UNIVERSITI PUTRA MALAYSIA

FOOD SECURITY AND ECONOMIC GROWTH IN DEVELOPING COUNTRIES

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FOOD SECURITY AND ECONOMIC GROWTH IN DEVELOPING COUNTRIES

By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

FOOD SECURITY AND ECONOMIC GROWTH IN DEVELOPING COUNTRIES

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NUR MARINA BINTI ABDUL MANAP

June 2015

Chair: Assoc. Prof. Dr. Normaz Wana Ismail, PhD
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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. The transitory food deficit is caused by two important reasons, where first is caused by the fluctuation in food production which is caused by lack of irrigation, fertilizers consumption and climatic problem that are faced by dry-land irrigation areas. Secondly, it is caused by the world food crisis that gives a huge impact for dry-land developing countries. In order to overcome food security problem in dry-land developing countries, United States Agency International Development (USAID) and Food and Agriculture Organization (FAO) have introduce several plans necessary for achieving food security and it is known as availability, accessibility, utilization and stability. Moreover, food security is very important to enhance economic growth. The objective of the study is to examine the impact of food input resources on food production in dry-land developing countries. Besides that, this research also investigates the role of food security dimension for food security achievement and the impact of food security on economic growth in dry-land developing countries. This research employs static panel data by using random and fixed effects analysis for the first and second objectives. Besides that, the estimation for the impact of food security and economic growth has used dynamic panel data analysis, which adopts Generalized Method of Moments (GMM) for the third objective of the analysis. The finding of this research shows that land irrigation has a positively significant impact on the food production in dry-land developing countries. However, fertilizer consumption and climate change do not give significant impact on food production. Besides that, the finding for the dimension of food security has found that the policy that has been built by USAID is more

appropriate which involves food availability, accessibility and utilization compared to FAO policy where this organization has added food stability in the policy and the result does not give significant impact on food security in dry-land developing countries. Finally, food security positively gives an impact to economic growth in dry-land developing countries. Besides that, reduction in poverty with better food security will increase economic growth. Additionally, life expectancy and total employment rate with better food security positively enhance economic growth in dry-land developing countries.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KESELAMATAN MAKANAN DAN PERTUMBUHAN EKONOMI DI NEGARA - NEGARA YANG SEDANG MEMBANGUN

Oleh

NUR MARINA BINTI ABDUL MANAP

Jun 2015

Pengerusi: Prof. Madya Dr. Normaz Wana Ismail, PhD
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Keselamatan makanan ditakrifkan sebagai keadaan di mana semua orang pada setiap masa mempunyai kedua-dua capaian fizikal dan ekonomi untuk mendapatkan makanan yang mencukupi bagi memenuhi keperluan pemakanan mereka untuk kehidupan yang produktif dan sihat. Masalah keselamatan makanan merupakan satu isu yang penting untuk pembangunan negara, pembasmian kemiskinan dan menjadi isu global kerana mengejar sasaran Matlamat Pembangunan Milenium (MDG) menjelang tahun 2015. Masalah keselamatan makanan berlaku apabila terdapat penurunan yang mendadak dalam keupayaan untuk menghasilkan atau mempunyai akses makanan yang mencukupi untuk mengekalkan status pemakanan yang berkhasiat dan juga dikenali sebagai kekurangan makanan sementara. Kekurangan makanan sementara disebabkan oleh dua alasan penting, pertama oleh turun naik dalam pengeluaran makanan berpunca daripada kekurangan pengairan, penggunaan baja dan masalah iklim yang dialami oleh kawasan pengairan tanah kering. Kedua, disebabkan oleh krisis makanan dunia yang memberikan kesan yang besar kepada negara-negara tanah kering yang membangun. Dalam usaha untuk mengatasi masalah keselamatan makanan di negara-negara tanah kering yang membangun, Agensi Pembangunan Antarabangsa Amerika Syarikat (USAID) dan Organisasi Makanan dan Pertanian (FAO) memperkenalkan beberapa pelan yang perlu untuk mencapai keselamatan makanan dan pelan tersebut dikenali sebagai ketersediaan, ketercapaian, penggunaan dan kestabilan. Tambahan pula, keselamatan makanan adalah sangat penting untuk meningkatkan pertumbuhan ekonomi. Objektif kajian ini adalah untuk mengkaji kesan sumber input makanan kepada pengeluaran makanan di negara-negara tanah kering yang membangun. Selain itu, kajian ini juga menyelidik peranan dimensi keselamatan makanan untuk pencapaian keselamatan makanan dan kesan keselamatan makanan kepada pertumbuhan ekonomi di negara-negara tanah kering yang membangun. Kajian ini menggunakan data panel statik berasaskan analisis kesan rawak dan tetap untuk objektif pertama dan kedua. Selain itu, anggaran untuk kesan keselamatan makanan

dan pertumbuhan ekonomi menggunakan analisis data panel dinamik, yang mengguna pakai *Generalized Method of Moments* (GMM) bagi analisis objektif ketiga. Dapatan kajian ini menunjukkan bahawa pengairan tanah mempunyai kesan positif yang besar ke atas pengeluaran makanan di negara-negara tanah kering yang membangun. Walau bagaimanapun, penggunaan baja dan perubahan iklim tidak memberi kesan yang besar ke atas pengeluaran makanan. Selain itu, penemuan oleh dimensi keselamatan makanan telah mendapati bahawa dasar yang telah dibina oleh USAID yang melibatkan ketersediaan makanan, ketercapaian dan penggunaan adalah lebih sesuai berbanding dasar FAO di mana dasar organisasi ini telah menambah kestabilan makanan dalam dasar dan keputusan itu tidak memberikan kesan yang besar ke atas keselamatan makanan di negara-negara tanah kering yang membangun. Akhir sekali, keselamatan makanan secara positif telah memberi kesan kepada pertumbuhan ekonomi di negara-negara tanah kering yang membangun. Selain itu, pengurangan kemiskinan dengan keselamatan makanan yang lebih baik akan meningkatkan pertumbuhan ekonomi. Di samping itu juga, jangka hayat dan jumlah kadar pekerjaan dengan keselamatan makanan yang lebih baik secara positif meningkatkan pertumbuhan ekonomi di negara-negara tanah kering yang membangun.

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"May Allah Blessed all of you till Jannah InsyaAllah ameen"

I certify that a Thesis Examination Committee has met on June 2015 to conduct the final examination of Nur Marina Binti Abdul Manap on her thesis entitled "Food Security and Economic Growth in Developing Countries" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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Name of Member of Supervisory Committee:	Associate Professor Dr. Shaufique Fahmi bin Ahmad Sidique

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LIST OF ABBREVIATION

UNDP	United Nation Development Programme
FAO	Food and Agriculture Organization
MDER	Minimum Dietary Energy Requirement
IMF	International Monetary Funds
USDA	United States Department of Agricultures
WFP	World Food Programmed
DES	Dietary Energy Supply
IWMI	International Water Management Institute
SME	Small-Medium Enterprise
USAID	United States Agency International Development
WTO	World Trade Organization
LDCs	Least Development Countries
MDGs	Millennium Development Goals
PFI	Prevalence Food Inadequacy
N	Nitrogen
P	Phosphorus
K	Potassium
BTC	Biological Technical Change
ET	Evapotranspiration
OECD	Organization for Economic Co-operation and Development
HVC	High Value Crop
GDP	Gross Domestic Product
R&D	Research and Development
GATTs	General Agreement on Tariff and Trade
IFAD	International Fund for Agriculture Development
POLS	Pooled Ordinary Least Square
GMM	Generalized Method of Moment
FAOSTAT	Food and Agriculture Organization Statistic
CO2	Carbon Dioxide
IPCC	Intergovernmental Panel on Climate Change
FIVIMS	Food Insecurity Vulnerability Information and Mapping System
WHO	World Health Organization
UNICEFF	United Nations Children's Fund
JMP	Joint Monitoring Programmed
LSDV	Least Square Dummy Variable
EPA	Environmental Protection Agency
IFPRI	International Food Policy Research Institute
VAT	Value Added Tax
LLDCs	Landlocked Developing Countries

CHAPTER 1

INTRODUCTION

1.0 Introduction

The world has seen continued famine, starvation and malnutrition, concentrated mostly within poor and developing Third World countries. Starvation and malnutrition have a negative impact on health, leading to poor productivity, and thus gradually affecting overall economic growth. Factors such as climate change, natural disasters, overpopulation, food crises, higher food prices, and diminishing resources have aggravated the situation and are now beginning to impact the rich and developed countries. These problems have become global concerns and are recognized worldwide as food security issues.

