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Determinants of Rice Production, Its Economic Contribution to Household Income and Poverty Alleviation in Guinea: Case Study Prefecture of Faranah

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Abstract
In Guinea, agricultural potential is enormous; the land potential is estimated at 6.2 million hectares of which 1.6 million hectares are cultivated only. Rice is amongst the most important cash crops in the agricultural sector and contributes to 77% of cereal production in the country. The study aims at examining rice production in order to assess its contribution on farmers' income in Faranah Prefecture, Guinea. The study involved 270 respondents from eight rural communes plus Faranah center (Bagna, Beindou, Heremakono, Nialia, Passayah, Sandenia, Songoyah, Tiro and Faranah center). Data were collected taking into account the status of producers in each area: small (0-2.5 ha), medium (2.6 -5.5 ha) and large producers (> 5.5 ha).The regression model was used for 11 variables (gender, age, education, farm experience, household size, farm size, labor cost, fertilizer, capital inputs, household income and training where F values of all producer categories were F = 48.831 ***, F = 4.52 * and F = 2.39 * and the corresponding values indicated R^2=0.807; R^2= 0.417 and R^2=0.317respectively. The gross margin analysis shows that incomes of each producer category were between (4639 - 10553 US$/ha), (2781-14866 US$) and 8903.77- 1557 US$/ha) respectively. The benefit cost ratio (BCR) of each producer categories were at (1.8–2. 07), (4 - 1.8) and (1.2 - 1.7) respectively. In sum, it would be concluded that the level of productivity remains lower compared to the size of land being accessed by the rice farmers. Therefore, the study recommends that the Government of Guinea should strengthen its institutions in order to improve the quality of agricultural land, stabilize the rice market and allocate more resources for improving rice farmer's asset.
Keywords: Rice producer, profitability, Faranah prefecture, linear regression model, poverty alleviation

1. Introduction

In Guinea, agricultural potential is enormous; the agricultural potential is estimated at 6.2 million hectares of which 1.6 million hectares are cultivated. Rice is amongst the most important cash crops in the agricultural sector and contributes to 77% of cereal production. Estimates provided by the results of the survey on access to rice statistics in Guinea show that the total area under cultivation has increased from 47 6 000 ha in 2000 to 797 120 ha in 2010. The average combined yield rose from 1.55 to 1.71 tonne per hectare in 2009 (Bayo, Lansana, 2000). Guinean agriculture is largely dominated by family-type farms, which constitute almost all of the village's agricultural activities. These farms cover about 60% of the population and occupy about 95% of the country's agricultural land (Japanese embassy in the Republic of Guinea, 2005)

This type of farms, are generally of modest size (0.30 to 0.50 ha), in which production and consumption are closely linked. Within these production systems, rain fed crops is predominant and represent 95% of the total area under development. Areas under irrigated crops are insignificant. Of the rainfed crops, more than 40% are on hills or mountains and 30% on plateaus. Lowlands and mangroves are poorly exploited (Berthome et al, CIRAD 1999).

According Bayo, L (2000), the production rice sector continues to be the area most affected by the dynamics of agricultural development, because of the place that rice occupies in the food system of the Guinean population. The attempt to respond to the demands associated with the rapid increase in rice consumption has led the Guinean authorities to allocate reasonably big for monetary resources to the development of food crops (60 million $ for Crop production revival for the enforcement of alimentary and economic security; 69 million $ for Infrastructure access and agricultural and breeding market programs, (MAE, 2009).

For Boun Tieng Ly et al (2001), the rice sector continues to be at the center of national agricultural development policies. Self-sufficiency in rice, which has always been regarded by policy-makers as a priority issue, has led the government to implement several strategies for the development of rice production. Locally produced varieties have been prioritises as they appear to be competitive with a significant contribution to the food security challenge (MAE, 2009). Follow Rossignol, L. (2008), despite its growing importance, full scale development of the rice production chain is still hampered by structural dysfunctions in the production areas (marketing circuit, inaccessibility of production areas, difficulties in accessing financing for the countryside, insufficient security of land ...), and logistical bottlenecks such as input supply and increased competition of

imported rice (Idiong, I. Agom D and Ohen, S. 2006).

Rice is the staple food for many Guineans and constitutes a major part of the diet for many other African countries, (Richards, P. 2009). During the past three decades, the demand for rice has increased steadily, playing a major role in the strategic food security planning policies of many countries, (Florent Okry and *al*, 2010). In sub-Saharan Africa, rice is produced in five main ecosystems, namely rainfed uplands, rainfed lowlands, inland swamps, irrigated ecosystem and mangrove swamps, (Norman, J. and E. Otoo 2003). Following Tshibaka, T. and A. Klevor (2002), in 2003, Africa produced about 15.08 million tonnes of paddy rice on 10.23 million ha – 3.3 and 6.11 % of the world's total rice production and rice area, respectively. West Africa accounts for 70.4% (approx. 8.74 million ha) of rice area. The major contributing countries are Nigeria (47.9%), Guinea (5.20%), Côte d'Ivoire (5%) and Mali (4%). East Africa accounts for 16.1% of rice area. The major contributing countries are Tanzania (6.0%) and Madagascar (3.19%). Central and southern Africa accounts for 7.5% of rice area, the major contributing countries are Democratic Republic of Congo (4.05%) and Mozambique (1.8%) (WARDA, Diagne, A., S.A. Adekambi, F.P. Simtowe, 2006).

