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DEVELOPMENT POLICY OF SEAWEED FARMING IN KUPANG DISTRICT OF EAST NUSA TENGGARA PROVINCE, INDONESIA

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ABSTRACT

This research aimed at analyzing policy alternative that can be conducted to increase seaweed farmer's income. The method practiced in this research was a survey method; while the population was a household whose livelihoods were a seaweed farmer. Data analysis applied to answer the objectives of the research was policy simulation. The research result revealed that policy alternative that can be carried out as a priority of business development and to increase seaweed farmer's household income includes : labor wage increase by 15%, one-year experience addition and thallus length addition by 15%; one-year experience addition, one-year education addition, and thallus length addition by 15%; labor wage increase by 15%, one-year-experience addition, one-year-experience addition and one-year-study addition; labor wage increase by 15%, one-year experience addition; one-year experience addition, one-year educational addition, and cleanliness rate addition by 5%.

KEY WORDS

Simulation, seaweed, farming, policy, development.

Fisheries resource is a renewable resource, thus the number of fish stock in the sea will constantly grow until the limit of environmental carrying capacity. However, the additional rate of total fish population truly depends on the internal factor of the fish and external environmental factor. In addition to those two factors, human as an actor taking benefits from fisheries resource will truly influence. Human behavior in exploiting fisheries resource will contribute to influence the number of fish stock in the sea. Population growth rate will continuously increase and will decrease after reaching the optimum point of its growth, while the human behavior in extracting fisheries will constantly increase as long the business player still sees the advantage from the activity of catching fish. At the end of the time there will be an economic inefficiency since the business player does not get an optimum advantage from the activity of fisheries resources extraction (Suhana, 2009). Taking into account the condition of capture fisheries above so that the alternative to illustrate fisheries sector is through the way of sustainable capture fisheries management, and the development of aquaculture.

Seaweed is one of strategic commodities in the program of fisheries revitalization excludes shrimp and salmon. Indonesia's area for seaweed farming activity was 1,110,900 ha, but seaweed farming development just utilized it for only 222,180 ha (20% from potential area). The most favorite seaweed is *Euchema spinosum*, *Euchema cottonii* and *Gracilaria* sp. In addition to be food sources, according to the research result, seaweed also can be utilized as a source of energy, namely as biofuel material. That was what delivered by the Minister of Maritime Affairs and Fisheries Freddy Numbery during the opening of Seaweed International Business Forum and Exhibition in Makassar, South Sulawesi (28/10/08). The existence of seaweed as an energy alternative source is a new thing that must be supported and developed. Micro algae as a biodiesel are considered more competitive than another commodity. In which, 1-ha micro algae land can produce 58,700 liters (30% oil) per year or higher than corn (172 liters/year) and palm oil (5,900 liters/year) (Directorate General of Aquaculture)

Kupang district is an island area having coastal length by 26 Km, in which having a big potential for fisheries development such as for seaweed farming development. According to the data from East Nusa Tenggara Maritime Affairs and Fisheries Service in 2016, potential

and production rate of seaweed was in the first rank compared to other Districts/Cities in East Nusa Tenggara Province, in which the potential for seaweed farming was 8,890.5, while those have been utilized was by 1,259.3 ha (13.9) with the total dried seaweed production by 860,307 ton (DKP NTT, 2017).

Seaweed farming business in Kupang district is conducted by household, in which all family members both husband, wife and children are actively getting involved in every stage of business activities, started from preparing farming area until taking the result, the average total of working hours (Tot Jk) for woman is 210.47 and for man is 218.77, while children is surely shorter by only 68.13 (Sunadji et.al. 2012).

The regulation of Kupang Government through Kupang Maritime Affairs and Fisheries service has been executed includes the policy capital assistance, training on seaweed farming business, post-harvest management, but all of them are still partial in nature. In respect of the explanation above so it needs to conduct a research on the policy simulation of seaweed farming development in Kupang district, East Nusa Tenggara province with Household economics approach. The problem of this research is what policy alternative is which can be practiced to increase seaweed farmer's income. While the objective of this research was analyzing policy alternative which can be conducted to increase seaweed farmer's income.

