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## Article

# Are young maize and rice farmers' profit efficient? A gender differential analysis

Cogent Economics & Finance

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**Suggested Citation:** Fani, Djomo Choumbou Raoul; Ukpe, Udemé Henrietta; Tabetando, Rayner; Nkwi, Gama Emmanuel; Mainassara, Zoubeirou (2023) : Are young maize and rice farmers' profit efficient? A gender differential analysis, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 11, Iss. 2, pp. 1-18, <https://doi.org/10.1080/23322039.2023.2236887>

This Version is available at:

<https://hdl.handle.net/10419/304146>

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**To cite this article:** Djomo Choumbou Raoul Fani, Ukpe Udeme Henrietta, Rayner Tabetando, Gama Emmanuel Nkwi & Zoubeirou Mainassara (2023) Are young maize and rice farmers' profit efficient? A gender differential analysis, Cogent Economics & Finance, 11:2, 2236887, DOI: [10.1080/23322039.2023.2236887](https://doi.org/10.1080/23322039.2023.2236887)

**To link to this article:** <https://doi.org/10.1080/23322039.2023.2236887>



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Published online: 27 Jul 2023.



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Received: 27 March 2023  
Accepted: 09 July 2023

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## DEVELOPMENT ECONOMICS | RESEARCH ARTICLE

# Are young maize and rice farmers' profit efficient? A gender differential analysis

Djomo Choumbou Raoul Fani<sup>1</sup>, Ukpe Udeme Henrietta<sup>2</sup>, Rayner Tabetando<sup>1</sup>, Gama Emmanuel Nkwi<sup>3</sup> and Zoubeirou Mainassara<sup>4\*</sup>

**Abstract:** The recent trend of development policy makes emphasis on gender disparity in performance, especially in the agricultural sector whereby women partake and play a crucial role and their contribution to the sector cannot be overemphasized. However, the contention is whether such disparity in performance exists typically at old age or whether it exists at youth age as well. A representative household survey with structured questionnaires and assistance from extension agents who served as enumerators make use of multistage sampling techniques to collect datasets from 1019 young producer-marketers involved in the two value chains from three regions of Cameroon including Far North, North, and West Regions. Findings show that the mean profit efficiency for young males is 0.53, and 0.61 while for young females are 0.59, and 0.69 respectively. The result found a significant difference (.001; .002) in the profit efficiency among young males and females rice and maize producer-marketers due to socioeconomic and financial factors such as household size, cost of transport, tax paid, amount of credit received, membership to the association, cost of labour, cost of seed, cost of

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### PUBLIC INTEREST STATEMENT

The long-run impact of public agricultural policy in developing countries like Cameroon will depend on the ability of farmers to manage the resources at their disposal. The emphasis on the need to support youths in agriculture especially the young women who constitute a large proportion of the farming population despite their limited access to productive resources affects mainly their productivity and increases the poverty gap compare to their male counterparts. To this end, this study was undertaken to identify socioeconomic and financial factors that affect young male and female maize and rice profit efficiency. Our findings show that young female maize and rice producer-marketers utilize the available resources at their disposal better than their male counterpart with higher profit efficiency. This is significant because it shows the ability of young women to contribute to sustainable agribusiness. Therefore, suggesting that the performance of youth in agriculture cannot be overemphasized.

herbicides and cost of fertilizer. Findings indicate that there is a need to set up agrochemical and improved seed varieties subsidy schemes with special attention given to young female rice and maize producer-marketers given that cost of agrochemical and improved seed varieties significantly affect their profitability. Young females engaged in the rice and maize value chains could benefit from setting up labour-sharing arrangements for mutual help.

**Subjects:** Development Studies; Rural Development; Gender & Development

**Keywords:** agriculture; microanalysis of farm firms; farm households; farm input markets; agricultural markets and marketing; cooperatives; agribusiness; econometric and input-output models; other models

**Subject:** Q1; Q12; Q13; R15

**Keywords:** Profit efficiency; stochastic frontier analysis; producer-marketers; maize; rice; youth

## 1. Introduction

For the past decade, the Food and Agriculture Organization (FAO) has prioritized and recognized the role played by women in the agricultural sector due to their contributions in terms of the workforce and daily survival of the family. Despite such attention, women are yet to be given the same opportunity as their male counterparts in terms of access to productive resources. Empowering young women's participation in agriculture in the context of climate change, and low earnings from farming activities in Cameroon cannot be overemphasized. This study hypothesizes that there is a significant difference in the profit efficiency among young male and female maize and rice producer-marketers. Our study contributes to the literature and filled the knowledge gap by exploring the gender difference at the level of specific determinants of inputs price and inefficiency variables with emphasis on socioeconomic and financial factors that affect their profit efficiency in the production and marketing of rice and maize. Limited or no study emphasized the empirical evidence for young male and female maize and rice producer-marketers<sup>1</sup> profit efficiency to measure gender difference using Stochastic Frontier Analysis (SFA). This study is of interest to potential investors in the two value chains that may take advantage of the comparative analysis of the gender youth performance in the study area especially with the adverse effect of climatic change that required adaptation strategies and availability of young energetic and skilled labour.

