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Simulation Model of Household Economy on Production and Welfare of Catfish (*Pangasianodon hypophthalmus)* Farmer in Banjar Minapolitan, South Kalimantan

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Abstract: *This study aimed to analyze correlation of varies decision on household economy of catfish (Pangasianodon hypophthalmus) farmer, and formulate alternatives policies to increase production and improved household welfare of farmers. Total of 83 household sample of catfish farmer in 6 villages of 2 sub-districts in Minapolitan Area, Banjar Regency was simple randomly selected. The household's economic model of catfish farmer is built of 22 simultaneous equations by develop theory of Agricultural Household Models. We used regression analysis of two stage least square (2SLS) and simulation models. The results show that linkage of varies decisions impact on household economic improvement of catfish farmers, except for an increase in stocking density that will be followed by the increase in the number and cost of feed. Consequently, household income is becoming lower. Selected alternative policies for increasing production and improved farmer's welfare is a combination of pond extension, application of improved farming technologies, subsidizing the price of pellet feed, and education subsidies.*
Key words*: catfish (Pangasianodon hypophthalmus), economy model, farmer, household*

I. Introduction

Aquaculture is a way to produce high protein food that in food security efforts opened job opportunities, increase revenues and foreign exchange earnings (FAO, 2010). Developing countries with low-cost fish farming can alleviate poverty through increasing the income. Consequently, they will capable to buy more groceries (Asche and Khatun, 2006; Rustadi, 2011).

Indonesian has the potential waters area for enhancing freshwater aquaculture of 2.2305 million ha (Directorate General of Aquaculture, 2004). This suggests that the production of freshwater aquaculture in Indonesia has significant opportunity for improving the low level of utilization. Therefore, Indonesia continues to improve fisheries production with overall production target in the period of 2010-2014 to 353%, i.e. from 5.26 million ton to 16.89 million ton (KKP, 2010).

One area of freshwater aquaculture development in Indonesia is Banjar Minapolitan, South Kalimantan with vast potential to ±1.195 ha, and favored commodities are catfish (*Pangasianodon hypophthalmus*). Catfish farming productivity in Banjar of 2006-2011 periods reached 13040 $kgha^{-1}yr^{-1}$. The production level is still considered as low compared to the average production capacity of catfish farming in other countries such as Vietnam (213846 $kgha^{-1}yr^{-1}$) and Thailand (31250 $kgha^{-1}yr^{-1}$) (Wilkinson, 2008; Ahmed *et al.*, 2010). The low productivity of catfish farming in this region is due to the lack knowledge of farming technology, education level of farmers, capital, and commercial pellet feed prices which tend to increase.

Aquaculture implies some form of intervention in the maintenance process to increase production such as stocking density, feeding and protection from predators. Availability of fish juvenile from a local hatchery is limited and almost 76% of the juvenile still imported from Bogor, West Java (Bappeda Banjar, 2009). Distant juvenile source lead to high price of Rp 350 to Rp 500 per juvenile, and farmers received uneven juvenile quality (results of the survey, 2012).

Fish feed (pellets) is a major production factor. Pellet feed requirements and price is high costs – the largest portion of the overall operating costs of fish farming, reach 60-70%. Most catfish farmers still rely on commercial pellet feed, but the prices of pellet feed rise continuously and decreasing farmers's income. To overcome this, some farmers have been used the self-processed feed because of its less cost. However, the protein content of self-processed feed is ±10-15% – below the standard fishmeal protein ± 20-22% – resulting low *Feed Conversion Ratio* (1.91 to 2.26). Fish culture period to reach enough commercial length is 8-12 months. These conditions have the same effect on the amount of capital production, especially for the feed supply.

Agricultural activities in developing countries carried out by semi-subsistence farmers, which have no separated characteristic between production activities with consumption decisions of farmer's household (Ellis, 1993; Taylor and Adelman, 2003). Aside of aquaculture operation capital's fulfillment, catfish farmers are also acquired needs of their household consumption especially during the maintenance period, which has no production and income. Fulfillment of basic food needs is still a top priority for household farmers. While the fulfillment of basic non-food consumption (education and healthcare) are still perceived as being not affordable by most households of catfish farmers.

Education and healthcare is an investment in human resources. Human resource investments will improve productivity, additional value, income and consumption. Education level of fish farmer influenced on level of knowledge, skill development, exposure to production technologies and marketing practices, and the level of technology adoption (Singh, 2003; Onumah and Acquah, 2010; Agboola, 2011). Level of education can also assist in designing appropriate training programs with the thinking level of farmers (Asamoah *et al.*, 2012). Therefore, educational improvements for farmers is essential for the development of aquaculture industry.

Based on above description, we need necessary approach to understand the various efforts to improve production and wellfare of fish farmer. This approach needs to notice the patterns of decision making on household of fish farmer – both internal and external influences. This study aimed to analyze the correlation on the household economic decisions of catfish farmers, and formulated alternatives policies for increasing production and improving household welfare of farmers.

