Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 5 Issue 21 (December 2020) PP. 200-211
DOI 10/35631/JTHEM.5210012

JOURNAL OF TOURISM, HOSPITALITY AND ENVIRONMENT MANAGEMENT (JTHEM)
www.jthem.com

THE LINKAGES BETWEEN AGRICULTURAL INPUT AND FOOD PRODUCTION IN LEAST DEVELOPING COUNTRIES

Nur Marina Abdul Manap[1*]

[1] Department of Economics, Finance and Banking (SEFB), Universiti Utara Malaysia, Malaysia
Email: nurmarina@uum.edu.my
[*] Corresponding Author

Article Info:

Article history:
Received date: 01.11.2020
Revised date: 15.11.2020
Accepted date: 03.12.2020
Published date: 10.12.2020

To cite this document:

Manap, N. M. A. (2020). The Linkages Between Agricultural Input and Food Production in Least Developing Countries. Journal of Tourism, Hospitality and Environment Management, 5 (21), 200-211.

DOI: 10.35631/JTHEM.5210012.

Abstract:

Food is among the basic human needs for social development. Sufficiency of food depends not only on domestic food production but also on food imports and food aid. However, all countries need to increase their food production to fulfil domestic sufficiency so they will not be too dependent on food imports and food aid. This paper examines the linkages between agriculture input and food production in the least developing countries. The data sets of the variables in this paper were obtained from FAOSTAT and the variables were considered throughout the analysis were food production index, fertilizers consumption, land irrigation, gross fixed capital formation, and employment in the agriculture sector. The static panel data was adopted using fixed effect and the findings of this study showed that fertilizer, land irrigation, and capital formation in the agriculture sector positively significantly give an impact to food production in the least developing countries. In accordance with the objectives of this study, land irrigation provides a huge impact on food production. The governments, in partnership with public and private institutions, need to work toward defining and implementing comprehensive strategies for irrigation development

Keywords:

Food Production, Fertilizer, Land Irrigation

Introduction

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. The Food and Agriculture Organization (FAO) has determined four important input resources for food production – land and irrigation, labour, Capital, and fertilizers. 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

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 5 Issue 21 (December 2020) PP. 200-211
DOI 10/35631/JTHEM.5210012

& Facon, 2009). According to Hasnip & Hussein (1999), 40% of total world food crops are produced through small scale irrigation systems such as lift irrigation system by using pump supply system, where the water is pump from open water and ground water. Another 60% is produced through rain-fed agriculture. Rain-fed agriculture produces much of the food consumed globally and by poor communities especially in least developing countries. However, the highest marginal productivity in crop production is through irrigated agriculture, compared to rain-fed agriculture systems. This statement is supported by NMA Manap & NW Ismail (2017) where according to these authors, land irrigation give a significant positive impact on food production.

Moreover, irrigated agriculture has evolved significantly, where according to figure 1.1 below shows that arable land equipped for irrigation in least developing countries increased from 19,032 thousand hectares in 2010 to 19, 724 thousand hectares in 2016. 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 least 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 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 least 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 least 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). According to figure 1, its shows an increasing trend for irrigation system for least developing countries. This figure shows that irrigation system is very important to improve food production in least developing countries.

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 5 Issue 21 (December 2020) PP. 200-211
DOI 10/35631/JTHEM.5210012

