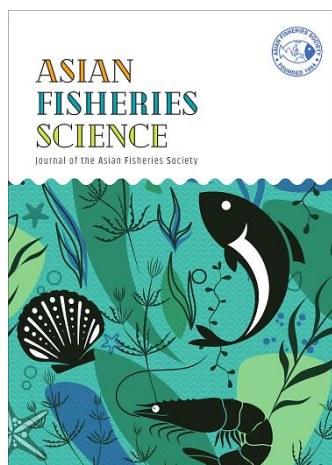




Price Premium and Resource Rents from Nile Tilapia *Oreochromis niloticus* (Linnaeus, 1758) Farming in Lake Sebu, Philippines

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ISSN: 0116-6514

E-ISSN: 2073-3720

<https://doi.org/10.33997/j.afs.2020.33.4.006>

Abstract

With deep lakes and cool weather, high-quality tilapia *Oreochromis niloticus* (Linnaeus, 1758) is produced in the Municipality of Lake Sebu in the southern Philippines, fetching a price premium that results in Ricardian resource rent for fish cage operators. This extra rent has induced unsustainable aquaculture practices such as overcrowding fish cages, overstocking and overfeeding, which in turn, have resulted in water pollution and fish kills that partially wipe out the rent. This paper aims to estimate sustainable tilapia production and potential resource rent from tilapia farming in Lake Sebu using primary data gathered from key informant interviews, focus group discussions and a survey of tilapia cage owners. Results indicate that potential annual resource rent ranges from PHP49–61 million (USD0.95–1.18 million). Expressed on a per square meter of fish cage area, rent is calculated to be PHP12.22–15.21 or USD0.24–0.29, 8–10 times more than the annual fish cage permit fee of PHP1.5 (USD0.03). This Ricardian rent may be collected to fund the necessary lake water quality rehabilitation programs and aquaculture monitoring and regulation enforcement activities to prevent rent-dissipating fish kills and to ensure the preservation of the natural fisheries capital. Rent collection may be in the form of an additional permit fee that follows a progressive rate structure to address poverty and equity issues. The study illustrates the multi-faceted role of resource rent in fisheries exploitation and management, and adds to the still scarce literature on resource rent estimation in fisheries.

Keywords: aquaculture, resource rent taxation, resource management

Introduction

In the Philippines and many developing countries, aquaculture has great potential to provide for the increasing food as well as livelihood requirements of a growing population (FAO, 2020). Aquaculture has also offered an alternative source of income to fishing communities around inland water bodies and along coastlines. One major drawback of aquaculture, however, is its impact on the environment. Overcrowded and over-fed fish farms in marine waters (Caruso et al., 2003; Mirto et al., 2009; Mancuso, 2015) and freshwater bodies (Tacon and Forster, 2003; Palanca-Tan, 2018) have caused massive fish kills (Gyllenhammar and Hakanson, 2005) and pollution (Tacon and Forster, 2003; Zacccone et al., 2005), affecting catch fisheries and other income-generating and leisure activities (FAO, 2009), and causing losses in biodiversity (Krkosek et al., 2007; Mirto et al., 2009;

Martinez-Porchas and Martinez-Cordova, 2012).

Recognising the potential efficacy of aquaculture in addressing livelihood development and poverty reduction as well as global food security concerns, multilateral agencies promoted aquaculture development initiatives (Asian Development Bank, 2005). In the late 1980s, the Asian Development Bank (ADB) and the United Nations Development Programme provided funding for the Philippine-based International Centre for Living Aquatic Resources Management to undertake a program to develop technologies for the breeding of improved but low-cost strains of tilapia (FAO, 2005). This paved the way for the rapid expansion of tilapia farming in the Philippines. Though tilapia *Oreochromis niloticus* (Linnaeus, 1758) fish farms are concentrated in the central and southern portions of Luzon, accounting for about 85 % of tilapia production in the Philippines

(Palanca-Tan, 2018), tilapia farming has also spread to freshwater bodies in southern Mindanao, such as the municipalities of Lake Sebu in South Cotabato and Lutayan in Sultan Kudarat.