Global food shortages, if unchecked, could lead to a major crisis and present significant challenges to humanity's food security. In addition to the factors described above, politically related constraints such as war and civil unrest and other national constraints such as dry-land status, poor infrastructure, and water irrigation problems are exacerbating the situation.

1.1 Background of the studies

Dry-land developing countries cover 40 percent of the world's area and accommodate 2.3 billion people. Dry-land areas are most prevalent in Africa and Asia, and in these regions about one billion people rely on dry-land ecosystem services through rain-fed, irrigated farming and pastoralism. Dry-land areas are categorized by a scarcity of water, which has an impact on primary production and nutrient cycling (CGIAR, 2013). Water shortages negatively impact crop production, forage, and others plants, and negatively impact human bodies. The Food and Agriculture Organization (FAO) has defined dry land as areas in which the growing period (LGP) lasts from 1-179 days. Besides that, the United Nations Convention to Combat Desertification (UNCCD) has classified these areas as having a ratio of annual precipitation to potential evapotranspiration of between 0.05 and 0.65.

A dry-land area also includes aridity zones in which the average climatic condition is one of limited rainfall and water supplies, also known as drought. According to the United Nations Environment Programme (UNEP), there are three dry-land subtypes known as dry sub-humid, semi-arid, and arid. This type of dry-land is based on the level of aridity or moisture deficit. The level of aridity is based on the ratio of the mean annual precipitation to the mean annual evaporative demand, also known as potential evapotranspiration. Dry-land areas comprise grassland, agriculture lands, forest, and urban areas. These areas provide grain and livestock, forming a habitat that supports many vegetables, fruits, and micro-organisms. Moreover, dry land has high variability in rainfall and experiences prolonged periods of drought. There are four types of drought: First is meteorological drought, which is a measure of the departure of precipitation from normal. Due to climate change differences, a drought in one location is not the same as drought in another. A second type is known as agriculture drought, a condition in which the amount of soil water is no longer sufficient to meet a crop's production needs. Third is hydrological drought, which occurs when the surface and

subsurface are below normal. Finally there is socioeconomic drought, where water shortages will affect people (UNDP, 2000).

Table 1.1 shows the aridity zone in dry-land areas. Asia and Africa are the highest aridity areas; Asia's aridity zone, for example, covers 18,401 thousand square kilometers, followed by Africa, where the aridity zone covers 12,933 thousand kilometers square. Based on aridity zones in Dry-Land Developing countries which is based on UNEP (2011) its shows that there is no inequality in food production between these countries because there are no differences in geographical issues.

Table 1.1: Aridity Zones in Dry-land areas

Regions	Aridity Zones (1,000km^2)			
	Arid	Semi-Arid	Dry Sub-Humid	All Dry Land
Asia	6,164	7,649	4,588	18,401
Africa	5,052	5,073	2,808	12,933
Oceania	3,488	3,532	996	8,016
North America	379	3,436	2,081	5,896
South America	401	2,980	2,223	5,614
Central America and Caribbean	421	696	242	1,359
World Total	15,910	23,739	13,909	53,558

Source: (UNEP, 2011)

Generally food production shortages in dry-land countries are caused by dry-land degradation (UNEP, 2011). The degradation of dry lands is caused by unsustainable land and water use and climate change factors. The World Health Organization (WHO) has found that land degradation is caused by extreme weather conditions such as drought, pollution from human activities, deteriorating quality of soils, and poor land utility, all of which negatively affect food production. Degradation will reduce biological productivity and have an impact on an ecosystem's ability to absorb and use rainwater. Besides that, climate change also has a huge impact on food production, especially in rain-fed African agriculture systems.

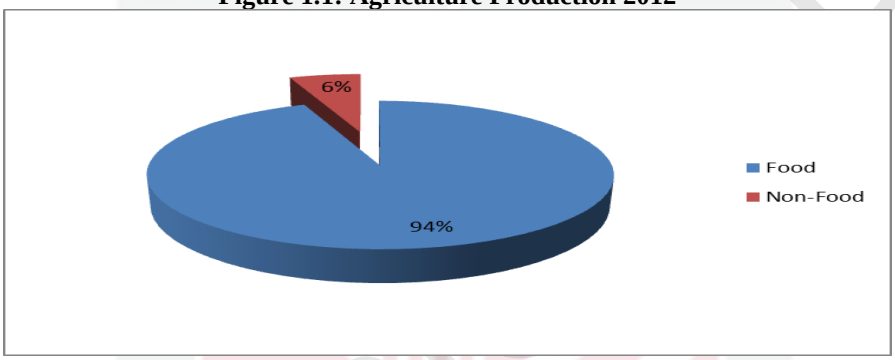
Food is among the basic human needs for social development. Food can be defined as an element people consume to provide nutrients such as carbohydrates, fats, proteins, vitamins, and minerals for the body. It originates from either plant or animal sources. Food absorbed by the body helps to produce energy and stimulate healthy growth. In the past, people traditionally acquired food through primitive hunting and farming methods. Today, our methods of food collection have changed considerably. Most traditional and primitive methods have been sidelined by the introduction of intensive industrial farming and agriculture. Improvements in cultivation methods have also helped to increase production capacity substantially. Food is now a product supplied by industries led by multinational corporations.

Food is essential for survival, but serious questions are being raised whether there is enough food available for the world's burgeoning population. World Bank statistics show that the world's human population increased to 7.1 billion people in 2013. The

regions making the largest contribution to this accelerating population figure are China, India, and Southeast Asia, which together make up 60% of the world's population. In view of this increase in human population, humans must strive to maintain the ability to support a sustainable increase in food production.

Food and Agriculture Organization Statistics has classified food production is a part of agriculture production and there is no conflict between agriculture production and food production. Agriculture production commodities are divided into two groups: food and non-food commodities. Figure 1.1 below shows the percentage of food and non-food production as components of agriculture production in developing countries in 2012. The pie chart below illustrates that food production contributes 94 percent of agriculture production, compared to non-food production, which is only 6 percent.

