Analysis of production factors that affect the productivity of Danish seine at the Archipelagic Fishery Port (AFP) of Karangantu, Banten Province, Indonesia

[1]Erick Nugraha, [1]Bongbongan Kusmedy, [1]Hari Prayitno, [1]Eddy Sugriwa Husen, [1]Eli Nurlaela, [1]Tonny E Kusumo, [2]Sopiyan Danapraja, [3]Yuli Purwanto, [4]Faisal Yusuf

[1] Faculty of Fishing Technology, Jakarta Technical University of Fisheries, South Jakarta, Indonesia; [2] Faculty of Fisheries Extention Jakarta Technical University of Fisheries, South Jakarta, Indonesia; [3] Faculty of Capture Fisheries, Bitung Marine and Fisheries Polytechnic, North Sulawesi, Indonesia; [4] Capture Fisheries Production Manager, Kendari Oceanic Fishing Port, Southeast Sulawesi, Indonesia. Corresponding author: E. Nugraha, nugraha_eriq1@yahoo.co.id

Abstract. The purpose of this study was to determine the productivity of the Danish seine and to analyze the production factors that affect the productivity of the Danish seine which includes: vessel length (x1), vessel engine power (x2), amount of fuel oil (x3), number of days per trip (x4), operational costs (x5), and number of crew members (x6). This research was carried out using a survey method. The primary data collected are the catch volume of the Danish seine (y), the length of the vessel (x1), the power of the vessel's engine (X2), the amount of fuel oil (x3), the number of days per trip (x4), the operational costs (x5), the number of crew members (x6) and the fishing ground of the Danish seine. Meanwhile, the secondary data are documents of the vessel and crew of the Danish seine, literature on the Danish seine and the annual the AFP Karangantu report. In order to determine the production factors that affect the productivity of the Danish seine, a multiple linear regression analysis via computer software was used. The results of this study explain that the correlation between the productivity of the Danish seine (y) and the variables x3, x4, x5 is very strong and positive. The correlation between productivity (y) and the variable x6 is moderate and positive, while the correlation between the productivity (y) and the variables x1 and x2 is weak and positive. Taken together, the independent variables x1, x2, x3, x4, x5 and x6 have a significant effect on the increase of the Danish seine productivity (y). However, individually (partially) only the variables x4 and x6 have a significant effect, while the other variables have no significant effect on the increase of the Danish seine productivity (y).

Key Words: CPUE, *Leiognathus equulus*, FMA 712, AFP Karangantu.

Introduction. The Archipelago Fishing Port (AFP) of Karangantu has a strategic role in the fishery and marine development (Puspitasari et al 2013; Suherman et al 2020). The potential of marine and fishery natural resources of the Banten Province is spread across three water areas: the Indian Ocean, the Sunda Strait and the Java Sea (Rizal 2013; Oktaviyani et al 2015). The types of fishing gear used include lift nets, purse seine, danish seine and hand line (Rahmawati et al 2017; Diniah et al 2012).

The total production of fish caught in the AFP Karangantu in 2013 was as many as 2,797 tons (Hamzah et al 2015). In 2014, the AFP Karangantu recorded 2,881 tons of landed catches. The Danish seine had the highest contribution, among the other operating fishing gears, reaching 1,548 tons or 55.07% of the total catch (AFP 2015). Productivity is a measure that states how well resources are managed and utilized to achieve optimal results (Sarjono 2001).

The Danish seine is similar to a trawler, being relatively simple (Ardidja 2010; Sudirman & Mallawa 2004). It is a fishing gear that is more likely to replace trawling in the exploitation of demersal fishery resources (MMFA 2011). This condition allows herds of fish to enter the net (Antika et al 2014). The dimensions of the main vessel is the main parameter, covering the length, width and height (Fyson 1985), determining the vessel's design (Tangke 2010; Purnama et al 2015).

The main catch of Danish seine is shrimp and demersal fish such as: goldband goatfish (*Upeneus moluccensis*), doublewhip threadfin bream (*Nemipterus nematophorus*), sea catfishes (*Ariidae*), grouper (*Serranidae)* and Jarbua terapon (*Terapon jarbua)* (Sudirman et al 2008; Nedelec & Prado 1990). Fishing operations using the Danish seine can be carried out in the morning or in the late afternoon, in less intense light conditions. The Danish seine catching trip is usually a one day fishing (Antika et al 2014) and it has the advantage of being much cheaper, since it is used on vessels that are much smaller than trawls (Semedi & Schneider 2021).

The production function is a mathematical relationship between production (output) and the factors of production (input) (Shephard 1970), independently of the prices. Mathematically the production function can be expressed by $y = (x_1, x_2, x_3, \dots x_n)$, where $x_1, x_2, x_3, \dots x_n$ is the input factor used to produce output (y). The function above explains that the resulting output depends on input factors, but does not yet provide a quantitative relationship between input and output factors (Salvatore 1995; Nicholson 1999).

According to Suharso (2006), the new production process can run if the requirements (factors of production) needed can be met. In capture fisheries, the minimum required production factors consist of resources (sea), labor (fishermen) and capital (vessels and fishing gear). The three factors of production must be available. Each factor of production has a different function and is interrelated with each other. If one of the factors of production is not available, the production process will not run. In addition to the three production factors mentioned above, the authors intend to examine six production factors that are thought to influence the productivity of dogol boats at AFP Karangantu, namely the vessel length, the strength of the vessel's engine, the amount of fuel oil, the number of days a fishing trip, operational costs and number of crew members. With a high level of Danish seine production, it is necessary to carry out research on the analysis of the factors that affect the productivity of the Danish seine.

Material and Method. The tools and materials used in this research were: Danish seine, fishing gear, calculator, meter, digital camera, GPS, stationery, computer and software. The data collected consists of primary data obtained from interviews with fishermen and direct observations, and the secondary data obtained from the vessel and crew specifications, the AFP statistics annual report, the literature on the Danish seine productivity and of the fishing ground maps.

