

Prospect for transboundary small pelagic fisheries management of Indonesia-timor Leste in Ombai Strait

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ABSTRACT

The small pelagic fisheries of the Ombai strait offer a pivotal role for fishers and local communities in Indonesia-Timor Leste, but uncontrolled fishing practices may cause copious number of problems. Regardless proper management, such condition enables to generate further problems associated with alleviation of fish resource and ecosystem services, which in turn capable of causing disturbances in several aspects such as economic, social, politic, and security. In this regard, there is a clear necessity to establish a collaborative management between Indonesia and Timor Leste in order to manage small pelagic resources. Several important factors that could strengthen the cooperation between two countries included transboundary resources, identic fishery characteristic (dominated by small-scale fisheries) and location, presence of informal agreement and co-operation among traditional fishers in fishing activities, and strong kinship, relationship between communities in boundary areas of Indonesia and Timor Leste. Therefore, in order to support transboundary small pelagic fisheries management, collaboration related to comprehensive studies and development of management regime is required.

Key words : Ombai strait, Small pelagic fish, Transboundary fishery management

Introduction

Small pelagic fish are well known to have high mobility rate and larger migrations compared to demersal and benthic species, allowing to deal with greater changes in pelagic ecosystem hydrobiological conditions (Doray *et al.*, 2017). They are mainly characterized by large fluctuations in abundance, which cause difficulties in their management (Bakun, 1997). Furthermore, Chambers and Trippel (2012) found that abundance of small pelagic fish in long term was associated with a large and rapid fluctuation. As a result, there is a strong decline in their catches of some regions during a particular period. Sadhotomo and Atmaja (2012) reported that

small pelagic fish had high growth rate and natural mortality.

Migration and distribution of small pelagic fish may frequently occur between coastal countries, making it a shared fish stock. According to FAO (2003), shared fish stock refers to transboundary stocks defined as fish resources crossing the Exclusive Economic Zone (EEZ) of one coastal country into the EEZ of one or more other coastal countries. Furthermore, as stated by Ba *et al.* (2017) that the transboundary migration of small pelagic fish often leads them as shared stocks, resulting in the necessity for collaboration in resource management between the countries.

Ombai Strait separates the south eastern part of

the Timor Island from islands of Alor and Pantar, in which the islands are part of Nusa Tenggara Timur (NTT), Indonesia. Meanwhile, Atauro and east part of Timor Island are integrated to neighborhood country, Timor Leste, and Wetar Island is a part of Maluku, Indonesia. Ombai Strait plays a pivotal role in sea water mass circulation between Pacific and Indian Ocean (Molcard *et al.*, 2001) and serves as essential habitat for important fish resources and highly migratory species (Kahn, 2004; Kahn and Fajariyanto, 2014), especially for tuna species (Akbar *et al.* 2016; Gigentika, 2017), crossing Banda and Flores Sea to Sawu Sea and Indian Ocean.

This current work aimed to analyze fish resource migration and habitat, migration of small pelagic fish, and important factors for transboundary management of small pelagic fish in Indonesia-Timor Leste in Ombai Strait.

Method

This present work was performed in fish production and marketing center of Belu, Nusa Tenggara Timur (Figure 1). Survey (semi-structured interview) and field observation (non-participative) were used to collect data. Respondents were selected by purposive sampling technique according to types of vessels and gears. Furthermore, the interview was also carried out with some subjects involved in fish trade, i.e. retailer, assembly agent, wholesaler, and consumer (buyer). Sampling for fish catch data (fork length and fish weight) was conducted in some fish landing sites of Belu. Exploitation rate of fish resources was analyzed using FAO-ICLARM Stock Assessment Tools (FiSAT), while fisheries performance and other important factors were descriptively analyzed.