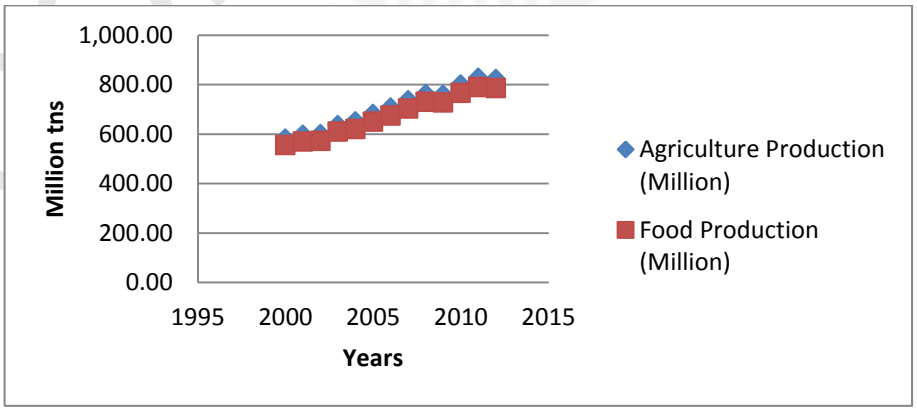
Figure 1.1: Agriculture Production 2012



Data Source: FAOSTAT

Moreover, figure 1.2 illustrates that agriculture production has a positive relationship with food production, in which increasing food production will increase agriculture production. This situation shows that agriculture production in terms of food production is very important for sustained food sufficiency in developing countries. Insufficiency of food will cause undernourishment and hunger and exacerbate the food security problem in developing countries.

Figure 1.2: Scatter Plot between Agriculture Production and Food Production



Data Source: FAOSTAT

1.1. Food Security in Developing Countries

Food security is a flexible concept that has evolved in the past 30 years to reflect changes in official policy thinking (Clay, 2002). About 200 definitions of food security have been published (Maxwell & Smith, 1992).The World Food Summit (1996) defined food security as a situation in which all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life. Food security at national level is the capability of ensuring a national food balance and ensuring sufficiency of the food supply and availability to fulfill the needs of national populations (Chen & Kates, 1994). At the household level, food security is linked to a household's entitlement in terms of food production resources, level of income, food expenditure, and food consumption (Chen & Kates, 1994). The degree of household food security depends on the minimal nutritional requirements of individuals, based on the period of analysis, and assumes that all households have the same entitlement to food and ignores non-economic vulnerabilities. Availability of food supply is subject to food markets, food price, transportation networks, storage facilities, weather conditions, and forms of food rationing, supplementation, or other entitlement programs (Chen & Kates, 1994).

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. Food self-sufficiency will save foreign exchange that can be used to purchase other agriculture commodities that cannot be produced locally. The production and growing of such food crops is done within a country, with minimum dependency on the international market to ensure that sufficient food is available to feed the local population. These activities will encourage the development of small-medium enterprises (SME). Meanwhile, countries with food self-reliance will determine their production needs based on international trade patterns. Countries that apply this concept will import staple foods from the world market when prices are lower than those of local foods. So the land will be used for other purposes, such as 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, and is achieved through improvements in physical infrastructure and credit facilities. Food security can be achieved by increasing local production and productivity, increasing food imports on a regular and assured basis, providing more jobs, increasing incomes to buy food needed, and by improving food distribution systems (FAO, 2002).

The Food and Agriculture Organization (2008) has identified four main dimensions of food security: availability, accessibility, utilization, and stability. The first dimension of food security is based on the physical availability of food. All nations need to ensure 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 food is made available through domestic production, food imports, and food aid. Table 1.2 below shows the average value of food production and the value of food imports for 2007-2009 and 2009 and 2011. The table also shows that food production for all regions is very important compared to food imports, whose average value globally increased from 296 to 303 US dollars per capita between 2008 and 2009 and 2009 and 2011. This situation was different for food imports, whose value remained stagnant between 2007 and 2009 and 2009 and 2011.

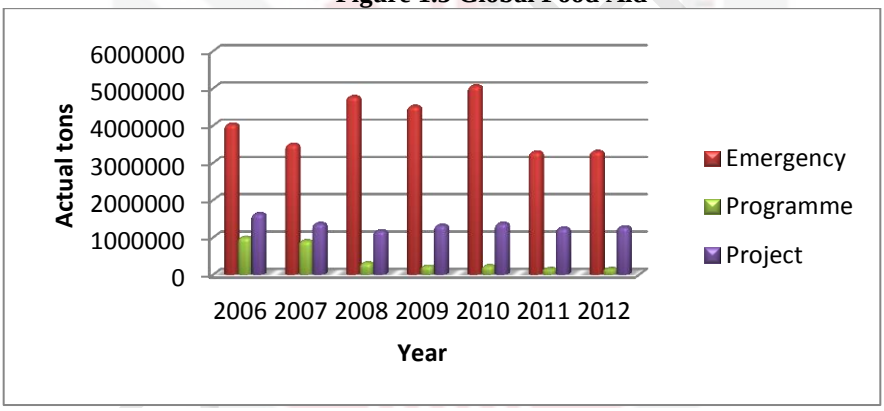
Table 1.2: Average value of food production and value of food imports

Regions	Average value of food production (constant 2004-2006 US$ per capita)		Value of food imports (percent)	
	2007-2009	2009-2011	2007-2009	2009-2011
World	296	303	5	5
Developing countries	254	263	5	5
Dry-land countries	183	192	9	9
Low-income economies	142	148	24	24

Data Source: FAOSTAT

Besides food production and food imports, food aid also plays an important role in sustaining food availability to achieve food security. There are three types of food aid: emergency, project, and program food aid. Figure 1.3 below shows the three types of food aid in the global situation from 2006 until 2012.

Figure 1.3 Global Food Aid



Data Source: Food Aid Information System, WFP

The figure above shows global food aid deliveries from 2006 until 2012. In 2012, global food aid deliveries fell slightly below 5 million metric tons, compared to previous years. The World Food Programme (WFP) was the primary means of delivering food assistance: the program managed 58 percent of global food aid in 2012. Global emergency aid was the most predominant category, followed by project food aid and program aid, which are the smallest aid categories in global food aid.

Additionally, there are several obstacles to food availability (USAID, 1992). These obstacles come from inappropriate agriculture knowledge, technologies, and practices; unsuitable economic policies (pricing, marketing, tax and tariffs); lack of foreign exchange; inadequate agriculture inputs; population growth rates that offset increased production or imports; marketing and transportation systems that inhibit the cost-effective movement of food from sources to destinations that need them; and the inability to predict, assess, and cope with emergency situations, thus interrupting food supplies. Other constraints are related to the availability of natural resources and climatic and disease constraints.

Next, economic and physical access to food is the second dimension that provides access to adequate resources for acquiring appropriate foods for a nutritious diet. The accessibility of food physically and economically is important for individuals and families to achieve food security. There are two types of food accessibility. The first is physical food accessibility in terms of transportation, infrastructure, storage, transformation, and marketing of these food commodities. The figure below shows the total road density, based on kilometers of road per hundred square kilometers of land areas. The figure also shows the highest changes of road density come from kilometers of road per hundred square kilometers of land areas in dry-land developing countries where the total road density has increased from 183 kilometers of road per hundred square kilometers of land area to 192 kilometers of road per hundred square kilometers of land area.

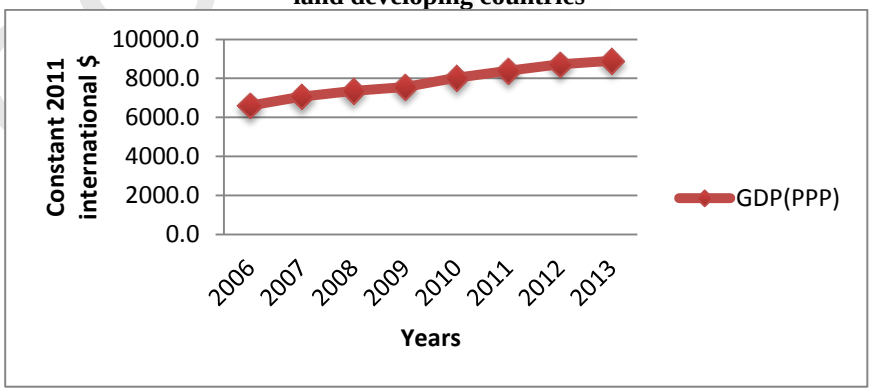
Table 1.3: Road Density in three types of income economies in 2012

Regions	Road Density (km of road per 100 square km of land area)	
	2007-2009	2009-2011
World	296	303
Least-developed countries	139	147
Dry-land developing countries	183	192
Low-income economies	142	148

Data Source: FAOSTAT

The second type of food accessibility is economic accessibility in terms of purchasing power and household income. This is considered the most important indicator affecting people's accessibility to healthy food. Figure 1.4 below illustrates Gross Domestic Product per capita in purchasing power equivalent, which shows that the purchasing power of households in dry-land developing countries has increased drastically. Increasing purchasing power will help households in developing countries spend more on quality food to fulfill their basic nutrition needs. Moreover, there are several accessibility constraints, such as inadequate aggregate economic growth, lack of job opportunities, inadequate training or job skills, and lack of income streams.