II. Research Methods

This study tried to develop a theory of semi-commercial farm household behavior (Becker, 1965; Barnum and Squire, 1978). We also develop model of the farm household-related aspects of farming and non-farming on particular basic non-food consumption (education and healthcare) due to the consumption of basic food consumption has become burden for rural communities. The model is composed of 22 interrelated equations (simultaneous), consisted of 12 structural equations (endogenous) and 10 identity equation (Table 1).

Model parameters are estimated with *Two Stage Least Square* (2SLS) method. Policy simulation models are validated with the criteria of *Theil's Inequality Coeficient* (U-Theil) and its decomposition (U^M = mean bias, U^S = regression slope bias and U^C = co-variance bias). A model has good predictive power when U^M and U^S close to 0 (zero) and U^C close to 1 (one).

A simulation model of the household economy was conducted to obtain the alternatives policy that increase the production of catfish aquaculture and improve welfare of household farmers. This simulation model is based on: 1. increasing 25% of juvenile density; 2. 25% area increase; 3. subsidizing 25% of commercial pellets feed; 4. increase in the farmers' education (12 years); 5. 25% improvement of the aquaculture technology application; 6. 50% subsidy of education; 7. 50% subsidy of healthcare; and 8. Multiple simulations.

Table1. Household Economic Model Component of Catfish Farmers in Banjar Minapolitan

No.	Sub model	Equations
I.	Production :	
	(1) Fish Production	PRI = $a_0 + a_1$ TEKKLM + a_2BNH + a_3 TEKPKN + a_4 TCKB + μ_1
	(2) Pond Width	KLM = $b_0 + b_1$SURB + b_2JAK + b_3PDKB + μ_2
	(3) Fish juvenile	BNH = $c_0 + c_1$SURB + c_2KLM + c_3DLM + μ_3
	(4) Pellet Feed	PKN = $d_0 + d_1$ SURB + d_2BNH + d_3PDKB + d_4PGLB + d_5HPKN + d_6KPNP + μ_4
	(5) Aquaculture Productivity	PRB = PRI : KLM
	(6) Technology	TEK = $e_0 + e_1$ SURB + e_2PDKB + e_3UPP + μ_5
II.	Work Expended:	
	(7) Family Labor	TKDK = $f_0 + f_1$KLM + f_2KUP + f_3TEK + μ_6
	(8) Non-family Labor	TKLK = $g_0 + g_1$SURB + g_2KLM + g_3 TKDK + μ_7
	(9) Total Labor	TCKB = TKDK + TKLK
III.	Income:	
	(10) Catfish Farming Income	PDTB = PRKB – BPB
	(11) Catfish Farming Receipt	PRKB = $h_0 + h_1$HIP + h_2PRI + μ_8
	(12) Production Cost	BPB = BTLK + BBNH + BPKN + BSP
	(13) Juvenile Cost	BBNH = BNH * HBNH
	(14) Pellet Feed Cost	BPKN = PKN * HPKN
	(15) Non-farming Household Income	PRNB = $i_0 + i_1$PDTB + i_2KUP + μ_9
	(16) Catfish Farmer Total Income	PDTK = PDTB + PRNB
	(17) Catfish Farmer Surplus Income	SURB = PDTK – TPKP
IV.	Expense:	
	(18) Staple Food Consumption	KPP = $j_0 + j_1$PDTK + j_2JAK + j_3PDKB + μ_{10}
	(19) Non-food Staple Consumption	KPNP = $k_0 + k_1$KPP + k_2JAK + k_3PKES + k_4PDDK + k_5PEGI + μ_{11}
	(20) Total Expense of Basic Consumption	TPKP = KPP + KPNP
	(21) Expense of Non-basic Consumption	KNP = $l_0 + l_1$INV + l_2TAB + l_3SEL + μ_{12}
	(22) Total Expense of Farmer's Household	TPRT = TPKP + KNP

Description of notation is presented in Appendix 1.

Research's location were purposively sampled, set as 6 villages in Martapura dan Western Martapura, Banjar minapolitan, South Kalimantan, Indonesia (Figure 1). Selected districts is center of freshwater aquaculture development with catfish as the main commodity. Catfish farmers households sampled randomly, total 83 respondents from 250 households of catfish farmers in Banjar minapolitan.

