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The nexus between food insecurity and socioeconomic characteristics of rural households in Western Indonesia identified with Food and Nutrition Technical Assistance´s approach by USAID

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Abstract. This study investigated correlation and regression analyses designed to asses the respective relationships between the Household Food Insecurity Access Scale/ Prevalence (HFIAS/ HFIAP) as a measure of food access, the Household Dietary Diversity Score, the Months of Adequate Household Food Provisioning (MAHFP) as a measure of food stability and (i) gender, (ii) education level, (iii) household income and (iv) agricultural strategies of households in North Sumatra province. Cross-sectional survey was conducted in Tobasa and Samosir Regency and its purpose was (1) to assess the food security status of rural households (N = 192), (2) to identify the influence of selected factors on their food security condition and (3) to deliver outcomes which might play an important role in establishing appropriate policies and intervention strategy to prevent and reduce food insecurity. Due to the proven applicability in many studies, Food and Nutrition Technical Assitance's method was implemented for the comprehensive household food security analysis. The findings showed that 51.6% (n = 99) households were considered as moderately or severely food insecure, 18.8% of the sample as mildly food insecure (n = 36) and less than a third (n = 57) of households was food secure. Further analysis investigated the correlation between household food security status and selected variables. The results higlighted the role of rural education, agriculture extension services, creation of employment opportunities and improved dietary diversity in reducing household food insecurity.

Key words: Food Insecurity, Food Access, Dietary Diversity, Indonesia.

INTRODUCTION

Despite global economic crises, Indonesia has witnessed economic growth in recent years, making the list of lower middle income countries in 2009 (Gillespie & Van Den

Bold, 2015; WB, 2016). However, poverty, food insecurity and malnutrition have been still serious topics and remain with large disparities between provinces and districts (Campbell et al., 2011; Sibhatu et al., 2015). Yusuf & Sumner (2015) point out that between September 2014 and March 2015 the share of the Indonesian population in poverty increased even though economic growth was close to 5%. In addition, Global Hunger Index identified Indonesia as one out of 52 countries in the world where hunger remains at serious or alarming levels (IFPRI, 2015). The agricultural sector is very important for the country; it currently employs 35% of the workforce and contributes around 14.4% to national GDP (WB, 2016). This situation denotes a relatively low level of labor productivity compared to other sectors, particularly to manufacturing sector. The position also reflects the reality that more than 60% of poor Indonesians live in the rural areas where they mostly rely on agriculture for their livelihood (FAO, 2015).

Unfortunately, food insecurity affect especially smallholder farmers, farm workers and fishers who are financially and materially unable to use the opportunities provided by the national economic growth (IFAD, 2015). Therefore with the collaboration of the UN, the Indonesian government adopted the new Medium-Term Development Plan (RPJMN) 2010–2014 with the vision 'development for all', with no groups left behind. The RPJMN is an inclusive development strategy targeted on several outcomes including sustainable livelihoods where food security is an important priority for the UN. The goals of the strategy are linked to the Sustainable Development Goals (SDGs), particularly to SDG 2 ('end hunger, achieve food security and improved nutrition, and promote sustainable agriculture') (FSVA, 2009; UN, 2016). Besides RPJMN's targets, the National Food Security Council (FSC) in collaboration with the United Nations World Food Programme (WFP) produced and launched the first Food Insecurity Atlas (FIA) in 2005. The publication identified 100 priority districts as food insecure requiring an urgent attention of policy makers. Based on results of the FIA, The Government of Indonesia allocated 32 million USD to the most vulnerable districts. The first FIA 2005 and its updated version titled as Food Security and Vulnerability Atlas 2009 (FSVA) confirmed that despite Indonesia's economic and food security achievements, attaining food security for all remains to be a major challenge (USDA, 2012; FAO, 2015). In 2015, the third edition of the FSVA was launched and the discussion on nutrition was expanded to reflect its importance, as Indonesia officially launched its Scaling Up Nutrition movement and has prioritized stunting in the RPJMN. In the following National Medium Term Development Plan 2015–2019, the Indonesian government formulated a number development initiatives aimed at strengthening food sovereignty through five major strategies: (i) increase food availability by enhancing domestic production of key crops, (ii) improve quality of food distribution and the food accessibility, (iii) improve the overall quality and nutrition value of the Indonesian diet, (iv) protect food security through preparedness against natural disasters and plant diseases and (v) improve livelihoods of smallholders, fisherman and food producers.

