The Macro Dimensions of Food Security in the Philippines: An Empirical Study Using Descriptive-Causal Approach

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ABSTRACT

Analysis of time series data of the selected commodities and crops based on the Food Staples Sufficiency Program (FSSP) covering 27 years from 1990 to 2016 in terms of the food availability, accessibility, and utilization showed a negative or a declining pattern, indicating threats on food security condition of the country. As a whole, however, food security index measured showed an upward trending pattern condition of food security. This suggests that the Philippines is food secure taken collectively the interaction of the three dimensions. Empirical results validated the major role of experts in agriculture in sustaining the food security condition of the country.

Keywords: Food security, food accessibility, food availability. Food utilization, OLS

INTRODUCTION

Food security is the state "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preference for an active and healthy life (World Food Summit, 1996). The continuing evolution of food security as a concept facing the rapid industrialization issues and difficulty of technical and policy issues involved are just a few of the reasons why it must be the major concern of every government.

Among the Asia's "tiger cub economies" from 2005-2012 the Philippines has the highest preponderance of food inadequacy (FAO, 2014). According to National Nutrition Survey (NNS) in 2011, 36% of Filipino adults and 23% of children claimed to be food insecure. The Autonomous Region in Muslim Mindanao (ARMM) had the highest food insecurity.

A food system is considered weak when at least one dimension of food security which includes food availability, food accessibility, and food utilization is unclear and insecure. The first macro dimension is food availability, which refers to the availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports including food aid. The second dimension is accessibility, which is a criterion of the capability to acquire right and is explained as the collection of reserves (including legal, political, economic, and social) that an individual requires obtaining access to food (A. Sen 1989 as cited in FAO 2003). A sufficient supply of food does not ensure that a person can obtain and consume food. A person must have first access to the food through his/her entitlements. The third dimension is food utilization which refers to the utilization of food and by what means a person is able to gain vital mineral from the food used.

While extant literature on food security (Gallero et.al, 2014, Gadhi et.al, 2014 and Ghattas et.al, 2013), the macro dimensions based on the availability, accessibility, and utilization are considerably missing in the literatures. This

missing information on the three dimensions is beneficial in the analysis of the real picture of food security in the Philippines.

The study aimed to determine the macro dimensions that will explain the food security in the Philippines using the framework developed by the Philippine Food Security Information System (PhilFSIS) (Figure 1) to show the macro dimensions of food security and the model by Smith and Haddad (Figure 2) to show the determinants to achieve food security. Results of the study can be used for policy formulation for a more food secure Philippines.

METHODS

The three dimensions of food security in the Philippines: availability, accessibility, and utilization had been taken into analysis. Each dimension is composed of indicators and is then translated into composite indices. The index is captured by including the weighted average of many different components. This is done to come up with a coefficient that will best describe the effect of each condition and dimension.

The annual data from the year 1990 to 2016 for a period of 27 years were used in the study and was sourced from published statistical reports from the Bureau of Agricultural Statistics, Department of Agriculture, and Philippine Food Security Information System under the Philippine Statistical Authority. The selection of the commodities and crops was based on the priority crops under the Food Staples Sufficiency Program (FSSP) of the Department of Agriculture (DA). The selected commodities and crops used in the analysis included rice, corn, cassava, sweet potato, banana (saba), pork, chicken, chicken egg, tilapia, and milkfish. The time series data on food available per capita and food production index focused on rice, corn, cassava, sweet potato, chicken meat and egg, pork, milkfish, and tilapia. The stock and cropping intensity indices covered rice/palay and corn. The import dependency ratios were examined for the focused commodities with imports such as rice, corn, cassava, pork, chicken and chicken eggs, milkfish, and tilapia.

The food accessibility indicators such as the time series data on farmer's share in consumer peso were examined for rice, corn, sweet potato, banana (saba), pork, chicken, tilapia, and milkfish. The Consumer Price Index (CPI) was analyzed by commodity group except for rice and corn.

The food utilization index was measured using the nutritional status of individuals which was determined by the percentage of children under five years old who are stunted, underweight, and wasted and infant and under five mortality rates. Adequacy of food is determined by the indicator on the ratio of food to total family expenditures. Nutrient intake of food is measured through Dietary nutrients (energy) consumed in proportion to RENI and dietary energy supply (DES) of cereals, roots and tubers. Table 1 shows the dimensions and indicators used to represent food security.