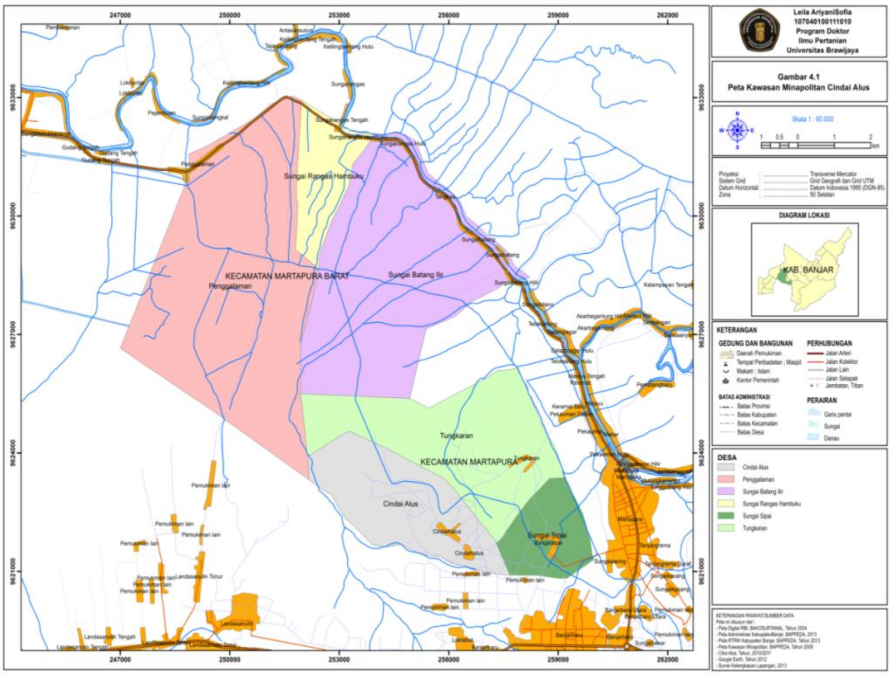

Figure 1. Research Location Map

III. Empirical Result

The model was re-specified repeatedly to produce good estimation parameters (Table 2). Coefficient of determination (R^2) in each equation is ranged from 0.16 to 0.99 (Table 2). In 12 structural equation, three equations have R^2 values less than 50%, ranging from 0.16 to 0.35; i.e. the equation income from non-catfish farming (PRNB), juvenile stocking density (BNH), and work expended of non-family labor (TKLK). Nine equations have R^2 values more than 50%, ranged from 0.53 to 0.99; i.e. fish production (PRI), pool width (KLM), pellet feed number (PKN), application of aquaculture technology (TEK), work expended of family labor (TKDK), income of catfish farming (PRKB), staple-food consumption (KPP), non-food staple consumption (KPNP) and non-basic consumption (KNP). F test results indicate that all endogenous equations have significant value ($\alpha = 1\%$). It means the equation is affected by the endogenous explanatory variables.

The results of statistical test on predictive power of the model (Table 3) show that all endogenous variables have an average prediction relatively close to the actual average, while the U-Theil decomposition obtained from U^M and U^S close to zero and U^C close to one. Thus indicates that in general the obtained model is quite decent because obtained parameter values are consistent with the theory and according to the existing phenomenon and has a proper predictive power.

Table 2. Estimation on Variables of Structural Equation in Household Economy Models of Catfish Farmers

No.			Equation	R^2 and F_{stat} Values
(1)	PRI	=	0.016042°TEKKLM + 0.211903***BNH + 0.003231*TEKPKN + 20.34498***TCKB	0.97656 822.85***
(2)	KLM	=	0.000045***SURB + 19.00155JAK + 31.22157*PDKB	0.64017 47.44***
(3)	BNH	=	1740.529 + 0.000372***SURB + 3.715349***KLM + 23.74588DLM	0.35090 14.24***
(4)	PKN	=	0.000165°SURB + 1.389573***BNH + 295.1026**PDKB + 196.1709°PGLB - 0.35415 HPKN - 0.00010 KPNP	0.95747 288.93***
(5)	PRB	=	PRI : KLM	
(6)	TEK	=	5.046E-7***SURB + 5.046E-7***PDKB + 0.139963***UPP	0.94621 469.11***
(7)	TKDK	=	0.048972***KLM + 10.85990*KUP + 8.547249***TEK	0.92797 343.54***
(8)	TKLK	=	3.207E-6***SURB + 0.019502**KLM - 0.19542***TKDK	0.34180 13.85***
(9)	TCKB	=	TKDK + TKLK	

(10)	PDTB	=	PRKB – BPB	
(11)	PRKB	=	-1.146E8 + 8243.698***HIP + 13851.02***PRI	0.99928 55388.2***
(12)	BPB	=	BTLK + BBNH + BPKN + BSP	
(13)	BBNH	=	BNH * HBNH	
(14)	BPKN	=	PKN * HPKN	
(15)	PRNB	=	7712180 + 0.18444*PDTB + 2442887***KUP	0.15991 7.61***
(16)	PDTK	=	PDTB + PRNB	
(17)	SURB	=	PDTK – TPKP	
(18)	KPP	=	-508127 + 0.137937***PDTK + 1450627***JAK+ 95726.75°PDKB	0.52297 28.87***
(19)	KPNP	=	747265.8 + 0.043229°KPP + 72715.30JAK + 1.098329***PKES + 0.998052***PDDK + 0.977020***PEGI	0.98397 945.27***
(20)	TPKP	=	KPP + KPNP	
(21)	KNP	=	2830026 + 1.081397***INV + 1.532720***TAB + 1.592900SEL	0.81317 114.61***
(22)	TPRT	=	TPKP + KNP	

