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Spatial Equilibrium of Tilapia (*Oreochromis niloticus bleeker*) Market in South Borneo Province, Indonesia

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Abstract

The purpose of this research is to analyze the spatial equilibrium of tilapia marketing system in South Borneo Province. The analysis method used is quantitative analysis of two approaches, named (a) Spatial Price Equilibrium Analysis and (b) Programming Linier Analysis. The analysis showed that the price equilibrium decrease after the optimization, while the producer and consumer surplus increase, which caused the increasing of consumer and producer welfare in the tilapia commodity market. In the optimal distribution concept, the transportation cost must be minimum, to achieve the better tilapia marketing system. Therefore, government needs to increase the information access in the tilapia marketing system in South Borneo Province, so that the allocation of tilapia commodity to any area can be control.

Keyword: Tilapia, Price equilibrium, Optimal distribution, Welfare

1. Introduction

The characteristic of the aquaculture commodities is the production scale located in many places, which caused the commodities distribution inefficient, and the comparative benefit can be found only in a few places as the production center (Hanafiah and Saefuddin, 1996). In the South Borneo Province, there are some tilapia productions centers that expected to be enable to fulfill the demand of tilapia in the deficit area. It is known based on the total production in each region as shown in Figure 1 (South Borneo Bureau of Marine and Fishery, 2012).

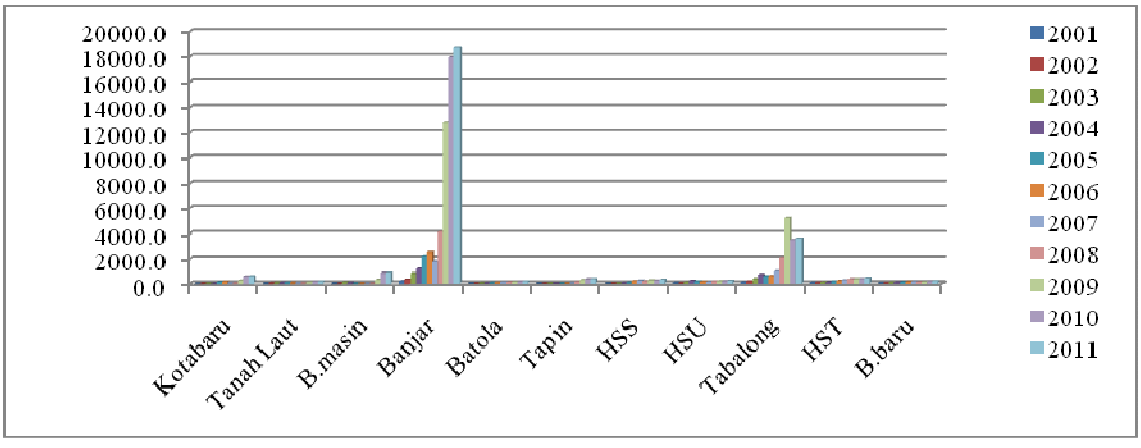


Figure 1. Total production of tilapia in South Borneo 2001-2011 (ton)

Tilapia productions in South Borneo Province are distributed to fulfill the market demand in the South Borneo province and surrounding with a price changes which commonly different among each area. The distribution of tilapia commodities flows from surplus to deficit market with an expectation that all production can be absorbed

optimally. The market demand of tilapia commodities commonly influence by several factors, including the fluctuation of retail price in the market. Based on the secondary data from South Borneo Bureau of Marine and Fishery (2012), retail price of tilapia commodity tend to increase and there are a price different among markets in the different area. Tilapia price of the producer and consumer level can be seen in Figures 2 and 3.

