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Farm Economic Efficiency Gap Due to Gender Discrimination-Evidence from Usaid Markets II Programme Participating Small-Scale Farmers in Kano State of Nigeria

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ABSTRACT: *The study explores the influence of gender discrimination on the agricultural economic efficiency gap between women and men farmers in Nigeria's Kano State, as part of the USAID MARKETS II initiative. A structured questionnaire supported by an interview schedule was utilized to extract cross-sectional data from 189 participants selected by a multi-stage sample technique using a simple cost-route strategy. Both descriptive and inferential statistics were applied to the acquired data. Gender disparity has both an effect and an impact on the farm economic efficiency of women farmers, putting them at a disadvantage compared to their male counterparts, according to scientific research. Besides, the extension gap which affected the farm economic efficiency of the women farmers compared to the men is due to gender stereotype. Further, in isolating the impact of gender differential, it was observed that gaps of technical and cost efficiencies between the two genders owe majorly to gender discrimination. In addition, both gender discrimination and the endowment factor had an equal contribution to the yield gap between the two groups. However, the profit efficiency gap between the genders is due majorly to endowment effect. In general, it can be concluded that gender discrimination, i.e. gender inequality and gender stereotype, has slowed the active engagement of women beneficiaries in the program, hence impeding the continuation of their farm businesses. As a result, in order for the program to be sustainable, it should include a gender budget in its strategy, allowing women to break the curse of gender inequality, which has limited access to and control over productive resources.*

Keywords*: Gender, differential, gap, programme, Nigeria*

INTRODUCTION

Low agricultural productivity growth rates are often viewed as one of the key causes of Africa's current high poverty and food insecurity levels, particularly in rural regions. Despite tremendous progress over the last two decades, Africa continues to lag behind in terms of production and yield levels, modern input utilization rates, technology acceptability, and access to finance and insurance markets that are usually failing or incomplete (Dillon and Barrett, 2014; FAO, 2015).

The African agricultural sector's poor performance is a major hindrance to the continent's economic development and precludes fundamental transformation (AfDB *et al*., 2015). Increased agricultural productivity for smallholder farmers in Sub-Saharan Africa (SSA) is thought to reduce poverty more effectively than growth in other economic sectors (de Janvry and Sadoulet, 2010; Kilic *et al*., 2013; Mukasa and Salami, 2015). Many efforts, such as the USAID MARKETS, IFAD, and FADAMA programmes, have been created in recognition of agriculture's vital role in Africa's socio-economic development and productivity increase.

Aside from the aforementioned roadblocks to African agriculture reform, it's also worth mentioning the frequently identified gender inequities in agriculture. Over the last three decades, there has been a greater emphasis on gender issues and women's empowerment in terms of agriculture and economic growth (Olakojo, 2017). This is based on a growing recognition that failure to pay closer attention to men and women's differing societal positions in terms of resource allocation, opportunities, and rights in the formulation, design, and implementation of development policies and projects can have a negative impact on development outcomes (Olakojo, 2017).

Gender has long been recognized as a significant determinant in the allocation and use of productive resources around the world. Gender disparities in the agriculture sector may have an impact on the sourcing and efficient application of production elements (World Bank, 2012; Odunlami *et al*., 2016). The causes and effects of agricultural production inequalities between male and female farmers are of great concern, particularly in sub-Saharan Africa. In SSA, women account for over half of the agricultural workforce, but they have limited access to credit and other financial markets. They also have limited control over their resources, low agricultural yields, low rates of modern input and technology adoption, and a scarcity of people and physical capital (Mukasa and Salami, 2015). Despite claims that female farmers' lower levels of physical and human capital lead to lower measured productivity or an inability to respond to economic incentives, this is not the case (Sadiq *et al*., 2020a; Gebre *et al*., 2021).

Gender-based inequalities in economic capacities and incentives, which affect intra-household resource allocation, land productivity and welfare levels, limit women's ability to contribute to and participate in economic progress. Though the size of these agricultural gender disparities varies by SSA countries and over time, they typically range from 20% to 30% (Kilic *et al*., 2013; Croppenstedt *et al*., 2013; Aguilar *et al*., 2014; Oseni *et al*., 2015; Gebre *et al*., 2021; Kilic *et al*., 2013). According to the World Bank and the United Nations, failure to recognize (gender) responsibilities, inequities, and injustices poses a serious threat to the agricultural development agenda's efficacy (Olakojo, 2017). Increased integration of Africa's agriculture sector into the global value chain is also critical for the region's transformation, according to the African Development Bank (2015). The economic empowerment of women through increased productivity and engagement in commercial and higher-value-added agricultural operations is, nevertheless, one of the most essential parts of this development (AfDB, 2015; Olakojo, 2017).