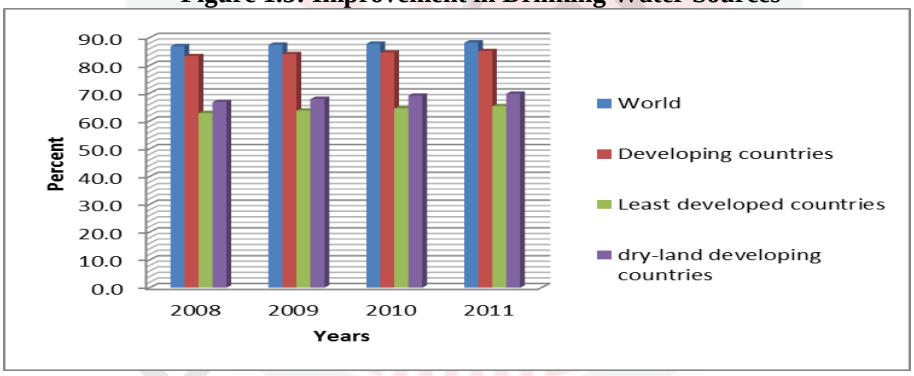
Figure 1.4: Gross Domestic Product per capita (purchasing power parity) in dry-land developing countries



Data Source: FAOSTAT

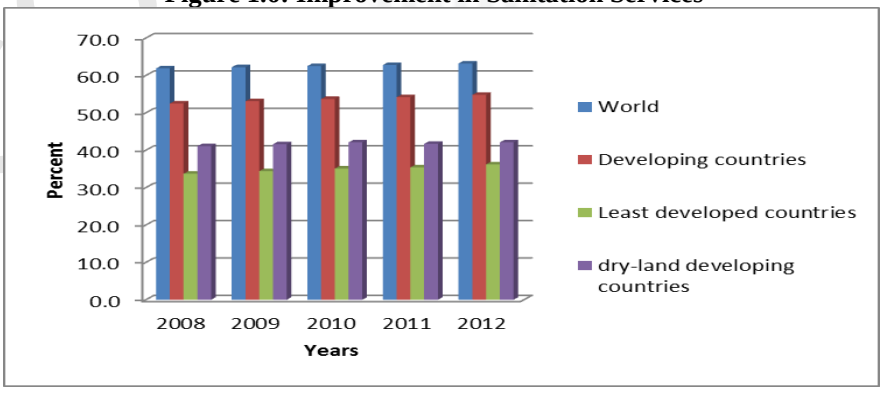
Food utilization also plays an important role in the dimension of food security. Utilization is an important element of non-food security and is usually known as the way the body makes the most of various nutrients in foods. Food utilization also shows that food is properly used by employing appropriate food-processing and storage techniques, and adequate knowledge of nutrition and childcare techniques. Utilization has an impact on food security through adequate diet, clean drinking water, sanitation, and healthcare to enable people to reach a state of nutritional well-being in which all physiological needs are met. Constraints to food utilization include nutrient losses associated with food preparation and inadequate knowledge and poor practice of healthy techniques. Improvement in drinking water and sanitation facilities are very important to achieve food security. Figure 1.5 and 1.6 illustrate the percentage improvement of drinking water and sanitation facilities. Based on figure 1.5 below, the bar chart shows that more than 80 percent of drinking water sources have improved in developing countries, and dry-land developing countries have improved their drinking water sources by 69 percent in 2012. However, drinking water sources in the least-developed countries are lower than 70 percent in 2012. Continuously, for sanitation facilities, figure 1.6 illustrates that improvement in sanitation facilities in developing countries increased by more than 50 percent, compared with least-developed countries and dry-land developing countries, where the improvement of sanitation facilities is lower than 50 percent.

Figure 1.5: Improvement in Drinking Water Sources



Data Source: FAOSTAT

Figure 1.6: Improvement in Sanitation Services



Data Source: FAOSTAT

Finally, food needs to be secured through stability. All populations, households, and individuals must have access to sufficient food at all times. They should not risk losing access to food because of sudden shocks, such as economic or climatic crises, or be cyclical in the vein of seasonal food insecurity. Therefore, the concept of stability can refer to both the availability of the dimensions of food security and access to it. Stability of food security depends 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.

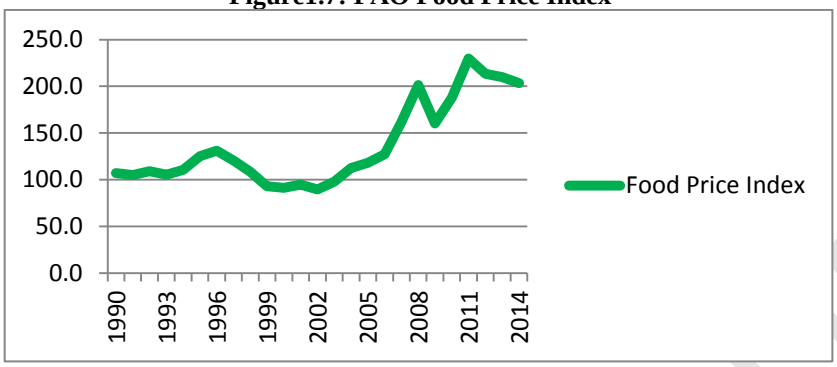
1.2. Global Food Insecurity Situation

The food security problem, scientifically known as food insecurity, is a situation in which people do not have adequate physical, social or economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2010). These situations can cause undernourishment when caloric intake is below the Minimum Dietary Energy Requirements (MDER). The MDER defines the amount of energy needed to maintain a minimum acceptable weight for one's attained height.

Generally, there are two types of food insecurity. The first is chronic food insecurity, which is a long-term or persistent situation that occurs when people are incapable of meeting their minimum food requirements at all times. Chronic food insecurity is caused by a 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 productive resources, in order to raise the ability to meet minimum food requirements and reduce poverty. The second type of food insecurity is transitory food insecurity and is a short-term, temporary situation. The availability of food is reduced because of short-term shocks and fluctuations in domestic food production, food prices, and household income. To achieve food security, affected countries must strive to reduce poverty, increase cognitive and physical development, raise productivity, and promote economic growth.

Food insecurity began during World War II due to a limited supply of food, which led to higher food prices and then led to a food crisis. Since then, global food crises are major challenges to food insecurity. Figure 1.7 below shows the evolution of food commodity prices as represented by an index of various food commodities composed by IMF statistics, which increased slowly from 2003 to 2006 and surged upward from 2006 to 2008. This situation led to a global food crisis that impacted the political and economic stability of poor and developing countries. The food price started falling in 2009 but increased dramatically towards the end of 2009 until 2013, when the price was slightly higher than the food price index was in 2008. However, food prices fell between 2013 and 2014 due to a decrease in the oil price. There are several theoretical considerations concerning the link between oil and food prices. Among these is the fact that crude oil is an important input factor to agriculture productivity through its use in machinery, fuel, fertilizers, and transportation. Besides that, increasing energetic input with commodities such as oil will impact the final products of food commodities.