The empirical model proposes that food security index as the dependent variable. On the other hand, the independent variables were the economic determinants related to agriculture namely: share of population engaged in agriculture to total population, the proportion of employed person in agriculture to total employed, ratio of agricultural food imports to total food imports, and share of agricultural budget in total general appropriations act. FS = f (SAT, PEP, RAI, SBG)

Where: FS is dependent variable (Food Security Index), SAT is the share of population engaged in agriculture to total population, PEP is the proportion of employed person in agriculture to total employed, RAI is the ratio of agricultural food imports to total food imports, and SBG is the share of agricultural Budget in total general appropriations act.

The economic models presented are dynamic in nature. Therefore, it is necessary to test the

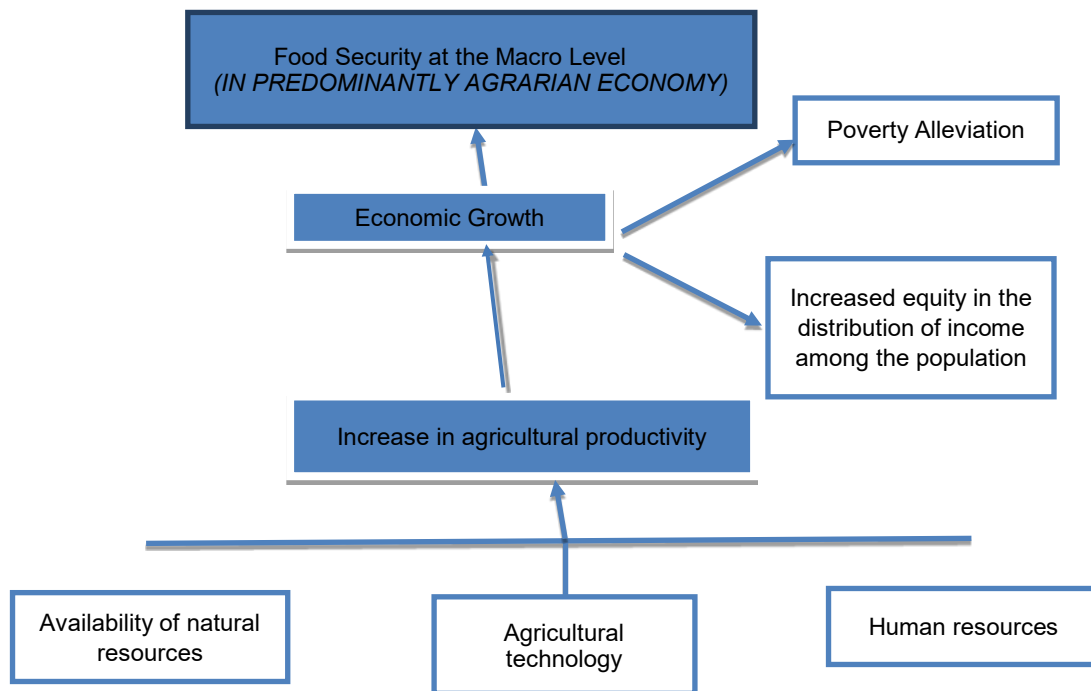Figure 1. Food Security Dimensions and Indicators

Figure 2. Achieving food security at the macro level (in predominantly agrarian economy)

Smith and Haddad (2000), Food and Nutrition Security Framework

theory. Since the data are time series in nature the appropriate tool to be use is time series regression using Ordinary Least Square (OLS). The model for multiple regression equation consists of a slope and an intercept (Salvatore, 2001). The following economic model is designed to provide a statistical basis for accepting the null hypothesis of this study. The model was estimated using multiple regression analysis.

$$Fs_t = {}_0 - \beta_0 SAT_t + \beta_1 PEP_t + \beta_2 RAI_t + \beta_3 SBG_t + \mu.$$

Where: Fs_t is Food Security Index, SAT_t is the share of population engaged in agriculture to total population, PEP_t is the proportion of employed person in agriculture to total employed, RAI_t is the ratio of agricultural food imports to total food imports, SBG_t is the share of agricultural budget in total general appropriations act, and μ is the error term.

