



## Economic impact of the eel. eel (*Anguilla bicolor*) aquaculture on local communities in Banyuwangi Regency

Osmaleli<sup>ab</sup>, Dwi Wara Widiyaningtyas<sup>b</sup>, Tridoyo Kusumastanto<sup>ab</sup>

a Center for Coastal and Marine Resources Studies, IPB University, Bogor, Indonesia

b Department Resources and Environmental Economics, Faculty of Economics and Management, IPB University, Indonesia

### Article Info:

Received: 25 - 08 - 2022

Accepted: 17 - 10 - 2022

### Keywords:

Aquaculture, economic impact, giant mottled eel, local communities

### Corresponding Author:

Osmaleli

Center for Coastal and Marine Resources Studies, Bogor, IPB University;

Phone: +6285281083533

Email:

osmaleli@apps.ipb.ac.id

**Abstract.** *Aquaculture in Indonesia has several superior commodities, one of which is eel. Eel (*Anguilla bicolor*) is a fish with high economic value and an export commodity (Japan, Hong Kong, Germany, Italy, and several other countries). This condition is inversely proportional to the level of domestic eel consumption, which is still relatively low. Aquaculture activities provide direct and indirect impacts on the local society, one of them is the economic impact of the existence of giant mottled eel aquaculture in the Banyuwangi District. The research aimed to analyze the economic impact of giant mottled eel aquaculture activities. The Survey research method was used, and data were analyzed using descriptive and multiplier effect analysis. The research result of the economic impacts of giant mottled eel aquaculture that provides a positive economic impact on local society is indicated by the development of giant mottled eel aquaculture activities and the other sectors. Keynesian Local Income Multiplier value was 2.65. Type I Multiplier Income Ratio was 1.16, and Type II Multiplier Income Ratio was 1.6.*

### How to cite (CSE Style 8<sup>th</sup> Edition):

Osmaleli, Widiyaningtyas DW, Kusumastanto T. 2023. Economic impact of the eel. eel (*Anguilla bicolor*) aquaculture on local communities in Banyuwangi Regency. *JPSL* 13(1): 114–121. <http://dx.doi.org/10.29244/jpsl.13.1.114-121>.

## INTRODUCTION

Indonesia is the world's largest archipelagic nation, with two-thirds of its total ocean waters containing some of Earth's most abundant and diverse concentrations of marine resources. The total area of Indonesia's marine waters is 5.8 million km<sup>2</sup>, consisting of Archipelagic and Territorial Sea (KKP 2015). It is the second-largest fish producer in the world after China, with capture fisheries and aquaculture production, including aquatic plants, estimated at 6.5 and 14.4 million tons, respectively, in 2014 (Stacey et al. 2019). In 2019, the production volume of aquaculture in Indonesia amounted to approximately 15.13 million metric tons (Statista Research Department 2021). Having the second-longest coastline in the world, fisheries play an important role in Indonesia. More than six million people in Indonesia are involved directly and indirectly in the sector.

Aquaculture in Indonesia has several superior commodities, one of which is eel. Eel (*Anguilla bicolor*) is a fish with high economic value and a type of fish that is an export commodity (Japan, Hong Kong, Germany, Italy, and several other countries). This condition is inversely proportional to the level of domestic eel consumption, which is still relatively low. Indonesian people are not familiar with eels as fish for consumption (Affandi 2005). Eels are in great demand by foreign markets because of their content and benefits. Eel meat is rich in vitamins A, B1, B2, B12, D, and E, which are useful for building body tissue systems (Fisheries Extension 2018). Eels have a catadromous nature or migrate to the sea to spawn and live in freshwater. Eels

have a catadromous nature or migrate to the sea to spawn and live in freshwater (Haryono 2016; Kardin et.al. 2016).

