

## CLIMATE CHANGE-FOOD SECURITY-FINANCIAL ASSETS NEXUS: EVIDENCE FROM INDONESIA

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Article History: Received on 02<sup>nd</sup> January, Revised on 30<sup>th</sup> March, Published on 15<sup>th</sup> April 2019

### Abstract

**Purpose:** The aim of the study is to investigate the position of household food security when they face climate change and examine the influence of financial asset on food security dynamic. Additionally, we investigate the impact of livelihood assets such as human capital, financial capital, social capital, natural capital, and physical capital on food security dynamic.

**Methodology:** There are four categories of food security dynamic namely household that always secure, improved, worse, and always food insecure. Taking the case on Kulonprogo, Yogyakarta Special Region, we use primary data with a longitudinal survey when El Nino (2015) and La Nina (2016). The sample size is 107 households of Program KeluargaHarapan's receiver. To examine the association between financial assets and food security dynamic we used Multinomial Logit Regression.

**Results:** The results of the study indicates that households in the face of climate change did not experience significant changes in food security positions in both seasons (El Niño and La Niña). Mild food insecurity still dominates impoverished households.

**Implications:** Thus, the proportion of households that experienced improvement or decline was dominated by mild food insecurity. Furthermore, financial assets such as saving and credit can enhance poor household food security. Meanwhile, there are not all household livelihood assets improve food security yet; only human capital and natural capital can improve household food security. The appropriate food security strategies can be the focus on financial sector intervention program.

**Keywords:** *Climate Change, Financial Asset, Food Security, Household livelihood assets, El Niño and La Niña*

### INTRODUCTION

Climate change is one of the factors that influence food security. It is due to climate change causing pressure on the all of food system such as availability, access and utilization ([Gregory, Ingram, & Brklacich, 2005](#)). Furthermore, [Gitz et al. \(2016\)](#) states that climate change is one of the drivers of poverty and food insecurity. The existence of climate change will increase the poor population between 35 to 122 million in 2030 compared to the future without climate change. Also, the World Bank estimates that without efforts to deal with climate change, extreme air will encourage crop loss by 5% by 2030, which will increase food prices ([Economist Intelligence Unit, 2012](#)). The impacts of climate change affect global food balance, both demand and supply, and local food systems where smallholder communities depend on domestic production ([Wheeler & von Braun, 2013](#)).

Climate change can be in the form of El Niño and La Niña, marked by an increase in sea surface temperature in the Pacific Ocean around the equator. This phenomenon threatens food production due to a decrease in rainfall and long droughts in several regions, one of which is in Indonesia. Another phenomenon is La Niña which often follows the El Niño, which is the cooling of sea level surfaces in the tropical Pacific. For the case of Indonesia, variability and climate change have exacerbated the risk of disasters in Indonesia today. For four decades, floods, droughts, storms, landslides and forest fires have become the biggest threats to livelihoods, economic growth and environmental sustainability ([The World Bank Group, 2011](#))

Indonesia is a priority country for FAO concerning the impacts of El Niño, namely the occurrence of drought, forest fires and cyclones. The effects of El Niño in the form drought phenomena result in a harvest that is not optimal. It causes losses for both farmers and consumers. Farmers will suffer the loss of income from the harvest, while consumer face food price increases. This condition will affect household food security. Because of climate change in the form of El Nino to La Niña has potential to cause household food security dynamics. So, household in both seasons can experience changes are improvement or decline. Therefore, it is essential to know the position of food security during the El Niño and La Niña phenomena. Climate change is a challenge for food security, so we need some effort to cope that. The adaptation of the food system will improve food security for the poor and vulnerable to prepare themselves to face the negative effects of climate change. It requires wider attention not only on the issue of agricultural production ([Ziervogel&Ericksen, 2010](#)). Besides, [Wheeler and von Braun \(2013\)](#) states that the estimation of the food security dimensions includes many long-term, not short-term trends. Whereas the estimate of short food security dimensions can show essential consequences of climate variability in a given year.

For this reason, it is necessary to conduct a study on the determinants of food security, especially in the face of climate change in the short term. Moreover, according to [Misselhorn \(2005\)](#), food security is a multidimensional concept. Five factors cause food insecurity, namely economic, socio-political, scientific and technological, cultural and religious,

physical, biological, chemical, and demographics. One economic factor that consistently affects food security is financial assets which can be income, savings or credits.