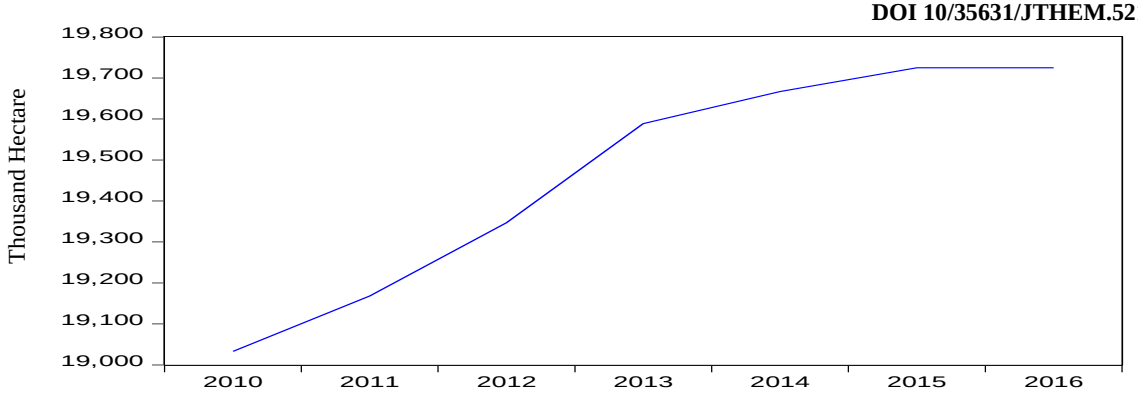

Figure 1: Irrigation System Trend (2010 – 2016)

Source: Food and Agriculture Organization Statistic (FAOSTAT)

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 sulphur, 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 2 below illustrates the trend of fertilizer consumption in nutrients used for agriculture used where Fertilizer consumption (nutrients) increased from 2010 until 2016. These fertilizer products include nitrogenous, potash, and phosphate fertilizers (including ground rock phosphate). However, traditional nutrients, such as animal and plant manures, are not included.

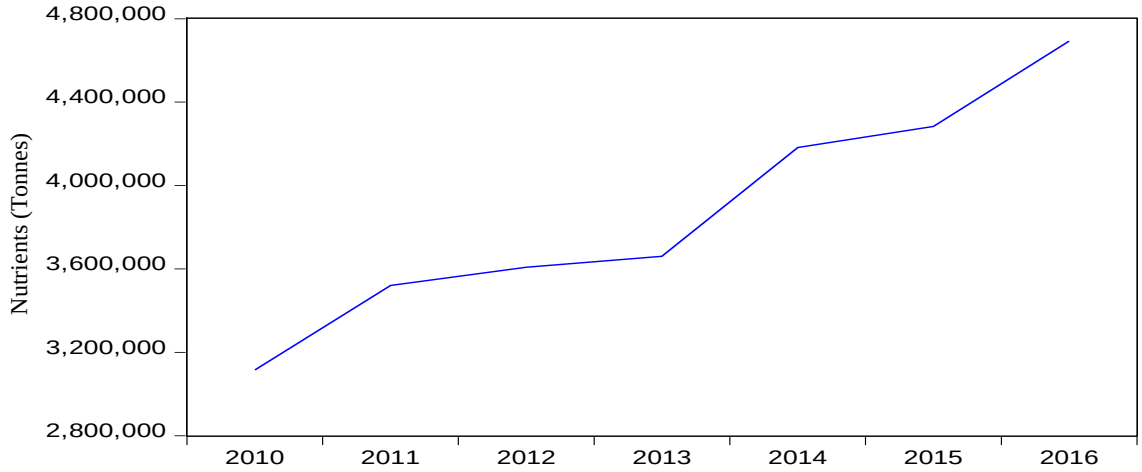

Figure 2: Trend of Fertilizer Consumption (2010 – 2016)

Source: Food and Agriculture Organization Statistic (FAOSTAT)

The next resources for food production are labour and capital formation. Labour and capital play an important role in food production. However, according to figure 3, labour in agriculture sector shows a decreasing trend from 2010 until 2016 its shows a declining trend on average at nearly 1 per cent per year, as a share of total employment, the proportional rate of decline has generally been fastest in least develop countries where the level of agricultural employment is high.

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 5 Issue 21 (December 2020) PP. 200-211
DOI 10/35631/JTHEM.5210012

