



## **The Impact of Food Policy on Food Insecurity in Developing Countries**

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### **ABSTRACT**

Food insecurity is one of the major issues in the developing countries which are debate seriously. The affected countries suffer from hunger and undernourishment, due to their incapability to provide sufficient nutritious food. Insufficiency on nutritious food is cause by several factors such as climate change, food crisis and natural disaster problem. The United States Agency International Development (USAID) food policy highlights food availability, accessibility and utilization as three major dimensions in achieving food security. The proxy for food insecurity is based on three important variables namely Prevalence of Food Inadequacy (PFI), Prevalence of Undernourishment (POU) and Depth of Deficit (DFD). This paper examines the impact of these dimensions on food insecurity in selected developing countries, using the country fixed effect model. The findings of this study show that an increase in food production, food import, purchasing power parity and water improvement are found to have positive impacts on improving food insecurity.

**Key words:** food insecurity, availability, accessibility and utilization

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## INTRODUCTION

The world has seen continued famine, starvation and malnutrition in many countries, mostly among the poor and developing third-world countries. Starvation and malnutrition have a negative impact on health, leading to poor productivity and gradually affecting overall economic growth. Factors such as climate change, natural disasters, overpopulation, food crisis, higher food prices and diminishing resources have worsened the situation and are now beginning to affect the rich and developed countries. These problems have become a global concern and are recognized worldwide as food insecurity issues.

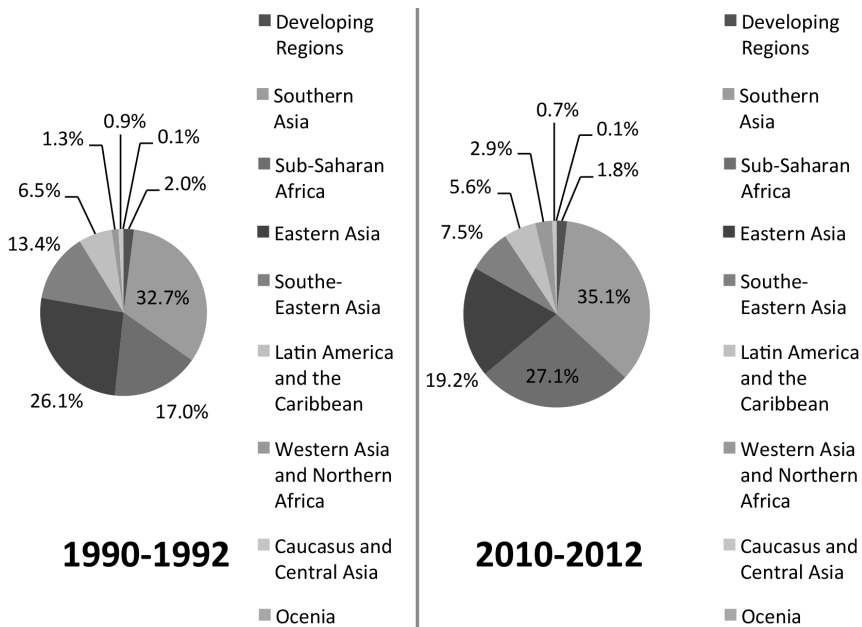
Food insecurity occur when people do not have adequate physical, social or economic access to sufficient, safe and nutritious food that meet their dietary needs and preferences for an active and healthy life (FAO, 2010). These situations can cause undernourishment when calorie intake is below the Minimum Dietary Energy Requirement (MDER). The MDER defines the amount of energy needed to maintain a minimum acceptable weight for one's attained height. Food insecurity began in the days of World War II due to the limited supply of food, which led to higher food prices, and consequently resulted in a food crisis.

In this paper, the food insecurity improvement is examined based on the three dimensions identified in the United States Agency International Development (USAID) food policy, namely food availability, accessibility and utilization. There are limited literature and research that have examined the impact of these dimensions on food insecurity in developing countries.

