SOCIO-ECONOMIC INDICATORS AFFECTING FOOD SECURITY AT RICE FARMER'S HOUSEHOLD IN TARLAC, THE PHILIPPINES

OKTAFIANUS SILA[1] AND MARTHEN ROBINSON PELLOKILA[2]

[1] Nusa Cendana University in West Timor, Indonesia

[2] Doctoral Student in University of Philippines at Los Banos

ABSTRAK

Penelitian ini bertujuan untuk mengetahui factor-faktor sosial ekonomi yang mempengaruhi ketahanan pangan. Studi ini dilakukan pda rumah tangga petani padi sawah di Tarlac, Luzon Tengah, Filipina. 318 rumah tangga petani padi sawah dipilih sebagai responden dengan menggunakan metoda purposive random sampling. Ketahanan pangan pada rumah tangga petani didefinisikan dengan menggunakan Food Security Score (FFS).

Data yanag dikumpulkan dianalaisis dengan menggunakan poison regression. Untuk mengetahui pengaruh dari faktor-faktor sosial ekonomi terhadap ketahanan pangan rumah tangga petani, setiap faktor dianalisis dampak marginalnya secara terpisah.

Berdasarkan hasil analisis diketahui bahwa produksi pangan dalam artian produksi beras, score keanekaragaman pangan (dietary diversity score) mempunyai dampak negatip pada FFS. Sementara pengeluaran rumah tangga untuk pangan, jumlah anggota keluarga mempunyai dampak positip. Di lain pihak luas area persawahan tidak mempunyai pengaruh pada FFS.

Kata kunci: Ketahanan Pangan, Jumlah Anggota Rumah Tangga, Luas Lahan Sawah,

ABSTRACT

This study aims to know socio-economic factors, which affects food security. The study had been conducted among rice farmer's household in Tarlac, Central Luzon, Philippines. There were 118 farmers household had been chosen as respondents using purposive random sampling. Food security among these farmer's households was defined using Food Security Score (FFS).

Data was analyzed using poison regression. To know the effect of each socio-economic factor on food security in terms of food security score the marginal effect on each socio-economic factor was derived partially.

Based on the result of the analysis shows that food production in terms of rice production and dietary diversity score has significant and negative impact on food security score. Meanwhile, food expenditure and family size has significant and positive impact on food security score. On the other hand, rice area does not have impact on food security score.

Keywords: Food Seurity, Fmily Sze, Rce Aea,

INTRODUCTION

Food is essential in human being's life. Enough food in terms of quantity and quality for all people is an important factor for a nation to continue its development. Lack of food in long terms will lead to hunger and starvation that can cause dead. It has been realized that there is a relationship between food and health; however, it is difficult to trace it. Surely lack of certain food could cause a certain disease. On the other side, enough food is a necessity condition to be well nourished.

Solving problems for the lack of food, many countries are trying to increase their food production through agricultural production. Unfortunately, improving food production is not a guarantee to be free from food insecure. In fact, food insecure and malnutrition problems are prevailing in those countries, which its economy relies on agricultural sector (Committee on World Food Security, 1998). This finding was supported by Webb (2002), he stated that, increasing in food supply never fully succeeded to eradicate hunger problems. Sufficient food was produced by the end of the 20th century to meet minimum requirements for all people in world if distribution system of the food redistributed appropriately. However, from the 1990s onwards the social and environmental costs of productivity maximization came to be recognized as a potential threat to longer-term sustainability goals. High input/high output agriculture was widely condemned as compromising the environment and poor people's lives through its over reliance on chemicals and biotechnology, and by its displacement of traditional biomes and methods. Farming had come full circle and was increasingly seen as part of the problem of hunger, no longer the solution. He affirmed that, food security would not be attained for all people simply by producing more food is known today.

Combating food insecure and malnutrition problems requires attention not only to yields but also to the human capital technology investments that may enable poor people to become more productive themselves, and it needs an integrated policy, which involves many sectors. However, data that is related with food insecure and, malnutrition problems is important in order to make a good planning, monitoring and even evaluation.

