Gender Analysis Of The Access To Factors Of Rice Production In Sub-Saharan Africa

T. Kinkpe[1]; R. Fiamohe[1]; K. Saito[2]

1: Africa Rice Center, , Benin, 2: Africa Rice Center, , Côte d'Ivoire

Corresponding author email: kinthagosagro@gmail.com

Abstract:

This paper aims to assess the access to rice production factors in SSA and its determinants. The data were collected from 268 farmers. The results show that male farmers had larger land for rice cultivation than females. They had lower access to extension service, chemical fertilizer and mechanization for land preparation than females. Both males and females used children for bird and rat control. The experience, the membership to associations, the education and the cropping system are the determinants. Holistic approach taking into account gender and youth is needed for enhancing the access to various rice production factors in SSA.

Acknowledgement: This study was supported by Global Rice Science Partnership (GRiSP); International Fund for Agricultural Development (IFAD) under the project Strengthening Rice Value Chains in West and Central Africa [I-R-1428-AFRICARICE]; and African Development Bank under the project Support to Agricultural Research for Development of Strategic Crops in Africa [2100155022217]. The authors would like to thank Dr Cara Raboanarielina and Mr Abdoulaye Kabore for their contributions to implementation of the survey.

JEL Codes: D13, Q15

#2631

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Abstract

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Key words: Land and mechanization, agricultural knowledge, chemical inputs, rice cropping in SSA, Gender

1 Introduction

Agriculture is very important for Sub-Saharan Africa (SSA). It produces about 25% of the Gross Domestic Product (GDP) in SSA (Schaffnit-Chatterjee, 2014). More than 50 million SSA small farms depend on agricultural income (Schaffnit-Chatterjee, 2014). Moreover, the SSA has huge agricultural potential. There is yet vast amounts of uncultivated area (Schaffnit-Chatterjee, 2014). Then SSA could still increase its agricultural production. To increase the production, it is important to have good access to production factors such as land, technologies, knowledge, labor, fertilizer and pesticides. However, can we assert that, African farmers have good access to production factors? To answer that question, it is important to seriously look at the access to production factors in Sub-Saharan Africa.

Rice is one of commodities for which SSA strongly depends on imports (FAS/USDA, 2016), despite the huge production potentialities of the region. However, rice consumption is growing at even faster rates, and replacing more traditional crops due to population growth and urbanization (AfricaRice, 2012). It is then important to increasingly increase the rice production in SSA in order to improve food security level. This could follow two ways: increasing of rice area and/or yield. According to Tanaka et al. (2015) and Tanaka et al. (2013), there is an important gap between the observed yield for rice in SSA and the potential of the produced varieties. Then, the current yield level for rice in SSA can be increased. For that, it is important to have good access to suitable rice production factors.

Some researches were made on access to production factors for rice cropping in SSA with identification of eventual gender gaps. In Ghana, male farmers have more access to land (in terms of area) than female ones (Adinson et al., 2016). However there is no significant difference between the area of female farmers and the one of male farmers. According to Ayoola et al. (2011), male rice farmers have more access to land than female farmers. They showed that the farmer access to land would likely enhance rice production in Nigeria. These researches show that the male rice farmers have the possibility to have access to land and to cultivate more area for rice than females. According to Adinson et al. (2016), male farmers have more (in terms of quantity) access to inputs such as fertilizer and seed in Ghana. Ayoola et al. (2011) showed a gender gap in access to rice production inputs such as fertilizers and herbicides with an advantage for males. So there is a gender gap in access to production factors for rice cropping in SSA.

Globally, West African rice cropping systems do not present a significant gender gap in access to production knowledge (Zossou et al., 2016). Among the West African countries such as Benin, Côte d'Ivoire, Niger, Nigeria and Togo, only Benin presented a significant advantage for women in the access to both national research and extension services and to national, and international NGOs. So Zossou et al. (2016) showed that there is no significant gender gap in access to agricultural knowledge.

