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Utilising the Total or Cultivation (TFC) and Multiple Regression (MR) Models to Examine the Factors Influencing Rice Cultivation Farms in the Bombali District, Sierra Leone

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Abstract

Many obstacles to attaining rice self-sufficiency in Sierra Leone, is the stumpy cultivation of this staple food crop which transformed to inadequate rice availability for the entire sierra Leonean population. Several determinations have been made by the successive Sierra Leone governments towards rice self-sufficiency. Much attention is constantly given to improving the inputs utilised by the rice cultivators, and improvement of better-quality rice seed varieties whereas the main reasons of the low rice cultivation are left unaddressed. Consequently, this study focussed on the examination of the main factors that influence rice cultivation farms in Bombali district, North-Eastern of Sierra Leone. Through a multi-stage sampling technique, approximately 600 rice farms were selected.

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This study used primary source with structured questionnaire for the collection of data. The data were analysed by using mean, percentage, standard deviation, Total Factor Cultivation (TFC) and Multiple Regression (MR) techniques. The result from data analyses confirms that the size of rice farm, household size, and extension visitation positively and significantly influenced cultivation of Bombali district rice farms, whereas the herbicide practise and age of the farmer negatively influenced cultivation of Bombali district rice farms. Additionally, the result disclosed that a 1% surge in herbicide amount significantly reduced the cultivation of rice farms by 3.84 %. Consequently, Sierra Leone Agricultural Research Institute (SLARI), and other agricultural agencies that are responsible for the training of farmers should strengthen effort in the herbicides practise. Systematic and thorough soil analysis ought to be conducted in Bombali district rice farms to establish the compatibility of soil and herbicide practice.

Keywords: Influential Factors; Rice Farming; Rice Farmers; Bombali District; Examine.

1. Introduction

In agricultural processes, rice cultivation is measured as the ratio of rice output to the quantity of inputs utilized to produce the output[1]. It is the production or cultivation cost or amount divided by the number of factors used in the cultivation process[2]. Hence, cultivation can be perceived as the link between the amount of output and the amount of input used in producing the output.

Output have numerous effects on the nation's economy in addition to the development of any sectors. Several literatures have submitted that higher output involve higher agricultural activities, and hence, higher revenues. Higher agricultural output is essential for fostering economic growth as well as attaining food independence in many developing nations. Acceptance of advance agricultural technology by rice farmers might cause increase in agricultural output, and encourage the movement from a low agricultural output to a higher agricultural output. Increase in the output of agricultural produce is essential for poverty reduction[3] and attainment of other developmental goals. Prevailing literatures founds that increase in overall factor output, eases poverty, and higher agricultural output is crucial for poverty [4] Lately, output researches on agriculture activities have captivated the attention of the economists, and policy decision makers in both less developed and developed countries[5]. Researches showed that it is difficult for a nation to gain economic stability without attaining a substantial development in agricultural output. According to Constantin, M. and his colleagues [6], the

unproductivity in

Sierra Leonean agricultural sector hinged largely on the use of outdated skills in the Agricultural sector. Minimal rice output was associated to the frequent rain-fed, low rice cultivation activities, minimal input utilised, and persistence use of obsolete rice seed varieties. Roughly 78 % of rice cultivation in Sierra Leone is rain-fed and 22 % is irrigated. In Sierra Leone, the annual average rice harvest in rain-fed zones is between 1.3 to 5.3 tones /ha. Accordingly, the urge for rice is so alarming owing to the population growth [7]. Sierra Leone is one of the leading importer of rice in the West Africa region, and the highest importer of rice within the Mano River Union countries [8]

In spite of the countless policies and schemes implemented by the successive Sierra Leonean governments in the rice sub-sector, rice production or cultivation in Sierra Leone is far below the local demand. For instance, the demand for rice in 2020 was estimated at 1.8 million metric tons (MT), however, about 0.8 million MT was locally produced, leaving a gap or deficit of about 1 Million MT.

The demand for rice increased to about 2.1 million MT in 2021 with a domestic production or cultivation rate of about 1 million MT. The desire to balance the demand and supply gap has led to higher rice importation in Sierra Leone. It was stated that Sierra Leone is spending over one billion dollar annually on rice importation[9]. Though considerable progress has been taken in increasing the land area under rice cultivation, drop in rice output has affected the gains already made in the cultivated rice. The domestic rice cultivation and output dropped in 2020 compared to the 2012 cultivation and output. It is evident from the prevailing research works that Sierra Leone rice output is among the lowest when compared with countries like Mali, Togo and DRC with an average harvests of 1.7 tons/ha[10]. Previous studies on rice cultivation in Sierra Leone are centred on commercial contribution in rice cultivation[11] ,thus producing a research gap which this study tends to filled. This study targets the important factors that have effect on rice output in the Bombali district rice farms.

2. Methodology

Bombali district was chosen as the study area. In Bombali district, Agriculture is regarded as a main occupation and about eighty nine percent of the inhabitants are getting their livelihoods from all sort of agricultural activities. At the moment, the district of Bombali occupies a total area of 7,985 km^2 [12]. There are several Bombali district agricultural potentials, and one of which, is Rolakor rice cultivation farms, which plant rice in an approximated land area of 35,000 hectares by over one thousand rice cultivators.