METHODS OF RESEARCH

This research was undertaken on March until July 2017. It took Kupang District of east Nusa Tenggara Province as the location under the consideration that Kupang District was the biggest seaweed producer in East Nusa Tenggara Province. Population of this research was a seaweed farmer as a breadwinner running seaweed farming business in the waters (not a pond), managing his own business and domiciled in the coastal zone of Kupang District. The number of seaweed farmer was about 1,073 Head of Households (KK) spread in 4 sub-districts. The number of the sample, according to Slovin's formulation, amounted to 136.4 or rounded off to 136 farmers. According that calculation, it was designated at least 136 farmers and determined 140 farmers, and to decide the number of sample in each sub-district (sub-population) was used 'sample fraction' by taking into account the number of sample and the number of population using a formulation proposed by Nazir, 1988.

Data collected in this research included primary and secondary data. Primary data was collected through survey technique to get a clear and detailed description. This survey was conducted by doing interview with respondents using an interview guideline so that it can be more directed. Secondary data was collected from related institution like village hall, sub-district, Maritime Affairs and Fisheries Service, regency BAPPEDA, BPS, or other institutions having similarity with this research. Policy simulation analysis was used to analyze policy alternative functions to increase seaweed farmer's income.

RESULTS AND DISCUSSION

Decision-Making Involvement Model Estimation Result of Seaweed Farmer Household. Simultaneous equation model of this research involves 17 endogenous variables consisted of 11 structural equations and 6 identity equations. Parameter estimation of these equations was conducted using Two Stage Least Square Methods (2SLS Method) and its result ii presented in the following table 1.

Model Validation. Model validation aimed at determining the power of model prediction. The result of model validation illustrates how close prediction value to the actual value from endogenous variable observed which was showed in the following table 2.

Statistic test being the criteria of model prediction capacity is UM, US, and UC, according to table 2 above; UM value tends to approach 0 so the model does not experience systematic bias. In addition, US value also seems to approach 0 which means prediction value is able to follow fluctuation of actual value. On the other hand, model validation shows that UC value approaches 1. It means, model mistake does not mean and is not patterned,

but spreading at all observation data. This model validation can show that the set model is valid to be acted as simulation tools.

Table 1 – Estimation result of simultaneous equation

Q	= -7521.55 + 0.3244LH + 41.134CTKK + 7.16 JBNH + 0.000012KRED + 1464.473 PENG + 291.1175PEND + 409.3217PJAL - 415.513JARTAN + 4.3488FREKON + 26.86175 KEDTAN + 34.6534LPHRAN
LH	= -40.1904 + 0.000036MOD + 0.096JBNH + 264.32TL
JBNH	= -1164.24 + 0.11593Q + 0.0886P
CTKK	= 33.181 + 0.002922LH + 6.6806JART + 0.8637PEND + 0.8303PENG
P	= 5805.414 - 0.00086Q - 123.968RWPAP + 12.499TKBER - 7.63KDAR + 91.171JPDG - 13.189LPENYIM
BT	= 35968.09 + 147.49JPLP + 0.910BTL + 735.85JPK + 1260.91JPBRT + 0.942 BPRH
BTT	= 118716 + 248.831JBNH + 62399.56JTLR
KP	= 2829178 + 357464.9JART + 0.136IRT + 628611.2PEND
KNP	= 743765.9 + 100563.5JART + 1.0691BPEND + 0.9477BKES + 0.0205SURT
INBRL	= 2121133 - 0.1374IBRL + 0.2209SURT + 697.8117UMR + 264735PEND + 245632.5JART
INP	= -8939332 - 0.0574IBRL + 25095.79UMR + 321180.4PEND + 218.8345UPH
PNBRL	= Q*P/8;
IBRL	= PNBRL-BTRL;
BTRL	= BT+BTT;
IRT	= IBRL+INBRL+INP;
TPRT	= KP+KNP;
SURT	= IRT-TPRT;

Source: analysis result of primary data, 2017.

Note:

Q = Production (kg/yr) KNP = Non-food consumption (idr/yr);
 LH = Land area (M²) P = seaweed cost (idr/kg);
 JBNH = total seed (kg/yr) INP = non-fishery income;
 CTKK = family labor allocation (HOK) PNBRL = seaweed acceptance (idr/yr);
 INBRL = non-seaweed income (idr/yr) IBRL = seaweed income (idr/yr);
 BT = fixed cost (idr/yr) BTRL = total cost of seaweed (idr/yr);
 BTT = non-fixed cost (idr/yr) IRT = total household income (idr/yr);
 KP = food consumption (idr/yr) TPRT = total household expenditure (idr/yr);
 SURT = household surplus (idr/yr).

