Analysis of the Competitiveness of Floating Net Cage Aquaculture in Indonesia

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Abstract

The purpose of this study is to analyze the competitiveness profile of floating net cage aquaculture in Indonesia. The research was conducted in February – June 2021 at the Directorate General of Aquaculture, Ministry of Marine Affairs and Fisheries of the Republic of Indonesia. The data collection method used in this study is the literature survey method. Primary data in the form of questionnaires with expert judgment respondents as many as 13 people consisting of 11 Lecturers of the Faculty of Fisheries and Marine Sciences, Padjadjaran University, and 2 employees of the Directorate General of Aquaculture, Ministry of Marine Affairs and Fisheries of the Republic of Indonesia regarding the proportion of competitiveness of floating net cage aquaculture fisheries. Secondary data in the form of statistical data on floating net cage aquaculture in 2017 was obtained from the Directorate General of Aquaculture, Ministry of Marine Affairs and Fisheries of the Republic of Indonesia. Data analysis was carried out by using quantitative descriptive analysis. The results showed that Central Java Province which was supported by facilities and infrastructure variables, West Java Province which was supported by human resources and production variables, and North Sulawesi Province which was supported by science and technology variables were in the top three with very high competitiveness category, while the Riau Islands Province and the Bangka Belitung Islands Province are in the bottom two ranks with the low competitiveness category.

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1. INTRODUCTION

Indonesia is a country located between two continents, Asia and Australia, as well as two oceans, the Indian and Pacific [1], with a coastline of ± 99.123 km and a total area of 6.315.222 km² of Indonesian waters [2], and consists of 34 provinces [3]. Indonesia has numerous natural resources, particularly fisheries, based on its geographic location. Capture fisheries, aquaculture (marine and freshwater), and marine biotechnology are all part of Indonesia's fisheries sector [4]. Floating net cages are a form of freshwater aquaculture.

Floating net cages are fish rearing places made of net material that can cause water to enter and leave freely so that water exchange occurs from the cage to the surrounding waters [5]. The production of a freshwater floating net cage in Indonesia has increased rapidly, where the total production in 2003 was 57.628 tons and in 2017 it was 353.748 tons [6]. Aquaculture activities in floating net cages have the potential to increase people's income, expand job opportunities, and business opportunities as well as foreign exchange-earners [7].

Competitiveness is the power to strive to be superior in certain respects, whether in individuals, groups, institutions, or regions [8], while provincial competitiveness is a province that has the ability compared to other provinces in setting strategies to improve people's welfare [9]. Competitiveness in the field of floating net cage aquaculture can be used as a benchmark for development in creating economic productivity, job creation, and regional income.

Competitiveness is one of the criteria in determining the success and achievement of a better goal by a country in increasing income and economic growth which can be seen from the aspect of freshwater aquaculture, namely floating net cages. In addition, with the trend of decentralization, there will be a stronger need to know competitiveness at the provincial level [10].

2. MATERIALS AND METHODS

2.1 Time and Place

The research was carried out for five months, from February to June 2021 at the Directorate General of Aquaculture, Ministry of Marine Affairs and Fisheries of the Republic of Indonesia to determine the competitiveness profile of floating net cage aquaculture in Indonesia.

2.2 Types and Data Sources

The data collection method used in this study is a literature survey. The data in this study was made up of both primary and secondary sources. Secondary data is data consisting of four variables, namely human resources consisting of the number of fishery and cultivating households, facilities and infrastructure variables consisting of the amount of feed and land area, and production variables consisting of the amount of production and production value obtained from Directorate General of Aquaculture, Ministry of Marine Affairs and Fisheries of the Republic of Indonesia in 2017, as well as science and technology variables consisting of productivity obtained from the calculation results.

Primary data is data obtained from an expert judgment questionnaire of 13 people consisting of four lecturers from the Department of Social Economics, Faculty of Fisheries and Marine Sciences, Padjadjaran University, seven lecturers from the Department of Aquaculture, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, and two employees of the Directorate General. Aquaculture Ministry of Marine Affairs and Fisheries of the Republic of Indonesia.

2.3 Data Analysis Methods

Data analysis was carried out by using quantitative descriptive analysis which included an analysis of the competitiveness profile to obtain a competitive profile of floating net cage aquaculture in Indonesia.

