



Survey Analysis of Ponds Aquaculture Development Trend in West Java Province

**Dhea Tiara Nurmahendra^{1*}, Asep Agus Handaka Suryana¹, Evi Liviaty¹
and Atikah Nurhayati¹**

¹*Department of Fisheries Faculty of Fisheries and Marine Science, Universitas Padjadjaran, Bandung
Sumedang Highway KM 21, Jatinangor 45363, Indonesia.*

Authors' contributions

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

Article Information

DOI: 10.9734/AJFAR/2021/v14i230291

Editor(s):

(1) Dr. Bruno Fiorelini Pereira, Federal University of West of Bahia, Brazil.

Reviewers:

(1) Yasodha Thirumal, India.

(2) Walied Mohamed Abdelwahab Fayed, Alexandria University, Egypt.

Complete Peer review History: <https://www.sdiarticle4.com/review-history/72938>

Original Research Article

Received 05 July 2021
Accepted 04 August 2021
Published 27 August 2021

ABSTRACT

The fishery sector has a strategic role in national development. West Java is one of the areas with the highest fisheries sector because it has abundant fisheries resources and commodities, so that West Java Province is one of the aquaculture sectors in Indonesia. Ponds are a culture medium for freshwater fisheries that dominate most of the production in West Java Province. The purpose of this study is to analyze the development trend of ponds aquaculture competitiveness in the regency/city of West Java Province. The study was conducted in November 2020 – June 2021. The method used was a literature survey to determine the development trend of aquaculture in ponds in West Java Province. The data obtained in the form of primary data and secondary data were analyzed descriptively. Primary data in the form of expert opinions as many as 20 people consisting of nine lecturers from the Faculty of Fisheries and Marine Sciences, Padjadjaran University and 11 employees of the Department of Marine and Fisheries of West Java Province. Secondary data is in the form of aquaculture statistical data in ponds with the main indicators, namely human resources, facilities, infrastructure, production, and Science and Technology with time series data from 2004 – 2019 Department of Marine and Fisheries of West

*Corresponding author: Email: dheatiara9b@gmail.com;

Java Province. The results showed that the trend of fisheries competitiveness in 2004 – 2019 illustrates that the movement of ponds aquaculture development in the regency/city of West Java Province is experiencing fluctuating changes, seen from the development of aquaculture production from year to year experiencing positive changes.

Keywords: Development; West Java; aquaculture in ponds; trends; human resources; facilities; production; science and technology.

1. INTRODUCTION

Economic development is essentially an effort to improve people's welfare. The implementation of economic development is based on a populist economic system and the development of leading sectors, especially those that absorb a lot of manpower, which is supported by increasing the capacity of human resources and technology to strengthen the foundation for sustainable development and increase competitiveness and be oriented towards economic globalization [1].

The fishery sector has a strategic role in national development, because it plays a role in absorbing labor and is a potential activity to utilize the results of fishery resources and can provide high added value for the national economy [2]. West Java is one of the areas with the highest fishery production after East Java. Coastal and ocean areas in West Java Province have abundant fisheries resources and commodities, so that West Java Province is one of the aquaculture sectors in Indonesia [3].

Ponds are a culture medium for freshwater fisheries that dominate most of the production in West Java Province. Pond aquaculture is the largest provider of overall employment due to its high production and productivity [4]. Freshwater aquaculture activities carried out in ponds in West Java Province are one of the sub-sectors that are quite important in producing fishery products. The largest aquaculture production in West Java Province in 2009 – 2013 was goldfish, which was 786,642 tons, which increased every year [5].

Aquaculture in ponds increased by 819,809 tons or 37.9%. The most abundant water potential is the potential for freshwater land with aquaculture production in West Java Province as much as 990,764 tons, with aquaculture production in ponds as much as 333,975 tons. This can indicate that there is still a large potential for pond land to increase cultivation productivity [6].

West Java is an area that has good prospects for the development of fish production, this is

because the West Java area has a fairly high rainfall so that it can trigger fish to breed well. As is known for West Java, fish farming is usually found in Tasikmalaya, Indramayu, Bogor and Ciamis [7]. In addition, Bogor Regency is one of the areas that has developed freshwater aquaculture carried out in ponds [8].

The trend is a movement (tendency) up or down in the long run, which is obtained from the average change over time. On average these changes can increase or decrease. If the average change increases, it is called a positive trend or the trend has an upward trend. Conversely, if the average change decreases it is called a negative trend or a trend that has a downward trend [9]. The trend shows changes in the value of a variable that is relatively stable in population changes, changes in prices, changes in technology, and increased productivity. In addition, there is a trend of decentralization which has led to a stronger need to determine competitiveness at the regional level [10].

2. METHODOLOGY

The research was carried out in November 2020 – June 2021 in Bandung City, West Java Province. This research activity began with the collection of secondary data from the Department of Marine Affairs and Fisheries of West Java Province. The primary data used is the opinion of experts or people who are competent in the field of aquaculture. Secondary data and primary data which have been obtained will then be analyzed by descriptive quantitative.