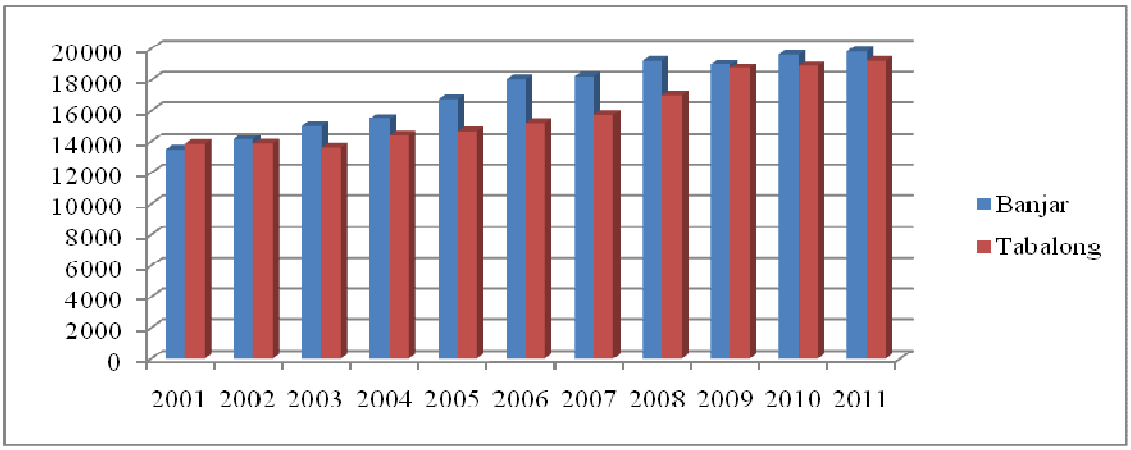


Figure 2. Price producer of tilapia in South Borneo Province 2001-2011 (IDR)

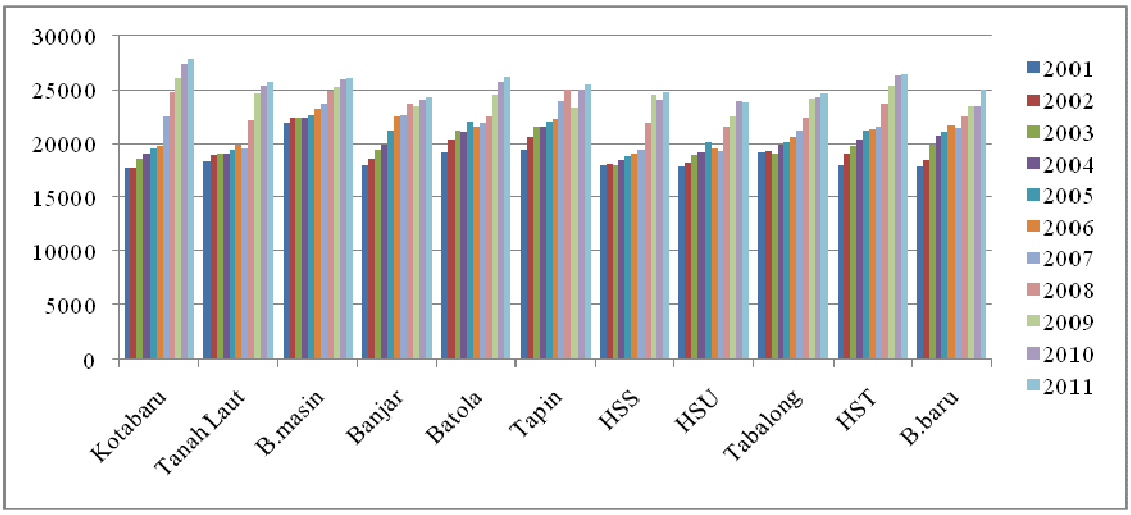


Figure 3. Price consumer of tilapia in South Borneo Province 2001-2011 (IDR)

The principle of price different between two areas influence by the existent of transportation cost (Lohano and Mari, 2005). When the price different higher than the transfer cost, retailer will buy the product from any market with lower price then distributed it to the market with higher price, at the end, the price movement from lower to higher market will create a new equilibrium (Pompermayer, Florian, Leal and Soares, 2006).