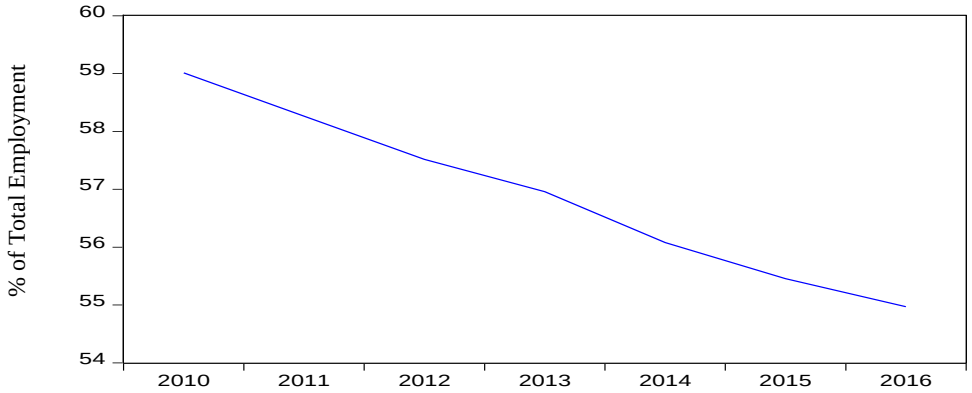

Figure 3: Trend of Employment in Agriculture Sector (2010 – 2016)

Source: Food and Agriculture Organization Statistic

Moreover, Least Develop Countries recorded a remarkable growth in Food Production Index for the period of 2010 until 2016 and this growth is parallel with the growth of capital formation in agriculture sector where this input has increase drastically from US$207,315 in 2010 to US$302,121 million in 2018.

Insufficiency of food production and the global food crisis have caused least 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. The population in least-developed countries has increased more than 10 percent. Although food production has increased, it is not enough to fulfil all the populations' needs. Insufficient food production will cause an undernourishment problem, increase the food deficit and will cause a food security problem. Figure 4 below shows the prevalence of Undernourished for least develop countries for year 2010 until 2018.

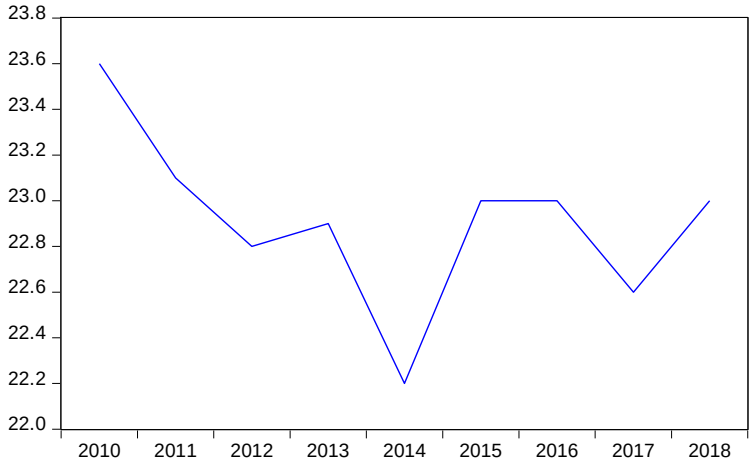

Figure 4: The Plots of Prevalence of Undernourished in Least Develop Countries

Source: Food and Agriculture Organization Statistic (FAOSTAT)

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 5 Issue 21 (December 2020) PP. 200-211
DOI 10/35631/JTHEM.5210012

Figure 4 above illustrates the percentage prevalence of undernourishment in least developing countries. The percentage prevalence of undernourishment decreased from 2010 until 2012. increase in 2013. The prevalence of Undernourished has spike in 2015 and 2018 which is increase to 23 per cent. This shows that the food security problem is still a critical issue and needs to be overcome to achieve food security. The objective of this paper is to examine the linkages between agricultural input and food production in Least Developing Countries.

Literature Review

Generally, several studies have been conducted to determine the link between food sufficiency and food security. Sufficiency of food depends not only on domestic food production but also on food imports and food aid. However, all countries need to increase their food production to fulfil domestic sufficiency so they will not be too dependent on food imports and food aid. The Neoclassical Production Theory has identified five important factors that impact food production: raw materials, machinery, employment, capital goods, and land. However, this study focuses only on land factors, and these factors are divided into two important elements: irrigation land and fertilizer