Results

Characteristic of Fish Resource and Their Habitat

Small pelagic fisheries offer significant roles in fishers and local communities in border of Indonesia – Timor Leste, as indicated by their great contribution to the total fish production of Belu. Capture fisheries statistics of NTT in 2016 reported 13 types of small pelagic resources responsible for total production of Belu. In 2016, total fish production reached 1.993 ton, in which small pelagic fish are responsible for 1.056 ton (52.9%). In this case, there are 5 groups of small pelagic fish possessing high contribution (> 75%) to total small pelagic fish of Belu, including short-bodied mackerel of 261 tons (24.72%), halfbeak of 173 tons (16.38%), mangrove mullet of 173 tons (16.38%), flying fish of 142 tons (13.45%) and fringerscale sardinella of 72 tons (6.82%), as exhibited in Table 1.

In general, the exploitation status of small pelagic fish in Ombai Strait has been at optimum level. The rate of exploitation (E) for small pelagic fish landed in fish landing center of Atapupureached 0.168 (fringerscale sardinella), 0.641 (flying fish) and 0.523 (needle fish). Pauly *et al.* (1984) found that exploitation rate of less than 0.5 ($E < 0.5$) or maximum $E = 0.5$ was regarded rational and sustainable. This suggests that fringerscale sardinella was under exploited, while the exploitation rate of needle fish and flying fish was fully exploited and over exploited, respectively.

Habitat is expected to be important to small pelagic fish in Indonesia-Timor Leste in Belu, including coral reefs, mangrove, and seagrass. In this case, coral reefs are found at good condition with hard coral percentage of 39.1%. Mangrove condition is represented by composition of vegetation consisting of 17 species from 8 family. *Rhizophora apiculata*,

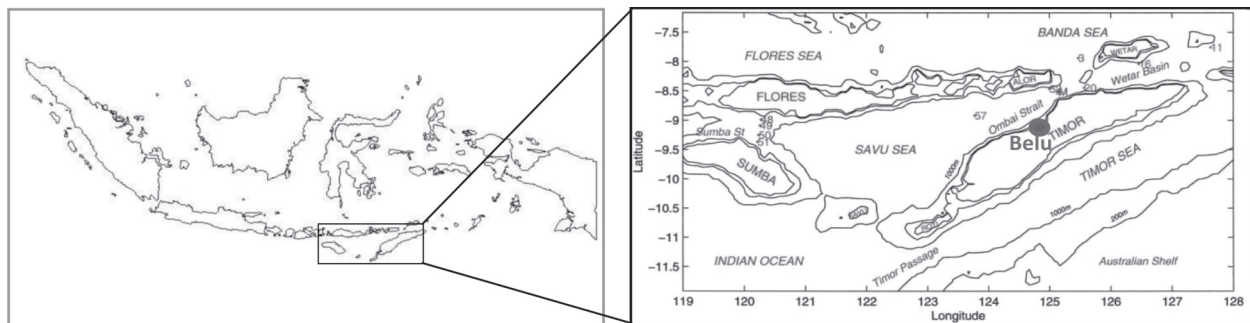


Fig. 1. Area study in Belu, Nusa Tenggara Timur, Indonesia (Source: Molcard *et al.* 2001)

Table 1. Types and production of small pelagic fish resources in transboundary of Indonesia-Timor Leste in Belu

No.	Name	Scientific name	Production (ton)	Percentage (%)	Rank
1.	Indian mackerel	<i>Rastrelligerkanagurta</i>	47	4.45	7
2.	Mangrove mullet	<i>Mugilcephalus</i>	173	16.38	3
3.	Oxeye scad/Bigeyesca	<i>Selarboops</i>	2	0.19	13
4.	Needle fish	<i>Selarcrumenophthalmus</i>	36	3.41	9
5.	Queen fish	<i>Chorinemusspp</i>	42	3.98	8
6.	Flying fish	<i>Cypselurusspp</i>	142	13.45	4
7.	Halfbeaks	<i>Hemirhampusspp</i>	173	16.38	2
8.	Short-bodied mackerel	<i>Rastrelligerbrachysoma</i>	261	24.72	1
9.	Scad	<i>Decapterusspp</i>	12	1.14	11
10.	Trevallies	<i>Selaroidesspp</i>	9	0.85	12
11.	Fringerscalesardinella	<i>Sardinellagibbosa</i>	72	6.82	5
12.	Torpedo scad	<i>Megalaspiscardyla</i>	32	3.03	10
13.	Other small pelagic fish		55	5.21	6
			1056		