One of the important information which is enable to solve the price different problem is an equilibrium price information, especially the information related to the fish price among area that can gives anticipation to increase farmers welfare (Hanafiah and Saefuddin, 1996). Consumer and producer behavior are mostly influence by price information. In a perfect information market, chance in price will easily spread in the marketing system. Retail price is the basic information which is used to determine both wholesaler and producer or farm gate price, *vice versa*. Farm gate price will influence the total volume of production that available to distribute to the wholesaler and retailer. When the farm gate prices satisfy the farmer expected price, the total production offered to the market increase and vice versa (Hanafiah and Saefuddin, 1996).

Theoretical concept used to examine the price equilibrium and optimal trade of tilapia between regions is called spatial equilibrium. This concept is used to estimate price at each market, to see the value of producer and consumer surplus, to measure the level of welfare of society, and to estimate the number of tilapia traded. If spatial equilibrium is achieved, so it will describe the condition of tilapia trade in South Borneo and its effect to welfare of farmers.

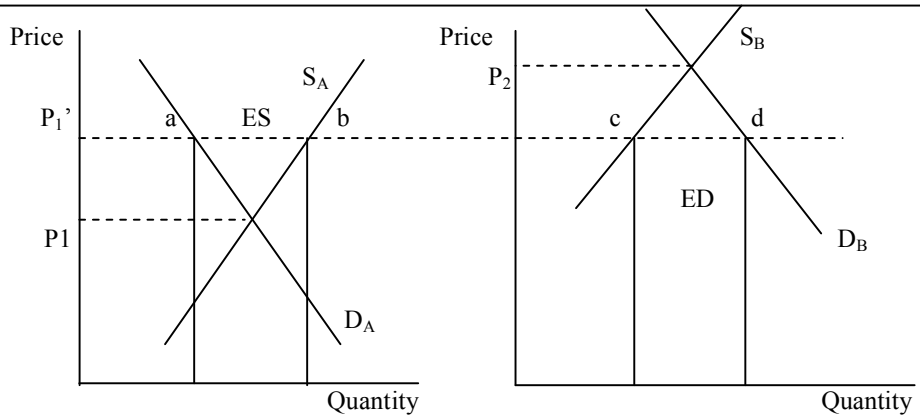
Based on the explanation above, it is important to do research about tilapia market spatial equilibrium in South Borneo. This research is expected to be able to provide information about the condition of tilapia trade that is useful for improving social welfare including producer welfare in South Borneo Province.

Based on the problems proposed above, the objectives of this research are to know the spatial equilibrium of tilapia market in South Borneo as follows:

a. To analyze the price taken place at each market, to analyze the value of consumer and producer surplus and their social welfare.
b. To analyze the optimal distribution of tilapia traded.

2. Literature Review

Spatial equilibrium analysis discusses about market with both surplus and deficit potencies (Costa and Rosson, 2007). Potential market surplus is a market, which has excess reserves to consumption, while potential market deficit is a market with deficit reverse to consumption (Anindita, 2011). The general principle to develop the inter region trade model is described using diagram showing the function of *supply* and *demand* on each market as shown in Figure 4.



a. Market A : Area Surplus b. Market B : Area Defisit

Figure 4. *Equilibrium* model of two regions / markets

By using spatial equilibrium model, it is possible to estimate the prices established in each market; measure the magnitude of producer and consumer surplus; measure the level of society welfare; and estimate total commodity which is going to distribute (Langyintuo, De Boer and Arndt, 2003).

Spatial equilibrium analysis start with the intersection of demand function which have negative slope and supply function which have positive slope. The solution of the equilibrium model determine by comparing the price different among regions based on the quantity of supply and demand. Equation 1 and 2 shows the supply and demand function (Tomek and Robinson, 1990).

