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Gender Role, Input Use and Technical Efficiency among Rice Farmers at Ahafo Ano North District in Ashanti Region of Ghana

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Abstract This paper examined gender role, input use and technical efficiency between male and female rice farmers. Similar studies have been conducted, however, the relationships between gender role, input use and farmer efficiency remains neglected and under researched. The question addressed in this study is 'Does gender role influence input use and farmer efficiency? Structured questionnaires were used to collect primary data from one hundred (100) households, and stochastic frontier model was used to estimate the technical efficiency levels among male and female rice farmers. Our study finds labour, land and fertilizer significant contributors to higher output and yield, and that male labour input tends to promote higher rice output than that of their female counterparts. We also show that males are more efficient in rice production than their female counterparts. Furthermore, farm labour, extension contacts and land size tend to reduce inefficiency in rice production in the study area. Since labour participation was found to be among the variables that contributed to the differences in farm output and efficiency, the study suggests the promotion of multipurpose labour-saving household and farm tools to free up females labour time to improve female output and efficiency to ensure food security in in Ghana.

Keywords: *Ahafo, Ghana, gender role, input use, rice production, technical efficiency*

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1. Introduction

Rice production is a labour intensive activity as compared to other cereals. It is recorded that farmers in India allocate 125 work days per hectare for wet paddy rice, but allocate only 33-47 days per hectare for dry wheat [1]. Another study reported that in China farmers spent 12-25 days of work per mu (approx. 0.165 acres) of rice versus four to 10 days of work per mu of wheat [2]. Again, it is noted that marginal returns to labour in wheat production are lower and decrease more rapidly with greater employment of labour" when compared with rice production [3]. The laborious nature of rice cultivation has been theorized to have an impact on the work ethic of those societies that have historically depended on this crop for sustenance [4]. The initial land preparation, seed preparation and nursery, transplanting, weeding, fertilizer, weedicides and pesticides applications, bird scaring, harvesting and drying, threshing and winnowing and milling require high labour input which are sometimes very detrimental to the health of the farmers. As a result, traditionally, rice production is male dominated activity in Ghana.

Recent evidence shows that more males now seek alternative income generating activities in non-farm activities in Ghana [5], leaving females to engage in rice production. Females are constrained in this regard in several ways: reproductive activities at home reduce the labour time allocated to farming; lack of control over family labour; and lack of access to hired labour even where labour market exists. It is generally believed that females devote much time to domestic activities. However, rice is a very important staple crop in terms of food security, income generation and poverty alleviation. Rice has high income elasticity, and as urban incomes increase, this is expected to increase too. Its per capita consumption in Ghana is projected to increase from 30 kg in 2008 to 63 kg in 2018 [6]. However, it is indicated that the rice sector in Ghana experiences low yield [7]. Also, studies have shown that technical efficiency measures for Ghana's agriculture are low [8,9,10]. The ability of Ghana to contain the expected increase in consumption without recourse to import will critically depend on its ability to improve technical efficiency.

In an effort to achieve an improvement in technical efficiency of rice farmers, government of Ghana has put in several interventions in rice sector. Yet, an important constraint to technical efficiency remains neglected and under researched - traditional gender role and the resulting

time poverty faced by female farmers. Time constraints faced by female rice farmers are not addressed within these interventions. Accordingly, the expected positive gain from these interventions have the potential to register intended negative outcome; that can further aggravate the existing income disparities between male and female farmers. In the light of this, the study seeks to answer this question: Does gender role influence farmer efficiency? Such a study is necessary because it could support a decision to develop new strategies to improve efficiency in the short run. More importantly, enhanced technical efficiency will not only enable farmers to improve the use of rice inputs to increase income, it will also give direction for the adjustments required in the long run to achieve food security sustainably. Considering the current focus of Ghana on investing in the rice sub-sector to improve food security in Ghana, the results of this study should be of interest to policy-makers.

The remainder of the paper is organized into three sections. A brief review of related studies follows this section. Section three describes materials and methods. Empirical results and discussion as well as the conclusions and recommendations of the study are given in sections four.

2. Review of Related Literature

2.1. Gender Role, Division of Labour and Farm Output

Food and Agriculture Organization (FAO) has indicated that gender is not determined biologically, as a result of sexual characteristics of either female or male, but is the socially constructed relations between males and females, both perceptual and material. It is a central organizing principle of societies, and often governs the processes of production, reproduction, consumption and distribution [11]. Again, gender is defined as a social construct that identifies the socially expected rights, responsibilities, privileges and obligations of males and females [12]. Gender role refers to the socially differentiated roles assigned to males and females [13]. It is the basis for a very basic division of labour between males and females within most societies: the division between “productive”, “reproductive” and ‘’communal’’ activities. The gender “division of labour” is an important issue in farming areas which define what activities are deemed appropriate for males and females in developing countries. In these areas, certain tasks are considered to be carried out solely by either males or females, and there can also be gender division on who can make decisions about those tasks. Gender division of labour vary by country, agro-ecosystem, socio-economic status, cultural norms, degree of mechanization, market orientation (subsistence and commercialized), and availability of male labour [14].

