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GOVERNMENT AGRICULTURAL SUBSIDY PROGRAMMES IMPACT ON RICE PRODUCTION IN GHANA FROM 2005 TO 2018

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ABSTRACT

Agricultural subsidies are considered an essential tool of policy to improve food production (or productivity), farmers' income and welfare in developing countries. There is no doubt that the role of subsidies programmes is important for farmers or rural areas, but impacts of subsidies are different from crops, inputs, government programmes and so on. Over the past years, Ghana's agricultural sector has experienced policies changes such as Ghana Shared Growth and Development Agenda (GSGDA I and II), Food and Agricultural Sector Development Policy (FASDEP I and II) and Medium Term Agricultural Sector Investment Plan (METASIP I and II) that support improving agricultural productivity, creating jobs and increasing income. The government of Ghana recognizes that food and nutrition are high priorities and conducts various subsidy programmes of agricultural inputs and outputs. Rice is the second most consumed crop in Ghana. Rice consumption in Ghana would keep increasing due to the growing population, urbanization and change in consumer lifestyles or food preference. This study analyzed the impacts of different subsidy programmes on rice production across the 10 regions in Ghana. The data used in the study starts from 2005 to 2018. The first estimation model evaluated the impacts of before-subsidies and after-subsidies on rice production in Ghana. The results from the first model showed that rice production increased after subsidies. Specifically, fertilizer after subsidies had a positive impact on rice production. However, labor after subsidies did not have statistically significant effects on rice production. The second estimation model compared two different subsidy programmes: Fertilizer Subsidy Programme (FSP) and Planting for Food and Jobs (PFJ). This study found fertilizer with FSP was more effective than with PFJ; however, labor with FSP was less effective with PFJ. The programme of FSP was intensively focused on fertilizer; however, the programme PFJ aims to cover a diverse range of fertilizer, seed, extension services, marketing and so on.

Key words: Rice, Ghana, Fertilizer, Labour, Subsidy programme, Random effects

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INTRODUCTION

The agricultural sector plays a vital role in most developing countries and has a great impact on poverty reduction and food security. In Ghana, the agricultural sector accounts for about 20% of GDP and provides 44.7% employment of the total workforce in 2017 according to Ministry of Food and Agriculture (MoFA) in Ghana [1]. Over the past years, Ghana's agricultural sector has experienced major advancements [2]. These advancements have changed to the implementation of policies such as Ghana Shared Growth and Development Agenda (GSGDA I and II), Food and Agricultural Sector Development Policy (FASDEP I and II) and Medium Term Agricultural Sector Investment Plan (METASIP I and II) that support improving agricultural productivity, creating jobs and boosting a national economy further. Such policies emphasize the need for food security in Ghana, especially in the major crops such as rice, maize, soybean and sorghum. Rice is the second most consumed crop in Ghana. Rice consumption in Ghana has increased along with population growth. It has been a main part of the diet in many Ghanaian homes since it is relatively convenient and palatable in preparation. According to Statistics, Research and Information Directorate (SRID) of MoFA in Ghana, the per capita consumption of rice has been increasing from 24 kg in 2012 to 34kg in 2016. Approximately 70% of total rice consumed in Ghana is in urban areas, mainly Accra and Kumasi [3]. Rice consumption in Ghana would keep increasing due to the growing population, urbanization and change in consumer lifestyles or food preference.

The government of Ghana recognizes that food and nutrition are high priorities and conducts several government programmes, among which are agricultural prices of inputs and outputs control through a subsidy programme. According to Mokwunye [4], price of fertilizer has been high in sub-Saharan Africa and it has an adverse effect on food security and farmer's income. In view of high fertilizer price, many sub-Saharan African countries have implemented policies in order to support basic farm inputs. The Ghana government in 2008 re-organized the Fertilizer Subsidy Programme (FSP) to make fertilizer more accessible and affordable to farmers. In addition, the government introduced the expanded programme "Planting for Food and Jobs (PFJ)" in 2017, to support overall agricultural sector. The PFJ programme promotes the certified seeds and a market to sell agricultural products as well as fertilizer. In addition, the programme provides with quality, extension delivery and an e-agriculture platform.

There is no doubt that a government subsidy program plays an important role in an agricultural sector; however, impacts of subsidy programmes on farm can vary depending on various local environments. This study was interested in different effectiveness of government agricultural programmes of rice across different regions. The general objective of this study was to estimate and to compare impacts of subsidies on rice production across the different regions in Ghana. The specific objectives were:(1) to determine the impacts of fertilizer and labor on rice production and to compare before- and after-subsidy imposition across the 10 regions in Ghana; and (2) to compare the impacts of two different government programs (FSP and PFJ) on rice production across the 10 regions of Ghana. In order to estimate the objectives, fixed or random effects models were applied.