2.1 Types and Sources of Data

The data used in this research consists of primary data and secondary data. The primary data is in the form of a questionnaire as many as 20 expert judgments or people who are competent in the field of aquaculture consisting of nine lecturers from the Faculty of Fisheries and Marine Sciences, Padjadjaran University and 11 employees of the Department of Marine and

Fisheries of West Java Province. Secondary data consists of seven types of data sourced from the Department of Marine Affairs and Fisheries of West Java Province in the period 2004 to 2019.

2.2 Sampling Technique

The data collection method used in this research is literature survey. The data obtained and used in the form of primary data and secondary data which is realized in the form of numbers and analyzed using descriptive statistics. Secondary data in the form of data on the main indicators of competitiveness of aquaculture ponds in West Java Province which consists of human resources, facilities, facilities and infrastructure, production, as well as Science and Technology. This research uses time series data from 2004 to 2019.

2.3 Data analysis

Data analysis was performed using quantitative descriptive analysis. Quantitative descriptive analysis in this study is intended to get the development trend of ponds aquaculture in the Regency/City of West Java Province. The analytical tool used for the trend of competitiveness development is the development index.

Analysis of ponds aquaculture development trend in the regencies / cities of West Java Province through several stages, as follows:

1. Determine the main indicators and variables including human resources, facilities and infrastructure, production and production value, the application of science and technology for mini aquaculture fisheries, and productivity.
2. The stage of carrying out the research is taking data in the field of pond aquaculture in West Java Province from 2004 to 2019.
3. Identify priority weights or relative importance between indicators, variables, and sub-variables.
4. Taking primary data in the form of expert judgment which gives weight to the main indicators and variables. The experts who became respondents were 20 people consisting of nine lecturers of the Faculty of Fisheries and Marine Sciences, Padjadjaran University and 11 employees of the Department of Marine Affairs and Fisheries of West Java Province.

5. Calculate the weight of the results of the expert judgment of each indicator, variable and sub-variable.
6. Processing data that has been obtained during the study, using secondary data, namely fisheries statistics of West Java Province in 2019 to determine the competitiveness profile of each regency/city.
7. Calculate scores and values of main indicators, variables and sub-variables from secondary data and calculate values based on weights and scores obtained.

$$\text{Score} = \frac{\text{Data each Regency/City}}{\text{Total Province Data}} \times 100$$

$$\text{Value} = \text{Weight} \times \text{score}$$

Ponds aquaculture development index analysis in the Regency / City of West Java Province uses the development index formula used according to the Annual Fisheries Index book by the Province 2006-2009 [11]. The development index calculated is:

- a. Ponds Aquaculture Fisheries Production Development Index

$$IPPi_{jk} = \frac{Q_{ijk}}{Q_{ijkl}} \times 100 \dots\dots\dots (1)$$

Information:

- IPP : Ponds Aquaculture Fisheries Production Development Index
 - Q : Production Volume (tons)
- The types of fish produced are in the hatchery and enlargement stage
- i : Regency i (i = 1, ..., 27)
 - j : Types of Fisheries Classification
 - k : The period time
 - kl : 1 year before a period time

- b. Fisheries Household / Fishing Company Development Index (Labor)

$$IPNi_{jk} = \frac{N_{ijk}}{N_{ijkl}} \times 100 \dots\dots\dots (2)$$

Information:

- IPN : Labor Development Index
 - N : Number of Fish Aquaculture Workers (people)
- i : Regency i (i = 1, ..., 27)
 - j : Types of Fisheries Classification
 - k : The period time

- kl : 1 year before a period time
- c. Aquaculture Facility Development Index
$$IPQF_{ijk} = \frac{Q_{fijk}}{Q_{fijkl}} \times 100 \dots\dots\dots (3)$$

Information:

- IPP : Aquaculture Facility Development Index
- Q : Facility Volume (tons)
- Types of facilities used are milling plots, enlargement plots, and water pumps
- i : Regency i (i = 1, ..., 27)
- j : Types of Fisheries Classification
- k : The period time
- kl : 1 year before a period time

- d. Aquaculture Production Facilities and Infrastructure Development Index
- e.
$$IPQs_{ijk} = \frac{Qs_{ijk}}{Qs_{ijkl}} \times 100 \dots\dots\dots (4)$$

Information:

- IPS : Aquaculture Production Facilities and Infrastructure Development Index
- S : Fisheries Production Facilities and Infrastructure (unit)
- Types of facilities and infrastructure used are fertilizer, feed, and lime
- i : Regency i (i = 1, ..., 27)
- j : Types of Fisheries Classification
- k : The period time
- kl : 1 year before a period time

- f. Aquaculture Area Development Index
$$IPLs_{ijk} = \frac{QL_{ijk}}{QL_{ijkl}} \times 100 \dots\dots\dots (5)$$

Information:

- IPL: Aquaculture Area Development Index
- QL : The volume of fish farming area (ha)
- i : Regency i (i = 1, ..., 27)
- j : Types of Fisheries Classification
- k : The period time
- kl : 1 year before a period time

3. RESULTS AND DISCUSSION

3.1 Geography of Research Location

West Java Province is located at a position of 104°48'- 108°48' East Longitude and 5°50" - 7°20" South Latitude. The area in West Java

Province has a land area of 35,377.76 km² with a coastline of 724.85 km. West Java Province has regional boundaries, namely to the north of the Java Sea and DKI Jakarta, to the west of the Sunda Strait, to the south of the Indonesian Ocean, and to the east of Central Java Province.