The recent trend of development policy makes emphasis on gender disparity in performance, especially in the agricultural sector whereby women partake and play a crucial role. However, the contention is whether such disparity in performance exists typically at old age or whether it exists at youth age as well. Several studies have been carried out on gender differences (Aletheia et al., 2020; Bacha et al., 2019; Gebre et al., 2019; Slavchevska, 2015). However, these studies put little or no emphasis on the gender dimensions among young agriculturalists. Women are constrained in accessing and controlling important factors of production such as land, agricultural inputs, financial resources (credit, subsidies, grants, etc.), and modern agricultural techniques due to disparities established by community customs that lay emphases on male supremacy (Nkhonjera, 2011; Siwajibu, 2017). For example, men are the decision-makers on the use of cash from crop farming and income-generating activities within the household. This pattern allows the management of crops which traditionally form the household diet to be a primary responsibility of women (Leavens & Anderson, 2011; Siwajibu, 2017).

Most farmers in Cameroon are small-scale and they are responsible for the production of about 80% of the country's food crops among which rice and maize are gradually becoming important

staple food due to changes in consumer preferences and rapid urbanization (Epule & Bryant, 2016). To sustain the sector in the increase of national production, policies, and programmes are being set up to support farmers including fertilizer distribution, irrigated areas, milling factories, improved seed varieties, agricultural credit, etc. Despite all these efforts, the country is still relying on the urged importation of Rice and Maize to close the national demand and production gap (Sneyd, 2014).

Young and educated Cameroonians are increasingly deciding on engaging in farming enterprises to earn their living. They more and more acquiring land and other farm inputs to engage in maize production for job creation and income generation. In addition, the Cameroonian Ministry of Agriculture and Rural Development implemented a support project for the installation of young farmers (PEJAB), a program aiming at supporting by training and providing financial start-ups to young farmers to set up their businesses in the agricultural sector, through targeted financial support programs for the youth to engage in the value chain of crops such as Maize, Plantain, Cocoa and Potato (Mbom, 2018).

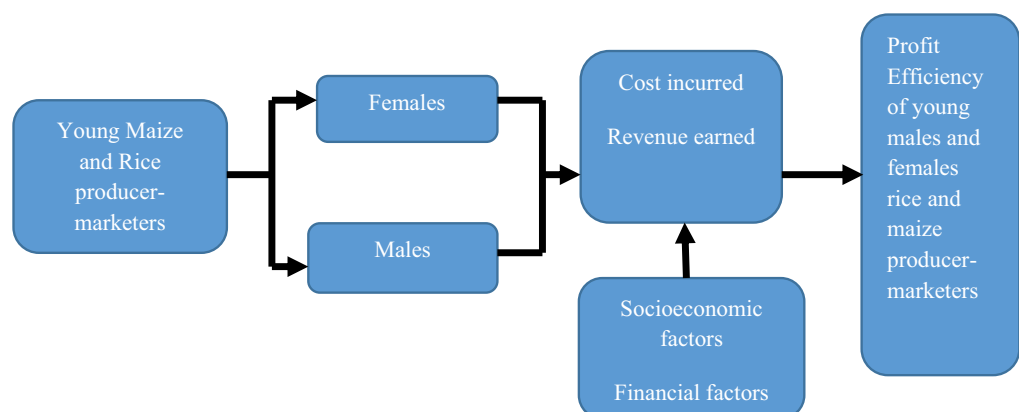
The government of Cameroon has been making considerable efforts over the years to promote and sustain the maize and rice subsectors by empowering the youth in farm businesses and ensuring that they play a key role in development and growth in the present volatile climatic and business environment. Despite these efforts, young agriculturalists are still suffering from declining agricultural productivity and efficiency, especially the females. It is against this backdrop that this study assessed a gender differential in rice and maize profit efficiency with emphasis on the performance of females' agriculturalist.

The result found a significant difference in the profit efficiency among young males and females rice and maize producer-marketers due to socioeconomic and financial factors such as household size, cost of transport, tax paid, amount of credit received, membership to the association, cost of labour, cost of seed, cost of herbicides and cost of fertilizer. Findings indicate that there is a need to set up agrochemical and improved seed varieties subsidy schemes with special attention given to young males and females rice and maize producer-marketers given that cost of agrochemical and improved seed varieties significantly affect their profitability.

