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Food Security in ASEAN Countries

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Abstract

Food security is defined as a situation in which all people at all times have both physical and economic access to sufficient food to meet their dietary need for a productive and healthy life. Food security problem is a crucial issue for national development, poverty alleviation and becomes a global issue due to the Millennium Development Goals (MDG) target by 2015. Food security problem occurs when there is a sudden drop in the ability to produce or have access enough food to maintain a good nutritional status and it is known as transitory food deficit. United States Agency International Development (USAID) have introduce several plans necessary for achieving food security and it is known as availability, accessibility and utilization. The objective of the study is to investigates the role of food security dimension for food security achievement in Asian countries. This research employs static panel data by using random and fixed effects analysis

Keywords: Food Security, Availability, Accessibility and Utilization.

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1. Introduction

Food is among human basic needs for social development. Food can be defined as an element that people consume to provide nutrients such as carbohydrates, fats, proteins, vitamins and minerals for the body. It originates from either plant or animal sources. Food absorbed by the body helps to produce energy and stimulate healthy growth. Food sufficiency is very important in order to reduce the problem of undernourished and hungry people, an idea based on the availability to maintain a food supply through food production, food importing, and food aid to feed the population of the world. Moreover, food also can be secured through accessibility, Utilization and stability.

Food security was defined in the World Food Summit (1974) as the availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices. Increase in population will have the same effect on the consumption of food per capita and will increase the changes in diets toward high-nutrition foods due to increase in income for certain countries. In order to overcome this situation, ASEAN Countries need to focus on their food supply problems in order to ensure availability and affordability. Food supplies are derived from food production, food imports and food aid. The main contributor of food supply is food production. To ensure a better yield and sustainable food production, factors such as irrigation, hybrid technology, and application of fertilizers must be in place. However, the main obstacle in producing enough food is the scarcity of water supply for irrigation.

Food security is a flexible concept that has evolved in the last 30 years to reflect changes in official policy thinking (Clay, 2002). During the mid-1970s, there was great discussion of international food problems at that time of the global food crisis, known as the World Food Conference of 1974. The focus of this discussion was on food supply problems, which relate to the availability and price stability at the international and domestic levels. There were several definitions of food security supplied, and about 200 definitions were published (Maxwell & Smith, 1992). The description of food security at the regional or national level is the capability of a national food balance and ensuring sufficiency of food supply and availability to fulfill the need of national populations (Chen & Kates, 1994). The proxy that is used to measure the degree of national food security is based on the minimal population nutritional requirements selected (in per capita dietary calories) and usually presumes equal access by all regions and social classes to the available supply over a time period of a year or more (Chen & Kates, 1994). Availability is from the supply side of food security and is determined by the level of food production, food aids and food imports (FAO, 2008). In addition, additional variables such as land availability, crop yields, national environmental factors such as weather conditions and the socio-political situations of the countries will determine food production sufficiency at the national level (FAO, 2008).

Food security is normally discussed with reference to food self-sufficiency and food self-reliance at the national level. Food self-sufficiency is the ability of domestic production to meet local consumption, particularly of staple food crops. The production and growing of such food crops is done within the country with minimum dependency on the international market. Indirectly, these activities will encourage the development of small-medium enterprises (SME). Many Southeast Asian and Southern African countries attempted to apply the same concept, as any short-run fluctuation in staple food price will not have a serious impact on the poor in terms of malnutrition. Poor domestic infrastructure has made import costs too high and thus difficult to manage. Landlocked countries like Zimbabwe, Malawi, Zambia and Tanzania are being subjected to high international marketing costs that are below import parity and above export parity level.

Meanwhile, countries with food self-reliance will determine their production needs based on the international trade patterns. Countries that apply this concept will import staple foods from the world market when the prices are lower than those of local foods. So the land will be used for other purposes, like growing crops for biofuel as a substitute for fossil fuels. The intention of this concept is to promote market liberalization and export oriented agriculture along with support from strong, local markets, achieved through improvements in physical infrastructure and credit facilities.