According to [Chang et al. \(2014\)](#) theoretically and empirically shows that the financial capacity of households to borrow and save provides the possibility of a security buffer from food insecurity. It supported by studies stating that financial assets in the form of credits ([Asenso-Okyere, Mekonnen, & Zerfu, 2013](#)), access to security ([Dzanja, Christie, Fazey, & Hyde, 2013](#)) and savings ownership ([Guo, 2011](#)) affect food security. For income supported by the study of [Akinboade et al. \(2016\)](#), [Sekhampu et al. \(2013\)](#), [Guo \(2011\)](#), [Radha and Prasanna \(2010\)](#), [Butt and Iram \(2004\)](#), [Li and Yu \(2010\)](#), [Martin et al. \(2004\)](#), [Muche and Tadele \(2015\)](#), [Osayande and Ada-Okungbowa \(2014\)](#), and [Shahid and Siddiqi \(2010\)](#).

But studies linking climate change, food security and financial assets are still limited. [Demeke et al. \(2011\)](#) examined the effect of rainfall and financial capital in Ethiopia on food security. The results show security, savings groups, has no impact on food insecurity. The rainfall and variability are influential. Therefore, this study intends to examine the effect of financial assets on the dynamics of food security between times when climate change occurs. In addition to financial assets will also be reviewed other assets that incorporated in livelihood assets, namely human capital, physical capital, natural capital and social capital.

The Sustainable Livelihood Framework approach provides a framework for the influence of assets on food security. The higher a person's access or ownership to social capital, financial capital, human capital, physical capital, natural resource capital, then one will be more empowered to improve the ability to compile strata e sustainable life. Assets owned by the poor will increase the capacity of the poor to survive shock or vulnerability, one of which is climate change.

## METHOD

Research conducted in Banjararum, Banjarasri, Banjarharjo and Banjaroyo Villages in Kalibawang District. According to [Rachman \(2004\)](#), the fourth one has dynamic food security. It has seen from the condition of food security until 2012 which is all of villages showed food insecure. But, in 2014 all villages had achieved food security ([KulonProgo Regency Regional Government, 2016](#)).

Data collected was carried out at two time points, namely the longitudinal data type. Data collection conducted in November 2015 and December 2016. Data collection in November 2015 to obtain data during a long dry season as a result of the El Niño phenomenon, while data collection in December 2016 to obtain events as a result of the impact of La Niña.

The unit of analysis in the study was women from impoverished households. Respondents selected were women, because according to [Maxwell and Caldwell \(2008\)](#) people who prepare food were women. Also it plays a role in improving the family nutrition profile ([Smith, 1997](#)). Women are also producers, resource managers, recipients of income, household food managers and food security ([Quisumbing&Meinzen-Dick, 2001](#)) Therefore, according to [Sharaunga et al. \(2016\)](#) women have the potential to reduce the vulnerability of food insecurity, if women get empowerment.

The selection of the household analysis unit based on [Wheeler and von Braun \(2013\)](#) which states that the estimation of the food security dimensions comes more from aggregate data than households or individuals. Therefore, it is necessary to estimate at the household level. The selection of impoverished families because the poor are considered to have a higher level of food insecurity related to the ability to buy food commodities ([Sekhampu, 2013](#)), besides poverty is also a driving factor for food insecurity ([Misselhorn, 2005](#)). Respondents who meet these two criteria are households who are beneficiaries of the Family Hope Program (PKH). The complete number of samples in two seasons, and has fulfilled missing value test and outliers is 107 households.

The dependent variable is the dynamics of food security between times obtained through three stages. First, calculating the Coping Strategies Index (CSI) food security indicators. Changes in CSI scores indicate changes in the status of food security whether declining or experiencing improvement. The higher the CSI, food security tends to decrease ([Maxwell & Caldwell, 2008](#)). Coping Strategies Index calculations are carried out for each season both El Niño and La Niña. Second, we determine food security position of each respondent based on studies conducted by [Maxwell et al. \(2013\)](#) which divided respondents into three categories, namely food security, food mild insecurity and moderate food insecurity/heavy. An analysis to determine the category of food security using the K-Mean Cluster ([Ziaei, Shirani, Eshraghi, & Keramatzadeh, 2013](#)). Third, after assessing the classification of food security, prone to mild food and moderate/severe food insecurity, it will be determined the dynamics of food security between times.