Source: DKP NTT (2016)

Sonneratia alba, and *Ceriop tagal* are dominantly found as tree, sapling and seedling in the observed area. Whereas, seagrass in the location consists of 8 species belonging to 6 genus and 2 family. They exist in some straits, i.e. Gurita, Aufuik, Aidila, Berluli, Jenilu, Pasir Putih, Sukaer Laran, Halibada and Seroja. Diversity index of the seagrass ranged from 0.4239 to 0.6840, while the highest and lowest diversity was found in Aufuik and Sukaer Laran, respectively (Bappeda NTT, 2005).

Performance of Small Pelagic Fisheries

Small pelagic fishery in the border of Indonesia-Timor Leste in Belu was categorized as small-scale fisheries, as indicated by dominant number of fish-

ing boats used by local fishers, i.e. non-motorized boat and motorized boat of <10 GT, while passive and simple fishing gears were dominantly used, including hand lines and gillnet. Additionally, fishing ground especially in coastal waters reaches 4-6 miles from fishing base. The fishing gears and fishing grounds are described in Table 2.

We found that small pelagic fishery in Belu (Indonesia) and Bobonaro (Timor Leste) displayed similarity, particularly number of fishers, types and number of fishing boats, caught small pelagic fish, and fishing ground. The number of fishermen in Belu and Bobonaro District reached 431 fishermen (DKP NTT, 2016) and 468 fishermen (NDFFA MFA RDTL 2012), respectively. Fishing vessels in both

Table 2. Fishing gears and fishing grounds of small pelagic fish in Belu

No.	Type of boats	Fishing gears	Fishing grounds
1.	Non-motorized boat	Gillnet, hand lines	<1 mile, fishing grounds in tidal zone around mangrove forest, seagrass bed and coral reefs.
2.	Outboard motorized boat, <1 GT, engine capacity of 15 – 30 PK	Hand lines	Fishing grounds: - 4 – 6 miles for one day fishing - >12 miles for 2-3 days fishing of demersal fish and tuna
3.	<i>Ketinting</i> boat, <1 GT, engine capacity of 5,5 – 13 HP	Hand lines, monofilament purse seine	Fishing grounds up to 4 – 6 miles from fishing base
4.	Inboard motorized boat, 1 – 5 GT, engine capacity of 15 – 30 HP	Hand lines	Fishing grounds up to >12 miles for 2-3 days fishing of demersal fish and tuna
5.	Inboard motorized boat, 5 - 10 GT, engine capacity of 30 – 60 HP	Mini purse seine	Fishing grounds between 1 – 4 miles

Source: primary data (2018)

areas were dominated by non-motorized boats and outboard motorized boats. Similarly, gill net and hand lines were more widely used by fishermen. Based on report of local fishermen, the small pelagic fish landed by fishermen from Belu and Bobonaro were obtained from same waters, as well as the type of fish (*pers. comm.* Belu's fishermen), as presented in Table 3.

Capture fishery in border area of Indonesia-Timor Leste is particularly characterized by its fishing vessels, i.e. non-motorized boats and outboard motorized boats (DKP NTT 2016; NDFA-MFA RDTL 2012) with limited fishing grounds. The fishing activities by fishermen in transboundary area are highly disrupted by a growing number of illegal fishing practices, enabling to induce conflicts on the resource use. Fish stocks migrating in transboundary of Indonesia-Timor Leste also caused limitation to the access of fish resource for fishermen from both countries. ATSEA (2011) identified emerging issues in transboundary of Indonesia – Timor Leste, including depletion and even extinction of coastal and marine resources due to IUU Fishing, over-exploitation, non-sustainable fishing activities, and bycatch. Based on these findings, there is an important necessity to comprehensively manage small pelagic fisheries using ecosystem-based approach in border area of Indonesia – Timor Leste.