Generally, domestic food production depends on adequate irrigated land and water. The efficiency of irrigated land will benefit all farmers and increase their food production and hence food supply, reduce hunger, and achieve food security (Dabour, 2002). Moreover, Dowgert et al. (2006) have listed several benefits of irrigation systems in domestic food production, stating that an efficient irrigation system will minimize drought-induced crop failure and famine, which have an indirect positive impact on the environment. In addition, this system will increase nitrogen fertilizer utilization, reduce nitrous oxide emission, increase the value of agricultural land, increase domestic production, and result in crop yield stabilization. Efficient irrigation technology is very important to increase food production, achieve food sufficiency, prevent hunger, and stimulate economic growth (Oriola, 2009). According to Smilovic et al., (2015), irrigation with groundwater is more efficient compare surface water irrigation system because irrigating with groundwater often allows for both the tailoring of volumes of water and timing of application as compared to irrigating with surface water, and accordingly groundwater irrigation often results in higher grain production.

Besides that, climate change has a significant impact on the availability of water and irrigation (Mu & Khan, 2009). These authors have stated that if China were to address the climate change problem in terms of irrigation, it would increase its total grain production from 400 million tons in 2000 to 521 million tons in 2030. Making China's irrigation systems more efficient would directly increase food production and food security in that country.

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 other forms of agriculture production. Fertilizers include three important primary elements: nitrogen (N), phosphorus (P), and potassium (K). Fertilizers also contain secondary nutrients such as sulphur, calcium, and magnesium. Fertilizers sustain the soil by returning essential mineral nutrients and thus ensuring hardier growth. All primary and secondary types of fertilizers are very important and need to be sufficient to increase crop production.

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 5 Issue 21 (December 2020) PP. 200-211
DOI 10/35631/JTHEM.5210012

Additionally, increases in food productivity and crop yields are based on two types of fertilizer categories: natural fertilizers and chemical fertilizers (Kueh, 1984). The main issue that has arisen is whether substitution of natural fertilizes for chemical fertilizers is important in order to increase food production and whether a combination of both kinds of fertilizers has a huge benefit on Chinese food grain production. The author has found that the overall supply of natural fertilizers has grown at a slower rate than chemical fertilizers, because natural fertilizers will increase nitrogen use and cause shortages in phosphorus and potassium, and the ineffectiveness of natural fertilizers in some areas in China will occur. This is in contrast to the performance of chemical fertilizers, which have benefitted agricultural output consistently, and aggregate average and marginal rates of yield returns in China are estimated to remain high in the future.

However, some authors have argued that natural fertilizers or nitrogen fertilizers (N) are very important in that they supply sufficient food energy and protein to the current global population (Dawson & Hilton, 2011). The main purpose of this issue is to examine the potential causes of increasing nitrogenous fertilizers and increasing food production to feed the global population. Global food security achievements are based on sufficient and efficient strategies to supply nitrogen fertilizers for future production. In addition, the quantity of N that is required for food production in the future also depends on the global population and the extent to which reactive N can be recycled and losses minimized. Improving fertilizers used will increase agriculture growth, improve human welfare, and raise economic development, especially in Sub-Saharan Africa (Larson & Frisvold, 1996). Sub-Saharan Africa faces a great food deficit and large-scale food insecurity. To overcome these problems, the agricultural sector needs to increase its crop production by 4%. An increase in fertilizer use is an important factor in sustaining agriculture growth and will increase crop yields. The average fertilizer application rates in Sub-Saharan Africa must match the fertilizer use rates found in Kenya and South Asia, which are about 18% of the annual growth rate, to prevent loss of soil nutrients. The main strategy in fertilizer use in Sub-Saharan Africa is to increase the availability of fertilizers, which will result in lower prices of fertilizer, increase demand, and solve problems related to fertilizer subsidies.

Previous studies show that fertilizers play an important role in increasing crop production and crop yields. However, Diwan & Kallianpur (1985) found that fertilizers have less impact on food grain production in India. Their research included the development of Biological Technical Change (BTC), using fertilizers as a proxy and adopting land-labour substitution to measure biological technology and land productivity in terms of fertilizers and food production in India. Countries' governments and international agencies can play a role in increasing the use of fertilizers. For example, the Indian Government has made a large investment in irrigation and fertilizers, which has resulted in an increase of about 2.5 million hectares under irrigation, so fertilizer consumption will increase about 12%.