Table 2 – Statistic test result of model prediction capacity

Variable	Label	Actual Mean	Predicted Mean	UM	US	UC
Seaweed Production	Q	31645,10	25490,30	0,28	0,01	0,71
Land Area	LH	5511,10	5453,50	0,03	0,00	0,96
Total seed	JBNH	3107,30	2373,00	0,27	0,01	0,73
Family labor allocation	CTKK	81,68	60,93	0,32	0,30	0,38
Seaweed acceptance	IBRL	26671464,0	21256342,00	0,30	0,01	0,69
Seaweed cost	P	6803,60	6721,10	0,34	0,05	0,60
Fixed cost	BT	1654461,00	1638598,00	0,02	0,00	0,97
Non-fixed cost	BTT	11737004,0	9910219,00	0,27	0,02	0,71
Total cost	BTRL	13391464,0	11548816,00	0,28	0,02	0,70
Seaweed acceptance	IBRL	13280000,0	9707525,00	0,26	0,01	0,73
Non-seaweed acceptance	INBRL	4384286,00	4496911,00	0,00	0,41	0,59
Non-fisheries income	INP	2337964,00	2542984,00	0,01	0,21	0,78
Total household income	IRT	20002250,0	16747421,00	0,18	0,00	0,82
Total household expenditure	TPRT	1358540,0	13085614,00	0,03	0,06	0,91
Food expenditure	KP	11130900,0	10686814,00	0,03	0,08	0,89
Non-food expenditure	KNP	2454507,00	2398800,00	0,02	0,01	0,97
Household surplus	SURT	6416843,00	3661807,00	0,14	0,03	0,83

Source: Primary data analysis result, 2017.

Note:

UM = bias proportion;
 US = variant proportion;
 UC = covariant proportion.

Household Policy Alternative in the Household Economics Development of Seaweed Farming. To decide household policy alternative in the economic development of seaweed farmer, it was conducted policy simulation in the forms of single and double simulation.

Single Simulation. Single simulation was grouped into four parts:

- Input changes of seaweed farming business towards household economics of seaweed farmer include: land reclamation by 15%, one-person labor increase, credit assistance increase by government for 15%, seaweed seed increase by 15%, labor wage increase by 15%, one-year farmer's experience addition, and one-year farmer's education addition.
- Process changes of seaweed farming business towards household economics of seaweed farmer include : planting distance addition among the cluster by 15 %, thallus length addition by 15%, control frequency addition once a week, deep of planting addition by 15%, one-day crop husbandry addition.
- Output management changes of seaweed farming business towards household economics of seaweed farmer include : one-day harvest time slot and fir curing initial addition, seaweed cleanliness rate addition by 5%, water content decrease by 5%, one-person trader addition, seaweed storage times additions by one day.
- Consumption changes/expenditure towards household economics of seaweed farmer, consisted of the increase of total family members by one person, tuition fee increase by 15%, health cost increase by 15%.

One of the examples of that single simulation result is single simulation in the forms of land reclamation by 15 % presented in the following table 3.

Table 3 – Simulation of land reclamation by 15%

Variable	Basic Simulation	Simulation Scenario	Changes
Dried seaweed production (kg)	25490,3	25599,1	0.43%
Land Area (M ²)	5453,5	5454,7	0.02%
Total seed (kg)	2373	2385,6	0.53%
Family labor allocation (HOK)	60,925	60,9285	0.01%
Seaweed cultivation acceptance (IDR/yr)	21256342	21344749	0.42%
Dried seaweed price (IDR/yr)	6721.1	6721	0.00%
Fixed cost (IDR/yr)	1638598	1638598	0.00%
Non-fixed cost (IDR/yr)	9910219	9941594	0.32%
Total seaweed cost (IDR/yr)	11548816	11580192	0.27%
Seaweed cultivation income (IDR/yr)	9707525	9764558	0.59%
Non-seaweed income (IDR/yr)	4496911	4501301	0.10%
Non-fisheries income (IDR/yr)	2542984	2539710	-0.13%
Household income (IDR/yr)	16747421	16805569	0.35%
Food expenditure (IDR/yr)	10686814	10694748	0.07%
Non-food expenditure (IDR/yr)	2398800	2399809	0.04%
Total household expenditure (IDR/yr)	13085614	13094556	0.07%
Household surplus (IDR/yr)	3661807	3711013	1.34%

Source: Primary data analysis result, 2017.