## BACKGROUND OF STUDY

The World Food Programmed has defined malnutrition as a situation where people have a difficulty in growing and fighting for disease. Malnutrition also affects the ability to learn and do physical work. The State of Food Insecurity in the World shows that the number of undernourished people based on the Dietary Energy Supply (DES) is 870 million people, which is 12.5 per cent of the global population, with 852 million people living in developing countries (FAO, 2012). According to Figure 1, there is an increase in the percentage of undernourished people in Southern Asia, Sub-Saharan Africa, Western Asia and Northern Africa from the period 1990-1992 to the period 2010-2012. However, other developing regions namely Eastern Asia, South-Eastern Asia, Latin America and the Caribbean, Oceania, Caucasus and Central Asian have shown a reduction in the percentage of undernourished people between the two time periods.

Generally, there are two types of food insecurity. The first type is known as the chronic food insecurity, which is a long-term or persistent situation. This situation occurs when people are not capable to meet their minimum food requirement at all times. The chronic food insecurity is caused by long-term poverty problem, lack of assets and insufficient access to productive and financial resources. This problem can be overcome with long-term development such as improving education and increasing access to the productive resources, in order to raise the ability to meet the minimum food requirement and reduce the poverty problem. The second type of food insecurity is known as the transitory food insecurity and it is a short-term and temporary situation. The availability of food is reduced because of short-term shocks and fluctuations in the domestic food production, food price and household income. To achieve food security, the affected countries must strive to reduce poverty, increase cognitive and physical development, raise productivity and promote economic growth.



Source: FAO, 2012

**Figure 1** Percentage of Undernourished by Region, 1990-1992 and 2010-2012

To improve food insecurity, a country must fulfill the needs for food availability, accessibility and utilization as a whole (USAID, 1992). Food availability plays an important role in providing the necessary nourishing element to citizens of each country. The quantity of food comes in the form of supplies through domestic production, food imports and food aid. Domestic food production is very important to improve food insecurity. Based on Conceicao et al. (2011), Food Security and human development have a strong relationship through food production. Increasing in food production can improve food insecurity problem, reduce famine and hunger problem. Besides domestic food production, improvement in food insecurity also relies on food imports and food aids. This situation are supported by Wagstaff (1982), this author has claim that there is no strong relationship between food supply and food production. This shows that food production is not the only solution for food insecurity, food aids and food imports also need to play a simultaneous role (Magnan et al., 2011). Moreover, developing countries are classified as net food exporters for commercial food products such as coffee, cocoa, tea, spices, sugar and tropical fruits and are also known as net food importers because of their insufficient production of staple food (Valdés and Mccalla, 1999). Beside food import, food aid also plays an important role to overcome food insecurity problem. food aids plays an important role in emergency situation and also to fulfilled the food shortage in long term situation del Ninno et al. ( 2007). Moreover food aids also plays an important role in increasing national food stocks through financial support and technical assistance for national food strategies (Thomson, 1983).

Accessibility is where individuals have sufficient income or other resources for acquiring suitable food for a nutritious diet. The availability of a better access to the food system is important to achieve food security (Kennedy et al. 2004). Accessibility to safe water, sanitation, communication and paved roads as well as better infrastructure are considered as the Millennium Development Goals (MDG) for improving food insecurity. Roads, specifically paved roads that are not subject to seasonal deterioration, are relevant measures of accessibility because they represent the interstate movement of goods and the market access. World Bank (1997), has discovered that paved roads have a huge impact on agriculture sector where based on world bank report, improvement in market access in term of paved road can improve food insecurity problem in developing countries. The World Bank report then support by Breisinger et al. (2010), the author has claimed that paved road is one of the indicators for food insecurity improvement. However, Chen and Kates (1994) found that the economic access, in terms of household income, also plays an important role in improving food insecurity.