Following (Tshibaka and Klevor 2002) and Biaou, G (2009), rice consumption has also become increasingly popular in many countries in sub-Saharan Africa (SSA), where rice is not traditionally a major food crop, for example, Benin, Burkina Faso, Cape Verde, Ghana, Guinea, Mali, Niger and Togo. The income generated from rice cultivation and postharvest activities provides cash to cover the expenses of clothing, housing, education and other social activities of the majority of people in rural areas (Rubyogo, J. C. and Sperling, L. 2009).

2. Material and methodology

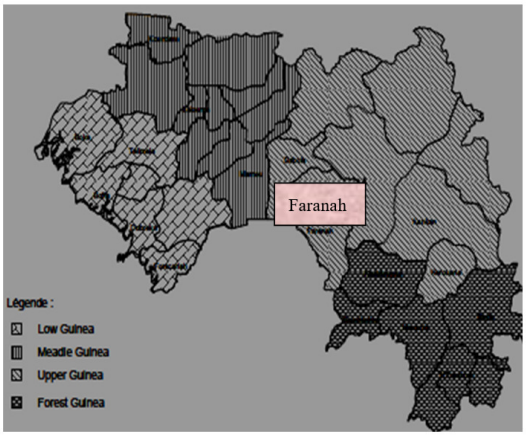
2.1 Research design

The study aims at examining rice production in order to assess its contribution on farmers' income in Faranah Prefecture, Guinea. Specifically, it was conducted to achieve the following objectives: 1. identify the potential socio-economic characteristics that influence rice production in our production area; 2. measure the net income and profitability of production on households by production area; 3. identify with the producers all challenges related to their production activities.

2.2 Study area

The prefecture of Faranah is located 482 km from the capital Conakry. It is between 10 degrees 10 of the North attitude and the 10 degrees 42 and 11 degrees 50 west longitude with an average altitude of 340 m. It covers an area of 18994 km^2 with a population of 280511 people, of which 136100 men and 144411 women. The average population density is 15 inhabitants per km^2 (Prefectural plan of Faranah, 2016).The prefecture of Faranah is one of the 8 prefectures of Upper Guinea. It is bounded to the Northwest by Dabola, Northeast by Kouroussa, and Southeast by Kissidougou, to the West by the Republic of Sierra Leone, and to the South by Kissidougou and Gueckedou. This region is the most endowed in terms of rice growing potential because of the large arable land area esteemed at 443443 ha. In spite of all this great natural attributes, the prefecture has little land under cultivation, making it as one of region with lowest per capita income in the country. According to Ministry of Agriculture, Agricultural Productivity Program in West Africa (PPAAO 1 C – Guinea, 2015), only 102469 ha of all crops were grown in 2014, the rice alone made 59055 ha., 80% of its farmland is mainly rain-fed and its multiple consequences (floods) leading to devastation of crops. It is also geographically located near the Niger River and its tributaries which could facilitate irrigation of the vast plains compared to the rest of the country.

Study area map



http://www.emapsworld.com/guinea-regions-map.html

2.3 Data collection and analysis

The prefecture of Faranah is located 482 km from the capital Conakry. It is between 10 degrees 10 of the North attitude and the 10 degrees 42 and 11 degrees 50 west longitude with an average altitude of 340 m. It covers an area of 18994 km^2 with a population of 280511 people, of which 136100 men and 144411 women. The average population density is 15 inhabitants per km^2 (Prefectural plan of Faranah, 2016).The prefecture of Faranah is one of the 8 prefectures of Upper Guinea. It is bounded to the Northwest by Dabola, Northeast by Kouroussa, and Southeast by Kissidougou, to the West by the Republic of Sierra Leone, and to the South by Kissidougou and Gueckedou. This region is the most endowed in terms of rice growing potential because of the large arable land area esteemed at 443443 ha. In spite of all this great natural attributes, the prefecture has little land under cultivation, making it as one of region with lowest per capita income in the country. According to Ministry of Agriculture, Agricultural Productivity Program in West Africa (PPAAO 1 C – Guinea, 2015), only 102469 ha of all crops were grown in 2014, the rice alone made 59055 ha., 80% of its farmland is mainly rain-fed and its multiple consequences (floods) leading to devastation of crops. It is also geographically located near the Niger River and its tributaries which could facilitate irrigation of the vast plains compared to the rest of the country.