West Java Province is divided into 27 regencies/cities, which include 18 regencies and 9 cities. In addition, it consists of 626 sub-districts, 641 ward, and 5,321 villages [12].

West Java has 514 large and small rivers, most of which empty into the Java Sea and partly into the Indian Ocean and the Sunda Strait. The natural conditions in West Java that are suitable for fish cultivation are supported by a long-standing tradition of fish farming in the community. Cultivation in calm water ponds and rice fields has long been known in West Java, then afterwards also developed swift water ponds and floating net cages. So that West Java Province is known to be the largest producer of freshwater aquaculture in Indonesia [13].

3.2 Profile of Aquaculture in Ponds in West Java Province

Aquaculture business carried out in ponds has not been started for a long time, this system only developed around the end of 1970. Freshwater aquaculture activities carried out in ponds in West Java Province are one of the sub-sectors that are quite important in producing fishery products [5]. West Java is also one of the provinces that has the largest area of cultivation, the number of cultivators, and the contribution of freshwater fishery production in Indonesia. Subsistence and commercial aquaculture is a business that has long been known in West Java [14].

West Java is one of the provinces in Indonesia as a producer of fishery production which is quite high at 60% [3]. West Java Province has each area whose geographical conditions support the fisheries sector with different business branches. One area in West Java that is a center for fisheries includes ponds, namely the Regency [15].

In 2019, the total production of aquaculture in ponds in West Java Province reached 592,107,989 tons (Table 1). Bogor Regency gave the largest contribution in pond cultivation in West Java Province with a percentage of 20.50% (121,405 tons). Ciamis Regency ranks

2nd in the total contribution of aquaculture production in ponds with a percentage of 16.31% (96,579,247 tons), and is followed by Indramayu Regency with a percentage of 15.57% (92,192,606 tons). Meanwhile, the area that received the lowest contribution was owned by the City of Cirebon with a percentage of only 0.01% (111,684 tons).

3.3 West Java Province Pond Aquaculture Development Index

Based on the research that has been carried out, the value of the aquaculture trend development index in ponds in West Java Province in the period 2004 to 2019, includes the development index of RTP (Fishing Household) which is included in HR (Human Resources), the development index facility development index, infrastructure development index, production development index, and aquaculture area

development index in ponds in West Java Province [11].

3.4 Human Resource Trends Development Index

The data used in this study is in 16 years from the period 2004-2019. During that period the development of ponds aquaculture fisheries (RTP) in West Java Province was very volatile (Fig. 1).

In the graph above, it can be seen that the City of Sukabumi has a very significant increase and decrease, in 2004 the area had an index of 0 because there were almost no RTP (Fishing Households) in the Sukabumi City area, but then in 2007 experienced a very significant increase with the index value was 10433.3 until it decreased again in 2010 with an index value of 100, then after that it remained stable until 2019.

Table 1. Contribution of aquaculture production in Regency/City Ponds in West Java Province in 2019

No.	Regency/City	Amount of Aquaculture Production in Ponds (tonnes)
1.	Bogor Regency	121.405
2.	Sukabumi Regency	34.566,405
3.	Cianjur Regency	55.383,92
4.	Bandung Regency	12.006,816
5.	Garut Regency	31.960,446
6.	Tasikmalaya Regency	58.227,471
7.	Ciamis Regency	96.579,247
8.	Kuningan Regency	15.379,029
9.	Cirebon Regency	13.953,169
10.	Majalengka Regency	7.476,13
11.	Sumedang Regency	7.426,782
12.	Indramayu Regency	92.192,606
13.	Subang Regency	12.501,854
14.	Purwakarta Regency	1.377,84
15.	Karawang Regency	2.947,878
16.	Bekasi Regency	4.117,768
17.	Bogor City	5.019
18.	Sukabumi City	1.280,458
19.	Bandung City	656,467
20.	Cirebon City	111,684
21.	Bekasi City	1.683,52
22.	Depok City	372,4
23.	Cimahi City	335,118
24.	Tasikmalaya City	9.301.822
25.	Banjar City	2.177,62
26.	Bandung Barat Regency	3.504,735
27.	Pangandaran Regency	162,804
Total		592.107,989

