Contribution of Freshwater Aquaculture in Supporting the Economy of Pangandaran Regency

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Authors' contributions

This work was carried out in collaboration among all authors. Author SS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AN, J managed the analyses of the study. Author AAH managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This research aims to determine the superior fish commodities and the contribution of freshwater aquaculture in the last five years in Pangandaran Regency. This research was in form of case study. The sampling technique used was purposive sampling or the selection of respondents deliberately (not randomly) as a sampling method. The result of the study were analyzed by Location Quotient (LQ) analysis techniques, value weighting analysis and Shift Share (SS) analysis based on income. The result showed that the superior fish commodity in Pangandaran were *Barbonymus gonionotus*, *Osphronemus goramy* and Giant freshwater prawn. The most freshwater culture fisheries contribution in Pangandaran over 5 years period analysis (2014-2018) was in 2014 reaching 0.92% to Gross Regional Domestic Product (GRDP).

1. INTRODUCTION

The fisheries sector has an important meaning in supporting the food security chain, where the world's protein needs can be met by fisheries resources, both from capture fisheries and aquaculture [1]. Aquaculture is an important part of the development of the fisheries sector in

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Indonesia which contributes to the national level food security, job creation and state income. At present the aquaculture sector has a large influence on the economic development of rural areas [2]. The economic value of the marine and fisheries sector reached 1.2 trillion dollars per year or around 7.5 times the 2014 state budget and 1.2 times the country's GDP with a potential employment of more than 50 million people. Estimates of the amount of land for fish farming are more than 1.22 million hectares with the potential for fish fisheries around 10 million tons per year [3].

Besides producing ponds and marine fish culture, Pangandaran Regency also produces fresh fish culture mainly from pond water, swift water ponds and floating net ponds [4]. The Pangandaran community explores the potential of brackish water by building fishponds. The potential of freshwater fisheries is still carried out by cultivating freshwater fish cultivation which even has a very large area compared to pond fisheries business.

The fisheries sector can have an impact on economic activity in various regions [5]. The impact at the regional level is in the form of contributions to GRDP [6]. Besides that, it is also important to know the superior commodities in Pangandaran Regency. These superior commodities make two contributions in the form of direct effects that can make an increase in the income of regional production factors and regional income as well as for local industrial production [7].

This research aimed to determine the leading commodity in freshwater aquaculture in Pangandaran Regency; analyze the contribution of freshwater aquaculture in Pangandaran Regency. This is done to determine the role of freshwater aquaculture in supporting the economy in Pangandaran Regency.

2. MATERIALS AND METHODS

The method used in this research is case study. The study was conducted in Pangandaran Regency is October - December 2019. Pangandaran Regency is regency in the Province West Java with the capital of the Regency located in the District of Parigi. Pangandaran Regency with a total area of +/- 1.010 km^2, was formed based on Law Number 21 of 2012 concerning Establishment of Pangandaran Regency in West Java Province [8]. Based on its astronomical location, Pangandaran Regency is located at 108°8´0" up to 108°50´0" East Longitude and 7°24´0" up to 7°54´20" Latitude South. Administratively, there are 10 district in Pangandaran Regency namely Parigi, Cijulang, Cimerak, Cigugur, Langkaplancar, Mangunjaya, Padaherang, Kalipucang, Pangandaran and Sidamulih [9].

The data collection method used in this study was the purposive sampling method. This study uses two data sources, namely primary data and secondary data. Primary data sources were obtained from the results of direct interviews with relevant agencies namely the Office of Maritime Affairs and Fisheries of West Java Province, the Office of Maritime Affairs of Fisheries and Food Security of Pangandaran Regency, the Regional Development Planning Board of Pangandaran Regency and the Central Statistics Agency of Ciamis Regency. Secondary data was obtained from research results, reports or other documents. Data analysis techniques used in this study are by using Location Quotient (LQ) analysis techniques and Shift Share analysis.