Providing food insecure related data is a need to have good food-related information system that will help target scarce resources toward the food insecure. Although targeting is not a new tool, its use has become more relevant today's era of ever shrinking aid budget. In order to be successful, somehow, a targeting system must use indicators that are valid and reliable for identifying at risk groups and still straight forward and inexpensive to use.

Currently, food security is a major concern of the Philippine government since more than one hundred million people have to be fed early in the next century. The per capita food supply in the Philippines continue to decline over the years due to the diminishing local production brought about adverse weather conditions, massive land conversion and unabated destruction of natural resources complicated by a high population growth rate of 2.3 percent (national Statistical Coordination Board, 1998)

Ensuring food availability does not guarantee that all families will be able to secure their food needs (Eicher, et al, 1990, UNICEF, 1997 and National Nutrition Council, 1992). The poor may not produce enough food for their needs or are not able to buy food. In 1997, 30% of the total population in the Philippines was considered poor and over 70% were found in rural areas (National Statistical Coordination Board, 1998)

Economic resources determine food availability and thus play a big role in ensuring food security at household level (Food and Nutrition Research Institute of the Philippines, 1989). Results of the 1993 Fourth National Nutrition Survey of the Philippines confirmed the direct relationship between income and food security. Consumption pattern of higher income groups tend to be more diversified (Food and Nutrition Research Institute of the Philippines, 1994). Periodic or seasonal shortfall in food supplies at household level are sometimes inevitable particularly in poverty stricken communities. Several actions to ensure availability and access to food are adopted by households in order to meet dietary needs. Copying with those problems, the Philippines government should be able to develop a targeting mechanism that could be able to reach poor people at last cost in order to maximize limited fund. Thus, the specification of indicators to provide early warning of food crises and to monitor the extend to which keys sections of the population are undernourished is important.

The main objectives of the study is to know how generic indicators of food security that developed by Chung et all (1996) affect food security that measured by food security score for the case of the Philippines.

Adapted from Webb et al (1993), Chung et al (1997) categorized generic indicators of food security into five groups, namely resources, production, income, consumption, and nutrition. From these groups, food production, irrigated area in terms of area of irrigated rice field, food expenditure, family size, and food frequencies in terms of dietary diversity score were selected in order to know how these generic indicators affect food security.

METHODOLOGY

Food Indicator, Measurement and Definition

The specification of indicators for food and nutrition is important to provide early warning of food crises and to monitor the extent to which key sections of population are malnourished (Eele, 1994). Furthermore, Haddad et al (1994) noted that the identification, use, collection, and analysis of valid and reliable indicators are the cornerstones of a viable food and nutrition monitoring.

Eele (1994) suggested that in order to classify indicators for monitoring food security and nutrition status, an analysis of the food system must be made. This approach is useful in explaining the link between food supply and consumption and highlighting which outcomes are affected by key processes. He proposed five categories of indicators, as follows:

- Levels of flows either in income or commodities;
- Incidence of exogenous events or shocks to the system;
- Prices that can link income and commodity flows;
- Levels of resources and assets; and
- Outcomes.

As to which outcome indicators are preferred; this will depend on what information will be used for what level, which are as follows:

- Individual level (e.g., anthropometric measurement)
- Household level (e.g., measurement of the quantity of food consumed, number of meals per day, and type of staple consumed)
- Community level (e.g., the proportion of children who are below 80 % of the standard weight for their age and who visit clinics for checks-up
- National level (e.g., measurement of national food security or aggregate food import requirements derived from food balance sheets)

Maxwell et al (1992) proposed two indicators in assessing household food security, namely:

- Process indicators, which reflect both body and food access;
- Outcome indicators, which serve as proxies for food consumption.