For Paris (2013), the gender division of labor varies essentially with the country, the cultural realities, the socio-economic and the environmental characteristics. In the agricultural sector, labor division among gender in SSA presents some rigidities especially due to the fact that the females spend large part of their time on domestic works (Adinson et al., 2016; Quentin and Yvonne, 2010). It is then clear that gender division of labor in the households influences the female labor availability for economic activities in SSA (Quentin and Yvonne, 2010; Ardayfio-Schandorf, 1991). Adinson et al. (2016) showed that in Ghana rice production systems, female labor is implied in almost all activities. However, as in many SSA countries, females are more implied in activities which do not need a lot of strength or precaution such as land preparation, herbicide application. They are more implied in activities such as transplanting or sowing, drying, etc. (Adinson et al., 2016; FAO, 2004). Moreover, it was demonstrated that in SSA, globally, the female labor share in crop production is lower (about 40%) than the male labor (Palacios-Lopez, 2015). Accordingly, female labor produces less output than male labor (Adinson et al., 2016). In addition, Adinson et al. (2016) showed that female rice farmers were highly inefficient in comparison with male rice farmers in Ghana. These results indicate that the male labors are currently more profitable for rice production systems in SSA than female ones. However, female labor in rice production can allow improving women income and contribute to improve food security in SSA. It is then important to work toward more implication of female labor in rice production activities (Adinson et al., 2016). Gender division of labor in agricultural activities in general and rice farming activities in particular need more attention in order to contribute effectively to food security and poverty reduction in SSA.

These evidences in SSA show that agricultural researchers must focus on access to production factors and the eventual gender gaps for rice cropping in order to really contribute to sustainable production increasing (Ayoola et al., 2011). So the question "what are the gender issues in the access to rice production factors in the rice development hubs in SSA?" is still current. The present paper aims to answer that question. The objectives are (i) to assess the access to rice production factors in SSA rice production hubs following the gender and (ii) to analyze the factors determining that access. This research targeted 5 SSA countries divided in 3 sub-regions. In West-Africa (WA) this research targeted 3 countries: Benin Republic, Côte d'Ivoire and Gambia. In East-Africa (EA), 1 country was targeted: Tanzania. In Central-Africa (CA), 1 country was targeted: Cameroon.

2 Data and methods

This section presents the study area, the data collection and the analysis methodology.

2.1 Study area

The data were collected on SSA rice development hubs in which the Africa Rice Center actions are executing. At total, data were collected on 5 SSA countries. 3 West African (WA) countries were concerned: Benin Republic, Côte d'Ivoire and Gambia. Respectively One East-African (EA) country (Tanzania) and one Central-African (CA) country (Cameroon) were also targeted.

In each of these countries, there were one or two rice development hubs. Data were collected in these hubs. In each hubs, the most important rice production villages were selected for the study. In Glazoué hub in Benin, the villages of Camaté, Essèbrè, Kpota, Loulè 1, Ouèdèmè and Sowé 2 were selected. In Gagnoa hub in Côte d'Ivoire, the villages of Bayota, Guiberoua, Ouragahio, Tiétiékou were selected. There were 2 hubs in Gambia: the hub of West Cost Region and the one of Central River Region. In the hub of West Coast Region, the villages of Brefet and Jambur were selected and in the hub of Central River Region, the villages of Jahally, Jakaba, Nema and sintet were selected. In the hub of Kahama in Tanzania, the villages of Chela, Kalagwa, Ntobo A and Nyambula were selected. In the hub of Ndop in Cameroon, the villages of Baigom-Foumbot, Bamessing and Bamunka were selected.

2.2 Data collection

In each of the selected village, a diagnostic survey was carried out on the whole rice production systems. In each village, some Key Informants (KI) were randomly selected using snowball method. Data were collected from the selected KI using voice recording method. The collected data included, the farmers' gender, the production systems, the access to land, the access to input such as fertilizer and herbicides, the access to mechanization (tractor or animal) for land preparation, the access to extension services, the education of the farmer, the membership to a farmers' association and the division of labor. After the data collection, the voice of each KI was transcribed. Afterwards, the whole database was made computerizing the data from all KI in an Excel database. The total size of the sample was 268 rice farmers. The table 1 shows the distribution of the sample following the production systems, the country and the farmers' gender.