Food utilization is the third dimension identified as important for food security. Food utilization benefits food security through adequate diet, clean water, sanitation

and health care that enables people to reach a state of nutritional well-being where all physiological needs are met. Based on the Sanitary and Phytosanitary Measures, sanitation services are important in order to achieve food safety and food security (WTO, 1995). The lack of sanitation facilities and clean water has contributed to 925 million people being categorized as chronically undernourished people (Howard and Bartram, 2003). Clean water and sanitation improvement are very important in poor and developing countries to promote healthy living (Mara, 2003). By 2025, these countries need to meet the target for water supplies and sanitation improvement with access to water supplies for 2.9 billion people and improvement in sanitation for 4.2 billion people. Mara (2003) found that all developing countries have simple, appropriate, affective and affordable technologies for access to a good water supply and to improve sanitation services for their people, but the government expenditure is spent more on other needs. However, water supplies and sanitation improvement may not depend solely on government expenditures; these facilities can also be financed by investment, specifically public health investment (Watson, 2006). This study investigated the impact of the project on improving sanitation infrastructures in the U.S. Indian reservation in 1960. The investment for sanitation benefits the country by reducing the cost of supplying clean water for households and helping to reduce Native American infant diseases such as the waterborne

### MODEL SPECIFICATION

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 insecurity (FIS), especially in developing countries.

$$FIS = f(FAVs, FACs, Fu) \quad (1)$$

The measurement for food availability (FAVs) is based on food production (Fp), food imports (Fm) and food aid (Fa). Purchasing power parity (PPP) and paved road (PR) are used to measure food accessibility (FACs), while sanitation services (SS) and water improvement (WI) are used to measure food utilization (Fu).

$$FAVs = f(Fp, Fm, Fa) \quad (2)$$

$$FACs = f(PR, PPP) \quad (3)$$

$$Fu = f(SS, WI) \quad (4)$$

The proxies for food insecurity are based on three indicators identified as the Prevalence of Undernourishment (POU), the Depth of the Food Deficit (DFD) and the Prevalence of Food Inadequacy (PFI). These proxies are obtained from the Food and Agriculture Organization Statistic (FAOSTAT). The food insecurity improvement models are as follows:

$$\begin{aligned} \ln FIS_{it} = & \alpha_0 + \beta_1 \ln FP_{it} + \beta_2 \ln FM_{it} + \beta_3 \ln Fa_{it} + \beta_4 \ln PR \\ & + \beta_5 \ln Ppp_{it} + \beta_6 \ln SS_{it} + \beta_7 \ln WI_{it} + \beta_8 \ln X_{it} \\ & + \mu_r + \tau_t + \varepsilon_{it} \end{aligned} \quad (5)$$

$$\begin{aligned} \ln FIS_{it} = & \alpha_0 + \beta_1 \ln FP_{it} + \beta_2 \ln FM_{it} + \beta_3 \ln Fa_{it} + \beta_4 \ln PR \\ & + \beta_5 \ln Ppp_{it} + \beta_6 \ln SS_{it} + \beta_7 \ln WI_{it} + \beta_8 \ln gdpcc_{i,t} \\ & + \beta_9 \ln al_{i,t} + \mu_r + \tau_t + \varepsilon_{it} \end{aligned} \quad (6)$$

Food production is measured based on the net per capita Food Production Index (2004-2006=100). By definition, this index is calculated from the net food production after deduction for feed and seed of a country's agriculture sector per person relative to the base period 2004-2006, covering all agriculture food products containing nutrients except coffee and tea (United Nations). Food aid includes various instruments and it is based on three important channels of distribution, which are known as programmed food aid, project food aid and emergency food aid (Lowder and Raney, 2005). Programmed food aid involves donated food or food that has been sold to a government at a concessional price for the government to sell in its domestic market (Clay and Benson, 1990). Project food aid offers free food distribution to participants in programs that are run by non-governmental organizations to promote the agriculture sector or to enhance the economic development. Emergency food aid distributes food to the recipient countries that face food insecurity due to crises such as war, famine or natural disasters. For food imports, we use the Food Import Value Index as a proxy. This index represents the current value of imports that has been converted to the US Dollar and stated as a percentage of the average for the base period 2004-2006 (FAOSTAT). The second variable is food accessibility, which is proxy by paved road ( $\ln PR_{it}$ ). In addition, food accessibility also depends on the individual, household and national purchasing power. We refer to the Food and Agriculture Organization / Food Insecurity and Vulnerability Information and Mapping System (FAO/FIVIMS) Framework to measure food accessibility in terms of the national purchasing power parity ( $\ln Ppp_{it}$ ). Food utilization is achieved through adequate clean water, good sanitation services and proper health care through the application of nutritional food. Based on the