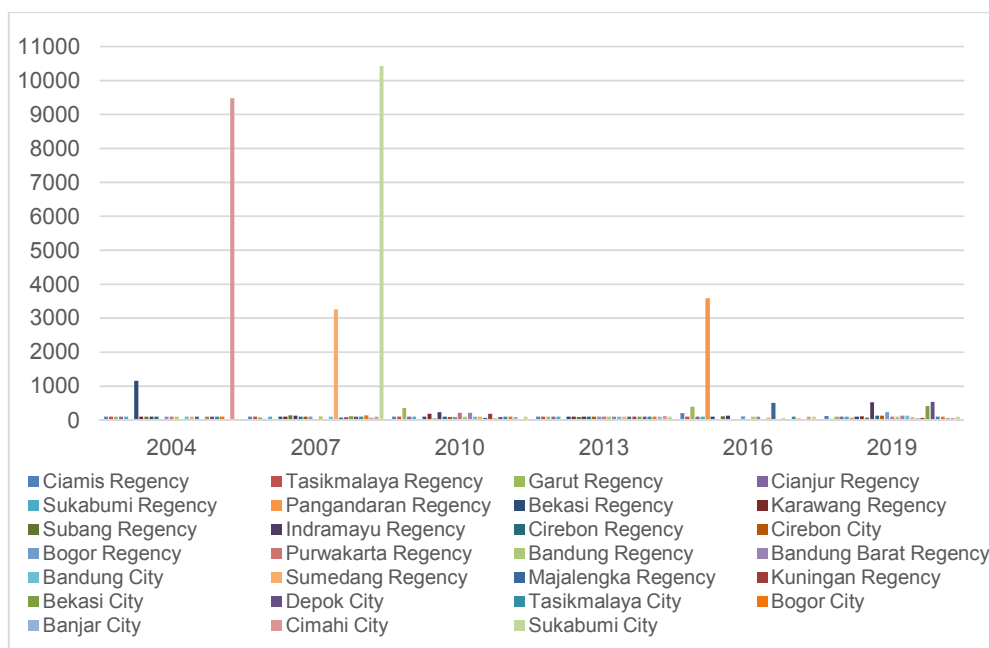


Fig. 1. Development Index of RTP Cultivation in Ponds in West Java Province

While the City of Cimahi in the period 2004 - 2019 experienced a significant decline as in 2004, the City of Cimahi had an index of 9480 but then decreased drastically in 2007 with an index value of 100, then continued to decline until it reached an index value of 6.79 in 2010, but increased again significantly in 2013 with an index value of 122.22 and then in 2019 it decreased with an index value of 69.231.

Sumedang Regency in the period 2004 – 2019 experienced a significant increase and decrease, this can be seen from 2004 which had an index value of 100 then increased drastically in 2007 with an index value of 3265, but decreased in 2010 with an index value amounted to 100.04 and continued to be stable until 2013, then in 2016 it decreased again until 2019 with an index value of 90.89.

Garut Regency for the trend of human resource development has increased and decreased significantly, this can be seen from 2004 with an index value of 100 then decreased in 2007 to 84.22 then in 2010 there was a very significant increase with an index value of 346.64 and decreased again in 2013 to 100, but in 2016 it increased with an index value of 394.75 and decreased again in 2019 with an index value of 98.99.

The development of the fishery sector must receive attention from the government by

providing an optimal allocation of funds. Increasing fishery production directed at aquaculture by involving the community with the aim of expanding job opportunities so that community welfare and economic growth will increase human resources in the area [16].

3.5 Facility Trend Development Index

The facilities used for aquaculture in ponds in West Java Province in the period 2007 to 2013 include the number of logging plots and rearing plots, water pumps, waterwheels, and water test kits. The number of facilities used during the period 2007 – 2013 is useful for describing the level of progress of the Regency/City in West Java Province for aquaculture in ponds (Fig. 2).

In the graph above, it can be seen that there is a high development index value and a very significant increase and decrease in the City of Tasikmalaya, which in 2007 had an index of 100.1 but then experienced a significant increase in 2010 with an index of 774.45 but in 2013 it decreased again with an index value of 100.

Then after Tasikmalaya City, the second highest facility development index which experienced a significant increase and decrease was Banjar City, because in 2007 it had an index of 0 and then increased significantly until 2010 to 284.96 until it decreased again in 2013 with an index of 0. by 0 again.