According to Brandt (1967), equilibrium model can be reviewed from both supply and demand overview. From the demand side, consumer expects that the price will decrease, while in the supply side, producer wants the price increase steadily. Therefore, the expected price between producer and retailer are different. However, in the long term, producer and consumer price will meet in the market equilibrium point. Equilibrium condition achieved when producer and consumer agree to take the transaction of good (service) in any level of price. However, the real price in the market commonly didn't meet the equilibrium level of price. This condition stimulates the existent of consumer and producer surplus in the market (Labys and Yang, 1997).

The total of welfare function in all area is the sum of the welfare function from each area minus by total transportation cost. In the equilibrium pattern, the information of commodity distribution is another important factor after price information. When the transfer cost higher than the minimum cost, the distribution remain inefficient. Therefore, it is important to emphasize that the existing distribution pattern in the market is the simplest pattern to link the production and consumption pattern (Hong Keun, 1970).

To determine the equilibrium among region, we need to consider transfer cost, through vertical sum of the price axis in the surplus area (Hong Keun, 1970). Cost transfer is cost that need to distribute goods from two areas or more. Transfer cost is a cost which needed to displace goods from two areas or more. Transfer cost can be divide into some categories, such as transportation cost, loading cost, retribution, and soon. Further, transportation cost is operational cost that needed to transfer good between two area (Keith Knap dan Kazim Konyar, 1990).

3. Research Method

3.1 Research Approach

Research area determine purposively by using purposive sampling method in the South Borneo Province. Time series data from 2001 to 2011 are used in this research, which is collected from publication publish by South Borneo Bureau of Marine and Fishery, and any related source. The characteristic of this research is Explanatory research.

Empirical result will proof the causality relationship between independent variable toward dependent variable. The type of research that will be applied is quantitative research. Quantitative research required a massive numerical data, not only for the data collection, but also in the interpretation, and representation. Therefore, the empirical result will be better when it is completed with table, graph, chart, and picture (Arikunto, 2006).

3.2 Data Analysis

3.2.1 Spatial Price Equilibrium Analysis

Spatial equilibrium solution is found by comparing the price differences among areas based on the amount of the formulated supply and demand (Tomek dan Robinson, 1990) :

$$Qsi = a_1 + b_1 Psi \quad (1)$$

$$Qdi = a_2 - b_2 Pdi \quad (2)$$

From the equation (1) and (2) can initiate the equation with supply-demand equilibrium formulated as follow (Samuelson, P.A., 1952) :

$$Qsi = (Psi - a_1)/b_1 \quad (3)$$

$$Qdi = (Pdi - a_2)/b_2 \quad (4)$$

$$Qsi = Pdi \quad (5)$$

then :

$$P^* = (a_1 b_2 - a_2 b_1)/(b_2 - b_1) \quad (6)$$

,

So :

$$Qsi^* = ((a_1 b_2 - a_2 b_1)/(b_2 - b_1))/b_1 \quad (7)$$

$$Qsi^* = Qdi^* \quad (8)$$

Equation (6) and (7) indicate the result of price and supply-demand equilibrium. P* is the tilapia price to the supply-demand equilibrium, and Qsi* = Qdi* is the value of supply-demand when market in balance condition.

According to Samuelson (1952), spatial equilibrium among markets can be obtained by maximizing Net Welfare given by adding consumer surplus (Cs) and producer surplus (Ps). Equation (6) and (7) will be used to determine the amount of producer and consumer surplus in the form of integral equation as follow (Dumairy, 2003) :

$$Cs = \int_0^{Q^*} f(Q).dQ - Q^* P^* \quad (9)$$

$$Cs = \int_0^{Q^*} Pdi.dQdi - Q^* P^* \quad (10)$$

$$Ps = Q^* P^* - \int_0^{Q^*} f(Q).dQ \quad (11)$$

$$Ps = Q^* P^* - \int_0^{Q^*} Psi.dQsi \quad (12)$$

$$\text{Total surplus} = \int_0^{Q^*} f(Q).dQ - Q^* P^* + Q^* P^* - \int_0^{Q^*} f(Q).dQ \quad (13)$$