## 2. Literature review

For the past years, the analysis and measurement of efficiency have been a topic of great interest in the economic literature in developing countries with emphasis on economic, cost, allocative, and technical efficiencies (Ankaro et al., 2022; Arbelo-Pérez et al., 2017; Belek & Abega, 2021; Molua et al., 2020; Mzyece & Ng'ombe, 2021; Njikam & Alhadji, 2017). In addition to these, most studies related to efficiency analyses compared the differences between men and women based on productivity across samples using plot size as a referential measure for

**Figure 1. SmartArt chart for the gender differential analysis in profit efficiency.**



gender differences in agricultural productivity. Hence, this study is needed and conceptualised as Figure 1 to objectively bridge the research gap and shed light on the role of youth in Cameroon's agriculture industry. Analysing profit efficiency is a paramount source of information for enterprise management than the partial vision offered by analyzing cost efficiency (Abbas & Siddiqui, 2022). Berger and Mester (1997) show that, contrary to initial expectations, profit efficiency is not positively correlated with cost efficiency, suggesting the possibility that cost and revenue inefficiencies may be negatively correlated. Other studies such as Okorie et al. (2021) analyzed the profit efficiency of smallholder cassava farmers in Enugu state, Nigeria. The study employed a multi-stage random sampling technique in selecting 240 cassava farm households. The results showed that profit efficiency ranged between 34.19 and 99.98%, while mean efficiency was 73% with the 27% loss in profit attributed to a combination of technical and allocative inefficiencies. Also, educational level and years of farming experience were the major significant factors that influence profit efficiency positively. Aletheia et al. (2020) assessed gender differences in agricultural productivity in Cote d'Ivoire. They used ordinary least squares with control and non-control variables and found that there are gender differences in agricultural productivity between males and females in Cote d'Ivoire. Bacha et al. (2019) analysed gender differences and their effect on agricultural productivity in Yubdo district, Ethiopia. They used Cobb-Douglas the productivity difference and found that females could have a higher output than males if they have equal access to productive resources. Gebre et al. (2019) examined gender differences in the agricultural productivity of maize farm households in Southern Ethiopia. They used an exogenous switching treatment effect model and found that the productivity of male-headed households was higher than that of female-headed counterparts. Slavchevska (2015) examines gender differences in agricultural productivity using panel data for Tanzania. An Oaxaca-Blinder-type decomposition showed that important factors explaining the gender differential are plot area and family labour. Okonya and Kroschel (2014) analysed gender differences in access and use of selected productive resources among sweet potato farmers in Uganda. They used descriptive statistics and found that male and female-headed households have equal access to and use of agricultural information and credit. Purwanto et al. (2014) on the efficiency of 31 small- and medium-sized tofu enterprises in Salatiga using data envelopment analysis found that only two SMEs were overall efficient, four SMEs were efficient in scale and eight SMEs were technically efficient. The remaining 23 SMEs were inefficient. They also found that the determinants of inefficiency were soybean availability, production expenses, the width of the production area, and the number of employees. Bahta and Baker (2015) find an average profit efficiency of 58% for a sample of 556 small livestock producers in Botswana. The finding established that the factors that influenced the high degree of inefficiency (42%) are education level, distance to the commonly used market, herd size, access to information, and income from crop production.

### 3. Methods

#### 3.1. The study areas

The study was conducted in Cameroon-Far North, North, and West Regions. The Far North Region of Cameroon is located within latitude 11°30'43.20" North and longitude 14°33'03.60" East (Japan International Cooperation Agency JICA, 2015). Far North Region has the highest production area of rice and accounts for 55.28% of the national production. Maize is the third main crop grown in the region after rice and sorghum. The region produced 10% of the national production of Maize (JICA, 2015).

The North Region is located within latitude 8.5809° North and longitude 13.9144° East. Rain-fed agriculture is practiced as in any other part of Cameroon. North Region accounts for 14% and 22% of the national production of Maize and Rice respectively (INS. Institut National de la Statistique, 2015).

West Region is located in the West-Central part of Cameroon within latitudes 5° 20' and 7° North and longitude 9° 40' and 11° 10' East (Djomo et al., 2020; Yerima & Van, 2005). West Region accounts for 18% and 4% of the national production of Maize and Rice respectively (INS, 2015).

### 3.2. Data collection and sampling procedure

With the use of well-structured questionnaires, a multi-stage sampling strategy was employed to collect data for the study. Three of Cameroon's 10 regions were purposefully chosen in the first round based on a priori knowledge that they are maize and rice-producing areas. In the second stage, two important maize and rice markets were chosen at random in each of the three areas, totaling six markets in the West, North, and Far North. A list of maize and rice farmers was collected from the Ministry of Agriculture and rural development's regional delegation in the third step. Following natural criteria such as education, age, and membership, a total sample frame of 2223 and 1615 maize and rice producer-marketers were stratified into young males and females (youth in this study referred to people who have the minimum and maximum age of 18 to 40 years to enter into public civil service in the context of Cameroon). Given that the population sizes of rice and maize producer marketers are widely known, the sample sizes for the various strata were determined via randomization to get the number of respondents for the various strata; a 5% error margin was used to pick the sample size. Rice and maize producer marketers were randomly selected from each group using the Taro Yamane algorithm, yielding sample sizes of 428 (288 males and 140 females) and 591 (434 males and 157 females) respectively.

$$n = \frac{N}{(1 + Ne^2)}$$

$n$  = sample size

$N$  = population of Rice or Maize Producer and Marketers

$e$  = error margin

### 3.3. Model specification/Estimation technique

This study focused on the theory of efficiency using a Stochastic Frontier Analysis (SFA) framework's profit frontier with a Cobb Douglas (CD) functional form. SFA describes a random shock affecting the production not directly attributable to the producer or underlying technology (Aigner et al., 1977; Meeusen & van de Broek, 1977). It assumes that shocks are random and are described by a common distribution. It also analyses the case where the producers are treated as profit maximizers (Kumbhakar & Lovell, 2003). In a two stages approach, SFA is estimated and subsequently, deviations from the frontier are regressed on producers' characteristics (Baltas, 2005).