Reducing gender gaps and, as a result, empowering women has affected the actions and policy objectives of SSA governments, while the international development community has contributed major resources to the fight against gender bias. Over half of the agricultural workforce in SSA is female, yet they have restricted access to credit and other financial markets.

With a fast growing population requiring an ever-increasing supply of food, a national poverty rate of 63 percent, and a labor force dominated by agricultural activity, Nigeria's efforts to improve agricultural productivity could not be more timely. Despite the fact that women account for a large share of Nigeria's agricultural workforce, little is known about their actions, duties, and constraints. By thoroughly researching women's agricultural activities, it will be possible to determine not only what they are doing in the agricultural sector, but also how to successfully reduce their limitations and increase productivity.

To build development policies aimed at empowering women and improving their living conditions, in-depth evaluations of the scale and sources of gender productivity gaps are required. Because agriculture is the economic backbone of the study area and the country as a whole, determining the extent and causes of gender productivity disparities is crucial for creating policy responses and empowering women. If the government, civic society, and other players had a greater understanding of women's roles in agriculture, they could more effectively reduce barriers to women farmers and improve the effectiveness of agricultural programs and policies. As a result, the research theme "impact of gender differential on farm economic efficiency in Nigeria's Kano State" was developed along these lines. The study's particular goals were to determine the effect and influence of gender differences on farm economic efficiency, as well as to isolate the impact of gender discrimination on farm economic efficiency.

RESEARCH METHODOLOGY

Kano state lies in northern Nigeria, with latitudes ranging from 10° 33 to 12° 37N and longitudes ranging from 07° 34 to 09° 25E of the Greenwich meridian time. The northern and southern portions of the state's vegetation are characterized by the Northern-Guinea savannah and Sudan savannah, respectively. The yearly rainfall in the Northern-Guinea savannah ranges from 600-1200 mm to 300-600 mm in the Sudan savannah. Furthermore, in the Sudan savannah region, arable crop growth seasons range from 90 to 150 days, and in the Northern-Guinea savannah region, they range from 150 to 200 days. The population of the state is predicted to reach 9.4 million people by 2050 (NPC, 2006), with a 3.5 percent annual growth rate. There are around 1,754,200 hectares of arable land in the state. The bulk of the state's people work in agricultural commodities trading, making it well-known for its commercial activity.

A multi-stage sampling procedure was utilized to choose 195 farmers as a representative sample size from the project sites. The research intentional selection of six (6) participating Local government areas (LGAs) out of nine (9) LGAs for the USAID MARKETS II program was based on a large concentration of smallholder rice producers in the first stage. The LGAs chosen are Bunkure, Garun-Mallam, Kura, Dambatta, Bagwai, and Makoda. Second, each of the listed LGAs had five (5) participating localities chosen at random. In the third stage, nine (9) farmers from Bunkure, Garun-Mallam, and Kura LGAs were picked at random, while four (4) farmers from Dambatta, Bagwai, and Makoda LGAs were chosen at random. As a result, the representative sample size was set at 195 farmers. Only 189 questionnaires, however, were declared valid and were subjected to analysis. Besides, of the total sample size, the men and the women accounted for 116 and 73 respondents respectively. A well-structured questionnaire was used to collect the data for the 2018 rice cropping season, which was supplemented by an interview schedule. Chow-test and Average treatment effect, as well as Endogenous switching regression and Oaxaca-Blinder decomposition models, were used to achieve objectives I and II.

Empirical model

1. Chow F-statistic test

The F-statistics tests for the influence of gender differential, test for homogeneity of slopes, and test for differences in intercepts are listed below, according to Amaefula *et al.* (2012); Sadiq *et al.* (2020a&b); Sadiq *et al.* (2021).

The error sum of squares for asset function of (i) women (ii) men (iii) pooled data without a dummy variable (iv) pooled data with a dummy variable (men =1, women =0) are as follows to isolate the effect of gender differential:

Test for effect of gender differential:

$$F^* = \frac{[\sum \varepsilon_3^2 - (\sum \varepsilon_1^2 + \sum \varepsilon_2^2)]/[K_3 - K_1 - K_2]}{(\sum \varepsilon_1^2 + \sum \varepsilon_2^2)/K_1 + K_2} \quad (1)$$

Where $\sum \varepsilon_3^2$ and K_3 represent the error sum of square and degree of freedom for the pool (women and men), $\sum \varepsilon_1^2$ and K_1 represent the error sum of square and degree of freedom for the women group, and $\sum \varepsilon_2^2$, and K_2 represent the error sum of square and degree of freedom for the men group.

If the F-cal is bigger than the F-tab, it means that the women's gender has an impact on farm economic efficiency.