In the Municipality of Lake Sebu, tilapia farming is done in two of its lakes, Lake Sebu, the biggest lake with a surface area of 354 ha, and Lake Seloton, a much smaller lake with a surface area of only 47 ha (Lake Sebu Municipal Planning and Development Office, 2016). This paper looks into the benefits of tilapia farming in this freshwater ecosystem in terms of the concepts of price premium and resource rent. The experience of Lake Sebu presents an interesting example of the need to utilise resource rent to sustainably manage fishery resources.

In the Philippines, minimal permit fees for fish farms in marine and freshwater bodies, calculated based on a fixed amount per unit of fish farm area, are collected yearly from fish farms owners. The fees are set at very low levels as aquaculture is considered a poverty alleviation measure, an alternative source of livelihood in poor fishing communities where catch fisheries have become an unstable and insufficient source of income. However, the concentration of fish farm ownership in the hands of a small number of individual and sometimes corporate, large-scale fish farm operators have resulted in an inequitable share of resource rent. Thus, there is a need to redesign resource rent taxation so that more of the fisheries rent can be collected and utilised for resource rehabilitation and preservation without disadvantaging subsistence fish farmers.

To date, there is scarce literature on resource rent and its estimation in fisheries (Scherzer and Sinner, 2006). Many of the existing studies on resource rent are on oil and mineral resources (Land, 2010), and on the link between resource rent and economic development (Leamer et al., 1999; Papyrakis and Gerlagh, 2004; Blanco and Grier 2012). This paper aims to fill the gap in the fisheries economic literature by presenting the case of tilapia farming in Lake Sebu as an example of how resource rent is generated, why it is important for the local government to collect rent for use in rehabilitation and preservation programs to prevent overexploitation and the consequent rent dissipation, and how it can be collected equitably.

Materials and Methods

Study site

The Municipality of Lake Sebu is one of 13 municipalities in the Province of South Cotabato in Region XII, the southernmost portion of the Philippines. The Municipality is approximately 40 km away from Koronadal, the capital and only city of South Cotabato and the regional centre of Region XII (Fig. 1).

Within the Municipality's predominantly rugged terrain of several mountain ranges are abundant surface water bodies that include three major lakes – Lake Sebu, Lake Seloton and Lake Lahit. Lake Sebu and Lake Seloton are utilised for highly profitable tilapia farming while Lake Lahit is restricted to open fishing activities (LSMPDO, 2016).

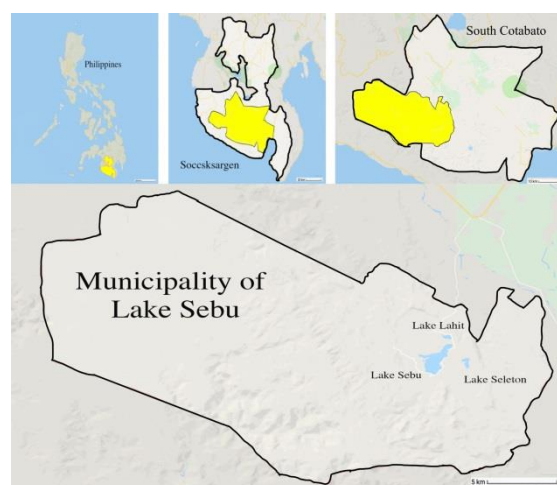


Fig. 1. The Municipality of Lake Sebu in the Province of South Cotabato in Region XII in the southern Philippines.

Data collection

The research employed a combination of primary and secondary data collection techniques. Records of fishing data, ordinances and programs were obtained from the municipal and provincial government offices. Published materials by the local government units (LSMPDO, 2014, 2016), reports prepared by their consultants, as well as annual aquaculture data from the Fisheries Statistics of the Philippines were used.