RESULTS AND DISCUSSION

In the study of Smith and Haddad (2000), the macro dimensions of food security were linked to agricultural productivity that fuels economic growth by the availability of natural resources, agricultural technology, and human resources. In this study, three macro-economic dimensions namely; availability, accessibility, and utilization

Table 1. The dimensions and indicators of food security

Dimensions	Definition	Indicator
Food Availability	Availability of sufficient quantities of food of appropriate quality supplied through domestic production or imports	Food Availability Index 1. Food Available per capita 2. Food Production Index 3. Cereals stock index 4. Cropping intensity index 5. Import Dependency Ratio
Food Accessibility	Access of individuals to adequate resources acquiring appropriate foods for a nutritious diet	Food Accessibility Index 1. Farmer's Share in Consumer Peso 2. Consumer Price Index
Food Utilization	Ability of the human body to ingest and metabolize food through adequate diet, clean water, good sanitation and health care to reach a state of nutritional well-being where all physiological needs are met	Food Utilization Index 1. Prevalence of stunting, underweight and wasting among children aged 0 to 5 years old 2. Infant and under five mortality rates 3. Share of food in total family expenditures 4. Dietary Energy Supply of Cereals, tuber and root crops 5. Dietary Nutrients (energy) consumed as proportion to RENI (Recommended Energy and Nutrient Intake)

were identified.

The first dimension, food availability covered the following indicators: food available per capita, food production index, cereals stock index, cropping intensity index, and import dependency ratio. Figure 3A shows the trend depicting the availability of food in the Philippines. The last five years' data shows a decreasing pattern of food availability in terms of food available per capita as represented by rice statistics. Rice is the staple food of Filipinos, which posts a serious threat to the supply of the country's basic food. The contraction of harvest areas and lower yields is a result of La Nina Phenomenon (PSA, 2016). Notwithstanding the food situation, in terms of food production side and cereal stocks, statistical data showed an increasing pattern throughout the years under analysis, which is opposite the food available per capita.

Given the food supply situation, the country still imported foods. FAO (2006) stressed the importance of international trade and domestic production in assuring that a country's food supply is sufficient. According to Mina and Reyes (2009), the reason why the Philippines had to remain a net importer of rice was because domestic production could hardly meet local demand. Hence, by adding imports in the equation, the supply could already meet the local demand. However, Madley (2000) in his analysis on trade and food security argued that increased competition from imports will intensify rural poverty. Many households whose livelihoods depend on crop/food production would be significantly affected as cheap food imports flood markets driving down prices and household income.

The second dimension is accessibility. Since food availability could translate to national food security, it is important to differentiate it from food security because enough food does not mean that the poor have access to food. . Figure 3B shows the pattern of accessibility to food from periods 1990 to 2016 in the Philippines. The trend showed that in terms of food accessibility,

the food security situation is threatened by the continuous increase of food price as depicted by the upward trending line of consumer price index. Farmer's share is the ratio of food farm price to food retail. It indicates how much of the price paid by the consumer goes back to the farmers.

Tilapia (19%) had the biggest farmer's share in consumer peso followed by milkfish (17%), corn (15%), chicken (12%), sweet potato (11%), banana (10%), pork (9%), and rice (7%). The statistical data on consumer price index showed that prices of basic commodities were generally increasing particularly in rice. The rice crisis in 2008 brought prices up causing a notable increase in the index by 26.20 index points from the base year.

The third dimension is food utilization which determines if the available food in a given period of time had been accessed and utilized. A household makes decisions on what food to consume and how to allocate food within the household. Appropriate food intake is essential for the nutritional status of the populace. Figure 3C shows the trend of utilization of food in the Philippines for the last 27 years covering the period of 1990-2016.

The highest peak of food utilization was experienced in 2016 and the increasing share of food in total family expenditures was noted in 1994. According to Philippine Statistical Authority (2013), food expenditures comprised 42.80 percent of the total family expenditures. However, on the average, the proportion of food expenditures contracted by 1.72 percent per annum. The good condition of food utilization is evident on the status of decreasing prevalence of stunting, wasting and underweight, and the infant mortality rate.

The identified factors that affect food utilization are dietary energy consumed in proportion to Recommended Energy and Nutrient Intake (RENI), dietary energy supplies of cereals, roots, and tubers, infant mortality rate, and prevalence of stunting. Data showed that only the dietary energy supply of cereals, roots and tubers and

infant mortality rate has a significant effect on food utilization.