Source: Estimation of SAS, 2013
*** : significant different α = 1%   * : significant different α = 15%
** : significant different α = 5%   ° : significant different α = 30%

Table 3. Statistics Test Result on Power Level Prediction Models

Variables	Actual average	Predicted average	U^M	U^S	U^C
PRI	7290.9	7188.8	0.00	0.12	0.88
KLM	868.7	850.2	0.00	0.07	0.93
BNH	9216.9	9146.3	0.01	0.02	0.97
TEK	14.9578	14.5986	0.00	0.09	0.91
PKN	15346.1	15255.5	0.00	0.09	0.90
PRB	11.4133	8.5872	0.13	0.30	0.57
TKDK	201.3	194.9	0.01	0.03	0.97
TKLK	15.7204	14.8039	0.05	0.06	0.90
TCKB	217	209.7	0.01	0.03	0.96
BPB	75672218	78235653	0.02	0.04	0.94
BBNH	3484880	3553194	0.02	0.01	0.97
BPKN	66668761	67041681	0.01	0.03	0.96
PRKB	99759446	98297992	0.00	0.12	0.88
PRNB	10077108	10428140	0.00	0.35	0.64
PDTK	32042137	30490479	0.04	0.02	0.94
KPP	8965314	8751279	0.01	0.03	0.96
KPNP	11752241	11742996	0.00	0.00	1.00
TPKP	20683456	20494275	0.01	0.00	0.99
KNP	11324581	11324580	0.00	0.01	0.99
TPRT	32042137	31818855	0.01	0.01	0.99

Source: Estimation of SAS, 2013
U^M = proportion of bias; U^S = proportion of variance; U^C = proportion of co-variance

Linkage of Various Household Economic Decision of Catfish Farmers

Linkage of varies household decisions of catfish farmers in aquaculture production, allocation of work expended, income and consumption based on a single simulation analysis of various variables (Table 4). The addition of juvenile stocking density of 25% (SIM 1) affect on increasing fish production up to 6.74%. Similar to Sikiru *et al.* (2009) explained that the greater stocking density leads to greater productivity of aquaculture. However, increasing stocking density show unknown impacts on juvenile to the farmer's income.

Result of SIM 1 simulation analysis shows that the addition of juvenile is also accompanied by increased production costs, especially feed costs by 20.89%. The cost increase in production is quite large (19.04%), despite income of households increased from farming and non-farming 6.83% and 14.47% respectively, household income will be decreased by 21.89%. The decline of household spent income is lead to decreasing of household expenses, both staple food consumption (-10.52%) and non-food staple consumption (-0.34%).

Improvement of farmers' formal education (SIM 2) refers to improving the quality of graduated human resources from primary school (6 years) to high school graduates (12 years) would cause a rise in labor work expended of 5.77%. It is possible that the improvement of education lead to more intensive farmers to manage aquaculture, in which an increase in work expend of family labor and the application of aquaculture technology respectively 6.52% and 6.44%. In addition, household welfare also improved as indicated by the increase in staple consumption by 0.38%.

Tabel 4. Simulation Results for Linkage Test on Various Household Economic Decision of Catfish Farmers

Variable	Basic Simulation	Persentage of basic simulation change (%)						
		SIM 1	SIM 2	SIM 3	SIM 4	SIM 5	SIM 6	SIM 7
PRI	7188.80	6.74	4.46	5.87	7.10	0.00	0.00	0.00
KLM	850.20	0.00	11.2	25.01	0.00	0.00	0.00	0.00
BNH	9146.30	25.00	3.87	8.63	0.00	0.00	0.00	0.00
TEK	14.60	0.00	6.44	0.00	25.00	0.00	0.00	0.00
PKN	15255.50	20.85	9.16	7.19	-0.02	1.98	1.98	0.64
PRB	8.59	6.69	-7.7	-15.38	7.24	0.00	0.00	0.00
TKDK	194.90	0.00	6.52	5.34	16.01	0.00	0.00	0.00
TKLK	14.80	0.00	-4.22	14.26	-41.18	0.00	0.00	0.00
TCKB	209.70	0.00	5.77	6.01	11.97	0.00	0.00	0.00
BPB	78235653.00	19.04	8.14	6.57	-0.02	-14.45	-14.45	0.55
BBNH	3553194.00	25.00	3.86	8.65	0.00	0.00	0.00	0.00
BPKN	67041681.00	20.89	9.3	7.21	-0.02	-16.87	-16.87	0.65
PRKB	98297992.00	6.83	4.52	5.94	7.19	0.00	0.00	0.00
PRNB	10428140.00	14.47	3.42	-1.25	-12.54	-20.00	-20.00	0.77
PDTK	30490479.00	-21.88	-5.17	1.89	18.96	30.25	30.25	-1.16
KPP	8751279.00	-10.52	0.85	0.91	9.11	14.54	14.54	-0.56
KPNP	11742996.00	-0.34	0.03	0.03	0.29	0.47	0.47	-8.31
TPKP	20494275.00	-4.69	0.38	0.41	4.06	6.48	6.48	-4.99
KNP	11324580.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TPRT	31818855.00	-3.02	0.24	0.26	2.61	4.17	4.17	-3.22