These ideas are supported by Ladha et al., (2005), who carried out a study on the efficiency of nitrogen fertilizers in cereal production, providing both retrospective data and prospects for the future. Based on their study, 50% of the world's food production relies on nitrogen fertilizers totalling around 83 million metric tons. Sixty percent of global nitrogen fertilizers are used to produce three major crops – rice, wheat, and maize. In addition, efficiency and improvements in nitrogen fertilizer usage is very important in order to increase cereal grain production by about 50% to 70% to feed 9.3 billion people globally by 2050. The challenge with regard to fertilizer use is improving farmers' knowledge about fertilizer use and ensuring the techniques

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 5 Issue 21 (December 2020) PP. 200-211
DOI 10/35631/JTHEM.5210012
used are cost-effective and user-friendly. Prasad (2015) also agree with previous author where nitrogen fertilizers has play an important role to increase crop yields and contribution to reducing environmental pollution and health hazards.

Finally, machine and employment play important roles in food production based on the neo-classical production theory. Fishelson (1974) has mentioned that capital and employment substitute for each other, and that the elasticity of substitution between employment and capital is smaller than unity. The efficiency of employment has risen more than capital, which shows that employment can substitute highly for capital. This shows that increasing employment efficiency will increase agriculture production. These issues are supported by Dorward (2013), who has suggested that agriculture employment productivity is very important in the development of agriculture. An improvement in agriculture employment productivity will increase agriculture production, increase food availability, increase incomes, and increase food expenses. Besides that, higher employment productivity in agriculture will release agriculture employment from food production to the production of other goods and services. Moreover, in low-income countries, increases in employment productivity in the agriculture sector result in productivity increases in these countries.

Besides employment productivity, machinery is an agricultural production or also known as capital input based on production theory. Agricultural machines are designed for use in agriculture production. These machines are used for soil management, seeding, fertilizing, and harvesting (Nemecek & Kagi, 2007). Nemecek & Kagi (2007) have classified agriculture machinery into six classes: tractors, harvesters, trailers, agriculture machinery (general), agriculture machinery (tillage), and slurry tankers. Additionally, crop production involves several machinery operations, crop management, input costs, and other factors to increase productivity. An optimal combination between crops and machinery will sustain farming systems. To enhance productivity, Yousif et al. (2013) have developed a computer system using Excel-Visual basic software for farm management to estimate machinery and farm costs and also net returns from crops grown under different farming systems.

Methodology

This paper will employ a static panel data which are also known as longitudinal or cross-sectional time series data, is the dataset in terms of the behaviour of entities such as countries, regions, companies, and firms observed over time. There are benefits to using panel data estimation because panel data can control all variables that cannot be observed, such as cultural factors; furthermore, this method will control variables that change over time but not across countries or regions. This paper using a fixed-effects model because this model is suitable if unobserved individual characteristics are assumed to be correlated with the error term. Fixed-effects (FE) models are used to analyze the impact of fluctuating variables over time. Besides that, fixed-effects models are used to determine the relationship between predictor and outcome variables within a country. Each country has its own characteristics that may or may not influence predictor variables. Besides that, this method can also add time effects to the country-effects model to have a time- and country-effects regression model. In a fixed- effects model, time invariance cannot be included because the values will be equal to zero for all time periods. Based on a 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 of the fixed-effects models not to be biased because these models have omitted

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 5 Issue 21 (December 2020) PP. 200-211
DOI 10/35631/JTHEM.5210012

time-invariant characteristics. An alternative way to substitute a fixed-effects model, is by using a random effects model. The difference between fixed effects and random effects is whether the unobserved individual effect represents the elements that have correlated with the regressors in the model, and it does not matter whether either of these effects are stochastic or not. The random effects model is the most suitable model if the error term or the differences across countries are linked with the dependent variable. Time-invariant variables can be included in this random effects model. Lastly, to identify whether the fixed-effects model or random-effects model is more suitable for this study, we needed to run a Hausmen test.

