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EFFICIENCY OF RESOURCE USE IN SMALL-SCALE WHITE SHRIMP (*PENAEUS VANNAMEI*) PRODUCTION IN LAMONGAN REGENCY, EAST JAVA PROVINCE, INDONESIA

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Abstract. This study carried out to determine the efficiency of recourses used in white shrimp (*Penaeus Vannamei*) production in Lamongan Regency, East Java Province, Indonesia. The simple random sampling technique used to select 125 small-scale white shrimp farmers from six-study areas in Lamongan Regency. The white shrimp production function was estimated using Ordinary Least Square (OLS) technique. The results indicated that Double Log production function had the best fit in explaining the relationship between output of white shrimp and inputs used. The coefficient of determination (R^2 = 0.846) indicated that the eighty-four point six percent of variation in output of white shrimp was explained by the independent variables in the model. Findings showed that labor, fertilizer, feed and stocking density are significant determinants of production inputs. Moreover, the estimates of the ratio of the value of marginal product (VMP) to marginal factor cost (MFC) revealed that the non-optimal combination of inputs among the white shrimp farmers, it showed that the aquaculture farms resources were inefficiently utilized for labor, feed and stocking density by 1.94, 1.93 and 171.4 respectively, while fertilizer showed otherwise by 0.11 or over utilized.

Key words: production efficiency, white shrimp farming, intensive technology, small-scale, East Java Province

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INTRODUCTION

Aquaculture plays an important role to Indonesian fisheries in providing employment, food security, income, foreign exchange and securing livelihood for the people [Nurdjana 2006, Herianto 2010]. In addition, aquaculture activities can also reduce pressure on fishery resources and supporting rural economic development [The State... 2010]. According to Marine and Fisheries Statistic [Marine... 2010], millions of people in Indonesia depend on aquaculture for their livelihood. There were 1 099 684 households involved in the aquaculture industry, representing around 60.17% of the total number of people employed in the fisheries sector in 2009.

Indonesian aquaculture grew rapidly with an average growth rate of 21.47% between 2005 and 2009 [Marine... 2010]. According to Dyspriani [2007], the main activity and source of investment in aquaculture is shrimp farming. Shrimp production has grown significantly from 280 629 tons in 2005, and then production in 2009 reported to have risen to 338 062 tons. This represents an average annual increase of 5.73% in quantity since 2005. Increase in shrimp production triggered by export, local consumer demand and the Government policy on fishery revitalization.

The shrimp species that cultivated in Indonesia are still limited. At first, most of the shrimp farmers in Indonesia cultivate black tiger shrimp (*Penaeus monodon*). However, since they faced the harvest failure during 1990 until 2000 due to the outbreaks of shrimp diseases, some of them tried to cultivate white shrimp (*Penaeus vannamei*) and rostris shrimp (*Penaeus stylirostris*). These shrimps are not native species; the Indonesian Government has imported from Hawai and Taiwan in 2000 and 2001 respectively. The recent fast growth of white shrimp farming is due to its rapid reproduction compared to black tiger shrimp. White shrimp also have stronger endurance and can be cultivated with higher biomass density [Poernomo 2004]. Under the shrimp revitalization program in 2005, the extensive black tiger brackish water ponds with area of 140 000 ha (40% of extensive brackish water ponds) shifted to extensive white shrimp farming with target 0.6-1.5 ton/ha/years. Moreover, 8000 ha of intensive black tiger brackish water ponds shifted to intensive white shrimp farming with the target 20-30 ton/ha/years [Marine... 2006].

In general, shrimps are cultivated in brackish water ponds. Some characteristics of shrimp farming in Indonesia are small-scale, local ownership, low capital, technology, and productivity. According to size of management and input factors, shrimp farming is classified into small scale, medium and large scale. Small-scale farms are typically less than five ha in total brackish water pond areas usually operated by a family group and sometimes hired labor, simple facilities, and low level of management. In term of technology used in shrimp farming, it varies from location to location, depending on the level of technology applied. Based on stocking density and other supporting factor, shrimp farming in Indonesia has known four technologies in the shrimp cultivation, which are traditional, extensive, semi intensive and intensive.