They further explained that process indicators could be divided into two parts: a) indicators that reflect food supply, including inputs and measures of agricultural production, access to natural resources, institutional development and market infrastructure, and exposure to regional conflict or its consequences; and b) indicators that reflect food access which is also known as coping ability. On the other hand, outcome indicators can also be divided into two, namely: a) direct indicators of food consumption such as household budget and consumption surveys, household perception of food security and food frequency assessments; and b) indirect indicators of food consumption such as storage estimate and nutritional status assessments.

Haddad et al (1994) suggested some indicators for food security based on the results of their research in several countries, namely:

- Household size is a predictor of household calorie adequacy;
- Household dependency ratio which is associated with the lowest calorie adequacy tercile;
- Land used and land owned per capita related with food insecurity;
- The number of unique foods;
- The number of income sources; and
- Food expenditure.

USAID (1992) defined food security as "When all people, at all time have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life.

Bouis and Hunt (1999) defines household food security when all of the members of the household have, at all times, access to food a quantity and quality consistent with an active and healthy life.

Data Collection and Analysis

Data was collected using simple random sampling. One hundred and eighteen respondents of shallow tube well irrigation rice field farmers were chosen from three barangays (villages) in Tarlac, Central Luzon, the Philippines

The indicators that will be used to determine Food Security at household level are: rice production, food expenditure, family size, rice area, and dietary diversity score, and welfare change (producer surplus change, due to the change of level water table).

The measurement of food security at household level using Core Food Security Module (CFSM) that was developed by Bickel et al (2000).

The general model of food security as follows:

$$NS = f(\text{food production, food expenditure, family size, rice area, dietary diversity score})$$

The relationship between food security measured by CFSM and its indicators was analyzed using Poisson regression that based on fact that dependent variable (CFSM) takes counted values or discrete values that ranges from 0 – 18.

The Poisson regression model is formulated as follows: Y is a latent variable that is the Poisson variable, which ha probability distribution

$$f_p(Y_i = y_i|\lambda_i) = \frac{e^{(-\lambda_i)}(\lambda_i)^{y_i}}{y_i!} \quad for\ \lambda_i > 0 \qquad \text{..........................(1)}$$

$$= 0\ otherwise$$

Y_i is the i^th^ observation on the count variable of interest , y_i =0,1,2,3, … are the possible value of Y_i, λ_i is the Poisson parameter to be estimated, and i = 1,2,3,…n observation. Since this is the one parameter distribution the mean and the variance of Y_i equal to λ_i. In a count regression model, let the expected count, $E(Y)_i \cong \lambda_i$ to vary according to

$$\lambda_i = e^{\beta_o + \beta_j x_i} \Rightarrow ln\lambda_i = \beta_o + \beta_j x_i \qquad \text{..(2)}$$

where x_i and β are corresponding vectors exogenous variables and parameters, respectively.

The likelihood function is given by

$$L = \prod_{i=1}^{n} \left(e^{-\lambda_i} \frac{\lambda_i^{y_i}}{y_i!} \right) \qquad \text{............(3)}$$

$$= exp\left(-\sum_i \lambda_i + \beta_o \sum_i y_i + \sum_{j=1}^{p} \beta_j \sum_i x_{ij} y_i \right)\left(\prod_i y_i! \right)^{-1}$$

Hence

$$ln\,L = -\sum_i \lambda_i + \beta_o \sum_i Y_i + \sum_{j=1}^{p} \beta_j \sum_i x_{ij} y_i - \sum_i ln(y_i!) \qquad \text{...............................(4)}$$

Nevertheless, for count data truncated on the left at the value of zero, the common statistical structure of truncated estimators is the probability of observing y_i, given that it exceeds a truncation point, say c (Groger and Carson, 1991; Gomez and Ozuna, 1993). This concept coul be written in terms of probability distribution function as:

$$f_i(y_i) = \frac{F_p(y_i)}{1 - F_p(t)} \text{...(5)}$$

where $f_i(y_i)$ is the truncated probability function above truncation point c, $f_p(y_i)$ is the probability function and $F_p(c)$ denotes the distribution function evaluated at the truncation point c.