Essential Factors in Transboundary Fishery Management

The border area of Indonesia – Timor Leste in Ombai Strait constitutes a meaningful habitat for pelagic fish especially small pelagic fish. Based on data,

small pelagic fish are dominantly captured by fishermen in that area, especially flying fish, short-bodied mackerel, halfbeaks, fringer scale sardinella, scad fish, eastern little tuna, and mangrove mullet. According to initial observation and interviews, we found that captured fish landed in Belu and Bobonaro came from similar type of fish in same period of time. This indicates that small pelagic fish available in the border area distribute in both Indonesia and Timor Leste around Ombai Strait, which in turn make them as shared fish stock.

The capture fishery in Belu and Bobonaro District is considered similar in term of these parameters, i.e. (1) dominated by small-scale fisheries, (2) major fishing boats including non-motorized boats and outboard motorized boats (> 90%) with size of <1 GT, (3) common fishing gears including gill net and hand lines. The capture activities of small pelagic fish in transboundary waters of Indonesia – Timor Leste are mainly from Belu, Indonesia. To date, fishing vessels from Belu are recorded to reach >200 units, with size of <10 GT, using outboard motorized boats (15 PK and 30 PK) and inboard motorized boats. On the other hand, in waters of Timor Leste, especially in Bobonaro, the fishing vessels included 150 units of motorized boats. The fishing spots for capturing small pelagic fish located in Ombai Strait covering two water zones of Indonesia and Timor Leste. The fishermen from both countries have long established an agreement in relation to the small pelagic fish capture, in which fishermen from Belu are allowed to capture fish in waters of Timor Leste and *rumpun* (fish aggregating device, FAD) owned by Bobonaro's fishermen. The small pelagic fish catch obtained from the FAD is properly

Table 3. Current status of small pelagic fish in Belu and Bobonaro

Characteristics	Belu (Indonesia) ¹	Bobonaro (Timor Leste) ²
Fishermen (people)	431*	468
Fishing Boat (unit):	521	300
- Non-motorized	293	148
- Motorized	228**	152
Major fishing gear	Purse seine, gill net, hand lines	Gill net, hand lines
Fish production (tons)	1.993	147.1
Main small pelagic fish caught	Short-bodied mackerel, halfbeaks, flying fish, mangrove mullet, fringer scales ardinella	Short-bodied mackerel, flying fish, mangrove mullet, fringer scales ardinella
Fishing grounds	Atapupu Waters and its surrounding area in Ombai Strait	Balibo and Atabae Waters in Ombai Strait

Note: * full time fishermen; ** outboard motorized boat and motorized boat

Source: 1. DKP NTT (2016); 2. NDFA MFA RDTL (2012)

distributed according to the existing agreement.

Local social and cultural practices in the border area of Indonesia – Timor Leste also need to consider in order to design fishery management. The social and cultural system in that area has been strongly established and connected, and the connectivity between two communities has been traditionally existed, separated by border lines of the countries. In addition, economy activities of the communities have developed since long time ago, as indicated by existence of some traditional markets in the border area.

Based on above elucidation, key factors for developing transboundary fisheries management in the border area of Indonesia – Timor Leste specifically in Ombai Strait are described as follows: (a) Biology: presence of transboundary resources, i.e. small pelagic fish as shared fish stock for fishermen from Indonesia and Timor Leste, (b) Technology: current fisheries condition in both countries demonstrates similar features, i.e. dominated by small-scale fisheries employing simple technologies, (c) Habitat and environment: existed in same landscape with a high similarity in the condition of habitat and environment, (d) Governance: the existing agreement and informal partnership between fishermen from both countries in term of small pelagic fish exploitation activities (e) Social and economy: both communities have a strong relationship and the relationship has been traditionally established in the border area of Indonesia – Timor Leste.