In 2005, the Indonesian Government has stated that Indonesia should consider white shrimp as a source of raw materials for processing industry and enhancement of export volume from aquaculture commodities. In order to support Government policy to increase national shrimp production, white shrimp farmers in Lamongan Regency using intensive technology in their shrimp cultivation. Intensive technology is high cost technology. On the other hand, the white shrimp farmers in this area dominated with small-

-scale farmers. In production, small-scale farmers are often faced with the problem of scarcity of resources as their inputs of production due to limited capital and brackish water pond area. The level of efficiency in using resources is one of the important factors to improve the aquaculture farms production. Efficiency of resources used such as labor, fertilizer, feed, stocking density and other inputs will ensure sustainable of production.

This study attempts to provide some useful information towards increasing white shrimp production using intensive technology. Thus, this study examines the efficiency of resource use in white shrimp production on small-scale aquaculture farms.

METHODOLOGY

The study was conducted in Lamongan Regency, East Java Province, Indonesia. Currently, East Java Province is the third largest shrimp-producing province in Indonesia. Lamongan Regency was selected because it is one of the largest white shrimp producing area in East Java Province. Together with milkfish, white shrimp is the main commodities in this region. In 2010, white shrimp production reached 19 110 tons or 52.9% of total aquaculture production.

The total 125 small-scale white shrimp farmers from six-study areas (Labuhan, Brengkok, Sedayu Lawas, Kranji, Tlogosadang, and Kandang Semangkon) were selected using simple random sampling. Data collection was conducted in November 2011 to January 2012. This study considers four explanatory variables in modeling the production function for white shrimp production. Based on a technical knowledge, four inputs were considered important in explaining variation in output of white shrimp, these are quantities of labor, fertilizer, feed and stocking density. The variables considered are (1) labor includes both family and hired labor used for land preparation, pre and post aquaculture operations, harvesting and marketing. It will measure in labor-days used for white shrimp production per ha. (2) Fertilizer includes all fertilizers used by the aquaculture farm for white shrimp production and will be measured in kg per ha. (3) Feed is the quantity of formulated feed applied to the white shrimp production, measured in kg per ha. (4) Stocking density is the number of white shrimp fries applied to the white shrimp production, measured in fry per ha. Inputs and output price were also taken based on the prevailing market price in study areas during data collection.

To determine the relationship between output of white shrimp and the selected input variables, data were analyzed using the Ordinary Least Square (OLS) multiple regression technique. The Exponential, Double Log and Semi Log functional forms were used to determine which of the forms would best fit the relationship between output of white shrimp and the input as explanatory variables.

The functional forms fitted specified equation below:

a) exponential

$$\log Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + e \quad (1)$$

b) double Log

$$\log Y = b_0 + b_1\log X_1 + b_2\log X_2 + b_3\log X_3 + b_4\log X_4 + e \quad (2)$$

c) semi log

$$Y = b_0 + b_1\log X_1 + b_2\log X_2 + b_3\log X_3 + b_4\log X_4 + e \quad (3)$$

where:

- Y – output of white shrimp (kg per ha),
- X_1 – labor (man-days per production cycle),
- X_2 – fertilizer (kg per ha per production cycle),
- X_3 – feed (kg per ha per production cycle),
- X_4 – stocking density (fry per ha per production cycle),
- b – regression coefficient to estimate,
- e – error term.

The lead equation was chosen not only based on the value of the coefficient determination (R^2) and the significance of the regression parameters but also other econometric criteria, such as fulfillment to the assumptions of ordinary least square. At last, the Double Log functional form is the best for estimation of the parameters used in efficiency analysis. Efficiency of resource use was determined by ensuring the ratio of the value of marginal product to the inputs price was equal to one. Efficiency of resources used employed in white shrimp production expressed as follows:

$$\frac{MPP.P_{\overline{Y}}}{P_{\overline{X}}} = 1 \quad (4)$$

equation 4 can be rewritten as:

$$\frac{VMP}{P_{\overline{X}}} = 1 \quad (5)$$

where:

- $P_{\overline{Y}}$ – average of output price (IDR per kg),
- $P_{\overline{X}}$ – average of unit input price (IDR per unit inputs),
- MPP – marginal physical product,
- VMP – value of marginal product;

three scenarios can be observed:

a) $\frac{VMP}{P_{\overline{X}_i}} = 1$ X_i is optimal,

b) $\frac{VMP}{P_{\overline{X}_i}} < 1$ X_i is over utilized,

c) $\frac{VMP}{P_{\overline{X}_i}} > 1$ X_i is under utilized.

