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Research paper



Food Security of Farm Households in Indonesia's Border Area, Sebatik Island

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Abstract

Food is one of the main parts of Indonesian national interests which can determine national stability and sovereignty. Furthermore, every nation has to ensure that all of its citizens can fulfill their daily diet. Many people living in Indonesia's border areas face challenges in fulfilling food demand, i.e. accessibility and high cost of farming. This study aimed; (1) to know food security level of farm households, (2) to know determinants of that food security level. This study was conducted in Sebatik Island, North Borneo Province, Indonesia. Purposive sampling was employed to define location of this study, while multi stage simple random sampling was used to define a sample of 81 farmer households who are living and cultivating in Sebatik Island. Data were collected with structured questionnaire. Food security level was identified by combining the amount of food consumption and share of food expenditure as the Johnson and Toole approach. Moreover, Logistic model was employed to define determinants of food security level. The result revealed that only 18.95% of farm households were 'food secure'. Meanwhile, 24.21% and 21.05% of farm households were categorized as 'vulnerable' and 'food insecure'; respectively. Other 35.79% of farm households were known as 'questionable' which were lack of food, but they have the ability to increase food consumption. Other result identified that size of household, consumed calorie, and non-food expenditure determined food security level of those farm households. It was recommended that controlling population growth, increasing access of food, and raising household income may improve food security level of farm households.

Keywords: *Food Security; Border Area; Farm Household.*

1. Introduction

Various policies have been generated by government in advancing agricultural sector in Indonesia. Sluggish growth, declining terms of trade, low productivity, and often many un-eco-friendly practices have been crucial problems that hamper agricultural development, especially achieving farm households' prosperity. In Indonesia, agricultural sector plays strategic roles within nation. Human basic needs are fulfilled from agricultural sector. Taking into the blueprint of constitution (Rancangan Undang-Undang) about Food ratified by House of Representatives (DPR) by 18 October 2012, food is defined as everything comes from natural resources such as farming, plantation, forestry, fishery, animal ranch, water resource, whether it is processed or not, aimed to be food and beverages for people consumption, including additional food material, raw material, and other materials used in the process of preparation, producing, and or manufacturing food and beverage.

Food is the main part of Indonesian national interest which can determine national stability and sovereignty. Furthermore, every nation has to ensure that all of its citizens can fulfill their daily diet. It is important to employ agricultural resources for national food security. The concept of food security is developing every year. In 1980s, when food crisis has abated, hunger was surprisingly raising (1). It demonstrated that food availability in national level could not ensure food sufficiency in family or individual level (2). (1) stated that there was center scratching in food security investigation from national or worldwide level of food availability into group (individual) level who suffered from hunger.

Located in the border, Sebatik Island is partitioned into two territories; the southern area belongs to Indonesia yet the northern area belongs to Malaysia. The level of indigenous people's welfare in the border area is remained lower than is expected. Anecdotal evidence showed the GDP for people living in the border line of West Borneo was around US$ 700 a year contrasted with those living on Serawak who reached the GDP US$ 4000 a year. It would make a time-explosion if the government or whoever is responsible did not make a genuine move to overcome.

Improving people's welfare in the Indonesia's border areas is not that simple since it has development constraints. Most of them are employees of primary sectors that yield low economic added value. In case of agricultural sector, many border areas of Indonesia face challenges in fulfilling food demands, i.e. accessibility and high cost of farming.

Another fact sheet presented that in the Sebatik Island, agricultural was fundamental handy assets in which majority of the general population in the region relied upon. On the other hands, development in agricultural sector had not been seriously performed. It caused a low rate or price of the exported agricultural product to Malaysia, otherwise local people had to afford the cheap imported product from Malaysia due to exceptionally included estimation of an item.

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Sebatik Island society are economically relied on Malaysia particularly Tawau. Almost all of the commodities produced by them, such as fish, palm oil, and coca were sold Malaysia. Geographically, Sebatik Island is closer to Tawau, which can be reached in less than 15 minutes compared with the mileage to Nunukan which requires longer hours-achieving one and half hour with the same transportation strategy yet three times more costly.