There were three primary data collection techniques employed for this paper: key informant interviews (KIIs), a focus group discussion (FGD), and a household survey. KIIs were conducted with the Municipal Agriculturist, the Provincial Agriculturist, and four fish farm owners. A FGD with nine fish farm operators was also undertaken to corroborate findings from the KIIs on aquaculture operations, particularly farm yields and costs. These data were used in estimating potential sustainable tilapia production. The 13 fish cage operators who participated in the KIIs and FGD accounted for 3 % of the 450 fish cage operators in the Municipality. They were drawn from the different aquaculture zones in the lakes and were invited through the Office of the Municipal Agriculturist (OMA).

A survey of household preferences and demand for Lake Sebu tilapia in the neighbouring city of Koronadal was undertaken to estimate the demand for Lake Sebu tilapia outside the Municipality. A sample of 516 respondents was generated through in-

person interview by experienced enumerators of the Research Centre of Notre Dame of Marbel University. All 27 barangays or districts of Koronadal were included in the sampling frame. The number of respondents in each barangay was set in proportion to the share of the barangay in the city population. The systematic sampling procedure was employed in selecting the respondents in each barangay. The results of the survey are presented in Table 3 in the Results section.

Analytical framework

Price premium

A price premium exists if the price of a product is significantly higher than similar competing products as a result of any or a combination of three reasons: (1) product differentiation (Becerra et al., 2013), (2) the product is unique, making its producer a monopolist to a certain extent, and (3) the product serves as a symbol of status, a Veblen good (Veblen, 1994; Bagwell and Bernheim, 1996).

The price premium, PP , is the percentage by which a product's selling price, P , exceeds a benchmark price, B (Farris et al., 2010):

$$PP = \left[\frac{P - B}{B} \right] \times 100$$

The benchmark price may be the average price of all similar goods in the marketplace, the average price of a selected group of competitors, or the price of a particularly close and direct competitor (Farris et al., 2010). For this paper, the benchmark price used is the price of tilapia farmed in fish pens in Lake Buluan in the neighbouring Municipality of Lutayan.

Resource rent

In economics, rent is the surplus of revenues after accounting for all costs and normal returns. Economic rent generated from the use of natural resources, such as marine and freshwater bodies, forests, and minerals, is referred to as resource rent. As normal profit is incorporated as a cost item in rent computation, resource rent is also referred to as supernormal or excess profit. A basic formula for calculating resource rent, RR , (Bostock et al., 2004) is:

$$RR = TR - (CI + CL + CK + NP)$$

TR is total revenue, CI is cost of intermediate inputs, CL is cost of labour, CK is cost of fixed capital, and NP is normal profit. NP is the opportunity cost of capital that is invested. Different prices arising from differences in the quality of resource-based produce may result in differential resource rents, referred to as quality or Ricardian rent (Scherzer and Sinner, 2006). If all cost items are similar for two resource sites, Ricardian rent may just be equated to the price

premium of the product coming from the superior resource.

Results

Poor resource management, fish kills and unstable tilapia production

Table 1 reveals a cycle of increasing and then decreasing tilapia produce. Severe drops in annual tilapia production volume were posted in 2006, 2011 and 2017 during which years massive fish kill episodes occurred.

Massive fish kills were attributed to very high levels of biological oxygen demand (Hingabay et al., 2016) resulting from the accumulation of organic matter from excess fish feeds, municipal wastewater, and dead algal biomass. Overcrowding fish cages, high fish stocking density, and overfeeding caused the accumulation of fish feeds (Natividad et al., 2015; Hingabay et al., 2015). The mushrooming of commercial resorts and residential houses with no proper sewerage and sanitation facilities around the lakes increased the inflow of municipal wastewater (Hingabay et al., 2016). Interviews with officials of the local government and official reports from Lake Sebu's Office of Municipal Agriculturist revealed that fertilisers and other chemicals from surrounding crop farms also caused the proliferation of algal blooms.