2.3.1 Theoretical considerations and empirical model: Linear regression model

The multiple regression studies involve the nature of relationship between a dependent variable and two or more explanatory variables. The techniques produce estimates of the standard error of multiple regression and coefficients of multiple determinants. In implicit form, the statement that a particular variable of interest (Y) is associated with a set of the other variables (X) is given as:

$Yi = f(X_1, X_2 ...)$ (1).

Where:

Yi is the dependent variable and X_I, X_2 ---$X_{n,}$ is a set of a key variable. The coefficients of multiple determination measures the relative amount of variation in the dependent variable (Y_i) explained by the regression relationship between Y and the explanatory variables (X_1).

The F- Statistics tests of the significance of the coefficients of the explanatory variables as a group. It tests the null hypothesis of no evidence of significant statistical regression relationship between Y_i and X_s is as against the alternative n-k-1 degrees of freedom, where n is the number of respondents and k is the number of explanatory variables. The standard error of regression coefficients is the measure of error about the regression coefficients. The nature of the relationship between an outcome variable (Y_i) and a set of explanatory variables can be modeled using different functional forms. The four functional multiple regression models were employed to select the one that has provided the best fit. The choice of best functional form was based on the magnitude of the R and R^2 value, number of significant variables, size and sign of regression coefficients as they conform to a priori expectation.

The four functional forms were specified implicitly as follows:

(i) Linear Function was used in this research

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + ei \quad (2)$$

(ii) Semi – log function

$$Y = Lnb_0 + b_1L_nX_1 + b_2L_nX_2 + b_3L_nX_3 + b_4L_nX_4 + b_5L_nX_5 + b_6L_nX_6 + b_7L_nX_7 + b_8L_nX_8 + b_9L_nX_9 + b_{10}L_nX_{10} + b_{11}L_nX_{11} + e_i \quad (3)$$

(iii) Exponential function

$$LnY = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + e_i \quad (4)$$

(iv) Cobb Douglas Function

$$LnY = L_nb_0 + b_1L_nX_1 + b_2L_nX_2 + b_3L_nX_3 + b_4L_nX_4 + b_5L_nX_5 + b_6L_nX_6 + b_7L_nX_7 + b_8L_nX_8 + b_9L_n X_9 + b_{10}L_n X_{10} + b_{11}L_nX_{11} + ei, \quad (5)$$

Where:

Y= Output of Rice in Kg/ tons; X_1 = Gender,

X_2 = Age in year; X_3 = Education level

X_4 = Household Size Farming

X_5 = Experience in Years; X_6= Farm Size in Hectares

X_7 = Labour Cost in US$;

X_8 = fertilizer in kg/ha;

X_9 = F capital inputs in US$; X_{10}=farm income in US$;

X_{11}=Training in year; ei = error term

2.3.2 Gross margin analysis

The Gross margin analysis will be also adopted in this research following (Nwaobiala Ezeh, (2010). The following expression was used for the gross margin analysis

$GM = \Sigma p_i (Q_i - \Sigma p_j X_i)$ (6),

Where:

GM = Gross Margin; P_i = Unit price of output; Q_i = Quantity of each output; P_j = Unit of each input; X_i =

Quantity of each input.

NR = GM – TC (7)

BCR = TR / TC (8)

Where:

NR = Net Revenue; TC = Total fixed costs derived by depreciation of fixed costs;

TR = Total Revenue; TC = Total Costs.

BCR = Benefit Cost Ratio

In our study area, it was basically a matter of calculating by category of producers (Small 0-2.5 ha, medium 2.5 to 5.5 ha and large above 5.5 ha). In this case, the study was carried out in 8 rural communes plus faranah center villages where we have: Bagna, Beindou, Common urban (Faranah center), Heremakono, Nialia, Passayah, Sandenia, Songoyah and Tiro. It was observed that in these places, the economics performance indicators were: the total cost of rice cultivation (labor cost, capital inputs, rent of lands, interest on loan, depreciation of farm tools), the gross margin or gross return (Total price of paddy rice produced during one year in dollar/hectare), the net income in dollar/hectare following Chowdhhury *et al*. (2012) and Hoque, M. and M. Haque (2014). The input cost was estimated as the sum total of cultural and intercultural operation cost; different inputs cost and harvest operation cost. Gross margin was defined by sum of the market price of paddy.