According to Debertin [2002], Soekartawi [2003] and Ugwumba [2010], a given resource optimally allocated when there is no divergence between its value of marginal product (VMP) and its acquisition cost (i.e. marginal factor cost or MFC). A firm maximizes its profit with respect to an input if the ratio of its VMP to MFC is unity. If the VMP is greater than the unit input price, it implies under utilization of the input and this indicates the scope for raising output efficiently by increasing the use of that particular input. Otherwise, if the value of marginal product is less than the input price, it implies over utilization and the firm should be reduced using particular input in production process.

RESULTS AND DISCUSSION

Socio-economic Characteristics of White Shrimp Farmers

Socio-economic characteristics of white shrimp farmers in the study areas in Table 1 showed that the white shrimp farmers whose ages less than 39 years constituted the majority. Overall, 67.2% fall into the productive age group of 20-49 years. Most of white shrimp farmers had the household size between four to six, but the size ranged from one to eight. In the study area, fish farming has become a hereditary occupation. They have been cultivating milkfish for the long time before white shrimp farming started in 2000. More than 80% of the sample stated that white shrimp farming had become their main occupation, while the remaining stated it as supplementary occupation. Furthermore, only 33.6% of white shrimp farmers have access to credit services due to lack of knowledge, restrictive procedure, lack of collateral and high interest rate.

Table 1. Socio-economic characteristics of white shrimp farmers
Tabela 1. Charakterystyka społeczno-ekonomiczna hodowców białej krewetki

Items Pozycja	Frequency Częstotliwość	%
1	2	3
Age (years) – Wiek (lata)		
≤ 39	48	38.4
40-49	36	28.8
≥ 50	41	32.8
$\bar{x}$	43.8	
Household Size (people) – Wielkość gospodarstwa domowego (osób)		
< 4	58	46.4
4-6	65	52
> 6	2	1.6
$\bar{x}$	3.6	
Occupation as White Shrimp farmers – Praca w charakterze hodowców białej krewetki		
main occupation – główne zajęcie	100	80
supplement – zajęcie dodatkowe	25	25

Table 1 – cont. / Tabela 1 – cd.

1	2	3
Access of credit – Dostępność kredytów		
have access to credit services mają dostęp do usług kredytowych	42	33.6
do not have access to credit services nie mają dostępu do usług kredytowych	83	66.4
Education (years schooling) – Wykształcenie (lata edukacji)		
< 6	7	5.6
6-9	67	53.6
> 9	51	40.8
$\bar{x}$	9.3	
Experience in White Shrimp Farming (years) – Doświadczenie w hodowli białej krewetki (lata)		
< 6	59	47.2
6-9	49	39.2
> 9	17	13.6
$\bar{x}$	6	
Land Holding (hectares) – Posiadana ziemia (ha)		
< 1	91	2.8
1-2	26	20.8
> 2	8	6.4
$\bar{x}$	0.78	
Number of Brackish Water Pond (ponds) – Liczba stawów z półsłoną wodą (stawy)		
1-2	104	83.2
3-4	11	8.8
> 4	10	8
$\bar{x}$	1.8	

One of the important and crucial aspects concerning planning decisions about production is the experience in white shrimp farming and education level of the white shrimp farmers. The white shrimp farmers in the study areas that have a senior high school certificate and the university degree reached 40.8% and 53.6% between six to nine years of schooling or junior high school level, while 5.6% in-group one to six years schooling or elementary school level. The results of the analysis revealed that 47.2% of white shrimp farmers had experience less than six years. However, 39.2% of the white shrimp farmers disclosed that they had experience between six to nine years, while 13.6% revealed that they had experience more than nine years.

The distribution of land holding in the study areas is shown in Table 1, which indicates that most of white shrimp farmers have the area of brackish water pond below one ha. The results revealed that 83.2% of white shrimp farmers had a number of brackish water pond between one until two. The average brackish water pond sizes are 0.42 ha;

this is a small size for brackish water pond. Most of white shrimp farmers in study areas are small farmers; they have limited resources and technology to manage their pond. Small pond size allows them to maintain water quality and health of white shrimp easier. Moreover, the small pond size requires fewer paddle wheels, means less investment required.