The dynamics of food security between times is the result of taking food security conditions between time, namely food security when El Niño and La Niña occur. There are four categories of food security, category 1, that is food security at all times for households that experience food security in two seasons. Category 2 for households that experience improved food security. Category 3 is households that experience a decrease in food security, and category 4 is food insecurity all the time where families experience food insecurity in both seasons. The division of categories is based on the method used by [Demeke et al. \(2011\)](#) and [Van Edig and Schwarze \(2011\)](#).

Explanatory variables include financial assets in the form of income, ownership of savings, and ownership of credits. In addition, other livelihood assets also included in the model, namely human capital in the form of household head's age,

work of household head and household size; natural capital, namely ownership of agricultural land; physical capital distance to the nearest market and social capital which measure with the amount of membership in the organization.

The analytical tools used are K-mean cluster, frequency distribution and Multinomial Logit regression (MNL). The K-mean cluster analysis tool to determine the position of household food security is very poor in each season. Frequency distribution to see changes in resilience status of very poor households between seasons. Furthermore, logit multinomial logit used to examine the effect of financial assets and other assets on the dynamics of food security.

## RESULTS

Table 1 shows the position of food security which divided into three clusters, namely food security, food insecurity and moderate/severe food insecurity. At the time of El Nino, impoverished households were dominated by the position of mild food insecurity by 58.9%, then those with food resistant positions reached 36.4%. The rest of the households that have a moderate/severe food insecurity position are 4.7%. Similar with the conditions when La Nina, the household was dominated by mild food insecurity (62.6%) then followed by food security (35.5%) and the last position was moderate/severe food insecurity (1.9%). This finding shows that there is no significant change in food security position in both seasons. Impoverished households are still dominated by mild food insecurity conditions.

**Table 1. Distribution of Respondents According to Inter-Time Food Security in Kalibawang District**

Food Security Conditions	El Nino		La Niña	
	f	(%)	f	(%)
Hold Food	39	36.4	38	35.5
Mild Food Prone	63	58.9	67	62.6
Moderate / severe food insecurity	5	4.7	2	19.0
Total	107	100.0	107	100.0

Source: Yuniarti, 2018

Table 2 describes in more detail the changes in the status of inter-season food security in Kalibawang District. There are two significant parts of respondents, namely households that did not change in both seasons and households experienced changes. In general, households that did not change were 61.7%, while those that experienced a change were 38.3%. It shows that the position of food security dominated by positions that have not changed. Impoverished households that did not change included food security in both seasons at 30.3% and mild food insecurity (69.7%). This finding shows that for the category of food security and mild vulnerability is relatively stable in both seasons.

Households that experienced a change consisted of two parts, namely those that experienced improved food security status and experienced a decline in food security. Households that experienced an improvement in food security were 19.6%, including mild food insecurity into food security (76.2%), moderate food insecurity to mild food insecurity (14.3%), and food insecurity being food resistant (9.5%). This finding shows that change dominated by households that experience mild food insecurity. Furthermore, for households that experienced a general decline in food security status by 18.7% consisting of food security to mild food insecurity (90.0%), food security to moderate / severe food insecurity (5.0%), and mild food insecurity to moderate food insecurity (5.0%). The proportion of households that experienced improvement or decline dominated by mild food insecurity. It shows that households that experience mild food insecurity are very sensitive to experience changes, both of experiencing enhancements and experiencing a decline.

**Table 2. Household Distribution Based on the Dynamics of Food Security between two times**

Change	Position	f	The Proportion of Amount (%)	Total Percentage (%)
Not Changing Status	Food security	20	30.3	61.7
	Mild food insecurity	46	69.7	
	Medium / severe food insecurity	0	0,0	
Repairing	Prone to mild food to food security	16	76.2	19.6
	Food insecurity is in the mild of food insecurity	3	14.3	
	Food insecurity is being food resistant	2	9.5	
Decreasing	Hold food to mild food insecurity	18	90.0	18.7
	Hold food to moderate food insecurity	1	5.0	
	Prone to mild food to moderate food insecurity	1	5.0	

Source: Yuniarti, 2018

We use multinomial logit to examine the determinants of food security. The test includes three stages, first seeing whether all independent variables can be used together to form a model or not. In Table 3 shows the value of -LL (Log Likelihood) only with intercepts only is 278,521, while the amount by entering the independent variable has decreased to 240,257, or a decrease in Chi-square of 38,264 and significant at p-value 0,002. These results indicate that models with independent variables provide better accuracy for predicting the dynamics of food security than those that do not include independent variables.