2.3.1 Competitiveness profile analysis

The stages of analysis of the competitiveness profile of floating net cage aquaculture in Indonesia are as follows:

1. Determine the variables and sub-variables that support the activities of floating net cages, namely human resources, facilities and infrastructure, production, and science and technology.
2. Collecting data on floating net cage aquaculture fisheries in Indonesia in 2017.
3. Identify priority weights or relative importance between variables, sub-variables, and indicators using a likert scale with 9 points which are contained in the questionnaire and filled in by expert judgement.

4. Collecting primary data in the form of expert judgement that gives weight to variables and sub-variables, 13 experts who became respondents consisting of four lecturers from the Department of Social Economics, Faculty of Fisheries and Marine Sciences, Padjadjaran University, seven aquaculture lecturers, Faculty of Fisheries and Marine Sciences, University of Padjadjaran, and two employees of the Directorate General of Aquaculture, Ministry of Marine Affairs and Fisheries of the Republic of Indonesia.

5. Calculate the weight of the results of the expert judgment questionnaire on each variable, sub-variable, and indicator.

6. Processing the data that has been obtained using secondary data, namely statistical data on floating net cage aquaculture in Indonesia to determine the competitiveness profile of each province.

Productivity is obtained from the calculation of statistical data on floating net cage aquaculture. Here is the formula to get productivity [11]:

a. Production Productivity divided by Land Area

The calculation of production productivity divided by land area is as follows [11]:

\[
P_{pt} = \frac{P_{ik}}{T_{ik}}
\]

Description:

\(P_{pt}\) : Production Productivity divided by Land Area (tons/m\(^2\))
\(P\) : Total Production (tons)
\(T\) : Total Land Area (m\(^2\))
\(i\) : Province i (i = 1, ..., 34)
\(k\) : Time Period (years)

b. Production Productivity divided by Cultivators

The calculation of production productivity divided by cultivators is as follows [11]:

\[
P_{pn} = \frac{P_{ik}}{N_{ik}}
\]

Description:

\(P_{pn}\) : Production Productivity divided by Cultivator (tons/person)
\(P\) : Total Production (tons)
\(N\) : Number of Cultivators (person)
\(i\) : Province i (i = 1, ..., 34)
\(k\) : Time Period (years)

c. Productivity Production Value divided by Land Area

The calculation of the productivity of the production value divided by the area of land is as follows [11]:

\[
P_{npt} = \frac{NP_{ik}}{T_{ik}}
\]

Description:

\(P_{npt}\) : Productivity of Production Value divided by Land Area (rupiah/m\(^2\))
\(NP\) : Production Value (rupiah)
\(T\) : Total Land Area (m\(^2\))
\(i\) : Province i (i = 1, ..., 34)
\(k\) : Time Period (years)

d. Productivity Production Value divided by Cultivators

The calculation of the productivity of the production value divided by the cultivators is as follows [11]:

\[
P_{npn} = \frac{NP_{ik}}{N_{ik}}
\]

Description:

\(P_{npn}\) : Productivity of Production Value divided by Cultivator (rupiah/person)
\(NP\) : Production Value (rupiah)
\(N\) : Number of Cultivators (person)
\(i\) : Province i (i = 1, ..., 34)
\(k\) : Time Period (years)

7. Calculating scores of variables, sub-variables, and indicators from secondary data and calculating values based on weights and scores.

8. To improve the competitiveness of floating net cage aquaculture fisheries among all provinces in Indonesia based on the weighted value.

Determining the competitiveness criteria for floating net cage aquaculture in all provinces.
using quartiles, where the competitiveness profile is divided into four categories, namely Q1 means it has very high competitiveness, Q2 means it has high competitiveness, Q3 means it has sufficient competitiveness, and Q4 means it has low competitiveness.

3. RESULTS AND DISCUSSION

The competitiveness profile of floating net cage aquaculture is obtained from the final value of the variables consisting of human resources, facilities and infrastructure, production, as well as science and technology in each province. The final score will describe the ranking and category of competitiveness of the provinces in Indonesia, but some provinces are not included in the rankings or quartiles because there is no data for that province (Table 1).