From the equation (6) and (7) above, it can also be seen spatial equilibrium models developed by Takayama and Judge (1964) with the equation :

$$Psi = fi(Qsi) \quad (14)$$

$$Pdi = fi(Qdi) \quad (15)$$

Explanation :

Psi	=	Supply price in region i
Qsi	=	Amount of fish which is offered in region i
Pdi	=	Demand price in region i
Qdi	=	Amount of fish which is requested in region i

Equation (11) and (12) is changed into certain integral equation as presented as follow:

$$Psi = \int_0^{Qsi} Psi.dQsi \quad (16)$$

$$Pdi = \int_0^{Qdi} Pdi.dQdi \quad (17)$$

Equation (16) and (17) is used to see the welfare functions in each region and can be defined as the area between the supply and demand curves (Khachatryan, Zeller and Haring AM, 2008).

$$Wi(Qsi^*, Qdi^*) = \int_0^{Qdi} Pdi.dQdi \quad - \quad \int_0^{Qsi} Psi.dQsi \quad (18)$$

Total function of welfare in all regions is the amount of welfare function of each area minus total transportation cost. For example Tij represents some goods which is sent from I to J with the transportation cost as Cij, then welfare net is (Okumu and Nyankori, 2010) :

$$NW = \sum_i Wi(Qdi, Qsi) - \sum_i \sum_j CijTij \quad (19)$$

In spatial equilibrium, transportation cost holds crucial part as the limitation which is used to the distribution process of tilapia from surplus area to the deficit area. This limitation include the supply equilibrium which ought the transferring enter to the bigger area than or equal to the supply of certain area (Taha, 1996).

$$Qdi \leq \sum_i Tij \quad \text{for all i}$$

And demand equilibrium ought the shipping out do not more than the demand of a certain area.

$$Qsi \geq \sum_{i} Tij \quad \text{for all i}$$

3.2.2 Algorithm Linier Programming

Model is used to determine the optimum allocation related to the amount of tilapia commodity which is traded and the ideal marketing route with minimum cost, named transport models (Anderson and Wilson, 2005).

Assume that x_{ij} represents the goods which are sent form source i to j, then the Linier Programming model represents the transportation problem which is commonly known as follow (Taha, 1996) :

Minimizing: Transportation cost : $Z = \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij}$

Constrain :

$$\sum_{i=1}^{m} x_{ij} \leq a_i \quad \text{for i=1,2..., m} \qquad (20)$$

$$\sum_{j=1}^{n} x_{ij} = b_i \quad \text{for j=1,2..., n} \qquad (21)$$

$$x_{ij} \geq 0 \text{ for i=1,2..., m and j=1,2..., n} \qquad (22)$$

4. Result And Discussion

4.1. The equilibrium of tilapia aquaculture market price

The model of regression analysis equation between supply and demand variable of price had produced of price equilibrium. From price equilibrium and commodity can be known value of consumer and producer surplus and net welfare for 11 areas sample in South Borneo Province were presented in Table 1.

Table 1 explained that there were 6 regions with the tilapia equilibrium price above the market equilibrium price of production in South Borneo Province; it covered the regions of Kotabaru regency, Tanah Laut regency, Banjarmasin town, Batola regency, Tapin regency dan Banjarbaru town. While the 5 other regions only owned price below the equilibrium such as Banjar regency, Hulu Sungai Selatan regency, Hulu Sungai Utara regency, Tabalong regency and Hulu Sungai Tengah regency.

Since the real prices are higher than the equilibrium price, the market supply *(Q_S)* are bigger than the market demand *(Q_D)*. It means that tilapia markets in the research area are under excess supply condition, where farmers couldn't distribute their product optimally. In contra, the lower price of tilapia commodity cause the fish supply less than the demand, which lead to a shortage condition in the market.