Test for homogeneity of slope:

$$F^* = \frac{[\sum \varepsilon_4^2 - (\sum \varepsilon_1^2 + \sum \varepsilon_2^2)]/[K_4 - K_1 - K_2]}{(\sum \varepsilon_1^2 + \sum \varepsilon_2^2)/K_1 + K_2} \quad \dots\dots (2)$$

The error sum of squares and degree of freedom for the pool (both women and men) with a dummy variable are $\sum \varepsilon_4^2$ and K_4, respectively.

If the F-cal is higher than the F-tab, it means that the gender gap causes a structural shift in the farm economic efficiency parameter.

Test for differences in intercepts:

$$F^* = \frac{[\sum \varepsilon_3^2 - \sum \varepsilon_4^2]/[K_3 - K_4]}{\sum \varepsilon_4^2/K_4} \quad \dots\dots\dots (3)$$

If the F-cal is higher than the F-tab, it means that the women's agricultural economic efficiency differs from that of the men.

2. Average treatment effect (ATE)

ATE shows the average difference in outcomes between units assigned to care and those assigned to placebo (control). Lokshin and Sajaia (2011); Wang *et al*. (2017); Sadiq *et al.* (2020a & b); Sadiq *et al.* (2021) provide the following equation:

Gender index of the women is given by: $E(y_{1i}|I = 1; X)$ ... ... (4)

Gender index of the men is given by:

$E(y_{2i} \mid I = 0; X)$ .... (5)

Gender index of the women if there is no gender difference is denoted by:

$E(y_{2i} \mid I = 1; X)$ ... ... (6)

Gender index of the men if there is a gender difference is denoted by:

$E(y_{1i} \mid I = 0; X)$ ... ... (7)

Where:

$E(.)$ = Expectation operator

y_{1i} = Economic efficiency of the women farmers (dependent variable)

y_{2i} = Economic efficiency of the men farmers (dependent variable)

I = Dummy variable (1 = women, 0 = men)

X = Explanatory variables that is common to both women and men farmers.

ATT $= E(y_{1i} \mid I = 1; X) - E (y_{2i} \mid I = 1; X)$ (8)

$ATU = E(y_{1i} \mid I = 1; X) - E (y_{2i} \mid I = 1; X)$ (9)

Average Treatment effect on Treated = ATET

Average Treatment effect on Untreated = ATEU

Equations (8) and (9) were further simplified as:

$$\text{ATT} = \frac{1}{N_1}\sum_{i=1}^{N_1}[p\ (y_{1i} \mid I = 1; X) - p(y_{2i} \mid I = 1; X)] \ldots\ldots\ (10)$$

$$\text{ATU} = \frac{1}{N_2}\sum_{i=1}^{N^2}[\ p\ (y_{2i} \mid I = 0; X) - p(y_{1i} \mid I = 0; X)] \ldots\ldots (11)$$

Where, N_1 and N_2 are number of women and men farmers respectively, and p= probability.

Endogenous switching regression model:

Y=dependent variable (efficiency indices-technical, cost, profit; and, Yield); X_{1-n}= independent variables; β_0= Intercept; β_{1-n} = Regression coefficient; and, ε_t = Stochastic.

3. Oaxaca-Blinder decomposition model

Using the classic Oaxaca-Blinder technique, the extent to which discrepancies in observable human capital traits may be explained by farm economic efficiency disparities between women and men farmers was studied (Oaxaca, 1973; Blinder, 1973; Marwa, 2014; Revathy *et al*., 2020; Sadiq *et al.*, 2020a&b; Sadiq *et al.*, 2021). The farm economic efficiency functions are as follows:

$ln\bar{Y}_F = \beta_0 + \beta_i \sum_{i=1}^{i} X_i + \varepsilon_i$ ... ... (12)

$ln\bar{Y}_M = \beta_0 + \beta_i \sum_{i=1}^{i} X_i + \varepsilon_i$ ... ... (13)

Where, $\bar{Y}_F$= average farm economic efficiency of women farmers; $\bar{Y}_F$ = average farm economic efficiency value of men farmers;

$X_{i-n} = explanatory\ variables; \beta_0 = intercept;$ $\beta_{i-n} = parameter\ estimates;$ and, $\varepsilon_i = stochastic\ term.$

The total difference can be explain by,

$\Delta lnY = ln\bar{Y}_F - ln\bar{Y}_M$ ……...................….. (14)

The Oaxaca-Blinder decomposition equation is,

$ln\bar{Y}_F - ln\bar{Y}_M = \left(\bar{X}_F\hat{\beta}_F - \bar{X}_M\hat{\beta}_M\right) + \left(\bar{X}_M\hat{\beta}_F - \bar{X}_M\hat{\beta}_F\right)$.. (15)

$\therefore ln\bar{Y}_F - ln\bar{Y}_M = (\bar{X}_F - \bar{X}_M)\hat{\beta}_F + \left(\hat{\beta}_M - \hat{\beta}_F\right)\bar{X}_M$ (16)

Where the first $(\bar{X}_F - \bar{X}_M)\hat{\beta}_F$ and the second $\left(\hat{\beta}_M - \hat{\beta}_F\right)\bar{X}_M$ terms respectively, captured the endowment effect (characteristics difference between the women and men) and the structural (discrimination) effect.