Banyuwangi Regency is one of the areas that have abundant fishery potential. Also supported by the condition of the waters in Banyuwangi Regency, which are still clean and have very potential for eel cultivation (BMKG 2011). The high interest and price for eel are expected to help increase aquaculture production and increase economic activity in Banyuwangi Regency (Banyuwangi Regency Government 2018). Eel cultivation activities in Banyuwangi Regency are directly or indirectly able to have an impact, one of which is providing jobs for the surrounding community and the existence of service providers and business units. Eel farming can have a multiplier impact on the sector providing goods or services and other economic sectors. Eel cultivation can be an alternative business that is economically profitable, and thus eel cultivation in Banyuwangi Regency can increase income and significant employment. Through eel cultivation, it is expected to be able to utilize and manage the potential of eel resources sustainably while still paying attention to environmental aspects for the sake of improving the economy of Banyuwangi Regency (Budhiman et.al. 2012). Therefore, research is needed on the analysis of the economic impact of the eel cultivation business in Banyuwangi Regency.

The business of eel cultivation is very dependent on the availability of eel seeds in nature (Megawati et al. 2014). Eels are catadromous fish that migrate to the sea to spawn and live in freshwater (Suryono and Badjeori 2013; DPP 2018). This causes eel seeds to be difficult to cultivate (Sarwono 2011; KKP 2015). The head of the Sidawangi Group stated that other obstacles experienced by eel cultivators in Banyuwangi were the high price of eel feed, lack of facilities and knowledge about eel cultivation, weak access to capital, lack of government attention, and no technical and economic assistance. Based on the description above, the formulation of the problem in this study is: What is the economic impact caused by eel farming in Banyuwangi Regency?.

## **METHOD**

### **Study Areas**

The method used in this research is a survey method. The survey method is a research technique that is limited by data collected from samples or populations to represent the entire population (Singarimbun 2006). The emphasis of this study is on analyzing the economic impact of Eel farming. The location of research was carried out in the Districts of Wongsorejo, Kalipuro, Banyuwangi, Glagah, Rogojampi, Srono, Cluring, Muncar, Tegaldelimo, Purwoharjo, Genteng, Tegalsari, and Glenmore, Sidawangi, Banyuwangi. Data collection was carried out from April to June 2019.

### **Data and Analysis**

This research needs primary and secondary data that can be picked out by deep-interviewed and direct observation of respondents about seven parameters and also to local governments for asking about location overview and water quality. The sampling method that was used is census and purposive sampling, where respondents consist of cultivators, laborers, business units, and key persons (31, 28, 50, and 10, respectively). These can be seen in Table 1 and 2 below. While data processing and data analysis methods can be seen in Table 3.

Table 1 Types and sources of data

<b>No.</b>	<b>Data Type</b>	<b>Parameter</b>	<b>Unit</b>	<b>Data source</b>
1.	Primary	Cultivator's Perception	-	Interview and direct observation
		Community income	Rupiah	Interview
		Community output	Rupiah	Interview

No.	Data Type	Parameter	Unit	Data source
		Price of Eel	Rupiah	Interview and direct observation
		Production cost	Rupiah	Interview and direct observation
		Amount of eel production	Kg	Interview
		Sidawangi's overview	Descriptive	Interview and direct observation
2.	Secondary	Location overview	Area (Ha) Resident (soul) Descriptive	Banyuwangi local government
		Water Quality		BPPP Banyuwangi

Table 2 Total of respondent and sampling method

No.	Respondent	Population	Number of samples	Sampling method
1.	Cultivator	31	31	Census
2.	Labor	28	28	Census
3.	Business unit	50	50	Census
4.	Key Person	-	10	<i>Purposive sampling</i>

Table 3 Matrix of data processing and data analysis

Destination	Data source	Measured variables	Data type	Data analysis method
Analyzing the economic impact caused by eel farming in Banyuwangi Regency	Questionnaire and interview	Economic impact	Primary	Multiplier effect analysis

### **Descriptive Analysis**

Farmers' perceptions of the sustainability of eel seeds in nature with the existence of eel cultivation in Banyuwangi Regency and policy recommendations to overcome the obstacles faced by eel cultivators in Banyuwangi Regency are presented in the form of descriptive analysis. Descriptive analysis is an analytical tool used to make broader conclusions (Sugiyono 2012).

