AQUACULTURE AND HAPPINESS –
A MICROECONOMETRIC ANALYSIS IN VIETNAM

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ABSTRACT

The contribution of aquaculture development to the Vietnamese national economy and to farmers' incomes has been documented in various government reports as well as working papers produced by development projects. However, the role of aquaculture in the life satisfaction of poor farmers has not been considered rigorously. In particular, it is very difficult to find any literature relating aquaculture adoption to job or life satisfaction of the adopters. Due to the controversial role of income in creating happiness and the increased contribution of fish production in the livelihoods of small scale farmers, there exists a question of whether income increases from adoption of aquaculture would raise happiness of farmers. This study identifies some determinants of job satisfaction and subjective well-being of small scale fish farmers in Vietnam and examines the role of earnings from fish production in generating their happiness. Cumulative logistic models with data from a 2001 survey in Southern Vietnam show that relative income, not absolute income, from aquaculture raises their job satisfaction. Higher satisfaction is also associated with involvement in extension services, a larger relative pond surface and a higher expectation level on earnings from aquaculture. The role of income per capita in job satisfaction or happiness is not confirmed. Happiness of the farmers increases with cash earnings from fish farming and income from wild fish relative to total household income.

Keywords: *job satisfaction, subjective well-being, fish culture, farmer, logistic model*

INTRODUCTION

Aquaculture is a farming activity that is almost as old as humanity. However, there is now, more than ever, a growing awareness of the importance of food fish production on human nutrition, employment, poverty (Bailey and Skladany, 1991; Edwards, 2000), and even recreation in more developed societies (Jolly and Clonts, 1993). In Vietnam, aquaculture has also been considered an important economic sector due to its rapid growth and its 30-40 percent contribution to total national fisheries production (FAO and NACA, 1997). In addition, seafood is the third most important export product of Vietnam after crude oil and textile-garments. Alongside capture fisheries, aquaculture revenue constituted 4% of Vietnamese GDP in 2003 and $2.35 billion in exports in 2004 (FAO, 2005), or 10% of the country's total export revenue. The total area used for aquaculture in Vietnam is 902,229 hectares of two million hectare potential water surface areas (FICEN, 2005), covering 3% of the total land area.

The contribution of aquaculture development to the Vietnamese national economy and to farmers' incomes has been the focus of various government reports as well as working papers produced by development projects. However, the role of aquaculture in the job satisfaction of poor farmers has not been considered rigorously. In particular, it is very difficult to find any literature relating aquaculture adoption to happiness or life satisfaction of the adopters although since the 1990s, a number of studies of the determinants of happiness have been conducted by economists following a long history of happiness analysis by psychologists (Frey and Stutzer, 2002). Furthermore, the relationship between income and happiness is confounded by economists and social researchers because the terms *happiness, subjective well-being, satisfaction, utility*, or even *welfare* are usually used interchangeably (Easterline, 2001).

Di Tella, MacCulloch and Oswald (2003) state that happiness equations are monotonically increasing in income and that they have a similar structure in different countries. Higher income persons are likely happier because they have more opportunities to get what they desire (Frey and Stutzer, 2002). The important role of higher income in lasting human happiness is also supported by Andrews (1986), Argyle (1999), Diener (1984), Diener and Lucas (1999), Lykken and Tellegen (1996), Schwars and Strack (1999). Although it does not provide lasting happiness, more money allows for lifestyle improvements, whether those improvements arise from more money or other desirable objects (Lee, 2006).

Despite evidence that increased income raises happiness, according to Frank (2005), the absolute income increases of recent decades have failed to translate into corresponding increases in measured well-being. The evidence thus suggests that if income affects happiness, it is relative, not absolute, income that matters. Frey and Stutzer (2002) argue that higher income aspirations reduce individuals' life satisfaction.

Due to the controversial role of income in creating happiness and the increased contribution of fish production in the livelihoods of small-scale farmers (Edwards, 2000), there exists a question of whether income increases from adoption of aquaculture would raise the happiness of farmers. This study uses cumulative logistic models to explore the level of farmers' happiness, examines impacts of aquaculture on beneficiaries' lifestyle improvements and thus complements previous studies on contributions of aquaculture to farmers' lives. Furthermore, secondary micro data measuring happiness, especially related to job satisfaction with fish culture, are unavailable in a developing country as Vietnam. Thus, primary data from a field survey used this study are unique.

