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EFFICIENCY ANALYSIS OF PROCESSED FISHERY PRODUCTS WITH DATA ENVELOPMENT ANALYSIS METHOD

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Abstract

This study aims to measure the efficiency level of processed fishery products in Teluk Santong Village and provide strategies for solving inefficiency problems that occur in the business. This study uses secondary data, namely Fish Resources (SDI), production costs, and the number of workers as input variables and profits as output variables. The analytical tool used is Data Envelopment Analysis (DEA) with the assumption of a Constant Return to Scale (CRS) model.

The results of the analysis showed that salty and small crab products were efficient, while shrimp paste, fish crackers, empek-empek, and shredded products were inefficient. The use of managerial strategies in DEA can overcome the problem of inefficiency in products by increasing profits by 14.5% for shrimp paste, 60% for fish crackers, 45.2% for empek-empek, and 64.9% for shredded fish.

Keywords: Efficiency, Data Envelopment Analysis, Industrial Economy, Fishery Products, Constant Return to Scale

INTRODUCTION

The industrial sector, especially the manufacturing industry, is currently a sector that gets special attention in development, both at the national and regional levels. Focusing on the development of the industrial sector is important in order to encourage the economic growth of a region/region with rapid acceleration. Considering that Indonesia is a maritime country where 2/3 of its territory is ocean, it certainly has extraordinary fishery potential. The abundance of potential fishery products is a big capital in order to develop the industrial sector in coastal areas in Indonesia.

One area that has the potential to develop processed fishery products is Teluk Santong Village. This village is located in Plampang District, Sumbawa Regency. Santong Bay, which is included in the coastal village category, is one part of the SAMOTA strategic area (Saleh Bay, Moyo, and Tambora). SAMOTA is a strategic area initiated by the NTB Provincial Government which is directed at regional economic development and is intended to become world-class maritime tourism and economic destination in the NTB Province.

Based on its potential, in the document for accelerating the development of SAMOTA, Teluk Santong Village is directed at the priority of developing the fishery sector, which focuses on the center of the fishery product processing industry and the culinary tourism center.(PPIK Samota Team, 2017). Based on the results of an initial survey conducted by researchers in Teluk Santong Village, there are several processed fishery products that have the potential to be developed to turn Santong Bay into a center for the fishery product processing industry and culinary tourism. These products include crab, salty (shrimp sauce), shrimp paste, shredded fish, fish crackers, and empek-empek.

In the economic context, the processing of these products includes upstream and downstream industries. The upstream industry includes hatcheries, equipment, and machinery, then the downstream industry includes the product and service processing industry. Therefore,

connectivity between the fisheries sector as a provider of raw materials and the industrial sector needs to run efficiently.

As an initial step to develop processed fishery products in Teluk Santong Village, an academic study is needed that places more emphasis on achieving efficiency in the processing process. This will be one of the strategic steps to develop the industrial sector in Teluk Santong Village which leads to the acceleration of the SAMOTA area in the Province of NTB.

THEORETICAL BASIS

Importance of Fishery Sector Agroindustry as a Comparative Advantage

According to Daryanto (2010), The agricultural sector in a broad sense (including the fishery sector) has been proven to have an important role in the economic development of a country. This is based on the contribution of the agricultural sector which does not only play a role in the formation of GDP, creation of job opportunities, increasing people's income, and earning foreign exchange. In the context of the regional economy, the potential of the fisheries sector is a comparative advantage for Indonesia, which incidentally is an archipelagic country.

The concept of comparative advantage was first put forward by David Ricardo (1917) when discussing trade between two countries. In this theory, Ricardo proves that if there are two countries that trade with each other and each country concentrates on exporting goods which for that country have a comparative advantage, both countries will be lucky. It turns out that this idea is not only useful in international trade but is also very important to pay attention to in the regional economy(Dance, 2010). The theory of comparative advantage itself is identical to the pure export base theory which was first developed by Tiebout. Basic activities are activities that are exogenous, meaning that they are not tied to the internal conditions of the regional economy and also function to encourage the growth of other types of work(Dance, 2010).

The theory of economic basis then bases its view that the rate of economic growth of a region is determined by the magnitude of the increase in exports from that region. The growth of industries that use local resources, including labor and raw materials for export, will generate regional wealth and create job opportunities(Arsyad, 2012).

Overview of Efficiency

Production efficiency is optimizing or maximizing the value of output based on several inputs, both in terms of quantity and economic value (Kirana, 2001). In other words, inputs that result in wastage need to be avoided, so that there are no unused resources. Efficiency in the economy consists of technical efficiency and allocation efficiency. Technical efficiency is a combination of the capacity and ability of an economic unit to produce up to the maximum level

of output from the number of inputs and technology, while allocation efficiency is the ability and willingness of an economic unit to operate at the level of marginal product value equal to marginal cost, MVP=MC(Saleh, 2000).