The CD has the advantage over other functional forms because it estimates assumed elasticity and it is easy to manipulate the CD functional form mathematically compared to other functional forms. The estimated coefficient of the inefficiency function provides some explanation for the relative profit efficiency levels among individual farmers. Since the coefficient of the error term represents inefficiency, a positive sign of the estimated parameter implies that the associated variable has a negative effect on profit efficiency and vice versa. Therefore, the Cobb-Douglas functional form is specified following (Ashok et al., 2017; Bocher & Simtowe, 2016; Saysay, 2016).

$$Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + V_1 - U_1$$

This is assumed to be independently distributed such that Nonnegative random variables are obtained by truncation (at zero) of the normal distribution with variance ( $\delta^2$ ) and mean  $U_1$ .

The inefficiency model of the profit function is expressed in terms of factors such as:



$$U1 = \sigma_0 + \sigma_1 Z_1 + \sigma_2 Z_2 + \sigma_3 Z_3 + \sigma_4 Z_4 + \sigma_5 Z_5 + \sigma_6 Z_6 + \sigma_7 Z_7$$

Where

$Y$  = Gross Margin is measured in Fcfa (1 Fcfa = 0.0017 USD) per kg

$X_1$  =Cost of seeds is measured in Fcfa

$X_2$  =Cost of farm labour is measured in Fcfa

$X_3$  =Cost of fertilizer is measured in Fcfa

$X_4$  =Cost of herbicides is measured in Fcfa

$X_5$  =Transportation cost is measured in Fcfa

$X_6$  =Tax paid is measured in Fcfa

$X_7$  =Selling Price was measured in Fcfa

$Z_1$  =Age is measured in years.

$Z_2$  =Years in school is measured in the number of years.

$Z_3$  =Experience is measured in years.

$Z_4$  =Household Size is measured in the number of people living in a household.

$Z_5$  =Distance to market is measured in kilometers.

$Z_6$  = Amount of credit used is measured in Fcfa

$Z_7$  = Membership to the association is a dummy variable (member = 1, non-member = 0).

This study provides updated empirical evidence using cross-section data to validate whether young males performed better than females in the production and marketing of Rice and Maize as well as identifying the socioeconomic and financial factors that significantly affect their profit efficiency. This gives an overview of the characteristics of young Maize and Rice producer-marketers and the degree to which prices reflect on all available information that will help the Ministry of Agriculture and Rural Development, and other research institutes to proffer recommendations on the available opportunities for youths in agribusiness. It also provides a critical understanding of how Maize and Rice producer-marketers' decision-making and practices enable the various stakeholders to plan their purchases. It also provides a depth knowledge of the processes in profit of Maize and Rice producer-marketers that will help the Ministry of Agriculture and rural development to assess the revenue of the marketers and implement policies aimed at improving their standard of living while sustaining both Maize and Rice subsector.



## 4. Results and discussion

### 4.1. The determinants of profit efficiency for young male and female maize and rice producer-marketers are presented in Table 1

For young male and female maize producer-marketers, the results presented in Table 2 show that the cost of seed is negative and significant at 1% implying that a unit increase in the cost of seed will decrease young male and female profit by 27.1% and 35.3% respectively. Also, the negative sign of the coefficient of fertilizer for young female producer-marketers implies that a unit increase in the cost of fertilizer will decrease the profit of young female maize producer-marketers by 13%. This result could be explained by the low purchase power of young females in the absence of an input subsidies scheme which is likely to reduce the quantity of fertilizer use and thereby impact negatively their productivity. This result is in line with Komarek et al. (2017).

Similarly, the coefficient of the cost of labour is negative and significant at 5% for young male and female maize producer-marketers implying that a unit increase in the cost of labour will decrease young male and female maize producer-marketers' profit by 2.9% and 5.2% respectively. This result could be explained by the fact that women generally face gender-specific constraints as agricultural labourers and in hiring farm labour. Also, low levels of human capital, i.e. education, health, and nutrition are also constraints to women's labour productivity in agriculture and other sectors unlike their male counterparts (Behrman et al., 2004; Team, 2011).

The negative sign of the coefficient of the cost of herbicides for young male and female producer-marketers implies that a unit increase in the cost of herbicides will decrease the profit of young male and female maize producer-marketers by 7.9% and 23.7% respectively. This result is in line with Méndez et al. (2011).