In Ghana, the allocation of responsibilities in the household is determined from childhood and from the onset girls work more hours than boys in domestic activities and are also more active in productive activities especially between 12 and 14 years of age. It is reported that in Ghana, nearly two thirds of young rural males (between 15 and 24 years of age) spend up to 10 hours weekly on domestic work, whereas over a quarter of their female counterparts spend 50 hours or more on domestic work [15]. The report further shows that 65 percent of males spend close to 10 hours per week on domestic activities, 89 percent of females spend 10 hours or more per week and about 20 percent of females allocate more than 60 hours per week to domestic activities. Also a study conducted in Ethiopia reported that the average total work time per week rises to 52 hours for females, while it is only about 36 hours for males. Moreover, the average duration of housework per week is 39 hours for females and 13.6 for male; nearly three times higher for females while the average duration of market work per week is 36 hours for males and 24 hours for females; that is more than 10 hours longer for males [16]. According to Suárez, females work longer hours than males in the household, while the reverse is true for males at the market and farm levels. It is documented that in spite of the changes that have occurred in females’ participation in the labour market, females continue to bear most of the responsibilities for the home: caring for children and other dependent household members, preparing meals and doing other housework [17]. Gender division of labour in the household has affected female’s participation in labour market and confined them to lower paid jobs [18]. In Ghana, agricultural sector remains lower paid job and females contribute, at least, half of the total labour inputs in food production.

In rice production, the labour requirements have substantially been met by family members and hired workers, comprising male and female. Generally, males clear the land while females undertake most of the remaining farming activities, particularly weeding and processing. In many areas, tasks related to rice planting, weeding, harvesting, processing, marketing and preservation of seeds are in the domain of females [19]. In sub-Saharan African countries, the average female labour share in crop production is at 40 percent, and it is slightly above 50 percent in Malawi, Tanzania, and Uganda, and substantially lower in Nigeria (37 percent), Ethiopia (29 percent), and Niger (24 percent) [20]. Males control cash crop production, relegating the production of food crops and activities related to household maintenance and care work to females. A study reported owing to unequal gender division of labour, the increase in prices of cash crop benefit males relative to females within a typical agricultural household [21].

Generally, labour is the single most important input in peasant farming system in Ghana. As a result, the unequal division of labour between males and females in the household may influence farm output. It was recorded the unequal gender division of labour and the resulting time poverty among females has impeded the growth of household's agricultural output in Mozambique [22]. It was found that a decrease in farm labour input results into lower output in maize production in Malawi [23]. The examination of family caregivers in Tanzania showed that due to the pressure of caring for the sick, females significantly reduced their labour hours for cultivation on the farm which affected their farm output [24]. A study indicated that the extensive pressure of work on females eventually causes a decline in their output, thus, slowing down the growth of the cash and subsistence crops sectors [25]. Gendered division of labour is seen to influence an

output of female-headed households' plots more than that of male-headed households' plots [26].

In Sierra Leone, there is evidence that females allocate substantial time to domestic chores which limit their economic opportunities [27]. The report showed the time spent on domestic chores lower output which may limit their income and decision-making power within the household. The necessity to combine child care, domestic work and other activities implies that females' economic undertakings will remain small-scale [28]. Generally, family labour and non-family labour (almost entirely unpaid exchange labour) are devoted more intensively to plots controlled by males than that of females resulting in lower output for females [29]. An agricultural cooperative in Vietnam, comprising female farmers, was able to benefit from a 60 percent increase in output when good child care facilities were provided [30]. Therefore, the review concludes that gender role have influence on male and female rice farmers output.

3. Materials and Methods

3.1. Study Area and Data Collection

A cross sectional survey was conducted in Ahafo-Ano North district in Ashanti region of Ghana. A multi-staged sampling technique was used. The first stage was purposive selection of the district and communities, due to their significance in rice production in the Ashanti region of Ghana. The selected communities include Tepa, Adumasa, Manfo, Kyekyewere, Jacobu, Ntewie, Afotoko, Abuagya, Dwaaho, and Katabo. The second stage involved random selection of ten (10) households from each of the ten communities. The final stage involved interviewing individual farmers who were farm managers and also owned rice plots in the 100 rice farm households. At the end of the interview, a hundred and fifty (150) rice farmers, comprising fourty seven (47) females and a hundred and three (103) males' farm managers were interviewed. Structured questionnaire was used to gather data from the rice farmers. Data were collected during the 2015 major cropping season, with prior briefing of respondents about the objective and aims of the survey. The completed questionnaires were carefully validated for consistency. To complement the quantitative data, key informant and focus group interviews were also conducted to gather some qualitative information on gender role and rice production activities in the district, especially in the communities selected for the study. Informal discussions were used to probe issues and concerns of the rice farmers, and made relevant observations all of which provided additional anecdotal data for the interpretation of the quantitative data and provided recommendations for the study.