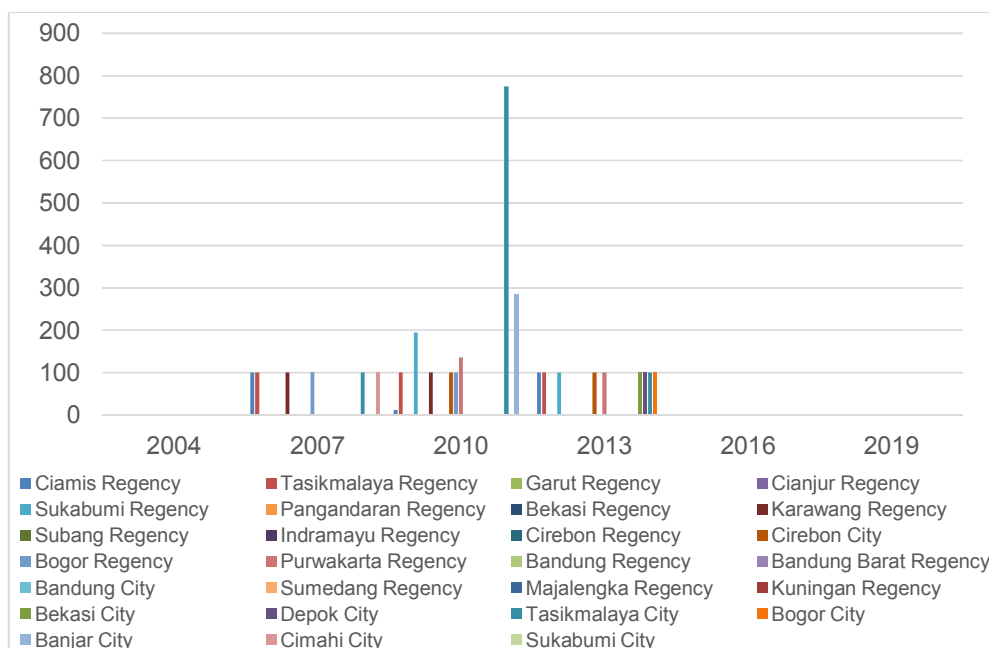


Fig. 2. Development Index of Ponds Facilities in West Java Province

Ciamis Regency experienced a very significant increase and decrease, this can be seen in 2007 Ciamis Regency had an index value of 100 then decreased drastically in 2010 with an index value of 12.43 then in 2013 it increased again with an index value of 100. In addition, there is the City of Sukabumi which experienced a decline in the facility development index that occurred in 2010 with an index value of 194.96 then decreased to 100 in 2013.

In addition, there is a constant and stable index result value, namely in the City of Tasikmalaya with a facility development index value of 100 from 2007 to 2013, this indicates that the number of facilities used during that period did not have any additions or reductions in the number of facilities, which means from year to year the number of facilities used is the same.

3.6 Infrastructure Trend Development Index

The facilities and infrastructure used for aquaculture in ponds in West Java Province for a period of 16 years varied greatly, such as the amount of feed used, fertilizers used, lime, pesticides, electricity, and fuel used. The number of facilities and infrastructure during the period 2007 to 2013 is useful for describing the level of progress of districts/cities in West Java Province for aquaculture in ponds (Fig. 3).

In the graph above, it can be seen that there is a high index value for the development of facilities and infrastructure and has a very significant increase and decrease compared to other regencies/cities, namely Ciamis City, which in 2007 had a facility and infrastructure development index of 109.03. then experienced a very drastic increase in 2010 with an index value of 25490, but in 2013 it experienced a significant decrease with a development index value of 63,539.

Tasikmalaya Regency experienced a very significant increase and decrease in the index for the development of facilities and infrastructure as well, this can be seen from 2007 with an index value of 115.68 then in 2010 there was a drastic decrease to 32, but experienced a significant increase again in 2013 with index value of 549.26. In addition, Garut Regency is also seen experiencing a significant trend of development, seen from 2007 with an index value of 4.54 then increasing drastically to 334.55 in 2010 but in 2013 there was a significant decline with an index value of 26.62.

Meanwhile, districts/cities in West Java Province which have a low index of infrastructure and facilities development are 0 from year to year, namely Pangandaran Regency and Depok City. This means that there is no optimal use of facilities and infrastructure from these

regencies/cities in supporting cultivation activities in ponds. Optimal use of facilities and infrastructure will support smooth production. Facilities and infrastructure that support pond aquaculture activities so that it will increase development in a positive direction, namely by providing optimal feed and in accordance with the needs of the fish to be cultivated, optimal fertilization, and the use of water pumps to facilitate the circulation of aquaculture water [17].

3.7 Production Trend Development Index

Aquaculture production in ponds in West Java Province for a period of 16 years from the period 2004 – 2019. During this period the development of aquaculture production in ponds in West Java Province was very volatile. The number of production developments is useful for describing the level of progress of districts/cities in West Java Province for aquaculture in ponds (Fig. 4).