Location Quotient (LQ) Main Commodity

To find out superior commodities in freshwater aquaculture in Pangandaran Regency using the LQ formula with superior production data of fish commodities. The LQ analysis was formulated as follows [10]:

$$LQ = \frac{pi\,/\,pt}{PI\,/\,PT}$$

Information:

LQ = Location Quotient
Pi = Production of types of fish commodities at the Regency level (tons)
Pt = Production of all types of fish commodities at provincial level (tons)
PI = Provincial type of fish commodity production (tons)
PT = Production of all fish commodities at Provincial level (tons)
Measurement Criteria
LQ> 1 = Sector or commodity is a base sector
(superior)
LQ <1 = Sector or commodity is a non-base sector (not superior)

Approach to the concentration of freshwater aquaculture production with LQ is divided into 2 groups. Each group consists of 3 criteria and 2

criteria. The first group is seen from the value of the LQ calculation itself, namely centralized (LQ> 1), approaching centered (LQ = 0.80 to 0.99) and not centralized (LQ <1).

Based on the sum of the two weight values, then calculate the width of the class by reducing the value of the highest total weight subtracing the lowest weight value, then it is given the number of classes, namely (18-6) / 3. Determine the class interval limit by knowing the upper and lower limits. The leading commodity class limit is> 12, the neutral commodity has a class limit of 9-12 and for non-leading commodity the class limit is 6-9. Leading commodities become priority for development of freshwater aquaculture production in Pangandaran Regency.

Location Quotient (LQ) Aquaculture

This analysis is used to determine the role of freshwater aquaculture in supporting development in certain areas. Systematically LQ analysis can be written as follows [11]:

$$LQ = \frac{vi \,/\, vk}{Vi \,/\, Vk}$$

Information:

vi = Freshwater aquaculture income at Pangandaran Regency level (Rp)
vk = total income of Pangandaran Regency (Rp)
Vi = Revenue from freshwater aquaculture at the
level of West Java Province (Rp)
Vt = West Java Province total income (Rp)
Analysis of Fisheries Contribution Using Share of GRDP Pangandaran Regency

Shift Share analysis is one of the quantitative techniques commonly used to analyze changes in the regional economic structure relative to the structure of administrative regions [12]. This analysis is based on the share of fisheries to the Gross Regional Domestic Product (GRDP) of Pangandaran Regency expressed by the following formula [13]:

$$Z = \frac{X1}{Y1} \times 100$$

Information:

Z = The amount of contribution in year i
X1 = Total fishery income in year i
Y1 = Total GRDP in year i

3. RESULTS AND DISCUSSION

3.1 Location Quotient of Freshwater Aquaculture

To determine the role of freshwater aquaculture in the economy aspect of Pangandaran Regency, it can be seen through the calculation of LQ and freshwater aquaculture to fishery income in Pangandaran Regency. The total value of LQ calculation results of freshwater aquaculture to fishery income in Pangandaran Regency can be seen in Table 1.

Based on Table 1 it can be seen that the role of freshwater aquaculture in Pangandaran Regency is a non-base sector in the economic development of Pangandaran Regency. It can be said that for a period of 5 years, which is from 2014 to 2018, freshwater aquaculture has not been able to export to other regions.

Based on Fig. 1 it can be seen that the LQ total value in each year for a period of 5 years has decreased the amount of production. The highest LQ total value in 2014 was 0.75 and the lowest LQ total value in 2015 was 0.04. Thus, freshwater aquaculture in Pangandaran Regency is a non-base activity, so that freshwater aquaculture cannot export to outside the region.

Table 1. Value location quotient of freshwater aquaculture fisheries in Pangandaran Regency Year 2014 – 2018

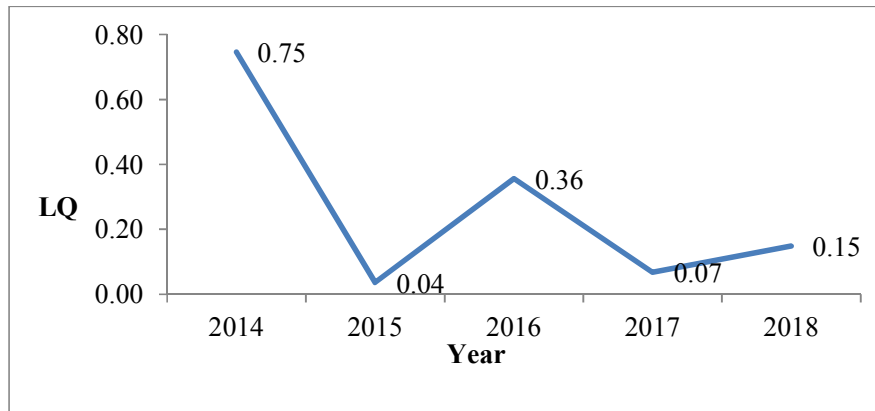| Year	vi Million Rupiah	vt Million Rupiah	Pi Million Rupiah	Pt Million Rupiah	LQ Location Quotient	Information (B/NB)
2014	55,255.17	161,560.65	10,054,070.25	21,945,879.18	0.75	NB
2015	805.00	83,786.86	4,945,554.45	18,409,119.19	0.04	NB
2016	9,494.50	48,500.95	35,080,036.54	63,841,399.00	0.36	NB
2017	3,161.32	79,766.92	28,775,767.30	49,208,802.00	0.07	NB
2018	3,160.15	80,926.46	8,014,161.03	30,466,992.58	0.15	NB