3. Results and discussion

3.1 Socio-economic profile of the respondents

Table 1: Distribution of the respondent's socio-economic characteristics

Character	Unit	Categories	%	Frequency	Mean	St.dev
Gender	Male and Female	Male	48	132	3	1.03
		Female	52	138	4	2.13
Age	years	young (24-35)	18	49	29	3.38
		Adult (36-50)	49	131	43	4.77
		Old (>50)	33	90	58	3.40
Education	years of schooling	illiterate (0)	51.5	139	10.32	1.58
		Primary (6)	19	51	10	3.91
		Secondary (7)	22	60	9	4.74
		University (5)	7.5	20	9.6	0.51
Household size	Persons	Small (1 - 3)	8.5	17	2.24	1.05
		Medium (4-6)	58.5	155	5.19	1.08
		Large (7-9)	33	98	7.47	0.52
Farm experience	years	(1-5)	6.29	17	4.11	0.78
		(6-10)	37.77	102	9.21	1.36
		(>10)	56	151	12.47	1.22
Farm size	Ha	Small (0-2.5)	52.22	141	1.53	1.52
		Medium (2.6-5.5)	27.40	74	4.32	1.46
		Large (> 5.5)	20.37	55	6.53	0.49
Labour cost	US$	Low (50-150)	21	57	109.92	29.38
		Medium (150-350)	52	140	268.79	58.63
		High (Above 350)	27	73	496.18	121.7
Fertilizer	Kg/Ha	Low (52-140)	43.70	118	101.91	26.16
		Medium (140-304)	35.59	88	198.80	47.76
		High (Above 304)	23.70	64	592.77	157.4
Capital inputs	US$	Low (65-180)	20.37	55	101.91	26.16
		Medium (180-350)	34.81	94	198.80	47.76
		High (Above 350)	44.81	121	592.77	157.4
Household income	US$	Low (100-359)	5.56	15	282.93	109.9
		Medium (350-400)	20.74	56	742	152.2
		High (> 400)	73.70	199	1826.7	658.3
Training	year	No training (0 day)	33.33	90	0.32	0.16
		Low training (1)	25.19	68	1.47	0.18
		medium(2-3)	41.48	112	2.5	0.50

Source: calculated from survey data, 2016

The findings revealed that 52% of the respondents were female farmers whereas 48% of them were male rice growers. This implies that more female respondents participated in the study than their counterparts. This

situation came into being because most of men do engage in off-farm activities with the expectation of earning more income. This allows more women to remain the main actors in the agricultural sector.

Results in Table 1 show that the age of respondents between 36-50 years ranked the highest while those greater than 50 years was the least. Only 18% of the respondents had less than 36 years. Based on the indicated findings, it is evident that majority of the respondents had more than 35 years of age. This implies that most of young people do participate in non-agricultural activities which can enable them to earn more income and thus improve their livelihood status.

As regards education level of respondents, Table 1 shows that more than 50% of the respondents were illiterate meaning that they could not read, write and count. About 19% of the farmers had attained primary education and 22% of them were secondary school leavers. Only 7.5% of the respondents had attained higher education. This indicates that most of the respondents did not attend formal education. This might hinder prosperity of agricultural activities hence lower income generation.

The findings indicate that the highest percentages (58.5%) of the respondents had medium household size while 33% of the rice growers had large household size. The results revealed that only 8.5% of the farmers had small household size with less than 4 household members. This shows clearly that households with large number of people have more labours to work in the field than their counterparts with small number of household members. Therefore, the number of household members may determine the level of productivity and income among the rice producers.

Farm, experience were determined by two edges where 56 % of the respondents had above 10 years as experience in rice production, however, 6.25% of them were young and only 5 years in field, that judged very less. It was indicated that Farm size has been divided in three groups where the higher percentage (52.22 %) was for the small producers (0-2.5 hectares), with 141 households. However, the study indicated the medium producers (2.6-5.5 hectares) was estimated at 74 respondents (27.40%), while the large (> 5 hectares) with (55) respondent had (20.37 %) of the households.

As regards labour cost, medium (140) with (52 %) of the farmers, had spent between 150 -350 US$ while the low cost and large were 50-150 US$ and 350 US$ respectively. we conclude that in the study area, the labour cost is one of the serious issues of rice producers poverty, because judged very high.

The finding shows that in terms of fertilizers using, the higher percentage was 43.7% of the respondents a proportion of (52-140 kg), which mean rice production is based on low input use and these households were small producers; in other hand, it was also revealed that the medium level fertilisation was allowed between (141 -304 kg) with (35. 59 %) for a total of farmers of 88 respondents where the high quantity of fertilizer was used by large producers (above 304 kg) estimated at 64 farmers for (23.7%) .

It was indicated that for the all levels, capital inputs were used from US $ 65 to US $ 180, with 55 farmers with 20.37% qualified as low. Whereas, according to the middle and high capital inputs, 94 farmers whit (34.81%) and 121 (44.81%) respectively as a higher resources level using.

According to Table 1, the higher annual income was 73, 70% for 199 respondents, while 20, 74 % of 56 respondents were the medium got from 350 to 400 US $ / ha.