### **Multiplier Effect Analysis**

The economic impact is measured by using the multiplier effect of the cash flows that occur. The economic impact of eel farming activities on the surrounding community can be measured by two types of multipliers (Vanhove 2005), namely Keynesian Local Income Multiplier and Income Multiplier Ratio. Keynesian Local Income Multiplier which is in the form of a value that shows the amount of expenditure for eel cultivators has an impact on increasing overall income from activities in the eel cultivation area. While, Income Multiplier Ratio is in the form of a value that shows the perceived impact of receiving community income from eel farming activities that have an impact on the overall economy of the local area. This multiplier effect measures the indirect effect which is described by the Type I Ratio Income Multiplier and the induced

one which is described by the Type II Income Multiplier Ratio. Thus mathematically can be formulated in equation 1 to 3. Keynesian Local Income Multiplier:

$$\frac{D + N + U}{E}$$

Ratio Income Multiplier, Type I :

$$\frac{D + N}{D}$$

Ratio Income Multiplier, Type II:

$$\frac{D + N + U}{D}$$

Information:

E = spending on eel cultivators in 2019 (IDR)

D = local income obtained directly from E in 2019 (IDR)

N = local income obtained indirectly from E in 2019 (IDR)

U = local expenses incurred induced from E in 2019 (IDR)

The assessment criteria for the three equations above can be explained as follows: (a) The value of less than or equal to zero ( $\leq 0$ ) indicates that eel cultivation does not have an economic impact on the people in Banyuwangi Regency; (b) The value between zero and one ( $0 < x < 1$ ) indicates that eel farming has a relatively low economic impact on the people of the Banyuwangi Regency; (c) A value greater than one ( $> 1$ ) indicates that the eel fish farming business has had a significant economic impact on the people of Banyuwangi Regency. The calculation of the multiplier value is carried out using a Microsoft Excel 2016 computer. The data that has been collected will be processed qualitatively and quantitatively.

## **RESULTS AND DISCUSSION**

### **Economic Impact of Eel Cultivation Business in Banyuwangi Regency**

#### ***Value of Economic Activity of Eel Cultivation in Bayuwangi Regency***

Eel farming activities in Banyuwangi Regency require costs incurred by cultivators in supporting business units in Banyuwangi Regency. Expenditures for cultivators become costs in the eel production process. These costs include the cost of making a pond and its equipment, eel seeds, feed, and harvesting equipment. The total cultural land area for all Sidawangi Group members is 15.7 hectares. The cost components in detail can be seen in Table 4.

Based on the analysis of the expenditure of eel cultivators for one year on the financing of eel cultivation in the Sidawangi Group, the cost component of purchasing eel seeds has the largest proportion of the expenditure structure of 61.7 percent. The availability of eel seeds is very dependent on nature, so it affects the price of the eel seeds. The price of eel seeds used by cultivators currently ranges from IDR 150,000 to IDR 165,000 per kg. The next largest cost component is feed, which is 31.6 percent. This is because the feed used is a factory-made product specifically for eels with a price of up to IDR 42,000 per kg.

Table 5 shows the proportion of expenditure of eel cultivators in the Sidawangi Group to support business units in the Banyuwangi Regency. The average expenditure of eel cultivators per hectare per year is IDR 43,904,610, which is influenced by several cost factors, such as the production costs that have been incurred.

Table 7 presents the expenditure components of eel cultivators in the Sidawangi Group each year in the Banyuwangi Regency of IDR 1,361,042,900. The amount of expenditure for cultivators is based on the area of land managed in one year, which is 15.97 ha, with the assumption that all ponds are producing.

