The migrant anchovy fishery in Kabui Bay, Raja Ampat, Indonesia: Catch, profitability, and income distribution

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Abstract

We estimate the unregulated catch and fisher income of the Kabui Bay migrant anchovy fishery operating in the Raja Ampat regency, Papua, Indonesia. Interviews with migrant fishers were conducted in April and November 2006, and estimates were generated through Monte Carlo simulations. Anchovy fisher income averaged US $1835 per year, about twice the average fisher income in the area. The income levels estimated by this study suggests that there is potential for the Raja Ampat Fisheries Bureau to capture some economic rent from the fishery to help fund a fisheries management program, from which Raja Ampat could benefit.
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1. Introduction

As a country composed of over 17,000 islands, differing marine resource management needs are felt throughout Indonesia. Historically, the capital city of Jakarta, on the island of Java, has been the center of resource control. But like many other countries, Indonesia has seen destruction of its coral reefs and the serial depletion of fish stocks, mainly sharks, tunas, and reef-associated fishes [1]. In 1999, the Indonesian government instituted a decentralization plan throughout the country, giving more power to regency level authorities [2]. One of the main reasons for this shift is the assumption that local authorities will have a more accurate idea of the needs of their communities, and thus potentially manage their resources more efficiently [2–4].

Despite decreasing fish stocks and habitat degradation in other areas of the country, the ecosystem on the western most side of the province of Papua is relatively healthy. A new political unit called the Raja Ampat regency has been created in this area, and recent ecological surveys suggest that the region boasts the highest coral reef biodiversity in the world [5,6]. This biodiversity, however, is threatened by increasing fishing activity, both legal and illegal, in Raja Ampat [6,7]. Neighbouring provinces (Komodo, Sulawesi) and countries (Philippines, Palau) can no longer catch sufficient fish from their own depleted waters, and thus fishers from these areas are fishing in the waters of Raja Ampat [5–7]. Not much is known in terms of how much fish is being caught by migrant fishers, or how much revenue these fisheries generate. Such unregulated catches can negatively affect fish stock sizes and undermine management goals [8]. Thus there is a need to quantify the migrant fishery catch to help ensure that fish stocks in Raja Ampat are being fished sustainably.

This paper provides a description of the Raja Ampat area as well as an overview of one of the major migrant-dominated fisheries: the anchovy lantern fishery. Annual anchovy catch is estimated and the economics of the fishery are analyzed. Annual gross revenue is calculated and costs are discussed, to produce an estimated annual profit for 2006, from the fishery's point of view (i.e., private costs and benefits). The economic content in this paper is simple, and thus whatever value it has lies in its contribution in spite of the scant literature and available data pertaining to fisheries in Raja Ampat. The Fisheries Bureau in Sorong,

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the closest landings port adjacent to Raja Ampat, has no official catch statistics for migrant anchovy fisheries, and thus this paper can hopefully be used by the Raja Ampat regency as they attempt to develop their marine resource management plans in the coming years.

2. Area description

The province of Papua is the most easterly of Indonesia's 33 provinces, and shares its island with the country of Papua New Guinea to the east. Raja Ampat was designated a regency in 2002 and includes the four main islands of Waigeo, Batanta, Salawati, and Misool, where the majority of the population resides, and consists of about 600 other islands [5–7]. There are about 32,000 people dispersed throughout the 4 million hectare area that makes up Raja Ampat [9].

Over 1200 species of fish are present in Raja Ampat [6,10]. Fish caught in the area include wrasse, grouper, snapper, parrotfish, tuna, surgeonfish, squid, and small pelagics such as sardine and anchovy [5–7].

In this regency, marine resources are paramount. Throughout the year most regency inhabitants are involved in subsistence fishing, even though they may be employed in other industries as their main economic source (farming, construction, pearl farming, etc.) [6,7]. A recent valuation report conducted by Conservation International estimates that 70% of the population engages in fishing [9]. Small-scale commercial sale of fish, often just within a village, occurs throughout the year. When weather permits (during calm seas), the amount of commercial fishing for export in Raja Ampat increases, and catch is often sold at the Sorong fish market on mainland Papua [6,7].

The dispersed population and large regency area means that fisheries management in the Raja Ampat area has historically been limited, or non-existent. But with a new regency government in place, Raja Ampat officials are seeking to increase development in the area, with increases in the fisheries sector highlighted as a probable development path [6,11]. This will mean that members of the Raja Ampat Fisheries Bureau (DKP) will need to implement effective monitoring, control, and enforcement for the development to proceed sustainably. Both native and migrant fishing activity will need to be managed.