Central Java Province is in first place with a final score of 20.62 (Table 1). Central Java Province is in the first quartile (Q1) which means it has a very high level of competitiveness. The first and quartile province, Central Java, is driven by one of the variables, facilities and infrastructure, which has a value of 12.54, which is greater than the other provinces. The variables of facilities and infrastructure consist of the amount of feed and land area. Central Java Province has a large aquaculture potential and can improve people’s welfare [12]. One example is in the Kedung Ombo Reservoir, where people who work as farmers switched professions to cultivating floating net cages after the reservoir operated in 1991 and in 2017 the number of floating net cages was 3.781 units but the number of floating net cages allowed was only 1.134 plots, so not to exceed the carrying capacity of the waters of the Kedung Ombo Reservoir [13].

West Java Province is in second place with a final score of 20.07 (Table 1). West Java Province is in the first quartile (Q1) which means it has a very high level of competitiveness. Human resources, with a value of 5.87, and production, with a value of 7.53, lead West Java Province to second place and the first quartile. The human resource variable consists of the number of fishery and cultivating households, and the production variable consists of the total production and production value. The population of West Java Province who works in the fishery sector in 2007 – 2011 always increases [14]. In addition, it can be seen that in 2012 the Province of West Java was recorded in the Book of Marine and Fisheries Statistics, which contributed to the production of 43% of the total fish production in KJA aquaculture in Indonesia [15].

North Sulawesi Province is in third place with a final score of 10.86 (Table 1). North Sulawesi Province is in the first quartile (Q1) which means it has a very high level of competitiveness. North Sulawesi Province, which is ranked third and in the first quartile, is influenced by one of the factors, science and technology, which has a value of 5.40. Aquaculture activities in floating net cages have experienced rapid development, both in terms of business scale and the number of cultivators involved [16]. One example is in Lake Tondano, where floating net cage aquaculture activities have been carried out since 1984 and production in 2003 reached 16.576 tons/year [17].

Riau Islands Province is ranked 27th with a final score of 0.00155 (Table 1). Riau Islands Province is in the fourth quartile (Q4) which means it has a low level of competitiveness. Because the Riau Islands Province has flaws in all variables, including human resources, facilities and infrastructure, production, and science and technology, this is the case. In addition, it can also be caused by the dominant community carrying out marine aquaculture activities because it has the highest amount of production compared to other aquaculture production, which is 72.553 tons, where marine aquaculture consists of marine cage cultivation with a production of 60.008 tons and seaweed cultivation as much as 12.545 tons. then followed by pond cultivation with a production of 22.589 tons in 2017 [6]. This is supported by the Department of Maritime Affairs and Fisheries of the Riau Islands Province that the Riau Islands Province has a sea area of 24.121.530 Ha (95.79%) and a land area of 1.059.511 Ha (4.21%) which has a very high potential for aquaculture, especially in marine aquaculture (mariculture) [18], and in the 2017 Statistical Information Book it is noted that there are no lakes/situ in the Riau Islands Province and only has 1 dam/reservoir [3].

Bangka Belitung Islands Province is ranked 28th with a final score of 0.00014 (Table 1). The Province of the Bangka Belitung Islands is in the fourth quartile (Q4) which means it has a low level of competitiveness. All variables, including human resources, facilities and infrastructure, production, and science and technology, are deficient in the Province of the Bangka Belitung Islands. This can be caused by water pollution
originating from tin mining waste such as tailings in the form of sand materials containing heavy metals such as Cu (Copper) and Zn (Zinc) which can accumulate in fish bodies, for example in the Baturasa River, Kabupaten Baturasa. Bangka [19]. In addition, it can also be caused by people who carry out more aquaculture activities in ponds and ponds although the amount of production produced is not very high, the amount of production in the two cultivations is 1.421 tons and 1.141 tons respectively in 2017 [6], and This can be caused by the dominance of marine capture fisheries activities which reached a production of 217,959.17 tons in 2017 [20].

The provinces of DKI Jakarta, East Nusa Tenggara, North Kalimantan, West Sulawesi, Southeast Sulawesi, and Maluku are not included in the ranking or quartiles because there is no data for these provinces (Table 1).