The maximum likelihood estimator could be computed by applying a suitable discrete probability function to the condition probability function in equation (1) (Groger and Carson, 1991). For the case of Poisson distribution truncated at zero, the probability function can be expressed as:

$$f_{tp}(Y_i = yi|\lambda_i, Y_i > 0) = \frac{e^{-\lambda_i} \lambda_i^{y_i}}{y_i!} [1 - F_p(0)]^{-1} \text{ ....(6)}$$

Where i =1,2,3…m observation (m<n) $y_i = min[y, c]$ is the observed variable that are positive integer values larger that 0 and $F_p(0)$ is the probability distribution of the basic Poisson model evaluated at zero. The first part on the right hand side of equation (6) is the probability density function of the standard Poisson model and the second part accounts for the unobserved zeroes.

Greene (1998) shows also that the general probability function for a truncated distribution from below for instance, at a value and that the distribution of y, applies only to values above c. thus the equation (…) can also be written as:

$$Prob[y_i = j|y_i > c] = \frac{e^{-\lambda_i} \lambda_i / y_i}{Prob[y_i > c]}, for\, y_i = c+1, c+2, K \text{ ....(7)}$$

where c is known integer that is zero in this case. For computational purposes, the distribution function is reduced to $Prob[y > c] = 1 - Prob[yi \le c]$.

The log likelihood for this model (reduced to sufficient statistic) is:

$$ln\, L = \sum \{ y_i(\beta_o + \beta_j x_j) - ln[e^{\lambda} - 1] \} \text{ ....(8)}$$

where $\sum$ is the summation from I=1,2,3,m observation (truncated sample). Then the complete Poisson regression model will be formulated as follows:

$$ln\, L = \sum \{ y_i(\beta_o + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5) - ln[e^{\lambda_i} - 1] \} \text{ ....(9)}$$

where

y_i = food security score

x_1 = rice production; x_2 = food expenditure, x_3 = family size, x_4 = rice irrigated area and

x_5 = dietary diversity score

Consistent parameter estimates for equation (9) could be got from using Newston's method of approximation

Definition of the Terms and Measurement.

1. Food security

Definition of food security

The self-perceived ability of household members to provision themselves with adequate food through whatever means (Gillespie and Mason, 1991 in Hadad et al (1994)

The measurement of food security was used Food security score. The score ranged from 0 to 18 and 0 to 10 for the households with children and households without children respectively based on the questionnaire developed by Bickel et al (2000) so called Core Food Security Module

2. Rice production

Rice production is rice yield of irrigated field for one season only. Rice production was measured in term of quintal per rice farming

3. Food expenditure

Food expenditure is the amount of money that allotted by household to buy food in a year. Food expenditure was measured in percentage that was the proportion of household's income that used to buy food

4. Family size

Family size is the number of person that consists father and mother or father alone or mother alone with children or other persons whose care subjects to the head of household. The family size was measured in terms of number person regardless age and sex.

5. Rice irrigated area

Rice irrigated area is the total rice field which has irrigation facilities. Measurement of rice irrigated area in acre

6. Dietary Diversity Score

Dietary diversity score is a score for food variation that consumed by a household in certain period. Dietary diversity score ranged from 1 to 12 based on the type of food. In this case, type of food is based on Food Consumption Table (FCT) of the Philippine which consist 12 kind of food. To measure dietary diversity score was used Food Frequency Questionnaire (FFQ)

RESULT AND DISSCUSSION

The variable nutrition security (NS) was measured based on the percentage of the normal weight of the anthropometric measurement (Table 31). Each household was represented by one anthropometric measurement among 4 groups of household members.

The weigh-for-age was used as the anthropometric measurement for three groups of household members, namely, pre-school children, school children, and adolescents, while the body mass index (BMI) was used for housewives.