3. The migrant anchovy fishery

Migrant fishers (fishers who travel from one area to another in search of work, engaging in employment away from their permanent residence) can often enter Raja Ampat waters, drop their lines or nets, and fish uninterrupted. This type of migrant fishing activity is rarely regulated. Illegal, unreported, and unregulated (IUU) fisheries in Indonesia, and the world over, make fisheries management difficult [12]. Fisheries stock assessment work depends on accurate records of catch and effort, both of which are underestimated with IUU fishing [8]. For future development of fisheries resources, the DKP will

need to invest adequate resources to identify the types of unregulated migrant fishing activity in the area, and to estimate the catch and profitability of such fisheries. Regulating migrant fisheries can increase fisheries revenue to the regency, and can help the DKP monitor destructive fishing practices, a major problem in Indonesia [13].

The anchovy fishery in Kabui Bay is an unregulated migrant fishery. The fishers operate in an area where there are no catch limits set by the DKP, and no requirements for reporting that catch. In 1999, 20 men from the Indonesian province of South East (SE) Sulawesi came to Papua for fishing access in Kabui Bay, on the southwest side of Waigeo Island. At that time, Raja Ampat was under the authority of the Sorong regency, based on mainland Papua. The migrant fishers paid a one-time access fee of 1 million Rupiah (IDR) (US $111) to the Sorong Fisheries Department, and have been fishing in the bay ever since. The fishers set up a temporary settlement camp, but this has become a second home for the men. Today, about 250 migrant fishers live in Kabui Bay fishing anchovy. Although they no longer pay money to regency level authorities, the anchovy fishers do owe monthly access fees to two villages in order to live on the land, and fish in the bay's waters.

Fresh anchovy is fished at dusk by dropping nets attached between two wooden boats manned by five fishers. The nets are lowered about 13 m down, and the fishers turn on a kerosene lantern. The light attracts the anchovy, and a few hours later the nets are pulled up with manual winches. Anchovies are then set on dozens of racks for one and a half days to dry out. This fish is called *puri* or *ikan teri* by Indonesians. Vendors in Sorong will sell bags of puri at the local market, but the fish caught in Kabui Bay are all transshipped at sea to Java, western Indonesia.

Fishers remain at the settlement camp for 4 or 5 months, at which time they go back to their homes in Buton, SE Sulawesi. It is in the province of SE Sulawesi that most of the income generated from the fishery will be spent. Other than rice, the men farm or fish everything they consume, including cassava, tomatoes, chili peppers, bananas, and coconut. Similar anchovy fisheries are set up elsewhere in Raja Ampat, namely, Aljui Bay and the area north of Misool. However, like Kabui Bay, there are limited catch data from these fisheries. As far as the Kabui Bay anchovy fishers can recall, the DKP has never asked them what, or how much, they are fishing. Furthermore, because the majority of the anchovy catch is never officially landed anywhere in Papua, the province has incomplete catch statistics.

This paper presents annual catch and fisher profitability estimates for 2006. A static analysis was chosen to simplify the issue of changes in annual group composition (i.e., number of vessels fishing), changes in costs and revenues of fishing as well as inter-annual catch variation.

4. Interviews

Official anchovy fishery data from Raja Ampat do not exist and thus could not be acquired from the Fisheries Bureau database. Therefore, quantitative data were obtained

from interviewing the migrant anchovy fishers in Kabui Bay. Interviews took place at the temporary settlement camp in Kabui Bay, Raja Ampat, on April 19, 2006, and November 28, 2006. These times coincide with the dry and wet seasons, respectively. We came with a prepared list of questions, and had anticipated speaking with individuals one at a time. However, our April visit sparked the camp's interest, bringing around 100 men to join the first interview. Ultimately, this led to only one set of questions being asked, with one primary respondent giving answers and other respondents occasionally pitching in. Our timing was off in November, as most of the people in the camp had traveled back to SE Sulawesi for Ramadan, and had yet to return to the settlement. In November, only two fishers were interviewed. Answers to questions pertaining to prices were given in Indonesian Rupiah (IDR), but are reported in the paper in US dollars (USD) by using the rounded current exchange rate of 9000 IDR to 1 USD. The authors recognize that due to the interview limitations (small sample size) this analysis serves only as a rough snapshot estimating the catch and profitability of the fishery. A more rigorous interview process would serve to better estimate catch, effort, revenues and costs. Hopefully, this work will prioritize more elaborate data collection efforts.