Data analysis method. The Catch Per Unit Effort (CPUE) data was collected at the same time as the fish landings. The relationship between catch and work is linear through the origin (Makwinja et al 2021). The CPUE is calculated based on the total production and on the number of trips, using the following formula (Gulland 1983):

$$CPUE=C/f$$

Where:
CPUE - production per unit of effort (kg a trip);
C - production (kg);
f - catch effort (trip).

To determine the factors that affect the productivity of the Danish seine, a production function analysis is carried out using the multiple linear regression analysis which is presented in tables and graphs. A parameter testing is carried out at the significance level (α) of 5%, in order to obtain a linear regression equation (Sugiyono 2015):

$$y = a + b1x1 + b2x2 + b3x3 + b4x4 + b5x5 + b6x6$$

Where:
y - productivity of the Danish seine (kg);
a - constant;
b - multiple regression coefficient;
x1 - length of vessel (m);
x2 - engine power (PS);
x3 - amount of fuel (L);
x4 - number of days per trip (days);
x5 - operational costs (USD);
x6 - number of crew members (people).

Results and Discussion. This research was conducted at the AFP Karangantu, Serang City, Banten Province, Indonesia (Figure 1).

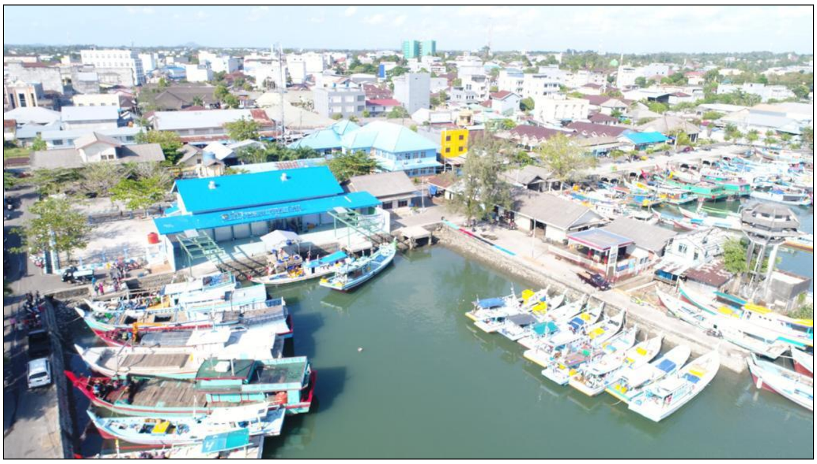

Figure 1. The Archipelagic Fishery Port (AFP) of Karangantu (MMAF 2021).

Danish seine. Danish seine is very effective because operating does not depend on the fishing season as it is the case with other fishing gear so that it can be operated at any time. The shape of the Danish seine can be seen in Figure 2.

Figure 2. Danish seine (original).

Danish seine at the AFP Karangantu is made of wood with relatively the same length, of 10-15 m. The number of units was 46 in 2014, while in 2013 there were only 42 units. The dominance and development of this gear is justified by its level of productivity, namely 1,548 tons or 55.07% of the total fish catch of 2,811 tons, in 2014 (AFP 2015). In this research, sampling was carried out among the 10 Danish seine landed at the AFP of Karangantu. Data on these vessels is presented in Table 1 below.

Table 1

Danish seine research sample

Name of fishing vessel (FV)	*Length (m)*	*Width (m)*	*GT*	*Engine power (PS)*
FV. Putri Timbul	11.40	3.95	15	120
FV. Bunga Indah 01	12.20	4.34	14	120
FV. Bunga Indah 02	11.85	3.95	14	100
FV. Sari Jati Mulya	10.50	2.60	10	100
FV. Sari Jati Untung	13.20	4.05	18	120
FV. Sari Mulya	10.50	3.40	10	100
FV. Setia Jaya	14.50	4.42	19	120
FV. Setia Kawan	13.60	3.95	20	120
FV. Tirta Raya Mina 01	12.00	4.00	11	120
FV. Tirta Raya Mina 02	12.50	4.25	15	120

Fishing ground. Danish seine is operated at the bottom waters, which consists of sand, mud or a mixture of both. The Danish seine landed at The AFP of Karangantu has a fishing ground in the FMA-712, namely the North Jawa Sea, in the Sunda Strait, around Tunda Island and Panjang Island. This can be seen in Figure 3 below.

Gambar 3. Danish seine fishing ground.

Danish seine catches. From 10 samples of Danish seine, the types of fish landed at AFP Karangantu during the period February 15 to April 15 2015 consisted of 4 types of dominant fish (Table 2).

Table 2

The type of catch of the Danish seine at The AFP Karangantu for the period February - April 2015

No	*Type of catch*	*Total production (kg)*	*Percentage (%)*
1	Common ponyfish (*Leiognathus equulus*)	61,420	51.06
2	Goldband goatfish (*Upeneus moluccensis*)	20,298	16.87
3	Doublewhip threadfin bream (*Nemipterus nematophorus*)	6,234	5.18
4	Squid (*Loligo* spp)	5,680	4.72
5	Others	26,653	22.16
	Total	120,285	100.00

Source: MMAF 2016.

Danish seine Catch Rate (CPUE). The catch rate of Danish seine is the number of catches divided by the number of trips. The 10 Danish seines were used as objects of observation and the catch rate per vessel is reported in Table 3 below.

Table 3

Catch rate of Danish seine at The AFP of Karangantu

No	*Name of fishing vessel (FV)*	*Total production (kg)*	*Trip (times)*	*Average (kg trip^{-1})*
1	FV. Tirta Raya Mina 01	3,305	2	1,652.5
2	FV. Tirta Raya Mina 02	6,391	6	1,065.2
3	FV. Sari Jati Untung	17,872	19	940.6
4	FV. Sari Mulya	3,371	4	842.8
5	FV. Setia Kawan	7,387	13	568.2
6	FV. Bunga Indah 01	22,514	40	562.9
7	FV. Setia Jaya	18,372	34	540.4
8	FV. Putri Timbul	12,370	23	537.8
9	FV. Bunga Indah 02	20,300	42	483.3
10	FV. Sari Jati Mulya	8,403	18	466.8
		Average		766.1

From the table above it can be seen that FV. Tirta Raya Mina 01 has the highest catch rate, which is 1,652.5 kg trip^{-1}. Meanwhile, FV. Sari Jati Mulya is a lowest catch rate, which is 466.8 kg trip^{-1}.