Food insecurity is a serious social and public health problem in rural Indonesia as a whole. The geographic patterning of food insecurity such as the alarming rates in North Sumatra province, as well as the variation in rates that is found among districts, suggest that reducing the prevalence of food insecurity requires attention and action by all levels in government (FSVA, 2009; FSVA, 2015). The Indonesian minister of agriculture assured that food security in the country is one of the government priorities and through agriculture, forestry and fishery revitalization, the government has been consistently

increasing food availability. The result was that Indonesia was able to escape from global food crisis and to regain self-sufficiency (FSVA, 2015). The government has been also improving basic infrastructure to smooth and expedite food distribution, improvement of people access to basic health facilities which results in improvement of health and nutrition indicators. As the president of the Republic of Indonesia states that food is human basic necessity therefore its fulfillment is not only to satisfy basic human rights or moral obligation of the Indonesian people but it also becomes economic as well as social investment to have better generation in the future (FAO, 2010).

This study aims to investigate the food insecurity in Western Indonesia at micro level and to assess the relationship between the socioeconomic characteristics and food security condition of households. Despite the warning food security situation in Indonesia, there is very poor empirical evidence focused on causes of household food insecurity. FSVA and other national reports give a comprehensive overview about food security situation on macro level. However, the scientific evidence oriented solely on household level remains neglected. Therefore, the data in this study provide an impetus for discussion that is critical to the development of programs and policies by all sectors aimed at tackling food insecurity in rural Indonesia.

MATERIALS AND METHODS

Data Collection

In two time periods; August 2013 and July 2014, a cross-sectional was conducted survey in two regencies of North Sumatra province; Samosir Regency and Tobasa Regency, in eight municipalities (Table 1). Semi-structured questionnaire, with both close and open ended questions, was developed and translated into local Batak language and then used for the data collection. To avoid later misunderstandings related to questions and ensure the accurate answers, the phase of pilot testing was included into the survey. The group of ten respondents was observed when filling the questionnaire; their hesitation, erasures and skipped questions. Random sampling was implemented to select households in each municipality, using the most recent household list available for the municipality and as the result, 192 households was used as the sample for upcoming analysis. The sample size in each regency (Table1) was independent of the size of the regency. Therefore, representativeness at regency level was not controlled.

Table 1. The Sites Participating in the Cross-sectional Survey (N = 192)

Regency	Subregency	Municipality
Samosir	Simanindo	Ambarita (n = 22)
(n = 68)	(n = 68)	Garoga (n = 27)
		Martoba (n = 19)
	Sigumpar	Sigumpar Dangsina (n = 30)
	(n = 79)	Dolok Jior (n = 26)
		Nauli (n = 23)
	Laguboti	Pasar Laguboti (n = 25)
	(n = 45)	Gasaribu (n = 20)

Survey Tools

From the collected data, frequently used food security indicators were computed to assess the food security status of the households. For this assessment a method developed by USAID's Food and Nutrition Technical Assistance (FANTA) was used. Its validity and applicability was used in many development studies such as De Cock et al., 2013; Maxwell et al., 2014; Salarkia at al., 2014; Desiere et al., 2015; Frayne & McCordic, 2015; Musemwa et al., 2015. Maxwell et al. (2014) point out that combining of indicators improves the measurement of food insecurity. Therefore, we computed the following three food security indicators and one categorization capturing different elements of the multidimensional notion of food security.

The Household Food Insecurity Access Scale (HFIAS) consists of nine questions which represent apparently universal domains of the household food insecurity (access) experience and it is used to assign households and populations along a continuum of severity, from food secure to severely food insecure (Radimer et al., 1990; Coates et al., 2007). The set of questions examines whether the household experienced a form of insufficient access to food in the past 30 days and with what frequency if the situation occurred. Based on these nine questions we computed the HFIAS score which measures the level of household food (access) insecurity (Coates, 2004). The respondents could choose four possible answers to each of nine questions; never, rarely, sometimes and often. The higher frequency means the greater score (0–27) and the higher household food (access) insecurity (Coates, 2004; Coates et al., 2007). According to the empirical evidence (Maxwell et al., 2014), the HFIAS indicator was found as well correlated capturing a mix of sufficiency and psychological factors of food insecurity.