The negative sign of the coefficient for the cost of transport for young male and female producer-marketers indicates that a unit increase in the cost of transport will decrease the profit of young male and female maize producer-marketers by 8.8% and 26.2% respectively. This could be explained by the poor road network associated with the high cost of transport. This result is in line with Khapayi and Celliers (2016), who explained that transportation cost is a limiting and preventing factor for emerging farmers to progress to commercial agricultural farming in the King William's Town area of the Eastern Cape Province, South Africa.

The positive sign of the coefficient of selling price implies that a unit increase in the selling price will increase the profit of young male and female maize producer-marketers by 1.2% and 2.15% respectively. This result could be explained by the average selling price (144.75 FCFA) and the high demand for maize in the study area. This result could also be explained by the fact farmers sell directly to potential buyers without the middlemen. These results are in line with the findings of Piabuo et al. (2020) who found that there is a significant price and profit gap between vegetable farmers who sell directly to the market and those who sell through middlemen in the North West Region of Cameroon.

On the inefficiency model, the significance of the values of sigma v for young male and female maize producer-marketers indicates the goodness of fit and correctness of the specified distribution assumption of the composite error terms. Also, the significance of Lambda for male and female maize producer-marketers implies that 1.438% and 0.12% of the variability in maize profit is due to profit inefficiency respectively. The negative sign of the coefficient of age for young female maize producer-marketers implies that age increases their profit efficiency. This could be because on average females are younger than their counterpart males (32 years against 35 years) and could have more energy which could in turn lead to an increase in their profit efficiency. This result is in line with the findings of Tauer (2017) who found that Productivity increases with age, peaks at mid-life, and then decreases by age for each census year.

**Table 1. Summary statistics of socioeconomic and financial factors for young male and female maize and rice producer-marketers**

Variables	Maize						Rice					
	Males			Females			Males			Females		
	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev
Cost of labour used in Fcfa	0	204500	32192.65	38556.5	0	375000	83086.04	74571.55	0	170000	29315.35	29052.5
Cost of seeds used in Fcfa	0	30000	4860.323	5289.26	750	17500	3833.121	3037.303	1500	36000	8270.486	5730.613
Cost of fertilizer used in Fcfa	0	555000	62630.99	60714.22	9500	114000	43812.1	21057.95	0	396000	80321.39	58500.97
Cost of herbicides in Fcfa	0	144000	9257.719	10170.51	0	24000	8688.854	4618.173	0	150000	4724.306	9196.191
Age of producers and marketers in years	22	40	35.08	12.85	18	39	32.03	9.24	21	40	38.75	13.56
Average Household size	2	22	7.728	4.76	2	15	5.59	4.10	3	14	7.75	4.46
Years of Experience in production and marketing	3	17	11.27	9.30	3	13	8.36	7.05	3	18	16.56	12.77
Years spent in school	0	18	7.85	4.28	0	16	6.16	3.72	0	16	6.88	3.98
Monthly income in Fcfa	1500	30000	22434.79	19904.67	1000	70000	19105.1	10238.98	2500	30000	37810.76	31796.33
Average Farm size in hectares	.45	4	2.14	2.36	.25	4	1.84	.901	.2	5.5	.83	.62
Level of Output harvested per hectare in bags (100kg)	800	14000	3233.45	3961.81	200	6000	2353.50	1269.84	800	24700	4062.15	2893.93
Selling price of Maize in fcf	100	250	144.75	57.65	100	220	139.17	20.75	100	400	133.94	57.82

(Continued)

Variables	Maize						Rice									
	Males				Females				Males				Females			
	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev	Min	Max	Mean	Std dev
Walking distance from farm gate to market in minutes	0	180	16.41	27.32	0	3600	38.59	51.04	0	90	25.32	14.96	0	120	24.5	15.27
Amount of credit received in Fcfa	0	250000	1728.11	17955.8	0	90000	872.61	8081.89	0	700000	21875	75991.41	0	200000	6214.28	29491.32
Cost of transport paid for Maize/Rice from farm gate to market	0	280000	14955.25	27307	0	55000	17152.87	13736.31	0	32000	19285.24	27741.59	2400	45000	15437.86	12012.14
Cost of Tax Paid per bag of Maize/Rice (100kg)	0	9500	1223.50	1856.47	0	13000	2046.49	1810.31	0	28000	3618.75	4537.09	0	28000	3712.14	4320.71

The negative sign of the coefficient of years in school for young females' maize producer-marketers implies that years in school increases their profit efficiency which could be because education provides the opportunity to acquire additional knowledge and innovation which could increase their profit efficiency. Also, there is a tendency that female farmers are more proactive to apply and adopt new technology, unlike their male counterparts. This study is in line with Paltasingh and Goyari (2018) who found that education enhances farm productivity in India.

The positive sign of the coefficient of farming experience implies that farming experience decreases young female maize producer-marketers' profit efficiency. This could be because female maize farmers could be reluctant to adopt new technology and are mostly focused on outdated tools and practices which could decrease their profit efficiency. Following Doss and Morris (2001) and Méndez et al. (2011), female farmers had a much lower adoption rate of modern crop varieties (59 versus 39 percent) due to less access to land, lower availability of family labour, and less access to extension services.