5. Computations

Catch and revenue distributions were generated using the Monte Carlo simulation method. Answers to most interview questions were given as ranges (for example, the weight of anchovy in the baskets used to collect fish from the nets ranged from 5.5 to 6.5 kg), and all variables were assumed to be distributed uniformly over the range. Ten thousand random draws were sampled from within the variable ranges to produce a frequency distribution of all possible catch, revenue, and cost estimates.

5.1. Catch

The amount of fish caught annually per boat was estimated from a number of responses from the fishers, and varies with season. The Kabui Bay fishers do not weigh their fish directly, but know that each basket of caught fish they fill is equal to about 6 kg of fish. Effort for this fishery is represented by the number of days fished per month and per season. Seasonal catch h_s is calculated by the following:

$$h_s = n_s w d_s m_s,\qquad(1)$$

where n_s is the number of baskets caught on a given night in season s (either dry or wet), w is the weight of fish per basket (does not vary with season), d_s is the number of days fished per month in season s, and m_s is the number of months fished in season s.

The total annual catch per boat is thus the sum of these two seasonal estimates:

$$h = h_d + h_w,\qquad(2)$$

where h_d and h_w are the total catches in the dry and wet seasons, respectively. To estimate catch for the entire fleet, the estimate per boat was multiplied by all possible number of boats operating during a period, which ranged from 50 to 60.

5.2. Revenue

To obtain revenue, the seasonal catch estimates were first divided by two. For the anchovy fishery, it is assumed that the weight of the catch once dried is about one half of the fresh weight harvested (A. Muljadi, personal communication). This dried catch is then multiplied by the price for landed, dried fish, in each season. That is, the total revenue in 2006 is

$$TR = p_d \frac{h_d}{2} + p_w \frac{h_w}{2},\qquad(3)$$

where p_d and p_w are the prices per kilogram of dried anchovy in the dry and wet seasons, respectively.

The ex-vessel price of anchovy caught and dried during the dry season is fixed at about \$1.30 per kilogram. Fish caught and dried during the wet season, however, fetch a lower and variable price due to unfavorable drying conditions leading to lesser quality fish. The wet season ex-vessel price ranged from \$0.40 to \$0.56 and this range was used in the Monte Carlo simulations.

5.3. Cost

The total cost (TC) of the fishery is composed of both fixed, FC, and variable, VC, costs:

$$TC = FC + VC.\qquad(4)$$

The fixed costs in the anchovy fishery include the boat and net setup and the access fees paid by boat owners to the villages. Variable costs include gasoline for the boat engine and kerosene for the lanterns, as well as labor costs. The fishers said that their income depends on the revenue. Each fisher receives $\frac{1}{16}$th of the total revenue in the form of personal income. The boat owner, on the other hand, takes $\frac{3}{16}$ths of the total revenue for his personal income. Therefore, the total labor-associated costs equal $\frac{8}{16}$ths, or one half, of the total revenue.

5.4. Profit and gains from the fishery

Profit in this fishery is considered for two cases: boat owner profit and fisher profit. The owner's profit, π_o, is the difference between the total revenue and total cost of the fishery:

$$\pi_o = TR - TC.\qquad(5)$$

The fisher profit, π_f, is the difference between the personal income earned from the anchovy fishery, C_l, and the fisher's opportunity cost, OC, essentially the average annual income the fisher could make in another fishery in