Making future agricultural policies in border areas needs deeper understanding of the main issue, in this study, food security is the first indicator that can figure out the fundamental farm household condition. Thus, this study was conducted to identify food security level and its determinant to earn initial strategy which can upgrade the agricultural sector performance in border area. This study aimed; (1) to know food security level of farm households, (2) to know determinants of that food security level.

2. Literature Review

The term "food security" earned much interest since the World Food Conference in 1974 and hence has become a significant issue for various academic communities and stakeholders. (3) defined food security as "access by all people at all times to sufficient food for their active and healthy life". This interpretation generated a standard for more progressive definitions and discussion about the issues of food security indicators. Furthermore, (4) defined food security as a situation when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for a healthy and active life. This definition does not address the amount of food sufficiency, but also the food quality (safety and nutrition) to be consumed by people. Yet, it is not that easy to combine quality and quantity of consumed food for making such appropriate food policies.

Determining food security has to imply many dimensions in order to provide proper description about community or even national food security level. (5) employed four main dimensions of food security, i.e. physical food availability, food utilization, economic and physical food accessibility, and stability.

Physical food availability refers to the production or supply of food security which is determined by the level of stock levels, food production, and trade. The next dimensions, *food utilization*, can be defined as the way the body makes the most of various nutrients in the food. In other words, sufficient energy and nutrient consumed by individuals is the result of good concern on feeding practices, food preparation, diversity of the diet and intra-household distribution of food. Economic and physical food accessibility emphasizes on adequate supply of food not only at the national or international level, but also at the household level, by focusing on expenditure, income, market, and price for achieving food security objectives. Meanwhile, *stability* considers sustainability of achieving high food security which is related with periodic food supply, risk of environmental conditions, political instability, or other economic factors.

There are many indicators and formulas proposed by experts and researchers to measure household food security level. One common indicator is calorie adequacy which captures food sufficiency in a term of its quantity but does not emphasize on the quality of diet or other determinants. The conventional method of measuring household food security using dietary intakes are counting an optimal caloric intake based on a recommended daily allowance (RDA) for the equivalent of an active adult and comparing it to an observed household caloric intake per adult equivalent (6-10).

A complex method of measuring (precisely 'categorizing') was proposed by (10). This method considers both calorie adequacy and economic aspect which is represented by the proportion of the total household budget expended to food consumption. It has been more comprehensive and appropriate with food policy making that related with economical issue. Four categories are provided by this method, i.e. food secure; vulnerable; food insecure; and questionable. Food secure class is an indication that food consumption is adequate and proportion of the budget on food is small. This category is relatively secured from shocks. Vulnerable group indicates that current food consumption is adequate but a so high proportion of the budget is allocated to food that small shock could decrease food consumption. A questionable group has low food consumption and low proportion of the budget allocated to food. Food insecure group refers to low food consumption and high proportion of the budget allocated to food, and it is the weakest group in achieving food security objectives

Food security is one of the most complex challenges faced by developing countries' government, including Indonesia government. Although Indonesia has a high number of employment in agricultural sector, it is a difficult to gain high food security level due to the fact that people who live in rural areas contribute at least 70% of the world's poor population. This evidence has hindered the attainment of food security objectives since the increasing crop productivity, the key factor of supplying food, needs financial resources. Food security has direct and indirect dependencies on agricultural productivity because there are no other sector that cannot replace the role of agricultural sector in supplying food (11).

Border areas in Indonesia have a significant role in economic, politic, and national defense. Distributing welfare to community living in border area is the main obligation to ensure that national integrity sustains. (12) found the borders in Kalimantan, Indonesia are still in underdeveloped status. This condition took place because of several factors such as geographical isolation, high number of poor, high cost of inputs, and limited information from the government. In case of achieving food 1security objectives, as a part of community welfare, those factors have high probability to inhibit the achieving progress.

3. Methodology/Materials

a) Basic Method

The basic method of this research was descriptive method. This basic method is usually used to analyze a group of humans, an object, a mindset or an event in the present (13). The researcher also can compare a specific phenomenon (comparative study). Moreover, not only did the researcher make a classification and give a description, but also explained the relationship, tested hypotheses, made predictions, and got the meaning and implications of the problem to be solved.

b) Location and Sample of Respondents

The research was located in Sebatik Island, North Kalimantan, Indonesia. This location was determined by purposive sampling method that was considered to research objectives and conditions. In Sebatik Island, we did the research just in two regions West Sebatik and North Sebatik. Those areas directly face to Malaysia and become the region with the highest population of farmers on Sebatik Island.