RESEARCH METHODS

The Cumulative Logistic Model

Since subjective well-being is a broader concept than decision utility, including experienced utility as well as procedural utility, Frey and Stutzer (2002) suggest a microeconometric function to measure happiness: $W = \alpha + \boldsymbol{\beta}\mathbf{x} + \varepsilon$ in which W is level of happiness and $\mathbf{x}$ is a vector of explanatory variables of demographics and socioeconomics characteristics. Therefore, cumulative logit models are used to explore the effects of economic rewards from fish culture on farmers' job satisfaction and also to the improvement of their life quality. Given that utility levels are represented by ordinal variables, a farmer's utility (represented by satisfaction or happiness from aquaculture) takes the following function

$$U_i = \alpha^* + \boldsymbol{\beta}^*\mathbf{x}_i + \sigma\varepsilon_i, \qquad \text{(Eq. 1)}$$

in which U is utility level, $\mathbf{x}$ is vector of explanatory variables, and *i* represents individual respondent.

However, U_i can not be observed directly. Instead, according to Greene (2003), there exists a set of cut off points or thresholds, $\pi_{1, \ldots,} \pi_{J-1}$, that are used to transform U_i into the observed variable Y, as follows:

$Y_i = 1$ if $\pi_1 \leq U_i$ (Eq. 2)
$Y_i = 2$ if $\pi_2 < U_i \leq \pi_1$
$Y_i = 3$ if $\pi_3 < U_i \leq \pi_2$
•
•
$Y_i = J$ if $U_i \leq \pi_{J-1}$

Assuming that ε_i has a standard logistic distribution, it follows that the dependence of Y on **x** is given by the cumulative logit model.

$$\text{Log}\,[F_{ij}/(1-F_{ij})] = \alpha^* + \boldsymbol{\beta}^*\mathbf{x}_i \qquad j = 1, \ldots, J-1; \tag{3}$$

In which $F_{ij} = \sum_{m=1}^{j} p_{im}$ represents cumulative probabilities (4)

Agresti (2002) defines the cumulative probabilities in simpler form:

$$P(Y \leq j|\mathbf{x}) = p_1(\mathbf{x}) + \cdots + p_j(\mathbf{x}) \qquad (j = 1, \ldots, J) \tag{5}$$

and the cumulative logits are

$$\text{logit}[P(Y \leq j \mid x)] = \frac{\text{log}P[(Y \leq j \mid x)]}{1 - \text{logp}[(Y \leq j \mid x)]} \qquad (j = 1, \ldots, J-1) \tag{6}$$

A model that simultaneously uses all cumulative logits is given by

$$\text{logit}[P(Y_i \leq j \mid x)] = \alpha_{ij} + \mathbf{x}_{ij}'\beta \tag{7}$$

in which Y_i is response level, i= respondents and j = 1, …, J − 1 and J represents the number of categories of responses; in our study, J = 5, and **x** is the vector of explanatory variables.

Each cumulative logit has its own intercept α_j increasing in j but the same coefficient β for each explanatory variable, representing the effect of explanatory variable x on the response Y. The response curves for j = 1, …, J-1 have the same shape determined by β. They share exactly the same rate of increase or decrease but are horizontally displaced from each other. According to Agresti (2002), for fixed j, the response curve is a logistic regression curve for a binary response with outcomes Y≤j and Y>j.

Allison (1999) states that the coefficients in equation (7) are related to equation (1) by

$$\alpha_j = \frac{\alpha^* - \pi_j}{\sigma} \tag{8}$$

and $\boldsymbol{\beta} = \boldsymbol{\beta}^*/\sigma$. (9)

Allison (1999) emphasizes that coefficients $\boldsymbol{\beta}$ are not affected by the placement of the thresholds. Some π's may be close together while others are far apart, but the effects of the explanatory variables stay the same. The effect of π is on the intercepts.

The levels of pleasure from fish culture are proxy for job satisfaction. The respondents were asked the question "*Do you feel completely satisfied or pleased by integrating fish culture into farming?*" To measure the farmers' life satisfaction, a proxy for their subjective well-being or happiness (Frey and Stutzer, 2002), the respondents were asked "*Do you recognize generally a considerable improvement in quality of life in your household since adoption of fish culture*?"