Table 1. Correlation coefficients of the factors affecting the nutrition security of 118 STW-irrigation rice farmer-users at the household level, Tarlac City, Tarlac, dry season 2001

PARTICULARS	CORRELATION COEFFICIENT NS	T-STAT	SIGNIFICANCE LEVEL
Nutrition security (NS) (percentage from the normal weight)	1.000000		
Food production, (rice production in ton)	0.180018	1.97105	0.95
Food expenditure (peso/ year)	0.099070	1.07229	0.80
Family size (No. of household members)	-0.138562	-1.50689	0.90
Mother's education (number year in school)	-0.075357	-0.81393	ns
Nutrition knowledge of the mother (score)	0.051230	0.55248	ns
Household sanitation (Score)	-0.047523	-0.51242	ns
Dietary diversity Score/DDS (Score)	0.196760	2.16142	0.95
Welfare change/Change in producer surplus (peso)	0.182528	1.99947	0.95

t-table = 0.8452, 1.2907, 1.6607, 2.3620 for α = 0.20, 0.10, 0.05, and 0.01 respectively. n = 116

The vulnerable group of household members were considered to represent the nutritional status of the household, ranked as follows: pre-school children, school children, adolescent females, housewives and adolescent males.

Correlation Analysis

The nutrition security variable was correlated with the amount of food production, food expenditure (peso), family size, educational attainment of mother (number of years in school attendance), nutrition knowledge score of the mother, household sanitation score, dietary diversity score, and the amount of change in producer surplus (peso).

The results of the correlation analysis show that the following variables: the amount of food production (rice production), the amount of food expenditure, family size (number of family members), dietary diversity score, and welfare change or producer surplus, are significantly correlated with the nutrition security percentage variable. The rest of the variables, namely, the educational attainment of the mother, nutrition knowledge of the mother, and household sanitation are not significantly related.

Food production has a positive and significant relationship at 5 % level of significance on the percentage of nutrition security (r = 0.180018). This means that if the amount of food production in terms of rice production increases, there will also be an increase in the percentage of nutrition security, which suggests an improvement in the nutrition security at the farmers' household level.

Like food production, food expenditure has a positive and significant relationship with the percentage of nutrition security but at the 20 % level of significance and with a correlation of r =

0.09907. This means that if the food expenditure at the farmer's household increases, the percentage of nutrition security also increases.

Assuming that food expenditure represents the household's income and the anthropometric measurement in terms of weight or height would represent the nutrition consumption, then the results of the analysis would proved that Houtakers' law prevailed in the consumption pattern of rice farmers in Tarlac. Houtaker's law states that the proportion of consumption for good quality food increases as income increases (Timmer, 1983).

Unlike the first two variables, family size has a negative and significant relationship at 10 % level of significance on nutrition security with coefficient correlation r = -0.138562. This means that an increase in the family size will decrease the nutrition security at the household level, and likewise reduce the family's consumption of quality food, thereby decreasing nutrition security.

On the other hand, the dietary diversity score has a positive and significant relationship at 5 % level of significance on the percentage of nutrition security with coefficient correlation r = 0.19676. This means that if the dietary diversity score increases, there will also be an increase in the percentage of nutrition security, which is an improvement in the nutrition security at the farmer's household level. This result suggests that consuming a variety of foods would mean better nutrition for rice farmers.

The change in producer surplus (welfare change) has a positive and significant relationship at 5 % level of significance on nutrition security (r = 0.182528). This implies that an increase in the change in producer surplus will also increase nutrition security. As the other input productions are held constant, the change in producer surplus will merely depend on the amount of water extracted. The greater the volume of water extracted, the higher would be the production, thus, the net income of rice farmers will also increase. The increase in income will contribute to the total household income, which in turn will ensure availability and accessibility of food in terms of quantity and quality, thus, improving nutrition security.