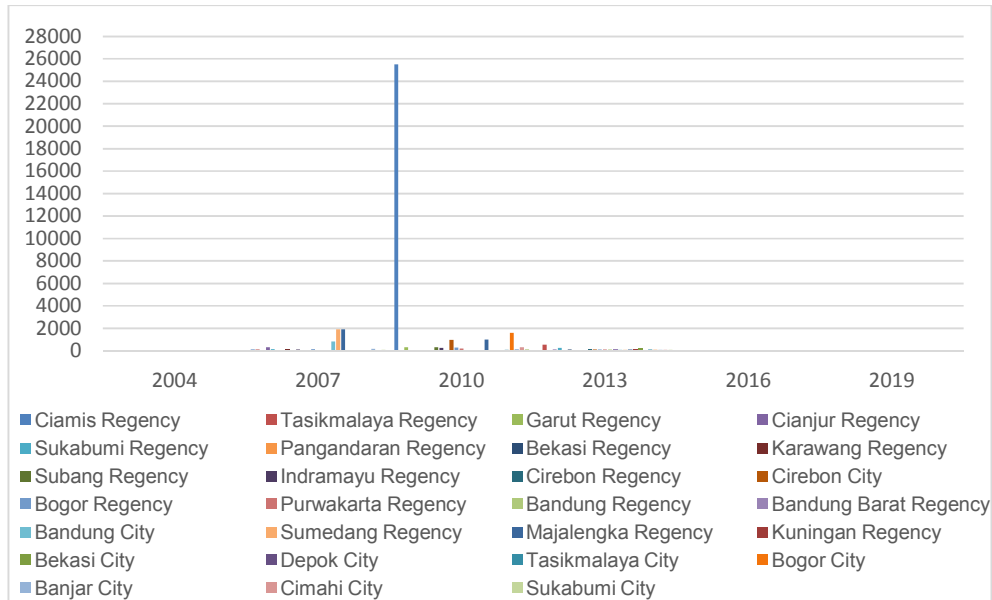


Fig. 3. Development Index of Aquaculture Facilities and Infrastructure in Ponds in West Java Province

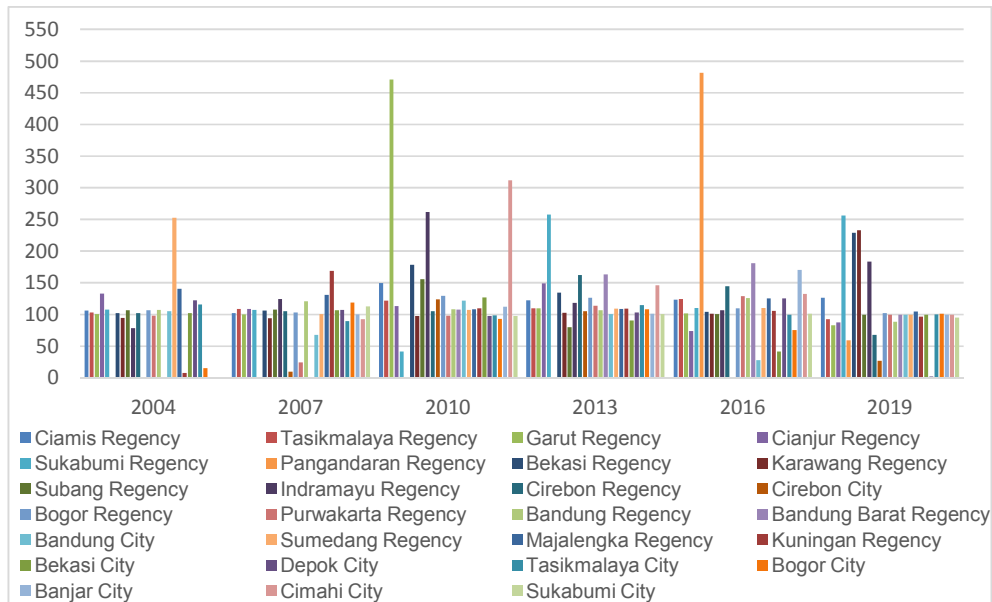


Fig. 4. Development Index of Aquaculture Production in Ponds in West Java Province

In the graph above, it can be seen that there is the highest production development index result value, namely Pangandaran Regency since the addition of this district to the West Java Province with an index value of 481.06 in 2016, but experienced a very significant decrease to 59.274 in 2016. In addition, Garut Regency placed the second highest production development index with index results in 2004 and 2007 which tended to be stable at 100 and then increased in 2010 with an index value of 470.85 but then decreased again in 2013 with an index value 109.78 and continued to decline until 2019 with an index value of 83.33. This is because Garut Regency excels in the use of semi-intensive technology. improvement and change in cultivation systems from traditional or semi-intensive systems requires changes in the behavior of cultivators and changes in mastery of cultivation technology which will increase production for Garut Regency [18].

Indramayu Regency has a significant trend of production development, this can be seen from 2004 with an index value of 78.26 then increased significantly to 124.45 in 2007 and continued to increase until 2010 with an index value of 262.19 but there was a decrease in 2013 to 2019 with an index value of 183.35. The market conditions that are quite extensive are used by the people of Indramayu to cultivate catfish which is the flagship of Indramayu Regency with a production of 59,190.48 tons, the cultivation system applied

has also used an intensive cultivation system [19].

Sukabumi Regency also has a significant trend of production development, this can be seen from 2004 with an index value of 107.86 which remained stable until 2007, but there was a drastic decline in 2010 with an index value of 41.19 then in 2013 there was an increase. which is significant until 2019 with the acquisition of an index value of 256.38. The increase in production that occurs can be caused by intensification through various existing fishery activities [20].