3.2. The Analytical Framework

The study is based on the production theory that relates farm output to farm inputs which is also the foundation for computing efficiency of production. Several approaches have been applied to estimate production efficiency. However, the stochastic frontier approach is mostly employed particularly in agricultural production, because of its ability to separate inefficiency effect from measurement error and random shock. The generalized stochastic frontier as proposed by [31,32] can be specified as:

$$Y_i = f(x_i, \beta)e^{v_i - u_i} \quad (1)$$

Equation (1) is an exponential function. To make the parameters in equation (1) estimable, it is linearized by taking natural logarithm of both sides of the equation. This results in a generalized Cobb-Douglas production function which is expressed as:

$$\ln Y_i = \beta_0 + \sum_{j=1}^{J} \beta_j \ln x_{ij} + v_i - u_i \quad (2)$$

where ln denotes natural logarithm, Y_i denotes farm output, x_{ij} is a vector of farm inputs. v_i is the systematic random error that accounts for measurement error and other factors that are not under the control of the farm household while u_i denotes the asymmetric non-negative random error component that measures technical inefficiency effects. β_j is a vector of parameters to be estimated. The appropriateness of the Cobb-Douglas production function would be tested using the likelihood ratio test. To measure effect of gender on efficiency of production, an inefficiency model is specified which relates inefficiency to a vector of socioeconomic variables including gender and farm input use.

$$u_i = \phi_0 + \sum_{j=1}^{J} \phi_j Z_{ij} + \varepsilon_i \quad (3)$$

where Z_j is a vector of socioeconomic variables including gender and farm input. ϕ_0 and ϕ_j are parameters to be estimated whereas ε_i is the error term. To obtain unbiased and consistent estimates a single stage procedure as proposed by [33] is employed to simultaneously the parameters in equations (1) and (2).

The variance parameters, gamma and sigma squared are estimated from the stochastic frontier model. They are expressed as in (4):

$$\sigma^2 = \sigma_v^2 + \sigma_u^2 \ , \ \ \gamma = \sigma_u^2 / \sigma^2 \text{ and } 0 \le \gamma \le 1 \quad (4)$$

The technical efficiency (TE_i) of the gender group can be computed from equations (2) and (3) using the expression below:

$$TE_i = \frac{Y_i}{Y_i^*} = \frac{f(x_i;\beta)e^{v_i - u_i}}{f(x_i;\beta)e^{v_i}} = e^{-u_i} \quad (5)$$

3.3. Empirical Model Specification

Different functional forms including the Cobb-Douglas, translog, linear, and quadratic functions were explored. The results of the test indicate that translog production function is the most appropriate functional form for rice production in the study area. The translog production function can be specified empirically as:

$$\ln Rice_i = \beta_0 + \beta_1 \ln Land_i + \beta_2 \ln Labour_i + \beta_3 \ln Seed_i + \beta_4 \ln Fertiliser_i + \beta_5 \ln Weed_i + v_i - u_i$$

$$
\begin{aligned}
&+\beta_6(\ln Land_i)^2+\beta_7(\ln Labour_i \bullet \ln Land_i)\\
&+\beta_8(\ln Seed_i \bullet \ln Land_i)+\beta_9(\ln Fertiliser_i \bullet \ln Land_i)\\
&+\beta_{10}(\ln Weed_i \bullet \ln Land_i)+\beta_{11}(\ln Labour_i)^2\\
&+\beta_{12}(\ln Seed_i \bullet \ln Labour_i)\\
&+\beta_{13}(\ln Fertiliser_i \bullet \ln Labour_i)\\
&+\beta_{14}(\ln Weed_i \bullet \ln Labour_i)+\beta_{15}(\ln Seed)^2\\
&+\beta_{16}(\ln Fertiliser_i \bullet \ln Seed_i)\\
&+\beta_{17}(\ln Seed_i \bullet \ln Weed_i)+\beta_{18}(\ln Fertiliser_i)^2\\
&+\beta_{19}(\ln Fertiliser_i \bullet \ln Weed_i)+\beta_{20}(\ln Weed_i)\\
&+\beta_{21}(Gender \bullet Flabour_i)+v_i-u_i
\end{aligned}
\tag{6}
$$

where $Rice_i$ is the quantity of rice harvested in kilograms; labour is number of man-days per acre per cropping season; land is area cultivated in acres; fertilizer is quantity used in kilograms per acre; seeds used in kilograms per acre; and quantity of weedicide applied in liters (L) per acre. The interaction term $(Gender \bullet labour_i)$ is introduced in the production function to capture the effect of gender labour participation in rice production on male and female production levels. There are also interactions between the farm inputs to show their substitutability or compliment ability in rice production. Credit and pesticides are excluded because a large number of farmers did not use it. The inefficiency model is specified as follows.

$$
\begin{aligned}
u_i &= \phi_0+\phi_1 Gender_i+\phi_2 Education_i+\phi_3 Land_i\\
&+\phi_5 Extension_i+\phi_6 Domestic\_Lab_i\\
&+\phi_7 Farm\_Lab_i+\varepsilon_i
\end{aligned}
\tag{7}
$$

where u_i denotes the inefficiency term; gender is the sex of the farmer which is denoted 1= male and 0 otherwise; education is number of years in school; Land is the area cultivated in acres; extension is number of extension contacts per cropping season; domestic labour is the number of man-days used to carry out domestic activities per cropping season; and farm labour is total man-days employed in rice production per land area under cultivation per cropping season. The disaggregation of labour input into domestic and farm labour is intended to capture type and quantity effects.

4. Results and Discussion

4.1. The Socioeconomic Characteristics of the Rice Producers

The distribution of the socio-economic characteristics of the respondents by gender is shown in Table 1. Generally, rice production in the study area was male dominated (about 67 percent). The high percentage recorded for male respondents is consistent with a finding of [34] who recorded a low number of female rice farmers involved in upland rice production in sub-Saharan Africa. The author attributed low female involvement to socio-economic factors (including resource endowment, capital and land). The average age of all farmers was 40.77 with the males recording a mean age of 41.74 and that of their female counterparts recording 38.64. The mean difference of their ages was significant at 10 percent, implying males were generally older than females. Majority of the farmers had formal education up to seventh year with the males and females recording on the average 8.6 and 4.2 years of formal education respectively. It was found that their mean difference of the number of years of formal education was highly significant at one percent. This indicates that there was high literacy rate among males than females. The high illiteracy rate among females is confirmed by [35] which indicated that the illiteracy rate in Ghana is still high but is very prominent among females.