Fig. 1. LQ value of freshwater aquaculture in Pangandaran Regency Year 2014 – 2018

Tabel 2. LQ of freshwater aquaculture for GRDP in Pangandaran Regency in 2014 – 2018

Year	vi Million Rupiah	Vk Million Rupiah	Pi Million Rupiah	Pk Million Rupiah	LQ (Location Quotient)	Information (B/NB)
2014	55,255.17	5,973,548.76	10,054,070.25	1,149,216,060.00	1.06	B
2015	805.00	6,271,096.21	4,945,554.45	1,207,332,340.00	0.03	NB
2016	9,494.50	6,602,732.97	35,080,036.54	1,275,619,240.00	0.05	NB
2017	3,161.32	6,939,636.80	28,775,767.30	1,343,864,430.00	0.02	NB
2018	3,160.15	7,315,303.90	8,014,161.03	1,419,689,120.00	0.08	NB

Tabel 3. Contribution of freshwater aquaculture to GRDP Pangandaran Regency in 2014 – 2018

No	Year	Freshwater Aquaculture Revenues(000 Rupiah)	Total Regency Revenue (000 Rupiah)	Contribution
1	2014	55,255,170.00	5,973,548,760.00	0.92%
2	2015	805,000.00	6,271,096,210.00	0.01%
3	2016	9,494,495.00	6,602,732,970.00	0.14%
4	2017	3,161,320.00	6,939,636,800.00	0.05%
5	2018	3,160,149.00	7,315,303,900.00	0.04%

Tabel 4. Production of freshwater aquaculture by type of fish in 2014 – 2018

No	Commodity	Production (tons)				
		2014	2015	2016	2017	2018
1	*Cyprinuscarpio*	151.24	2	40.42	4.72	3.73
2	*Barbonymusgonionotus*	101.07	1	43.89	3.78	3.71
3	*Oreochromisniloticus*	1,037.48	9	109.73	34.46	24.76
4	*Osphronemusgoramy*	332.64	4	153.62	37	15.17
5	*Giant freshwater prawn*	18.44	1	8.78	1.46	14.25
6	*Pangasius*	38.11	2	10.33	0.117	1.1
7	*Clarias*	22.91	22.19	19.41	22.77	24.41
8	*Other fish*	1,116.78	8	18.49	6.32	2.47
	Amount	2,818.67	27	404.67	110.627	89.6

3.2 Location Quotient of Freshwater Aquaculture Based on GDRP Indicators

The role of freshwater aquaculture in the economy aspect of Pangandaran Regency can be known through the calculation of Location Quotient (LQ) with freshwater aquaculture for all sectors in Pangandaran Regency. The total value of LQ calculation results of freshwater aquaculture to fishery income in Pangandaran Regency can be seen in Table 2.