2.3 Data analysis method

Two data analysis methods were used to analyze the data in the frame of this paper. First, the descriptive statistics of all variables was made following gender using frequency calculation method and Pearson Chi square test (Glèlè Kakaï et al., 2006; Glèlè Kakaï and Kokodé, 2004). Finally, the factors determining the access to rice productions were analyzed using econometrical regression method (Greene, 2005; Sadoulet and de Janvry, 1995).

2.3.1 Analytical framework

Generally, the production functions of the agricultural commodities are Cobb-Douglas (Sadoulet and de Janvry, 1995) as follow:

$$\mathrm{P} = \mathrm{A}\mathrm{L}^{\alpha}\mathrm{K}^{\beta} \qquad (1)$$

with P= production, A= constant, L= invested labor quantity, K= invested capital, α and β are the estimated parameters. K includes production factors such as land, animal or tractor, knowledge, fertilizer and herbicide.

The access to production factors can be deduced from this function.

$$\mathrm{P} = \mathrm{YS} \qquad (2)$$

with Y= yield and S= cultivated area. Then,

$$\mathrm{YS} = \mathrm{A}\mathrm{L}^{\alpha}\mathrm{K}^{\beta} \qquad (3)$$

From this function the cultivated area can be deduced as an indicator of access to land is:

$$\mathrm{S} = \mathrm{f}(\mathrm{L}, \mathrm{K}) \qquad (4)$$

with f denoting function.

Likewise, the access of each other production factor is:

$$\mathrm{K} = \mathrm{f}(\mathrm{L}, \mathrm{S}) \qquad (5)$$

In addition, the farm characteristics (C) can affect the access to production factors and then farm performance (Addison et al., 2016; Sadoulet and de Janvry, 1995).

So equations (4) and (5) become:

$$\mathrm{S} = \mathrm{f}(\mathrm{L}, \mathrm{K}, \mathrm{C}) \qquad (6)$$

$$\mathrm{K} = \mathrm{f}(\mathrm{L}, \mathrm{S}, \mathrm{C}) \qquad (7)$$

2.3.2 Empirical Models Specification

The farmer gender is the mean indicator of labor availability (Addison et al., 2016). Since the labor used in the targeted SSA rice development hubs was not quantified, the farmer gender was used as labor indicator.

Let S_i^{rice} be the cultivated area for rice by the farmer *i* (expressed in naperian logarithm); K_i^{oland} be the land ownership of the farmer *i* for rice cropping; K_i^{mechan}be the access to animal or tractor by the farmer *i* for land preparation in rice field; K_i^{knowl}be the access to extension services (agricultural knowledge) by the farmer *i*; K_i^{fertil}be the access to chemical fertilizer by the farmer *i* and K_i^{herb}be the access to chemical herbicide by the farmer *i*.

In SSA countries, the access to some capital K depends on the access to extension services because apart from the agricultural knowledge they provide to farmers, the governments ensure the access to some other production factors such as mechanization, fertilizer and pesticides through them. Based on these realities, the access to production factors can be:

$$\mathrm{S}_i^{rice} = \mathrm{f}\left(\varphi_i, \mathrm{K}_i^{knowl}, \mathrm{C}_i\right) \quad (8)$$

$$\mathrm{K}_i^{oland} = \mathrm{f}\left(\varphi_i, \mathrm{S}_i^{rice}, \mathrm{C}_i\right) \quad (9)$$

$$\mathrm{K}_i^{mechan} = \mathrm{f}\left(\varphi_i, \mathrm{S}_i^{rice}, \mathrm{K}_i^{knowl}, \mathrm{C}_i\right) \quad (10)$$

$$\mathrm{K}_i^{knowl} = \mathrm{f}\left(\varphi_i, \mathrm{S}_i^{rice}, \mathrm{C}_i\right) \quad (11)$$

$$\mathrm{K}_i^{fertil} = \mathrm{f}\left(\varphi_i, \mathrm{S}_i^{rice}, \mathrm{K}_i^{knowl}, \mathrm{C}_i\right) \quad (12)$$

$$\mathrm{K}_i^{herb} = \mathrm{f}\left(\varphi_i, \mathrm{S}_i^{rice}, \mathrm{K}_i^{knowl}, \mathrm{C}_i\right) \quad (13)$$

with φ_i denoting the gender of the farmer i. $\varphi_i$is represented by the dummy variable which takes the value 1 for female farmers and 0 for males.