RESULTS and DISCUSSION

Effect of gender differential on farm economic efficiency

A perusal of Table 1 shows that gender differential has an effect on the farm economic efficiency *viz*. technical, cost, profit efficiencies, and productivity of the women as evidenced by the plausibility of their respective Chow F- statistics at 10% level of significance. This implies that gender inequality--poor access to and control of productive resources induced disparity in the farm economic efficiency of women, thus a disadvantage to women's active participation in the programme. Besides, given that economic inefficiency also owes to extension gap, it can be inferred that gender stereotype *viz.* cultural and religious barriers inhibited the economic efficiency of the women farmers involved in the programme. Furthermore, for the slope homogeneity test, the plausibility of all the farm economic efficiency indicators' F-statistics at 10% level of significance implies that gender differential brought about a structural change or shift in the resource endowment of the women. This confirms heterogeneity of slopes-- gender difference gave rise to differences in the farm economic efficiency between the women and men. In addition, it implies that the slopes of the farm economic efficiency functions are heterogeneous. The heterogeneity of slopes indicates that the economic efficiency functions are factor-biased. Besides, the empirical evidence showed that gender differential has an effect on the technical know-how i.e. managerial efficiency of the women as evidenced by the respective F-statistics of the economic efficiency indicators that are within the acceptable margin of 10% significance level.

Impact of gender differential on farm economic efficiency

Except for inverse-probability weight estimation, the negative sign and plausibility of the ATEs coefficient of regression adjustment, propensity-score matching, and nearest-neighbor matching at 10% level of significance imply that gender differential has a negative significant impact on the technical efficiency of the women (Table 2). Consequently, the decline in the average technical efficiency score of the women farmers by 12.91, 7.92, and 14.68% respectively for regression adjustment, propensity-score matching, and nearest-neighbor matching against the men farmers. Furthermore, the plausibility of the ATETs for all the treatment effect estimations showed that due to gender differential, poor access and control of productive resources coupled with a gender stereotype, averagely, the women group lost technical efficiency scores of 11.46, 11.87, 11.87, and 12.57% vis-à-vis regression adjustment, propensity-score matching, nearest-neighbor matching, and inverse-probability weight, respectively. Whereas due to the gender differential, adequate access and control of productive resources, except propensity-score matching and inverse-probability weight, averagely, the men gained technical efficiency of 13.82 and 16.43% vis-à-vis regression adjustment and nearest-neighbor matching ATEUs estimated coefficients, respectively. Generally, the possible reason for the lagging technical efficiency *viz.* poor output potential of the women owes to gender inequality-disadvantage in access, and control over productive assets and gender stereotype, religion and cultural constraints which inhibit their active participation in the rice upstream supply chain.

Using the mean estimates *viz.* regression adjustment, both gender categories are not operating on the frontier. The average efficient score of 0.908 for the men show them to be more efficient than the women who recorded an average technical efficiency score of 0.779. The men has a marginal potential efficiency gap-output loss of 9.2% compared to 22.1% for the women. Besides, the average technical efficiency score gap between the women and the men is 14.21% [1-(0.779/0.908)*100]. Likewise, the mean efficiency values of the inverse-probability weight showed both genders not to be on the frontier vis-à-vis efficiency scores of 0.912 and 0.888, respectively, for men and women. However, there is an improvement in the average efficiency score when compared to the regression adjustment estimation. Thus, it implies that the men and women were 8.79% and 11.23%, respectively, from the potential output level while the efficiency gap-output gap between them is 2.67% [1-(0.888/0.912)*100]. Both treatment estimations show the mean efficiency scores of both gender categories to be within the acceptable margin of 10% error gap.

Table 1. Effect of gender differential on farm economic efficiency.

Asset	Items	ESS	DF	Test	F-stat
TE	Female	0.090429	71		
	Male	0.194314	114	I	350.8044***
	Pooled	0.824684	186	II	31.00561***
	Pooled with dummy	0.438114	186	III	164.1171***
CE	Female	0.648957	71		
	Male	3.561433	114	I	34.07652***
	Pooled	4.985933	186	II	22.7169***
	Pooled with dummy	4.902321	186	III	3.172341***
PE	Female	2.275771	71		
	Male	3.638185	114	I	17.30726***
	Pooled	6.467223	186	II	9.765459***
	Pooled with dummy	6.375466	186	III	2.67695***
Yield	Female	12.49604	71		
	Male	29.90082	114	I	38.12508***
	Pooled	51.13407	186	II	21.41371***
	Pooled with dummy	49.76203	186	III	5.128397***