Productivity of the Danish seine. The productivity of the Danish seine is the average level of production per trip, which is determined by a number of variables, grouped into 6 categories, namely: the level of production according to the vessel size, the engine power, fuel consumption, number of days per trip, operational costs, and the number of crew members.

Danish seine production rate according to vessel length size. The Danish seine units sampled in the measurements were installed on 10 vessels of variable sizes. However, among the 10 vessels, there are 2 vessels that have the same length, namely FV. Sari Jati Mulya and FV. Sari Mulya. It was assumed that the length of the vessel will determine the level of productivity. The level of production of the Danish seine according to the vessel size is presented in Table 4 below.

Table 4

Danish seine production rate per trip according to the vessel length

Name of fishing vessel (FV)	*Vessel length (m)*	*Trip (times)*	*Production (kg)*			
			Total	*Average trip^{-1}*	*Min.*	*Max.*
FV. Sari Jati Mulya	10.50	18	8,403	467	259	714
FV. Sari Mulya	10.50	4	3,371	843	420	1,167
FV. Putri Timbul	11.40	23	12,370	538	272	863
FV. Bunga Indah 02	11.85	42	20,300	483	244	793
FV. Tirta Raya Mina 01	12.00	2	3,305	1,653	1,171	2,134
FV. Bunga Indah 01	12.20	40	22,514	563	378	899
FV. Tirta Raya Mina 02	12.50	6	6,391	1,065	610	1,790
FV. Sari Jati Untung	13.20	19	17,872	941	509	1,763
FV. Setia Kawan	13.60	13	7,387	568	306	899
FV. Setia Jaya	14.50	34	18,372	540	228	823

Table 4 shows that the average production of the Danish seine for each trip is different according to the length of the vessel. The results from the 10 Danish seines gave a difference in the value of landed fish production. However, this difference shows that the Danish seine with a larger size has almost the same efficiency as a smaller vessel. This is because the length of the vessel is not consistent with the size of the fishing gear. The relationship between the length of the vessel and the dependent variable, namely the production, is illustrated in Figure 4.

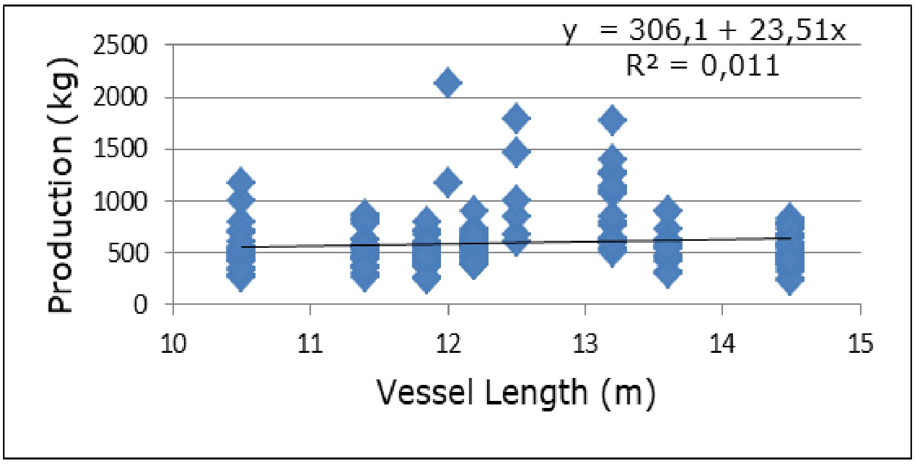

Figure 4. Graph of the relationship between production and vessel length.

In the equation described by the graph above, the correlation coefficient (R) is 0.104. In this case, the correlation between production and vessel length is weak and positive.

By squaring R, the coefficient of determination (R^2) can be obtained, which is useful for knowing how far the independent variable (x) can predict the dependent variable (y). From the graph above, it is known that the coefficient of determination (R^2) between production (y) and vessel size (x_1) is 0.011 which means that 1.1% of the production obtained is influenced by the vessel size and the remaining 98.9% is influenced by other factors (Ghozali 2011).

Danish seine production rate according to engine power vessels. According to the engine powers, the 10 sample vessels observed were divided in 2 categories, namely vessels with engine powers of 100 ps and 120 ps. There are 3 vessels with an engine power of 100 ps and 7 vessels with an engine power of 120 ps. The level of Danish seine production according to the vessel's engine power is presented in Table 5 and Figure 5.

Table 5

Danish seine production rate per trip according to the size of the engine power

Engine power (ps)	*Trip (times)*	*Production (kg)*			
		Total	*Average trip^{-1}*	*Minimum*	*Maximum*
100	64	32,074	501	244	1,167
120	137	88,211	644	228	2,134

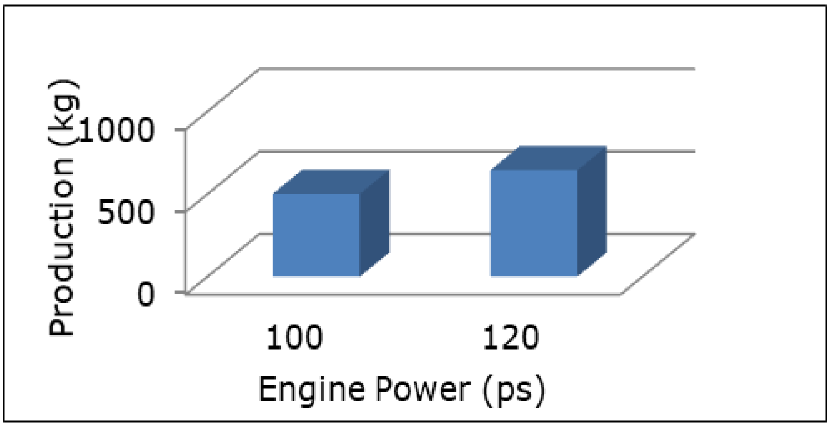

Figure 5. The average production rate according to engine power.