Following these logics, the drivers of the cultivated area for rice S_i^{rice}, the land ownership K_i^{oland}, the access to mechanization for land preparation K_i^{mechan}, the access to agricultural knowledge via extension services K_i^{knowl}, the access to chemical fertilizer K_i^{fertil} and the access to chemical herbicide K_i^{herb} can then be determined by regressing these variables to the following set of covariates: ,

$$\mathrm{S}_i^{rice} = \alpha + \boldsymbol{\beta}_i\boldsymbol{\varphi}_i + \boldsymbol{\delta}_i\boldsymbol{K}_i^{knowl} + \boldsymbol{\gamma}_i\mathbf{C}_i + \varepsilon_i \quad (14)$$
$$\mathrm{K}_i^{oland} = \alpha + \boldsymbol{\beta}_i\boldsymbol{\varphi}_i + \boldsymbol{\theta}_i\boldsymbol{S}_i^{rice} + \boldsymbol{\gamma}_i\mathbf{C}_i + \varepsilon_i \quad (15)$$
$$\mathrm{K}_i^{mechan} = \alpha + \boldsymbol{\beta}_i\boldsymbol{\varphi}_i + \boldsymbol{\theta}_i\boldsymbol{S}_i^{rice} + \boldsymbol{\delta}_i\boldsymbol{K}_i^{knowl} + \boldsymbol{\gamma}_i\mathbf{C}_i + \varepsilon_i \quad (16)$$
$$\mathrm{K}_i^{knowl} = \alpha + \boldsymbol{\beta}_i\boldsymbol{\varphi}_i + \boldsymbol{\theta}_i\boldsymbol{S}_i^{rice} + \boldsymbol{\gamma}_i\mathbf{C}_i + \varepsilon_i \quad (17)$$
$$\mathrm{K}_i^{fertil} = \alpha + \boldsymbol{\beta}_i\boldsymbol{\varphi}_i + \boldsymbol{\theta}_i\boldsymbol{S}_i^{rice} + \boldsymbol{\delta}_i\boldsymbol{K}_i^{knowl} + \boldsymbol{\gamma}_i\mathbf{C}_i + \varepsilon_i \quad (18)$$
$$\mathrm{K}_i^{herb} = \alpha + \boldsymbol{\beta}_i\boldsymbol{\varphi}_i + \boldsymbol{\theta}_i\boldsymbol{S}_i^{rice} + \boldsymbol{\delta}_i\boldsymbol{K}_i^{knowl} + \boldsymbol{\gamma}_i\mathbf{C}_i + \varepsilon_i \quad (19)$$

where α is a constant parameter to be estimated; $\boldsymbol{\varphi}_i$ is a vector of the female farmer i; $\boldsymbol{K}_i^{knowl}$ is a vector of the access to extension services by the farmer i; $\mathbf{S}_i^{rice}$ is a vector of the rice area of the farmer i; $\mathbf{C}_i$ is a vector of the characteristics of the rice farm of the farmer i including the whole cultivated area for all crops (ha expressed in naperian logarithm), dummy variables representing the production system in the targeted countries, the experience in rice farming (years expressed in naperian logarithm), a dummy variable representing the membership to producers association, and a dummy variable representing the education of the farmer (1 if any education and 0 otherwise); $\boldsymbol{\beta}_i$, $\boldsymbol{\delta}_i$, $\boldsymbol{\theta}_i$ and $\boldsymbol{\gamma}_i$ are parameter vectors to be estimated, and ε_i is a stochastic error term. Equation (14) was estimated through robust ordinary least squares correcting eventual heteroskedasticity while equations (15), (16), (17), (18) and (19) were estimated through probit model (Greene, 2005).