Raja Ampat

$$\pi_f = C_l - OC. \tag{6}$$

6. Results

6.1. Catch

Annual per boat catch varied from 49 to 76 tonnes, with a mean of 62 tonnes. Annual catch for the entire fleet (50–60 boats) ranged from 2493 to 4468 tonnes, with a mean of 3389 tonnes. The 95% confidence intervals are indicated in Figs. 1 and 2.
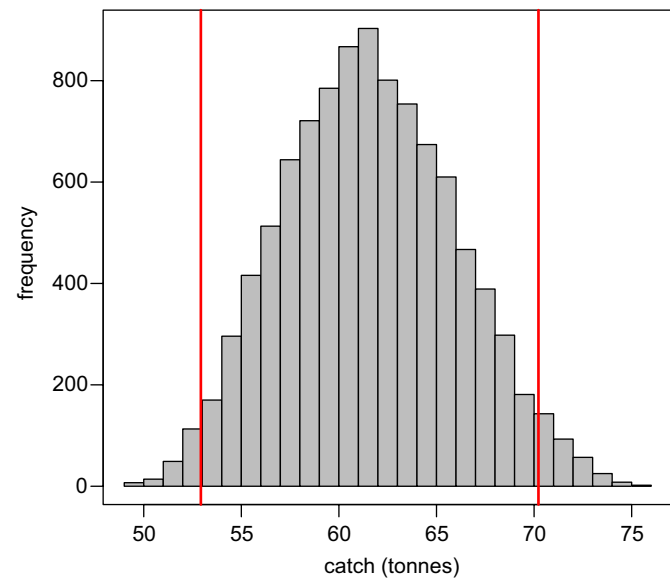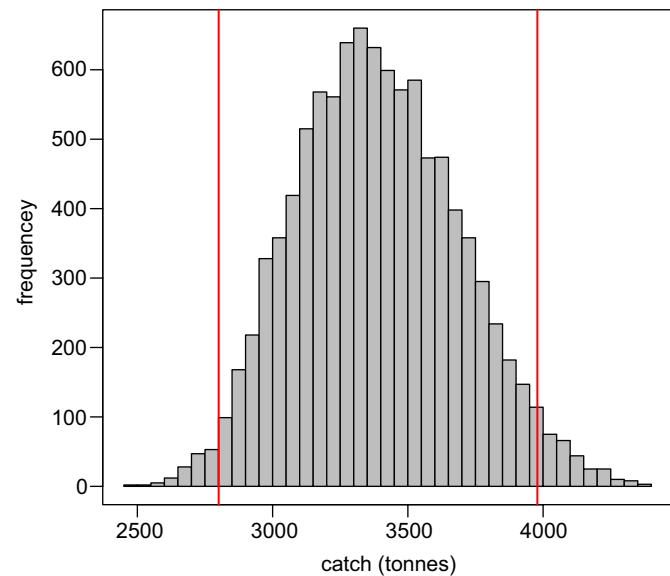
6.2. Revenue

Estimated annual revenue per boat ranged from US $23,280 to $36,730, with a mean annual revenue of $29,380. Annual revenue for the entire fleet ranged from an estimated $1.16 million to $2.1 million, with a mean of $1.62 million. The 95% confidence intervals are shown in both Figs. 3 and 4.

6.3. Costs

Discussions with the fishers gave the following cost estimates: annual access fees amount to $267; annual

Fig. 1. Annual catch per boat (tonnes).

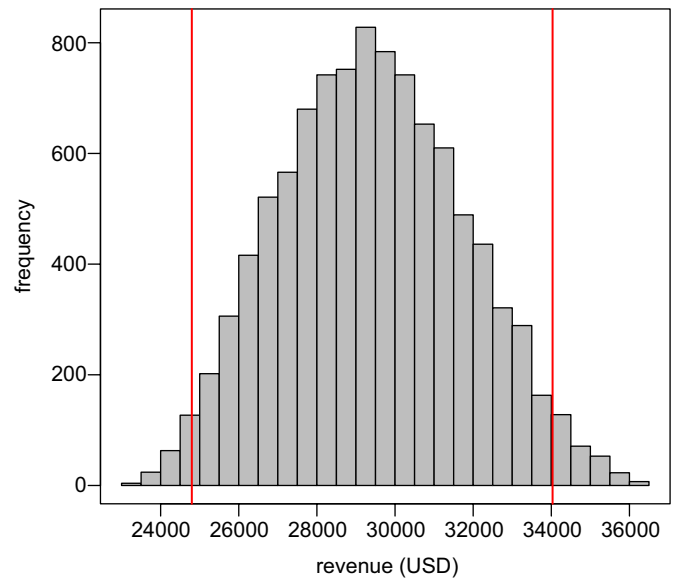Fig. 2. Annual fleet catch (tonnes).
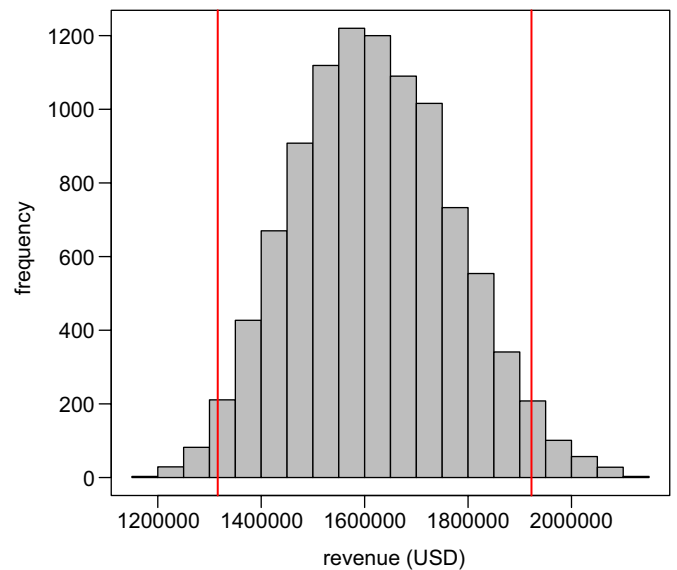