The respondents were farm households in research area and selected by the multistage sampling method. The first stage involves the selection of representative candidates by their household head's occupation, so they could be classified as farm households. This research involved 81 farm households which consisted of 538 family members in order to answer the research objectives. Data was collected in June 2015.

c) Analytical Method

i. Defining Food Security

This research employed formula proposed by (10) to define food security level of farm households. As mentioned previously, this formula considers both calorie adequacy and economic aspect which is represented by the proportion of the total household budget expended to food consumption. The formula is shown in Table 1.

Table 1: Food Security: Combination of Calorie Adequacy and Share of Expenditure on Food

	Share of Expenditure on Food	
	LOW (total expenditure is less than 60%)	HIGH (total expenditure is more than 60%)
Calorie adequacy per adult equivalent unit ADEQUATE (more than 80% Energy sufficiency)	(Group 1) Food Secure	(Group 2) Vulnerable
INADEQUATE (less than 80% energy sufficiency)	(Group 3) Questionable or Lack of food	(Group 4) Food insecure

Source: Johnsson and Toole, 1991 in (10)

The first indicators, Calorie adequacy (CA), measurement approach was used to measure the food security of farmer household. It was measured by calculating the completely household members' consumption to get the energy consumption per year, following (14) equation below:

EC = RC / FS

Notes:
EC = Energy consumption equivalent per capita (kcal/capita/day)
RC = Real energy consumption of household (kcal/day)
FS = Number of household member

Furthermore, daily recommended calorie requirement was used to measure real CA in order to get partial indicators of defining food security level. The measurement is shown in the following formula bellow:

CA = EC / 2,150 x 100%

Notes:
CA = Calorie adequacy (%)
EC = Energy Consumption equivalent per capita (kcal/capita/day)
2150 = constant (the average energy needed by person in a day) (Act of the Indonesian Ministry of Health Number 75 of 2013).

The second indicator, share of expenditure on food, was approached by the following formula:

SF = EF / TE x 100%

Notes:
SF = share of expenditure on food (%)
FE = Expenditure for Food (IDR)
TE = Total Expenditure (IDR)

Calorie adequacy was cross-classified with the share of expenditure on food to conclude the food security level or category of farm household. A cutoff of 80 percent of the calorie requirement was combined with a food share greater than 60 percent of total expenditure.

ii. Identifying Determinants of Farm Households' Food Security Level

Logistic regression model was employed to identify determinants of farm households' food security level in Sebatik Island. This regression model used appropriate variables which are adapted from the former researcher and related with farm households' socio-economic status. The variables involved in the regression model are as follows:

Table 2: Variable Determining Farm Households' Food Security Level

Variable	Description	Measurement	Expected Correlation
RP	Rice price	IDR / kg	-
FP	Fish price	IDR / kg	-
HS	Size of household	Person	-
CC	Consumed calorie	Kkal / cap / day	+
NE	Non-food expenditure	IDR	+
EDH	Duration of formal education enrolled by household head	Year	+

Rice Price (RP) is one of the most important variables that can be correlated with farm households' food security level. It is possible to include rice as independent variables because it supplies most farm household daily diet in Sebatik Island. The words can be given to fish price (FP) variable. Fish is the biggest contributor in supplying protein for farm households.
Size of household (HS) and consumed calorie (CC) represent the daily need of food which has to be fulfilled by farm households. The bigger size of household, the more daily need of food will increase and the more likely food security level if a household degrades if a household does not have enough ability to afford its food. Meanwhile, the bigger the consumed calorie, the better they will achieve food security objective, in case of sufficient food supply.
Non-food expenditure (NE) represents financial ability of farm household to access their need. Higher non-food expenditure shows that farm household owns higher resources to purchase its daily needs. Another variable, duration of formal education enrolled by household head (EDH), means the level of education. Education is a capital which has a possibility to encourage achieving food security objectives. The educated person has capability to apply more information than uneducated ones do. Education can increase opportunities to get higher salary jobs, thus, it can improve accessibility of food.