Table above indicates that input changes in the form of land reclamation will increase seaweed production by 0.43%, total seed by 0.53% and income from seaweed cultivation by 0.59% as well as increasing household surplus by 1.34%. While another variable has a relative small changes in spite of being increase, excluding non-fisheries income, this is caused by the increase of land reclamation will make the farmer more concentrate to the seaweed farming business than a business out of fisheries sector. However, in general, the increase of land reclamation by 15% has a relative small influence by less than 1% excluding household surplus.

While for the entire result of that single simulation and connected to the household economics subsystem of seaweed farmer in the forms of production, family labor allocation, income, and expenditure as well as added by one component namely household surplus presented in the following table 4.

Double Simulation. According to the above single simulation result, it is obtained 11 single simulations giving a big enough influence both positive and negative (greater 10 %) on the development of seaweed farmer's household. Furthermore was conducted double simulation by combining those eleven variables so received 45 double simulations. From

those 45 double simulations results was chosen 17 double simulation giving positive influence on the household economics of the seaweed farmer. Recapitulation of double simulations result that having positive influence if related to the production changes, family labor allocation, income, expenditure, and household surplus can be presented in the following Table 5.

Table 4 – Single simulation result recapitulation is associated with household subsystem.
Seaweed cultivation farmer

No	Policy Simulation	Changes Percentage					Total
		Q	CTKK	IRT	TPRT	SURT	
	Land reclamation by 15 %	0.43	0.01	0.35	0.07	1.34	2.2
2.	Total labor increase by one person	21.04	0.28	17.95	3.53	69.48	112.48
3.	Credit increase by 15%	0.06	0.00	0.05	0.01	0.20	0.32
4.	Total seaweed seed increase by 15%	20.75	0.34	15.45	3.04	59.80	99.38
5.	Labor wage increase by 15%	0.00	0.00	9.53	1.88	36.89	48.3
6.	One-year farmer's experience addition	35.51	1.84	30.21	5.95	116.91	190.42
7.	One-year farmer's education addition	7.74	1.52	9.90	6.66	21.48	47.3
8.	15%-planting distance among the cluster addition	-27.27	-0.37	-23.13	-4.55	-89.53	-144.85
9.	Thallus length additions by 15%	16.29	0.22	13.84	2.72	53.55	86.62
10.	Additional control frequency once a week	0.07	0.00	0.06	0.01	0.22	0.36
11.	Additional plant depth by 15 %	3.25	0.04	2.77	0.54	10.71	17.31
12.	One-day maintenance period addition	6.42	0.09	5.47	1.08	21.15	34.21
13.	Additional period one-day harvest and initial fir curling	-0.42	-0.01	-0.88	-0.17	-3.41	-4.89
14.	Cleanliness rate addition by 5 %	2.17	0.04	4.53	0.89	17.55	25.18
15.	Water content reduction by 5 %	0.16	0.00	-0.13	0.07	1.33	1.43
16.	One-person trader addition	1.35	0.02	2.82	0.56	10.92	15.67
17.	One-day maintenance period addition	-0.19	0.00	-0.40	-0.08	-1.56	-2.23
18.	One-person family labor addition	0.66	1.13	1.64	3.75	-5.91	1.27
19.	Tuition fee increase by 15 %.	0.00	0.00	-0.22	1.01	-4.64	-4.18
20.	Health cost increase by 15 %	0.00	0.00	-0.08	0.35	-1.63	-1.36

Source: Primary data analysis result, 2012.

Note:

Q = seaweed production (kg/yr);

CTKK = Family Labor Allocation (HOK);

IRT = Household Income (idr/yr);

TPRT = Total Household Expenditure (idr/yr);

SURT = Household Surplus (idr/yr).