3 Results and discussion

Here we presents the results and their discussion. First, a descriptive statistic is presented following farmers' gender, second, the division of the responsibility of the rice farm activities is presented following farmers' gender and finally, the factors determining the access to rice production factors is presented.

3.1 Descriptive statistics following gender

The table 2 shows the descriptive statistics following farmers' gender. About 40% of the surveyed farmers were female. The majority of them received formal education, owed land for rice cropping, belonged to an association of farmers, had access to extension services and chemical fertilizer. They had access to mechanization for land preparation for rice production. Female farmers had significantly better belonging to association, access to tractor or animal for land preparation, access to extension services and access to chemical fertilizer. These results tally with those of Zossou et al. (2016) who demonstrated that in Benin, there is a significant advantage for women in the access to extension services.

The average rice area in the 5 target Sub-Sahara African countries was about 1.8 hectares while each target farmer cultivated for all crops in average, about 4.4 hectares (table 2) with in average 19 years of experience in rice cropping. Male farmers were significantly (threshold of 1%) better provided with production area. This results is consistent with Adinson et al. (2016) and Ayoola et al. (2011) who showed that male rice farmers have more access to land than female farmers respectively in Ghana and Nigeria.

3.2 Division of the responsibility of the rice cropping activities following farmer gender

The table 3 shows the division of the responsibilities of the rice cropping in the Sub-Saharan Africa (SSA) target countries. For all activity, there were some farmers using human hired labor. In general, the land preparation (clearing, bunding, bund maintenance, residue management and tilling), the fertilizer application, the water management and product transportation were mostly the responsibility of the men. In average, almost 90% of the male respondents against about 70% of the female respondents were responsible of the land preparation, fertilizer application and water management. Moreover, for more than 50% of the female respondents, their spouses were the responsible of these activities. These results are consistent with Adinson et al. (2016) and FAO (2004) in terms of land preparation and fertilizer application.

Concerning the sowing, the transplanting, the weeding and the threshing, the female were mostly responsible. However, they were strongly helped by their spouses and children. The results on sowing, transplanting and weeding are consistent with Adinson et al. (2016) and FAO (2004). However Adinson et al. (2016) found that in Ashanti district in Ghana, male farmers were the mean responsible of threshing. The present paper shades this fact showing that in the 5 SSA target countries, 66% of male respondents were responsible of threshing but almost 60% were assisted by their spouses. The female farmers were mostly assisted in the threshing responsibility by their children.

For the harvesting, men were the mean responsible with large assistance of women. As far as bird and rat scaring is concerned, men and children are mostly responsible. In global, these results tally with Adinson et al. (2016) concerning the children. In fact, to faith the rats, the majority of the target farmers used the rat poisons. These products being dangerous, the men charge the responsibility of their manipulation, hence the responsibility of men in bird and rat scaring. This is consistent with Adinson et al. (2016) who showed that the men are the mean responsible of pesticide application.

3.3 Factors determining the access to rice production factors

The table 4 shows the factors determining the access to rice production factors in the target SSA rice production hubs. All the 6 estimated models for access to production factors were globally significant at the threshold of 1%. The factors significantly determining the rice area and the land ownership were the farmer gender, the total cultivated area, the production systems in the countries and the membership to rice producers' association. The sign of these variables show that male farmers relatively to females, had high rice area and owned the land they use for rice production. These results are consistent with Adinson et al. (2016) and Ayoola et al. (2011). An increasing of the total cultivated area of 1% causes an increasing of the rice area of 0.66%. This shows that rice is an important crop in the target hubs. Its area increases with the total cultivated area showing that those with large cultivated area (for all crops) have also large cultivated area for rice. In upland in Benin, rainfed lowland in Benin, irrigated lowland in Gambia and irrigated lowland in Cameroon, the rice area is relatively low. Likewise, in upland in Benin, rainfed lowland in Benin, rainfed lowland in Côte d'Ivoire, irrigated lowland in Côte d'Ivoire, upland in Gambia and irrigated lowland in Gambia, the farmers were relatively not owner of the land they use for rice cropping.