The Household Food Insecurity Access Prevalence (HFIAP) classifies the households into four grades of food insecurity; food secure, mildly/ moderately and severely food insecure (Coates et al., 2007). The advantage of the tool is that it is not time consuming and invasive method compared e.g. anthropometry and it is the only tool that measures a direct experience of household food security (Coates, 2004).

*The Household Dietary Diversity Score (HDD*S) captures food quality and diversity (Maxwell et al., 2014). It mirrors the number of different food groups consumed by the households over a given reference period. These 15 food groups includes cereals, tubers and roots, vegetables, fruits, meat, eggs, fish and seafood, pulses/legumes and nuts, milk and milk products, oil/fats, sugar/honey and miscellaneous (Hoddinott & Yohannes, 2002; Swindale & Bilinsky, 2006).

The Month of Adequate Household Food Provisioning (MAHFP) measures how many months of the past year a household was not able to access enough food to meet their household needs (Bilinsky & Swindale, 2010).

The questionnaire data were captured and analyzed in the field using the SPSS Data Entry BuilderTM and the the latter data were analyzed using StatSoft's STATISTICA™12 and Gretl 1.9.14. Food security indicators (HFIAS, HFIAP, HDDS and MAHFP) were computed based on data collected and assessed the household food security status in various dimensions. The next stage of data analysis included several statistical methods to assess the correlations between calculated food security indicators and variables. Statistical significance was assessed using descriptive statistics, frequency distributions, two-sample t-tests, and chi-square test in contingency table. For further analysis, we selected multivariate linear models through the evaluation of variables proposed and retention of those variables that improved model performance. We used

multivariate linear models where the HFIAS is interpreted as a regression function of constant, average total household income and diversity of off-farm activities adopted by the households.

RESULTS AND DISCUSSION

A basic exploratory analysis (Table 2) shows means, standard deviations and maximum values of used food security indicators. The average HFIAS score is 6.11 which falls into the first quarter of 0–27 possible range (the higher the score the more food insecure the household is). Average of the HDDS is 5.3 which means that average household consumes only less than a third of the different food groups available to them. This result confirmed a statement of The Economist's Global Food Security Index which identified five challenges for improving food security in Indonesia; (i) public expenditure on agricultural research and development, (ii) corruption, (iii) gross domestic product per capita, (iv) protein quality and (v) diet diversification (GFSI, 2015). According to Rah et al. (2010) low dietary diversity is a strong predictor of stunting among children aged 6–59 months and it also plays an important role for development of mental disorders (Poorrezaeian, 2015). Therefore, diet diversification should be considered as a high priority for improving food and nutrition security in North Sumatra Province. The MAHFP indicates that households are able to provide for themselves with adequate food for 11.41 months per year in average.

Table 2. Summary Statistics of the 3 Food Security Indicators

Indicator	Mean	Stdev	Max. value recorded
HFIAS[a]	6.11	6.59	27
HDDS[b]	5.30	2.57	15
MAHFP[c]	11.41	1.07	12

[a] Household Food Insecurity Access Scale; [b] Household Dietary Diversity Score;
[c] Months of Adequate Household Food Provisioning.

Following figures (Figs 1–3) show frequency distribution of the food security indicators. The frequency distribution of the HFIAS and the MAHFP is unimodal (Figs 1 and 3) while the data distribution of the HDDS (Fig. 2) is right-skewed. This shape in Fig. 2 indicates overall poor dietary diversity among households in both regencies. Fig. 4 shows a bimodal distribution; the highest peak is represented by severely food insecure households (31.6% of total respondents) and the second one by food secure households (30%). Fig. 4 indicates that (i) there is similar number of households in both regencies who are considered as severely food insecure and food secure (ii) there is nearly the same number of moderately and mildly food insecure households.

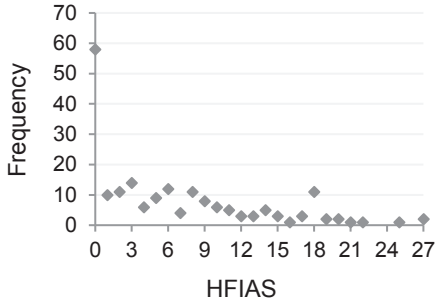

Figure 1. The HFIAS Score Distribution.