Farmers' responses to the above questions are based on the Likert scale ranging from one ("strongly agree") to five ("strongly disagree"). Frequencies of the responses are summarized in Table 1.

Table 1 Frequency of Dependent Response Variables

	Level	Frequency	Percent
Satisfied with	1 – *strongly satisfied*	25	20.83
fish culture?	2 – *satisfied*	74	61.67
(*pls_fish*)	3 – *undecided*	19	15.83
	4 – *dissatisfied*	2	1.67
	5 – *strongly dissatisfied*	0	0
Improved	1 – *strongly agreed*	4	3.33
quality of life?	2 – *agreed*	71	59.17
(*happy*)	3 – *undecided*	41	34.17
	4 – *disagreed*	3	2.5
	5 – *strongly disagreed*	1	0.83

The scales of j=1,2 indicate that the farmer is satisfied with his/her fish farming experiences (for the question on job satisfaction) or that he/she is happy with his/her life (for the question on life satisfaction). At fixed threshold j=2, the response curve is a logistic regression curve for a binary response with outcomes $Y \leq 2$ and $Y > 2$. From this, we can obtain the estimated cumulative probability p of farmers' satisfaction or happiness from which we can calculate marginal effects that are then used to calculated elasticities of continuous explanatory variables for each observation. For dummy variables (say, D), the marginal effects are differences between $P(Y \leq 2 \mid D=1, x)$ and $P(Y \leq 2 \mid D=0, x)$.

The SAS logistic regression procedure with backward selection is used, setting a maximum P-value of 10 percent. From the logistic procedure the best fit model is selected. Elasticities are also calculated to measure the magnitude of effects of explanatory variables. Since elasticities are nonlinear functions of the observed data, the logit function is not guaranteed to pass through the mean point (Train, 1986). Elasticity calculated at the means tends to overestimate the probability response to a change in an explanatory variable (Hensher and Johnson, 1981). The elasticity measured at means is thus not used to measure effects of continuous variables in this study. Instead, based on Hensher and Johnson's (1981) formulation, the weighted average elasticities are calculated from the marginal effects.

Data Description

The data for this study are obtained from a 2001 field survey involving 120 fish farmers in three provinces of Binh Phuoc, Tay Ninh and Long An in Southern Vietnam. Because of poor resources due to dry soil and water scarcity as well as remote distances to urban regions, aquaculture was underdeveloped in the provinces before 1994. Limited resource farmers in these provinces live mainly on subsistence agriculture and are irregularly employed in off-farm labor. Aquaculture has been adopted as a solution for rural development and improvement of farmers' livelihoods. The investigated region is also the target area of an aquaculture development program, UAF-Aqua Outreach Program (UAF-AOP), which was implemented in 1994 under the cooperation of the provincial extension agencies and Faculty of Fisheries (the University of Agriculture and Forestry, currently renamed Nong Lam University, Thuduc, Hochiminh City, Vietnam). Between 1994 and 2000, the program had transferred appropriate and low cost technologies, utilizing local resources, to small scale farmers involved in on-farm trials. Since the beginning of the program, aquaculture has been continuously growing in both water surface and production intensity, mostly within extensive and semi-extensive aquaculture systems in the area (Duc, 2002).

Prior to the development project, aquaculture was underdeveloped in the survey area. However, overall pond area has increased considerably since 1995, the beginning of the UAF-Aqua Outreach Program. This study focuses on small-scale fish farmers, whose pond area is generally small or very small, ranging from 40 to 9,000 m^2, and whose ratio of pond to land ranges from 0.25 – 80.00%. The land area owned by households in this survey ranges from 0.05 to 12.00 ha. Headed mostly by men, the surveyed households had an average size of five members, ranging from one to sixteen, and a median number of two men, while the age of the respondents (also household heads) ranged from 26 to 80, with a mean of 47, mostly concentrated in the 35 - 60 year old range. The respondents had quite high education levels, with more than 75 percent of them having completed secondary or higher levels. The rather high educational level of the farmers should make them more willing to adopt new farming technologies, thereby improving their livelihoods.