Data Description

Next, to fulfilled this paper objectives, the data sets of the selected variables in this article were obtained from the Food and Agriculture Organization Corporate Statistical Database (FAOSTAT). Five variables were considered throughout the analysis where Food Production Index are used as a dependent variable and explanatory variables include Fertilizers consumption in nutrients, Land equipped with irrigation, gross fixed capital formation and employment in agriculture sector. The analysis of data covered from 2010 until 2016 in 47 Least Developing Countries. Table 1 illustrate the source of data and variables description.

Table 1: Detail of Variables

Variable Name	Abbreviation	Unit of Measurement	Source
Food Production Index	fpi	Gross Production Number (2004 - 2006 = 100)	FAOSTAT
Fertilizers by Nutrient (NPK)	fert	Total Nutrients (tons)	FAOSTAT
Land area equipped for irrigation	il	Thousand Hectare	FAOSTAT
Capital Formation	cf	Value US$, 2010 prices	FAOSTAT
Employment in agriculture	lb	(% of total employment)	FAOSTAT

Model Specification

Food production is one of the food availability components that play an important role in improving food security at national level (USAID, 1992). To feed the populations of developing countries, food production needs to increase by about 40 percent by 2030, according to an FAO (2006) analysis. Model specifications are based on the theoretical production model adopted from Yuan (2011) and Stern (2006). The model is illustrated below as:

$$\ln y_t = \alpha_0 + \beta_1 \ln fert_t + \beta_2 \ln il_t + \beta_3 \ln cf_t + \beta_4 \ln lb_t + \mu_r + \tau_t + \varepsilon_{it} \quad \ldots \quad (1)$$

Where Y_t is Food Production Index (FPI) in year t, fertilizer (fert), irrigation land (il), Capital formation (cf), employment (lb), regions unobserved fixed effects (μ_r), time-specific unobserved fixed effects (τ_t), and error term (ε_{it})

This paper highlights two factors that impact food production: land irrigation (Carruthers et al.,1997), and fertilizer use (Borlaug, 2008). The control variables are capital formation which, based on the World Bank, is a proxy for input agriculture indicator. The last control variable is rural manpower (Mr), which, based on the Food and Agriculture Organization (FAO), is a

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 5 Issue 21 (December 2020) PP. 200-211
DOI 10/35631/JTHEM.5210012

proxy for percent of employment in the agriculture sector. All these two control variables are based on Yuan's (2011) approaches.

Result and Discussion

The descriptive analysis shows mean, standard division, minimum and maximum of the study variables. Table 2 provides the descriptive and correlation analysis where the mean results show that fertilizers generate a high value of 9.8154. Besides that, the standard deviation analysis for fertilizers also show this variable is the most explosive variable with the highest deviation of 2.28 followed by Land equipped with irrigation (il). According to correlation analysis, its illustrate that fertilizer, land equipped with irrigation, capital formation has positive relationship with food security. However, employment in agriculture sector show negative relationship with food production.

Table 2: Descriptive and Correlation Analysis

Variables	fpi	fert	il	cf	lb
Mean	4.8532	9.8154	4.0115	4.3707	3.9402
Std. Dev.	0.2127	2.2849	2.2634	1.9057	0. 4029
Minimum	4.0992	2.3786	-2.0402	-1.0621	2.2083
Maximum	5.3562	14.6535	8.6125	7.6599	4.5230
Observation	324	201	293	322	315
Correlation					
fpi	1.0000				
fert	0.4118	1.0000			
il	0.3189	0.6809	1.0000		
cf	0.3535	0.7596	0.6635	1.0000	
lb	-0.0705	-0.1623	-0.0965	-0.0473	1.0000

Next, static panel data analysis presented in Table 3 shows the impact of fertilizer consumption, land irrigation, capital formation and employment in agriculture sector on food production in Least Developing Countries. This analysis has employed fixed effect model to determine the linkages between agricultural input and food production based on hausman fixed test whose results illustrate that it is significant at the 1 per cent level. Based on this result, the fixed effect model is the preferred model.