Regarding frame training, the high percentage 33.33%) was the score of the year followed by (41.48 %) and 25.19 % respectively in which we qualified the very low for a sustainable rice production practices in our study areas

3.2 Linear regression model applied to the rice producers 'profitability

Table 2: Regression analysis showing influence of Socio-economic factors on profitability of small producers

SI No	Independents variables	Regression coefficients (β values)	Std. Error	t values	level of significance (P values)
1	Gender	-36.716	50.359	-0.729	0.467
2	Age	-.700	2.448	-0.286	0.776
3	Education	.345	7.021	0.049	0.961
4	Household size	31.974	20.217	1.582	0.116
5	Experience	11.824	9.937	1.190	0.236
6	Farm size	374.754	103.925	3.606	0.000***
7	Labor cost	-1.257	.456	-2.758	0.007**
8	Fertilizer	-.850	1.092	-0.778	0.438
9	capital inputs	1.016	.330	3.076	0.003**
10	Household income	.722	.134	5.365	0.000***
11	Training	-1.897	21.594	-0.088	0.930

Source: calculated from survey data, 2016. R= 0.897, R^2 = 0.805, F = 48.83***, **= significance at 5% level, and *** = significant at 1 %

Regression analysis was used to determine the influence of various socio characteristics of the respondents (small, medium and large) producers on the profitability of rice production in the prefecture of Faranah. In terms of small producer's return in the study area, the linear regression qualified the socio characteristics factors and mentioned them as the major determinants of rice production because of their high correlation values. In our study, data presented that the small producers has more advantage in rice production where R and R^2 values on full model regression were 0.897and 0.805 respectively with a corresponding F- change (4.883^{***}), highly significant at (1%). R^2 is combined at 8.05 % of the total variance of small rice production profitability on the eleven (11) selected socio factors. That means the selected factors got high values with the profitability of small rice producers. It was indicated that, the household income, farm size, capital inputs and labor cost were significantly highers at 1% of the rice profitability and capital inputs and labor cost where significant at 5% level.

Table 3 Regression analysis showing influence of Socio-economic factors on profitability of medium producers

SI No	Independents variables	Regression coefficients (β values)	Std. Error	t values	level of significance (P values)
1	Gender	-1.142	3.601	-0.317	0.752
2	Age	10.807	8.979	1.204	0.233
3	House size	-9.171	29.366	-0.312	0.756
4	Experience	16.860	16.051	1.050	0.298
5	Farm size	-34.958	49.021	-0.713	0.478
6	Labour cost	-2.470	0.633	-3.903	0.000***
7	Fertilizer	0.911	0.305	2.984	0.004**
8	Capital inputs	0.811	0.359	2.259	0.027*
9	Household income	0.140	0.116	1.206	0.232
10	Training	11.942	32.224	0.371	0.712

Source: calculated from survey data, 2016. R= 0.646, R^2 = 0.418; F= 4.52**, = significant at 5%, ** = significance at 1% level, ***= Significant at 1%.

Considering medium producers, the regression analysis revealed that R and R^2 values were 0.646 and 0.418 respectively, which means the corresponding R^2 = 4.18 % of the total variance of the medium rice productivity was judged low significantly compared to the small producer. The corresponding F- values was (F = 4.52*) at 10 %, which should explain the weakness of the significance of these categories of producers production. From these medium producers, the factor like labor cost was highly significant (1%) and Fertilizer and capital inputs were respectively significant at 5% and 10%. Owing to the fact that this category of producers did not have owners sufficient lands for cultivation, had payed or rented to landowners at high prices and has been expending more on the fertilizer and in farm labour .

Table 4: Regression analysis showing influence of Socio-economic factors on profitability of large producers

SI. No	Independents variables	Regression coefficients (β values)	Std. Error	t values	Level of significance (P values)
1	Gender	395.220	231.175	1.710	0.095*
2	Age	8.955	13.015	0.688	0.495
3	Education	-6.696	18.248	-0.367	0.715
4	Household size	26.519	109.156	0.243	0.809
5	Experience	-33.662	45.850	-0.734	0.467
6	Farm size	-314.624	220.361	-1.428	0.161
7	Labour cost	-4.285	1.267	-3.383	0.002**
8	Fertilizer	2.033	1.077	1.888	0.066*
9	Capital inputs	1.127	0.689	1.636	0.109
10	Household income	.460	0.224	2.049	0.047*
11	Training	70.536	95.610	0.738	0.465