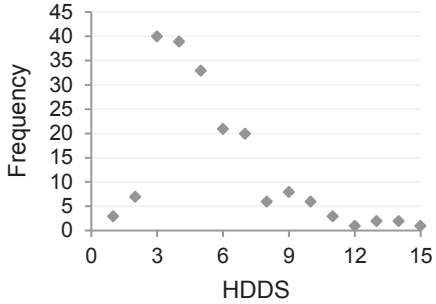

Figure 2. The HDDS Score Distribution.

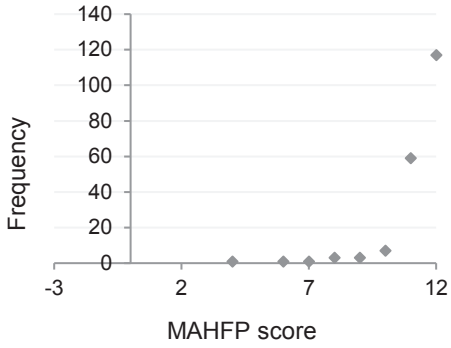

Figure 3. The MAHFP Distribution.

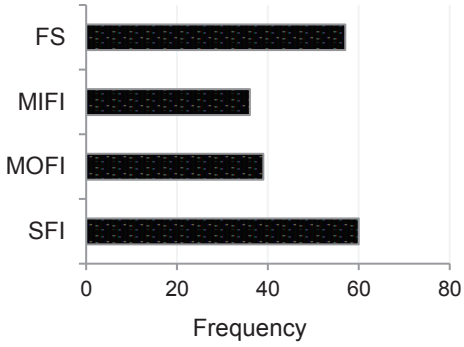

Figure 4. The HFIAP Distribution, Food secure (FS), Mildly food insecure (MIFI), Moderately food insecure (MOFI), Severely food insecure (SFI).

In accordance with the survey's objectives, the correlation between HFIAS, HDDS, MAHFP, HFIAP and selected variables was assessed.

(i) Gender

Two-sample t-tests were used for testing difference between male-headed and female-headed households in each indicator. In general, status of women in Indonesia is disadvantaged; particularly in terms of their socioeconomic situation (Retnaningsih, 2013; Swamy, 2014; Guilmoto, 2015; Sohn, 2015) and it is also reflected it their deteriorative nutrition security condition (Vaezghasemi et al., 2014). Results of these studies are supported by the UNDP´s Gender Inequality Index which is 0.49, ranking Indonesia 110 out of 186 (UNDP, 2015). Table 3 gives results about differences in terms of gender depending on household food security status. On each indicator the female-headed households experience more severe status of food insecurity than male-headed households. However, differences between male-headed and female-headed household related to two out of three food security indicators (the HFIAS and the HDDS) are not statistically significant. In culture of Batak Ethnicity, there are no expressive differences in livelihoods of men and women, particularly in gender division of labor which may explain low statistical differences between the gender and the HFIAS and the HDDS.

Batak women are used to working in the field, carry out most home food processing and have primary responsibility for raising children. This labor division and livelihood strategies adopted by Batak women make them and their households less vulnerable to food insecurity in the case of death of a spouse or separation. However, in the case of the MAHFP indicator, the difference between male and female-headed households is statistically significant ($\alpha = 0.01$). It indicates that female-headed households have disadvantaged access to food during the year to meet their dietary needs; 10.69 months per year compared to male-headed households' access – 11.47 months per year. This result is in contradiction with the findings about low statistical differences between remaining food security indicators (the HFIAS and the HDDS) and gender. The difference may be explained by the different on-farm activities adopted by men and women. In North Sumatra, women direct their on-farm activities on growing of traditional crops while men as farmers are more likely to grow cash crops which enable them to generate cash for purchasing of food easily.

Table 3. Food Security Indicators in Relation to Gender

	Male-Headed Households		Female-Headed Households		t-stat
	Mean	Stdev	Mean	Stdev	
HFIAS[a]	5.96	6.52	7.44	7.50	0.856
HDDS[b]	5.27	2.58	5.81	2.67	0.810
MAHFP[c]	11.47	0.86	10.69	2.26	2.856***

[a] Household Food Insecurity Access Scale; [b] Household Dietary Diversity Score;
[c] Months of Adequate Household Food Provisioning; ***1% significance level.