Logistic regression model follows this function:

$$P_i = F(Z_i) = \frac{1}{1+e^{-(\alpha+\sum \beta i Xi)}}$$

Notes:
Pi = Food security (insecure = 1; lack of food=2; vulnerable=3; secure=4)
X1 = Rice price (IDR / kg)
X2 = Fish price (IDR / kg)
X3 = Size of household (person)
X4 = Caloric availability (kcal / cap /day)
X5 = Formal education enrolled by household head (year(s))
X6 = Non-food expenditure (IDR)

4. Results and Findings

a). Socio-Economic Characteristic of Farm Households

i. Farm Household Gender Structure

The socio economic gender structure indicates the difference in the numb of male and the female inhabitants. The analysis of the socio economic gender structure involved all samples of the farm household members. As shown in table 3, it can be seen that the percentage of the female inhabitants is a little lower than that of male inhabitants. The percentage of male inhabitants determined the job to obtain the household income. Meanwhile, male inhabitants had two functions which should be implemented, namely, the domestic and public functions. The female domestic function was shown by the role of the woman managing the households such as caring the children, preparing meals, cleaning the house, and so on. The female public function was manifested in the roles of the female in the economic activities.

Table 3: The Farm Households based on Sex

Sex	Percentage (%)
Male	52.14
Female	47.86
Total	100.00

ii. Farm Household Age Structure

The age reflects the individual capabilities such as the physical strength and the power of thought which influence the productivity in working. Besides, the age structure also indicates the availability of the labors for the economic activities, especially in the farming sector (15). For the farm household, the productive ages can be expected to have the abilities to work more in cultivating the plants and the livestock compared to the under-productive ages and post-productive ages. Therefore, the productive age may become the determinant to get higher income for the households.
As shown in Table 4, it can be seen that most of the household members, i.e. 69%, are included in the category of productive age (15-64 years) and only 2% who are not included in the category of productive age (>64 year). The data indicate that most of the farm household members possessed the physical strength and power of thought to support the daily activities at work so that the probability to get higher income was relatively bigger.

Table 4: The Farm Households based on Age

Ages	Percentage (%)
Under-productive (< 15)	28
Productive (15 - 64)	69
Post-productive (> 64)	2

iii. Farm Household Education Structure

Education is one of the economic resources that can determine the job as the income sources. Education is very important for the individual because it directly affects the pattern of thought and power of absorption of many information and new things. Based on the finding of (16), the bigger involvement of the individual in the education, the bigger the ability to apply the important information in the productive activities, the individual had. At the meantime, (17) found the fact that lower education level could hamper the access to a more profitable job.

Table 5: Duration of Undertaken Formal Education

Education (Years)	Percentage (%)
< 6	63
7-9	16
10-12	15
> 12	6

This research applied the approach to the number of years undertaken by the respondents in formal education to measure the education level. Table 5 indicates that most members of farm household had taken the elementary education (0-6 years). The number of members of the farm household, who undertook the education up to the higher education, is not so high and it is only 6%. From that data, it can be identified that most members of farm household have low education level. This condition could obstruct the attainment of objective of the food security because the opportunity to get the relatively-high income occupation was limited. For the farmers who did not receive formal education, they could take the non-formal education in their own farm groups, especially those related to farming techniques.

iiii. Farm Household Occupation Structure

Occupation is the society's source of living which can support their household food and non-food needs. Table 6 indicates that the occupation type of farmer is the main job of most of the farm household members in the two areas. The other household members who had higher education and capability chose to pursue the occupation as entrepreneurs and civil servants in many sectors that promised more sustainable income source at the smaller risk.

Table 6: Farm Household Occupational Structure

Main Occupation	Percentage (%)
Farmer	32
Housewife	11
Worker	4
Teacher	1
Village Apparatus	1
Entrepreneur	2
Student	24
Unemployed	24

b). Food Security Classification of Farm Households in Sebatik Island

i. Calorie Adequacy (CA)

Calorie adequacy (CA) is a value showing the amount of of energy which is consumed by a person. CA can be measured in a unit of kilo calorie per capita per day. CA in this research is generated by the conversion of food actual amount which reflects nominal food security status. An individual can be categorized as food secure status if he / she grabs at least 80% of recommended daily allowance (RDA), based on the average energy needed by person in a day as regulated by the Act of the Indonesian Minister of Health Number 75 of 2013. The following table shows the result of farm households' distribution according to their calorie adequacy.