The production achieved can be maintained if the implementation of aquaculture must be continuously increased but still pay attention to the conditions of the aquaculture environment. The application of aquaculture development in order to be sustainable must of course be integrated with all existing ecosystems [21].

3.8 Land Area Trend Development Index

The land area of aquaculture in ponds in West Java Province for a period of 16 years from the period 2004 – 2019 is based on gross area and net area (Ha). During this period the development of cultivated land in the pond was very volatile. This amount of land area development is useful for describing the level of progress of districts/cities in West Java Province for aquaculture in ponds from year to year (Fig. 5).

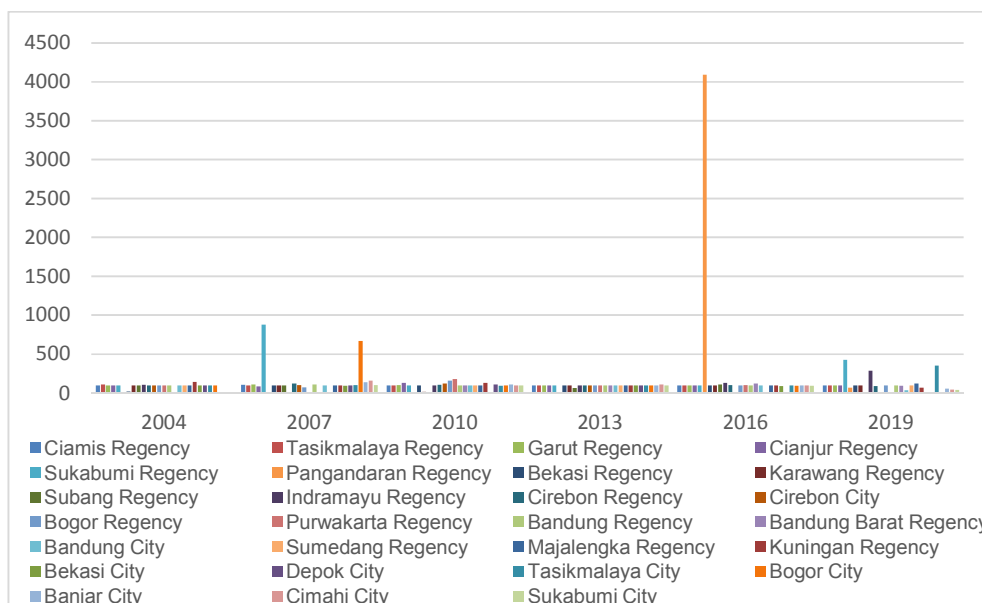


Fig. 5. Development index of Pond Cultivation Land Area in West Java Province

In the graph above, it can be seen that there is the highest land area development index value, namely Pangandaran Regency since the addition of this district to West Java Province with an index value of 4094 in 2016, and decreased in 2019 with an index value of 66,914. Then there is Sukabumi Regency which is significant, namely in 2004 it had a land area index result value of 100 then increased in 2007 to 879.47, then decreased again in 2010 with a yield value of 100 and remained stable until 2016, then returned increased in 2019 with a land area index of 430.04.

The development of freshwater aquaculture such as ponds is currently very strategic if its development is towards increasing productivity. This is because various existing limitations, especially the use of land and water, make increasing productivity which means intensification is a development direction that must be continuously encouraged. So if the development of land area for pond cultivation use tends to be positive, it will increase the productivity of the regency/city [14].

Tasikmalaya Regency has a trend of land area development that tends to be stable from 2004 to 2019 with an index value of 100. This is the same as Ciamis Regency which tends to be stable from year to year, this can be seen from 2004 with a land area index value of 100 and only increased slightly in 2007 by 107.13 then decreased in 2010 and remained stable until 2019 with an index value of 100.

Rational use of land area means placing a plot of land according to its potential [22]. Land suitable for cultivation development will minimize the impact on the surrounding environment and improve the community's economy and reduce land and water use conflicts [23].

4. CONCLUSION

From the present study It had been concluded that the trend of the development of pond aquaculture in the Regency/City of West Java Province which is seen from the aspect of human resources, facility, facilities and infrastructure, production, as well as the area of cultivated land experienced fluctuating changes during the period from 2004 to 2019, regencies/cities that show a positive development trend need to be maintained, while for regencies/cities that show negative development trends, it becomes a priority in development to increase the

competitiveness of aquaculture in ponds in the province of West Java.

Trends show changes in the value of a variable such as human resources, facilities, infrastructure, production, and land area, which must be managed in their development. This is useful for determining the trend of competitiveness in each regency/city that has potential for aquaculture in ponds in West Java Province. This encourages government policies to see and encourage the competitiveness of the aquaculture sector in ponds to become a sustainable economic sector in West Java Province.