For the confirmation of these findings, we extended analysis on testing of correlation between the HFIAP categorization and gender. Because of low frequencies, the HFIAP categories were coupled into two groups; (i) food secure and mildly food insecure and (ii) moderately food insecure and severely food insecure. For this analysis, we used chi-square test in contingency table (power of performed test with $\alpha = 0.050$). The test confirmed the previous result that level of household food insecurity was not associated with gender (*p-value* = 0.155).

(ii) Education Level

In general, education contributes to development in social, institutional and also to economic spheres. Based on this theory, education is expected to have a significant explanatory power in relation to food security in rural areas (Tawodzera, 2011; Chatterjee et al., 2012; Akerele et al., 2013) However, there is empirical evidence with the opposite tendency (De Cock et al., 2013; Musemwa et al., 2015). Table 4 displays the average values of the food security indicators for different education levels of the head of households. In the case of the HFIAS, the clear interaction between level of food security and education is obvious; the higher education level, the lower the HFIAS (the milder the household food insecurity). This indicates that households headed by educated people achieve higher levels of food security. If we compare the values of the HFIAS (scaled on a range of 0 to 27) at the primary (11.1) and a master education (0.7), we conclude that there is a strong correlation between household food security and education as a representative of households' human capital. In the case of the HDDS,

some fluctuations may be observed. Based on the results, households headed by people who achieved master degree consumes in average purely 4.0 food groups out of 15 possible food groups. While heads of households with educational attainment at vocational school consume in average 7.5 food groups. This finding may be related to increased consumption of wild crops by people with lower educational levels.

According to FSVA (2015), wild foods obtained from hunting and gathering can significantly contribute to food and nutrition security, particularly in remote areas. Gathered wild crops are believed to contribute substantially to calorie intake and hunted rodents, mammals and insects provide important sources of animal protein. The MAHFP returns with its tendency to the HFIAS and affirms the initial hypothesis. Households headed by people with higher educational levels have an improved food provisioning. For comparison, people with master degree and their households have and adequate access to food in 12 months per year whiles those with primary education experience adequate food availability 11.1 months per year in average. Despite these results, a statistically significant difference was not observed. However, overall results confirmed the importance of education as human capital and support an assumption that rural people with more education are more likely to experience higher levels of food security.

Table 4. Relation of Food Security Status and Education Level of Head of Household

Head of Household Education Level	HFIAS [a]	HDDS [b]	MAHFP [c]
	Means (Stdev)		
Primary school	11.1 (7.7)	5.0 (3.1)	11.1 (1.0)
Junior high school	7.6 (6.9)	5.7 (2.8)	11.5 (0.6)
Senior high school	5.8 (6.5)	5.0 (2.4)	11.4 (0.9)
Vocational school	5.5 (3.5)	7.5 (3.5)	11.5 (0.7)
Associate bachelor	6.3 (6.6)	5.9 (2.2)	12.0 (0.0)
Undergraduate degree	3.2 (5.4)	5.3 (2.1)	11.6 (1.3)
Master degree	0.7 (0.6)	4.0 (1.7)	12.0 (0.0)
No data	3.8 (4.3)	6.3 (3.7)	10.0 (2.9)

[a] Household Food Insecurity Access Scale; [b] Household Dietary Diversity Score; [c] Months of Adequate Household Food Provisioning.

(iii) Household Income

Low income is considered as one of the main determinants driving households into food insecurity (Alderman, 2009). Many studies conducted in developing countries confirmed that economically vulnerable households are more likely to be food insecure (Rosen & Shapouri, 2001; Rose & Charlton, 2002; Labadarios et al., 2011), particularly in rural areas. Low-income households have limited access to agricultural inputs which is influencing the quality and volume of their agricultural production as 82.3% of respondents direct their livelihood on on-farm activities. Based on these, it is expected that low-income rural households in Tobasa Regency and Samosir Regency achieve low levels of food security.