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LITERATURE REVIEW

Subsidies are government incentives, which play pivotal role in economic growth of many developing countries. According to Meeta *et al.* [5], the purposes of subsidies are to amend market failures, to protect domestic production from global competition, to reduce import dependence, to make basic goods and services affordable to all, to encourage employment, to ensure the balanced regional development. Since more than 70% of African people live in rural areas and most of them are engaged in agricultural industry, it is essential that sustainable increases in agricultural productivity and rural incomes are the basis for economic growth [6]. Input subsidy programs for agricultural development strategies, especially fertilizer promotion programs have emerged across several Africa countries such as Nigeria, Ethiopia, Kenya, Zambia, Malawi, Tanzania, and Ghana [7]. The agricultural subsidies must be instrumental in stabilizing prices of inputs and outputs, yielding plentiful food production and improving farm household income in order to strengthen agriculture sector.

There are several researches to analyze effects of subsidy programmes in African countries. Druilhe and Barreiro-Hurlé [8] examined the differences in average yields of major crops in African countries where the subsidy programmes have been implemented. Their study compared the impacts between pre-subsidy period (1995-2007) and post-subsidy period (2008-2010) and found that Ghana, Mali, Senegal, Zambia, Rwanda and Malawi had the significant increases in major crops. Dorward and Chirwa [9] evaluated the case when a farm input support programme was introduced in Malawi. The study showed that maize production was increased by about 54% under the subsidy programme. However, Messina *et al.* [10] reported that a farm input support programme in Malawi did not have significantly positive impacts on maize production. Kato and Greeley [11] showed the case in Kenya and Tanzania. They showed although the cultivating areas of major crops were increased due to fertilizer subsidy, crop yields were decreased.

The government of Ghana had implemented different forms of agriculture subsidies over the last 10 years to help increase farmers' incomes and to ensure food security in rice, maize and sorghum. The subsidies through various programmes have provided with basic farm inputs such as fertilizer and certified seed, farm infrastructure as irrigation facilities and farm mechanization equipment such as tractors among others. Fearon *et al*. [12] measured the impacts of Ghana's fertilizer subsidy programme, using crop production and subsidy budget data from 2007 to 2010. They found that the impacts of Ghana's Fertilizer Subsidy Programme (FSP) on crop production was relatively positive and was not statistically significant at the 10% level. Druilhe and Barreiro-Hurlé [6] reported that the Fertilizer Subsidy Programme in Ghana led to the increases in maize, sorghum and millet production. Wiredu *et al*. [2] indicated that Fertilizer Subsidy Programme in Ghana led to an increase in land productivity, but a reduction in labour productivity because more family labour was used in weeding and harvesting.

Several researches showed that subsidy programmes have generally positive impacts on crop production, but the degree effect is different according to the inputs supported. Most

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previous studies about the impacts of subsidies in Ghana analyzed the effectiveness of the Fertilizer Subsidy Programme on various crop production or productivity. This study focuses on the effect of fertilizer distributed and the effect of labour; in addition, the study estimates and compares the impacts of different subsidy programmes, Fertilizer Subsidy Programme and Planting for Food and Jobs, on rice production across different regions.

MATERIALS AND METHODS

Study Area and Data

Ghana consisted of 10 administrative regions; however, in 2019 six regions were mapped out for additional administrative regions. Thus, this study collected data from the 10 traditional regions of Ashanti, BrongAhafo, Central, Eastern, Greater Accra, Northern, Upper East, Upper West, Volta and Western. The data start from 2005 to 2018. The data were sourced from the Ministry of Food and Agriculture (MoFA) and the Ghana Statistical Service (GSS), from the Directorate of Crops Services (DCS) and from Statistics, Research and Information Services Directorate (SRID) in Ghana.

Table 1 presents the data that were classified into the three different periods for subsidies programmes according to the implementation of the subsidy. The period from 2005 to 2007 was defined as before-subsidies. The period from 2008 to 2018 was defined as after-subsidies and during the period there were two subsidy programmes. The Fertilizer Subsidy Programme (FSP) was conducted from 2008 to 2016. The Planting for Food and Jobs (PFJ) programme has been conducted from 2017. The main variables used in the study were rice production, fertilizer distribution, rural household population. The rural households were used as a proxy for agricultural labour since most of members in a rural household work for an agricultural sector. The certified seed was an important variable to measure impacts of PFJ, but this variable was not used for the estimation because of lack of information.

