line that involving 2 agent *i.e.* fisher and consumer directly, was only appear in TL supply line. Yet, tuna supply line apparently shorter than live reef fish supply line that operated around Wakatobi which involved 5 agents (Tadjuddah et al 2012). Additional link in live reef fish supply line was collector (so called coordinator/ponggawa) who sources fish directly from the fisher at the sea.

Generally, there are three stages of material flow *i.e.* material flow from suppliers to manufacture (which manufacturing raw materials into finished goods) and ready to be distributed to the customer through distributor (Marimin et al 2013). As other agricultural products, fishery products are unique because they do not have to always follow the order of the above chain. For example, suppliers and processors can directly supply products to retailers without going through a distributor (Murray & Fofana 2002). It is also common in the tuna fishery, where both tuna originating from TL and PL can be distributed directly to retailers without going through wholesalers or processors.

Total supply line tuna from TL consists of 6 lines, more than PL which consists of 4 lines only. This can be attributed to many factors, including supply capacity and flexibility of the fleet. As smaller fleet, TL is more flexible to each agent capacity. That is opportunity for each agent (including the final consumer) to source fish directly from TL fisher. Additionally, TL can be landed anywhere including around traditional markets, fish-processing facility, or along the beach. Tuna from TL can thus be distributed through intermediaries, retailers, processors, and even directly to the final consumer. Small volume and number of involved agents apparently characterized small-scale fishery (Tindall 2009). In contrast, tuna supplied by PL is only sold in bulk (wholesale), thus limiting involved agents into traders or large capital retailers only.

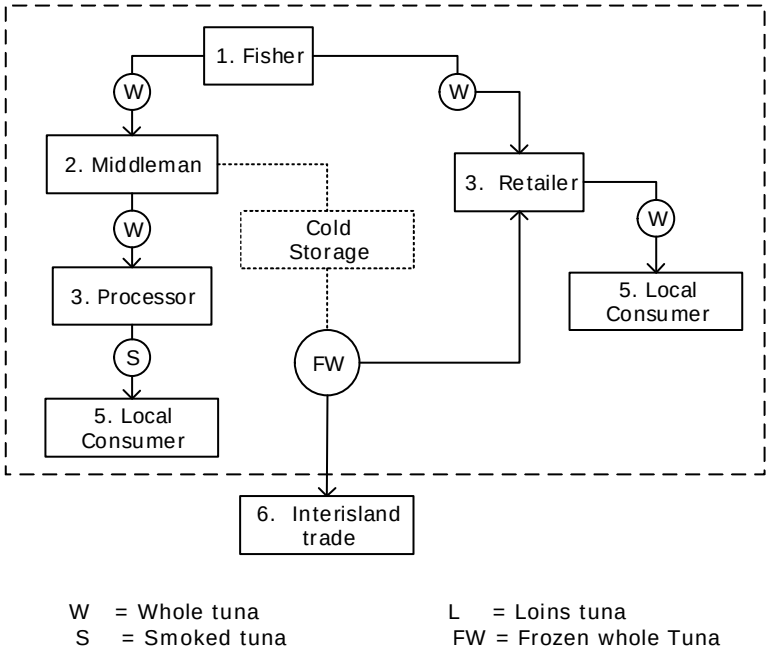

Figure 4. Tuna supply line which source is from pole and line fishery.

Small-scale fisheries are the most important fish suppliers in developing countries, primarily for the needs of the local market (Weber 1994). TL and PL fishery play the same role as a supplier of tuna for inter-island trade and the local market. However, since whole/round tuna price offered by middleman is usually lower than retailer (local market), fishers tends to propagate their products through retailers. Hence, if production (catch) was low, fishers are more likely to supply tuna to local market needs in Baubau, Wakatobi, Buton Utara, and Buton. Supplier tendency indicates the strength of local market. However, local market was bounded by it capacity, hence tuna can be distributed only on a limited scale.

In addition to traders and retailers, other tuna producer is tuna processor. Tuna processing in this area dominated by smoked tuna that traditionally processed by small scale processor. Commonly, processor act as retailers also. Tuna processors in Baubau generally purchase tuna directly to the tuna production center in the sub-district towns like Sampolawa, Buton. In Bone Lipu Village, Buton Utara, processor purchase tuna

directly from fisher that landed along the beach. As the same as whole/round tuna, smoked tuna sold in this area are more oriented towards local market.

Conclusions. TL fishery of Southeast Sulawesi southern waters was supplying a wide range of sizes than the PL fishery. Tuna weighing more than 20 kg/individual has better prices opportunities than the smaller tuna that are mainly supplied by PL fishery. The length of supply line is on average, but tuna originated from TL fishery can propagate in more varied link than from PL fishery. This condition probably influenced by several factors such as supply capacity and landing flexibility of each fishery. More links may lead to greater involvement between TL as supplier with downstream agents.

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