Figure1.7: FAO Food Price Index

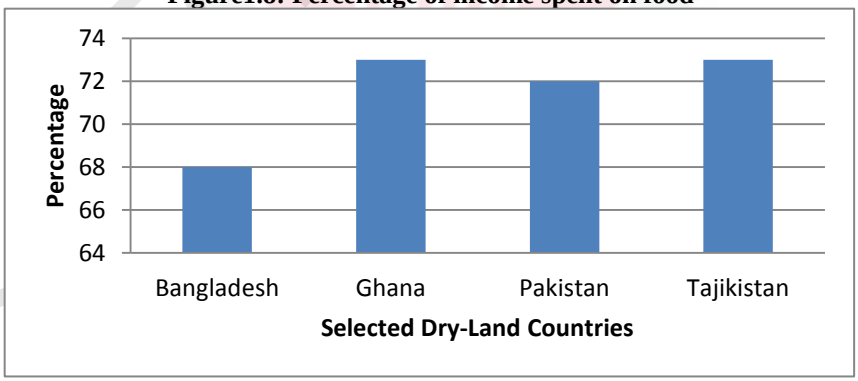


Notes: Indices based on world prices in US dollars. The Food Price Index consists of cereals, vegetable oils, meat, seafood, sugar, bananas, and oranges.

Fluctuations in the food price impact food-importing and food-exporting countries. Increasing food prices have a negative impact on food imports because of the higher cost of the import bill. A higher import bill will reduce food imports and increase food deficits, which gives rise to food security problems (United Nations, 2011). Besides that, food-exporting countries are also affected by a food price crisis. Food-exporting countries, also known as food-producing countries, have restricted their exports to sustain their domestic food sufficiency for households and to fulfill their basic nutrition needs (Giordani, Rocha & Ruta, 2011).

Many developing countries, especially low-income countries, spend almost half of their income to buy food and to address the need to feed their citizens. Figure 1.8 below shows that Bangladesh, Ghana, Pakistan, and Tajikistan have spent more than 60% of their income on food. Increases in the food price followed by unchanged household incomes will cause a decrease in the quality and quantity of food intake and contribute to the problems of malnutrition, hunger, and undernourishment.

Figure1.8: Percentage of income spent on food

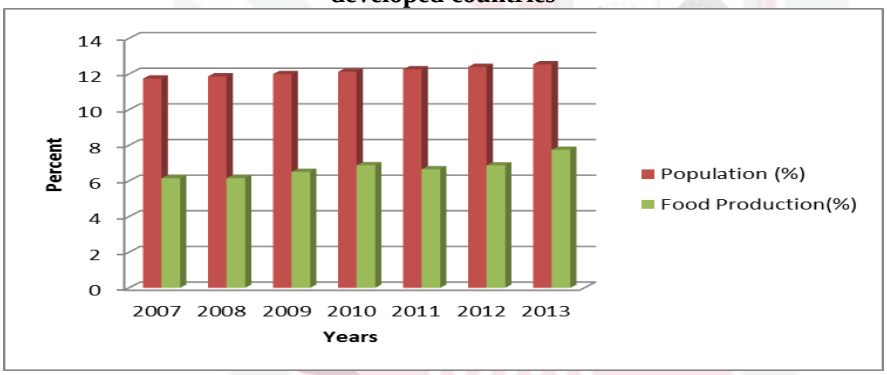


Source: FAO (2011c)

1.3. Food Security and Food Production

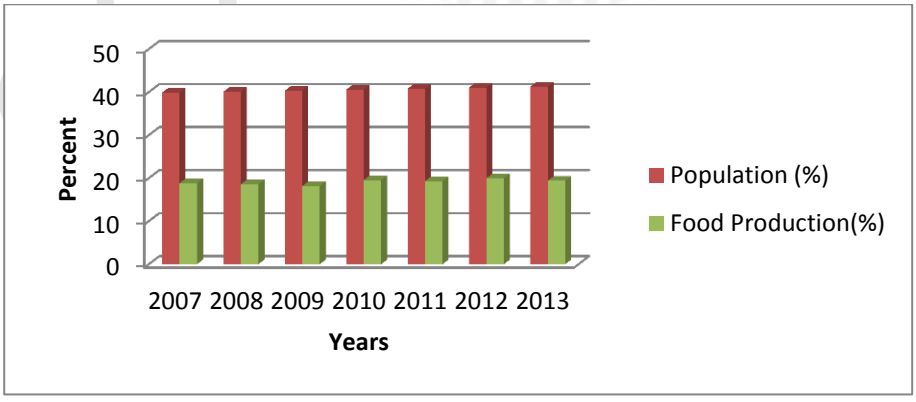
Insufficiency in food production has been classified as a transitory food security problem. Food production is insufficient due to population increases, especially in least-developed countries, low-income countries, and dry-land developing countries. Figures 1.9, 1.10, and 1.11 below show the percentage of food production and the population from 2007 until 2013 for Least-Developed Countries, Low-Income Countries and Dry-land Developing Countries. The three figures below illustrate that food production has not been sufficient to fulfill all the populations' needs, especially in least-developed countries, low-income countries, and dry-land developing countries. The population in least-developed countries has increased more than 10 percent. Although food production has increased, it is not enough to fulfill all the populations' needs. The situation is the same in low-income and dry-land developing countries, where increasing food production is not adequate for all the populations' basic food needs. Insufficient food production will cause an undernourishment problem, increase the food deficit and will cause a food security problem.

Figure 1.9: Percentage of food production and population from 2007-2013 in least-developed countries



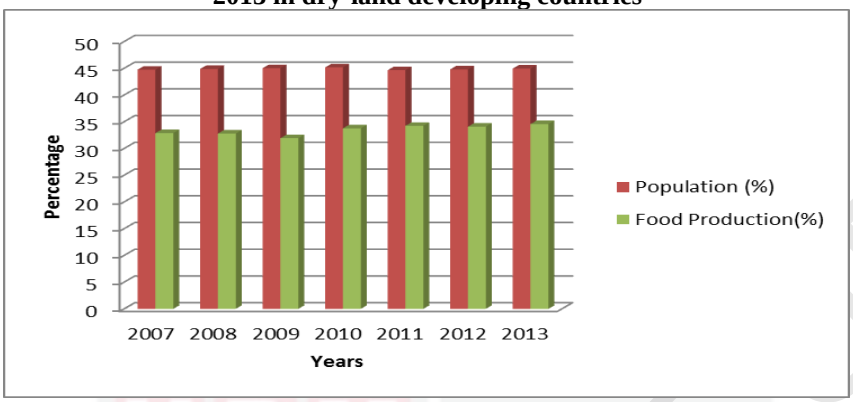
Data Source: FAOSTAT

Figure 1.10: Percentage of food production and population from 2007-2013 in low-income countries



Data Source: FAOSTAT

Figure 1.11: Percentage of food production and population from 2007-2013 in dry-land developing countries



Data Source: FAOSTAT

The Food and Agriculture Organization (FAO) has determined five important input resources for food production – land and irrigation, labor, machinery, fertilizers, and pesticide. The first input resource for food production is known as the land irrigation area. Irrigation plays an important role in increasing food production and sustained food security throughout the world (Mukherji & Facon, 2009). According to Hasnip & Hussein (1999), 40% of total world food crops are produced through irrigation systems, and another 60% is produced through rain-fed agriculture. However, the highest marginal productivity in crop production is through irrigated agriculture, compared to rain-fed agriculture systems.