1.1.1. The Dimension of Food Security

Previously, this study explained the definition and concept of food security, which has a direct link to the main dimension of food security. The dimension was based on four main points, known as *availability*, *accessibility*, *utilization* and *stability*. Firstly, the dimension of food security was based on the physical availability of food. All nations need to elucidate the availability of sufficient quantities of good quality foodstuffs. Food availability plays an important role in providing the necessary nourishing elements to citizens of each country. This quantity of foods was in the form of supplies through domestic production, stock levels, food imports and food aids. Based on the United States Agency International Development (USAID) Policy Determination (1992), the constraints to food availability come from inappropriate agriculture knowledge, technologies and practices, unsuitable economic policies (pricing, marketing, tax and tariff), lack of foreign exchange, inadequate agriculture inputs, population growth rates that offset increased production or imports, marketing and transportation systems that inhabit the cost-effective movement of food from source to need and the inability to predict, assess and cope with emergency situations, thus interrupting food supplies along with natural resources and climatic and disease constraints.

Next, economic and physical access to food was the second dimension which provides access to adequate resources for acquiring appropriate foods for a nutritious diet. The accessibility for food physically and economically was important to individuals and families to achieve food security. There are two types of food accessibility. First is physical food accessibility in terms of transportation, infrastructure, storage, transformation and marketing of these food commodities. Second is the economic accessibility in term of purchasing power and household income, which is considered the most important indicator affecting people's accessibility to healthy food. In addition, households also face accessibility constraints to individual food access including inadequate aggregate economic growth, lack of job opportunities, lack of incentives to become a productive participant in the economy, negative impact of national economic policies, inadequate training or job skills and lack of income streams.

Food utilization also plays an important role in the dimension of food security. Utilization is an important element of non-food security and is usually known as the way the body makes the most of various nutrients in foods. Food utilization also shows that food is properly used through the employment of proper food processing and storage techniques, adequate knowledge of nutrition and childcare techniques. Utilization has an impact on food security through adequate diet, clean water, sanitation and health care to enable people to reach a state of nutritional well-being where all physiological needs are met. Constraints to food utilization include nutrient losses associated with food preparation and inadequate knowledge and practice of healthy techniques.

Finally, food needs to be secured through stability. All populations, households and individual must have access to sufficient food at all times. They should not risk losing access to food as a consequence of sudden shocks, like economic or climatic crises, or be cyclical in the vein of seasonal food security. The concept of stability can therefore refer to both the availability and access to the dimensions of food security. Stability in food security is dependent on the capacity of storage and saving at the household level, the stability of the market (which depends on the balance between supply and demand) and the government's capacity to react in an emergency.

2. Model Specification

United States Agency International Development (USAID) has identified three type variables which are known as availability, accessibility and utilization play important roles to improve food security especially in ASEAN Countries. However the measurement is not directly through these three variables but based on the determination of these variables where the determination for food availability is food production, food import, food aid and food stock. While, purchasing power parity and paved road is the determination for food accessibility. Finally sanitation services are the determination for utilization variable.

In this model, three sets of variables are used to represent the three dimensions identified in the USAID food policy. Food Availability (*FAVs*), Food Accessibility (*FACs*) and Food Utilization (Fu) are examined of their impact on improving food security (*FS*), especially in ASEAN Countries.

$$FS = f\left(FAVs, FACs, FU\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.13)$$

The measurement for food availability (*FAVs*) is based on food production (*fp*), food imports (*fm*) and food aid (*fa*). Purchasing power parity (*ppp*), Road Density (*rd*) and paved road (*pr*) are used to measure food accessibility (*FACs*), while sanitation facilities (*sf*) and water improvement (wi) are used to measure food utilization (*FU*).

$$FAVs = f\left(fp, fm, fa\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.14)$$

$$FACs = f\left(pr, rd, ppp\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.15)$$

$$Fu = f\left(sf, wi\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.16)$$

The food security improvement models are as follows:

a. Food Availability

$$\ln fs_{it} = \alpha_0 + \beta_1 \ln fp_{it} + \beta_2 \ln fm_{it} + \beta_3 \ln fa_{it} + \beta_4 \ln sf_{it} + \beta_6 \ln gdp_{it} + \beta_7 \ln al_{it} + \mu_r + \tau_t + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.17)$$

b. Food Accessibility

$$\ln fs_{it} = \alpha_0 + \beta_1 \ln ppp_{it} + \beta_2 \ln rd_{it} + \beta_3 \ln sf_{it} + \beta_4 \ln gdp_{it} + \beta_6 \ln al_{it} + \mu_r + \tau_t + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.18)$$

c. Food Utilization

$$\ln fs_{it} = \alpha_0 + \beta_1 \ln sf_{it} + \beta_2 \ln wi_{it} + \beta_3 \ln gdp_{it} + \beta_4 \ln al_{it} + \mu_r + \tau_t + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.19)$$