Moreover, we will test the model whether the model is fit or not with the data. Deviance values indicate that Chi-square has a probability of 0.999 greater than 5%. It means that the Chi-square value is not significant. This finding shows that the model is fit with empirical data. To see how much variation of the dependent variable is affected by the independent variable, we use the Pseudo R2. This value shows the variety of the dependent variable dynamics of food security that can be explained by all independent variables. Nagelkerke values explain the variation of the model by 0.327 indicate that 32.7 % of the variation in the dynamics of food security can be explained by independent variables, while other variables outside the model explain 67.3 %.

Table 3 presents the results of multinomial logit regression analysis consisting of 3 categories, which are food security all the time, experience improvement, and experience a decrease in food security position with the reference category of food insecurity over time. Based on the results multinomial logit model 1, variable that can predict the position of food security over time are financial capital namely ownership of savings and credit ownership. Other influential assets are human capital, the age of the family head and the number of families.

**Table 3: Multinomial Logit Result**

Variable	Always Food Secure			Has Improved Food Security			Has Decreased Food Security		
	Coef	Wald	Odds ratio	Coef.	Wald	Odds ratio	Coef.	Wald	Odds ratio
Constant	3,910	3,048		-5,563	5,044		-2,401	1,181	
Household Head is farmer (Yes = 1)	-0,645	1.006	0.525	0.365	0.373	1,440	-0.257	0.177	0.773
Age of household	-0.073	4,764 *	0.930	0.055	1,657	1,057	0.023	0.326	1,023
Household size	-0.542	3,248 **	0.581	0.312	1,889	1,366	0.151	0.433	1,163
Household own saving (Yes = 1)	1,220	2,938 **	3,387	0.462	0.559	1,587	-0.441	0.527	0.644
Household own credit (Yes = 1)	2,877	5,323 *	17,764	1,133	0.760	3,105	2,246	3,549 **	9,454
Income	0,000	0.132	1,000	0,000	1,473	0.225	0,000	0.337	0.562
Distance	0,000	0.534	1,000	0,000	1,473	1,000	0,000	0,000	1,000
Household own land (Yes = 1)	-0.383	0.318	0.682	1,198	3,040 **	3,312	-0.009	0,000	0.991
Number of organisations the household is member of	0.061	0.066	1,063	-0.92	0.146	0.912	-0.68	0.089	0.935
Number of observation	107								
-2 Log Likelihood intercept	278.521								
-2 Final Log Likelihood	240.257								
Deviance	0.981								
Nagelkerke	0.327								

Note : \* Significant at 5%; \*\* significant at 10%.

Source : Yuniarti, 2018

Savings ownership has an odds ratio greater than one indicating that households that have savings have a higher probability of food security than households without savings ownership. It is because savings can be a reserve that can be used at any time by the household. According to [Guo \(2011\)](#), savings are the most stable determinant of food security when an economic crisis or shock occurs. Furthermore, financial savings capital can maintain household liquidity when facing vulnerabilities. Households in Kalibawang sub-district that have savings at El Niño are 42.1%, the remaining 57.2% do not have savings. At the time of La Niña, savings ownership decreased to 28.0%, while those that did not have 72.0%. It means that there are changes in ownership of savings in two seasons.

Moreover, the similar finding suggested by credit ownership which significantly affects food security where the odds ratio is more than 1. This variable is one of the factors capable of supporting food security. This finding is consistent with the

study conducted by [Asenso-Okyere et al. \(2013\)](#) and [Dzanja et al. \(2013\)](#). This finding supported by empirical studies that show that buying food with debt is one of the coping strategies chosen by households in the face of limited income and food ([Cordero-Ahiman, Santellano-Estrada, & Garrido, 2018](#); [Gupta, Singh, Seth, Agarwal, & Mathur, 2015](#); [Ziaei et al., 2013](#); [Tanziha & Ariani, 2010](#)).

Households that had a credit when El Niño were 88.8%. When La Niña households that have credits have decreased to 76.6%, so those who do not have credits are 23.4%. The number of households that have credits when El Niño is more than in La Niña. But in general, the majority of households have credits in both seasons. The most significant sources of credits come from social institutions or organizations which followed by households such as cooperatives, relatives, bank, and neighbors.