Table 5 gives the income quintiles for the sample. For a clearer analysis, data set was divided into five groups with the approximately equal frequency of households, ranked by amount of household total cash income. Results document that high-income households (quintile 5) have eleven fold higher average total household cash income than low-income households (quintile 1) which indicates high income inequality in the

region. Indonesia has one of the fastest rising rates of inequality in the East Asia region. Its Gini coefficient has increased from 0.32 in 1999 to 0.41 in 2012. Therefore The World Bank has been working closely with the Government of Indonesia in analyzing the trends and consequences of inequality (Miranti et al., 2014; WB, 2016). The phenomenon of high inequality among households was confirmed in our survey.

Table 5. Income Quintiles (in IDR and USD)

Income Quintile	Avg. HH Total Income (IDR)	Lower Limit (IDR)	Upper Limit (IDR)	Avg. HH Total Income (USD)	Lower Limit (USD)	Upper Limit (USD)
20% (1)	662,500	75,000	1,000,000	51.3	5.8	77.4
40% (2)	1,314,063	1,000,000	1,600,000	101.7	77.4	123.8
60% (3)	2,007,813	1,650,000	2,500,000	155.4	127.7	193.5
80% (4)	3,368,750	2,500,000	4,500,000	260.7	193.5	348.2
100% (5)	7,400,000	5,000,000	35,000,000	572.7	387.0	2,708.6

Table 6 shows a clear correlation between food security indicators and household income. The most significant differences may be observed in case of the HFIAS when the higher is the score, the more severe household food insecurity is. Low-income households achieve in average score of 12.4 while high-income households attain only score of 2.4 out of maximal score of 27. These results may be taken as evidence supporting the claim that food accessibility and availability increase with household income. Similar findings associating food insecurity and income are reported in other studies (Tawodzera, 2011; Chatterjee et al., 2012; Akerele et al., 2013). However there is also evidence about the opposite tendency when food secure households are considered as low-income (De Cock et al., 2013; Musemwa et al., 2015).

Table 6. Food Security Indicators in Relation to Total Household Income Quintile

	Income Quintile 1	Income Quintile 2	Income Quintile 3	Income Quintile 4	Income Quintile 5	No Data
	Means (stdev)					
HFIAS [a]	12.4 (7.6)	7.9 (6.5)	4.4 (5.7)	4.2 (4.7)	2.4 (3.2)	5.3 (6.2)
MAHFP [b]	10.9 (1.2)	11.3 (0.9)	11.4 (1.2)	11.8 (0.6)	11.9 (0.3)	11.2 (1.5)
HDDS [c]	5.2 (3.0)	5.2 (2.2)	5.5 (2.4)	6.0 (2.4)	5.8 (3.1)	4.2 (2.0)

[a] Household Food Insecurity Access Scale; [b] Months of Adequate Household Food Provisioning; [c] Household Dietary Diversity Score.

(iv) Agricultural Strategy

In Table 7, the differences in the HFIAP scores depending on on-farm activity are given. Because of low frequencies, we merged the original four categories into two categories with higher frequencies. Groups depending on certain type of livelihood strategy were divided into four clusters as it is described in Table 7. Households which drive their livelihoods on no crop and no livestock production (Crop production=0, Livestock production=0) provably attain the highest levels of food security. These households tend to be from 61.8% food secure or mildly food insecure and from 38.8% moderately or severely food insecure. While households which focus their livelihoods on both crop and livestock production are more likely to be moderately of severely food insecure – from 57.7%.

Table 7. The HFIAP Categorization in Relation to Crop and Livestock Production

Livelihood strategy	FS[a] + MIFI[b] %	MOFI[c] + SFI [d] %	n=	u-statistics
Cluster 1: Crop production=0, Livestock production=0	61.8	38.2	34	1.336
Cluster 2: Crop production=0, Livestock production=1	53.3	46.7	15	0.258
Cluster 3: Crop production=1, Livestock production=0	51.3	48.7	39	0.160
Cluster 4: Crop production=1, Livestock production=1	42.3	57.7	104	-1.151

[a] Food secure; [b] Mildly food insecure; [c] Moderately food insecure; [d] Severely food insecure.