Apart from the age and level of education, the mean man-days of domestic labour for males and females were 49.35 and 92.27 respectively and their mean differences were highly significant at one percent each, indicating the females spent more time in domestic activities than males. This confirms that of [27] which indicates that females allocate substantial time to domestic chores which limits their economic opportunities. In the case of the farm labour, the males recorded an average farm labour of 146.57 man-days and that of females was 87.94 man-days. Their mean differences were highly significant at one percent each, indicating that males spent more time on rice production than their female counterparts.

Table 1. Summary Descriptive of the Socioeconomic Characteristics of the Rice Producers

Variable	Male (N = 103)		Female (N = 47)		Mean Difference	Pooled	
	Mean	SD	Mean	SD		Mean	SD
Age	41.74	9.53	38.64	11.09	3.10*	40.76	10.11
Education	8.63	5.12	4.19	4.60	4.44***	7.24	5.36
Household size	7.049	2.55	6.57	3.63	0.47	6.90	2.93
Farm experience	16.52	9.92	14.49	9.10	2.03	15.89	9.68
Domestic labour	49.35	64.50	92.27	58.53	-42.92***	62.80	65.61
Farm labour	146.57	100.06	87.94	62.34	58.63***	128.20	93.80
Extension contact	0.75	0.46	0.70	0.46	0.05	0.73	0.46

***, ** and * represent statistical significance at the 0.01, 0.05 and 0.1 levels, respectively. **Source: Computed from survey data (2015).**

4.2. Gender Roles in Rice Production

Table 2 shows the roles and labour allocation in domestic work and rice production by male and female rice farmers. The results give very interesting findings regarding socially constructed roles for male and female rice farmers. Labour allocation within the household indicates a fairly high degree of specialization by gender on labour tasks in the study area. Children tend to assist with all labour tasks in the household. The more strenuous activities such as land preparation (about 63%), weedicides application (67.2%), harvesting (about 53%), threshing (55.7%), treatment of paddy for storage (60%)

and processing (53%) are mostly carried out by males. Comparatively, females are more dedicated into activities such as planting (77.2%), weeding (56%), carting (58.6%), drying and winnowing (88.6%), and storage (50%). This is inconsistent with that of [19] which documented that in many areas, tasks related to rice harvesting, processing and marketing are in the domain of females.

Table 2. Gender roles and labour participation in various activities in rice production

Activity	Only women (percent)	Mostly women and children (percent)	Both men and women (percent)	Only Men (percent)	Mostly Men and children (percent)
Land acquisition	14.3	21.4	18.6	35.7	10.0
Land preparation	7.1	17.1	10.0	62.9	22.9
Seed preparation and nursery	8.5	42.9	12.9	11.4	23.3
Transplanting/ direct sowing	77.2	47.1	15.7	11.4	8.6
1st fertilizer application	14.3	12.9	18.6	44.3	10.0
1st weedicide application	12.9	4.3	2.9	80.0	97.1
1st manual weeding	57.1	44.3	18.6	12.9	17.2
2nd fertilizer application	7.2	11.4	11.4	52.9	17.1
2nd weedicide application	2.9	15.7	18.6	54.3	8.6
2nd manual weeding	54.3	55.7	17.1	11.4	10.0
Fungicide application	4.3	15.7	25.7	47.1	7.1
Bird scaring	7.1	57.1	21.5	5.7	8.6
Harvesting	5.7	10.0	21.4	52.9	10.0
Threshing	5.7	10.0	17.1	55.7	11.4
Drying and winnowing	88.6	50.0	12.9	10.0	8.5
Bagging and carting	10.0	15.7	55.7	5.7	12.9
Storage	12.8	52.9	14.3	10.0	10.0
Treatment of paddy	4.3	11.4	12.9	60	11.4
Carting to milling facility	62.9	17.2	11.4	48.6	10.0
Milling/ processing of paddy	11.4	12.9	14.3	52.9	2.9
Bagging and wholesaling	17.1	12.9	15.7	51.4	2.9
Storage after milling	50.0	7.1	15.7	14.3	12.9
Carting to the nearest market	54.3	4.3	12.9	11.4	17.1
Marketing	31.4	8.6	12.9	38.6	8.6

Source: Computed from survey data (2015).

4.3. Labour Participation among Males and Females in Rice Production

The study further sought to find out labour participation of males and females in rice production activities, and the results are presented in Table 3. The results show a breakdown of gender time allocation for both productive and reproductive activities at the study area. The main activities carried out on daily basis are domestic work, farm work during cropping season and other income activities. The contribution of males to household chores varies from a mere two hours to four hours, whilst that of females varies from eight hours to 10 hours. The results show that females allocate more labour time into house chores with little time for productive activities and leisure. This finding is consistent with that of [36] indicating that females in the farm households are relatively more involved in reproductive roles like household chores but less involved in productive activities as compared to males who dominate in field work, non-farm activities and marketing.