The age of the head of the family has an odds ratio of less than one indicating that households with older heads of household have a smaller probability of being able to withstand food at all times than those with younger heads of age. Likewise, the number of families has an odds ratio of less than 1, households that have more families have a lower probability of holding food at all times. A large number of families will cause greater fulfilment of food needs. This finding is in line with the studies of [Sekhampu \(2013\)](#), [Demeke et al. \(2011\)](#), [Purwaningsih et al. \(2010\)](#), [Radha and Prasanna \(2010\)](#), and [Li and Yu \(2010\)](#). The survey results show that the average number of families in Kalibawang District is five people, consisting of two adults and three children. When viewed from the composition of families that are still dominated by children, it suggests that the number of families still gives more burden to fulfil food security, so that it will reduce the possibility of households to hold food.

Model logit 2 shows that the critical asset is natural capital, namely ownership of agricultural land. The odds ratio of land ownership greater than 1 indicates that households that have agrarian land have a probability of experiencing improved food security than those without agrarian land. This condition because households that have agricultural land have the potential to increase resilience by producing their food. Empirical studies that support this relationship involved [Amwata et al. \(2016\)](#), [Osayande and Ada-Okungbowa \(2014\)](#), [Ejaz et al. \(2012\)](#) and [Li and Yu \(2010\)](#).

Model logit 3 describes the category of households that experience a decrease in food security by reference to food insecurity at all times. A significant factor in this model is credit ownership. Household that has credit will has higher probability to experience decline position. Credits have a particular effect because they affect two categories, namely households that are food resistant all the time and experience a decline. On the one hand, ownership of a credit can affect food-resistant households at all times. It may be due to the security being used to buy food. But the opposite happens when the credit used for non-food needs. It will increase the burden to fulfil food. Therefore, the effect of the credit depends on the credit allocation.

The financial capital of income, the work of the head of the household, the distance to the nearest market, and social capital have not been able to predict all categories of food security. Financial capital in the form of income has no impact because households do have limitations in income. According to [Guo \(2011\)](#) for low-income households, income is not a determinant of the status of food security, but instead, household assets are a major determinant of household food security. Furthermore, this is made possible by the problem of revenue allocation. According to [Maxwell et al. \(2013\)](#), the allocation of income is not only for food but also for non-food expenditure, such as health care, and education. This finding supported by the survey that the portion of income expenditure used in Kalibawang District for food expenditure is 42.4% and non-food is 57.6%.

Occupation of the household head has no effect on the dynamics of food security. This finding is consistent with the study of [Li and Yu \(2010\)](#) and [Sultana and Kiani \(2011\)](#) who found that the number of families working not in the agricultural sector did not affect food security. However, this finding is not in line with the studies of [Sekhampu \(2013\)](#) and [Amwata et al. \(2016\)](#). Income from agriculture is not sufficient to fulfil food security. This finding is in line with the study of [Aminah \(2015\)](#) who found that the characteristics and capacity of small farmers are low, so their influence on food security levels is also weak. Therefore, agricultural work cannot provide adequate income for farmer households to achieve food security.

The distance to the market is not significant in predicting all categories. This finding is possible because households obtain food from the nearest retailer, not to the market so that the distance does not affect the position of food security. Social capital as measured by the amount of household membership in an organisation or community activity is not significant in predicting all categories. The findings of this social capital are consistent with the study of [Demeke et al. \(2011\)](#), but inconsistent with [Dzanja et al. \(2013\)](#) and [Martin et al. \(2004\)](#). Involvement in many social, religious and peasant organizations cannot predict all food security positions. These results indicate that household involvement in social activities has not provided benefits yet for household.

## CONCLUSION

Based on the results, we can conclude that very poor households when facing climate change did not experience significant changes in food security positions in both seasons (El Niño and La Niña), where mild food insecurity still dominates impoverished households. Also, the proportion of households that experienced improvement or decline was dominated by mild food insecurity. This condition shows that households that experience mild food insecurity are very sensitive to change, both undergoing enhancements and decreasing. For that, there is a need to strengthen food security, especially in

households that experience mild food insecurity and moderate/moderate food insecurity. Other findings indicate that financial assets that can support food security over time are ownership of savings and credits. The unique position is shown by credit that have two sides, namely increasing the probability all the time, but on the other hand, can also increase the probability of a decrease in food security. Therefore, it is necessary to strengthen financial institutions for poor households to support food security both savings and credit. Strengthening existing institutions around homes can be an option to enhance food security. Strengthening financial institutions expected to be able to make financial institutions more organized, so poor household can make it as a buffer when face vulnerability.

## ACKNOWLEDGEMENT

The authors are appreciative to all households who participated in the interviews. Furthermore, we would like to thank all of enumerator for their contribution to the fieldwork. This study had been funded by the LPPM of Universitas Ahmad Dahlan.

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