Potential, sustainable tilapia production

Annual sustainable tilapia production in the Municipality is estimated with the assumption that the mandated 10 % allowable fish cage area is the true carrying capacity of both Lake Sebu and Lake Seloton. The estimation assumed an average yield of 400–500 kg for every standard fish cage of 120 m² with standard stocking density and feeding over a growing period of 8 months (equivalent to 1.5 growing cycles or harvests per year), based on the FGD and KIs with fish cage operators and OMA officials. Given Lake Sebu and Lake Seloton's surface areas of 354 ha and 47 ha, respectively, total allowable fish cage area is 40.1 ha, equivalent to about 3,342 fish cages. Hence, yearly potential tilapia production in the Municipality is estimated to range from 2,005–2,506 mt.

Lake Sebu tilapia price premium

Columns 4 and 5 of Table 1 reveal smaller fluctuations in the peso value of tilapia production, such that even when production volume fell by almost 10 % from 1,637 mt in 2004 to 1,577 mt in 2018, production value more than doubled from PHP62 million (USD1.177 million) to PHP145 million (USD2.753 million), equivalent to an average annual increase of 7 %. This may be attributed to surges in the price of tilapia.

Table 1. Tilapia *Oreochromis niloticus* production in the Municipality of Lake Sebu.

Year	Volume (mt)	Rate of change (%)	Value thousand PHP (thousand USD) ^a	Rate of change (%)
2004	1,637	-	62,380 (1,117.49)	-
2005	1,607	-1.78	72,606 (1,323.30)	16.39
2006	1,486	-7.52	71,749 (1,399.82)	-1.18
2007	1,544	3.88	79,553 (1,723.09)	10.88
2008	1,759	13.95	105,625 (2,377.12)	32.77
2009	1,652	-6.08	115,509 (2,427.44)	9.36
2010	1,722	4.18	134,149 (2,975.36)	16.14
2011	1,528	-11.27	120,198 (2,776.95)	-10.40
2012	1,472	-3.66	122,375 (2,899.68)	1.81
2013	1,391	-5.49	118,596 (2,794.30)	-3.09
2014	1,453	4.47	129,402 (2,914.51)	9.11
2015	1,693	16.51	149,262 (3,279.04)	15.35
2016	2,039	20.42	181,874 (3,829.66)	21.85
2017	1,309	-35.80	125,354 (2,488.31)	-31.08
2018	1,477	12.84	144,659 (2,746.08)	15.40
Annual average	1,581	0.33	119,351 (2,508.73)	7.38
Rate of change: 2004 to 2018		-9.75		131.90

Source of data: PSA Fisheries Statistics of the Philippines (2007, 2010, 2013, 2016, 2019), tables on freshwater fish cage production volume and value by type of species (data on tilapia) and by province (data on South Cotabato). Retrieved from <https://psa.gov.ph/sites/default/files/FStatPhil13-15docx.pdf>

^aNumbers in parentheses refer to USD values according to the annual average exchange rate.

Over the 15-year period, the price of Lake Sebu tilapia almost tripled from only PHP38 kg⁻¹ in 2004 to PHP96 kg⁻¹ in 2018 (column 2 of Table 2). On the average, the price of Lake Sebu tilapia increased by 7 % per year, impressively faster than that of the average price of tilapia for the whole Philippines with a 3 % annual average increase for the same period. In 2004, the price of Philippine tilapia was PHP53 kg⁻¹ (PSA, 2007), higher than that of Lake Sebu tilapia. By 2018, the situation reversed, Lake Sebu tilapia's price was 26 % higher than that for the whole Philippines of PHP77.75 kg⁻¹ (PSA, 2019).

To make the comparison more context-specific, price of Lake Sebu tilapia is compared with its closest competitor, Lutayan tilapia. Table 2 reveals that the price of Lake Sebu tilapia is about 49 % higher than Lutayan tilapia, on the average, in 2004–2018. The price difference was greatest (about 70–80 %) during the period 2009–2013. Most recently in 2017–2018, though the premium was lower, it was still very substantial at 37–38 %.