Table 7: Farm households' Sistribution according to Their Calorie Adequacy

Calorie Adequacy Categories	Percentage (%)	Average Gained Calorie (kcal / cap / day)
Inadequate (< 80% of RDA)	56.84	1,576
Adequate (≥ 80% of RDA)	43.16	

Table 7 indicates that the number of inadequate food-households is bigger than the adequate one. This fact was predicted since the

challenges faced by border area communities in order to fulfill their daily diet. Inadequate-food households refer to the lack of food that can be accessed by farm households in Sebatik Island. Moreover, the average value of calorie gained by farm households (1,576 kcal / cap / day) is still smaller than RDA. This circumstance is not good enough in case of achieving food security objectives in border area, especially in Sebatik Island.

Further information about calorie adequacy can be referred to Table 8 which shows the average proportion of many sources of calorie gained by all farm households. The table reflects various food and determines the main food which was consumed by them.

Table 8: Food Source Group of Farm Households

Food Source Group	Gained Calorie (kcal)	Calorie Adequacy (%)
Rice	817	37.99
Wheat	46	2.14
Yams	47	2.17
Nuts	63	2.95
Carnal Food	125	5.80
Oil and Fat	284	13.21
Fruits and Vegetables	65	3.02
Oily Beans	3	0.12
Sugar	107	4.98
Others	20	0.92
Total	**1,576**	**73.31**

Most of calorie gained by farm households originated from rice, which is 37.99% of their calorie adequacy. Oil and fat contributed more than 13% from total calorie adequacy. Meanwhile, carnal food which was supplied by egg, beef, milk, and other livestock, shares only 5.80% of calorie adequacy. It is reasonable since farm households produced rice as their main commodity in order to sustain their livelihood. Some part of their rice product might be consumed by themselves and the remaining part could be sold to the market**.**

ii. Share of Farm Households' Expenditure

The share of farm households' expenditure is divided into two categories, i.e. non-food and food expenditure. The defining food security level / status employs share of food expenditure of each farm households. The share of food expenditure is determined by comparing total financial value used by farm households to purchase food with their total expenditure. Table 9 shows the distribution of farm households according to their food share expenditure**.**

Table 9: Farm Households' Distribution according to Their Food Share Expenditure

Food Share Categories	Percentage (%)
Low (< 60% of total expenditure)	54.74
High (≥ 60% of total expenditure)	45.26

Most of farm households in Sebatik Island had low food share expenditure. They allocated more budgets to purchase non-food product. This fact indicates that farm households have ability to access various products in order to fulfill their needs. Financially, farm households in Sebatik Island lived in good condition which could avert them from financial and food price shocks.

iii. Farm Households Food Security Classification

Calorie adequacy is cross-classified with food shares. A cut off of 80% of the recommended daily allowance (RDA) is integrated with a food share that is greater than 60 percent of the total expenditure. Classifying the food security in this approach provides a dimension of security to an essentially cross-sectional indicator (Table 1). Farm households in group 1 are exactly food secure *that* is an indication of relatively secure from any shocks. Their food consumption is sufficient and they expend a relatively small proportion of their budget on food. Meanwhile, farm households in group 4 are clearly food insecure. Their food consumption is really inadequate and they spend a huge share of their budget on food. Group 2 could be defined as a vulnerable class. It has an adequate current consumption but has a high proportion of the budget to purchase food. Any shock could decrease their food consumption. Group 3 lacks food consumption but has small shares of food budget.