Methodology

This study measured the impact of fertilizer and labour before- and after-subsidies on rice production across 10 regions in Ghana over the 14 years and also evaluated the impact of different types of subsidies on rice production across 10 regions over the 7 years. The study emphasized the different impacts across the 10 regions and thus, it was designed by a one-way error component model which allows for a regional-specific error component in a panel data model. Based on the regional-specific error component, the fixed and random effects models were considered. The regional-specific error component in a fixed effects model was correlated with other variables; however, the regional-specific error component in a random effect model was distributed randomly. Hausman test was used to specify which of the effects models was appropriate for the given data. According to the results of Hausman test (Table 2), the random effects model was more preferred than fixed effects model. Thus, the one-way random effects model was applied for the estimation in the study. Since the period of subsidy implementation was different, the unbalanced estimation techniques were used.

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Rice production was used as a dependent variable while amount of fertilizer distributed, number of households and the subsidy implementation were used as the independent variables. The subsidy implementation was treated as a dummy variable. In addition, interaction variables were added to capture the interaction effect of the subsidies, fertilizer and labour. Log transformation for data was applied to deal with the skewed data [11]. In order to analyze two objectives, the study built two estimation models. The first estimation model was to determine the impacts of before- and after-subsidies and the model can be written as:

$$(1) \qquad lnY_{ijt} = \alpha_0 + \alpha_1 lnF_{ijt} + \alpha_2 lnL_{ijt} + \alpha_3 P_{jt} + \alpha_4 lnF_{ijt} * P_{jt} + \alpha_5 lnL_{ijt} * P_{jt} + \gamma_i + \mu_{ijt}$$

where, Y_{ijt} denotes rice production with j (subsidy or not), at the time t and in region i, F_{ijt} represents fertilizer with j at time t at region i, L_{ijt}represents the number of labour with j, at time t and in region i, P_{jt} represents a dummy variable of subsidy where j is one when subsidies are implemented at time t and zero otherwise at time t, γ_i represents the regional-specific error component. The regional effect included unknown characteristics such as land quality, availability of skilled labour and thus the variation across regions was assumed to be random and uncorrelated with other independent variables. $\mu_{ijt}$is an error term.

The second estimation model was to estimate the impacts of different subsidies programmes (FSP and PFJ) and the model can be expressed as:

$$(2) \qquad lnY_{ikt} = \beta_0 + \beta_1 lnF_{ikt} + \beta_2 lnL_{ikt} + \beta_3 G_{kt} + \beta_4 lnF_{ikt} * G_{kt} + \beta_5 lnL_{ikt} * G_{kt} + \gamma_i + \mu_{ikt}$$

where G_{kt} represents a dummy variable for a type of subsidy where k is one if FSP is implemented at time t and where k is zero if PFJ is implemented at time t.

RESULTS AND DISCUSSION

Hausman Test

The Hausman test was conducted in order to estimate whether fixed effects model or random effects model was more appropriate for the given data. Table 2 presented that we failed to reject the null hypothesis that the random effects model was more appropriate in the first and second estimation models. Based on the results of Hausman test, the study applied the random effects model to estimate the effects of agricultural subsidies.

Impacts of before- and after-subsidies

Table 3 showed the impacts of the before- and after-subsidies in Ghana. Fertilizer had positive impacts on rice production, although the value was not statistically significant at 5%. Labor had positive effects on rice production. An increase of 1% of labor significantly raises rice production by 0.967%.

From subsidy dummy variables, comparing impacts before-subsidies with after-subsidies, rice production increased during the subsidy implementation, but not significantly. From the interaction effects of the subsidy implementation and fertilizer, fertilizer after-subsidies had a positive impact on rice production compared to before-subsidies; however, labor after- subsidies had a negative impact on rice production. The interaction term of labor with subsidy had an adverse effect on rice production. The result implied that labor is an important input, but its effect was ambiguous. Thus, a government must carefully plan a subsidy program with labor.

Impacts of FSP and PFJ

Table 4 displayed the impacts of different types of the subsidies programmes (FSP and PFJ). In the estimation, the reference group was the period of the PFJ. Under FSP and PFJ programmes, fertilizer and labor had a positive impact on rice production, but the values were not statistically significant.