The table and graph above shows that the average production of a Danish seine for each trip is different according to the size of the vessel's engine power. The average production of a vessel with an engine size of 100 ps is 501 kg trip^{-1}, while for the larger vessel size, of 120 ps, it is of 644 kg trip^{-1}. The results of data processing from the 10 sample Danish seines gave a difference in the value of the fish production. This difference illustrates that a Danish seine with a larger engine power size has the ability to catch a larger volume of fish compared to a vessel with a smaller engine power, due to an accelerated fishing gear operating process.

Danish seine production rate according to total fuel oil. In terms of fuel consumption, the 10 sample vessels are divided into 11 categories. The level of production is shown in Table 6 and Figure 6 below.

Table 6

Danish seine production rate per trip according to the amount of fuel

No	*Fuel oil (L)*	*Trips (times)*	*Production (kg)*			
			Total	*Minimum*	*Maximum*	*Average trip^{-1}*
1	60	2	976	420	556	488
2	70	2	989	455	534	495
3	80	122	59,800	228	899	534
4	90	1	993	993	993	993
5	100	70	39,964	250	1,253	571
6	150	1	1,167	1,167	1,167	1,167
7	160	1	1,141	1,141	1,141	1,141
8	200	5	5,658	995	1,393	1,132
9	300	1	1,272	1,272	1,272	1,272
10	400	4	6,191	1,171	1,467	1,548
11	500	1	2,134	2,134	2,134	2,134

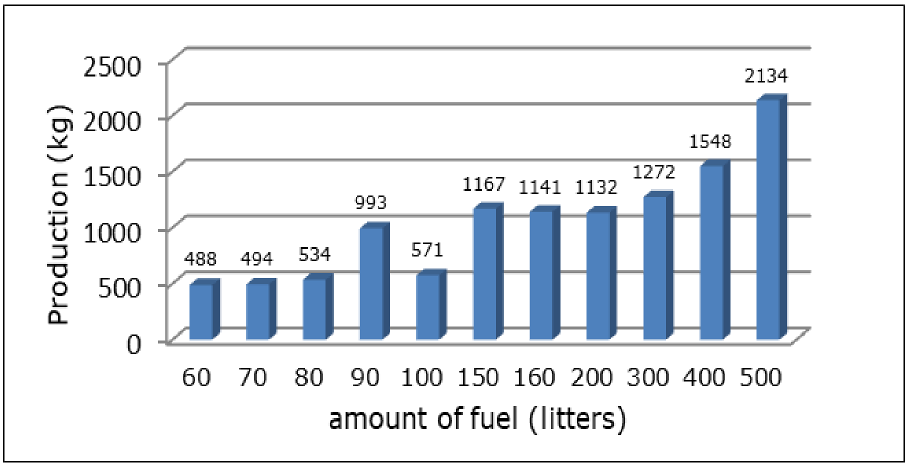

Figure 6. The average production rate according to the amount of fuel.

The table above shows that the average production of the Danish seine for each trip is different according to the amount of fuel. These results illustrate that the higher the amount of fuel, the higher the productivity of the catch. This is presumably because a higher fuel consumption is followed by a higher intensity and duration of the fishing gear operation. The relationship between the independent variable, namely the amount of fuel, and the dependent variable, namely the production, is illustrated in Figure 7 below.

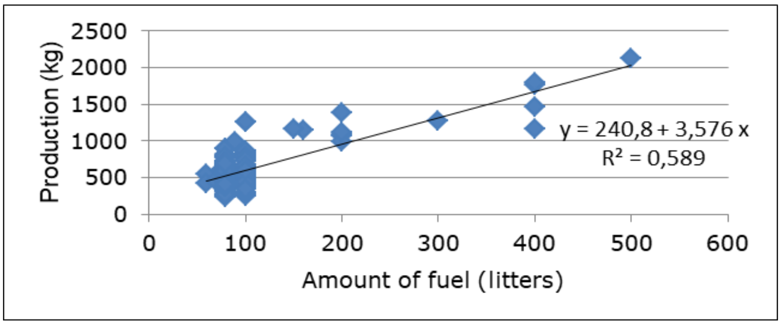

Figure 7. The relationship between production and amount of fuel.

In the equation described by the graph above, the correlation coefficient (R) is 0.767. From the correlation coefficient (R), it can be observed that the correlation between the production and the amount of fuel is strong and positive. The coefficient of determination (R^2) between production (y) and the amount of fuel (x_3) is 0.589, which means that 58.9% of the production obtained is influenced by the amount of fuel and the remaining 41.1% is influenced by other factors (Ghozali 2011).

Production rate of Danish seine according to the number of days per trip. Danish seine operating at AFP Karangantu generally have an average number of operating days of 1 day. However, of the 10 sample vessels, the number of days per trip was observed divided into 4 categories, namely: 1-day trips, 2-day trips, 3-day trips and 4-day trips. The level of Danish seine production according to the number of days per trip is shown in Table 7 and Figure 8 below.

Table 7

Danish seine production rate per trip according to the number of days per trip

Number of days trip^{-1}	*Trips (times)*	*Production (kg)*				
		Total	*Avg. trip^{-1}*	*Avg. day^{-1}*	*Min.*	*Max.*
1	180	95,719	532	532	228	899
2	16	16,019	1,001	501	505	1,272
3	4	6,413	1,603	534	1,393	1,790
4	1	2,134	2,134	534	2,134	2,134

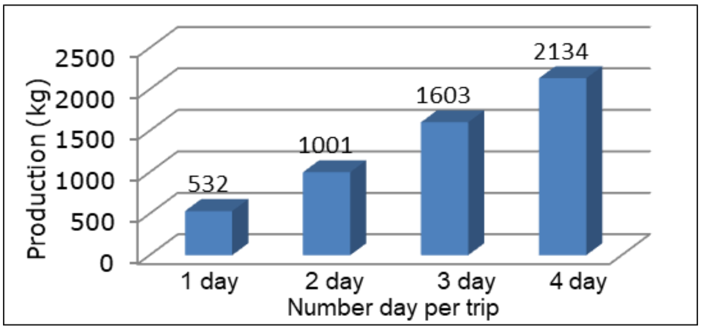

Figure 8. The average production rate according to the number of days per trip.