However, the relative majority of the farmers who were member of a farmers' association were owner of their rice land.

Females and those with relatively large rice area used machine or animal for land preparation. That is normal because with large area, farmers need help to prepare the land for rice cropping. Likewise, females do not have enough strength to prepare land without help. Their husband helps them (table 3) or they use mechanic labor (animal or tractor). This is consistent with Adinson et al. (2016). In Benin, in either upland or lowland, the access to animal or tractor for land preparation was relatively low while in Gambia, it was relatively high no matter the production system. The more experienced farmers had relatively high access to animal or tractor for land preparation. It could be explained by the fact that the more experienced rice farmers were the more aged. They need help to prepare their land. The mechanic labor is an important help for them. The members to associations did not have good access to mechanic labor. In fact, the members of association have chance to be helped by their co-members. Hence they do not really need a lot of mechanic labor.

Farmers with relatively large rice area had relatively large access to extension services. Likewise, the membership to the farmers' associations favored the access to extension services. However, the access to extension services in Benin (no matter the cropping system) and in rainfed lowland in Côte d'Ivoire was relatively limited. Likewise, the education limited the access to the extension services. This can be explained by the fact that the educated farmers do not really need help from extension services to master the production technics. These results are consistent with Zossou et al. (2016) who found that globally, there is no significant gender gap in access to public extension services in West Africa.

The rice area negatively impacted the access to the chemical fertilizer chowing that the farmers with small rice area used a lot of fertilizer to increase their production while those with large rice area did not use a lot of fertilizer. Likewise, the experience in rice cropping negatively impacted the access to the chemical fertilizer showing that the experienced farmers did not use a lot of chemical fertilizer. However, the membership to association favored rice farmers in their access to chemical fertilizer. Rice farmers in Benin, in Côte d'Ivoire and in Cameroon (no matter the system) had relatively high access to chemical herbicide.

4 Conclusion

The results show that there is gender gap in the access to several production factors. The male rice farmers have more access to land than the female ones. However, the female rice farmers have more access to mechanization than the male ones. In terms of access to labor, apart from the bird and rat control which is the responsibility of children, each farmer is the main responsible of the activities in his farm. Nevertheless, some specificities are noticed for some activities. Males are mainly responsible of the activities needing strength and/or precaution. In fact, in the farms headed by males, they are the main responsible of these kind of activities. However, in the farms headed by females, their spouses are the second responsible and strongly help them. Several female rice farmers use mechanization for the activities needing large strength.

Concerning the determinants of the access to rice production factors, there are some dissimilarities from a production factor to another. Apart from the access to chemical fertilizer and extension services, the farmers' gender is a determinant of the access to rice production factors. The rice area determines the access to mechanization for land preparation, the access to extension services and the access to fertilizer. The total cultivated area determines the rice area. Apart from the access to chemical fertilizer, the production system in the countries determines the access to rice production factors. The experiment in rice cropping determines only the access to mechanization for land preparation and the access to chemical fertilizer. The membership to producers' association determines the access to rice production factors apart from the chemical herbicide. The farmers' education determines only the access to mechanization for land preparation and the access to extension services.

These results suggest that the access to land is in advantage of male farmer. However, we could not suggest the improvement of the access to land for female because the access to labor might be a problem. Then, it is important to improve the rice yield for female farmer. The System of Rice Intensification (SRI) can be introduced in the rice development hubs especially for female farmers. These could help them to produce rice as much as male farmers with small area.