Table 3. Mean number of hours devoted to productive and reproductive activities

	Female		Male	
Period	**Per day (Hours)**	**Per six months**	**Per day (Hour)**	**Per six months**
Total work hrs.	12	1440	8	960
Domestic work hrs.	9	1080	3.23	387.6
Rice production hours	2.39	286.80	3.57	428.4
Other income earning hours	0.61	73.2	1.2	144

Source: Computed from data (2015).

The result of Table 4 shows a breakdown of gender labour distribution and percentage labour participation in rice production activities at the study area. Due to the strenuous nature of the initial land clearing and preparation, females recorded 10 man-days higher than their male counterparts per cropping season per acre. The average land area cultivated by males in acres was higher (2.74) than that of females (2.45). The percentage labour participation in rice production recorded by males was 82.30% and that for females was 47.86%. This is consistent with [20] who reported the average female labour participation in crop production in Sub-Saharan Africa is at 40%, and it is slightly above 50% in Malawi, Tanzania and Uganda and lower in Nigeria (37%), Ethiopia (29%) and Niger (24%). Result also shows there were labour gaps of 31.53 man-days and 95.81 man-days for males and females respectively.

Table 4. Mean gender differences in labour spent on rice production activities

Description	Male	Female
Total man-days needed/cropping season (6 months)/acre	65.00	75.00
Average area cultivated (acre)	2.74	2.45
Total man-days needed for producing rice/cropping season (6 months)/ average area cultivated (acre)	178.10	183.75
Actual total man days used in rice production activities (man-days)/cropping season (6 months)/ average area cultivated (acre)	146.57	87.94
Labour (man-days) gaps	31.53	95.81
Percentage labour participation in rice production activities	82.30	47.86

Source: Computed from survey data (2015).

4.4. Farm Input Use and Rice Production

The relationship between farm input use and rice output is shown in Table 5. The main farm inputs used at the study area were improved seed, fertilizer, weedicides and labour. The mean differences of fertilizer and seed were significant at one percent and 10 percent respectively. The mean difference of total farm labour was significant at five percent. The significant differences of mean values of fertilizer, seed and farm labour between male and female rice farmers indicate that males applied greater quantities of these farm inputs as compared to their female counterparts. The result also shows that the mean differences of rice output and yield between males and females were both highly significant at one percent, implying males recorded higher output and yield than females.

Table 5. Rice output and farm inputs

	Male (N =103)		Female (N = 47)		Mean difference	Pooled	
Variable	Mean	SD	Mean	SD		Mean	SD
Rice output (kg)	2826.70	1727.88	1395.53	1037.87	1431.17***	2378.27	1679.29
Rice yield (kg/acre)	2703.12	1274.11	1508.39	598.65	1194.73***	2328.77	1237.38
Fertiliser (kg)	213.73	144.69	151.42	128.59	62.31***	194.20	142.40
Weedicide (L)	2.97	2.21	2.80	2.65	0.16	2.92	2.35
Seed (kg)	28.59	19.80	22.35	16.98	6.24*	26.64	19.12
Labour (man-days)	254.98	196.75	195.53	124.32	59.46**	214.16	152.64
Land (acres)	1.26	0.95	1.03	0.83	0.23	1.19	0.91

*,**,*** denote 10%, 5% and 1% significant levels. Source: Computed from survey data (2015).

4.5. Empirical Estimates of the Translog Production Function

Table 6 gives the Maximum Likelihood Estimates (MLE) of the stochastic frontier for the pooled sample of rice farmers. The best practical performance (that is, efficient use of the available resources), are presented together with the diagnostic statistics such as the gamma, sigma squared, log likelihood and Wald chi-square. The results indicates that the Wald chi-square statistic (624.35) is statistically significant at 1% implying that the farm inputs included in the translog production frontier model jointly influence rice output. Furthermore, the gamma value (0.952) is also significant at 1% and suggests that about 92.50% of variation in farmers' output is attributed to inefficiency while the remaining 4.80% is due to measurement error and random shock. This demonstrates that inefficiency is the major contributor to low rice output in the study area. This suggests the need to identify the sources of this inefficiency in order to develop policy strategies to promote rice production. The sigma-squared value is statistically significant at 1% level indicating that the distributional assumption (half-normal) of the inefficiency term is validated.

From the estimated equation, the coefficient for land area was significant at 5 percent, indicating that either a unit increase in the land area or doubling land area would significantly (at 5%) influence rice output. The result may be attributed to the fact that in peasant societies, if farmers are using low levels of output-augmenting inputs, then the only way to increase total output is by cultivating larger areas. In fact, this is the main pathway for increasing output in smallholder agriculture in Ghana. The results also show that a unit increment in both farm labour and land area significantly (at 1%) influence rice output. The interaction between farm labour and land area was positive and highly significant at one percent. Also, the interaction between land area and fertilizer was negative and highly significant at one percent. This implies that fertilizer can be substituted for land and obtain similar results hence, instead of increasing the farm size, more fertilizer can be applied. The interaction between Farm labour and gender is included in the production function to capture the influence of farm labour participation in rice production on male and female rice farmers output. The results show that an increase in farm labour tends to increase rice output of the male rice farmers. Thus, a unit increment in farm labour, land and fertilizer contributed significantly to male rice farmers' rice output in the study area. Since males devoted more of these farm inputs into rice production than their female counterparts, it can be concluded that lower usage of these farm inputs by females in rice production contributed to lower rice output of female rice farmers. This is consistent with the findings of [37] who observed output differences between male and female farmers in Benin, although the result was attributed to scheme membership, access to land and equipment. Again, in Burkina, it was found that female farmers are significantly less productive than males in most crops and have total values of output that are about 15 percent lower [38].