From the table and graph above, the average production of the Danish seine varies according to the number of days per trip. The average production of a Danish seine, with the number of days per trip of 1 day is 532 kg trip^{-1}, the number of days per trip of 2 days is 1,001 kg trip^{-1}, the number of days per trip of 3 days is 1,603 kg trip^{-1}, and the number of days per trip of 4 days is 2,134 kg trip^{-1}. These values illustrate that a Danish seine with more days per trip has the ability to get a larger catch of fish than for fewer days per trip. However, when averaged, the production per day tends to be the same and there is no significant change. The relationship between the independent variable, namely the number of days per trip, and the dependent variable, namely the production, can be seen in Figure 9 below.

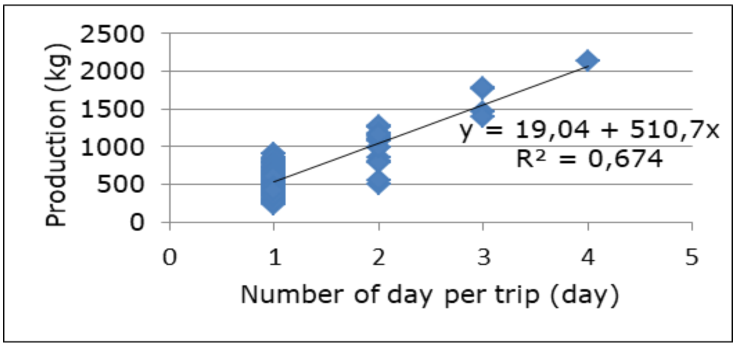

Figure 9. The relationship between production and the number of days trip^{-1}.

In the equation described by the graph above, the correlation coefficient (R) is 0.821. From the correlation coefficient (R), it can be observed that the correlation between the production and the number of days per trip is very strong and positive.

The coefficient of determination (R^2) between the production (y) and the number of days per trip (x_4) is 0.674 which means that 67.4% of the production obtained is influenced by the number of days per trip and the remaining is 32.6% influenced by other factors.

Danish seine production level according to operational costs. The Danish seine requires operational costs to meet its needs during fishing operations. The operational costs consist of the cost of fuel, engine oil, clean water, net equipment, ice, foodstuffs and others. The level of production of a Danish seine according to the operational costs used are presented in Table 8 and Figure 10 below.

Table 8

Danish seine production rate per trip according to operational costs

No	*Operating costs (USD)*	*Trip (times)*	*Production (kg)*			
			Total	*Average trip^{-1}*	*Minimum*	*Maximum*
1	51.28	28	15,961	570	361	899
2	54.95	5	2,503	501	285	714
3	55.68	1	420	420	420	420
4	57.14	1	501	501	501	501
5	58.61	46	23,280	506	228	993
6	62.27	20	10,230	512	276	899
7	65.93	44	24,269	552	263	843
8	69.60	15	9,124	608	362	863
9	73.26	22	11,124	506	250	793
10	80.59	2	1,161	581	350	811
11	87.91	3	3,358	1,119	852	1,253
12	109.89	1	791	791	791	791
13	124.54	1	1,167	1,167	1,167	1,167
14	161.17	1	1,141	1,141	1,141	1,141
15	168.50	1	1,077	1,077	1,077	1,077
16	175.82	1	1,393	1,393	1,393	1,393
17	183.15	3	3,188	1,063	995	1,084
18	190.48	1	1,272	1,272	1,272	1,272
19	241.76	1	1,790	1,790	1,790	1,790
20	256.41	1	1,763	1,763	1,763	1,763
21	278.39	2	2,638	1,319	1,171	1,467
22	318.68	1	2,134	2,134	2,134	2,134

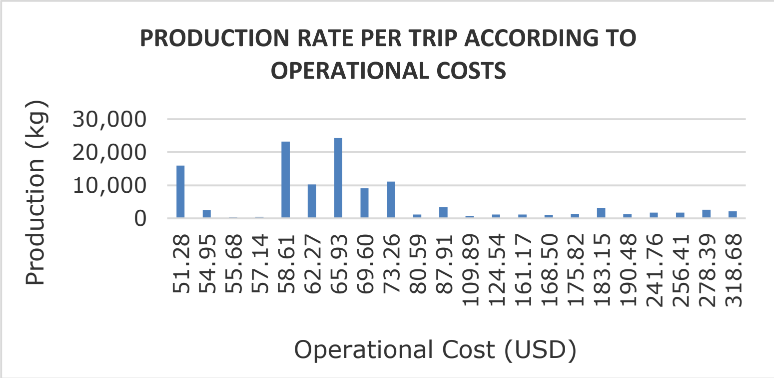

Figure 10. The average level of production according to the operational costs.

The table and graph above shows that the average production of a trip differs according to the operational costs. The results illustrate that a Danish seine with a higher operating cost has the ability to get a larger catch of fish than a vessel with a lower operating cost. The relationship between the independent variables, namely the operational costs and the dependent variable, namely the production, can be seen in Figure 11 below.

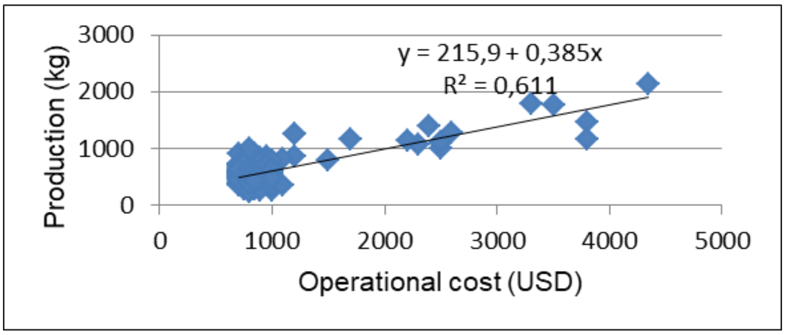

Figure 11. The relationship between production and operational costs.