Sanitary and Phytosanitary Measures, sanitation services are important in order to achieve food safety and food security (WTO, 1995). Data for sanitation services improvement ( $\ln SS_{it}$ ) and improvement in clean water ( $\ln WI_{it}$ ) are obtained from the FAOSTAT. A set of controlled variables,  $\ln X_{i,t}$ , is added in this model to control other factors that can affect food insecurity. These controlled variables consist of the GDP per capita ( $gdpcc$ ) and the arable land ( $\ln al_{i,t}$ ), as adopted from Akramov *et al.* (2010).

## METHODOLOGY

This paper employs the country fixed effects model because this model is suitable to consider unobserved individual characteristics that are assumed to be correlated with the error term. The fixed effects model is used to analyze the impact of fluctuating variables over time and to determine the relationship between the predictor variable and the outcome variable. Each country has their own characteristics that may or may not influence predictor variables. The basic model for estimation is as follows;

$$y_{it} = \beta_1 x_{it} + a_i + u_{it} \quad (7)$$

where,  $a_i (i=1, \dots, n)$  is the intercept for each country,  $y_{it}$  is the dependent variable,  $x_{it}$  is the independent variable,  $\beta_1$  is the coefficient for the independent variable,  $u_{it}$  is the error term,  $i$  and  $t$  represent country and time, respectively.

Meanwhile, the random effects model is an alternative for the fixed effects model to estimate coefficients on time-constant exogenous variable. The difference between the fixed effects model and the random effects model depends on whether the unobserved individual effect represents the elements that are correlated with the regressors in the model, notwithstanding whether the effect is stochastic or non-stochastic. The random effects model is more suitable if the error term or the differences across countries are related to the dependent variable. Time-invariant variables can be included in the random effects model. The random effects model can be represented as;

$$y_{it} = \beta_1 x_{it} + a_i + \varepsilon_{it} \quad (8)$$

where  $u_{it}$  is a between countries error and  $\varepsilon_{it}$  is a within countries error.

To identify which estimation is more suitable for this study, we run the Hausman test to choose between the random effects model and the fixed effects model. The null hypothesis of the test states that there is no correlation between the individual effects and the explanatory variables. This implies that both random and fixed effects

are consistent but only the random effect is efficient. Meanwhile, the alternative hypothesis states that the individual effects are correlated with the explanatory variables, implying that only the fixed effects approach is consistent and efficient. Based on the Hausman test, the best choice for this study is the fixed effects model.

## **DATA**

The analysis is conducted by compiling balanced panel datasets from 57 developing countries for the period 1990 to 2007. These datasets are obtained from the World Bank and the Food and Agriculture Organization (FAO) databases. Three dependent variables are used as proxies to measure food insecurity. These proxies are based on the measurements defined by the FAO, namely Prevalence of Food Inadequacy (PFI), Prevalence of Undernourishment (POU) and Depth of Food Deficit (DFD). 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, except for the Gross Domestic Product (GDP) which is represented as growth rate.