Other definitions of Efficiency is the ability to achieve an expected result (output) at the expense of minimal (input)(Sa'diyah, 2016). An activity has been said to be efficient if the implementation of the activity has achieved the target (output) with the lowest sacrifice (input), so that efficiency can be interpreted as the absence of waste.(Nicholson, 2002). according to Soekartawi (2003) Price efficiency is achieved when the ratio between the marginal production value (NPM) of each input and the input price is equal to 1 (one). This condition requires the Marginal Production Value (NPM), equal to the price of the production factors Px.

$$NPM = Px$$

$$bY.\frac{Py}{x} = 1$$

According to Soekartawi (2003) the actual fact that the above equation is not equal to 1 (one), which often happens is:

1. (NPM /Px) > 1, this means that the use of production factor x is not yet efficient, in order to achieve efficiency, the use of production factor x needs to be increased.
2. (NPM /Px) < 1 this means that the use of production factor x is not efficient, so it is necessary to reduce production factor x in order to achieve efficiency.

A use of production factors is said to be technically efficient if the production factors used produce maximum production. Price efficiency (allocative) occurs when the Marginal Product Value (NPM) is the same as the factor of production. And economic efficiency occurs when the company has achieved technical efficiency and price efficiency (allocative).

Data Envelopment Analysis (DEA)

Efficiency can be measured using ratio analysis and regression analysis. Efficiency is done by using ratio analysis is to use a comparison between the input used and the output used. This method has the disadvantage that there will be a lot of unused input and output.

Worthington and Dollery (2000)suggests that there are at least four approaches that can be used in analyzing efficiency. These approaches are the Deterministic Frontier Approach (DFA), Stochastic Frontier Analysis (SFA), Data Envelopment Analysis (DEA) / DEA approach and the Free Disposal Hull (FDH) / FDH approach. DEA analysis is a tool used to measure the relative efficiency of a unit of production in conditions of many inputs and many outputs, which is usually difficult to completely circumvent by other efficiency measurement analysis techniques

(Sa'diyah, 2016). Some of the reasons for choosing DEA analysis to measure efficiency are as follows (Saleh, 2000).

1. The weighting of the assessment for each performance determining variable is carried out objectively.
2. DEA is an analysis of extreme points that are different from the central tendency, so that each observation or unit of economic activity is analyzed individually.
3. DEA establishes a hypothetical reference (*virtual production function*) based on existing observational data.

According to Saleh (2000), the main problem in using the DEA model is the determination of inputs and outputs. Some of the reasons for choosing variables with the DEA model are:

1. The closeness of the selected variables to the performance of UKE can be determined by ranking the variables. Because not all variables are included in the model.
2. The level of data accuracy. For this reason, a good knowledge of the field is needed. The selected variable should have valid data. This will affect the performance measurement results of each UKE.
3. Variable specifications must be clear. The definition given must include the object clearly.

Decision Making Unit (DMU) is a term used for the unit whose efficiency is to be measured. In this case, research using the DEA approach will analyze the relative efficiency of a DMU in one observation group to another DMU(Sa'diyah, 2016). The first prime DEA model used, known as the Constant Return to Scale (CRS) model, assumes that every DMUs has been operating at an optimal scale.

RESEARCH METHODS

This research was conducted in Teluk Santong Village, Plampang District, Sumbawa Regency, West Nusa Tenggara. Respondents in this study were business actors engaged in the processing of fishery products. The data used in this study is primary data. The data used in this study is data on production costs, use of fish resources (SDI), the number of human resources and profits.

The data used is the average data of these components. This research was conducted to determine the relative efficiency of industrial units based on input and output conditions. The input variables in this study are the number of fish resources used, the total cost of production and the number of workers or Human Resources (HR) involved in production activities. The output variable in this study is the average operating profit per month. The analytical tool used in

this research is Data Envelopment Analysis (DEA). The data processing is carried out using the Win4Deap 2 software.

The model used in this research is Constant Return to Scale (CRS). In general, the model is formulated as follows (Saleh, 2000).