Source: Field survey, 2018
Note: *** ** * & NS means significant at 1%, 5%, 10% & Non-significant, respectively.
TE= Technical efficiency; CE= Cost efficiency; PE= Profit efficiency

A cursory review of the cost efficiency results showed only the regression adjustment ATE coefficient to be within the acceptable margin of 10% degree of freedom against treatment effect estimations ATEs coefficients viz. propensity-score matching, nearest-neighbor matching, and inverse-probability matching that were not different from zero at 10% error gap (Table 2). The positivity of the regression adjustment ATE implies that gender differential has positive significant impact on the cost efficiency of the women, thus incurred an extra cost of 5.26% to the average actual total production cost against their men counterparts. The possible reason for cost-cut disadvantage of the women may be majorly attributed to ineffective harnessing of social capital in the downstream rice supply chain. Furthermore, due to the gender differential, the women wasted cost of approximately 10.50, 6.29, 4.45, and 7.09% from their average actual total production cost vis-à-vis the treatment effect estimations as indicated by their respective ATETs parameter coefficients which are different from zero at 10% error level. While due to gender difference, the men gained cost-cut of 7.32% from their average actual cost as indicated by the inverse-probability weight ATEU coefficient which is within the permissible margin of 10% error gap. The possible reason for female gender cost wastage may be attributed to gender stereotype-poor utilization of social capital pooling in the rice downstream supply chain while the cost-cut gain of men owes to active utilization of social capital pooling-market intelligence-information-outlook *viz.* active participation in both the rice downstream and upstream supply chains.

Based on the cost efficiency mean scores *viz.* regression adjustment and inverse-probability weight, both genders are above the minimum cost frontier. However, for the former, the male gender is better in managing their costs compared to their women counterparts given the cost deviation percentages of 10.81 and 16.08% respectively. Whereas for the latter, the reverse is the scenario in cost wastage, given the cost deviation percentages of 12.77% and 8.69% for the men and women, respectively. The cost margins between the men and women are 4.75 and 3.76% vis-à-vis regression adjustment and inverse-probability weight, respectively.

All the treatment effect estimations showed that gender differential has no significant impact on the profit efficiency of the women as evidenced by their respective ATE estimated coefficients which were not different from zero at 10% probability (Table 2). Besides, within the women, treatment effect estimations *viz.* propensity-score matching and inverse-probability weight show gender differential to have negative impact on the profit efficiency of the women as evidenced by their respective ATETs estimated coefficients which were within the acceptable margin of 10% probability of error. This implies that due to gender differential, the women lost profit efficiencies of 15.46 and 15.03% vis-à-vis propensity-score matching and inverse-probability weight, respectively. The possible reason is poor access to market information *viz*. gender stereotype which inhibited their profit margin. While within the men, the plausibility of the inverse-probability weight ATEU estimated coefficient at 10% probability level and its negativity implies that due to gender differential, the men lost 15.36% of their profit efficiency. Given that men farmers are not constrained with gender stereotype and access and control over productive resources, the possible reason for the profit lost may be attributed to pressing need for cash requirement to meet farm and household obligations.

The negativity and plausibility of the regression adjustment and nearest-neighbor matching ATE estimated coefficients at 10% degree of freedom level imply that gender difference has negative significant impact on the average yield level of the women, thus plummeted their yield by 896.09 and 776.59 kg, respectively, against their men counterpart (Table 2). Thus, it can be inferred that gender inequality *viz*. poor access and control over productive resources affected resource productivity of the women, thus plummeted their average yield level. Furthermore, within the women, the negativity and plausibility of the ATET estimated coefficients at 10% vis-à-vis the regression adjustment and nearest-neighbor matching indicate that due to gender differential the women lost 1038.04 and 603.40 kg, respectively, of rice output. Whereas, the men category gained 807.22 and 885.03 kg in their output due to gender difference as evidenced by the plausibility of the ATEUs estimated coefficient at 10% level of significance vis-à-vis regression adjustment and nearest-neighbor matching, respectively.