Employing Enterprise Budgeting method (Jolly and Clont, 1993), household income includes farming income, off-farm income, non-farm income, and income from wild-caught fish, which plays an important role in the livelihoods of the target farmers. Total household income is divided by household size to get per capita income. Farming income includes incomes from farming enterprises, such as rice cultivation, livestock, fish culture, non-rice crop farming and fruit trees, all of which contribute to farmers' annual incomes. Any enterprises practiced solely for consumption and which do not contribute to a farmer's income are ignored in this study because farmers do not consider them as sources of income and because their role in farmers' livelihoods is not empirically relevant. In this study, "fish income" is defined as total income from fish production, including cash income received from fish harvest sales and "forgone" income from the amount of fish given away and eaten, while "wild fish catch income" is cash income received from selling wild fish caught off-farm. Cash income from fish culture is more appreciated by the farmers because they can use cash to buy necessities and to improve their livelihood. To explore income effects on farmers' satisfaction or happiness, enterprise incomes either in their absolute or in relative values are assumed exogenous and included in regression.

Furthermore, Michalos (1991) and Inglehart (1990) state that "individual well-being is determined by the gap between aspiration and achievement". Thus, this study includes the farmer's expectations of earnings from fish culture (from here called "fish expectation" in brief), which is defined as the difference between the farmer's estimated value of fish income relative to his/her total household income and the real value calculated from collected economic data of his/her actual operations. Descriptive statistics are summarized in Table 2.

Table 2 Summary of Data Descriptive Statistics

	Mean	S. Error	Minimum	Maximum
Age	47.52	0.97	26.00	80.00
age (dummy)	0.74	0.44	0.00	1.00
Edulevel	2.01	0.75	0.00	4.00
Hhsize	5.02	0.17	1.00	16.00
Men	2.39	0.09	0.00	5.00
land (ha)	1.46	0.17	0.05	12.00
Pond/land	12.94	1.46	0.24	80.00
hhincome ($)	1215.30	85.69	-637.93	5043.10
farmincome ($)	686.91	70.20	-1051.72	5043.10
fish/household income	27.76	2.33	1.40	100.00
fish/farm income	46.95	6.34	3.25	215.38
fish_income ($)	304.55	44.56	14.48	4172.41
fishcash ($)	176.54	20.51	0.00	1103.45
Capita income ($)	260.61	20.20	-159.48	1425.69
nonfarm_income ($)	494.14	691.37	0.00	4137.93
Catch_income ($)	10.82	38.82	0.00	344.83
Involvement	0.25	0.43	0.00	1.00
fish expectation	15.72	18.53	-8.00	75.86
Pleasure from fish culture	0.83	0.16	0.34	1.00
yield (kg/m^2)	0.58	0.57	0.02	3.33

RESULTS AND DISCUSSION

Satisfaction with Fish Culture

The pleasure that farmers receive from adopting fish culture may be considered a proxy for "job satisfaction", where "job" is the fish culture enterprise in which all respondents of this study are involved. Using a cumulative logistic model to estimate farmers' satisfaction with fish culture, the first explanatory variable included is fish yield, which is fish production divided by pond area. When fish yields increase, the satisfaction with fish culture is expected to increase. Demographic characteristics, such as age and education level of the respondents, are also included in the model, as suggested as Frey and Stutzer (2002).

Per capita income is included to control the effect of income on a respondent's satisfaction from fish culture. In the target area, fish culture had given an increasing contribution to household income of small-scale farmers (Duc, 2008). Due to capital constraints involved with fish culture (Duc, 2002), higher income farmers are expected to be more satisfied with fish culture. The absolute values of income from fish culture in addition to its relative income as proportions to total household income and farming income are major variables of interest and are considered exogenous to the farmers' satisfaction. The variables are used to explore the utility effects of earnings from fish culture. The number of men in a household represents the role of male labor in household livelihoods.

Land area is also considered because of its important role in the small-scale farmers' livelihoods (Quan, 1998); higher land area is expected to increase satisfaction derived from fish culture, assuming that farmers would expand operations in order to increase profits and utility.

On the other hand, for small-scale farmers, whose land is the only material resource invested in production, the relative area of pond to total land area defines the scale of fish culture on their farms and represents a farmer's investment in fish farming. The other explanatory variables are farmers' involvement in on-farm trials with support from AOP, and their "fish expectation."