The proxy of food security in national level known as Dietary Energy Supply (DES) which is based on Chen & Kates (1994) and also from Food Security Indicators published by United Nations (Gillespie et al.,1993). United States Department of Agriculture has classified three important variables to measure the improvement of food security. First is known as food availability where consists of food production, food import and food aid. The measurement of food production are actually based on Net per Capita Food Production Index Number (2004-2006=100). Net per capita food production index is presented as net food production after deduction for feed and seed of a country's agriculture sector per person relative to the based period 2004-2006 (United Nation). This index covers all agriculture food products which contain nutrients except for coffee and tea. Food aid is a various instruments and it is based on three important way of distribution which are known as program, project and emergency (Lowder & Raney, 2005). Programed food aid is donated food or food that has been sold to a government at a concessional price of a recipient countries and government will sell the food on the domestic market (Clay & Benson, 1990). Project food aid is a food distribution for free to participants in programs that run by non-governmental organization which is their main plan is to promote agriculture sector or to increase economic development. Emergency food aid is food that is distributed to the recipient countries that face food security problems due to the crisis such as war, famine or natural disaster problems.

Next is food import where Food Import Value Index is used as a proxy. The use of this index as a proxy because Food import value indexes is a current value of imports that has been converted to US dollar and stated as a percentage of the average for the base period 2004-2006 (World Bank). The second variable that has been used to improve food security is food accessibility and used Paved Road as a proxy and this proxy is adopted from Breisinger et al. (2010) which is based on their articles published by International Food Policy Research Institute

were based on this assessment, the availability and the sufficiency of food supply problems come from the accessibility of food in term of poor road network. It gives a huge impact to the food supply, creating chronic malnutrition problems and food security cannot be achieved especially in less ASEAN Countries like Sri Lanka.

Besides that, food accessibility also depends on individual, household and national purchasing power. To measure food accessibility in term of national purchasing power is based on national purchasing power parity which is based on Food Insecurity and Vulnerability Information and Mapping System (FAO/FIVIMS) Framework. Finally, utilization is the last variable that will be used to measure the improvement of food security. The measurement is a proxy by sanitation which is based on sanitation improvements measures by absolute thousand people that get improvement in sanitation services. These sanitation improvements data is gained from World Health Organization / United Nations Children's Fund (WHO/UNICEF) Joint Monitoring Programmed (JMP) for water supply and sanitation. In addition, control variables will be added in this model specification to control all factors that can give impact to food security. These control variables consist of GDP per capita and arable land per capita are adopted from Akramov et al. (2010).

3. Methodology

This research will employ panel data specification test for estimating first and second objectives by using Fixed Effects model because this model are suitable if unobserved individual characteristic that are assumed to be correlated with the error term.

Fixed effects (FE) models are used to analyze the impact of fluctuation variables over time. Besides that, fixed effects model are used to determine the relationship between predictor and outcome variables within country. This country has their own characteristics that may or may not influence predictor variables. The basic model to estimate this method is shown as below;

$$y_{it} = \beta_1 x_{it} + a_i + u_{it} \quad \text{.....} \quad (3.34)$$

Where, $a_i \left(i = 1.....n\right)$ is intercept for each country, y_{it} is a dependent variable, x_{it} is a independent variable, β_1 is a coefficient for independent variable, u_{it} is an error term, i is a countries and t is a time. Fixed effects model by using binary variables are shown as below;

$$y_{it} = \beta_0 + \beta_1 x_{1,it} + ... + \beta_k x_{k,it} + \gamma_2 E_2 + ... + \gamma_n E_n + u_{it} \quad \text{.....} \quad (3.35)$$