Table 6. MLE for Pooled Sample using Translog Production Function

Variable	Coefficient	Standard error	z-statistic	Probability
Lnlabour	-0.627	0.919	-0.68	0.495
Lnweedicide	0.712	0.817	0.09	0.931
Lnseed	1.244	1.206	1.03	0.302
lnland area	0.999**	0.456	2.19	0.028
Lnfertiliser	0.150	1.133	0.13	0.895
(lnlabour)^2	0.233**	0.101	2.29	0.022
(Land area)^2	0.092**	0.040	2.31	0.021
(lnfertiliser)^2	0.741	0.149	0.50	0.618
(lnlabour) x (lnweed)	-0.524	0.162	-0.32	0.746
(lnlabour) x (lnseed)	-0.293	0.184	-1.60	0.110
ln(labour) x (lnland area)	0.271***	0.086	3.15	0.002
(lnlabour) x (lnfertiliser)	-0.209	0.133	-1.56	0.118
(lnweed)^2	0.003	0.076	0.04	0.965
(lnweed) x (lnseed)	0.094	0.134	0.70	0.485
(lnweed) x (lnland area)	-0.032	0.074	-0.44	0.659
(lnseed) x (lnland area)	0.171	0.150	1.14	0.255
(lnseed) x (lnfertiliser)	0.056	0.200	0.28	0.778
(lnland) x (lnfertiliser)	-0.431***	0.143	-3.01	0.003
(Farm labour x Gender)	0.0008***	0.0003	2.60	0.009
Constant	7.297**	3.066	2.38	0.017
Diagnostic statistics				
Sigma squared	0.2427923***	0.0523314	4.639515	0.00
Gamma value	0.9516569***	0.2946566	3.2297	0.00
Wald chi-square	624.35(0.000)***			
Log likelihood	-18.917818			

Source: Computed from survey data (2015).

4.7. Distribution of Technical Efficiency Scores among Male and Female Rice Producers

The estimated technical efficiency scores for males and females are presented in Table 7. The best performing male rice producer had technical efficiency of 0.999 which is higher than that of the female counterpart (0.978). The average technical efficiency score of male was 0.981 which exceeds that of female (0.717) by 0.264. Furthermore, the majority of the males had technical efficiency scores ranging from 0.90 to 0.99 whilst that of the females ranged between 0.80 and 0.89. The mean difference of technical efficiency of male and female rice producers is highly significant at one percent, indicating the males are technically efficient than female rice farmers in the study area. The male higher technical efficiency scores could be attributed to their higher labour participation in rice production (254.98 man-days), larger acreage (1.26 acres) and higher application of fertilizer (213.17 kg) as compared to that of the females 195.53 man-days, 1.03 acres, 151.42kg respectively. On the contrary, [39] reported that female rice farmers are more technically efficient compared to male farmers in Osun State, Nigeria.

Table 7. Technical Efficiency Scores among Men and Women Rice Producers

Technical efficiency	Gender		Pooled
Score	Male	Female	
0.10 – 0.19	1	0	1
0.30 – 0.39	3	0	3
0.40 – 0.49	2	1	3
0.50 – 0.59	4	0	4
0.60 – 0.69	9	0	9
0.70 – 0.79	8	0	8
0.80 – 0.89	12	4	16
0.90 – 0.99	8	98	106
Total	47	103	150
Mean	0.981	0.717	0.899
Minimum	0.414	0.113	0.113
Maximum	0.999	0.978	0.999
Standard deviation	0.062	0.198	0.173
Mean difference	0.212****		

Source: Computed from survey data (2015).

4.8. Determinants of Technical Inefficiency

Table 8 gives a summary of the finding of technical inefficiency of the rice farmers in the study area. The coefficients of farm labour and extension contacts were both negative and at 10 percent significant level. This implies that efficiency is enhanced with greater application of farm labour and extension contacts for the

rice farmers in the study area. Thus, a unit application of the farm labour and extension contacts required in rice production tends to decrease inefficiency by 0.04 and 1.28 respectively (ceteris paribus). The result of the extension contact is consistent with that of [40] and [41] who recorded similar result. The coefficient of farm size was positive and highly significant at one percent. The highly positive and significant coefficient associated with the farm size suggested that farmers' yield is sensitive to farm size. This indicates that a unit increment of farm land tend to decrease inefficiency by 0.81, all things being equal. Gender emerges with the largest effect on production efficiency. The gender index is negatively associated with the level of technical inefficiency at 1% significance level, implying being a male is associated with higher efficiency than female. Thus, the main determinants of technical efficiency in the study area include farm labour, land, extension contact and gender. Similarly, [42] indicated female rice producers are relatively and technically inefficient than their male counterpart. Again, available studies reported similar results that male farmers are associated with lower inefficiency than their female counterparts [43,44]. This results finding validates the hypothesis that male rice farmers are more efficient than their female counterparts.