Based on the above table it can be seen that the Pangandaran Regency freshwater aquaculture in 2014 is included the base sector of the economy
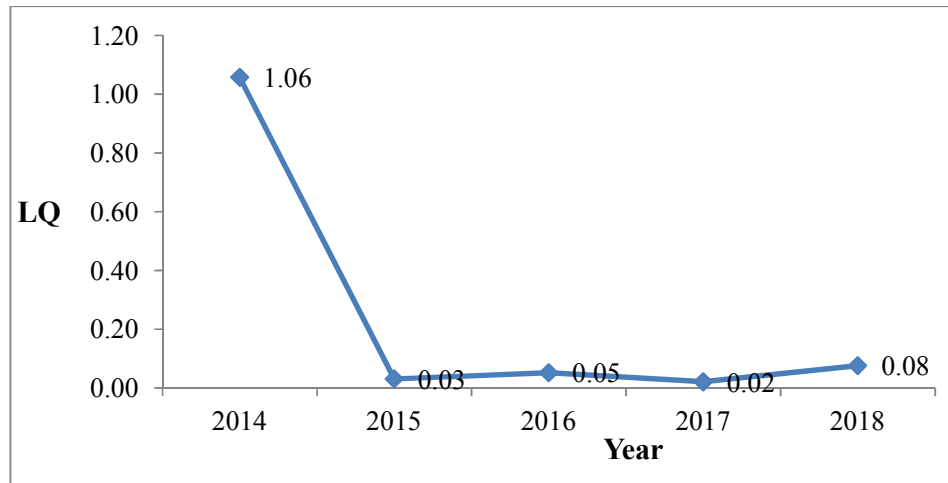
Fig. 2. LQ of freshwater aquaculture in Pangandaran Regency against GDRP Year 2014-2018

Tabel 5. LQ Calculation results for freshwater aquaculture commodities Pangandaran Regency in 2014 – 2018

No	Commodity	Production (tons)					
		2014	2015	2016	2017	2018	Average
1	*Cyprinus carpio*	0.33	0.17	0.43	0.42	0.16	0.30
2	*Barbonymus gonionotus*	4.77	2.40	11.70	5.05	3.37	5.46
3	*Oreochromis niloticus*	2.06	0.74	1.16	0.86	0.92	1.15
4	*Osphronemus goramy*	5.81	2.94	12.24	3.70	3.03	5.54
5	*Giant freshwater prawn*	22.98	58.52	39.09	6.98	63.32	38.16
6	*Pangasius*	0.73	1.58	1.13	0.02	0.47	0.79
7	*Clarias*	0.04	1.57	0.17	0.63	0.89	0.66

Tabel 6. LQ Total weight assessment in Pangandaran Regency 2014 – 2018

No	Year	The Weight Values is LQ					Trend	Total	Commodity
	Type of Fish	2014	2015	2016	2017	2018	Weight Value	Weight	
1	*Cyprinuscarpio*	1	1	1	1	1	1	6	Non Superior
2	*Barbonymusgonionotus*	3	3	3	3	3	2	17	Superior
3	*Oreochromisniloticus*	3	1	3	1	1	1	10	Neutral
4	*Osphronemusgoramy*	3	3	3	3	3	1	16	Superior
5	*Giant freshwater prawn*	3	3	3	3	3	3	18	Superior
6	*Pangasius*	1	3	3	1	1	1	10	Neutral
7	*Clarias*	1	3	1	1	1	3	10	Neutral

of Pangandaran Regency. This is because in 2014, the results of calculations that showed more than 1 LQ value calculated within a period of 5 years which is from 2014 - 2018. Declining LQ values can be seen in Fig. 2.

Based on Fig. 2 it's known that there are differences in LQ values in a period of 5 years. The highest LQ value in 2014 was 1.06 and the lowest LQ value in 2017 was 0.02. This is shown from the results of LQ calculations from 2014 - 2018. LQ values of more than 1 indicate that freshwater aquaculture in 2014 is a basic sector

of the economy of Pangandaran Regency besides having high competitiveness cause of addition to being able to meet the needs of the region itself, it can also export its products outside the region.

3.3 The Contribution of Freshwater Aquaculture (Shift Share Analysis)

Shift Share Analysis is used to illustrate the contribution of a sector to Gross Regional Domestic Product (GRDP). To find out the process of economic growth in a region by using

Shift Share analysis, important variables such as regional income are used. In this study used the variable income of freshwater aquaculture in PangandaranRegency and total income (GRDP) to describe the economic growth of PangandaranRegency.