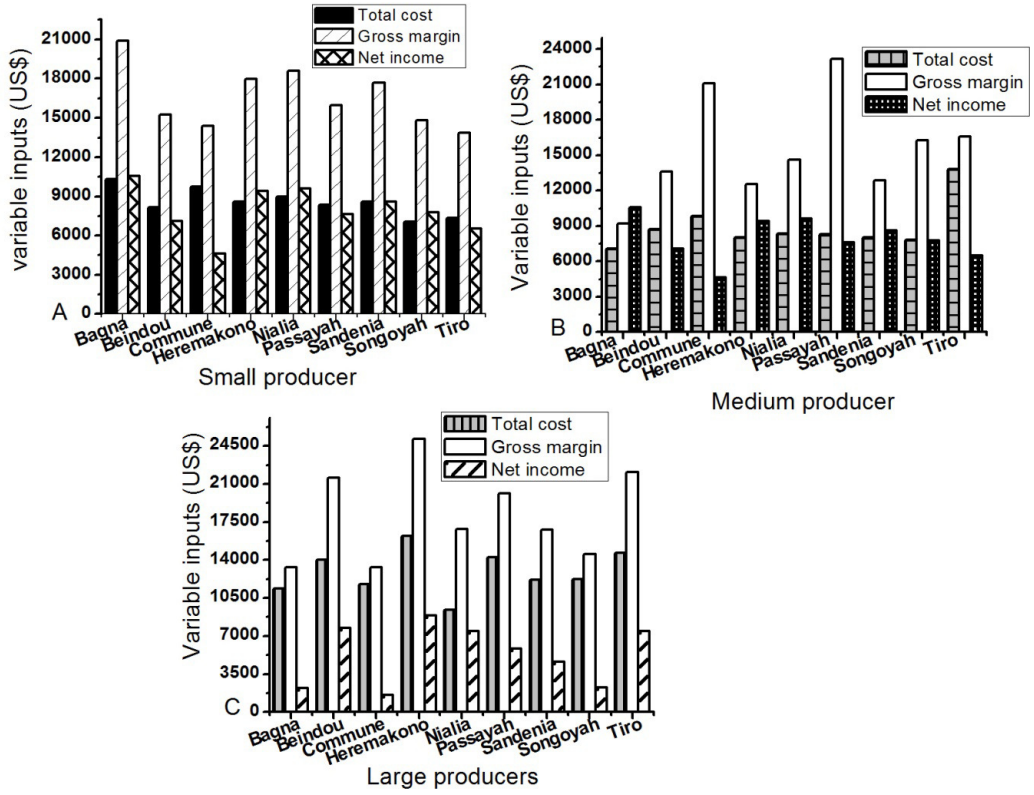
Source: from survey data, 2016: R= 0.616^a, R^2=0.379, F = 2.39**, = significant at 10% level, **= significant at 5 %

It was observed that the large producers had the same problems as the medium producers due the fact of the low significant of the socio economics factors. It was indicated that R and R^2 in full model regression were 0.616^a and 0.379 respectively and where R^2 = 3.79% of the total variance in the productivity. At the same time, it was revealed that the corresponding F. change value (2.39 *) was significant at 10% level, but explained the correlation with the profitability of the large, and it should be noted that factors such as training, household size,

education, age and experience were not significant because of their inadequacy in production systems. However, it was very interesting when factors such as labor cost, age, fertilizer and household income were significant at 5% and 10% respectively this proves that, despite the difficulties of the moment, these producers will be able to succeed in their production activities.

3.3 Gross margin analysis

Through this analysis, we calculate in each production area the indicators of economic performance of rice in the study area. The process of calculation has identified the total labour cost, gross income from the sale of annual production (paddy rice), net income and BCR (benefit cost ratio) for rice profitability).



Graph 1: Economic performance of each producer's category: A (small), B (medium) and C (large)

Through this graph 1, it was necessary to explain the economic performance of rice production using gross margin analysis. Following the reality of the area, it was realized three figures where the small producer were noted A, medium (B) and large (C) respectively. So, this analysis consisted to explain the economic performance of each variable input per production area in order to appreciate their contribution in the improvement of living conditions of the households in terms of income and profitability. Thus, it's related through the figure A, the villages of Bagna, urban commune, Nialia, Sandenia, Passayah and Tiro had higher total cost (10305; 9739; 8988; 8604; 8576.87; 8156 US$/ha) respectively due to the scarcity of labour in these localities because of the high prices at moments in their areas.