Source: Analysis Result (2013)

SIM : Simulation
SIM 1: Addition of juvenile stocking density 25%
SIM 2: Farmenr's Education Improvement (12 years)
SIM 3: Pond expanse 25%
SIM 4: Increasing of aquaculture technology application 25%
SIM 5: Subsidizing the price of pellet 25%
SIM 6: Subsidizing education 50%
SIM 7: Subsidizing healthcare 50%

The findings in terms of education according to Singha *et al.* (2012); Wang *et al.* (2011); Rousan (2007); Chirwa (2005), farmers with higher levels of education can easily learn and understand the importance of technology from different sources. They are more receptive to other things and accept changes to the new innovation. Similarly, Shang *et al.* (1998); Onumah and Acquah (2011) stated that the improvement of formal education and extense sufficient services/training (Oladoja and Olusanya, 2009) to fix the management capabilities of farmers to increase productivity (Djomo and Sikod, 2012; Riddell, 2007) and ensure the sustainability of farming activities. According to Ellis (1993), training for farmers is relatively low-cost method to achieve improved production efficiency.

The 25% addition of pond area (SIM 3) causes an increase in the work expended of labor (6.01%), where the increase in the work expended of hired labor (14.26%) is greater than the family labor (5.34%). The addition of the work expended of hired labor, especially for the pool preparation (drying, cleaning, liming, filling water) and harvesting. These results are consistent with the results of Oladejo (2010) that large pool is more economical but is not easily maintained.

The addition of pond area will increase fish production and household income 5.87% and 1.89% respectively. The same results to Rahman *et al.* (2011); Blank *et al.* (2009); Olagunju *et al.* (2007), that the size of the pool has a positive effect on the income of fish farmers. The increase in spent household income is encourages increased consumption of staple food and non-food household consumption 0.91% and 0.03% respectively.

Improvement of aquaculture technology implementation by 25% (SIM 4) will increase the work expend of family labor 16.01%. Application of aquaculture technology affects the self-processed food, construction of ponds and feeding. Improvements on aquaculture technology implementation will increase the household income of 18.96%. The increased income will be used to improve the quality and quantity of households consumed food 9.11% and non-food consumption by 0.29%.

Some farmers have used the self-processed feed (local raw materials such as rice bran, dried salted fish, and coconut cake) to obtain low price feed. However, the result's quality of the processed feed is still below the standard value of FCR (*Feed Conversion Ratio*) that lead to extended maintenance. Ahmed *et al.* (2010) explained FCR values of catfish farming in Bangladesh were higher in intensive systems because it used a qualified commercial pellet feed and maintenance period becomes shorter. FCR values can be improved with the right amount and formulation of feed compositions.

Availability of qualified pellet feed is still a major obstacle in increasing farming production. Imported feed ingredients are causing feed prices fluctuate – even tended to increase. Feed price increases are significantly influence the cost of production, then the simulated price subsidy on commercial pellet feed (qualified) are expected to help farmers in increasing their income.

Simulation with a subsidiary on commercial pellet feed price by 25% (SIM 5) show subsidies of pellet feed prices have no direct impact on production, but it will lower the cost of production (14.45%). Subsidies of commercial pellet feed prices will affect the increase in household income larger than other simulation results in 30.25%. These results different from the results of research Denning et al. (2009); Alumira and Rusike (2005); Crawford et al. (2003), that the input subsidy has the potential to accelerate agricultural production. However, consistent with the results of the study Abdelhak *et al.* (2012); Homolka and Svecová (2012); Špička *et al.* (2009); Omolehin *et al*. (2007); Ahearn *et al.* (2006); Key and Roberts (2006); Jehangir *et al.* (2002), that the operational subsidies directly affect the increase in farm household income. Household expenditure also rose by 4.17%, mostly the increase in the basic food (14.54%) and basic non-food (0.47%) consumption. This suggests that the subsidies price of pellet feed can increase household welfare of catfish farmers.

Education subsidies to households for catfish farmers by 50% (SIM 6) will give the same effect as SIM 5. Meanwhile, 50% healthcare subsidies (SIM 7) have less impact on the work expend, production, income and consumption of household farmers. We assumed that it caused by a relatively low value of household's healthcare expenditure. Farmer's households usually use only the market drug. Therefore, healthcare subsidies influence on household economic improvement of catfish farmers.