Table 10: Farm Households' Food Security Level

	Share of expenditure on food	
	LOW (total expenditure is less than 60%)	HIGH (total expenditure is more than 60%)
Calorie adequacy per adult equivalent unit ADEQUATE (more than 80% Energy sufficiency)	(18.95 %) Food Secure	(24.21%) Vulnerable
INADEQUATE (less than 80% energy sufficiency)	(35.79%) Questionable or Lack of food	(21.05%) Food insecure

Most of farm households were categorized as lacking food (35.79%). It means that those farm households lack food consumption but they have small shares of food budget. Financially, they have the ability to access food, but they didn't purchase more food in order to increase their calorie requirement. The second biggest group of food security level is the vulnerable class (24.21%). Farm households in this class have adequate current consumption of food but they have a high proportion of the budget to purchase food. Those households have high possibility to suffer a shock in case of increasing food price and decreasing income. Food insecure group possesses 21.05% of the proportion of farm households classification. Farm households classified in this group indicate that they did not consume adequate calorie and even had high share expenditure on food. Thus, they had limited ability to purchase more calories in case of rising food price and other disturbed food supply. As discussed earlier, the great challenge in supplying food in border areas, especially in Sebatik Island is that the food secure group earned the smallest proportion of farm households. Only 18.95% of farm households was classified as food secure group.

High input cost, big transportation constraints, and other geographical circumstances hampered the attainment of food security objectives. The border area, such as Sebatik Island, needs more affordable food policy to ensure that the community living there could purchase or access their daily diet source. This is not related with food sufficiency only, but also the national obligation in delivering welfare to whole citizens.

c) Determinants of Farm Households' Food Security

Identifying the determinants of farm households' food security employs variables which have relevancy with food security level in Sebatik Island. The socio-economic variables dominate the role as independent variables in logistic regression model. The result shows that the size of farm household, consumed calorie, and non-food expenditure determined food security level of those farm households. It agrees to what have been expected that those significant variables had appropriate correlation with food security level. Consumed calorie and non-food expenditure indicate positive correlation with farm households' food security level. Meanwhile, the size of farm household have negative correlation with farm households' food security level.

Table 11: Logistic Regression Output for Determinants of Farm Households' Food Security

Variable	Coefficient	Standard Error	P-value
RP	-0.194406	0.191483	0.3100
FP	0.628478	0.772611	0.4160
HS	-2.010223	0.889032	0.0238*
CC	1.791838	0.606802	0.0031**
NE	1.725644	0.442484	0.0001**
EDH	-0.195055	0.360554	0.5885

Source: Primary data analysis Number of Observation = 81
*significant at α = 5% **significant at α = 1%

Based on the result, calorie availability and non-food expenditure have positive correlation with food security level. It means that the greater amount of those variable will increase the possibility for achieving food security objectives. Greater calorie availability and non-food expenditure will avoid households from any shocks in case of increasing food price or decreasing household income (10). Important information is given by the fact that the size of household has negative correlation with food security level. The bigger size of household can decrease the possibility of achieving food security objectives. The households with many family members will tend to distribute their food consumption among the family members. The bigger the number of family members, the greater the financial and food supply they need. In case of low-income households, they will reduce the quantity of their food in the short term, and will rely on their relatives in the long term (18).

5. Conclusion

This research intended to measure food security level in the Indonesian border areas which have several economical and geographical constraints. It is a big challenge to ensure that welfare, especially food sufficiency, be well-distributed to all citizens who belong to Indonesia. Sebatik Island was selected to be the research location since it had relevance with research objectives. This research focused on farm households because they had their own resources and ability to supply food by themselves. It was surprising that only 18.95% of farm households were 'food secure'. Meanwhile, 24.21% and 21.05% of farm households were categorized as 'vulnerable' and 'food insecure'; respectively. Other 35.79% of farm households were known as 'questionable' which meant lack of food, but they have ability to increase food consumption. This study was able to identify determinants of farm households' security level. As presumed earlier, consumed calorie and non-food expenditure indicated positive impact to farm households' food security level. Meanwhile, the size of farm household had negative influence on farm households' food security level.

Based on those results, this study proposes policy recommendations. Intensifying efforts on family planning which control population growth should be conducted by governmental and non-governmental organizations. Furthermore, government should provide good transportation and agricultural infrastructure in order to encourage the economic benefits for the border area community. It is not that easy because of many constraints which exist in border area, but ensuring welfare for each and every citizen of Indonesiais a noble effort as a nation state.

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