The price premium exists because of a general preference for Lake Sebu tilapia in the region. Lake Sebu tilapia is described to be dark, having a small head, fleshy and fatty, and much better tasting without off flavour compared to Lutayan tilapia.

Markets and demand for Lake Sebu tilapia

Resorts and restaurants

As Lake Sebu is a holiday destination for residents of neighbouring municipalities and a prime eco-tourism destination in the southern Philippines (Palanca-Tan, 2020), resorts and restaurants comprise a big market for farmed tilapia. Using the 2016 visitor arrival data from the Municipal Tourism Office of 438 thousand and assuming that each visitor consumes about 0.25–0.50 kg of tilapia per visit, annual demand for tilapia of resorts and restaurants is estimated at 110–219 mt.

Table 2. Price premium of Lake Sebu tilapia *Oreochromis niloticus*.^a

Year	Price (PHP.kg ⁻¹)		Price difference (P-B)	Price premium (%) (P-B)/B
	Lake Sebu (P)	Lutayan (B)		
2004	38.12 (0.68)	32.46 (0.58)	5.66 (0.10)	17.43 (0.31)
2005	45.17 (0.82)	35.54 (0.65)	9.63 (0.18)	27.09 (0.49)
2006	48.27 (0.94)	38.21 (0.75)	10.06 (0.20)	26.33 (0.51)
2007	51.52 (1.12)	38.70 (0.84)	12.83 (0.28)	33.14 (0.72)
2008	60.03 (1.35)	39.87 (0.90)	20.17 (0.45)	50.58 (1.14)
2009	69.90 (1.47)	40.62 (0.85)	29.28 (0.62)	72.07 (1.51)
2010	77.92 (1.73)	43.49 (0.96)	34.43 (0.76)	79.17 (1.76)
2011	78.69 (1.82)	45.08 (1.04)	33.61 (0.78)	74.57 (1.72)
2012	83.16 (1.97)	47.68 (1.13)	35.47 (0.84)	74.40 (1.76)
2013	85.27 (2.01)	50.17 (1.18)	35.10 (0.83)	69.97 (1.65)
2014	89.06 (2.01)	63.63 (1.43)	25.43 (0.57)	39.97 (0.90)
2015	88.17 (1.94)	68.01 (1.49)	20.16 (0.44)	29.64 (0.65)
2016	89.21 (1.88)	69.24 (1.46)	19.97 (0.42)	28.84 (0.61)
2017	95.77 (1.90)	70.10 (1.39)	25.67 (0.51)	36.62 (0.73)
2018	97.94 (1.86)	70.99 (1.35)	26.95 (0.51)	37.97 (0.72)
Average 2004-2018	75.72 (1.59)	51.52 (1.08)	24.20 (0.51)	48.60 (1.02)

Source of data: PSA (2007, 2010, 2013, 2016, 2019) Fisheries Statistics of the Philippines, tables on freshwater fish cage production volume and value by type of species and by province. Retrieved from <https://psa.gov.ph/sites/default/files/FStatPhil13-15docx.pdf>. Effective price was derived by dividing annual tilapia production value by annual tilapia production volume for each of the two cities.

^aNumbers in parentheses refer to USD values according to the annual average exchange rate.

Residents of Lake Sebu

Fish cage operators sell their harvests to residents through public market vendors, itinerant vendors, and live tilapia vendors along the streets of the Municipality. To come up with an estimate of tilapia demand by Lake Sebu residents, the average per capita tilapia consumption in the Philippines for 2015 of 3.7 kg (BFAR, 2019) is applied on Lake Sebu's population of 87,442 (PSA, 2015). Annual tilapia demand of this market segment is thus estimated to be about 324 mt.