Table 4 Total proportion of the annual expenditure structure of eel cultivators

No.	Cost component	Total cost (IDR)	Proportion (%)
1.	Net	9,765,500	0.7
2.	blower	11,307,000	0.83
3.	Aerator	8,912,500	0.65
4.	Water Pump	2,849,500	0.2
5.	PH meter	1,765,000	0.12
6.	Thermometer	1,490,000	0.1
7.	O <sub>2</sub> Tube	815,000	0.06
8.	Scales	555,000	0.05
9.	Bak	2,678,500	0.2
10.	Fun	1,308,000	0.09
11.	Seed	839,600,000	61.7
12.	feed	429,859,400	31.6
13.	Vitamin	46,158,500	3.4
14.	Salt	3,979,000	0.3
Total		1,361,042,900	100

Table 5 Components of annual eel cultivator expenditure

Information	Amount
The proportion of expenditure of cultivators in Banyuwangi Regency (%)	100
The proportion of costs outside the cultivation site (%)	0
Cultivator's average expenditure (IDR/year)	43,904,610
Number of eel farmers (person)	31
Total expenditure of farmers (IDR/year)	1,361,042,900

### ***Analysis of the Economic Impact of Eel Cultivation Business in Banyuwangi Regency***

Eel farming activities can have an impact on the surrounding community in Banyuwangi Regency. The impact that can be felt is the economic impact of the eel farming business in the form of direct economic impacts, indirect impacts, and induced impacts.

#### ***Direct economic impact (direct impact = D).***

The direct economic impact is analyzed based on the expenditures from eel cultivation activities by cultivators who are members of the Sidawangi Group on supporting business units for one year. The amount of money flow shows the magnitude of the economic impact caused by the expenditure of farmers on the production process of eel in the Sidawangi Group in Banyuwangi Regency. Money flow is also related to total revenue and total cost of supporting business units during the eel production process, so it can be seen that the amount of income earned by supporting business units from each unit per year can be seen in Table 6.

The existence of an eel cultivation business creates a business opportunity for the surrounding community to open a business that is related to and supports the needs of eel cultivators in the production process. The amount of revenue received by the supporting business unit is the amount of expenditure for eel cultivators from eel farming activities used by the owner of the supporting business unit in carrying out the activities of

the supporting business unit. The main cost component of supporting business units is the cost of purchasing eel production inputs. Table 6 shows the total revenue from supporting business units for eel cultivation activities in the Sidawangi Group in Banyuwangi Regency in one year amounting to IDR 2,201,064,000 for 50 units.

Table 6 Total income of supporting business per year in Banyuwangi Regency

No.	Type of business	Total revenue (IDR)	Total cost (IDR)	Total income (IDR)
1.	Poultry	77,105,520,000	75,051,384,000	2,054,136,000
2.	Selling Eel Seeds	555,768,000	408,840,000	146,928,000
	Total	77,661,288,000	75,460,224,000	2,201,064,000

**Indirect economic impact (indirect impact = N)**

Supporting business units related to aquaculture activities, especially eel, which are carried out by the surrounding community in Banyuwangi Regency can be said to be quite numerous and adequate and spread throughout the Banyuwangi Regency because eel cultivation is a profitable economic activity and can have a good economic impact. directly or indirectly. Based on the information from the Chair of the Sidawangi Group, the current eel cultivation business is in great demand by the community, so the number of eel cultivators continues to grow, to provide job opportunities for the surrounding community. The greatest job opportunities are in the cultivation support business units and during the harvest period, but they still have an impact on the workforce on normal days. Most of the workforce works every day, working eight to ten hours per day. When the harvest season arrives, harvesting workers need working hours according to their needs. Total labor income can be seen in Table 7.

Table 7 Total labor income per year in Banyuwangi Regency

No.	Type	Average income (IDR)	Number of people	Total income (IDR)
1.	Month	1,265,522	23	28,900,000
2.	Year	15,078,264	23	346.800.000

The indirect positive economic impact is calculated from the proportion of expenditures made by supporting business unit actors for labor wages, which is IDR 346,800,000 (Table 7). Supporting business unit workers receive an average income of IDR 1,265,522 per month per person. This value can be said to be not too large because the workforce has constant working days and hours, so the wages given will be adjusted to the days and hours of work.