The cumulative logistic model for farmer satisfaction with fish culture is specified as

Logit[P(pls_fish≤j)] = f(yield, income, fishincome, fish-farminc, age, edulevel, men, land, pond-land, involve, expectation) Model (1)

in which

- *pls_fish*: categorical variable for farmer satisfaction with fish culture where *j* indicates the value of the Likert scale, representing five levels of job satisfaction from "strongly satisfied" to "strongly dissatisfied," j = 1…5

- *yield*: farmer's productivity of fish culture, total fish production divided by pond area

- *income*: capita household income in US dollar

- *fishincome:* total income from fish production

- *fish_farminc:* the ratio of *fishincome* to farming income

- *age:* dummy variable for age of respondent; *age* = 1 for age > 40, *age* = 0 otherwise.

- *edulevel:* dummy variable for education level of respondent; *edulevel* = 1 if the respondent had completed secondary school, *edulevel* = 0 otherwise.

- *men*: number of men in household

- *land:* farmer's total occupied land

- *pond-land*: the ratio of pond area to total area of land (*land*)

- *involve*: involvement with extension services*; involve* = 1 if the farmer is involved with extension services; *involve* = 0 otherwise.

- *expectation:* "fish expectation", farmer's expectation to the role of fish farming in household income, defined by the gap of farmers' estimation on the percentage of fish income in their household income and the actual percentage calculated by enterprise budgeting method.

The interaction between respondent's age, expectation in earnings from fish culture, and involvement in extension services and other variables are also added in the model.

From the logistic procedure, the best fit model for farmer satisfaction with fish culture is selected. The regression estimates, marginal effects and elasticities of explanatory variables are reported in Table 3.

The effect of age is significant in the model, meaning that older farmers achieve a higher probability of satisfaction with fish culture. The marginal satisfaction of *age* is 0.15. For older farmers, a larger relative area of pond appears to increase the probability of farmers' satisfaction with fish culture. A doubling in the ratio between pond surface and land area would raise satisfaction for younger farmers by only 7% but would increase satisfaction for older farmers by 13%. The regression results also show that younger farmers with higher expectations from fish culture are more satisfied with fish culture, although the effect is fairly small. A doubling in "fish expectation" results in a 10% rise in the probability of satisfaction level of younger farmers (less than 40 years old) from their fish enterprise relative to the older.

Table 3 Estimates and Marginal Effects for Farmers' Satisfaction with Fish Culture

	Regression Estimates		Marginal effect	Elasticity
Parameter	Coef.	S. Error	Weight average	Weight average
Age	1.2231*	0.6944	0.1500	
Edulevel	0.4164	0.5091	0.0267	
Pond_land	0.0616**	0.0272	0.0072	0.0725
Involve	2.3381**	0.9999	0.0203	
Expectation	0.1387***	0.0335	0.0162	0.1713
age.pond_land	0.0642**	0.0301	0.0073	0.0539
age.expectation	-0.0795***	0.0297	-0.0090	-0.0953
edulevel.involve	-2.1587*	1.2277	-0.1951	
Pond_land.expectation	-0.003***	0.00087	-0.0004	-0.0036
fish_farminc	1.8626*	0.9848	0.2176	0.2009

*Intercepts are not included; *,**, and *** represent significances at 90% , 95%, and 99% level*

The involvement in extension activities generally has a positive effect on farmer satisfaction with fish culture. Among farmers who were not involved in extension services, better educated farmers are more satisfied with their fish culture relative to the less educated. The negative effect of the interaction between education level and involvement in extension service suggests that the better educated farmers who were involved with extension services obtain less satisfaction from their fish culture. In other word, less educated farmers involved in extension services would get more satisfaction with their fish farming.

In general, farmers' expectations on earnings from fish culture raise their satisfaction from the enterprise. This scenario seems not to support the discussion of Frey and Stutzer (2002) who argue that 'wants are insatiable,' meaning that the more one gets, the more one wants and that higher expectation leads to less satisfaction. Their argument is possibly appropriate to the farmers who are older than 40 years old in this study or who have limited pond surface in the target area. Nevertheless, with higher expectation on earnings from fish culture, small scale farmers can maximize their use of limited resources to pursue fish farming, resulting in more production and higher income from the enterprise.