Residents of neighbouring cities and municipalities of Region XII

Fish cage operators sell their harvests to fish traders that in turn sell to public market vendors,

supermarkets and other retailers in other municipalities of the region. Table 3 summarises the results of the survey on consumer preferences for Lake Sebu tilapia. Almost all of the respondents (98 %) are aware that Lake Sebu tilapia is more expensive than tilapia grown in other places. Four-fifths are willing to pay the price premium for Lake Sebu tilapia. However, only 28 % have firm preference for Lake Sebu tilapia, that is, they only consume Lake Sebu tilapia. The majority (63 %) of households prefer Lake Sebu tilapia but also consume tilapia grown in other places. Only considering households with firm preference for Lake Sebu tilapia, and applying the average per capita tilapia consumption in the Philippines for 2015 of 3.7 kg (BFAR, 2019) on those with a firm preference for Lake Sebu tilapia among the population of Region XII of 4.5 million (PSA, 2015), total demand of other municipalities and cities of

Table 3. Survey results on preferences for Lake Sebu tilapia in Koronadal City.

Proportion (%) of households who	
Eat Lake Sebu tilapia only, does not consume other tilapia	28.49 %
Prefer Lake Sebu tilapia but also consume other tilapia	63.18 %
Do not care about the particular source of tilapia they eat	8.33 %
Proportion of respondents who	
Are aware that Lake Sebu tilapia is more expensive than other tilapia	98.06 %
Are willing to pay the higher price of Lake Sebu tilapia	79.69 %
Maximum price difference (premium for Lake Sebu tilapia) households are willing to pay	PHP46.27 kg ⁻¹ (USD0.90)

Region XII is conservatively estimated to be about 4,791 mt.

The total annual demand for Lake Sebu tilapia of all three market segments ranges from 5,225 to 5,334 mt, more than twice Lake Sebu's sustainable production.

Resource rent

Total Ricardian rent that accrues to the fish cage operators of the Municipality of Lake Sebu is equated to the price difference between Lake Sebu tilapia and Lutayan tilapia multiplied by Lake Sebu tilapia production volume. Using the average historical price difference of PHP24.20 kg⁻¹ (USD0.47) in 2004–2018 and the sustainable annual production volume of 2,005–2,506 mt, yearly Ricardian resource rent that can be generated from tilapia farming in Lake Sebu can range from PHP49–61 million (USD0.95–1.18 million).

Discussion

The estimated differential resource rent accrues to fish cage operators in the form of extra profit arising from having their fish farms in Lake Sebu or Lake Seloton. It is more profitable to operate fish farms in these lakes because natural characteristics, such as lake depth and cool weather, result in higher quality tilapia. Part of this Ricardian resource rent may be collected by the local government to fund necessary lake rehabilitation and preservation policies and programs such as aquaculture and agriculture training programs, fish farming monitoring activities to ensure that total fish farm area is limited to the 10 % lake carrying capacity and proper stocking and feeding practices are observed, agriculture regulation and monitoring activities to prevent negative impacts of poor farming practices on lake resources, and a sanitation and sewerage program to substantially reduce if not totally eliminate lake water pollution load coming from municipal wastewater. Lake quality degradation prevents the realisation of potential sustainable harvests, and the collection of resource rent for use in rehabilitation and preservation programs is consistent with the concept of scarcity

rent and sustainable resource management (Collier and Hoeffler, 2009).

Even a small fraction of the estimated annual Ricardian resource rent will generate a sizeable amount to start programs. For instance, 10 % of the estimated rent will generate PHP4.9–6.1 million (USD94–117 thousand), eight to ten times the proceeds from the current fish cage permit fee that can be collected from the allowable fish cage area of 40.1 ha which is PHP601,500 (USD11,609.73).