**Continuing economic impact (induced impact = U)**

Eel cultivation activities in the Sidawangi Group in Banyuwangi Regency not only have direct and indirect impacts but also have further impacts. Follow-up impacts are defined as expenses incurred by the owner of the supporting business unit and the workforce. These expenses can be regarded as daily expenses in meeting family needs. The continued positive economic impact is seen from the proportion of costs for the most important basic needs, namely the cost of consumption or the cost of food needs, the details of which can be seen in Table 8.

Table 8 Total consumption expenditure per year in Banyuwangi Regency

No.	Type	Total cost (IDR)
1.	Supporting business unit owners	693,000,000
2.	Supporting business unit workforce	251,520,000
	Total	890.52 million

Table 8 shows the magnitude of the value of the continued positive economic impact in one year from eel cultivation in Banyuwangi Regency obtained from the sum of the two costs for food or consumption needs, which is IDR 890,520,000. The usual amount of consumption is influenced by several factors, namely: (1) income level, the level of income that affects consumption patterns and lifestyles, the higher the income, the higher the level of consumption; (2) household expectations of the future, when a household predicts the future economy will improve, the consumption pattern will increase (Ariani 2014).

### **Multiplier Effect Value of Expenditures for Eel Cultivators in the Sidawangi Group in Banyuwangi Regency**

Impact through two types of multiplier, namely: (1) Keynesian Local Income Multiplier, the value generated from the expenditure of eel farmers as an impact on increasing the income of the surrounding community; (2) Ratio of Income Multiplier, the value generated from the expenditure of eel farmers as a direct impact on the local economy (META 2001).

Table 9 Value of money flow multiplier effect on eel cultivation in Banyuwangi Regency

No.	Multiplier value	Amount
1.	Keynesian Local Income Multiplier	2.65
2.	Ratio Income Multiplier Type I	1.16
3.	Ratio Income Multiplier Type II	1.6

Eel cultivation is one of the activities that can improve the economy and standard of living of the surrounding community in the Banyuwangi Regency. Based on the results of the calculations in Table 9, the Keynesian Local Income Multiplier value is 2.65, which means that every time there is an increase in the expenditure of eel cultivators by 1 rupiah, it will increase the income of the owner of the supporting business unit by about 2.65 rupiahs. The Keynesian Local Income Multiplier is the direct economic impact of the eel cultivator's expenditure which has an impact on increasing the income of the supporting business units.

The value of the Type I Income Multiplier Ratio is 1.16, which means that every time there is an increase in the income of the owner of the supporting business unit by 1 rupiah, it will increase the income of the workforce by 1.16 rupiah. The economic impact is not directly felt by the workforce, in the form of wages received. The value of the Type II Income Multiplier Ratio is obtained at 1.6, which means that every time there is an increase in the income of the owner of the supporting business unit by 1 rupiah, it will increase the direct economic impact (income of the owner of the supporting business unit), the indirect economic impact (labor income), and the continued economic impact (expenditures for supporting business unit owners and labor) of 1.6 rupiahs on the surrounding community in Banyuwangi Regency. Based on the results of data analysis shows the Ratio Value of Type I and Type II Income Multiplier is greater than one (1). This value indicates that the eel cultivation business in the Sidawangi Group has been able to provide a positive economic impact and become a new source of income for the surrounding community in Banyuwangi Regency.

### **CONCLUSION**

The results of the economic impact analysis show a positive value so that the eel farming business in Banyuwangi Regency has been proven to be able to provide an economic impact on the surrounding community and become a reliable source of income. The economic impact is marked by the development of eel aquaculture and other supporting sectors. Based on the research results, it is known that the economic impact can be said to be good. The Keynesian Local Income Multiplier value is 2.65. The Type I Income Multiplier Ratio is 1.16 and the Type II Income Multiplier Ratio is 1.6.