Where E_n is a country n. by using binary models which is dummy variable so countries with $\left(n-1\right)$ need to be added to this model. While γ_n is the coefficient for the binary regressors. Besides that, this method also can add time effects to the country effects model to have a time and country effects regression model as shown as follow;

$$y_{it} = \beta_0 + \beta_1 x_{1,it} + ... + \beta_k x_{k,it} + \gamma_2 E_2 + ... + \gamma_n E_n + \sigma_2 T_2 + ... + \sigma_t T_t + u_{it} \quad (3.36)$$

Where T_t is a binary variable (dummy) which is $\left(t-1\right)$ time periods and σ_t is the coefficient for the binary time regressors. Moreover, based on equation (3.7) above, the average of the equation over time for each unit of I will apply as shows below;

$$\bar{y}_{it} = \beta_1 \bar{x}_{it} + \bar{a}_i + \bar{u}_{it} \quad \text{.....} \quad (3.37)$$

Next, subtracting the equation as follow;

$$y_{it} - \bar{y}_{it} = \beta_1 \left(x_{it} - \bar{x}_{it}\right) + \left(u_{it} - \bar{u}_{it}\right) \quad \text{.....} \quad (3.38)$$

This equation shows that variables x and y as the observations of each panel with their mean per individual has been removed. This equation also known as the within transformation and the estimation are known as within estimator. The within estimator are become unbiased and consistent if all the explanatory variables are strictly exogenous. The

within transformation applies Least Square Dummy Variable (LSDV) model because the regression from LSDV will produce the same result as estimated the model from the original data and a set of $(N-1)$ indicators variables for all but from one unit of panel data. Based on LSDV, the effects of x_1 are based on the differences across countries. When the dummy variable for each countries are added, it will show the pure impact from x_1 with controlling the unobserved heterogeneity. Additionally the degrees of freedom for the fixed effects estimator would be $(N(T-1)-k)$. A constant term is included and F-test is required for the null hypothesis test where all coefficients $a_i^{'}$ is a zero, where $a_i^{'}$ are deviations from mean values $\overline{a}_i$. In fixed effects model, time-invariant cannot included because the values will be equal to zero for all time periods. Based on fixed effects assumption, all time-invariant characteristics are unique to all countries and cannot be correlated with others countries characteristics. This fixed effects model controls all time-invariant differences between countries and will cause the estimated coefficients for the fixed effects models cannot be bias because these models have omitted time-invariant characteristics. If time dummies full set $(T-1)$ are added, any explanatory variables that has a constant difference over time for each countries cannot be included because its relates with time constant effects.

There is an alternative way to substitute fixed effects model which is known as random effects models. The difference between fixed effects and random effects is whether the unobserved individual effect represents the elements that has correlated with the regressors in the model does not matter either these effects are stochastic or not. Random effects model is the most suitable model if error term or the differences across countries are linked with the dependent variable. Time-invariant variables can be included in this random effects model. The random effects model is;

$$y_{it} = \beta_1 x_{it} + a_i + u_{it} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.39)$$

Where u_{it} is a between countries error and ε_{it} is a within countries error.
Lastly, to identify which estimation either fixed effects model or random effects model are more suitable for this study, so it is needed to run a Hausmen test were the null hypothesis represents random effects model and the alternative hypothesis is a fixed effects model.

1. Data

The analysis is conducted by compiling balanced panel datasets from 9 ASEAN countries for the period 2000 to 2012. These datasets are obtained from the World Bank and the Food and Agriculture Organization (FAO) databases.

Eight dependent variables are used as proxies to measure food security. These proxies are based on the measurements defined by the FAO, namely Dietary Energy Supply (DES). Meanwhile, the independent variables are Food Import Index, Food Production Index, Food Aid, Purchasing Power Parity, Paved Road, Sanitation Services, Water Improvements and Arable Land. Data for all dependent and independent variables are log-transformed to measure the elasticity of the variables.

2. Empirical Result

Table 1 shows the empirical result for the fixed effects model. In examining food availability, the result reveals that food imports have negative and significant impacts on food security. This implies that higher food imports will increase import bills and increase the cost of the food in ASEAN countries. On the other hand, Food production and food aid significantly increase food security because increase in local production will minimize the cost of production and increase food security. Besides that, food aid also plays an important role to increase food security

because food aid further depends on three distribution channels (Lowder and Raney, 2005). Programmed food aid, project food aid and emergency food aid may not benefit all ASEAN Countries at the same time.