Equity in resource rent collection

The scale of fish cage operations in the Municipality varies widely. Table 4 shows the distribution of fish cage operators according to number and total area of fish cages. The smallest fish cage operator has only two fish cages on 280 m² area while the biggest operator has 170 cages and a total fish cage area of 17,500 m². On average, each fish cage operator has 13 fish cages and 1,511 m² of fish cage area. The standard deviations, 14 fish cages and 1,457 m², are close to their respective average levels, reflecting the wide disparity among individual fish cage operators. Looking more closely at the distribution of fish cage operators reveals that most fish cage operators are small-scale. Nearly half (42 %) of fish cage operators have only ten or fewer fish cages and a total fish cage area of less than 1 ha, and about four-fifths have less than 20 cages and less than 2 ha. On the other hand, there is a very small number with disproportionately very large-scale operations. Overall, only about 5 % of fish cage operators control 20 % of the fish cage area in Lake Sebu. This also means that these few very big fish cage operators (who are the capital-rich migrants, not the indigenous residents) will be getting 20 % of the potential Ricardian resource rent, which is about PHP9.8–12.2 million (USD189–235 thousand).

Resource rent taxation is generally set at very low rates so as not to discourage resource utilisation for economic gains. In practice, less than 50 % of resource rent is collected by government or regulatory bodies (Land, 2010). In the Philippines where aquaculture is considered a poverty alleviation measure, permit fees per unit of fish farm area are set

Table 4. Distribution of tilapia *Oreochromis niloticus* cage operators in Lake Sebu, by number of fish cages and fish cage area.

Number of fish cages area per operator	
Minimum	2
Maximum	170
Mean	13.44
Standard deviation	14.34
Proportion (%) of fish cage operators with	
less than 10 fish cages	41.56
10–19 fish cages	37.78
20–29 fish cages	12.67
30–39 fish cages	4.00
40–49 fish cages	0.89
50–59 fish cages	1.11
60–69 fish cages	0.44
70–79 fish cages	0.89
80 or more fish cages	0.66
Fish cage area per operator (m ²)	
Minimum	280
Maximum	17,500
Mean	1,511
Standard deviation	1,457
Proportion (%) of fish cage operators with fish cage area of	
less than 1,000 m ²	36.00
1,000–1,999 m ²	42.22
2,000–2,999 m ²	12.89
3,000–3,999 m ²	4.00
4,000–4,999 m ²	1.78
5,000–5,999 m ²	1.11
6,000–6,999 m ²	0.44
7,000–7,999 m ²	0.89
Larger than 8,000 m ²	0.66

Source of data: Office of the Municipal Agriculturist.

at very low rates, and even combined with subsidies (such as free fingerlings and nets). In Lake Sebu, the current system is an annual fish cage permit fee of PHP1.5 (USD0.03) for every square meter of fish cage area (just about a tenth of the excess Ricardian resource rent, which when expressed on a per square meter of fish cage area basis is PHP12.22–15.21 or USD0.24–0.29). The average fish cage operator with 1,511 m² of fish cage area is therefore paying an annual permit fee of PHP2,267 (USD43.76) or effectively only PHP189 (USD3.65) per month.

Table 5 compares the revenues of fish cage operators with different scales of operations. For the bottom group of fish cage operators comprising 42 % of operators, the average number of fish cages is six cages and the average fish cage area is 660 m². The average fish cage operator in the group pays an annual permit fee of PHP990 (USD19.11) (effectively PHP82.50 (USD1.59) per month). With 400 kg of harvest for every fish cage, 1.5 growing seasons in a year and a farm gate price of PHP100 kg⁻¹ (USD1.93) of tilapia, each fish cage operator, on the average, generates gross revenues of PHP360 thousand (USD6,948.47) in a year. After deducting costs of non-primary inputs (fingerlings, feeds and farm construction and maintenance), labour cost and

permit fee, the small-scale fish cage operator will be left with annual net revenues of PHP119 thousand (USD2,296.85) (equivalent to PHP9,918 (USD191.43) per month). If the small-scale fish cage operator is solely dependent on fish farming income, the net revenue is merely subsistence income, which is the rationale behind the low permit fee and subsidies given to fish farmers.