White Shrimp Farming and Production

In study areas, the white shrimp farmers were cultivating white shrimp twice a year, starting in May and November. The white shrimp fries require 110 to 130 days to grow up to the market size. The amount of white shrimp produced from brackish water pond per production cycles vary from place to place, which usually determined by the stocking density of white shrimp fry, natural mortality, level of management, and size of white shrimp when harvesting. Based on the results of the study, the average amount of white shrimp harvested was 5451 kg per brackish water pond (Table 2). Furthermore, the average productivity of white shrimp farming in the study areas was 13 116 kg per ha for the last production.

Table 2. Variables in white shrimp farming
Tabela 2. Zmienne w hodowli białej krewetki

	Unit Jednostka	Minimum Wartość minimalna	Maximum Wartość maksymalna	Mean Średnia	Price (IDR) Cena (w rupiach indonezyjskich) (IDR)
Yield Wydajność	kg/ha	3,500	9,430	5,451	46,375
Labor Praca	man-days dni robocze	160	216	188	64,700
Fertilizer Nawóz	kg/ha	1,590	3,830	2,412	47,400
Feed Pasza	kg/ha	6,300	13,200	9,036	13,350
Stocking density Gęstość obsady	fry/ha marybek/ha	190,000	560,000	353,271	55

The four inputs were observed in white shrimp production process are labor, fertilizer, feed and stocking density. Labor mainly used to prepare and manage the brackish water pond. With regards to labor use, the minimum value is 160 man-days and maximum arise to 216 man-days, which are depended on the size of brackish water pond and stocking density. Fertilizer and white shrimp feed referred to the quantity of fertilizer and formulated feed used in white shrimp production. In practice, the cost of feed is the highest ones among the costs for all inputs in white shrimp production. On the average, one brackish water pond was using 2412 kg of fertilizer and 9036 kg of formulated feed, depending on the size and environmental condition of brackish water pond, stocking density, natural mortality and the feeding rate. In the study areas, the white shrimp cultivated in brackish water ponds with different stocking density levels, the minimum value for stocking density was 190 000 and maximum arose to 560 000 fries per brackish water pond which was depended on the size of brackish water pond.

The farmers interviewed to elicit the problems relating to various aspects in white shrimp production (Table 3). The main problem faced by the farmers in white shrimp production is white shrimp diseases. About 37.6% of white shrimp farmers stated that one of their brackish water ponds was infected by *White Spot Syndrome Virus* (WSSV) or *Infectious Myonecrosis Virus* (IMV) in the last production cycle. Lack of capital to improve their production was the second problem raised by 22.4% of the farmers. The third problem was the quality of white shrimp fries (12.8%). In general, white shrimp farmers in study areas using *Specific Pathogen Free* (SPF) white shrimp fries. Lack of knowledge in white shrimp farming and poor environmental management has triggered the spread of disease.

Table 3. Problems in white shrimp farming
Tabela 3. Problemy w hodowli białej krewetki

Problems Problemy	Frequency Częstotliwość	%
Diseases – Choroby	47	37.6
Lack of capital – Brak kapitału	28	22.4
Insufficient Quality of White Shrimp Fry Niewystarczająca jakość narybku białej krewetki	16	12.8
Low Price of Shrimp Niska cena krewetki	12	9.6
Water Pollution from Human Activities Zanieczyszczenie wody spowodowane działalnością ludzką	9	7.2
High Production Costs Wysokie koszty produkcji	8	6.4
Inappropriate Pond Design Niewłaściwy projekt stawu	5	4

Efficiency analysis

The multiple regression analysis carried out to examine the determinants of factors effecting output in aquaculture farms by small-scale farmers in Lamongan Regency. The results of the regression analysis of factors influencing output of white shrimps are show on Table 4. The results indicated that Double log functional form had the best fit in explaining the relationship between output of white shrimp and inputs used, the coefficient determination ($R^2 = 0.846$) indicated that 84.6% of variation in output of white shrimp is explained by the independent variables, while the rest 15.4% of the variation was due to other variables that were not included in the model. The overall regression result was significant as $F_{Statistic}$ value of 164.9585 and significant at 1% level of probability. This provides evidence that the combination of labor, fertilizer, feed and stocking density had an impact simultaneously on output of white shrimp in the study areas. Again, the Durbin-Watson value of 1.99, which is approximately equal to two, indicated the absence of multicollinearity.