Based on the econometric analysis done using Ordinary Least Square Regression (OLS), the resulting equation yielded a significant positive relationship between the food security index as a whole and its forecasted value. Hence, the Philippines is food secure taken collectively the interaction of the three dimensions. The indicators suggest that food security is a multidimensional issue that the availability or supply of food alone doesn't explain the food security condition of a country. Other dimensions should be taken into consideration such as accessibility and utilization. Other factors that might contribute was the increase of government budget for agriculture (Philippine Statistical Authority, 2013). However, the declining pattern of major food items especially rice stocks might threaten food security conditions in the coming

years. The condition is expected to recover because of the increase in agricultural budget as depicted by the upward trending graph of production and cereal stock index of rice. The recovery is also supported by the stability shown by the cropping intensity index, because of the government interventions such as the Five Croppings in Two Years, Early Wet Planting, and Quick Turn Around Programs (Figure 3).

The analysis of the measurement is based on the econometric analysis using the ordinary least square regression using data set of food availability index, food accessibility index, food utilization index, and food security index of the Philippines from 1990 to 2016. Table 2 shows the descriptive statistics of the variables used.

Since the data in the model are in time series form, it is necessary to test the series if it is stationary or not using the Unit Root test before
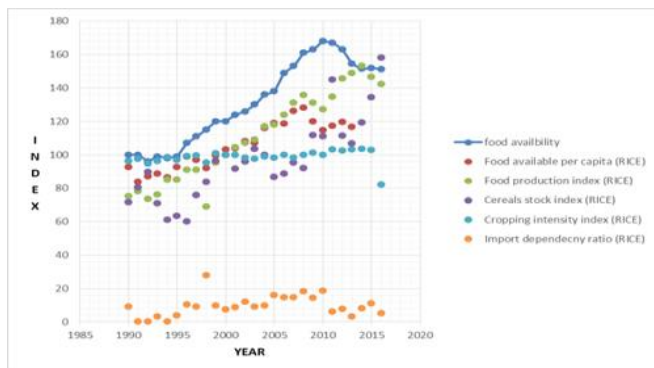

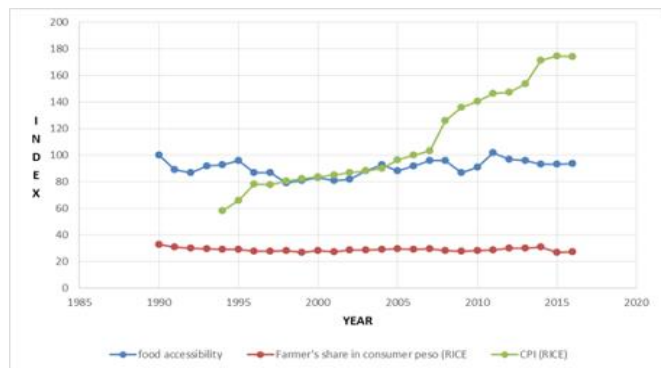Figure 3 A: Food Availability Index, Philippines 1990-2016

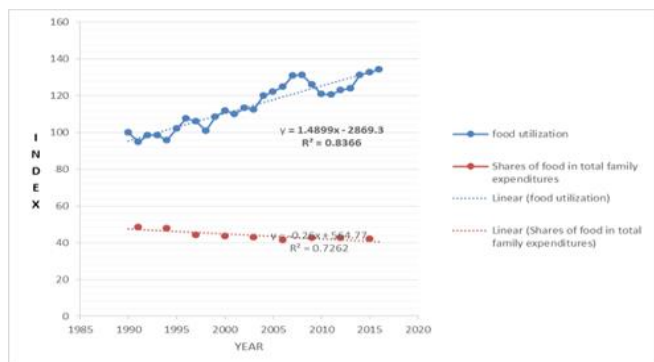Figure 3 B: Food Accessibility Index, Philippines 1990-2016