Alternative Policies on Increased Production and Improved Welfare of Farmers Household

Development of Minapolitan's Aquaculture is expected to increase the production and improve farmer household's welfare. This research combined different variables simultaneously (multiple simulation) with indicators of changes in production, employment, household income and expenditure of farmers (Table 5).

Based on the results, alternatives policies can be arranged with the following priorities: *first*, the policy with a combination on the addition of pond width, application of improved farming technologies and subsidies on the price of feed pellets, or education subsidies. This policy gives the best impact on all aspects of the Minapolitan goals development.

The *second* alternative policy is combination of increased education of farmers (12 years), application of improved farming technologies, and subsidies on the price of pellet feed or on education. The *third* alternative policy is the application of improved farming technologies, and subsidies on price of feed pellets or education subsidies. The *fourth* alternative policy is increasing the farmers' education (12 years), extent the pond width, subsidies on pellet feed price and healthcare.

Those four alternatives policies indicates the addition of pond width, application of improved farming technologies, subsidizing the price of feed pellets and education subsidies are the main policies that need to be taken in effort to increase production and ensure household welfare of farmers.

Table 5. Alternative Policies on Increased Production and Improved Welfare of Farmers Household

Simulation	**Fish Production (PRI)**	**Labor (TCKB)**	**Income (PDTK)**	**Expense (TPRT)**
Basic Simulation	7188.80	209.70	30490479.00	31818855.00
Policies Simulation	**Persentage on basic simulation change (%)**			
SIM 23	7.10	11.97	49.2	6.78
SIM 24	7.10	11.97	49.2	6.78
SIM 38	12.97	17.98	53.50	7.38
SIM 39	12.97	17.98	53.50	7.38
SIM 47	12.02	18.50	48.57	7.65
SIM 48	12.02	18.50	48.57	7.65
SIM 58	10.99	12.4	32.25	2.34

Source: Analysis Result (2013)

SIM : Simulations
SIM 23: Improvement of technology application 25% & subsidies on pellet feed price 25%
SIM 24: Improvement of technology application 25% & subsidies on education 50%
SIM 38: Pond width expand 25%, Improvement of technology application 25% & subsidies on pellet feed price 25%
SIM 39: Pond width expand 25%, Improvement of technology application 25% & subsidies on education 50%
SIM 47: Improvement of farmer's education (12 years), Improvement of technology application 25% & subsidies on pellet feed price 25%
SIM 48: Improvement of farmer's education (12 years), Improvement of technology application 25% & subsidies on education 50%
SIM 58: Improvement of farmer's education (12 years), Pond width expand 25%, subsidies on pellet feed price 25% & subsidies on healthcare 50%

IV. Conclusion

1. Linkage on various decisions affect the household economic improvement of catfish farmers, except for an increase in stocking density that followed by the increase in the number and cost of feed that possible to lower the household income.
2. Alternative policies on some integrated simulation of various variables have an impact on optimal household economic improvement, i.e. integrated simulation related to pond expansion, the improved application of farming technologies, subsidizing the price of pellet feed, and education subsidies.