Table 5 – Recapitulation of double simulation result as policy alternative associated with household subsystem of seaweed farmer

n/n	Policy Simulation	Changes Percentage					Total
		Q	CTKK	IRT	TPRT	SURT	
	1	2	3	4	5	6	7
1	an increase in labor by one person, 15%- seed increase and one-year experience increase	35.51	1.84	30.21	5.95	116.91	190.42
2.	one-person labor increase, 15%-seed increase and 15%-thallus length increase	16.29	0.22	13.84	2.72	53.55	86.62
3.	15%-total seed increase and one year-experience increase	35.51	1.84	39.74	7.82	153	237.91
4.	15%-wage labor Increase, one-year experience increase and one-year educational increase	43.25	3.37	49.61	14.47	175.18	285.88
5.	15% labor wage increase, one-year experience increase and 15 thallus length increase	51.80	2.06	53.53	10.54	207.16	325.09
6.	15% labor wage increase, one-year experience addition and one-day maintenance period addition	36.54	1.86	40.62	7.99	157.19	244.2
7.	15%-labor wage increase, additional one-year experience and cleanliness increase by 5%	37.67	1.88	45.28	8.91	175.22	268.96
8.	15% labor wage increase, one-year experience addition and one-person trader addition	36.86	1.86	43.18	8.50	167.13	257.53
9.	labor wage increase by 15%, one-year experience additions and family member addition by one-person	36.17	2.97	41.38	11.57	147.88	239.97

n/n	1	2	3	4	5	6	7
10.	one-year experience addition, one-year educational addition, and thallus length addition by 15%	59.53	3.59	53.86	15.31	191.62	321.91
11.	one-year experience addition, one-year educational addition, and one-day maintenance period addition	44.28	3.38	40.96	12.77	141.69	243.08
12.	one-year experience addition, one-year educational addition, and cleanliness rate addition by 5%	45.41	3.40	45.84	13.73	160.57	268.95
13.	one-year experience addition, one-year educational addition, and one-person trader addition	44.59	3.39	43.66	13.30	152.15	257.09
14.	one-year experience addition, one-year educational addition, and one-person family member addition.	43.91	4.49	41.72	16.35	132.38	238.85
15.	thallus length addition by 15%, one-day maintenance period addition, and cleanliness increase by 5%	19.49	0.27	19.74	3.89	76.40	119.79
16.	thallus length increase by 15%, one-day maintenance period addition, and one-person trader addition	18.67	0.26	17.84	3,51	69.05	109.33
17.	Thallus length increase by 15%, one-day maintenance period addition, and one-person family member addition	17.99	1.36	16.36	6.65	51.05	93.41

Source: Primary data analysis result, 2017.

According to the double simulation result above so it can be determined policy alternative priority in increasing household welfare of seaweed farmer by considering total percentage of the existing subsystem changes: 1). labor wage increase by 15%, one-year experience addition and thallus length addition by 15% with total percentage of 325.09; 2). one-year experience addition, one-year educational addition, and thallus length increase by 15% with change percentage of 321.91; 3). labor wage increase by 15%, one-year educational addition and one-year educational increase with total percentage of 285.88; 4). labor wage increase by 15%, one-year experience addition and cleanliness increase by 5% with changes percentage of 268.96; and 5). one-year educational additions, and cleanliness rate additions by 5% with change percentage by 268.95.

CONCLUSION AND SUGGESTIONS

According to the above research result and discussion, it can be concluded that policy alternatives that can be conducted as a priority in developing business and increasing household income of seaweed farmer include:

- labor wage increase by 15%, one-year experience addition and thallus length addition by 15%;
- one-year experience addition, one-year educational addition, and thallus length addition by 15%;
- labor wage increase by 15%, one-year experience additions and one-year educational addition;
- Labor wage increase by 15%, one-year experience addition and cleanliness rate increase by 5%;
- one-year experience addition, one-year educational addition, and cleanliness rate addition by 5 %.

According to the research results, it is suggested to develop seaweed farming business is suggested to perform the policy by increasing labor wage by 15 %, one-year experience addition, and thallus length addition by 5% jointly. However, before suggested policy alternative being applied to the seaweed farmer it needs to be tested in advance to know the level of success from that policy alternative.

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