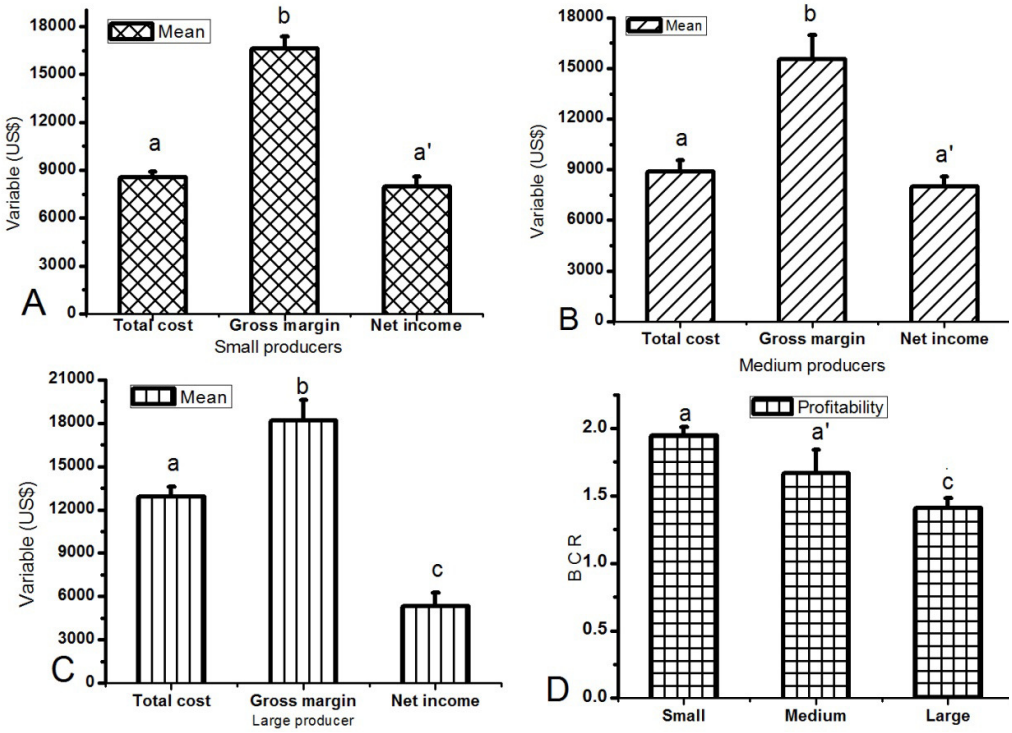
Whereas, in terms of gross revenue, the villages like Tiro and Songoyah got moderately (7361 and 7047 US$ /ha) inclusively, on the basis of Gross return, Bagna have high score (20,876 US$/ Kg) followed by Nialia and Heremakono (18,592 and 17,990 US$/ Kg) respectively. This situation is due to the high quantity produced through lands use techniques (permanent water regime, the land size judged appropriate to the small producers).The other villages do not knows the same reality insofar as the quantity produced is lower, but also due to the difference of the prices at the time from the sales as such as Passayah, Beindou (15948 and 15948 US$/ Kg), Songoyah, Urban commune and Tiro hade very low average (14378; 14015 and 13881 US$/ Kg) respectively. In terms of net income, it was observed that the highest average were founded in Bagna, Nialia and Heremakono (10553; 9604; and 9413 US$/ha) respectively compared to Urban commune, Tiro and Beindou (4639; 6520; and 7106 US$/ha. These incomes are not very sufficient because cropping techniques were not been widely followed and therefore affects the quantity produced at low selling prices not taking into account opportunity cost also.

According to figure B (medium producers), it is found that the rice producers of Tiro, Urban commune, and Beindou invest more in total cost values (13824; 9859 and 8716 US$/ha) respectively. On the other hand, places

such as Songoyah and Bagna, expended low averages in total cost (7823; and 7097 US$/ha).The high gross margin is observed in Passayah, Commune, Tiro, and Songoyah, (23143; 21111; 16605; and 16246 US$/ha) inclusively due to the high price of paddy rice kilogram (0.48 $/kg) and the availability of fertilizers in these different areas. It was noted that some areas like Nialia, Beindou, Sandenia, Heremakono and Bagna were making lower gross margins (14610; 13606; 12890; and 9174 US$/ha) due to the rice market managements challenges and the inadequacy of post-harvest management. It was shown that, this situation can influence significantly the value of annual net income. Thus, it was indicated that, the highest average net incomes from medium rice producers were observed in Passayah, (14,866 US$/ha). In certain communes such as urban commune, Songoyah, and Nialia the average net incomes were (11252; 8423 and 6275 US$/ha) respectively. However, the net incomes were judged so low in Sandenia, Heremakono, Beindou, Tiro and Bagna (4878; 4516; 4305; 2781 and 2076 US$/ha) respectively due to the higher expensing in production cost.

The finding shows that the economic performance of large producers (figure C) was explained in the same way as the medium producers, the production costs were very higher and the gross margin obtained were judged low, Logically, it was indicated that from the graph 1, the villages such as Heremakono, Tiro and Passayah has spent the total cost of (16199.2; 14661.4; 14256 US$/ha) respectively. However, the higher averages were founded in Heremakono, Tiro, Beindou and Passayah (25103; 22097; 21580 and 20118 US$/ha) where Songoyah, Bagna and Commune generated low had got (US$/ha 14515; 13314 and 13314)

It was observed that the net incomes were higher in Heremakono, Beindou, Tiro, Passayah, with the averages of 8903.77; 8903.77; 7435.64 and 7431.8(US$/ha) respectively compared to the lower average net incomes observed in Songoyah and Bagna (2255 and 2233.6 US$/ha).



Graph 2: LSD test by each producer's category (small, medium and large) and BCR of each producer category (Fig ABCD)

In general, LSD test was used to explain the significance existed or not between the different variables in the figures A, B C, D in which the data related to each producer category were localized (small, medium, large). To understand well our analysis in this case, it was indicated that each figure designates a category of producer (Figure A: small producers, Figure B: medium producers, Figure C: large producers) through which statistical analysis has shown the mean values of the variables and the standard error that we used to the LSD test and figure D to the average of benefit cost ratio (BCR) to each producer categories.