The second set of factors represents food accessibility, which is divided into two categories namely physical access and economic access. The latter is proxy by the purchasing power parity while the former is proxy by road density. The result reveals that the purchasing power parity are not significant give an impact on food security. However, physical access which is proxy by road density give a negative impact to food security due to the higher cost to build better road density to transfer foods prom producers to consumer especially in ASEAN Countries. Besides that, The other reason is because lack of data. Most of the paved road data is sparse and not standardize form. Even though the data has limitation but the trend are still visible but the result of data are contrast with the normal result.

The third set of factors represents food utilization, which is proxy by sanitation services and drinking water improvement. Based on the result, sanitation services show a negative and significant impact on food security, which implies that, an increase in sanitation services will reduce food security. This is probably due to the high cost of improving sanitation services, with estimated costs of US$115billion for the period 2010 to 2015, where 46 per cent is for the rural area (UNICEF, 2014). On the other hand, this paper has identified that improvement in drinking water give a positive impact on food security reveals that an increase in water improvement leads to an increase in the quality of water and thus enhances productivity in food production which reduces the prevalence of undernourishment and directly increases food security in ASEAN countries.

Table 1 Regression Results for the Fixed Effects Model

Food Availability	
Dietary Energy Supply (DES)	**Fixed Effects**
Food Import Index (Fm)	-0.0196
	(-1.35)***
Food Production Index (Fp)	0.1688
	(2.78)***
Food Aid (Fa)	0.0044
	(1.99)**
Sanitation Facilities (Sf)	-0.0719
	(-1.96)**
GDP Per Capita	0.0809
	(5.29)***
Arable Land	-0.0589
	(-0.57)
Intercept	6.8502
	(12.44)***
Observation	62
Countries	9
R-Square	0.8912
F-Test	49.95***
Hausman Fixed	77.24***

* ** ***significant in 10%, 5%, 1%

Food Accessibility	
Dietary Energy Supply (DES)	**Fixed Effects**
Purchasing Power Parity (Ppp)	0.0617

	(0.75)
Road Density (Rd)	-0.0230
	(-1.53)*
Sanitation Facilities (Sf)	0.0969
	(2.05)**
GDP Per Capita	0.0357
	(1.62)*
Arable Land	-0.2041
	(-2.53)***
Intercept	7.4729
	(11.98)***
Observation	42
Countries	9
R-Square	0.7743
F-Test	43.02***
Hausman Fixed	148.45***

* ** ***significant in 10%, 5%, 1%

Food Utilization	
Dietary Energy Supply (DES)	**Fixed Effects**
Drinking water improvement (wi)	0.5096
	(3.10)***
Sanitation Facilities (Sf)	-0.2674
	(-2.70)**
GDP Per Capita	0.0818
	(10.12)***
Arable Land	-0.1161
	(-1.90)*
Intercept	6.5817
	(13.86)***
Observation	88
Countries	9
R-Square	0.7528
F-Test	100.27***
Hausman Fixed	116.21***

3. Conclusion

This paper examines food security in selected ASEAN Countries, based on the three dimensions identified in the USAID food policy. There are three major findings in this study, with regards to food availability, food accessibility and food utilization. Firstly, based on food availability, an increase food production and food aid can improve food security. Secondly, based on food accessibility, an increase in road density infrastructure will reduce food security in ASEAN countries due to higher cost of infrastructure. However, purchasing power parity are not significant give an impact to food security in ASEAN countries. Thirdly, based on food utilization, our results show that sanitation services have a significant negative positive impact on food security. Sanitation services involve high costs and may

not be affordable by some ASEAN Countries, but alternatively, they could invest in water improvement to help increase food production.

Reduction in food security can be achieved by making improvement in all three important policy dimensions identified by USAID. Governments and international institutions should contribute by providing aids to improve infrastructure, provide training and better education for farmers and households, build more affordable health care centers and introduce rural off-farm opportunities for farmers to achieve higher productivity. An increase in food production can help households to gain profit from selling their crops and food. They can increase their purchasing power parity and enable them to purchase quality food. Governments benefit from the contribution to the economic growth and can afford to invest in better sanitation services. Overall, the problems of undernourishment and food security can be reduced.

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