Moreover, irrigated agriculture has evolved significantly; world arable land equipped for irrigation has increased drastically, from 21.2 per cent in 2000 to 23.2 percent in 2010. Table 1.4 below shows that arable land equipped for irrigation in developing countries increased from 28.3 percent in 2000 to 30.4 percent in 2010. The situation is different for least-developed and dry-land developing countries, where the percentage of the irrigation area has reduced drastically due to the high cost of producing a proper irrigation area.

Table 1.4: Arable Land Equipped for Irrigation

Sub-Groups	Arable Land Equipped for Irrigation		
	2000	2005	2010
World	21.2	22.4	23.2
Developing countries	28.3	29.7	30.4
Least-developed countries	11.7	11.5	10.7
Dry-land developing countries	16.5	15.5	14.7

Data Source: FAOSTAT

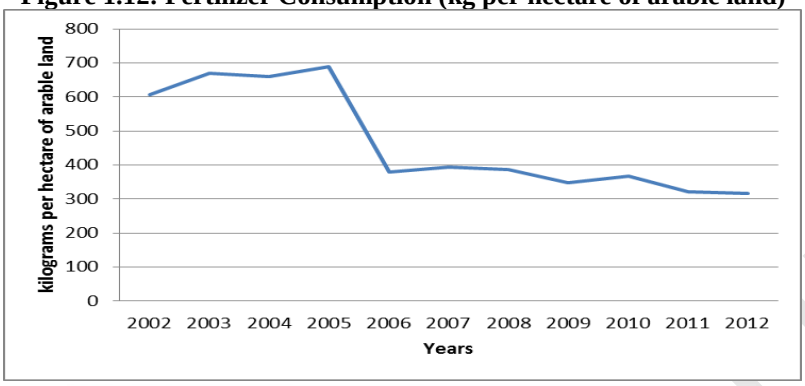
There have been many challenges in the irrigation sector, including a lack of adequate water maintenance and a decrease in technical support (Carruthers et al., 1997). Although certain developing countries have many river basins and irrigation canals, this has not increased the availability of water for irrigation, especially in the agriculture sector. In addition, more countries are facing severe water shortages because of higher costs of agriculture irrigation systems, which raises the food price index accordingly (Nhundu & Mushunje, 2010). This situation is critical for success in the near future. All North African dry-land countries are already facing acute water shortages and are importing half of their grain (UNEP, 2011). Better and improved water management is the only way to improve food production; otherwise, the prospects of increasing food security are remote.

Irrigation undoubtedly contributes significantly to global food security. The World Bank and United Nations Development Programme (UNDP) estimates show that improved irrigation could be extended over an additional 110 million ha in developing countries, producing enough grain for 1,500-2,000 million people where more than half of future increases in crop production are expected to come from irrigated land. There are two types of known irrigation systems, namely large-scale and small-scale irrigation. Most of the dry-land developing countries are engaging in small-scale irrigation systems, as they are more affordable than those of large-scale systems, but are still capable of increasing food production. Water harvesting is one of the small-scale techniques of collecting runoff rain water for irrigation purposes and has significantly improved both the yield and reliability of agricultural production. This method has proved successful in Sudan and Kenya. Additionally, the use of low-lift pumps and treadle pumps also provides other linkages of water distribution from domestic use to irrigation.

Thus, sustainable water management for irrigation is a major key to improving food production and reducing undernourishment, hunger, and famine. Some expansion of irrigation areas and improved efficiency of water supply usage will help these countries achieve food security. Failure to achieve efficiency and sustain irrigation areas could have a negative impact on land resources and accelerate the process of environmental degradation. Irrigation and water development strategies have not been given special attention by previous studies because of the lack of understanding of the link among water scarcity, food production, food security, and environmental sustainability (Carruther, et. al., 1997).

In addition to irrigation systems, fertilizers also have an impact on food production. Fertilizers are combinations of nutrients that are very important in the production of crops and agriculture production. Fertilizers include three important primary elements: nitrogen (N), phosphorus (P), and potassium (K). They also contain secondary nutrients such as sulfur, calcium, and magnesium. Fertilizers sustain the soil by returning essential mineral nutrients and thus sustaining hardier growth. All primary and secondary types of fertilizers are very important and need to be sufficient to increase crop production. Figure 1.12 below illustrates the trend of fertilizer consumption in kilogram per hectare of arable land. Fertilizer consumption measures the quantity of plant nutrients used per unit of arable land. Fertilizer products include nitrogenous, potash, and phosphate fertilizers (including ground rock phosphate). However, traditional nutrients, such as animal and plant manures, are not included. Fertilizer consumption increased from 2002 until 2005 and then decreased drastically in 2005 and 2006. After 2006, the trend was stable until 2012.

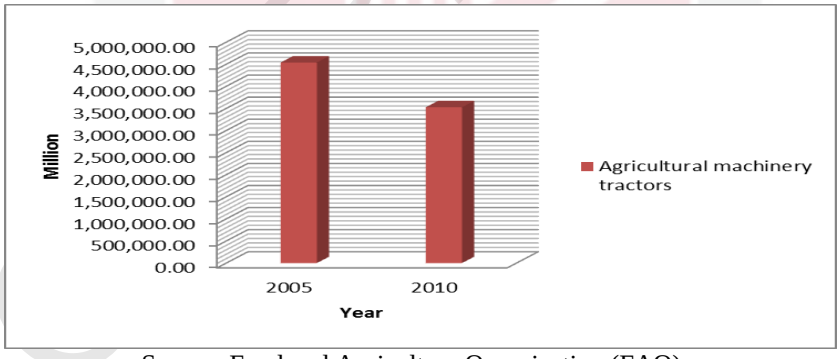
Figure 1.12: Fertilizer Consumption (kg per hectare of arable land)



Data Source: World Bank

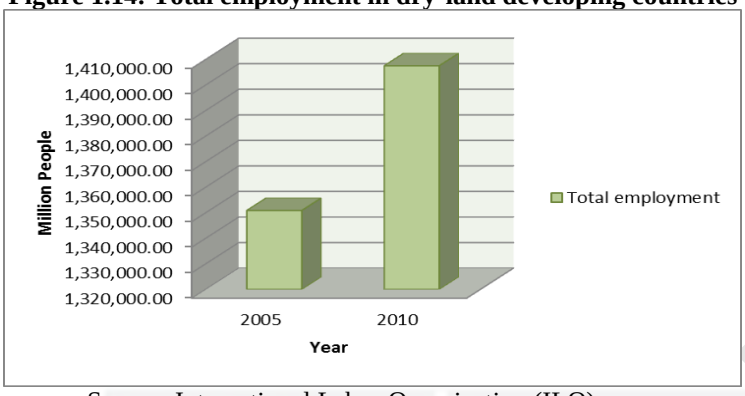
The next resources for food production are labor and machinery. Labor and machinery play a parallel role in food production. Figures 1.13 and 1.14 below show the total number of agriculture machinery tractors and the total population for 2005 and 2010. The total number of tractors used in agriculture decreased from 4.5 million in 2005 to 3.5 million in 2010 due to increasing global oil prices and the global food crisis. The reduction in total tractors, based on figure 1.14 illustrates that the total employment in dry-land developing countries increased from 1.3 million in 2005 to 1.4 million people in 2010. The substitution of humans for machinery was because the cost of labor was cheaper than the cost of maintenance of the machinery.