Unexpectedly, neither per capita income nor absolute fish income has a significant effect on the farmers' satisfaction with their fish culture. However, the regression estimates that a higher relative income from fish culture (*fishincome/farmincome*) creates a higher cumulative probability of farmer satisfaction with the enterprise, especially for farmers not involved in extension services. The income from aquaculture in this study includes not only cash income from the enterprise but also "hidden" indirect benefits from fish consumed and given away. However, those benefits are not quantifiable by the farmers. Their higher satisfaction with fish farming may be a positive consequence derived from the indirect benefits. Although income from fish culture has no explicit effect on farmers' satisfaction, fish production benefits the farmers as an available source of fresh and high-value food locally. This benefit is very important in rural areas with limited resources due to dry soil and water deficiency.

Fish Culture and Farmers' Happiness

Easterline (2001) states that the terms *happiness* and *subjective well-being* are usually used interchangeably. The level of happiness in this study is thus assumed identical to farmers' responses to life quality improvement, a proxy for subjective well-being. This section of the paper concentrates on the examination of the role of earnings from fish culture in improving farmers' quality of life and also verifies the role of fish culture in contributing to farmers' happiness.

Because absolute income may be not a determinant for quality of life (Frank, 2004) relative incomes calculated as the ratios of absolute income from fish culture ("fish income" in brief) and from captured wild fish ("catch income" in brief) to total household income (*fish_total* and *catch_total)* are included in the model to examine their effects on life quality improvement alongside the variable of *income*, per capita income. Cash income from fish culture is more appreciated by farmers because cash can be used to buy necessities and improve their livelihood. Therefore, cash income from fish culture relative to total household income (*fcash_total*) is also included in the model. Higher cash income is expected to lead to higher levels of happiness. The income from non-farm activities relative to total household income (*nonfarm_total*) is used to explore the effect of non-farm income.

According to Cantril (1965), a good job and personal characteristics are also associated with happiness. Satisfaction with aquaculture is thus expected to raise fish farmers' happiness levels. In this regression, farmers' satisfaction with fish culture (*pls-fish*) is represented by the estimated probability predicted in Model 1. Age, education levels of respondents (*edulevel*), number of men (*men*), and land area (*land*) occupied by their household are used as controlling variables in the model. In previous research, younger respondents reported the lower life satisfaction than did the older respondents (Frey and Stutzer, 2002). The number of men in a household controls for the possible role of male labor in creating income and improving household livelihood in poor and remote communities where women's roles in the labor market are limited. The importance of farm size in a farmer's livelihood merits inclusion of a land area variable (*land*) in the model; more land area is expected to result in higher levels of quality of life. The logit model is specified as

$$Logit[P(\ happy \leq j)] = f(pls\_fish,\ income,\ fcash\_total,\ nonfarm\_total,\ catch\_total,\ fish\_total,\ age,\ edulevel,\ men,\ land) \qquad \text{Model (2)}$$

where *happy* is a categorical variable of improvement in farmer's life quality

The logit regression coefficients, marginal effects and elasticities for explanatory variables in Model 2 respectively are reported in Table 4. The results show that the cumulative probability of life quality improvement increases with higher probability of farmer's satisfaction with fish culture. The elasticity of happiness with respect to probability of farmer's satisfaction is estimated by 0.91. When satisfaction of a farmer with fish culture increases by 10 percent, his (her) probability of happiness increases by 9.1 percent.

The significance of *pls-fish* permits the use of the Model 1 as the first stage and its predicted value as an instrument in a two-stage estimation of happiness determinants. Substituting *pls-fish* in Model 2 by its determinants found in Model 1, we can get marginal effects and elasticities of the farmers' happiness in respect to its determinants (Table 5).

Consistent with Frey and Stutzer (2002), the older are likely to be happier than the younger as the marginal utility of *age* dummy variable is estimated of 0.0946. Younger respondents appear to be more pessimistic than older respondents. Involvement with extension services also positively influences farmers' happiness as indicated by its marginal effect of 0.0125. Farmers who are less educated and involved in extension services would be happier than the better educated. This result also exhibits the role of extension in well-being of the poor farmers, who have less opportunity to get formal education relative to the richer.