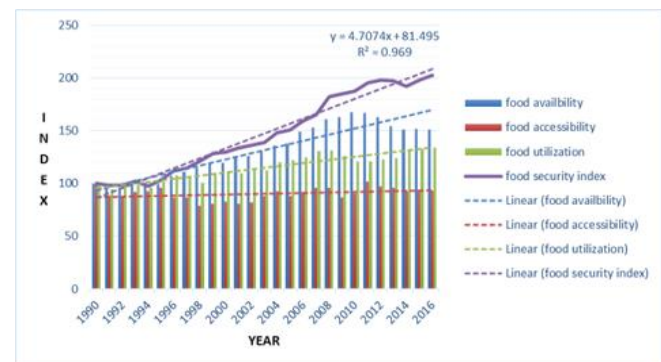Figure 3 C: Food utilization Index, Philippines 1990-2016

Figure 3 D: Food security Index, Philippines 1990-2016

Figure 3. Macro Dimensions of Food Security in the Philippines, 1990-2016

Table 2. Descriptive Statistics of Data

Variables	Definitions	Sources	Obs	Mean	Std. Dev.	Min.	Max.
FS	Food Security index	Philippine Statistics Authority Reports	27	147.39	37.956	97.810	202.920
SAT	Share of population engaged in agriculture to total population	Philippine Statistics Authority Reports	27	37.57	5.17	26.99	46.31
PEP	Proportion of population employed in agriculture to total population	Philippine Statistics Authority Reports	27	37.38	5.34	26.99	46.03
RAI	Ratio of agricultural food imports to total food imports	Philippine Statistics Authority Reports	27	6.56	2.02	2.00	10.43
SGB	Share of agricultural budget to GAA	Philippine Statistics Authority Reports	27	4.42	1.20	2.74	7.18

regressing it. The results showed that there is a unit root that exists and must be subjected to ADF at the first difference to replace the level form. After first differencing the computed ADF statistics for all the variables remained above the ADF critical values at one percent, five percent, and 10 percent levels of significance in absolute terms. All of the variables are stationary and have no unit root at fist difference. In other words, regression of time series variables is feasible in its level form.

Before estimating the effect of the independent variables to food security, the amount of multicollinearity was determined by measuring the variance inflation factor. The test shows that only ratio of agricultural imports to total food imports, and share of agricultural budget to total GAA has VIF of less than 10. The other two variables namely, share of population engaged in agriculture to total population and proportion of population employed in agriculture to total population has VIF of 36 and 39 respectively. This greatly exceeds 10 that means there is a serious sign of multicollinearity in these two variables. Therefore, only ratio of agricultural imports to total food imports and share of agricultural budget to total GAA was used as regressors. (Table 3)

The null hypothesis that the share of population engaged in agriculture to total population, proportion of employed person in agriculture to total employed, ratio of agricultural food imports to total food imports and share of agricultural budget in total general appropriations act have no significant effect, individually and collectively on food security index is rejected. The result shows that the share of agricultural budget to total GAA was highly significant at 1% level. That is an increase in the budget by one percent will increase food security by 0.65 percent. On the other hand, ratio of agricultural imports to total food imports does not show significance.

The computed R square also illustrates that 68% of the variation of the dependent variable (food security) was explained by the independent variables ratio of agricultural food imports to total food imports (RAI) and share of agricultural budget to total GAA (SBG). The results indicated further that the fitted model was statistically significant having an F ratio of 27.39.

Thus, economic determinants tend to exert a significant positive effect on food security if share of agricultural budget to total GAA is the determinant which is consistent with Baracol (2003) that food security and rice self-sufficiency

in the Philippines are components of the national goals of the administration. The assistance of the government through government budgets for research and development boosts the agricultural sector which provides the majority of the country's food needs.

There are various policy interventions have been pioneered by past and present governments to upgrade agriculture and food security. Different agricultural policies and programs since the green revolution up until now contribute to the accomplishment of agriculture transformation.

The Philippine government performed a key role in the development of the agricultural sector through the implementation of macroeconomic policies and programs. From 1960s to the 1980s, the Green Revolution has left a mark of remarkable increase in rice production and has improved the country's comparative advantage. It was also during the time when the Philippines acquired self-sufficiency in rice and became one of the rice exporters in Asia (Rosset, et.al, 2000). Likewise, the Masagana 99 Program (1970s) gearing toward attaining self-sufficiency

Table 3. Results of Augmented Dickey Fuller test of All the Variables at First Difference