Efficiency gap due to gender discrimination

In isolating the impact of gender differential *viz*. Oaxaca-Blinder decomposition technique, empirical evidence showed that technical and cost efficiencies gaps between the two genders owe largely to gender discrimination (Table 3). Gender discrimination accounts for 77.75 and 97.65% in respect of technical and cost efficiencies gaps while the endowment effect accounts for 22.25 and 2.35% gaps of the former and latter, respectively. For the yield gap, it was observed that the gap between the two genders owes equally to gender discrimination and the endowment effect; though the effect of the former is marginally higher than that of the latter. Thus, gender discrimination accounts for 50.89% of the yield gap between the two genders while the endowment effect accounts for 49.11%. Therefore, it can be inferred that the structural difference termed gender had dominant effects on the technical and cost efficiencies differential between the two genders while its effect was not dominant in the yield gap given that the explained and unexplained effects are almost at par. However, an inverse scenario was observed in the case of profit efficiency whereby the endowment effect dominates in determining the gap in the profit efficiency *viz*. 98.29% against gender discrimination 1.71%. This result clearly brings forward the reason for the non-significant impact of gender differential on profit efficiency observed under ATE. Therefore, based on the profit efficiency gap, it can be inferred that market imperfection is more correlated with endowed-related factors rather than gender discrimination. Further, the contribution of different factors towards the economic efficiency difference between the two genders arises due to the differences in the regression coefficients of the independent variables of the respective economic efficiency endogenous switching regressions.

For technical efficiency, it was observed that endowed factors *viz.* educational level, secondary occupation, mixed cropping, length of adoption of UDP, proportion of farm size cultivated under UDP, TLU and CI favourably contributed to the women group while age, marital status, household size, rice farming experience, extension contact, length of participation in USAID MARKETS II, farm size and dead-stock asset favoured the men. In the case of cost efficiency, empirical evidence showed marital status, educational level, secondary occupation, length of participation in USAID MARKETS II, farm size and dead-stock asset--endowed related farmers characteristics favoured the women while endowed related factors-- age, household size, rice farming experience, mixed cropping, extension contact, length of adoption of UDP, proportion of farm size cultivated under UDP, TLU and CI favoured the men. Besides, for profit efficiency, endowed characteristics *viz*. educational level, secondary occupation, mixed cropping, length of adoption of UDP and dead stock asset contribute favourably to the women while endowed characteristics *viz*. age, marital status, household size, rice farming experience, extension contact, duration of participation in USAID MARKETS II, proportion of farm size cultivated under UDP, TLU, CI and farm size contribute favourably to the men. Further, for yield, it was observed that age, educational level, secondary occupation, household size and farm size-endowed factors favoured the women whereas endowed factors *viz*. marital status, rice farming experience, mixed cropping, extension contact, duration of participation in USAID MARKETS II, length of adoption of UDP, proportion of farm size cultivated under UDP, TLU, CI and dead-stock asset favoured the men. It was observed that educational level and secondary occupation favourable contribution are common to women while rice farming experience and extension contact-favourable contribution are common to the men.

The average values of the women and men cum gaps for the technical, cost, profit efficiencies and yield are 0.7919, 0.9093 and 0.1174; 1.1455, 1.1481 and 0.0027; 0.5152, 0.6285 and 0.1133; and, 2760.77, 3309.50 and 548.73 kg, respectively. From the cost and profit efficiencies total differences of 0.0027 and 0.1133, respectively, the superior endowment of the women is 0.000063 and 0.1113 in respect of the former and latter. Whereas, gender discrimination account for 0.0026 and 0.0019, respectively, of cost and profit efficiency gaps. From the technical efficiency and yield gaps of 0.1174 and 548.73 kg, respectively, superior endowment of the men and gender discrimination are 0.0261 and 0.0912; and, 269.50 and 279.23 kg, respectively, for the former and latter. Therefore, it can be inferred that due to gender discrimination the women lost technical, cost, profit efficiencies and rice output of 9.12, 0.26, 0.19%, and 279.23 kg, respectively. Furthermore, the discrimination values represent 11.52, 0.23, 0.38, and 10.11% of the women's actual average values of technical, cost, profit efficiencies, and yield, respectively.

Thus, with gender discrimination against the women, their actual average technical, cost, profit efficiencies and yield should be 0.8831, 1.148, 0.5172 and 3039.99 kg, respectively. The portion of the gap that can be explained by differences in the covariates is negative vis-à-vis technical efficiency and yield while it is positive vis-à-vis cost and profit efficiencies. This implies that relative to the men, the women on average have more characteristics associated with higher cost and profit efficiencies. While relative to the men, the women on average have fewer characteristics associated with higher technical efficiency and yield.

Table 2. Impact of gender differential on farm economic efficiency.