Table 4 Estimates and Marginal Effects from Model 2

	Estimate		Marginal Effect	Elasticity
Parameter	Estimate	S.Error	Weight Average	Weight Average
Pls-fish	3.1232**	1.4613	0.6172	0.9059
Fcash_total	0.0226*	0.013	0.0045	0.0926
Nonfarm_total	-0.0415***	0.013	-0.0082	-1.1800
Catch_total	0.057**	0.0225	0.0113	1.1093
fish_total	0.4852	1.746		
Age	3.7583***	1.4564	0.0020	
Fish_total.age	-6.0363***	2.0856	-1.1659	-0.3208

*Intercepts are not included; *,**, and ***represent significances at 90% , 95%, and 99% level*

Table 5 Happiness Effects and Elasticities (Two-Stage Estimation)

Parameter	Logit Parameter	Marginal Effect	Elasticity
Fcash_total	0.0226	0.0045	0.0926
Nonfarm_total	-0.0415	-0.0082	-1.1799
Catch_total	0.0570	0.0113	1.1093
Age	7.5783	0.0946	
fish_total.age	-6.0363	-1.1659	-0.3208
fish_farminc	5.8173	0.1343	0.1820
pond_land	0.1924	0.0044	0.0657
Involve	7.3024	0.0125	
Expectation	0.4332	0.0100	0.1552
age.pond_land	0.2005	0.0045	0.0488
age.expectation	-0.2483	-0.0056	-0.0864
pond_land.expectation	-0.0095	-0.0002	-0.0032
edulevel.involve	-6.7421	-0.1204	

Pond surface relative to land area also increases happiness of the farmers, especially for older farmers. A 100 percent increase in relative pond area raises happiness probability of younger farmers by 6.6 percent but increases that of older farmers by 11.5 percent. This suggests that farmers who have larger scale fish culture operations get more satisfaction and happiness.

Farmers' expectations on fish culture also increase their well-being. Farmers who are younger and have higher expectation levels on fish culture are likely to be happier than those older. A 10 percent increase in farmers' expectation levels on fish culture contributes a 1.55

percent increase in happiness probability of the younger farmers. This contribution is less for older farmers by 0.86 percent, but, in total effect, they still experience higher happiness levels with higher expectation levels. For farmers who have larger relative pond areas, the happiness effect of their expectation level on fish production is also less, but by a small amount.

Per capita income has no effect on farmers' happiness. However, opposite to the negative effect of non-farm income, income from fish culture relative to farming income or income from wild fish capture relative to total household income raises farmers' happiness while the ratio of fish income to total household income lowers their utility. The negative effect of non-farm income indicates that fish farmers are happier with their farming work. In other words, non-farm work leads to dissatisfaction with life while farm work has a positive effect. Nevertheless, an 11.8 percent decrease in farmers' happiness, caused by a 10 percent increase in relative non-farm income, may be offset by a 10 percent increase in relative cash income obtained from wild fish catch.

Aquaculture contributes to happiness both through relative pond size and by earnings from the enterprise. Relative income from fish culture is estimated to raise farmers' happiness. A 100 percent growth in relative income from fish culture contributes to an 18 percent increase in happiness probability of the farmers.

The contribution of earnings from aquaculture to fish farmers' happiness is reflected by the cash income that the farmers receive from the enterprise. Affirming its important role in fish farmers' well-being, a double increase in cash income relative to household income raises their happiness by 9 percent.

CONCLUSION

Neither income per capita nor absolute income from fish culture has a significant effect on farmers' satisfaction with fish culture. However, the regression results show that relative income from fish culture raises the cumulative probability of a farmer's satisfaction from fish culture, demonstrating that relative income, not absolute income, is associated with job satisfaction. The higher satisfaction is also expressed by the farmers who were involved with AOP's aquaculture extension services, who have higher expectation levels on income earnings from fish culture, and who have larger pond surfaces relative to total land area. Older farmers are more satisfied with fish culture and are generally happier than the younger.

The negative effect of non-farm relative to total household income indicates that farmers are happy working on their farms. The probability that small scale fish farmers are happier is raised by higher relative income from wild fish caught, by higher ages of respondents, and by involvement in extension activities. The cumulative logistic regression also justifies that satisfaction from fish culture has positively contributed to an increase in the probability of small scale farmers' happiness. This significant effect merits aquaculture contribution to happiness both through relative pond size and by earnings from the enterprise.

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