Figure 1.13: Total agriculture machinery tractors in dry-land developing countries



Source: Food and Agriculture Organization (FAO)

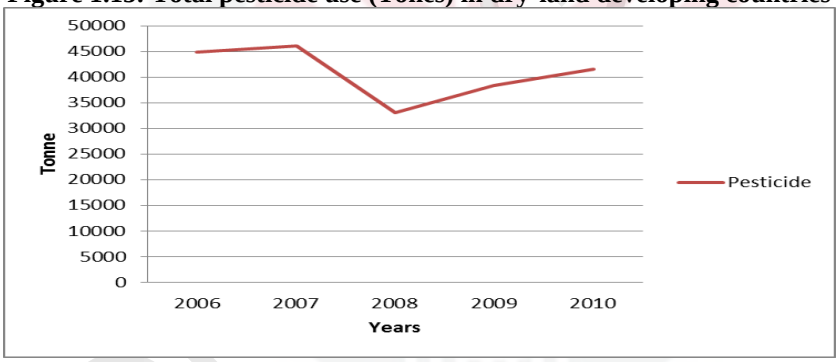
Figure 1.14: Total employment in dry-land developing countries



Source: International Labor Organization (ILO)

The final input for food production is pesticide. Pesticide is a product used to prevent damage caused by pests and is also used as a plant regulator, defoliant, or desiccant. Pests are living organisms that cause damage to crops. Figure 1.15 below shows that the total use of pesticide in dry-land developing countries increased in 2006 and 2007. However, the use of pesticide decreased drastically in 2008 due to the global food crisis that year. After the crisis, the trend increased dramatically until 2010.

Figure 1.15: Total pesticide use (Tones) in dry-land developing countries



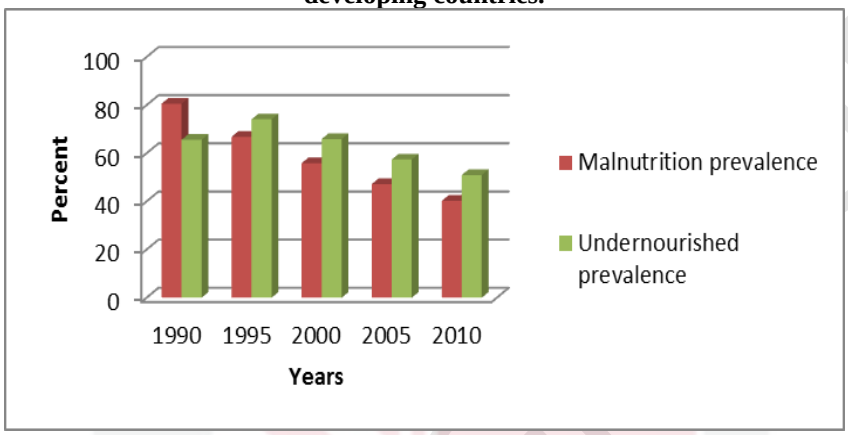
Source: World Development Indicator 2015, World Bank.

Apart from the aforementioned five important inputs, climate change also plays an important role in determining the sufficiency of food production (Fischer & Parry, 2010). Food production depends significantly on specific climatic conditions. Changes in the frequency and severity of droughts and floods presents major challenges to farmers, and extreme weather conditions can cause a reduction in food production. The effects of climate change need to be considered as a factor affecting food production (EPA, 2013).

Insufficiency of food production and the global food crisis have caused dry-land developing countries major problems of malnutrition, hunger, and a lack of proper nutrition. The World Food Programme defines malnutrition as a condition in which those affected have difficulty growing up and are susceptible to disease. Malnutrition also affects people's ability to learn and do physical work. There are two types of malnutrition: first there is protein-energy malnutrition, known as the lack of enough

protein and quality food to provide energy to the body. Second, is micronutrient deficiency of vitamins and minerals. The Food and Agriculture Organization (FAO) has defined undernourishment as the proportion of the population whose dietary energy consumption is less than a pre-determined threshold. The threshold is country specific and is measured in terms of the number of kilocalories.

Figure 1.16: Prevalence of malnutrition and undernourishment in dry-land developing countries.



Source: Food and Agriculture Organization

Figure 1.16 above illustrates the percentage prevalence of malnutrition and undernourishment in developing countries. The percentage prevalence of undernourishment and malnutrition decreased from 1995 until 2010. However, in spite of this decrease, the incidence of undernourishment and malnutrition was still high in 2010 (the prevalence of undernourishment was 50 percent and the prevalence of malnutrition was 39 percent). This shows that the food security problem is still a critical issue and needs to be overcome to achieve food security. The prevalence of undernourishment and malnutrition has declined consistently, but this prevalence is still below the global target. Moreover, Food and Agriculture Organization (2014), has identified that 790.7 million people in developing countries are starving with 226.7 million people is from Africa region, 525.6 million people from Asia Region, 37 million people from Latin America and 1.4 million people from Oceania.

Transitory food security problems, especially food production shortages, have a huge impact on food security in dry-land developing countries. Insufficient food production due to drastic increases in population, and a food crisis resulting from higher food prices have an impact on food shortages and increase the food deficit. This situation causes undernourishment, malnutrition, and hunger.

1.4. Food Security and Economic Growth.

In light of the problem of undernourishment, the United Nations Millennium Campaign has supported the establishment of the Millennium Development Goals (MDG). These MDGs were adopted by world leaders in 2000 and were set to be achieved by 2015. The MDGs have illustrated a framework for the world community to call for the eradication or reduction of world poverty (United Nation, 2014). The framework shows the following eight important goals to be fulfilled by 2015:

a) Eradicate extreme poverty and hunger
b) Achieve universal primary education
c) Promote gender equality and empower women
d) Reduce child mortality
e) Improve maternal health
f) Combat HIV/AIDS, malaria, and other diseases
g) Ensure environmental sustainability
h) Develop a global partnership for development

Therefore, the World Food Summit plays an important role in aiming to reduce half of the world's undernourished people by 2015. Some developing countries have already met the goals of MDG1. For example, Congo, Ghana, Mali, and Nigeria have already met the goals. Food Security is crucial to enhance economic growth through the Millennium Development Goals (MDGs) (United Nations, 2014). Establishing food security in developing countries will achieve the first of MDG's goals, which is to eliminate or reduce half the number of people suffering from hunger problems. The reduction of hunger will increase total productive employment and reduce poverty. Achieving food security will increase school attendance and learning capacity (MDG2), increase employment and education for women (MDG3), provide better immune systems among children, and reduce child mortality (MDG4). It will also improve maternal and infant health (MDG5), and reduce the incidence of HIV/AIDs, malaria, and other diseases (MDG6), enable the sustainable use of natural resources (MDG7), and increase the capacity to access the market and resources (MDG8). Improvement in the first and second MDGs will increase productive employment. Next, expansion of the third fourth and fifth MDGs will increase life expectance. Finally, MDGs seven and eight will sustain food production. All the MDGs' goals will enhance economic growth, especially in developing countries. Generally, the MDGs have achieved significant successes in reaching their targets, as shown below:

i) Poverty has been reduced in many countries. Despite the food and energy crisis in 2008-2009, all countries were still on track to achieve poverty reduction by 2015. Generally, poverty has been reduced below 15%, and it is still below the MDGs target, which is more than 23%. In addition, Malaysia has reduced the proportion of its population to below US$1 (PPP) per day, and reduced the poverty rate from 17% in 1990 to 4% in 2009. The worldwide reduction of poverty has had a positive impact on Eastern Asian growth, especially in China.

ii) A dramatic increase in the education sector has occurred in the poorest countries, including Burundi, Madagascar, Rwanda, Samoa,

Sao Tome and Principe, Togo, and the United Republic of Tanzania. In addition, Benin, Bhutan, Burkina Faso, Ethiopia, and Mozambique came close to reaching the target of increasing the net enrollment ratios in primary school to more than 25% from 1999 to 2009.

iii) Improvements in immunization coverage have reduced the number of deaths of children under the age of five worldwide, from 12.4 million in 1990 to 8.1 million in 2009.

iv) There has been an increase in investment in health in terms of preventing and treating HIV, which has resulted in the reduction of new HIV infection, principally in Sub-Saharan Africa. In 2009, 5.25 million people in low- and middle-income countries received antiretroviral therapy for HIV, resulting in a 19% decline of AIDS-related deaths during the same period. Besides that, malaria intervention programs have prevented the deaths of 3.3 million people from malaria and tuberculosis.

v) Access to clean water has improved in every region. An estimated 2.3 billion people gained access to improved drinking water sources over the period 1990-2010.