## ACKNOWLEDGEMENT

Thank you Mr. Supri Hadiyanto as the Chair of the Sidawangi Group and the farmers for the information regarding the eel fish farming business in Banyuwangi. Also, many thanks for the government institutions to provide me the data to support this research.

## REFERENCES

- [BMKG] Badan Meteorologi, Klimatologi dan Geofisika. 2011. *Bulletin 2011*. Jakarta: BMKG Indonesia.
- [DPP] Dinas Perikanan dan Pangan Kabupaten Banyuwangi. 2018. *Statistik Perikanan dan Kelautan*. Banyuwangi: DPP of Banyuwangi Regency.
- [META] Marine Ecotourism for the Atlantic Area. 2001. *Planning for Marine Ecotourism in The EU Atlantic Area*. Bristol: the University of the West of England.
- [KKP] Ministry of Marine Affairs and Fisheries. 2015. *Kelautan dan Perikanan Dalam Angka 2015 (Pusat Data dan Informasi Statistik)*. Jakarta: KKP.
- Affandi R. 2005. Strategy for utilizing eel fish resources, *Anguilla* spp. in Indonesia. *Indonesian Journal of Ichthyology*. 5(2):77–81.
- Ariani D. 2014. Analysis of factors influencing consumption in Nagan Raya Regency. *Journal of Economics and Policy of the Republic of Indonesia*. 1(1):1–7.
- Budhiman AA, Christijanto H, Kamarijah S, Budoyo GH. 2012. *Assessment of Fishery Management Performance using EAFM Indicators*. Bogor: PKSPL-IPB.
- Haryono WG. 2016. Mapping of the eel (*Anguilla bicolor*) seed crocodile habitat and its potential in the south coast of Java. *Omni-Aquatic Journal*. 12(3):47–58.
- Kardin, Sara L, Prince UK. 2016. Several biological aspects of eel (*Anguilla* sp) in the Mosolo River, Wawonii Island, Konawe Islands. *Journal of Aquatic Resources Management*. 1(4):355–365.
- Megawati C, Yusuf M, Maslukah L. 2014. Sebaran kualitas air ditinjau dari zat hara, oksigen terlarut, dan pH di Selat Bali Selatan. *Jurnal Oseanografi*. 3(2):142–150.
- Fisheries Extension. 2018. *Benefits and Content of Eel*. [accessed 2019 Jan 17]. <http://penguluhpi.blogspot.com/2017/10/benefits-dan-kandungan-ikan-sidat.html>.
- Banyuwangi Regency Government. 2018. *Regional Profile*. [accessed 2018 Sep 9]. <https://www.banyuwangikab.go.id/profile/imageanumum.html>.
- Sarwono B. 2011. *Cultivation of Eels and Eels*. Jakarta: Self-Help Spreader.
- Singarimbun M. 2006. *Survey Research Methods*. Effendi S, editor. Jakarta: LP3ES.
- Stacey N, Gibson E, Loneragan NR, Warren C, Wiryawan B, Adhuri D, Fitriana R. 2019. Enhancing coastal livelihoods in Indonesia: an evaluation of recent initiatives on gender, women and sustainable livelihoods in small-scal fisheries. *Maritime Studies*. 18:359–371.
- Statista Research Department. 2021. *Production Volume of Aquaculture Indonesia*. [accessed 2021 Oct 10]. <https://www.statista.com/statistics/784037/volume-of-aquaculture-production-indonesia/>.
- Sugiyono. 2012. *Quantitative, Qualitative, and R&D Research Methods*. Bandung: Alfabet.
- Suryono T, Badjeori M. 2013. Kualitas Air Pada Uji Pembesaran Larva Ikan Sidat (*Anguilla* Spp.) dengan sistem pemeliharaan yang berbeda. *LIMNOTEK*. 20(2):169–177.
- Vanhove. 2005. *The Economics of Tourism Destinations*. United Kingdom: Oxford University.