References

[1]. Abdelhak, S., J. Sulaiman and S. Mohammad. (2012). The role of assets in the enhancement of households' income: a study of poverty alleviation among rural communities of Kelantan and Terengganu. Asian Social Science. 8 (11): 145 – 153. doi:10.5539/ass.v8n11p145.
[2]. Agboola, W.L. (2011). Improving fish farming productivity towards achieving food security in Osun State, Nigeria: a socioeconomic analysis. Annals of Biological Research. 2 (3): 62-74.
[3]. Ahearn, M., H. El-Osta and J. Dewbre. (2006). The impact of coupled and decoupled government subsidies on off-farm labor participation of U.S farm operators. American Journal of Agricultural Economics. 88 (2): 393 -408.
[4]. Ahmed, N., Md. F. Alam, M.R. Hasan. (2010). The Economics of sutchi catfish (Pangasianodon hypophthalmus) aquaculture under three different farming systems in rural Bangladesh. J.Aquaculture Research. 41 (11): 1668-1682. doi: 10.1111/j.1365-2109.2010.02549.x
[5]. Alumira, J. and J. Rusike. (2005). The green revolution in Zimbabwe. Electron J. Agric. Dev. Econ. 2: 50 – 66.
[6]. Asamoah, E.K, F. K. E. Nunoo, Y. B. Osei-Asare, S. Addo and U. R. Sumaila. (2012). A production function analysis of pond aquaculture in Southern Ghana. J. Aquaculture Economics & Management. 16: 183-201. doi:10.1080/13657305.2012.704616.
[7]. Asche, F. and F. Khatun. (2006). Aquaculture: Issues And Opportunities for Sustainable Production and Trade. Series Issue Paper No. 5. International Centre for Trade and Sustainable Development. Geneva, Switzeland. pp. 50. http://www.ictsd.org.
[8]. Barnum, H.N. and L. Squire. (1978). An econometric application of the theory of the farm-household. North Holland Pub.Co.J.Dev. Econ. 6: 79-102.
[9]. Becker, G.S. (1965). A Theory of the Allocation of Time. J.Econ. 75 (299): 493-517.
[10]. Bappeda (Department of Regional Development Planning) Banjar Regency. (2009). Masterplan of region development in Minapolitan Cindai Alus, Martapura, Banjar Regency.
[11]. Blank, S.C., K.W. Erickson, R. Nehring and C. Hallahan. (2009). Agricultural profit and farm household wealth: A farm-level analysis using repeated cross sections. J. Agricultural and Applied Economic. 41 (1): 207 – 225.
[12]. Chirwa, E.W. (2005). Adoption of fertiliser and hybrid seeds by smallholder maize farmers in southern Malawi. Development Southern Africa. 22 (1): 1 – 12.
[13]. Crawford, E., V. Kelly, T.S. Jayne and J. Howard. 2003. Input use market development in sub-Saharan Africa: An overview. Food Policy. 28: 277 – 292.
[14]. Directorat General of Aquaculture, 2004. Production Statistic of Aquaculture 2003. Jakarta, Indonesia. pp. 121.
[15]. Denning, G., P. Kabambe, P. Sanchez, A. Malik, R. Flor, R. Harawa, P. Nkhoma, C. Zamba, C. Banda, C. Magombo, M. Keating, J.Wangila, and J. Sachs. (2009). Input subsidies to improve smallholder maize productivity in Malawi: toward an African green revolution. PLoS Biology. 7 (1): 2 – 10. doi:10.1371/journal.pbio.1000023.
[16]. Djomo, J.M.N and F. Sikod. (2012). The effects of human capital on agricultural productivity and farmer's income in Cameroon. International Business Research. 5 (4): 149 – 159.
[17]. Ellis, F. (1993). Peasant Economics: Farm Households and Agrarian Development. 2nd edn. Cambridge University Press. Cambridge, UK. pp. 309.
[18]. FAO (Food and Agricultural Organization), (2010). Assessing the Contribution Aquaculture to Food Security. FAO, Rome.
[19]. Homolka, J. and M. Švecová. (2012). Analysis of financial support influences on management of agricultural enterprises. Agris on-line Papers in Economics and Informatics. 4 (1): 13 – 20.
[20]. Jehangir, W. A., M. Ashfaq, A. Ali, and N. Sarwar. (2002). Use of credit for poverty reduction by small farmers, Pakistan. Journal of Applied Sciences. 2 (7): 777-780.
[21]. Key, N. and M. Roberts. (2006). Government payments and farm business survival. American Journal of Agricultural Economics. 88 (2): 382 – 392.
[22]. KKP (Ministry of Marine and Fisheries). (2010). Strategic Plan of Ministry of Marine and Fisheries 2010-2014. KKP Jakarta.
[23]. Oladejo, A.J. (2010). Economic analysis of small-scale catfish farming in Ido Local Government Area of Oyo State, Nigeria. Agricultural Journal. 5 (6): 318 -321.
[24]. Oladoja, M. A., and T. P. Olusanya. (2009). Impact of private feed formulation and production as a tool for poverty alleviation among poultry farmers in Ogun State Nigeria. International Journal of Poultry Sciences. 8 (10): 1006-1010. doi.org/10.3923/ijps.2009.1006.1010
[25]. Olagunju, F. I., I. O. Adesiyan and A.A. Ezekiel. (2007). Economic viability of catfish production in Oyo State, Nigeria. J. Hum. Ecol. 21(2): 121-124.
[26]. Omalehin, Ra., T. O. Ogunfiditini, and O. B. Adeniji. (2007). Factors influencing adoption of chemical pest control in cowpea production among rural farmers in Makarfi Local Government Area of Kaduna State Nigeria. *International Journal of Agricultural Research*. 2 (11): 920 – 928. doi.org/10.3923/ijar.2007.920.928.
[27]. Onumah, E.E. and H.D. Acquah. (2010). Frontier analysis of aquaculture farms in the Southern Sector of Ghana. World Applied Sciences Journal. 9 (7): 826-835.
[28]. Onumah, E.E. and H.D. Acquah. (2011). A stochastic production investigation of fish farms in Ghana. Agris on-line Papers in Economics and Informatics. 3 (2): 55-65.
[29]. Rahman, S.Md.A., A. Haque and S.Md.A. Rahman. (2011). Impact of fish farming on household income: a case study from Mymensingh District. Journal of Social Sciences. 7 (2): 127-131.
[30]. Riddell, W. C. (2007). The Impact of Education on Economic and Social Outcomes: An Overview of Recent Advances in Economics. In G. Picot, R. Saunders & A. Sweetman (Eds.), Fulfilling Potential, Creating Success: Perspectives on Human Capital Development. Montreal and Kingston: McGill-Queen's University Press.
[31]. Rousan, L. M. (2007). Factors influencing adoption of improved farm practices among women farmers in Northern Jordan. American-Eurasian Journal of Agriculture & Environmental Science. 2 (3): 220-226.