VARIABLES	1% C.V.	5% C.V.	10% C.V.	ADF STAT FIRST DIFFERENCE
(FS) Food security index	-4.34	-3.59	-3.23	-5.03
(SAT) Share of population engaged in agriculture to total population	-4.34	-3.59	-3.23	-4.59
(PEP) Proportion of population employed in agriculture to total population	-4.34	-3.59	-3.23	-4.61
(RAI) Ratio of agricultural food imports to total food imports	-3.70	-2.98	-2.63	-4.95
(SGB) Share of agricultural budget to GAA	-3.70	-2.98	-2.63	-9.24

Table 4. Regression Result using Ordinary Least Square Regression on food security in the Philippines

	Intercept	RAI	SBG	F Stat	R square	DW
Coefficient	3.77	0.13	0.65	27.24	0.68	1.01
t-statistics	22.49	1.47	4.75			
p value	0.00**	0.15	0.00**			

*p value (probability value) < 0.05 level of significance   ** p value <0.01 level of significance

in major staple crops namely rice and corn. There was a high acceptance rate of rice from 1960s to 1990s which improved the efficiency and profitability of farmers (David, Intal and Balisacan, 2007). Moreover, in the 1990s to 2000 the Liberalization policy of the government was represented with growth in the participation of the private sector, reduced public sector roles, market interventions, and protection of local industries from imports through tariff or non-tariff policy such as the tax exemption for fertilizer import. Furthermore, after 2008 under the Current Policy Environment and Structure is "self-sufficiency" through production of own food and a cutback of dependency on food imports.

To further validate the results of the regression test on the model because the result will be used in policy formulation, other econometric tests on the normality of residuals, specification of errors, structural stability, and co-integration among the variables tests are needed (Table 4). The Jarque -Bera test shows the normal distribution of residuals having the probability of 0.10. The parameter estimates are valid. However, the Ramsey Reset result suggests that the probability of obtaining these statistics greatly exceeds the five percent level of significance having F statistics of 0.001. Therefore, the hypothesis indicating that the economic models are misspecified is accepted. This suggests that the model obtained from the regression has omitted influential variables. This is so because the model focused only on the economic determinants related to agriculture. Other exogenous factors like environmental, political, and demographic factors were not included in the analysis.

The result also suggests that other exogenous variables need to be included in the regression. Co integration test is then utilized to avoid a possibility of spurious regression of the time series variables in the economic model. This was done after ensuring that the regression variables are stationary. Based on the cointegration test using the Johansen procedure,

there are two cointegrating vectors present in the model. Given the result, spurious regression was ruled out and there exists a genuine long term or equilibrium relationship between the dependent and independent variables.

CONCLUSION AND POLICY RECOMMENDATION

This work measures food security in the Philippines focusing on the three dimensions: availability, accessibility, and utilization, and integrating the effect of the structural breaks experienced by the country by adopting the inflation targeting framework. The model proved the claim that food security is not about food supply only but also food demand. Food availability answers only the national food security of a country which is only a part of the attainment of food security, that is enough food for Filipinos, however, it does not mean that poor can obtain and make use enough of it.

It was found out that food availability necessitates the increase in food importation in the short run to meet the food gap. Likewise, an increase in the production of food commodity in its original unprocessed form must be secured and taken into consideration in making a policy. In the food accessibility dimension, the continuous increase of food prices threatened the food security status of the country. Even though the citizens continue to buy food as prices increases it affects the consumption of food by many. The concerned government may consider giving subsidies to the people. On the other hand, it appears that the government has done its part in the decrease of child mortality rate. The improvement of the condition contributed significantly to better food utilization and ultimately food security.

It is significant and necessary for a country to measure and analyze the food security situation, not only aggregately but also in carefully examining its dimensions. A country that has enough food supply does not necessarily mean that its entire citizen are food secure. External

factors and policies implemented greatly affect its situation. Policies implemented always have side effects on the economy's welfare. Therefore, retooling of policies for sustainable economic development of a country is necessary.

The results further indicate that the macroeconomic dimensions of food security in the Philippines rely on agricultural productivity. The philippines will be more food secure in the long run if policies will be directed on supporting farmers especially those whose main source of income is farming. This will increase their capability to acquire adequate and nutritious food. Likewise, the government's continuous support in the form of monetary/financial aid to agriculture will help a lot in providing for the Philippines' future food needs.

ACKNOWLEDGMENTS

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