Table 4. Estimate of double log functional form
Tabela 4. Szacunkowa wartość postaci funkcyjnej podwójnego logarytmu

Variable Zmienna	Coefficient Współczynnik	$t_{Statistic}$ $t_{statystyczne}$	Probability Prawdopodobieństwo
Constant Stała	–10.121	–10.146	0.0000
Log X_1 Logarytmiczna X_1	1.653	10.923	0.0000
Log X_2 Logarytmiczna X_2	0.106	1.783	0.0770
Log X_3 Logarytmiczna X_3	0.589	7.643	0.0000
Log X_4 Logarytmiczna X_4	0.302	4.447	0.0000
$F_{Statistic}$ $F_{statystyczne}$	164.958		0.0000
R^2 Współczynnik determinacji R^2	0.846		
R^2 Adj. Dopasowany współczynnik determinacji R^2	0.840		
D – W	1.994		

The Double log functional form showed that all inputs positively related to the output of white shrimp. The estimated coefficients are positive; the coefficients of labor, fertilizer, feed, and stocking density are 1.653, 0.106, 0.589 and 0.302 respectively. Furthermore, labor, feed, and stocking density significantly affect the output of white shrimp at 1%, while fertilizer at 10% level of probability. Thus, it can be inferred that for every 1% increase in the use of labor from its present average level of 188 man days to 190 man days, output of white shrimp will increase by 1.65%; that is by 89.9 kg, ceteris paribus. Increasing by 1% in the use of fertilizer from its present average level of 2412 kg to 2437 kg will increase output of white shrimp, by 0.1% that is by 5457 kg, ceteris paribus. Moreover, increase by 1% in the use of feed from its present average level of 9036 kg to 9126 kg will increase output of white shrimp, by 0.5% that is by 5483 kg, ceteris paribus. For stocking density, increase by 1% from its present average level of 35 3271 white shrimp fry/ha to 35 6803 white shrimp fry/ha will increase output of white shrimp, by 0.3% that is by 5468 kg, ceteris paribus.

The value of marginal product (VMP) to marginal factor cost (MFC) ratios of resources in the production of white shrimp has been present in Table 5. From the findings of the study, it can be concluded that aquaculture farm resources were not efficiently utilized for white shrimp production. The allocative ratio for labor, fertilizer, feed, and stocking density was 1.94, 0.11, 1.93 and 171.4 respectively. By these results, labor, feed and stocking density were underutilized having allocative efficiency ratios greater than one while fertilizer with allocative efficiency ratio below one were over utilized. Lack of capital is one factor that led to the white shrimp farmers failure to use

Table 5. Estimated Value of Marginal Product (VMP), Marginal Factor Cost (MFC) and allocative efficiency ratios
Tabela 5. Szacunkowa wartość produktu marginalnego, marginalnego kosztu czynnika i wskaźników efektywności alokacyjnej

Variable Zmienna	VMP Wartość produktu marginalnego	MFC Marginalny koszt czynnika	Allocative efficiency Efektywność alokacyjna	Decision Decyzja
X_1	125 525	64 700	1.94	under utilized niewykorzystany w pełni
X_2	5 448	47 400	0.11	over utilized nadmiernie wykorzystany
X_3	25 781	13 350	1.93	under utilized niewykorzystany w pełni
X_4	9 429	55	171.4	under utilized niewykorzystany w pełni

inputs in optimal proportions, this implies that there is potential for white shrimp farmers to improve on production by increase labor, feed and stocking density in their brackish water pond.

Further, the result explained that with other inputs held constant, increasing labor by one unit would increase total value product by IDR 125 525. For another inputs, increasing feed and stocking density by one unit would increase the total value product by IDR 25 781 and IDR 9429 respectively. On the other side, fertilizer was employed above the optimum level, implying that fertilizer is been over utilized as indicated by its allocative efficiency ratio of 0.11. The reason behind over utilization of fertilizer inputs was attributed by the use of lime ($CaCO_3$) and dolomite [$CaMg(CO_3)_2$] in large quantities to increase the pH of mud in bottom of brackish water pond. Therefore, to improve efficiency in shrimp production, the white shrimp farmers should reduce fertilizer in their production.

CONCLUSION

The study examined the efficiency of resource use in aquaculture farms by small-scale white shrimp farmers in Lamongan Regency, East Java Province, Indonesia. The result indicated that there was inefficiency in the allocations of three inputs, namely labor, fertilizer, feed and stocking density among white shrimp farmers in the study area. Based on the result, the allocative efficiency ratios for labor, fertilizer, feed, and stocking density was 1.94, 0.11, 1.93 and 171.4 respectively. It was concluded that white shrimp farmers were inefficient in the use of aquaculture farm resources. The results reveal that the allocative ratios are greater than unity for labor, feed and stocking density. These ratios show that too few of the respective resource inputs, such as labor, feed and stocking density, were used in the white shrimp production process.