Table 8. Determinants of Technical Inefficiency

Variable	Coefficient	Standard error	z-statistic	Probability
Education (years)	0.1212954	0.826533	1.47	0.142
Farm Labour	-0.0350063	0.179501	-1.95	0.051
Farm Size	0.8081009	0.2519729	3.21	0.001
Extension	-1.277356	0.6634634	-1.93	0.054
Gender	-7.180425	2.128148	-3.37	0.001
_cons	-0.2845111	1.409134	-0.20	0.840

Source: Computed from survey data (2015).

5. Conclusion and Recommendations

The objective of this study is to examine the effect of gender differences in time allocation for rice production activities on farmer efficiency. The results show that there are rigidities in the division of tasks between females and males in the study area. The predominant pattern is for males to make much lower contribution of labour than females for direct domestic use. Thus, the contribution of males to household work varies from a mere two hours to four hours, while that of females varies from eight hours to 10 hours. The result of low male participation in domestic work is high male engagement in rice production activity as was shown in the study.

The study provides evidence to show that farm output is influenced by farm labour, land and fertilizer. Thus, to increase rice output, farmers can increase the use of these farm inputs. Also, the interaction between gender and farm labour was included to capture the influence of the farm labour on male and female rice farmers output and yield. The estimated coefficient on gender of the farmer is positive and highly significant at one percent, indicating that gender contributes significantly to the differences in farm output between male and female rice farmers. Thus, females produced lower output than that of their male counterparts.

Furthermore, a higher inefficiency was associated with female rice farmers than their male counterparts. The male rice producers obtained higher mean technical efficiency of 0.981 which significantly exceeds that of the females (0.717) by 0.264. The variables, farm labour, extension contacts and gender were significant and found to enhance rice farmers' efficiency thus, contributing to the observed variations of technical efficiency between male and female rice farmers in the study area. Since labour participation was found to be among the variables that contributed to the differences in male and female rice farmers' efficiency, the study suggests the promotion of multipurpose labour-saving household and farm tools to free up females labour time to improve female output and efficiency to ensure food security in Ghana. Such interventions have the potential to improve female rice farmers' income and reduce inequalities in income between male and female farmers.

References

[1] Boserup, E, The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure. London, G. Allen and Unwin, 1965; Chicago: Aldine, 124 pp. 1965.

[2] Bell, L.S, "Farming, sericulture, and peasant rationality in wuxi county in the early 20th century," in T. Rawski and L. Li., eds, Chinese History in Economic Perspective. University of California Press, Berkeley, 1992.

[3] Ruthenberg, H. Farming systems in the tropics. Clarendon Press, Oxford, 1976.

[4] Davidson, J. "We work hard: customary imperatives of the diola work regime in the context of environmental and economic change," African Studies Review, 52(2), 119-141. 2009

[5] World Bank, FAO, IFAD. Gender in agriculture: A sourcebook. Washington: World Bank, 2008.

[6] Kula, O. and Dormon, E. Global Food Security Response: Ghana rice study (Micro-Report No.156). Pp. 9. Attachment 1 to the Global Food Security Response. West Africa Rice Value Chain Analysis, 2009.

[7] Ragasa C, Dankyi, A, Acheampong P, Wiredu AN, Chapo-to A, Asamoah M, Tripp R Patterns of adoption of improved rice technologies in Ghana (Working Paper 35). Ghana Strategy Support Programme. 2013.

[8] Abdulai, A. and Huffman, W. "Structural adjustment and economic efficiency of rice farmers in northern Ghana". Journal of Economic Development and Cultural Change, 48(3), 503-520. 2000.

[9] Seidu, A. Farm-specific technical efficiency, resource use and employment: An analysis of smallholder rice farmers in the Upper East Region of Ghana". Unpublished PhD thesis, University of Ghana. 2004.

[10] Seidu, A., Sarpong, D.A. and Al-hassan, R. "Allocative efficiency, employment and rice production risk: An analysis of smallholder paddy farms in the Upper East Region of Ghana". Journal of Development Studies, 1(2): 142-63. 2004.

[11] Food and Agricultural Organization (FAO). Gender: the key to sustainability and food security. SD Dimensions, May 1997 (available at www.fao.org/sd).

[12] Olawoye, J.E., Agumagu, A.C., Gbadegesin, A., Akande, S.O. and Yahaya, M. Situational Analysis of Nigerian Women and Girls. Agricultural Production and Rural Productivity Sector for WORDOC coordinated research project for UNICEF. Ibadan. 1994.

[13] Buss, D.M. "Human mate selection: Opposites are sometimes said to attract, but in fact we are likely to marry someone who is similar to us in almost every variable". American scientist, Vol. 73, No. 1, pp. 47-51. February 1985.

[14] Paris, T. Women farmers in research and technology development. 2013. http://irri.org/index.php?option=com_k2&view=item&id=12636: women-farmers-in-research-and-technology-development.

[15] FAO. Gender inequalities in rural employment in Ghana: an overview. 2012. http://www.ststsghana.gov.gh (accessed 20/03/2015).

[16] Suárez, R. "Gender disparities in time allocation, time poverty, and labour allocation across employment sectors in Ethiopia". Africa Development Forum Series, Washington DC. pp. 299-332. 2010.

[17] Antonopoulus, R. and Hirway, I. "Unpaid Work and the Economy: Gender, Time Use and Poverty in Developing Countries", eds., Basingstoke, United Kingdom: Palgrave MacMillan, a division of Macmillan publishing limited, 3-4: pp: 1-21. 2010.