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Tables

Table 1: Distribution of the surveyed KI following the country, the production system and the gender

Country	Irrigated lowland		Rainfed lowland		Upland rice		Total
	Male	Female	Male	Female	Male	Female	
Benin	0	0	21	11	17	13	62
Côte d'Ivoire	12	1	30	5	0	0	48
Gambia	15	20	0	0	17	16	68
Tanzania	0	0	44	16	0	0	60
Cameroon	5	25	0	0	0	0	30
Total	32	46	95	32	34	29	268

Table 2: Farmers' characteristics and access to production factors following gender

Parameters	All	Male	Female	Statistical Variation following gender[a]
% of farmers surveyed	-	60	40	-
% of farmers receiving education	58	62	52	Chi2 (df:1)=2.5[NS]
% of farmers belonging to an association	70	65	79	Chi2 (df:1)=5.9**
% of farmers owning land for rice	76	76	78	Chi2 (df:1)=0.1[NS]
% of farmers having access to tractor or animal for land preparation	52	45	61	Chi2 (df:1)=6.8***
% of farmers having access to extension services	69	65	75	Chi2 (df:1)=3.2*
% of farmers having access to chemical fertilizer	79	74	86	Chi2 (df:1)=5.4**
% of farmers having access to chemical herbicide	46	51	39	Chi2 (df:1)=3.2*
Total cultivated area (ha)	4.4 (0.01 to 32.8)	5.1 (0.01 to 32.8)	3.3 (0.03 to 19)	t (df:257)=3.7***
Rice area (ha)	1.8 (0.01 to 24)	2.2 (0.01 to 24)	1.3 (0.02to15)	t (df:261)=3.1***
Number of year of experience in rice farming (years)	19 (0 to 65)	20 (0 to 66)	19 (1 to 65)	t (df:266)=0.6[NS]

Notes : a= Pearson Chi2 test for qualitative variables and Student t test for quantitative variables; ***= significant at 1%; **= significant at 5%; *= significant at 10%; NS= non-significant

Table 3: Gender division of the family labor following the famer's gender

Activities	Male respondent[a]					Female respondent[b]					Chi 2 following respondent gender					Correlation coefficient
	He or she is mainly responsible	Spouse is mainly responsible	Children is mainly responsible	Hired labor is mainly responsible	Animal labor is mainly responsible	He or she is mainly responsible	Spouse is mainly responsible	Children is mainly responsible	Hired labor is mainly responsible	Animal labor is mainly responsible	He or she is mainly responsible	Spouse is mainly responsible	Children is mainly responsible	Hired labor is mainly responsible	Animal labor is mainly responsible	
Land preparation	**87**	43	41	29	**26**	74	**58**	**42**	**39**	24	7.5***	6.5**	0.0^{NS}	2.5 ^{NS}	0.1 ^{NS}	0.90
Sowing	70	**50**	29	7	0	**83**	33	**42**	**7**	0	6.0**	6.9***	4.1**	0.0 ^{NS}	_	0.93
Transplanting	69	**63**	**48**	13	0	**72**	23	35	**26**	0	0.2 ^{NS}	22.8***	2.6^{NS}	3.7*	_	0.75
Weeding	73	**54**	**44**	**16**	0	**74**	42	40	15	0	0.0 ^{NS}	3.1*	0.5^{NS}	0.0 ^{NS}	_	0.98
Fertilizer application	**85**	30	14	**5**	0	79	**41**	**19**	1	0	1.4 ^{NS}	3.1*	1.0^{NS}	2.6 ^{NS}	_	0.94
Water management	**87**	20	**14**	**4**	0	56	**54**	13	1	0	25.6***	25.6***	0.0^{NS}	1.3 ^{NS}	_	0.76
Bird and rat scaring	**81**	**40**	62	**6**	0	70	37	**76**	4	0	3.6*	0.2 ^{NS}	4.6**	2.5 ^{NS}	_	0.97
Harvesting	**74**	**52**	**47**	19	0	70	41	36	**25**	0	0.5 ^{NS}	3.3*	3.2*	1.4 ^{NS}	_	0.97
Threshing	66	**58**	41	13	0	**82**	25	**46**	**15**	0	8.2***	27.0***	0.7^{NS}	0.1 ^{NS}	_	0.83
Transportation	**39**	15	19	**26**	**29**	35	**30**	**29**	24	19	0.5 ^{NS}	9.2***	3.6*	0.1 ^{NS}	3.1*	0.15