In the equation described by the graph above, the correlation coefficient (R) is 0.782. The correlation between production and operational costs is strong and positive. The coefficient of determination (R^2) between production (y) and operational costs (x_5) is 0.611 which means that 61.1% of the production obtained is influenced by operational costs and the remaining 38.9% is influenced by other factors.

Danish seine production level according to number of crew members. The number of crew members is a factor that needs to be considered in the operation of the Danish seine. Each crew member has its respective role and function. Of the 10 sample vessels that were observed, the crews can be divided into 7 categories, namely with 4, 5, 6, 7, 8, 9 and 10 people. The level of production of the Danish seine according to the number of crew members used can be seen in Table 9 and Figure 12 below.

Table 9

Danish seine production rate per trip according to number of crew

No	*Number of crew (people)*	*Trips (times)*	*Production(kg)*			
			Total	*Aver. trip^{-1}*	*Minimum*	*Maximum*
1	4	3	2.204	735	420	993
2	5	41	21.580	526	228	1.167
3	6	64	32.448	507	250	899
4	7	69	45.264	656	224	1.790
5	8	16	8.932	558	350	717
6	9	5	5.429	1.086	543	2.134
7	10	3	4.428	1.476	1.272	1.763

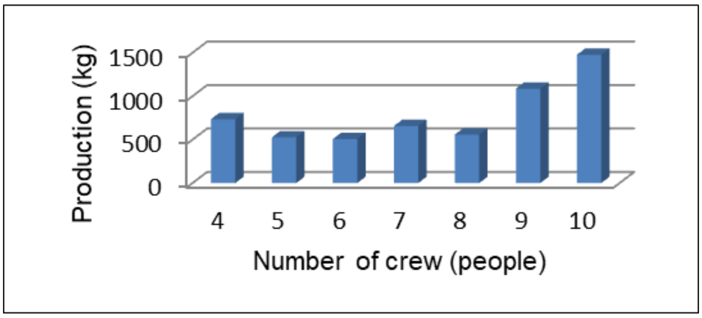

Figure 12. Average levels of production by number of crew.

The table and graph above shows that the average production of the Danish seine for each trip varies according to the size of the number of crew members used. This difference illustrates that a Danish seine with a larger crew has the ability to catch more fish than a vessel with a smaller crew. This is because more and more crew members will simplify and speed up the fishing gear operation.

The relationship between the independent variable, namely the number of crew members, and the dependent variable, namely the production, is described in Figure 13.

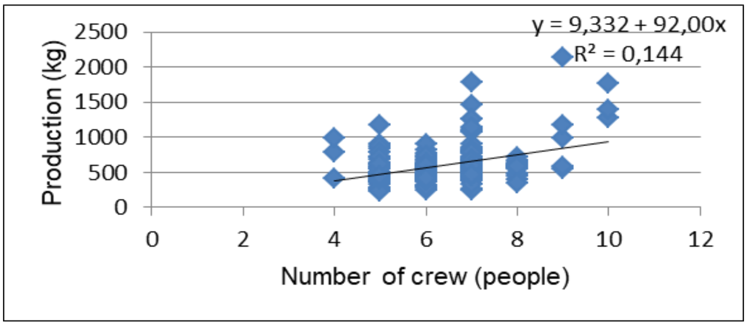

Figure 13. Relationship between production and number of crew members.

From the graph above, the correlation coefficient (R) is 0.379. The correlation between production and number of crew members is moderate and positive. The coefficient of determination (R^2) between production (y) and the number of crew members (x_6) is 0.144, which means that 14.4% of the production obtained is influenced by the number of crew members and the remaining 85.6% is influenced by other factors.

Combined factors affecting the productivity of Danish seine. To determine the influence of the linear combination of factors on the productivity of the Danish seine, a multiple linear regression analysis is performed. Data processing used the softwares Microsoft Excel and Statistical Product and Service Solutions (SPSS) version 17, with the parameter testing carried out at the significance level (α) of 5%. The results of the multiple regression analysis of variance can be seen in Table 10 (Suharso et al 2006).

Table 10

Analysis of variance multiple linear regression analysis of factors which affects the productivity of the Danish seine

No	*Source*	*Degrees of freedom*	*Sum of squares (JK)*	*Middle square (KT)*	F_{count}	*Probability > F*
1	Regression	6	1.043	1738443.139	83.661[a]	0.000
	Residue	194	4031244,511	20779.611		
2	Total	200	1.446			
3	R^2	0.721				
	R	0.849				

a-real at the 95% level (α=0.05).

The results of the analysis in Table 10 show that the coefficient of determination (R^2) is 0.721, which means that 72.1% of the productivity of the Danish seine (y) can be influenced by the variables: x_1 = length of the vessel, x_2 = engine power, x_3 = Amount of fuel, x_4 = number of days/trip, x_5 = operational costs, x_6 = number of crew, while the remaining 27.9% is influenced by other variables that are not included in the model.

The change in the Danish seine productivity can be explained with a 95% confidence level for all the 6 predefined variables (Suharso et al 2006).

The correlation coefficient (R) is used to determine the degree of closeness of the relationship between the dependent variable (y) and the independent variables (x). The results of the analysis showed that the coefficient (R) value is 0.849 with a positive sign, indicating that the dependent variable (y) has a strong relationship with the linear combination of independent variables (x).

Partial testing is used to test the effect of the independent variables individually on the dependent variable (y) using the t_{test}. A summary of the results of multiple linear regression analysis on the productivity of the Danish seine is presented in Table 11.

Table 11

Parameters value analysis of variance and multiple linear regression analysis of the factors affecting the productivity of the Danish seine

No.	*Explanatory description (x)*	*Regression coefficient (b)*	*t count*	*Probability > t*
1	Intercept	-514,355	-3,678	0,000
2	The length of the vessel (x_1)	13,069	1,251 [tn]	0,212
3	Engine power (x_2)	2,337	1,696 [tn]	0,092
4	Total fuel (x_3)	1,029	1,491 [tn]	0,138
5	Number of days per trip (x_4)	388,054	7,874 [a]	0,000
6	Operating costs (x_5)	-0,016	-0,199 [tn]	0,842
7	Number of crew (x_6)	24,687	2,423 [a]	0,016
8	The coefficient of determination (R^2)	0,721		

a-significant at the 95% confidence level (α=0.05); tn-not significant at the 95% confidence level (α=0.05).