Items	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat	Coefficient	t-stat
TE	Regression adjustment		Propensity-score matching		Nearest-neighbor matching		Inverse-probability weight	
ATE	-0.1291(0.0126)	10.18***	-0.0792(0.0321)	2.46**	-0.1468(0.0142)	10.27***	-0.0243(0.0342)	0.71^{NS}
ATET (F)	-0.1146(0.0156)	7.33***	-0.1187(0.0495)	2.40**	-0.1187(0.0166)	7.11***	-0.1257(0.0179)	6.99***
ATEU (M)	0.1382(0.0176)	7.83***	0.0545(0.0376)	1.45^{NS}	0.1643(0.0177)	9.28***	0.0048(0.0224)	0.22^{NS}
Mean (F)	0.7793(0.0138)	56.21***					0.9121(0.0063)	145.33***
Mean (M)	0.9084(0.0075)	121.02***					0.8877(0.0334)	26.57***
CE								
ATE	0.0526(0.0301)	1.75*	0.02629(0.02299)	1.14^{NS}	0.0196(0.0289)	0.68^{NS}	-0.0408(0.0365)	1.12^{NS}
ATET (F)	0.10497(0.0374)	2.80***	0.0629(0.0245)	2.57**	0.0445(0.0236)	1.88*	0.0709(0.0191)	3.71***
ATEU (M)	-0.0199(0.0394)	0.50^{NS}	-0.0034(0.0296)	0.11^{NS}	-0.00397(0.03776)	0.11^{NS}	0.0732(0.0329)	2.22**
Mean (F)	1.1608(0.0236)	49.10***					1.0869(0.0323)	33.6***
Mean (M)	1.1081(0.0184)	60.10***					1.1277(0.0165)	68.4***
PE								
ATE	-0.0543(0.0481)	1.13^{NS}	-0.0315(0.0650)	0.48^{NS}			0.1026(0.0821)	1.25^{NS}
ATET (F)	-0.0343(0.0517)	0.66^{NS}	-0.1546(0.0252)	6.13***			-0.1503(0.0354)	4.25***
ATEU (M)	0.0669(0.0651)	1.03^{NS}	-0.0456(0.0964)	0.47^{NS}			-0.1536(0.0569)	2.70***
Mean (F)	0.5458(0.0434)	12.59***					0.7445(0.0803)	9.27***
Mean (M)	0.6001(0.0253)	23.67***					0.6419(0.0171)	37.54***
Yield								
ATE	-896.09(397.64)	2.25**	19.398(906.50)	0.02^{NS}	-776.59(253.98)	3.06***		
ATET (F)	-1038.04(512.09)	2.03**	-740.38(1515.45)	0.49^{NS}	-603.39(324.26)	1.86*		
ATEU (M)	807.22(471.98)	1.71*	-495.09(1043.99)	0.47^{NS}	885.03(286.28)	3.09***		
Mean (F)	2602.45(300.69)	8.65***						
Mean (M)	3498.54(270.51)	12.93***						

Source: Field survey, 2018
Note: *** ** * $^{\&\ NS}$ means significant at 1%, 5%, 10% & Non-significant, respectively.
F= Female; M=Male

Table 3. Economic efficiency gap due to gender discrimination.

Items	Mean		TE coefficient		CE coefficient		PE coefficient		Yield coefficient	
	F	M	F	M	F	M	F	M	F	M
Intercept			0.669324	0.68947	1.113774	0.079847	0.651906	0.243695	8.074197	6.013784
Age	36	42.00862	0.00133	0.00172	0.00177	0.00337	0.000291	0.002794	-0.0091	0.004248
Marital status	0.931507	0.905172	-0.12762	-0.09225	0.082585	-0.03737	-0.07522	-0.07511	-0.55103	-0.01312
Educational level	2.178082	7.534483	-0.01376	-0.00557	-0.00563	0.0027	-0.01699	-0.00601	-0.02289	-0.00425
Secondary occupation	0.164384	0.422414	-0.0225	0.01144	-0.02766	-0.0291	-0.05666	-0.00292	-0.31978	0.064676
Household size	11.08219	8.206897	-0.00484	-0.00337	-0.00523	-0.00557	-0.00279	-0.00521	0.013058	-0.02056
Experience (rice)	6.60274	16.02586	0.010351	0.00337	0.002109	-0.00348	0.013562	0.007616	0.018973	-0.00151
Extension contact	0.657534	0.974138	-0.23043	-0.09278	0.000122	-0.03211	-0.11866	0.027656	0.012492	-0.33353
Mixed cropping	0.986301	0.991379	0.240956	0.180127	0.12397	0.159754	0.362972	0.314837	0.714819	1.071834
Length of participation in MKT11	3.369863	3.931034	0.0168	0.013897	-0.01344	0.015369	0.000966	0.020396	0.003172	0.150557
Length of adoption of UDP	2.452055	3.422414	-0.00462	-0.00146	0.016333	0.001251	-0.01493	-0.01867	0.024297	-0.03015
% of farm under UDP	56.23288	48.92241	7.42E-05	-7.2E-05	-0.00143	-0.00139	-0.00091	0.000172	-0.00134	0.001026
TLU	0.865753	1.443793	-0.00518	-0.00378	0.026357	-0.0119	0.072039	0.026695	0.139098	0.032189
CI	0.706389	0.703465	0.079554	0.105059	-0.04873	0.024192	-0.43797	-0.02134	-0.3727	0.711094
Rice farm size	0.597123	0.869138	0.016647	-0.01692	-0.06106	0.000802	0.072691	0.005631	-0.79716	-0.34841
Dead-stock (₦)	38097.12	100379.1	0.001565	0.004957	-0.00343	0.085185	-0.00782	-0.0079	0.023919	0.039292
TE	0.791906	0.909253	-	-	-	-	-	-	-	-
CE	1.145469	1.14814	-	-	-	-	-	-	-	-
PE	0.515207	0.628481	-	-	-	-	-	-	-	-

Source: Field survey, 2018

Table 3. Continued.