Table 3: The Linkages Between Agricultural Input Change and Food Production

Food Production	Fixed Effect Model
Fertilizers	0.0169***
Land Area Equipped for irrigation	0.8036***
Capital Formation in Agriculture	0.0406**
Employment in agriculture sector	-0.0640
Intercept	1.0645
Observation	196
R-Square	0.1072

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 5 Issue 21 (December 2020) PP. 200-211
DOI 10/35631/JTHEM.5210012

F-Test	39.41***
Vif	2.14
Breusch& Pagan Lagrangian Multiplier	398.72***
Hausman Fixed Test	13.44***

*, **, ***significant at 10%, 5%, 1%, respectively

According to the fixed effects analysis above, fertilizer gives a significant impact on food production in least developing countries. The result is in line with the theory, which asserts that fertilizer is very important to increase food production (Borlaug, 2008). This study found that fertilizer consumption is very significant and does contribute to increase food production where 1 percent increase in fertilizer consumption with better nutrients will increase food production 1.69 percent. The next variable is land irrigation, where this variable also plays a very crucial role in increasing agriculture production (FAO, 2002). Based on fixed effects analysis above, which shows that the increase of 1 percent in total area equipped for irrigation will increase food production by almost 80.36 percent. Irrigation systems help poor and smallholder farmers to increase their yields from crop production. The productivity of crop production is significantly higher in irrigated areas compared to the same crop production under non-irrigated areas (Hussain & Hanjra, 2004). Additionally, this research has adopted two important control variables, capital formation in agriculture sector and employment in agriculture sector. The results of a fixed-effects analysis show that capital formation in agriculture sector have positively significant give an impact on the food production while employment in agriculture sector are not significant give an impact on the food production in least developing countries. The insignificant impact between employment in agriculture sector and food production is caused by several factors such as working – age challenge, migration from rural to urban area, inequality in term of wage and decent employment issues (FAO, 2012).

Conclusion

Food is very important for social development with sufficient nutrition to produce energy and to protect human bodies from infection and disease. Recently, food security has been recognized as one of the most important global issues. Mainly, the objective of this study is to examine the linkages between food production and agriculture input. This study has proved that there is a positive linkage between agriculture input in term of fertilizer, land irrigation and capital formation in agriculture sector with food production in least developing countries. However, employment in agriculture sector are not significant give an impact on food production, where employment in agriculture sector are not having any linkages to increase food production in Least Developing Countries.

Policy Implication

In accordance with the objectives of this study and the result of this paper shows that land irrigation provides a huge impact on food production is these Least Developing Countries, the governments, in partnership with public and private institutions, need to work toward defining and implementing comprehensive strategies for irrigation development. There are four important strategies that should be implemented to increase land irrigation areas to boost food production in these countries. The first strategy is to increase the national budgetary allocations for irrigation infrastructure development, and the next is to develop a legal framework to ensure the land rights of farmers, which will motivate farmers to invest in irrigation. Crop

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 5 Issue 21 (December 2020) PP. 200-211
DOI 10/35631/JTHEM.5210012

diversification will enhance farmers' incomes and viability levels and promote cost recovery from users, which will be adequate to cover the operation and maintenance costs; this is the third strategy. Finally, capacity-building programs should be developed to strengthen, support, and enlighten farmers and encourage farmer participation in irrigation development (Nhundu & Mushunje, 2010).

Recommendation for Future Research

In line with the Sustainable Development Goals (SDG) indicator which is to ensure access to affordable, reliable, sustainable and modern energy to all, so the recommendation for future research need to add clean energy as one of the indicators that need to measure the examine the impact of clean energy to food production in Least Developing Countries.

References

Borlaug, N. (2008). *Fertilizer's Role in World Food Production*.

Carruthers, I A N;, Rosegrant, M. W., & Seckler, D. (1997). Irrigation and food security in the 21st century. *Irrigation and Drainage Systems*, *11*, 83–101.

Carruthers, I A N, Rosegrant, M. W., & Seckler, D. (1997). Irrigation and food security in the 21st century. *Irrigation and Drainage Systems*, 83–101.

Dabour, N. M. (2002). The role of irrigation in food production and agriculture development in the near East Region. *Journal of Economic Cooperation*, *3*, 31–70.