In graphic A, the LSD test shows that there is a significant difference between the total cost (a) and the gross margin (b) which is (8036±848) and no significance between total cost (a) and Net income (a') with (8625±848). However, it exists a significance between gross margin (b) and net income a' (8625±848), it was indicated that the average cost of production, gross margin and net income of small producers were significant. The graphic B shows that there it was indicated a significant difference between (a) and (b) with 15546±1451

and 6662±1733, while it is no different significant between (a) and (a').

Regarding the figure C, there is different significant between (a), (b) and (c) where the values were (5288±1466) and ((7558±1466). Between (b) and (c), the relationship is highly significant (12847±1466). That means that for the time being rice production is not very profitable for all categories of producers (small, medium and large), due the many reasons as such as the high cost of production per hectare, post-harvest management and market management.

The figure D (profitability) shows that, the small producers got much profitability advantage in the production systems than medium and large producers. In terms of average of benefit cost ratio (BCR), the highest BCR were observed as (1.8 to 2, 07); (1.4 to 1.8) and (1.2 to 1.7) respectively.

Photo 1: House built in rice income at Bagna

Photo 2: Fatou, the best producer in Bagna

Photo 3: A session of survey in Tiro

Photo 4: The old tractor used by a large producer

Figure 3: some photos from research areas illustrating the reality of rice production

4. Conclusion and Discussions

The study aims at examining rice production in order to assess its contribution on farmers' income in Faranah Prefecture using regression model and gross margin analysis to analyse rice production and its contribution to household incomes. The finding had identified eleven (11) independents variables following the list: gender, age, education, household size, farm experience, farm size, labor cost, fertilizer, capital inputs, household income and the training plus yield as the dependent variable, which had important implications for all producer categories (small, medium and large) in our production areas. The study reveals that these socio - economics factors were the key determinants of rice production and his profitability through which the three producer categories have been doing during the time. The linear regression model used for all producer categories shown that the small producers recorded the significant high value in which R and R^2 values on full model regression were 0.897and 0.805 respectively with a corresponding F- value (4.883^{***}), highly significant at (1%). R^2 is combined at 8.05 % of the total variance of small rice production profitability of small-scale producers where the factors such as household income, farm size, capital inputs and labor cost were highly significant at 1% of while rice

profitability and capital inputs and labor cost where significant at 5% level.

Regarding the medium producers, it was identified that the corresponding R and R^2 values were 0.646 and 0.418 respectively, which means the R^2 = 4.18 % of the total variance of the medium rice productivity was judged low significantly compared to the small producer F- values (F = 4.52*) significant at 10 %. From these medium producers, the labor cost was highly significant (1%) and Fertilizer and capital inputs were respectively significant at 5% and 10%.

The large producers finding show R and R^2 in full model regression were 0.616^a and 0.379 respectively and where R^2 = 3.79% of the total variance in the productivity of large producers. At the same time, it was revealed that the corresponding F value (2.39 *) was significant at 10% level. Using gross margin analysis, the economic indicators from small producers like labor cost, gross return, net income and cost-benefit ratio were highly significant in which the highest average of net incomes were observed in Bagna, Nialia and Heremakono (10553; 9604; and 9413 US$/ha) respectively and (1.8 to 2, 07) as BCR compared to Urban commune, Tiro and Beindou (4639; 6520; and 7106 US$ /ha). These results show that rice production is profitable and holds great potential for the small rice producer in Faranah prefecture.

The medium producers had generated low incomes and the benefit costs ratio were not very significant because of those producers do not have sufficient financial means to improve agro-technical system (works, pesticides, fertilizer). Among the medium producers, the net incomes were high in Heremakono, Beindou, Tiro, Passayah, (US$/ ha 8903.77; 8903.77; 7435.64 and 7431.8) respectively. In terms of average of benefit cost ratio (BCR), it was (1.4 to 1.8), so judged lowest due to the rice market management's challenges and the inadequacy of post-harvest management but also the low use of inputs, herbicides and the size of the field considered large but badly prepared.

The economic performance of large producers observed that the net incomes were high in Heremakono, Beindou, Tiro, Passayah, (8903.77; 8903.77; 7435.64 and 7431.8(US$/ha) respectively compared to the lower average net income in Songoyah Commune and Bagna (2255 and 2233.6 US$/ha). The highest average benefit cost ratios for the large producer's category were observed between (1.2 and1.7). This uncomfortable situation of low income among the major producers was due to the high production costs incurred, the land management systems, the poor rice market and keeps them in subsistence agriculture which lacks sufficient resources to invest well on their lands.

It was observed that, the small producers got much profitability advantage in the production systems than medium producers and large. In terms of average of benefit cost ratio (BCR), the highest BCR was observed with the small producer (1.8 to 2, 07); (1.4 to 1.8) and (1.2 to 1.7) for medium and large producers.

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