After the data was analyzed, the following equation was obtained:

$$y = -514.355 + 13.069\,x_1 + 2.337\,x_2 + 1.029\,x_3 + 388.054\,x_4 - 0.016\,x_5 + 24.687\,x_6$$

Where:
y - productivity of the Danish seine (kg);
x1 - length of vessel (m);
x2 - engine power (ps);
x3 - fuel consumption (L);
x4 - number of days $trip^{-1}$ (days);
x5 - operational costs (USD);
x6 - number of crew (people).

The appropriate use of factors that affect productivity, can be determined from the production elasticity to each variable change, as follows:

1. The length of the vessel variable (x_1) does not have a significant effect (a probability level of 0.212). The variable x_1 has a regression coefficient (b_1) of 13.069. This means that each additional 1 m of vessel length will increase the productivity of the Danish seine by 13.069 kg (if the other variables are constant). The length of the vessel does not significantly determine the amount of the catch, since its increase is not necessarily accompanied by an increase in the size of the fishing gear. seine
2. The machine power variable (x_2) does not have a significant effect (a probability level of 0.092). The variable x_2 has a regression coefficient (b_2) of 2.337. This means that every addition of 1 PS of engine power will increase the productivity of the Danish seine by 2.337 kg (if the other variables remain constant).

The power of the engine (x_2) will determine the speed of the vessel when the vessel is moving towards the fishing ground. Vessels with relatively high speeds can reach the fishing ground more quickly. With a large engine power, the fishing gear operating process will also be faster.

3. The amount of fuel variable (x_3) does not have a significant effect (a probability level of 0.138). The variable x_3 has a regression coefficient (b_3) of 1.029. This means that each additional 1 L of total fuel will increase the productivity of the Danish seine by 1.029 kg (if the other variables are constant). The larger the amount of fuel, the longer the catching trip (and the gear's operating period)
4. The operating time per trip variable (x_4) has a significant effect (a probability level of 0.000, smaller than 0.05). The variable x_4 has a regression coefficient (b_4) of 388.054. This means that each additional 1 day of operation will increase the productivity of the Danish seine by 388.054 kg (if the other variables remain constant). This positive relationship shows that productivity is directly proportional to the loength of the operating days of the Danish seine.
5. The operational cost variable (x_5) has no significant or insignificant effect (a probability level of 0.842). The variable x_5 has a regression coefficient (b_5) of -0.016 and the effect is negative. This means that each additional USD 0.00007 of the operational costs will reduce the productivity of the Danish seine by 0.016 kg (if the other variables are constant).
6. The variable number of crew (x_6) has a significant effect with (a probability level of 0.016, smaller than 0.05). The variable x_6 has a regression coefficient (b_6) of 24.687. This means that each additional 1 crew member will increase the productivity of the Danish seine by 24,687 kg (if the other variables remain constant). This positive relationship shows that the productivity of the Danish seine is determined by the number of crew members. The number of crew members has a real effect because a larger number of crew members accelerates the operation of the fishing gear.

Conclusions. Based on the results and discussion previously described, it can be concluded that:

1. The FV. Tirta Raya Mina 01 has the highest catch rate, which is 1,652.5 kg a trip, while the FV. Sari Jati Mulya is the Danish seine carrier with the lowest catch rate, which is 466.8 kg trip^{-1}. However, if the rate of catch per day is averaged, there is no significant difference in the catch rates.
2. The correlation between the productivity of the Danish seine with the variable amount of fuel (x_3), number of days per trip (x_4), and operational costs (x_5) is very strong and positive. while the correlation between productivity and the variable number of crew members (x_6) is moderate and positive. Meanwhile, the correlation between productivity and vessel size variable (x_1) or engine power (x_2) is weak and positive.
3. The linear combination of the independent variables (x) which consists of: variable length of vessel (x_1), engine power (x_2), fuel consumption (x_3), number of days per trip (x_4), operational costs (x_5) and number of crew members (x_6) has a significant effect on the increase in the productivity of the Danish seine (y). However, individually (partially) only the variable number of days per trip (x_4) and the number of crew members (x_6) had a significant effect, while the other variables had no significant effect on the Danish seines' productivity increase seine(y).

Conflict of interest. The authors declare no conflict of interest.

References

Antika M., Kohar A., Boesono H., 2014 [Financial feasibility analysis of Danish Seine capture fisheries business at fish landing base (PPI) Ujung Batu Jepara]. Journal of Fisheries Resources Utilization Management and Tecnology 3(3):200-207. [In Indonesian].

Ardidja S., 2010 [Fishing vessel]. STP Press Jakarta, 189 p. [In Indonesian].