[18] Ardayfio-Schandorf E. Enhancing opportunities for women in development: pamscad women in development project; Unpublished Base-line Survey Report, Western Region, prepared for WID Secretariat, Ministry of Local Government, Accra. 1991.

[19] FAO. "Building on Gender, Agrobiodiversity and Local Knowledge". Training Manual. FAO, Rome. 2004.

[20] Palacios-Lopez, A., Christiaensen, L. and Kilic, T. How much of the labour in African agriculture is provided by women? (Policy Research Working Paper 7282), World Bank Group. 2015.

[21] Warner, J.M. and Campbell, D.A. "Supply response in an agrarian economy with non-symmetric gender relations". World Development, 28(7):1327-1340. 2000.

[22] Arora, D. "Gender Differences in Time-Poverty in Rural Mozambique" Review of Social Economy, 73:2, 196-221. 2015.

[23] Edriss, A. Tchale, H. and Wobst, P. The impact of labour market liberalization on maize productivity and rural poverty in Malawi. working paper. Policy Analysis for Sustainable Agricultural Development (PASAD). Center for Development Research, University of Bonn, Germany. 2004.

[24] Tarimo, E.A.M. Kohi, T.W. Outwater, A. and Blystad, A. "Gender roles and informal care for patients with aids: a qualitative study from an urban area in Tanzania". Journal of Transcultural Nursing, 20(1):61-68. 2009.

[25] Darity, W.J. "The formal structure of a gender-segregated low-income Economy". World Development, 23(11):1963-1968. 1995.

[26] Njuki, J., Kaaria, S., Chamunorwa, A. and Chiuri, W. "Linking smallholder farmers to markets, gender and intra-household dynamics: does the choice of commodity matter? " European Journal of Development Research, 23(3), 426-443. 2011.

[27] Quentin, W. and Yvonne, Y. "Domestic work time in Sierra Leone". World Bank's Africa Development Forum, World Bank. Washington, DC: p.333-356, 2010.

[28] Konings, P. Gender and Plantation Labour in Africa: The Story of Tea Pluckers' Struggles in Cameroon. Oxford: African Books Collective. African Studies Centre, Leiden, 2012.

[29] Alderman, H., Hoddinott, J., Haddad, L. and Udry, C. Gender differentials in farm productivity: implications for household efficiency and agricultural policy. FCND Discussion Paper No. 6. Washington, D.C. 20036-3006 U.S.A. 1995.

[30] FAO. Women in agricultural cooperatives. Rome, Italy. 1983.

[31] Aigner, DJ., Lovell, C.A.K. and Schmidt, P.J. "Formulation and estimation of stochastic frontiers production function models". Journal of Econometrics, 6(1): 21-7. 1977.

[32] Meeusen, W. and van den Broeck, J. (1977). "Efficiency Estimation from Cobb-Douglas Production Functions With Composed Error", International Economic Review 18, 435-444. 1977.

[33] Coelli, T. and Battese, G. "Identification of factors which influence the technical inefficiency if Indian farmers". Australian Journal of Agricultural Economics, 40(2): 103-128. 1996.

[34] Adekunle, W. Improving smallholder incomes through intensification of upland rice. A case study produced by WREN media, funded by the Swiss Agency for Development and Cooperation (SDC) and implemented by the European Initiative on Agricultural Research for Development (EIARD). 2013.

[35] FAO. FAO policy on gender equality. attaining food security goals in agriculture and rural development. Rome: FAO. 2013.

[36] Parveen, S. "An empirical analysis of the gender division of labour in farm households: evidence from Bangladesh". Research Publication Journal, 2 (4): 693-699. 2009.

[37] Kinkingninhoun-Mêdagbé FM, Diagne A, Simtowe F A, Agboh-Noameshie R, Adegbola, P.Y. "Gender discrimination and its impact on income, productivity and technical efficiency: evidence from Benin". Agriculture and Human Values, 2 (1): 57-69. 2008.

[38] Bindlish, V. Evenson, R. and Gbetibouo, M. Evaluation of T&V-based extension in Burkina Faso. World Bank Africa Technical Department Paper No. 226. World Bank, Washington DC. 1993.

[39] Oladeebo, J.O. and Fajuyigbe, A.A. "Technical efficiency of men and women upland rice farmers in Osun state, Nigeria". Journal of Human Ecology, 22 (2): 93-100. 2007.

[40] Evenson, R.E. and Mwabu, G. The effects of agricultural extension on farm yields in Kenya. Discussion Paper No. 978. Economic Growth Center, Yale University. (1998).

[41] Owens, T., Hoddinott, J. and Kinsey, B. "The impact of agricultural extension on farm production in resettlement areas of Zimbabwe". Economic Development and Cultural Change, 51 (2): 337-357. 2003.

[42] Yiadom-Boakye, E, Owusu-Sekyere, E, Nkegbe, PK, and Ohene-Yankyera, K. "Gender, resource use and technical efficiency among rice farmers in Ashanti Region, Ghana". Journal of Agricultural Economics and Development. 2(3), 102-110. March, 2013.

[43] Udry, C. Gender, agricultural productivity, and the theory of the household (Discussion Paper TI 94-118). Amsterdam-Rotterdam: Tinbergen Institute. 1994.

[44] Saito, K. A., Mekkonen, H. and Spurling, D. "Raising the productivity of women farmers in sub Saharan Africa (World Bank Discussion Paper 230)". Experimental Agriculture, 31, pp 392-392. 1994.