Hence, the white shrimp farmers are inefficient in the use of the available factors of production. This implies that production could increased by increasing the use of these inputs. Too little use of the inputs by the white shrimp farmers are reflection of high prices of inputs, lack of credit and inadequacy of cash for purchasing feed and white shrimp fries. Otherwise, fertilizer on white shrimp aquaculture farms was employed above the economic optimum level, implying that fertilizer is been over utilized as indicated by its allocative efficiency ratio of 0.11.

REFERENCES

Debertin D.L., 2002. Agricultural production economics. MacMillan.

Dyspriani P., 2007. Governance and the study of shrimp revitalization program in Indonesia. Department of Social and Marketing Studies Norwegian College of Fisheries Sciences, University of Tromsø.

Herianto A.S., 2010. Agricultural fisheries extension in Indonesia – origins. Transportation and current challenges. Ext. Farm. Syst. J. 6, 1.

Marine and fisheries statistics. 2006. Manister of Marine Affairs and Fisheries Republic of Indonesia, Jakarta.

Marine and fisheries statistics. 2010. Minister of Marine Affairs and Fisheries Republic of Indonesia, Jakarta.

Nurdjana M.L., 2006. Indonesia aquaculture development. International Workshop on Innovative Technologiesfor Eco-Friendly Fish Farm Management and Production on Safe Aquaculture Food. Bali.

Poernomo A., 2004. Historical development of shrimp farming and technology in the brackish water pond. National Symposium on Scientific Development and Aquaculture Technology, (p. 18). Jakarta.

Soekartawi. 2003. Principles of agricultural economics, theory and its application. Raja Grafindo Persada, Jakarta.

The State of World Fisheries and Aquaculture. 2010. Food and Agricultural Organisation, Rome.

Ugwumba C.O., 2010. Allocative efficiency of 'Egusi' melon (*Colocynthis citrullus lanatus*) production inputs in Owerri West Local Government Area of Imo State, Nigeria. Journal Agricultural Science 1, 1: 95-100.

WYDAJNOŚĆ WYKORZYSTANIA ZASOBÓW W PRODUKCJI BIAŁEJ KREWETKI (*PENAEUS VANNAMEI*) NA MAŁĄ SKALĘ W REGENCJI LAMONGAN, PROWINCJI WSCHODNIA JAWA W INDONEZJI

Streszczenie. Badanie przeprowadzono w celu ustalenia wydajności wykorzystania zasobów w produkcji białej krewetki (*Penaeus vannamei)* na małą skalę w regencji Lamongan, prowincji Wschodnia Jawa w Indonezji. Metoda prostej próby losowej została użyta do wyboru 125 hodowców białej krewetki na małą skalę spośród sześciu obszarów badawczych na terenie regencji Lamongan. Funkcję produkcyjną białej krewetki ustalono za pomocą metody najmniejszych kwadratów. Wyniki wykazały, że funkcja produkcyjna podwójnego logarytmu była najbardziej odpowiednia do wyjaśnienia związku pomiędzy wydajnością białej krewetki a zastosowanym wkładem. Współczynnik determinacji (R2 = 0,846) wskazał, że 84,6% zmienności w wydajności produkcji białej krewetki zostało objaśnione przez zmienne objaśniające w modelu. Wyniki wykazały, że praca, nawóz, pasza i gęstość obsady są istotnymi wyznacznikami wkładu produkcyjnego. Ponadto szacunkowe kalkulacje wskaźnika wartości produktu marginalnego do marginalnego kosztu czynnika wykazały nieoptymalne połączenie wkładu wśród hodowców białej krewetki. Wykazały, że gospodarstwa akwakulturowe nie są wydajnie wykorzystywane pod względem pracy, paszy i gęstości obsady, gdzie wskaźniki wyniosły odpowiednio 1,94, 1,93 i 171,4. Natomiast wskaźnik dla nawozu osiągnął wartość 0,11, czyli był nadmiernie wykorzystywany.

Słowa kluczowe: wydajność produkcji, hodowla białej krewetki, technologia intensywna, mała skala, prowincja Wschodnia Jawa

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