The negative sign of the coefficient of household size implies that young male maize producers-marketers' profit efficiency increases with the number of people living in their household who automatically reduce the cost of farm labour and thereby increase their profit efficiency. This result could be associated with the fact that young male maize producer-marketers benefit from their gender to get help from other family members, unlike their female counterparts. This result is in line with the findings of Oyetunde Usman and Olagunju (2019) who found that household size increases the technical efficiency of agricultural households in Nigeria.

The negative sign of the coefficient of distance to market implies that young male and female maize producer-marketers' profit efficiency decreases with the distance to market. This could be because the few farmers who can sell their harvest in the market do not face competition which could increase their selling price and in turn could increase their profit efficiency. This result agrees with the findings of Saysay (2016) who found a negative relationship between distance to market and the profit efficiency of groundnut farmers in Malawi.

The negative sign of the coefficient of the amount of credit received implies that the amount of credit received increases young female maize producer-marketers' profit efficiency. This is an indication that young female maize producer-marketers could make use of the limited amount of credit received to them for the sustainability of maize production and marketing, unlike their male counterparts who are tempted to use the amount of credit received for different purposes. This result is contrary to the findings of Koloma (2010) who found that credit has no significant effect on farmers' productivity in Northern Ghana.

The negative sign of the coefficient of membership implies that membership in an association decreases young male maize producer-marketers' profit efficiency. This could be explained by the fact that membership in an association does not serve as a means of exchanging ideas, experience, and market information unlike the case may be for the females counterparts which could in turn decrease their profit efficiency. This result is contrary to the findings of Koloma () who found that membership in an association increases farmer's productivity in Northern Ghana.

For rice producer-marketers, the negative sign of the coefficient of cost of seed for young male rice producer-marketers implies that a unit increase in the cost of seed will increase their profit by 61.5%. This could be because, unlike their female counterparts, the majority of young male producers and marketers (76.04 percent versus 23.96 percent) use better seed types to increase their yields. This result is in line with the findings of Bocher and Simtowe (2016) who found that an increase in the cost of seed will increase the profit of small-scale Nigerian rice farmers.

The negative sign of the coefficient cost of labour for young male and female rice producer-marketers implies that a unit increase in the cost of labour will decrease their profit by 3.2% and 7.3% respectively. This could be because both males and females are eager to increase their productivity through intensive use of labour and are ready to spend as much (25,264.443 FCFA per hectare and 29,315.347 FCFA per hectare for females and males respectively) as possible on labour to meet up with all the farm activities such as clearing, planting, weeding, fertilizer application, and harvesting. This result is contrary to Komarek et al. (2017) who found that an increase in the cost of labour will increase the profit of female rice farmers in the Philippines.

The negative sign of the coefficient of the cost of transport for young male and female rice producer-marketers implies that a unit increase in the cost of transport will decrease their profit by 15.5% and 46% respectively. Similarly, the negative sign of the coefficients of tax paid for young male and female rice producer-marketers implies that a unit increase in tax paid will decrease their profit by 3.9% and 10.8% respectively. This could be explained by the fact that whenever there are increments in tax or the cost of transport, these translate into an increase in selling price (133.94 FCFA/kg and 160.35 FCFA/kg for males and females respectively) for both categories which will reduce customers' purchase power and thereby will decrease male and female rice producer-marketers' profit. This result is in line with Khapayi and Celliers (2016).

The positive sign of the coefficients of selling price for young male and female rice producer-marketers implies that a unit increase in selling price will increase their profit by 15.5% and 46% respectively. This result suggests that a unit increase in selling price will increase their profit by 68.3%. This result could be due to the volatile nature of market price which may likely affect the decision of both young male and female rice producers and marketers to sell their produce or otherwise. These results are in line with the findings of Piabuo et al. (2020).

On the inefficiency model, the significance of the values of sigma v for young male and female rice producer-marketers indicates the goodness of fit and correctness of the specified distribution assumption of the composite error terms. Also, the significance of Lambda for male and female rice producers and marketers implies that 2.82% and 1.61% of the variability in rice profit is due to profit inefficiency respectively.

The positive sign of the coefficient of household size implies that household size reduces young male rice producer-marketers' profit efficiency. This result is consistent with the findings of Bocher and Simtowe (2016) as cited in Ashok et al. (2017) who argued that larger households had the potential for providing cheaper farm labour, however, the fund that would have been used to purchase other farm inputs is often allocated to some other necessity like household consumption, hence the negative effect on overall efficiency.

The negative sign of the coefficient of distance to market implies that distance to market increases the profit efficiency of young male rice producer-marketers. This could be explained by the fact majority of young male rice farmers are full-time farmers (69.10% against 30.90% as part-time) and are ready to cover as much distance as they can sell their farm products, unlike their female counterparts who have home responsibilities to deal with. This result is in line with the findings of Anang et al. (2016) who found that distance to market increases farmer's productivity in Northern Ghana.