For the top group of fish cage operators (those with 80 or more fish cages) accounting for less than 1 % of operators (currently, there are only three of them), the average number of fish cages is 143 and the average fish cage area is 14,525 m². The average fish cage operator in the group pays an annual permit fee of PHP21,787.50 (USD420.53) (effectively PHP1,815.63 (USD35.04) per month). Nonetheless, the average fish cage operator in the top group generates annual gross revenues of PHP8.58 million (USD165,605.10) and net revenues of PHP3.97 million (USD76,626.13) (equivalent to PHP330,684 (USD6,382.63) per month). The top fish cage operators are clearly big capitalists who do not fit the low resource rent taxation justification but are rather capable of accommodating heavier resource rent taxation.

The comparison between the cases of the bottom and

Table 5. Comparative gross and net revenues of each tilapia *Oreochromis niloticus* cage operator, classified by the scale of operations (in terms of number of cages).^a

Fish cage operator group, by number of fish cages	Average number of fish cages	Average fish cage area	Annual permit fee (PHP1.50 per 1 m ²)	Annual gross revenues	Annual net revenues	Effective monthly net revenues
Less than 10 cages	6	660	990.00	360,000	119,010	9,918
10–19 cages	11	1,263	1,894.50	660,000	268,106	22,342
20–29 cages	23	2,314	3,471.00	1,380,000	626,529	52,211
30–39 cages	33	3,296	4,944.00	1,980,000	865,056	72,088
40–49 cages	43	4,403	6,604.50	2,580,000	1,163,396	96,950
50–59 cages	50	5,192	7,788.00	3,000,000	1,372,212	114,351
60–69 cages	60	6,150	9,225.00	3,600,000	1,670,775	139,231
70–79 cages	71	7,125	10,687.50	4,260,000	1,939,313	161,609
80 cages and more	143	14,525	21,787.50	8,580,000	3,968,213	330,684

^aAverage exchange rate (2019): USD1.0 = PHP51.81.

top groups and across all groups of fish cage operators warrants a progressive permit fee schedule. This may be a viable way for the local government to collect some of the Ricardian resource rent to fund lake rehabilitation and preservation programs without disadvantaging the small, subsistence fish cage operators for which poverty-alleviating aquaculture programs of the government are dedicated.

The bottom group may be spared of an additional permit fee initially, and just a fraction of the Ricardian rent may be initially collected from the upper groups of fish cage operators. But the rates may be gradually adjusted upwards as rehabilitation and preservation efforts funded by the collection of Ricardian rent gradually increases the productivity and profitability of fish farms until the maximum potential resource rent is realised.

Conclusion

Lake Sebu presents an example of the need to utilise resource rent to sustainably manage fishery resources and realise the poverty alleviation potential of aquaculture. The findings from this research yield three implications for aquaculture policy and program development.

First, part of the Ricardian resource rent of tilapia farm operators may be collected to generate funds for necessary water resources quality preservation programs such as: (1) training seminars on sustainable aquaculture practices, (2) enforcement of zoning and farm area limits, and stocking and feeding standards, (3) regulation of agricultural, residential and commercial activities that contribute to water pollution, and (4) construction of sewage collection and treatment facilities.

Second, the Ricardian rent may be collected in the

form of a progressive permit fee structure to address poverty and equity issues. A higher rate can be collected from large-scale fish farm operators who are reaping greater Ricardian rent while subsistence fish farmers may be charged a much lower rate so that aquaculture's poverty-alleviating impact among low-income rural fishing households is not negated.

Finally, there is a need to explain resource rent taxation to all stakeholders within the frame of environmental policy and management (Bardwell, 1991). Compliance of the resource rent earners can be realised only when they have a proper understanding of the source of the rent and the need for allocating part of the rent to support programs to preserve the natural assets. Fish farm operators must realise that without appropriate programs and policies, resource rent only dissipates.

Acknowledgements

This study was undertaken with a research grant from the Philippine Commission on Higher Education. Research assistance of Ms. Marilyn Palanca, Mr. Gerome Vedeja and Ms. Kristine Alloro, and the enthusiastic participation of KII, FGD and survey participants are also gratefully acknowledged.

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