Table 1 also explained that the value of consumer surplus was actually bigger than the producer surplus; it indicated that the consumers got the satisfactory which made the trade process run well. It happened because most of consumers paid with the cheaper price than the equilibrium. By the amount of satisfactory obtained by the consumers, it is expected that the selling of tilapia for the upcoming years will be increased.

Table 1. Price equilibrium, consumer and producer surplus, and net welfare of tilapia marketing in South Borneo Province (IDR)

No.	Regency/town	P* (IDR)	CS (IDR)	PS (IDR)	NW (IDR)
1	Kotabaru	23.266	1.357.225,00	577.608,40	1.934.833,40
2	Tanah Laut	28.984	3.399.185,27	1.359.551,68	4.758.736,95
3	Banjarmasin	25.118	1.493.224,81	562.955,71	2.056.180,51
4	Banjar	19.274	4.200.665,14	43.991,84	4.244.656,98
5	Batola	27.648	8.251.277,64	990.152,34	9.241.429,98
6	Tapin	23.116	710.162,55	177.316,46	887.479,02
7	Hulu Sungai Selatan	21.231	1.502.694,06	371.715,51	1.773.628,61
8	Hulu Sungai Utara	21.239	1.040.867,27	676.537,41	1.717.404,68
9	Tabalong	19.398	1.399.998,93	38.014,13	1.438.013,06
10	Hulu Sungai Tengah	21.537	2.089.908,23	453.680,43	1.339.058,60
11	Banjarbaru	23.446	2.672.979,15	607.502,60	3.280.481,75
	Average	23.114	2.522.947,07	532.638,77	3.055.585,85

4.2. The optimal distribution of aquaculture tilapia

The optimal distribution of tilapia commodity in South Borneo Province is highly related to the information about the surplus and deficit market. In general, South Kalimantan is the surplus area for tilapia commodity with the total supply is 383.666,00 ton higher than the total demand which is 122.472,65 ton, and total minimum cost is IDR 569.785,56. However, according to the supply-demand analysis in the level of district, there are only 2 areas with surplus condition that are Banjar District and Tabalong District, while the rest is deficit. Optimal distribution of tilapia commodity in South Borneo Province can be seen in Table 2.

Tabel 2. Optimal distribution of tilapia commodity in South Borneo Province

No.	From	To	Shipment
1	Banjar	Kotabaru	3.850,0
2	Banjar	Tanah Laut	7.548,7
3	Banjar	Banjarmasin	13.801,7
4	Banjar	Batola	6.719,3
5	Banjar	Tapin	1.001,9
6	Banjar	Banjarbaru	2.145,5
7	Tabalong	Hulu Sungai Selatan	936,4
8	Tabalong	Hulu Sungai Utara	898,7
9	Tabalong	Hulu Sungai Tengah	553,8

4.3. The equilibrium of tilapia aquaculture market price after optimizing

After optimizing the tilapia distribution from surplus region to some deficit regions, the model of regression analysis equation between supply and demand variable of price had produced of new price equilibrium, consumer surplus, producer surplus and net welfare were presented in Table 3.

Table 3. Price equilibrium, consumer and producer surplus, and net welfare of tilapia marketing after optimizing in South Borneo Province (IDR)

No.	Regency/town	P* (IDR)	CS (IDR)	PS (IDR)	NW (IDR)
1	Kotabaru	21.960	1.678.571,62	1.011.403,58	2.689.975,21
2	Tanah Laut	20.813	5.249.892,92	3.669.995,52	8.919.888,45
3	Banjarmasin	23.794	2.134.170,74	1.365.708,36	3.499.879,10
4	Banjar	19.279	4.198.675,10	43.116,20	4.241.791,29
5	Batola	22.194	9.509.327,45	2.349.201,10	11.858.528,55
6	Tapin	22.812	755.228,33	232.750,87	987.979,20
7	Hulu Sungai Selatan	20.777	1.438.029,43	474.073,73	1.912.103,17
8	Hulu Sungai Utara	20.621	1.145.048,60	844.331,27	1.989.379,87
9	Tabalong	19.474	1.382.546,05	57.988,94	1.440.534,99
10	Hulu Sungai Tengah	21.327	1.914.967,16	512.659,79	2.427.626,95
11	Banjarbaru	21.638	2.976.643,48	970.158,68	3.946.802,15
	Average	21.335	2.943.918,26	1.048.308,00	3.992.226,27