**Table 2. Determinants of profit efficiency of young male and female maize and rice producer-marketers**

Variables	Young male Maize producer-marketers		Young female Maize producer-marketers		Young male Rice producer-marketers		Young female Rice producer-marketers	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Cost of seed	-.271***	0.000	-.353***	0.000	-.615***	0.000	-.105	0.301
Cost of fertilizer	-.014	0.680	-.130**	0.036	-.003	0.788	-.021	0.190
Cost of labour	-.029**	0.026	-.052***	0.000	-.0320***	0.000	-.073***	0.000
Cost of herbicides	-.079**	0.018	-.237***	0.009	.005	0.554	-.0002	0.992
Cost of transport	-.088**	0.012	-.262***	0.004	-.155***	0.000	-.460***	0.000
Tax paid	-.056	0.253	.081*	0.083	-.039***	0.000	-.108***	0.000
Selling price	1.201**	0.001	2.151***	0.000	.142	0.205	.683***	0.000
Inefficiency model								
Age	.0117	0.919	-.537**	0.002	-.033	0.841	-.411	0.184
Years in school	-.059	0.323	-.274***	0.000	.028	0.451	-.058	0.315
Farming experience	-.036	0.620	.308**	0.005	-.091	0.140	.111	0.361
Household size	-.176**	0.041	-.118	0.142	-.179***	0.000	.010	0.891
Distance to market	-.275***	0.003	-.273***	0.000	-.192***	0.000	-.140	0.145
Variables	Young male Maize producer-marketers		Young female Maize producer-marketers		Young male Rice producer-marketers		Young female Rice producer-marketers	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Amount of credit received	2.24e-06	0.320	-.00001***	0.001	2.01e-06**	0.030	1.46e-06	0.301
Membership of association	.098***	0.002	-.006	0.843	-.012	0.540	-.017	0.477
Constant	3.027	0.096	-.138	0.947	5.126	0.000	6.381	0.000
Usigma_cons	-.214	0.196	-.745	0.002	-.953	0.000	-.1593	0.000

(Continued)

**Table 2. (Continued)**

Variables	Young male Maize producer-marketers		Young female Maize producer-marketers		Young male Rice producer-marketers		Young female Rice producer-marketers	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Vsigma_cons	-.942	0.000	-2.274	0.000	-3.03	0.000	-2.558	0.000
sigma_u	.898***	0.000	.084***	0.000	.620***	0.000	.450***	0.000
sigma_v	.624***	0.000	.052***	0.000	.219***	0.000	.278***	0.000
Lambda	1.438***	0.000	.120***	0.000	2.825***	0.000	1.619***	0.000
Log-likelihood	-624.5482		-158.3571		-236.2196		-96.8337	
LR test	64.73		24.41		42.96		23.88	

\*\*\* and \*\* are significant at 1% and 5% respectively



Finally, the positive sign of the coefficient of the amount of credit received implies that credit received by young male rice producer-marketers decreases profit efficiency. This could be explained by Oben (2016) that high transaction cost and administrative bottleneck in a credit application, inadequate credit information, bank stringent conditions, location of lending institutions, and bureaucratic processes in banks to late disbursement of loan facilities to farmers influences credit to use on the supply side. Also, there is a tendency for male farmers to use the credit received for other purposes, unlike their female counterparts who are committed to farm business despite the multi-task home activities. This result is contrary to the findings of Ashok et al. (2017) who found that farm credit can increase rice farming profit efficiency and reduce profit loss.

#### **4.2. Profit efficiency estimates of young male and female maize and rice producer-marketers are presented in Table 3**

For young male maize producer-marketers, profit efficiency estimates range between 8.15e-06 and .89 with a mean of 0.53 and a standard deviation of 0.2. Specifically, 12.2% have a profit efficiency of less than 0.2, 21.9% have a profit efficiency that ranges between 0.2 and 0.51, and 64.3% have a profit efficiency that ranges between 0.51 and 0.81. Finally, 1.6% have a profit efficiency greater than 0.81. As for young female maize producer marketers, profit efficiency estimates range between .007 and .89 with a mean of 0.59 and a standard deviation of 0.22. Specifically, 8.3% have a profit efficiency of less than 0.2, 22.9% have a profit efficiency that ranges between 0.2 and 0.51, and 56.1% have a profit efficiency that ranges between 0.51 and 0.81. Finally, 12.7% have a profit efficiency greater than 0.81.

For young male rice producer marketers, profit efficiency estimates range between 0.03 and 0.93 with a mean of 0.61 and a standard deviation of 0.23. Specifically, 6.9% have a profit efficiency of less than 0.2, 22.6% have a profit efficiency that ranges between 0.2 and 0.51, and 46.2% have a profit efficiency that ranges between 0.51 and 0.81. Finally, 24.3% have a profit efficiency greater than 0.81. For young female rice producer marketers, profit efficiency estimates range between 0.07 and 0.91 with a mean of 0.69 and a standard deviation of 0.18. Specifically, 2.1% have a profit efficiency of less than 0.2, 13.6% have a profit efficiency that ranges between 0.2 and 0.51, and 55.7% have a profit efficiency that ranges between 0.51 and 0.81. Finally, 28.6% have a profit efficiency greater than 0.81.