Diniah, Sobari M. P., Seftian D., 2012 [Archipelago Fisheries Port (AFP) services on the need for fishing operations]. Journal of Marine and Fisheries Socio-Economic Policy 2(1):41-49. [In Indonesian].
Fyson J. E., 1985 Design of small fishing vessels. Farnham, Surrey, U.K., Fishing News Books Ltd., 319 p.
Ghozali I., 2011 [Application of IBM SPSS 19 program multivariate analysis]. Diponogoro University Publishing Agency, Semarang, 68 p. [In Indonesian].
Gulland J. A., 1983 Fish stock assessment. A manual of basic method. FAO/Wiley Series on Food and Agriculture, Rome, 241 p.
Hamzah A., Pane A. B., Lubis E., Solihin I., 2015 [Superior fish potential as raw materials of processing industry in Karangantu Archipelagic Fishing Port]. Journal Marine Fisheries 6(1):45-58. [In Indonesian].
Makwinja R., Mengistou S., Kaunda E., Alemiew T., Phiri T. B., Kosamu I. B. M., Kaonga C. C., 2021 Modeling of Lake Malombe annual fish landings and catch per unit effort (CPUE). Forecasting 3:39–55.
Nedelec C., Prado J., 1990 Definition & classification of fishing gear categories. Food And Agriculture Organization of The United Nations, Rome, 92 p.
Nicholson W., 1999 [Economic micro]. Binarupa Aksara, 518 p. [In Indonesian].
Oktaviyani S., Boer M., Yonvitner, 2015 [Degradation and depreciation analysis of demersal fish resources on Dogol Fisheries in Sunda Strait]. Marine Fisheries 6(2):119-128. [In Indonesian].
Purnama A. S., Susanto A., Mustahal, 2015 Characteristics of Danish seine fishing boat in AFP of Karangantu Serang City-Banten. Journal of Agricultural and Fisheries Sciences 4(2):155-164.
Puspitasari N., Irnawati R., Susanto A., 2013 [Development strategy of Karangantu Archipelago Fishing Port (AFP), Serang City, Banten Province]. Journal of Agricultural and Fisheries Science 2(2):159-169. [In Indonesian].
Rahmawati E., Irnawati R., Rahmawati A., 2017 [The feasibility of boat lift net in the archipelagic fishing port of Karangantu Banten Province]. Journal of Fisheries and Marine Affairs 7(1):40–49. [In Indonesian].
Rizal A., 2013 [Fishery sector performance Banten Province]. Aquatics Journal 4(1):21-34. [In Indonesian].
Salvatore D., 1995 International economic. Prentice Hall, Englewood Cliffs, New Jersey, 778 p.
Sarjono H., 2001 [Productivity measurement model based on output per input ratio approach]. Journal The Winners 2(2):130-136. [In Indonesian].
Semedi P., Schneider K., 2021 Fishers' responses to the Danish Seiner ban and the history of fisheries governance on the Java North Coast. Springer Maritime Studies 20:43–62.
Shephard R. W., 1970 Theory of cost and production functions series: Princeton studies in mathematical economics. Princeton University Press, 322 p.
Sudirman, Musbir, Nurdian I., Sihbudi R., 2008 [Description of Danish seine fishing gear, by catch analysis and composition of fish caught in Takalar Waters]. Torani 18(2):160-170. [In Indonesian].
Sudirman, Mallawa A., 2004 [Fishing techniques]. Rineke Cipta, Jakarta, 39 p. [In Indonesian].
Sugiyono, 2015 [Educational research methods: (quantitative, qualitative and R&D approaches) Bandung]. Alfabeta (28):1-12. [In Indonesian].
Suherman A., Boesono H., Kurohman F., Muzakir A. K., 2020 [Performance of Karangantu Nusantara Fishing Port - Banten, Indonesia]. Depik Journal of Aquatic, Coastal and Fishery Sciences 9(2):344-355. [In Indonesian].
Suharso, Bambang N., Azis, Asriyanto, 2006 [Production elasticity of Tegal marine catching fisheries]. Pasir Laut Journal 2(1):26-36. [In Indonesian].
Tangke U., 2010 Evaluation and pole and line vessel design development at Dufa-Dufa Harbor North Maluku Province. Journal of Agribusiness and Fisheries Science 2(1):1-10.

*** MMAF, 2016 Classification of fishing tools. Directorate General of Capture Fisheries, Jakarta.
*** MMAF, 2021 https://desaindonesia.info/dimulai-di-pelabuhan-karangantu-kkp-terapkan-pnbp-pasca-produksi/
*** AFP, The Archipelago Fishery Port of Karangantu, 2015 Annual Report of the 2010 AFP Karangantu, Serang.

Received: 18 July 2021. Accepted: 27 September 2021. Published online: 06 October 2021.
Authors:
Erick Nugraha, Jakarta Technical University of Fisheries, Faculty of Fishing Technology, AUP Street, Pasarminggu 12620, South Jakarta, Indonesia, e-mail: nugraha_eriq1@yahoo.co.id
Bongbongan Kusmedy, Jakarta Technical University of Fisheries, Faculty of Fishing Technology, AUP Street, Pasarminggu 12620, South Jakarta, Indonesia, e-mail: bkhutapea@gmail.com
Hari Prayitno, Jakarta Technical University of Fisheries, Faculty of Fishing Technology, AUP Street, Pasarminggu 12620, South Jakarta, Indonesia, e-mail: hariprayitno46@gmail.com
Eddy Sugriwa Husen, Jakarta Technical University of Fisheries, Faculty of Fishing Technology, AUP Street, Pasarminggu 12620, South Jakarta, Indonesia, e-mail: sugriwastp@gmail.com
Eli Nurlaela, Jakarta Technical University of Fisheries, Faculty of Fishing Technology, AUP Street, Pasarminggu 12620, South Jakarta, Indonesia, e-mail: elimumtaza@gmail.com
Tonny E Kusumo, Jakarta Technical University of Fisheries, Faculty of Fishing Technology, AUP Street, Pasarminggu 12620, South Jakarta, Indonesia, e-mail: tonny_kusumo@yahoo.com
Sopiyan Danapraja, Jakarta Technical University of Fisheries, Faculty of Fishing Technology, AUP Street, Pasarminggu 12620, South Jakarta, Indonesia, e-mail: sopiyanraja@gmail.com
Yuli Purwanto, Faculty of Fishing Capture, Bitung Marine and Fisheries Polytechnic, Tandurusa street, Aertembaga Dua Bitung 95526, North Sulawesi, Indonesia, e-mail: yuli.purwanto38@gmail.com
Faisal Yusuf, Capture Fisheries Production Manager, Kendari Oceanic Fishing Port, Banawula Sin Apoy Street, Pudai Abeli, Kendari City 93231, Southeast Sulawesi, Indonesia, e-mail: faisalyusuf00@gmail.com

How to cite this article:
Nugraha E., Kusmedy B., Prayitno H., Husen E. S., Nurlaela E., Kusumo T. E., Danapraja S., Purwanto Y., Yusuf F., 2021 Analysis of production factors that affect the productivity of Danish Seine at the Archipelagic Fishery Port (AFP) of Karangantu, Banten Province, Indonesia. AACL Bioflux 14(5):2797-2811.