Based on Table 3 it can be seen that the contribution of freshwater aquaculture to the total GRDP from 2014 - 2018 has fluctuated from year to year, the occurrence of these fluctuations is likely due to freshwater aquaculture business activities carried out by the community began to decrease. Beside that, the freshwater aquaculture in Pangandaran District is still in the process of development related to the large amount of land and most of the fishery activities in Pangandaran District are more in capture fisheries. The largest contribution of freshwater aquaculture occurred in 2014 amounted to 0.92% while the lowest contribution occurred in 2015 with a value of 0.01%. In 2016 there was an increase of 0.13% from the previous year, which is in 2015. The increase was caused by the value of freshwater aquaculture revenues in 2016 has increased.

3.4 Leading Commodity of Freshwater Aquaculture

Production of freshwater aquaculture in Pangandaran District is divided into 8 types of commodities, which are: 1) Mas, 2) Tawes, 3) Nila, 4) Gurame, 5) Giant Prawns, 6) Patin, 7) Catfish, 8) The Other Fish. Table 4 shows that the production of freshwater aquaculture in Pangandaran District has increased and decreased each year. The highest amount of production was in 2014 amounted to 2,818.67 tons and the lowest amount of production was in 2016 amounted to 404.67 tons.

Criteria for calculating Location Quotient (LQ) produce 3 criteria, which is LQ> 1; it means that the commodity is the basis or becomes a source of growth. Commodities have a comparative advantage, the results can not only meet the needs of the region concerned but can also be exported outside the region. LQ = 1; it means that the commodity is classified as non-base, has no comparative advantage. Its production is only sufficient to meet the needs of the region itself and cannot afford to be exported. LQ <1; it means that this commodity is also non-base [14]. Commodity production in an area cannot meet its own needs so it needs to be supplied or imported from outside.

Based on the LQ calculation results in Table 5, giant prawns have the highest LQ value in a period of 5 years compared to the other fish commodities, which is in 2014 amounted to 22.98; in 2015 amounted to 58.52; in 2016 amounted to 39.09; in 2017 of 6.98; in 2018 it was 6.98 and in 2018 it was 63.32. LQ value for freshwater aquaculture commodities in PangandaranRegency has an average LQ value as follows: carp (0.30); Tawes (5.46); tilapia (1.15); carp (5.54); giant prawns (38.16); catfish (0.79); catfish (0.66). LQ value of more than one (LQ> 1) means that it allows the export of these fish species to other regions so as to increase the income of the Pangandaran Regency. LQ value is less than one (LQ <1), Pangandaran Regency must supply these types of fish from other regions. The dominant types of fish have a LQ value of more than 1 that occurred in the period of 5 years from 2014 to 2018. The types of fish include tawes, carp and giant prawns. The three types of fish have a LQ value of more than one which means they are able to export their products outside the Pangandaran Regency.

To determine the freshwater aquaculture commodity in Pangandaran Regency, further analysis of the LQ value is used, which is the value weighting technique. Based on the results of previous studies, that the calculation of LQ for determining superior commodities, LQ weight values and trend weight values can be determined [15]. Provisions for the LQ weight value are, if the LQ value> 1 then it is given a weight of 3; if the value 0.8 ≤ LQ ≤ 0.99 is given a weight of 2 and if LQ <0.8 is given a weighting 1. Provisions for the trend value ie if the trend has increased then given a weight of 3; if the trend is fixed then given a weight of 2 and if the trend has decreased then given a weight of 1.

Based on Table 6 on weighting the LQ value, it shows that there are leading commodities, neutral commodities and non-leading commodities by determining the class interval of the number of fish species. Class interval for leading commodities value ≥ 12, for neutral commodities value 9-12, whereas for non-superior commodities the value ranges are 6-9. Based on the value of the predetermined interval the fish included in the leading commodity consists of 3 types of fish namely fish Tawes, carp and prawns.

4. CONCLUSION

Based on the findings of the present study, it could be concluded that:

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- The contribution of freshwater aquaculture in Pangandaran Regency from 2014 to 2018 to the largest Gross Regional Domestic Product (GRDP) occurred in 2014 with percentage index 0.92%.
- Leading commodity of freshwater aquaculture in Pangandaran Regency includes 3 types of fish, which is tawes, carp and giant prawns. It has a value that more than 1 LQ (LQ> 1) and produces the highest weight value.
- The role of freshwater aquaculture in order to support the economy of Pangandaran Regency is included in non-base activities because the LQ value is less than one (LQ <1). This proved that freshwater aquaculture has not been able to meet consumption in its own area and have to import the commodities from the other regions.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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