Regression Analysis

To predict the correlation between food security status of households (represented by the HFIAS), diversity of off-farm activities and total household cash income we prepared several regression methods and used multivariate linear models and ordinary least squares method. This model interprets the HFIAS as a regression function of constant, average total household cash income and number of off-farm activities. We expect that the higher is the total household cash income and number of various off-farm activities, the milder the level of household insecurity is,i.e. the lower is the HFIAS. Therefore, estimated regression model is: $\boldsymbol{y\hat{} = 8.461 - 0.573\ x_1 - 1.004\ x_2}$, where y is the HFIAS, x1 is average total household income and x_2 is the number of off-farm activities. Estimated regression coefficients confirm that relation between the HFIAS and average total household income is indirect, and the same relation is for the HFIAS and the number of off-farm activities. An increase of the average household total income by 1 million IDR, an equivalent of 76.24 USD, results in the HFIAS decreasing by 0.57 points. Scores of the HFIAS are scaled on a range of 0 to 27. Similarly, an increase in number of various off-farm activities adopted by households by one causes a decrease of the HFIAS by 1.004 point. The quality of the regression model was approved by the *F-test* (*p-value* = 0.000035). Individual t-tests are statistically significant for constant and b_1 and statistically insignificant for b_2, i. e. average total household income is a suitable predictor for the HFIAS. The coefficient of determination is rather low, i. e. only lower proportion of variability of observed data was explained by the model. These findings confirm the importance of off-farm activities and higher household incomes for improving of food security in rural areas. In addition, the regression model developed can play an important role in food insecurity reduction as a tool in hands of policy makers. According to empirical evidence of McCarthy & Sun (2009), rural people who direct their livelihood on off-farm activities tend to be more educated than those focused on on-farm activities. This fact highlights the education as one of the key means how to mitigate household food insecurity. On the other hand, results of our survey showed that heads of households with higher education levels suffered the lower dietary diversity (Table 4).

CONCLUSIONS

This study aimed to assess the extent and determinants of household food insecurity in rural areas of North Sumatra Province. Cross-sectional survey involved 192 households from two regencies in North Sumatra province. The combination of several food security indicators used for data analysis ensured capturing different aspects of the multidimensional concept of food security. The results revealed that 20.3% of the households were classified as moderately food insecure and 31.3% as severely food insecure. 82.3% of the households drive their livelihood on on-farm activities and 17.7% is focused on off-farm activities. Further analysis showed that on-farm activities adopted by the households supported dietary diversity but did not contribute in alleviating food insecurity, particularly in the terms of availability and access. Households with neither crop nor livestock production were found as significantly more resistant to food insecurity. The average values of the food security indicators confirmed the alarming situation in North Sumatra province; the HFIAS (scaled on a range of 0 to 27) takes average value of 6.11, the HDDS 5.30 and the MAHFP 11.41. The low value of the average HDDS testifies poor dietary diversity among the rural households. On the contrary, obtained average value of the MAHFP indicates an excellent availability of adequate food during the year. The other results demonstrated food security condition of households depending on education level of head of household, total household cash income and gender. Despite disadvantaged status of women in Indonesia, statistically significant difference between male-headed and female-headed households was confirmed only in the case of the MAHFP. Overall analysis of correlation between the gender and household food security condition demonstrated that female-headed households did not tend to be more vulnerable to food insecurity. Further results highlighted the importance of education as a representative of human capital. Households headed by member with low education level experienced severe food insecurity; the average HFIAS for master degree was 0.7 while for primary school was 11.1. In spite of this conclusion, dietary diversity of households headed by more educated members was lower. Other results confirmed that household food insecurity increased with poor household cash income. Since the empirical evidence about household food security situation in North Sumatra has been currently very poor and therefore establishing an intervention strategy is difficult in the area, there are few recommendations coming from the study. Based on the analysis, the promotion of education in rural areas has power to mitigate the severe levels of household food insecurity, as education is significantly correlated with food security. Policy makers should take steps to support household income security as one of the main food insecurity determinants. Cash management seminars for head of households may contribute to better household income distribution and its effective utilization. Other policies should be focused on supporting labor market in rural areas with employment opportunities since higher number of off-farm activities adopted by households were significantly correlated with milder levels of food insecurity. The study produced a regression model demonstrating correlations among household income, off-farm activities and the HFIAS, as the measure of food access. Accordingly, the model should be considered as a tool to establish appropriate policies and intervention strategy in an effort to reduce the number of food insecure households in rural areas of Indonesia.

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