From subsidy dummy variables, FSP subsidy program positively influenced rice production compared to FSP; however, the coefficient values were not statistically significant at 5%. An increase in fertilizer under FSP raised rice production compared to PFJ. However, an increase in labor under FSP decreased rice production compared to PFJ. The programme of PFJ was more expanded than FSP. The programme of PFJ consists of various pillars such as seed, fertilizer, extension service, marketing and monitoring. Thus, the effects of PFJ could be dispersed into employment of a rice sector besides rice production.

Based on the results, this study suggests that the government of Ghana must be aware of farmers when they create a subsidy programme. Especially, the implementation of PFJ enters its third year of implementation so that the government must evaluate how to manage the programme and farmers should understand how to access the programme. Training and improvements in work conditions enhanced labor productivity [14]. This will help to curb some issues that happen during the implementation of PFJ. Also, there must be farmer training on proper application of inputs such as fertilizer in order to help boost rice production.

CONCLUSION

Subsidy programmes in an agricultural sector play an essential role on economy growth in most developing countries. Especially, the Ghana government has performed subsidy programmes to strengthen farmers' income and welfare since 2008. In the beginning, the subsidy programme concentrated on the fertilizer accessibility to all farmers and the programme is called: the Fertilizer Subsidy Programme (FSP). Recently, the government designed and implemented the Planting for Food and Jobs (PFJ) programme to increase food production as well as to create jobs. This study analyzed the impacts of subsidy programmes on rice production across the 10 regions in Ghana. Firstly, the impacts of fertilizer and labor under the before- and after-subsidies on rice production were determined. Then the study estimated and compared the impacts of fertilizer and labor under FSP and PFJ programmes. With the given data, the random effects model with a

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regional-specific error component was more appropriate than the fixed effects model with a regional-specific error component.

Comparing the effects of before- and after-subsidies, the random effects model showed that the relation of fertilizer and rice production was positive during subsidy implementation. However, the impact of labor was negative after subsidies. The fertilizer impact of FSP was positive on rice production compared to PFJ. However, the labor impact of FSP was negative on rice production compared to the PFJ. From the results, fertilizer effects of rice production after two subsidy programmes became clear even though labor effects after the subsidies were inconclusive.

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Table 1: Summary Statistics

Variables	Unit	Mean	Standard Deviation	Minimum	Maximum
Before implementation of subsidy (2005~2007)					
Production	MT	22,409	25,753	2,322	98,793
Fertilizer	MT	8,198	7,451	217	29,595
Labour	Persons	1,252,946	508,185	433,910	2,186,959
After implementation of FSP (2008~2016)					
Production	MT	51,506	60,663	2,561	228,354
Fertilizer	MT	11,029	10,801	216	47,393
Labour	Person	1,292,346	503,312	369,583	2,290,020
After implementation of PFJ (2017~2018)					
Production	MT	74,459	88,542	3,287	299,894
Fertilizer	MT	30,497	48,684	920	195,750
Labour	Persons	1,416,890	555,259	435,275	2,197,387
Certified Seed	MT	187	277	3	1,202

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Table 2: Hausman Test for Fixed vs. Random Effects

$$\boldsymbol{H_0}: \mathbf{Cov}(\boldsymbol{\epsilon_i}, \boldsymbol{X_{it}}) = \mathbf{0}$$

$$\text{vs.}\boldsymbol{H_A}: \mathbf{Cov}(\boldsymbol{\epsilon_i}, \boldsymbol{X_{it}}) \neq \mathbf{0}$$

	Test statistics (χ^2)	P-value
First estimation model (Equation 1)	0.880	0.972
Second estimation model (Equation 2)	1.571	0.905

Table 3: Random Effects Estimation of Before- and After-Subsidies

Variables	Estimates	P-values
Intercept	-4.733 (5.276)	0.371
Fertilizer	0.103 (0.146)	0.485
Labour	0.967 (0.382)	0.012*
After-subsidy	1.823 (6.254)	0.700
Fertilizer*After-subsidy	0.183 (0.173)	0.291
Labour*After-subsidy	-0.256 (0.453)	0.572

Note: Values in parentheses are standard errors. * represents the 5% significant level

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Table 4: Random Effects Estimation of FSP and PFJ Programmes

Variables	Estimates	P-values
Intercept	-2.490 (7.794)	0.750
Fertilizer	0.205 (0.231)	0.377
Labour	0.783 (0.564)	0.169
FSP_Subsidy	0.334 (8.701)	0.970
Fertilizer*FSP_Subsidy	0.089 (0.255)	0.729
Labour*FSP_Subsidy	-0.090 (0.630)	0.886

Note: Values in parentheses are standard errors

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