| Province              | X₁  | X₂  | X₃  | X₄  | Final Score | Ranking | Competitiveness Category |
|-----------------------|-----|-----|-----|-----|-------------|---------|-------------------------|
| Central Java          | 3.41| 12.54| 3.77| 0.91| 20.62       | 1       | Very High               |
| West Java             | 5.87| 6.07| 7.53| 0.60| 20.07       | 2       |                         |
| North Sulawesi        | 0.58| 0.13| 4.76| 5.40| 10.86       | 3       |                         |
| West Sumatera         | 2.40| 0.47| 2.55| 1.06| 6.47        | 4       |                         |
| Jambi                 | 3.09| 0.10| 0.88| 0.69| 4.76        | 5       |                         |
| East Java             | 1.84| 1.61| 0.77| 0.34| 4.56        | 6       |                         |
| Papua                 | 0.13| 0.00| 0.18| 4.23| 4.55        | 7       |                         |
| Lampung               | 0.38| 2.22| 0.53| 0.97| 4.11        | 8       | High                    |
| North Sumatera        | 2.38| 0.43| 0.82| 0.26| 3.90        | 9       |                         |
| Riau                  | 0.66| 0.04| 1.05| 2.10| 3.86        | 10      |                         |
| Gorontalo             | 0.30| 0.15| 0.62| 1.65| 2.72        | 11      |                         |
| South Kalimantan      | 0.35| 0.22| 0.54| 1.54| 2.65        | 12      |                         |
| West Kalimantan       | 1.57| 0.14| 0.40| 0.37| 2.47        | 13      |                         |
| Bali                  | 0.23| 0.06| 0.27| 1.10| 1.67        | 14      |                         |
| Bengkulu              | 0.09| 0.05| 0.16| 1.00| 1.29        | 15      | Sufficient              |
| Banten                | 0.20| 0.01| 0.07| 0.87| 1.15        | 16      |                         |
| West Nusa             | 0.57| 0.04| 0.09| 0.20| 0.89        | 17      |                         |
| Tenggara              |     |     |     |     |             |         |                         |
| Central Sulawesi      | 0.04| 0.00| 0.01| 0.73| 0.78        | 18      |                         |
| South Sumatera        | 0.47| 0.01| 0.03| 0.26| 0.77        | 19      |                         |
| Aceh                  | 0.15| 0.01| 0.03| 0.44| 0.63        | 20      |                         |
| Central Kalimantan    | 0.39| 0.05| 0.01| 0.02| 0.47        | 21      |                         |
| West Papua            | 0.00| 0.00| 0.00| 0.37| 0.37        | 22      | Low                     |
| East Kalimantan       | 0.01| 0.00| 0.00| 0.20| 0.22        | 23      |                         |
| North Maluku          | 0.02| 0.05| 0.00| 0.05| 0.12        | 24      |                         |
| South Sulawesi        | 0.00| 0.00| 0.04| 0.00| 0.04        | 25      |                         |
| D. I. Yogyakarta      | 0.01| 0.00| 0.00| 0.00| 0.01        | 26      |                         |
| Riau Islands          | 0.00| 0.00| 0.00| 0.00| 0.00        | 27      |                         |
| Bangka Belitung Islands | 0.00| 0.00| 0.00| 0.00| 0.00        | 28      |                         |
| DKI Jakarta           | 0.00| 0.00| 0.00| 0.00| 0.00        | -       |                         |
| East Nusa Tenggara    | 0.00| 0.00| 0.00| 0.00| 0.00        | -       |                         |
| North Kalimantan      | 0.00| 0.00| 0.00| 0.00| 0.00        | -       |                         |
| West Sulawesi         | 0.00| 0.00| 0.00| 0.00| 0.00        | -       |                         |
| Southeast Sulawesi    | 0.00| 0.00| 0.00| 0.00| 0.00        | -       |                         |
| Maluku                | 0.00| 0.00| 0.00| 0.00| 0.00        | -       |                         |

X₁ : human resources. X₂ : facilities and infrastructure. X₃ : production. X₄ : science and technology.
4. CONCLUSION

The provinces of Central Java, West Java, and North Sulawesi are in the top three ranks which are included in the very high competitiveness category with a final score of 20.62 each; 20.07; and 10.86. Central Java province ranks first, which is supported by the variables of facilities and infrastructure. West Java Province ranks second, which is supported by the variables of human resources and production. North Sulawesi Province ranks third, which is supported by the variables of science and technology. Meanwhile, the Provinces of the Riau Islands and Bangka Belitung Islands are in the bottom two ranks which are included in the category of low competitiveness with final scores of 0.00155 and 0.00014, respectively. Riau Islands Province is ranked 27th and Bangka Belitung Islands Province is ranked 28th, where both provinces have weaknesses in all variables.

CONSENT

As per international standard or university standard, respondents’ written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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