Fig. 3. Annual revenue per boat (USD).

Fig. 4. Annual fleet revenue (USD).

capital investment (cost of boat and net setup multiplied by 0.2; fishers told us that the setup lasts 5 years, therefore $\frac{1}{5}$ of the cost gets allocated to 2006) equals $156; fuel costs average $1455 per year, and kerosene costs average $468 per year. Thus, the boat owner's cost (excluding labor) averages $2346 per boat per year. As stated above, the revenue is split in half to pay labor costs. Each fisher receives $\frac{1}{16}$th of the revenue, which averages about $1835 per year. Recall there are five fishers per boat, so total labor costs paid out to the fishers average $9189 annually. The boat owner takes $\frac{3}{16}$ths for his personal income, averaging about $5513 per year.

6.4. Profit and gains from the fishery

The estimated annual owner profit, the difference between the total revenue and total costs, is about $10,870. This is quite substantial given that the average annual per capita income in the province of Papua was $938 in 2002 [14] (UNIPA, 2002). Furthermore, fishers told us that owners in fact take half of the revenue (averaging $14,698 per boat per year) to pay back their "capital investments", even though those costs, as described by the fishers, are substantially lower (recall non-labor costs equal $2346). Thus it appears that the boat owners are capturing the majority of rent from the fishery.

The estimated annual fisher profit is the difference between the fisher's personal income from the anchovy fishery and his opportunity cost. Unfortunately, direct statistics for average annual fishery income is not available for Raja Ampat. However, a valuation study conducted by Conservation International (CI) reported the average per capita Gross Regional Domestic Product (GRDP) in Raja Ampat in 2004 was US $824 (Bappeda, 2004 in [9]). The same CI study estimated the combined net value of artisanal and commercial fisheries in Raja Ampat at about $9.22 million and suggested that about 24,693 people within the regency participate in the fisheries sector [9]. By dividing the value of the fisheries by the number of fishers, we can roughly estimate that each fisher makes about $1024 per year. Note, however, that this is an average, and includes artisanal fishers *and* boat owners; groups that probably make very different incomes. If we do assume that the average fisher in Raja Ampat makes about $1024 per year, and using the estimate from the interviews with the Kabui Bay anchovy fishers yielding a mean annual income of $1835, it appears that the anchovy fishers are making about 1.8 times as much as other fishers in Raja Ampat.

7. Conclusion

The inequitable distribution of gains from the anchovy fishery seems quite apparent. Boat owners are capturing the majority of rent from the fishery, making about five times as much as the fishers. One possible consideration is that boat owners owe money to a broker who

sets up the boat owners with the vendors who buy the fish, and that this cost is unknown to the fishers we interviewed and thus not included in this analysis. The anchovy fishers themselves are also making substantial profits in this fishery, as their annual income is almost twice as much as the average Raja Ampat fisher.

The majority of these profits will be spent in Buton, when the fishers return home. Therefore, there is no possible argument that the large incomes earned by migrant fishers would directly benefit the people of Raja Ampat, through increased personal expenditure.

As current access fees are paid only to villages, and not directly to the regency government, the government is not generating any revenue from the migrant anchovy fishery. Because the regency is a newly created political unit, the initial terms of the original access agreement in 1999 might be subject to change. Regency revenue somehow generated from the profitability of the fishery could help the DKP fund regency-wide fisheries management, such as effort monitoring, stock assessment work, research on illegal and destructive fishing practices, and modeling of economic development options for the area through marine resource use. All of these management programs have the potential of increasing fishers' incomes in the medium and long term.