## **EMPIRICAL RESULT**

Table 1 shows the empirical result for the fixed effects model. In examining food availability, the result reveals that food imports and food production have negative and significant impacts on food insecurity. This implies that higher food imports and food production increase the availability of food in developing countries, reduce the prevalence of food inadequacy and undernourishment, and decrease depth of food deficit. On the other hand, food aid is not significant in reducing food insecurity 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 developing 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 paved road. The result reveals that the purchasing power parity has a negative impact on food insecurity. An increase in purchasing power parity increases economic access, and thus decreases the prevalence of food inadequacy and undernourishment, and reduces the depth food deficit. In other words, the result implies that improvement in economic access leads to a reduction in food insecurity in developing countries. However, physical access does not show a significant impact on food insecurity.



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Table 1 Regression Results for the Fixed Effects Model

<b>Dependent Variable / Independent Variable</b>	<b>Prevalence of Food Inadequacy (PFI)</b>	<b>Prevalence of Undernourishment (POU)</b>	<b>Depth of Food Deficit (DFD)</b>
Food Import Index (Fm)	-0.0822 (-4.31)*** [0.0191]	-0.0970 (-4.70)*** [0.0206]	-0.1232 (-5.01)*** [0.0246]
Food Production Index (Fp)	-0.6908 (-8.00)*** [0.0863]	-0.7720 (-8.27)*** [0.933]	-1.0317 (-9.28)*** [0.1112]
Food Aid (Fa)	0.0047 (0.79) [0.0059]	0.0045 (0.70) [0.0065]	0.0095 (1.23) [0.0077]
Purchasing Power Parity (Ppp)	-0.4046 (-6.03)*** [0.0671]	-0.3365 (-5.64)*** [0.0596]	-0.3276 (-4.40)*** [0.0744]
Paved Road (PR)	0.0007 (0.02) [0.0384]	-0.0224 (-0.54) [0.0415]	-0.0021 (-0.04) [0.0495]
Sanitation Services (SS)	0.4467 (6.51)*** [0.0687]	0.4153 (5.60)*** [0.0742]	0.5761 (6.51)*** [0.0884]
Water Improvement (WI)	-0.4868 (-4.11)*** [0.1184]	-0.4556 (-3.56)*** [0.1281]	-0.4341 (-2.84)*** [0.1526]
GDP Per Capita (gdppc)	0.0015 (1.27) [0.0012]	0.0015 (1.13) [0.0013]	0.0004 (0.25) [0.0015]
Arable Land (al)	-0.1451 (-3.70)*** [0.0392]	-0.1353 (-3.19)*** [0.0424]	-0.1574 (-3.12)*** [0.0505]
Intercept	10.7982 (21.29)*** [0.5072]	10.9364 (19.94)*** [0.5484]	12.9560 (19.83)*** [0.6533]
Observation	491	491	491
Countries	57	57	57
R-Square	0.1334	0.1989	0.4587
F-Test	50.78***	47.31***	40.02***
Hausman Fixed	58.71***	46.12***	37.26***

The third set of factors represents food utilization, which is proxy by sanitation services and water improvement. Based on the result, sanitation services show a positive and significant impact on food insecurity, which implies that, an increase in sanitation services increases food insecurity. 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, a negative impact of water improvement on food insecurity 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 food inadequacy and undernourishment, as well as the depth of food deficit.

## CONCLUSION

This paper examines the improvement of food insecurity in selected developing 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 imports can improve undernourishment and food insecurity. Developing countries that have underdeveloped agriculture sectors and rely highly on the primary agriculture sectors need to increase the quality of fertilized soils, reduce the environmental pollution and improve the irrigation system. Improvement in agricultural inputs will increase crop and food production, and thus reduce undernourishment and food insecurity. Secondly, based on food accessibility, an increase in the purchasing power parity can improve food insecurity. However, the impact of physical access is insignificant due to the poor infrastructure. Improvement in infrastructure like paved road can reduce transportation costs and increase physical market access to nutritious food. Thirdly, based on food utilization, our results show that sanitation services have a significant positive impact on food insecurity. Sanitation services involve high costs and may not be affordable by some developing countries, but alternatively, they could invest in water improvement to help increase food production.

Reduction in food insecurity 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 insecurity can be reduced.

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