CONSENT

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

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Huda M, Santoso EB. Development of Regency/City Regional Competitiveness in East Java Province based on Regional Potential. *Pomits Journal of Engineering*. 2014;3(2):2301-9271.
2. Triarso. Potential and Opportunities for Development of Capture Fisheries Business in Pantura, Central Java. *Journal of Fisheries Science*. 2012;8:1.
3. Center for Statistics and Information of the Ministry of Maritime Affairs and Fisheries (KKP). Marine and Fisheries Profile of West Java Province to Support KP Industrialization. Marine and Fisheries Ministry. Jakarta, Indonesia; 2013.
4. Phillips M, Henriksson PJG, Tran N, Chan CY, Mohan CV, Rodriguez UP, et al. Exploring the Future of Indonesian Aquaculture. Program Report, 2016-02. WorldFish. Penang, Malaysia; 2016.
5. Rhandika JM, Suryana AAH, Ujang S. Production Performance and Business Evaluation of Carp (*Cyprinus carpio*) Raising in Water Pond System (Case Study in Cijambe District, Subang Regency). *Journal of Marine Fisheries*. 2016;VII:1.

6. Central Bureau of Statistics (BPS). Aquaculture Production by Regency/City and Sub-sector in West Java Province. West Java Provincial Fisheries Service. Bandung; 2016.
7. Subangkit B, Rochdiani D, Budi S. Analysis of Costs, Income and R/C in Catfish Raising Business with the Longyam Method in Nasol Village, Cikoneng District, Ciamis Regency. AGROINFO GALUH Student Scientific Journal. 2021;8(1):215-223.
8. Sutiani L, Bachtiar Y, Amiruddin S. Analysis of the Freshwater Fish Cultivation Model Dominated by Gouramy (*Osphronemus gouramy*) in Sukawening Village, Bogor, West Java. Journal of the Center for Community Innovation. 2020;2(2)2020:207–214.
9. Maryati. Statistics of Economics and Business. Revised Edition. Second Printing. Yogyakarta (UPP) AMPYKPN; 2010.
10. BI Center for Education and Central Banking Studies (PPSK-BI). Profile and Mapping of District/City Regional Economic Competitiveness in Indonesia. Press Eagle. Jakarta; 2008.
11. Yulistyo. Marine Affairs and Fisheries in Figures. Marine and Fisheries Ministry. Jakarta; 2011.
12. Central Bureau of Statistics (BPS). Geographical Location in West Java. CV. Josevindo. Central Bureau of Statistics. Jakarta; 2021.
13. Suryana AAH. Dynamics of Total Factor Productivity of Freshwater Aquaculture and Its Impact on the Economy of West Java. Dissertation. Published. Regional and Rural Development Planning Science. Bogor Agricultural Institute. Bogor; 2013.
14. Suryana AAH, Akhmad F, Bambang J, Ernan R. Dimanika Interspatial Total Factor Productivity of Freshwater Aquaculture Business and Its Implications for the Economy of the West Java Region. Sociohumanities. 2014;16(1):89 – 94.
15. Cikitha P, Suryana AAH, Zuzy A, Atikah N. Analysis of the Role of the Fisheries Sector on Regional Development of Kuningan Regency, West Java. Journal of Fisheries and Marine Affairs. 2018; IX(1):1 – 8.
16. Ariani S, Mahyudin I, Emmy SM. The role of the fisheries sector in regional development and its development strategy in the context of regional autonomy in Balangan district (the role of fisheries sector in regional development and the strategy of its development in the framework). Journal of Fish Scientiae. 2014;4:8.
17. Kordi G. Aquaculture. PT. Image of Aditya Bakti. Bandung; 2009.
18. Bappenas/Ministry of VAT. Study of Sustainable Fisheries Management Strategy. Directorate of Marine Affairs and Fisheries. Jakarta, Indonesia; 2014.
19. Ferdian F. Ine Maulina, and Rosidah. Analysis of Demand for Dumbo Catfish (*Clarias gariepinus*) Consumption in Losarang District, Indramayu Regency. Journal of Fisheries and Marine Affairs. 2012;3(4):93-98. ISSN : 2088-3137.
20. Hamidi, Wahyu, Rahmita B. Ningsih, and Mayang Sari. The contribution of the fisheries sector in improving the economy of Riau Province. Journal of Economics. 2011;19(02).
21. Holmer MK, Black CM, Duarte N, Marba I. Karakasis. Aquaculture in the Ecosystem. Springer Science and Business Media B.V. 2008;326 .
22. Radiarta IN, Sudradjat A, Kusnendar E. Spatial Analysis of Potential Marine Cultivation Areas in North Maluku Province with the Application of Remote Sensing Data and Geographic Information Systems. Journal of Aquaculture Research. 2010;5:143 - 153.
23. Hossain MS, Chowdhury SR, Das NG, Sharifuzzaman SM, Sultana A. Integration of GIS and Multicriteria Aecision analysis for Urban Aquaculture Development in Bangladesh. Landscape and Urban Planning. 2009;90:119-133.

© 2021 Nurmahendra et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
 The peer review history for this paper can be accessed here:
<https://www.sdiarticle4.com/review-history/72938>