The values of profit efficiency estimates for young male and female maize producer-marketers imply that profit efficiency for young male and female maize producer-marketers needs to be increased by 47% and 41% respectively. Similarly, the profit efficiency estimates for young male and female rice producer-marketers imply that profit efficiency needs to be increased by 39% and 31% respectively. The increase in profit efficiency could be possible if available resources are efficiently utilized given the market price of the various input used. The gap between the two groups is explained by the commitment and availability of young females to support the subsector. These results are contrary line with the findings of Gebre et al. (2019) who found that the productivity of male-headed households was higher than that of female-headed counterparts. These results could be explained by the fact that young female maize and rice producer-marketers managed the available resources at their disposal better than their counterpart's young male maize and rice producer-marketers due to their full-time participation in the production and marketing activities of maize and rice.

In addition, Results show that p-values (Table 4) when equal and non-equal variances are assumed for the test of the difference between profit efficiency of young male and female rice and maize producer marketers implies that there is a gender gap in the management of resources in the production and marketing of maize and rice in Cameroon mainly due to socioeconomic and financial factors such as age, household size, years in school, distance to market, farming

**Table 3. Profit efficiency estimates of young males and females rice and maize producer-marketers**

Profit efficiency estimates	Young male Maize producer-marketers		Young female Maize producer-marketers		Young male Rice producer-marketers		Young female Rice producer-marketers	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	percentage
< 0.2	53	12.2	13	8.3	20	6.9	3	2.1
0.2–0.5	95	21.9	36	22.9	65	22.6	19	13.6
0.51–0.81	279	64.3	88	56.1	133	46.2	78	55.7
>0.81	7	1.6	20	12.7	70	24.3	40	28.6
Total	434	100	157	100	288	100	140	
Mean	.53		.59		.61		.69	
Maximum	.89		.89		.93		.91	
Minimum	8.15e-06		.007		.03		.07	
Standard deviation	.20		.22		.23		.18	

**Table 4. Test of difference between profit efficiency of young males and females rice and maize producer-marketers in cameroon**

Profit efficiency estimates	Young males and females' maize producers-marketers			Young males and females rice producer-marketers		
	t	df	Significance (2-tailed)	t	df	Significance (2-tailed)
Equal variances assumed	-3.294**	589	.001	-3.172**	426	.002
Equal variances not assumed	-3.158**	256.095	.002	-3.426**	337.155	.001

\*\*is significant at 5%

experience, tax paid, amount of credit received, membership to the association, costs of labour, seed, herbicides, transport, and fertilizer.

## 5. Conclusion and policy implications

This study hypothesizes and validates that there is a significant gender gap in profit efficiency among young male and female maize and rice producer-marketers following their inability to have access to productive resources and the volatility of market prices. The study concluded that young male and female rice and maize producer-marketers operate below the profit efficiency frontier level but young female maize and rice producer-marketers have higher profit efficiency due to socioeconomic and financial factors such as household size, tax paid, amount of credit received, and membership to the association, costs of labour, seed, transport, herbicides, and fertilizer. It is recommended that more road networks should be maintained and constructed given that transportation costs significantly affect young male and female rice and maize producer-marketers' profits. There is a need to set up agrochemical and improved seed varieties subsidy schemes with special attention to young male and female rice and maize producer-marketers given that the costs of agrochemical and improved seed varieties significantly affect their profitability. Further, young male and female producer-marketers in rice and maize value chains could benefit from setting up labour-sharing arrangements for mutual help. Following the fact that the quantity of credit acquired has a substantial impact on the profit efficiency of young male and female rice producer-marketers, farmers should be given no-interest loans and training on how to use agricultural credit, given their smallholding farms.

## Acknowledgments

We are grateful for the International Fund for Agricultural Development (IFAD) grant support and the International Institute of Tropical Agriculture (IITA)'s technical support. N.B. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the IFAD and the IITA.

## Funding

The grant used for this study came from the International Fund for Agricultural Development (IFAD) through the International Institute of Tropical Agriculture (IITA) under the project "Youth Researching Youth: Competitive Fellowships for Young African Scholars Researching Youth Engagement in Rural Economic Activities in Africa

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## Citation information

Cite this article as: Are young maize and rice farmers' profit efficient? A gender differential analysis, Djomo Choumbou Raoul Fani, Ukpe Udeme Henrietta, Rayner Tabetando, Gama Emmanuel Nkwi & Zoubeirou Mainassara, *Cogent Economics & Finance* (2023), 11: 2236887.

## Note

1. Producer-marketers in this study are referred to any operations which are performed by any young producer (male or female) in preparing for the market. It includes producing, selling, delivering, or disposing of for commercial purposes, to any potential buyer the commodity he/she has produced.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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