From the calculation result Table 1 and Table 3 was known that the average of price equilibrium, consumer and producer surplus, and the welfare of tilapia marketing in every area in South Borneo Province before and after optimizing was different, it can be seen in Table 4.

Table 4. Average of price equilibrium, consumer and producer surplus, and welfare of tilapia marketing before and after optimizing in South Borneo (IDR)

No.	Explanation	Before Optimizing	After Optimizing
1.	Equilibrium Price	23.114,00	21.335,00
3.	Producer surplus	532.638,77	1.048.308,00
3.	Consumer surplus	2.522.947,07	2.943.918,26
4.	Welfare	3.055.585,85	3.992.226,27

Table 4 explained that the price equilibrium of tilapia market price in South Borneo Province before optimizing was bigger that after optimizing. After optimizing, there was decreasing of tilapia market price in South Borneo Province. It happened because the production result from surplus area had been maximally absorbed and the need of tilapia consumer could be fully completed.

The absorption of tilapia maximally because most of consumer paid cheaper than equilibrium price (consumer surplus was bigger than producer surplus). In producer side, the low price of tilapia should not cause the production stops. It makes the supply of tilapia in deficit area stops. Because of that the equilibrium price is so crucial to keep so the loss can be avoided by both of sides, consumer and producer.

Keeping the price equilibrium not only based on market power, but it is also supported by government policy. Policy is needed to keep the price of tilapia is not far above the equilibrium price that makes the consumer with the low income cannot reach it, or to keep it for not too far below the equilibrium price that will damage the fisherman.

Table 4 also explained that the net welfare after optimizing was bigger than before optimizing. It happened because price control in the level of producer and consumer, and also the sufficient supplying of tilapia to fulfil the consumer need to give the maximum welfare to the producer and consumer, as well as giving the big contribution to the economic growth even directly or not.

5. Conclusion And Suggestion

5.1. Conclusion

The spatial equilibrium price of tilapia inter regions is the interaction which happens through trading and transportation. In trading, the formation of equilibrium price and quantity in market is the result of agreement

between buyer and seller where the required and offered quantity is same. If the equilibrium price was achieved, this equilibrium point will stand long and become the standard for buyer and seller to determine price.

The excessive of deficit areas indicated that the distribution of tilapia from surplus area to the deficit one needs to be improved. The optimal distribution with the minimum cost made the trade from surplus area can be shifted to some areas so tilapia can be optimally distributed and covering the demand from the deficit areas.

The research result showed that after the optimal distribution was done, the price equilibrium decreased the surplus of producer and consumer increased and improved the welfare of tilapia producer and consumer.

5.2. Suggestion

The commodity trade most of time is not efficient with the separated production sites such as tilapia commodity. The distance between production sites and consumption sites causes the absences of consumer-producer connection. The demand of tilapia from some consumer areas is not known by the producer for the lack of market information that cause the selling price in producer level low is low.

Market information has to be delivered to the producer so they know the amount of consumer demand and decide the appropriate volume of production to fulfil the demand. Market information which is accepted can assist producer to decide the selling price. Then price which is accepted will be the standard how big the production volume had been produced to sell to the trader. When the accepted price is satisfying, the production which is offered to the society will rise.

The increasing of production will cause the fulfilment of demand from the deficit areas so it is expected to trigger the price equilibrium, and also to improve the producer and consumer surplus as well as the net welfare of tilapia marketing in South Borneo Province.

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