Poisson Regression Analysis

The result of Poisson regression analysis is showed at Table 2. The result shows that food production, and dietary diversity score has significant and positive impact on food security score using Core Food Security Module approach. Meanwhile, food expenditure and family size has significant and negative impact on food security score. On the other hand, the area of rice field does not affect food security score yet. Theses result conform the theories regarding to food security. The higher the level of food production and dietary diversity score, the lesser, the food security score will be, hence, it means that increasing food production and the more diversity of food consumed by the household will lead to improving food security in the household.

The higher the level of food expenditure and the greater number of family size, the greater, the food security score will be. The greater the food security score is an indication of food insecure at the household level.

Table 2. The Estimated Poisson Regression Model to Determine Factors Affecting Food Security at Rice Farmer's Household Level

Variable	OLS		MLE Truncated Poisson Regression		
	Coefficient	Standard Deviation	Coefficient	Standard Deviation	$\partial E(Y)/\partial x_i$
Constant	5.002420***	2.003686	1.399857****	0.383128	6.607797
Food Production	-0.005003*	0.003443	0.001035*	0.645784	-0.004884
Food Expenditure	4.847872*	1.644111	1.207308****	0.332660	5.698904
Family Size	0.310285***	0.139293	0.694176****	0.246294	0.327674
Rice Irri. Area	0.004166^{ns}	0.011369	0.990653^{ns}	0.194588	0.004676
Diet.Div. Score	-0.605653****	0.146097	0.127254****	0.025578	-0.600683
F[5, 112] =	6.67****				
R-squared=	0.229534				
Log-L =			-292.632700		
Restricted (b=0) Log-L =			-317.683700		
Chi-squared (df=9, α =0.05)			50.1020****		
$E(Y)$ at all values of x_i	4.720339				
Scale Factor for Marginal Effects					4.720300

****, ***, **, *, - Significant at 1%, 5%, 10%, and 15% probability level; ns = not significant

Food production has a negative and significant impact on food security score. For each additional quintal of food production, the food security score will decrease by 0.004884 units, *ceteris paribus*. This result tells us that if there is an increasing in food production, there will be an improvement in food security at the household level. This fact could be found especially for households where most of the proportion of food production is allocated for domestic consumption.

Food expenditure has a positive and significant impact on food security score. For each additional proportion of income that allocates for food expenditure, the food security score will increase by 5.698904 units. This means that the higher proportion of food expenditure at the household level will lead to an indication of food insecure (see Engel's law, Timmer, 1983).

Family size has a positive and significant impact on food security score. For each additional number of family size, the food security score will increase by 0.327674 units. The greater number of family size the more food has to be provided in the household. Thence, if the stock of food in certain period is not changed this situation leads to lack of food in the family and it come up with food insecure at the household level.

Dietary Diversity Score has a negative and significant impact on food security score. For each additional unit of Dietary Diversity Score, the food security score will decrease by 0.600683 units. This result tells us that the more vary of food is available at the household level, the more chance of the household to provide any kind of food for the family's members, hence, the better will be the food security status at the household level. For those households that have the more vary of food are available at the household level, those households do not depend on the one kind of food merely. Lack of one kind of food could be replaced by another kind of food, which is available at the household.

CONCLUSION AND RECOMMENDATION

Conclusion

There are some conclusions could be made from result and discussion of the study namely:

1. Food production, and dietary diversity score has negative and significant impact on food security score using Core Food Security Module, while
2. Proportion of income allocated for food expenditure, and number of family size has positive and significant impact on food security score using Core Food Security Module.

Recommendation

Some recommendations could be derived from these conclusions

1. Food production that is produced by farmer's household still becoming one of the key to ensure food security at the farmer's household level. Therefore, increasing domestic food production for the family by whatever means should be given more attention. Market for input and output of agriculture, land reform policy, agricultural extension, improving agricultural technology, improving public facilities at rural areas those are means that could be used to increase agricultural production
2. Since dietary diversity score has a positive impact in improving food security at farmer's household, and most of the agricultural product produced by those farmers is allocated for domestic consumption, practicing crop and livestock diversification in the farm to those farmers should be encouraged.

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