Items	TE decomposition		CE decomposition		PE decomposition		Yield decomposition	
	EE	SE	EE	SE	EE	SE	EE	SE
Intercept		-0.02015		1.033927		0.408211		2.060413
Age	-0.00799	-0.0164	-0.01064	-0.06721	-0.00175	-0.10516	0.054657	-0.56056
Marital status	-0.00336	-0.03202	0.002175	0.108578	-0.00198	-9.6E-05	-0.01451	-0.4869
Educational level	0.073722	-0.0617	0.030155	-0.06276	0.090999	-0.08273	0.122609	-0.14042
Secondary occupation	0.005807	-0.01434	0.007136	0.00061	0.014621	-0.0227	0.082512	-0.1624
Household size	-0.01393	-0.0121	-0.01504	0.002751	-0.00802	0.019865	0.037545	0.275906
Experience (rice)	-0.09754	0.111878	-0.01987	0.08954	-0.12779	0.095279	-0.17879	0.328226
Extension contact	0.072955	-0.13409	-3.9E-05	0.031402	0.037568	-0.14253	-0.00396	0.337073
Mixed cropping	-0.00122	0.060305	-0.00063	-0.03548	-0.00184	0.04772	-0.00363	-0.35394
Length of participation in MKT11	-0.00943	0.01141	0.00754	-0.11323	-0.00054	-0.07638	-0.00178	-0.57938
Length of adoption of UDP	0.004486	-0.01081	-0.01585	0.051617	0.014485	0.012822	-0.02358	0.18633
% of farm under UDP	0.000542	0.007143	-0.01043	-0.00182	-0.00663	-0.05283	-0.00977	-0.11559
TLU	0.002995	-0.00202	-0.01524	0.055229	-0.04164	0.065467	-0.0804	0.154356
CI	0.000233	-0.01794	-0.00014	-0.0513	-0.00128	-0.29309	-0.00109	-0.76241
Rice farm size	-0.00453	0.029177	0.016609	-0.05376	-0.01977	0.058285	0.216839	-0.39003
Dead-stock (₦)	-97.49	-340.406	213.7394	-8895.24	487.008	8.56234	-1489.74	-1543.07
Endowment effect	-97.4673		213.7152		486.9544		-1489.54	
Discrimination effect		-340.507		-8894.25		8.494465		-1543.28
Overall effect		-437.975	9107.965			495.4489		-3032.82
% from overall effect	22.25409	77.74591	2.346464	-97.6535	98.2855	1.714499	49.11405	50.88595
Gap		-0.11735		-0.00267		-0.11327		-548.731
Contribution to Gap	-0.02611	-0.09123	-6.3E-05	0.002608	-0.11133	-0.00194	-269.504	-279.227
Without Discrimination (Disc)	0.883139	0.883139	1.148077	1.148077	0.517149	0.517149	3039.992	3039.992
% of Disc. in efficiency/yield		-11.5207		0.227713		-0.37695		-10.1141

Source: Field survey, 2018

Note: EE = Endowment effect; SE= Structural effect

$EE = \beta_F(\bar{X}_F - \bar{X}_M)$; $SE = \bar{X}_M(\beta_F - \beta_M)$

CONCLUSION and RECOMMENDATIONS

The empirical evidence showed that gender differential has a significant effect on the farm economic efficiency of women. Likewise, except profit efficiency, gender differential significantly affected the farm economic performance of women in the long-run, consequently affecting their farm business. Furthermore, in empirically isolating the impact of gender differential on farm economic efficiency, it was established that gender discrimination was majorly responsible for the differences in the technical and cost efficiencies between the two genders. In addition, the effect of gender discrimination was at par with the endowment effect in the case of the yield gap between the two genders. However, in the case of profit efficiency, the endowment effect was the major factor that caused the discrepancy in the profit efficiency between the women and men. Generally, it can be inferred that gender discrimination in access and control over productive resources alongside gender stereotype makes women farmers involved in the programme to be at a disadvantage, thus affecting their farm business. Therefore, the research calls for gender mainstreaming together with gender budget so as to enable the women farmers to overcome challenges posed by gender inequality-- access and control over productive resources. Moreover, there is a need for gender sensitization in the studied area focused on the necessity of women empowerment, and the women farmers should harness social capital *viz.* pooling, thus easing them from the vicious cycle of poverty.

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