Achievement of food security will increase economic growth through eight important millennium development goals. Generally, the first three goals, which have aimed to eradicate extreme poverty and hunger, achieve universal primary education, promote gender equality, and empower women, have played an important role in producing productive labor, increasing productivity, and enhancing economic growth. Moreover, the next three goals will help increase life expectancy as the countries reduce child mortality, improve maternal health, and combat HIV/AIDS, malaria, and other diseases. As the countries continue to sustain the environment, it will help strengthen their agriculture sectors and will help farmers gain higher income and sustain economic growth. Finally, when these developing countries have global partnerships for development, it will help them increase their trade and foreign direct investment. This will help the countries boost economic growth.

1.5. Problem Statement

The problem of food security is a critical issue that has received serious attention in terms of the prevention of malnutrition, hunger, and famine, especially in dry-land developing countries. This food security problem is caused by transitory food deficit, which occurs when there is a sudden drop in the ability to produce or access enough food to maintain a good nutritional status. Transitory food deficit is a short-term shock in which there is a fluctuation in food availability caused by an insufficiency of food production and a food price crisis. Generally, domestic food production depends on the adequacy of irrigated land. Adequacy of irrigated land will benefit all farmers by helping them increase their food production. Dabour (2002) highlighted the importance of irrigated areas for sustained increases in food production. Others elements that

influence agricultural food production are climate change (Douglas, 2009) and fertilizer usage (Tilman et al., 2002); an increase in the growth of fertilized land will sustain agriculture growth and lead to an increase in agriculture yields. However, overuse of organic fertilizer will have a negative impact on the environment (Larson & Frisvold, 1996). Finally, labor and machinery play an important role in increasing sufficiency in food production. Together, all these factors have a role to play in the sufficiency/insufficiency of food production due to the characteristics of dry-land developing areas. Moreover, insufficiency in food production and food price crises have resulted in malnourishment, malnutrition, hunger, and the food security problem in all dry-land developing countries.

In order to overcome the food security problem in dry-land developing countries, the United States Agency for International Development has introduced three important variables needed to measure the achievement of food security. These variables are: availability, accessibility, and utilization (USAID, 1992). Food availability is the adequate quantity of food supplies made available through food production, food imports, and food aid. This is followed by food accessibility, which provides an easier way for people to access adequate food for a nutritious diet. Finally, food utilization is achieved through adequate clean water, better sanitation services, and good health care through the provision of nutritional food. Sanitary and phytosanitary measures are important in order to achieve food safety and food security (WTO, 1995). Limited research has been conducted to determine these three variables that influence food security. Besides these variables, food stability also plays an important role in achieving food security, especially in dry-land developing countries (FAO, 2014b). The State of Food Insecurity in the World 2014 has mentioned that there are two types of stability in food security. The first is food security risk, which includes the area to be irrigated, and secondly is food security shock, which includes food prices (FAO, 2014b).

Finally, food security is very important to ensure enhanced economic growth (Arcand, 2001). 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 needs for a productive and healthy life (USAID, 1992). Food security has an impact on economic growth through the achievement of the MDGs (United Nations, 2014). However, the United Nations Development Programme (UNDP) faces many challenges in achieving several of the MDGs for dry-land developing countries. The first challenge is to eliminate or reduce the number of people suffering from hunger and poverty by half. But in dry-land developing countries poverty is a persistent problem caused by several factors, including poor infrastructure and lack of investment. This problem is compounded by the vulnerability of people to frequent droughts, aridity, and climate change. Besides poverty, hunger is also a common problem in dry-land countries where crop production shortages occur due to droughts. The next challenge is to reduce the mortality rate of children under five by two thirds. In dry-land areas few proper health facilities exist, which means too many children die of preventable causes and too many women die in childbirth. Besides that, dry-land areas have also faced the challenge of achieving the sixth MDG goal, which is to stop the spread of HIV/AIDS. HIV/AIDS reduces the ability of people to farm and negatively impacts food production. All these problems exacerbate the poverty problem, reduce life expectancy, reduce total labor employment, and decrease economic growth in dry-land areas.

1.6. Research Questions

There are several research questions that may arise from the issues that have been discussed in the research problems subsection. These questions are as follows:

i. Do climate change, land irrigation, and fertilizer usage have an impact on domestic food production in dry-land developing countries?
ii. Do food availability, food accessibility, and utilization have an impact on the achievement of food security in dry-land developing countries?
iii. Does food stability influence food security in dry-land developing countries?
iv. Does food security have a direct impact on economic growth; or does food security have an impact on economic growth through poverty, life expectancy, and total employment in dry-land developing countries?

1.7. Objective of the study

The general objective of this study is to examine the effects of food security on economic growth in dry-land developing countries. The study's specific objectives are as follows:

i. To examine the impact of food input resources on food production in dry-land developing countries.
ii. To investigate the role of the food security dimension on food security in dry-land developing countries.
iii. To examine the impact of food security on economic growth directly and through the channels of poverty, totals employment, and life expectancy.

1.8. Significance of the study

The significance of this research is in showing that food security is very important to ensure increased economic growth, reduced malnutrition, and increased labor productivity. In addition, food security can help certain countries grow their own food and meet their own needs, increase their domestic food production, reduce their dependency on food imports and food aid, reduce poverty and malnourishment, and increase economic growth. There has been a lack of research empirically measuring the link between food security and economic growth at the macro level, compared to the micro level. Although several studies have been conducted to measure food security at the micro level, these studies have focused only on one type of commodity in single countries, especially in Asian countries. However, few empirical studies have been conducted on the types of food commodities at the national and regional levels, especially in dry-land developing countries. Improved food security at the national level is very important for all countries, especially dry-land developing countries.

Previous research has examined the impact of food security constraints on food security improvements, but there are lack of studies that measure the impact of the four dimensions of food security – availability, accessibility, utilization, and stability, which are necessary to achieve food security, especially in dry-developing countries. United States Agency International Development (USAID) has states that food availability, accessibility and utilization are important indicators for food security achievement (USAID, 1992). Additional, Food and Agriculture Organization (FAO) also added food stability as one of the important variable for food security achievement (FAO, 2008). Finally, this study will help policy makers determine whether countries are dependent on food availability, accessibility, utilization and stability as a whole or depend only on two of the three factors for improving their food security in the whole world, especially in dry-land developing countries.

1.9. Organization of the study

This study will be organized into three chapters: the first chapter has discussed the background of the study, issues that arise related to the topic of this study, the objectives and research question, followed by the study's significance. The next chapter is related to previous studies. Chapter 2 will be divided into two sections, theoretical and empirical reviews. These reviews are based on issues discussed in Chapter 1. Chapter 3 will define the research methodology to be used for the empirical analysis. This chapter will start with the model specification, which is based on the objective of the study, followed by the research methodology, which comprises the static and dynamic model, to examine the empirical analysis. This chapter will also include a description of the various types of data and their different sources and unit measurements. Chapter 4 presents the empirical results of the analysis and interpretation of the results. Finally, Chapter 5 concludes the study, and provides policy implications and recommendations.

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