Notes : a = % of observations from male; b = % of observations from female; ***= significant at 1%; **= significant at 5%; *= significant at 10%; NS= non-significant

[orange] = The largest following the labor type [yellow] = The second largest following the labor type **Bold type** = The largest following the gender

Table 4: Factors affecting the access to production factors

Variables	Robust log–log model for cultivated area for rice (ha)	Probit models				
		Land ownership	Access to animal labor or tractor for land preparation	Access to extension service	Access to chemical fertilizer	Access to chemical herbicide
Female	–0.24 (0.10)**	–0.49 (0.24)**	0.82 (0.25)***	0.07 (0.22)	0.13 (0.23)	–0.36 (0.25)
Rice area [n] (ha)	_a	0.08 (0.10)	0.47 (0.13)***	0.18 (0.10)*	–0.28 (0.10)***	0.15 (0.12)
Total cultivated area [n] (ha)	0.66 (0.06)***	_a	_a	_a	_a	_a
Upland in Benin	–0.48 (0.28)*	–1.36 (0.42)***	–2.00 (0.54)***	–1.00 (0.30)***	_b	1.75 (0.38)***
Rainfed lowland in Benin	–0.72 (0.32)**	–1.70 (0.44)***	–1.51 (0.53)***	–1.09 (0.33)***	_b	2.33 (0.52)***
Rainfed lowland in Côte d'Ivoire	–0.43 (0.26)	–2.49 (0.42)***	_b	–0.98 (0.29)***	–0.43 (0.28)	2.43 (0.40)***
Irrigated lowland in Côte d'Ivoire	_b	–2.89 (0.56)***	_b	–0.71 (0.47)	–0.08 (0.47)	2.34 (0.62)***
Upland in Gambia	–0.34 (0.26)	–1.78 (0.44)***	1.52 (0.56)***	_b	_b	0.45 (0.39)
Irrigated lowland in Gambia	–0.48 (0.28)*	–1.42 (0.46)***	2.96 (0.56)***	0.16 (0.39)	0.67 (0.46)	–0.54 (0.55)
Rainfed lowland in Tanzania	0.23 (0.26)	_b	_b	_b	_b	_b
Irrigated lowland in Cameroon	–0.57 (0.29)**	_b	0.19 (0.36)	0.25 (0.36)	_b	2.58 (0.46)***
Experience in rice farming (years) [n]	0.02 (0.02)	0.06 (0.03)	0.26 (0.12)**	–0.02 (0.03)	–0.24 (0.13)*	–0.07 (0.12)
Access to extension service	_b	_a	0.17 (0.26)	_a	0.28 (0.22)	0.15 (0.27)
Membership to producers association	0.12 (0.11)	0.86 (0.24)***	–1.18 (0.27)***	0.90 (0.21)***	0.60 (0.21)***	0.40 (0.27)
Education	–0.01 (0.10)	0.12 (0.22)	0.84 (0.27)***	–0.46 (0.21)**	–0.32 (0.22)	0.13 (0.25)
Constant	–0.35 (0.28)	1.66 (0.41)***	–1.06 (0.44)**	0.63 (0.26)**	1.12 (0.45)**	–1.42 (0.52)***
Number of observations	256	263	260	260	260	245
F for the robust model	30.52*** (df1:12; df2:243)	–	–	–	–	–
LR Chi2 for the probit models	–	79.11*** (df:11)	169.66*** (df:11)	70.97*** (df:11)	45.72*** (df:9)	158.76*** (df:13)
R^2 or Pseudo R^2	0.59	0.28	0.47	0.22	0.17	0.47

Note. Standard errors are represented in brackets.

[n] expressed in naperian logarithm.

_a Not applicable.

_b dropped because of intercorrelation or the fact that it explains perfectly the dependent variable.

* Denotes statistical significance at the 10% level.

** Denotes statistical significance at the 5% level.

*** Denotes statistical significance at the 1% level.

df Denotes degree of freedom