Specific monitoring of the migrant anchovy fishery is an important consideration not currently part of the Bureau's management plan. The migrant respondents told us that the DKP had never come by their settlement to ask them what they are fishing or how much they are catching. As stated earlier, unreported catches have the potential to severely bias stock assessments and to undermine management objectives [8,15]. Furthermore, anchovy have been identified as a key prey item for higher level predators [16]. Within the Raja Ampat ecosystem, tuna, mackerel, billfish, as well as reef-associated and pelagic fishes feed on anchovy [10]. The groups fishing in Kabui Bay have noticed a decrease in the population of anchovy close to shore, and this could mean reduced prey availability for other fish species. Beginning last year, the fishers expanded their range, and are now traveling twice as far offshore as past fishers did. The fishers told us that they would stop fishing in Kabui Bay if their catches decreased to about half of what they catch now. In light of this, the DKP should monitor and manage this fishery, and other anchovy fisheries in Raja Ampat.

Furthermore, the profitability of the fishery, as reported here, should be incentive enough to manage it sustainably, to ensure the flow of benefits to the area through time. Recent work by Zeller et al. [17] highlights the need for better catch and revenue statistics in small-scale fisheries in the Pacific as these fishers can contribute substantially to GDP, but are often ignored. Hopefully, this study and the growing attention to the world's small-fisheries will encourage subsequent studies in Raja Ampat.

Acknowledgments

References

[1] Tomascik T, Mah AJ, Nontji A, Moosa MK. The ecology of the Indonesian Seas. EMDI and Periplus, 1997. 745pp.

[2] Usman S. Indonesia's decentralization policy: initial experiences and emerging problems. Governance Working Papers 123, East Asian Bureau of Economic Research, 2001.

[3] Satria A, Matsuda Y. Decentralization of fisheries management in Indonesia. Marine Policy 2004;28:437–50.

[4] Sachs J. The end of poverty: economic possibilities of our time. New York, NY: The Earth Institute; 2005. 396pp.

[5] Mckenna SA, Allen GR, Suryadi S. A marine rapid assessment of the Raja Ampat islands, Papua Province, Indonesia. Conservation International Report, 2002. 191pp.

[6] The Nature Conservancy. Report on a rapid ecological assessment of the Raja Ampat Islands, Paupa, Eastern Indonesia. The Nature Conservancy Report, 2003. 246pp.

[7] The Nature Conservancy. Coastal rural appraisal report in Kofiau and Misool area of Raja Ampat islands. The Nature Conservancy South East Asia for Marine Protected Areas Report, 2004. 28pp.

[8] Pitcher TJ, Watson R, Forrest R, Valtsson HP, Gunette S. Estimating illegal and unreported catches from marine ecosystems: a basis for change. Fish and Fisheries 2002;3:317–39.

[9] Dohar A, Anggraeni D. Laporan akhir valuasi ekonomi alam Kepulauan Raja Ampat (in Indonesian). Conservation International Indonesia Report, 2006. 72pp.

[10] Ainsworth CA, Varkey D, Pitcher TJ. Ecosystem simulation models for the Bird's Head Seascape, Papua, fitted to field data. In: Pitcher TJ, Ainsworth CH, Bailey M, editors, Ecological and economic analyses of marine ecosystems in the Bird's Head Seascape, Paupa, Indonesia: I, Fisheries Centre Research Reports 2007;15(5):6–174.

[11] Wanma M. Visi dan misi Kabupaten Raja Ampat (in Indonesian). Kabupaten Raja Ampat, 2002.

[12] Sumaila UR, Alder J, Keith H. Global scope and economics of illegal fishing. Marine Policy 2006;30:696–703.

[13] Pet-Soede L, Cesar HSJ, Pet JS. An economic analysis of blast fishing on Indonesian coral reefs. Environmental Conservation 1999;26(2): 83–93.

[14] UNIPA. Papua Dalam Angka (in Indonesian). State University of Papua. 2002. 485 pp.

[15] Clark CW. The Worldwide Crisis in Fisheries. Economic Models and Human Behavior. Cambridge: Cambridge University Press; 2006. 263pp.

[16] Skewgar E, Boersma PD, Harris G, Caille G. Anchovy fishery threat to Patagonian ecosystem. Science 2007;315:45.

[17] Zeller D, Booth D, Pauly D. Fisheries contribution to the gross domestic product: understanding small-scale fisheries in the Pacific. Marine Resource Economics 2006;21:355–74.