[32]. Rustadi. (2011). Role and adaptation in sustainable development aquaculture in Indonesia. Professor Oration, Faculty of Agriculture, Gadjah Mada University, Yogyakarta, November 16th 2011.
[33]. Shang, Y.C., Leung P. and Ling B.H. (1998). Comparative economics of shrimp farming in Asia. Aquaculture. 164: 183-200.
[34]. Singh, R.K.P. (2003). Economics of Aquaculture. Daya Publishing House. Delhi, India.
[35]. Sikiru, B.O., N.M. Omobolanle, B.J.O. Ayorinde and O.O. Adegoke. (2009). Improving clarias productivity towards achieving food security in Ijebu-Ode, Ogun State, Nigeria: A Socioeconomic Analysis. J. Biological Research 3 (1-2): 24-28.
[36]. Singha, A.K., M.J. Baruah, R. Bordoloi, P. Dutta and U. S. Saikia. (2012). Analysis on influencing factors of technology adoption of different land based enterprises of farmers under diversified farming system. Journal of Agricultural Science. 4 (2): 139-146. doi:10.5539/jas.v4n2p139.
[37]. Špička, J., J. Boudný and B. Janotová. (2009). The role of subsidies in managing the operating risk of agricultural enterprises. Agric. Econ. – Czech. 55: 169-180.
[38]. Taylor, J.E. and I. Adelman. (2003). Agricultural household models: genesis, evolution, and extensions. Forthcoming in Review of Economics of the Household. 1 (1). pp.45.
[39]. Wang, K., H. Xiao and W. Zhang. (2011). Analysis on influencing factors of farmers invoilving in Rural Social Endowment Insurance. J. Agricultural Science. 3 (1): 250-257.
[40]. Wilkinson, S. (2008). Better management practices for Vietnamese catfish. Aquaculture Asia.13: 8 – 11.

Appendix 1. Variables Notation on Household Economics Model of Catfish Farmers

BNH	:	Juvenile stocking density (juvenile yr^{-1})	BPB	:	Production cost (Rp yr^{-1})
BBNH	:	Juvenile cost (Rp yr^{-1})	BPKN	:	Pellet feed cost (Rp yr^{-1})
BTLK	:	Family labor work expended (Rp yr^{-1})	BSP	:	Cost of other production facilities (Rp yr^{-1})
DLM	:	Pond depth (m)	HBNH	:	Juvenile price (Rp $juvenile^{-1}$)
HIP	:	Catfish price (Rp kg^{-1})	HPKN	:	Pellet feed price (Rp kg^{-1})
INV	:	Spent for investation (Rp yr^{-1})	JAK	:	Number of household members (person)
KNP	:	Non basic consumption (Rp yr^{-1})	KLM	:	Operational pond width (m^2)
KPP	:	Staple food consumption (Rp yr^{1})	KUP	:	Number of productive age in family member (person)
PDDK	:	Educational spent cost (Rp yr^{-1})	KPNP	:	Non-food staple consumption (Rp yr^{-1})
PDTB	:	Income of catfish farmer's household (Rp yr^{-1})	PDKB	:	Formal education period of farmers (yr)
PGLB	:	Farmer experience (yr)	PDTK	:	Total household income of catfish farmer (Rp yr^{-1})
PKES	:	Healthcare cost (Rp th^{-1})	PEGI	:	Energy expense cost (Rp yr^{-1})
PRB	:	Productivity of catfish farming (kg m^{-2} yr^{-1})	PKN	:	Feed number (kg yr^{-1})
PRKB	:	Household income of catfish farming (Rp yr^{-1})	PRNB	:	Household income of non-catfih farming (Rp yr^{-1})
SEL	:	Expense on graceful event (Rp yr^{-1})	PRI	:	Fish production (kg yr^{-1})
TAB	:	Expense for savings (Rp yr^{-1})	SURB	:	Surplus household income of catfish farmer (Rp yr^{-1})
TCKB	:	Total expended work of catfish farming (HOK yr^{-1})	TEK	:	Application level of aquaculture technologies (score)
TKLK:	:	Expended work of non-family labor (HOK yr^{-1})	TKDK	:	Expended work of family labor (HOK yr^{-1})
TPRT	:	Total household expense (Rp yr^{-1})	TPKP	:	Total basic consumption spent (Rp yr^{-1})
UPP	:	Age of farmer (year)			