Maximize

$$h_n = \frac{\sum_{j=1}^{J} V_j Y_{jn}}{\sum_{i=1}^{I} U_i X_{in}}$$

With limitations

$$\sum_{j=1}^{J} U_j X_{jn} - \sum_{i=1}^{I} U_i X_{im} \leq 0, \qquad \sum_{i=1}^{I} U_i X_{in} = 1$$

$$V_j , U_i \geq \varepsilon$$

Where,

n : DMU, $\mathrm{n} = 1, 2, 3, \ldots, \mathrm{N}$

j : Jumlah output, $\mathrm{j} = 1, 2, 3, \ldots, \mathrm{J}$

i : Jumlah oinput, i = 1, 2, 3, …, I

Y_{jn} = Nilai dari output ke $-\ j$ dari DMU ke $-\ n$

X_{in} = Nilai dari input $ke - i$ dari DMU ke $-\ n$

ε = angka positif yang kecil

V_j , U_i = Bobot untuk output j, input i $(\geq \varepsilon)$

h_n = efisiensi relatif DMU $-\ n$

The stages in this research are

1. Data collection
2. DMU determination
3. Identify input variables and output variables
4. Identify the DEA mathematical model
5. DEA calculation using Win4Deap 2 software
6. Data analysis technique

RESULTS AND DISCUSSION

Efficiency Analysis With DEA

The efficiency values of each product are as follows.

Table 1. Efficiency Value of Processed Fishery Products in Teluk Santong Village

Business	Efficiency Value
Crab	100%
Shrimp paste	85.5%
salty	100%
Fish Crackers	39.9%
Empek-Empek	54.7%
Shredded Fish	35.1%

Source: processing results with Win4Deap 2

Based on the results of the calculations above, it was found that the small crab and fish business had an efficiency value of 100%. This means that the performance of these businesses is efficient, while the other four businesses, namely shrimp paste, empek-empek, fish crackers and shredded fish are not efficient. The smallest efficiency value is in shredded fish with an efficiency level of 35.1%.

Improvement Strategy Based on Efficiency Score or Weight

DEA analysis is able to provide scenarios or improvement values for each inefficient unit of economic activity or business. The efficiency value obtained based on the calculation of the shrimp paste business is 86.2%. The results of the managerial simulation conducted by DEA show that the shrimp paste business is too wasteful to use production costs and the amount of human resources. For this reason, the shrimp paste business must be able to reduce SDI by 15% and production costs by 14.5%. Thus, this scenario can increase profits by 14.5%.

Table 2. Scenarios of Terasi Product Improvement

Input (-)	Output(+)	actual	Target	To gain	Achieved
SDI		20	17	15%	85%
Cost		650000	556016	14.5%	86.5%
HR		2	2	0%	100%
	Profit	750000	876773	14.5%	86.5%

Source: processing results with Win4Deap 2

The strategy taken to overcome the problem of inefficiency in the fish cracker business is to reduce 50% of the use of SDI and reduce costs by 60%. With this optimization, profits can be increased by 60%.

Table 3. Fish Cracker Product Improvement Scenarios

Input (-)	Output(+)	actual	Target	To gain	Achieved
SDI		4	2	50%	50%
Cost		130000	51894	60%	40%
HR		2	2	0%	100%
	Profit	70000	175354	60%	40%

Source: processing results with Win4Deap 2

The problem of inefficiency in empek-empek can be overcome by reducing the use of SDI by 47% and costs by 45%. Thus, the profit can be increased to 45.2%.

Table 4. Scenarios for the Improvement of Empek-Empek Products

Input (-)	Output(+)	actual	Target	To gain	Achieved
SDI		15	8	47%	53%
Cost		975000	533685	45%	55%
HR		1	1	0%	100%
	Profit	375000	685094	45.2%	44.8%

Source: processing results with Win4Deap 2

Likewise with the problem of inefficiency that occurs in shredded fish products. This problem can be solved by reducing 60% of SDI usage and 65% of costs, so that profits can be increased by 64.9%.

Table 5. Scenarios of Fish Shredded Product Improvement

Input (-)	Output(+)	actual	Target	To gain	Achieved
SDI		5	2	60%	40%
Cost		320000	112240	65%	35%
HR		1	1	0%	100%
	Profit	80000	228082	64.9%	35.1%

Source: processing results with Win4Deap 2

CONCLUSION

Based on the DEA analysis, it is found that the crab and salted products have an efficiency level of 100%, which means that both products are efficient. Terasi products, fish crackers, empek-empek and shredded have an efficiency level below 100%, which means the product is inefficient. Some of the strategies adopted to overcome the problem of inefficiency are as follows.

1. Reduce SDI by 15% and production costs by 14.5% in shrimp paste production activities to increase profits by 14.5%.
2. In order to increase profits by 60%, the production of fish crackers reduces the use of human resources by 50% and reduces costs by 60%.
3. The problem of inefficiency in empek-empek can be overcome by reducing the use of SDI by 47% and costs by 45%, so that profits can be increased to 45.2%.
4. The problem of inefficiency that occurs in shredded fish products is solved by reducing 60% of the use of SDI and 65% of costs, so that profits can be increased by 64.9%.

In this research, only three inputs are used, namely natural resources, human resources and costs, while the output is profit. This research can be developed by adding other input variables such as technology availability, production time, amount of initial capital and marketing. Output variables can also be developed such as by increasing the amount of production.

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