Discussion

Transboundary fishery management is uneasy to build for its complexity, majorly related to the sustainable fishery management. In this case, some key issues need to consider, including international regulation and policy framework that govern transboundary fishery (Russel and VanderZwaag 2010). Furthermore, Laukkanen (2005) stated that transboundary fishery was highly dependent on commitment of the involved countries in relation to implement their regulation. Scholtens and Bavinck (2014) studied legality of transboundary fishery management and found that the most highlighted challenge was the attempt of reaching sustainability on environment and social. The challenge was mainly from difference in laws and regulation on fishery. The challenges of transboundary fishery

management are as follows: (a) scale difference; (2) law fragmentation; (3) power imbalances and (4) relationship of the subjects. Based on the conflicts of transboundary fishermen between India and Sri Lanka, Bavinck and Gupta (2014) asserted the presence of complex mixture relationship in a particular period of time. To deal with such condition, there is a need to create proper governance approach considering prudence and well coordination. Song *et al.* (2017) stated that studies on transboundary fishery closely related to following aspects, i.e. transboundary resources, transboundary fishing, transboundary trade and social dynamic, as well as transboundary governances.

Fishery management is an attempt to offer sustainability of the fish capture while also considering ecosystem sustainability. Gaichas (2008) elucidated that a strong correlation between ecosystem and sustainability on fishery management has demonstrated a particular characteristic from complex adaptive system in attempting a well relationship between ecosystem, economy and community. Ecosystem approach is based on ecosystem complexities showing effects on fishery resource dynamic. Piet *et al.* (2016) explained that fishery management could be a tool to provide optimum social-economy benefits, which are in same time, also undeniable to conserve ecosystem as one of the primary components for fish stocks. The interaction that involves ecosystem, fish resource, and social-economy in a single function and process in the fishery system is understood as the main reason for the importance of ecosystem approach. The essential principles for implementing ecosystem approach in fisheries management are listed as follows: (1) fishery exploitation needs to be managed at maximum limit in which its impact on ecosystem is still tolerable, (2) ecological interaction between fish resource and ecosystem is strictly maintained, (3) management tools should be compatible for all distribution of fish resource, (4) precautionary principles in policy making are used, and (5) fishery governance includes ecological and human system aspects (FAO 2003). Analysis of ecosystem approach in fishery management constituted a multi-attribute approach generally concerning the symptoms or performance of the current water ecosystem. The analysis was conducted through indicators divided into 6 domains: fish resource, habitat and ecosystem, fishing technology, economy, social, and institutions (KKP, 2015). Commonly, factors affecting the preservation

of resource are unlimited. Wade *et al.* (2001) mentioned that resource management could produce appreciable results due to 4 relevant factors, i.e. (a) characteristics of resource, (b) condition of communities relying on the resource, (c) institutional regime implemented to manage the resource, and (d) relationship of community and external factors and authorities such as market, government and technology. Lane and Stephenson (1995) argued that fishery resource management also needed to involve biological studies, with consideration of technical, economic and social aspects in coping with the complicated fishery systems.

Conclusion

1. Small pelagic fish in the border area of Indonesia –Timor Leste in Ombai Strait was regarded as shared fish stock and exploited by fishermen from both countries.
2. Small pelagic fish in the border area of Indonesia – Timor Leste displayed copious number of similar characteristics, and categorized as small-scale fishery.
3. Some key factors including fish resource and habitat, fishing technology, governance, social and culture, and economy remarkably contributed to the establishment of partnership in transboundary small pelagic fisheries management in Ombai Strait.

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