Dawson, C. J., & Hilton, J. (2011). Fertiliser availability in a resource-limited world: Production and recycling of nitrogen and phosphorus. *Food Policy*, *36*, S14–S22.

Diwan, R., & Kallianpur, R. (1985). Biological Technology and Land Productivity : Fertilizers and Food Production in India. *World Development*, *13*(5), 627–638.

Dorward, A. (2013). Agricultural labour productivity, food prices and sustainable development impacts and indicators. *Food Policy*, *39*, 40–50.

Dowgert, M., Marsh, B., Hutmacher, R., Thompson, T. L., Hannaford, D., Phene, J., Anshutz, J., & Phene, C. (2006). *Low Pressure Systems Reduce Agricultural Inputs*.

FAO. (2002). *Crops and Drops: Making the Best Use of Water for Agriculture*.

FAO. (2012). Decent rural employment for food security: A case for action. In *Gender, Equity and Rural Employment Division Economic and Social Development Department*.

Fishelson, G. (1974). Relative shares of labor and capital in agriculture: a subarid area, Israel, 1952-1969. *Rev. Econ. Stats.*, *56*(3), 378–386.

Hasnip, N., & Hussein, K. (1999). *Poverty reduction and irrigated agriculture* (Issue 1).

Hussain, I., & Hanjra, M. A. (2004). Irrigation and poverty alleviation: Review of the empirical evidence. *Irrigation and Drainage*, *15*(October 2003), 1–15.

Kueh, Y. Y. (1984). Fertilizer supplies and foodgrain production in China. *Food Policy*.

Ladha, J. K., Pathak, H., Krupnik, T. J., Six, J., & Kessel, C. Van. (2005). Efficiency of fertilizer nitrogen in cereal production: Retrospects and prospects. *Advances in Agronomy*, *87*(05).

Larson, B. A., & Frisvold, G. B. (1996). Fertilizers to support agricultural development in sub-Saharan Africa : what is needed and why. *Food Policy*, *21*(6), 509–525.

Mu, J., & Khan, S. (2009). The effect of climate change on the water and food nexus in China. *Food Security*, *1*(4), 413–430.

Mukherji, A., & Facon, T. (2009). *Revitalizing Asia's irrigation: to sustainable meet tomorrow's food needs.*

Nemecek, T., & Kagi, T. (2007). Life cycle inventories of Agricultural Production Systems, ecoinvent report No. 15. *Final Report 15*, 1–360.

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 5 Issue 21 (December 2020) PP. 200-211
DOI 10/35631/JTHEM.5210012

Nhundu, K., & Mushunje, A. (2010). Analysis Of Irrigation Development Post Fast Track Land Reform Programme . A Case Study Of Goromonzi District , Mashonaland East Province , Zimbabwe. *Agricultural Economists Association of South Africa (AEASA) Conference*.

NMA Manap, N. I. (2017). Land irrigation and food production in dry-land developing countries. *International Journal of Agriculture, Forestry and Plantation*, *5*(2011), 7–14.

Oriola, E. O. (2009). A Framework for Food Security and Poverty Reduction in Nigeria. *European Journal of Social Sciences*, *8*(1).

Prasad, P. (2015). Fertilizer Nitrogen, Food Security, Health and the Environment. *Proceedings of Indian National Science Academy*, *79*(4B), 997–1010.

Smilovic, M., Gleeson, T., & Siebert, S. (2015). The limits of increasing food production with irrigation in India. *Food Security*, *7*(4), 835–856.

Stern, N. (2006). What is the Economics of Climate Change ? *Review Literature And Arts Of The Americas*, *7*(2), 153–157.

UNEP. (2011). *Global Drylands :*

USAID. (1992). *Policy Determination: Definition of Food Security*. PD-19.

Yousif, L. A., Dahab, M. H., & Ramlawi, H. R. El. (2013). *Crop-Machinery Management System For Farm Cost Analysis* . *2*(11).

Yuan, Z. (2011). Analysis of agricultural input-output based on Cobb–Douglas production function in Hebei Province, North China. *African Journal of Microbiology Research*, *5*(32), 5916–5922.