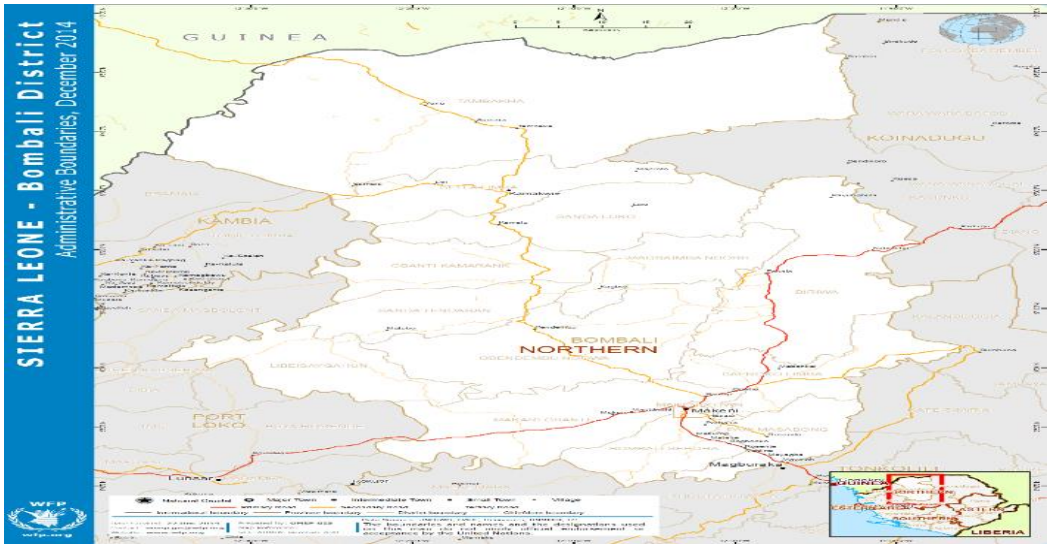

Figure 1: Map of Bombali District displaying the study area

This study utilised the Multi-stage sampling techniques. Initially, 5 out of 13 chiefdoms in the district were randomly chosen. In the subsequent stage, three villages each were randomly chosen from the 5 chiefdoms summing up to 15 villages. In the third stage, a total of 600 rice cultivators were randomly chosen from the lists of rice growers in 15 sampled villages. For this study, data were mainly collected from primary source with the help of confirmed structured questionnaire. Cost route survey method was utilised in collecting the desired data in three stages. These are, planting, weeding as well as harvesting of rice for the 2021 planting season. The appropriate data collected were analysed by employing descriptive statistics, the Total Factor Cultivation and the Multiple Regression models[13].

2.1. Total factor cultivation model (TFCM)

Output determines the performance of a specific sector[24]. The output of rice farming households[16] was assessed using the Total Factor Cultivation (TFC) model as was adopted and used by Mwaura and his colleagues [7].

$$\text{TFC} = \frac{Gross\ Cost\ of\ Output}{Gross\ Cost\ of\ Input\ Involved} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Higher ratio leads to prolific rice farms.

2.2. Multiple regression model (MRM)

For the purpose of examine the factors that might probable influence rice output, the multiple regression model was employed. The empirical model is quantified as:

$$A = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + \epsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where;$A =$ Output of rice farm , $\beta_0 =$ constant, $\beta_1 - \beta_{13} =$ parameters . X = Rice farmer

X_1 = Sex (Male 1 and female 0), X_2 = Age (years), X_3 = Farm Size (ha), X_4 = Health (amount spent on health), X_5 = Household size (number), X_6 = Education (years spent in formal education), X_7 = Variety planted (a dummy variable: 1= improved 0 = local), X_8 = Quantity of rice seed used (kg), X_9 = Amount of credit obtained for cultivation or faming (in Leone), X_{10} = Labour utilised in the cultivation or faming (mandays),X_{11} = Quantity of agrochemical utilised (kg), X_{12} = Quantity of fertilizer applied (kg), X_{13} = Extension visitation (number of visitations made per month), and ε_i = error term.

3. Results and Discussion

Several socio-economic features of rice cultivation or faming households such as sex, age, farm size, health, household size, years in formal education, rice variety, quantity of rice seed involved, extension visitation and years of rice planting experience were examined and displayed in Table 1. From the result presented in Table 1, majority (80.00 %) of the farmers were male whereas minority (20.00 %) of the farmers were female. This indicates that rice farmers in Bombali district are dominated by male. Age of the farmer influence the ability of the rice cultivator to do rice farming activities. The higher rice farmer's age, the more experienced he or she is anticipated to be, age helps in decision making[15]. Result in Table 1 also depicts that rice farmer`s average age was 45 years. This suggests that many rice farmers were within the prolific, and economic feasible phase, and can positively contribute to rice farming. This is in agreement with the research work of Jayne and his colleagues [16]. With regard to the availability of the labor force, huge household size can be advantageous to the rice farmers. Nevertheless, Table 1 details that the average households' membership of the rice farmers was 8.

This implies that most rice farmers have comparatively larger household sizes. This is certainly a positive sign of the availability of large family labor for rice farm activities. It is understood that educational status of a farmer influence his or her level of rice output. Similarly, the result showed in Table 1 discloses that the average years` spent by a rice farmer in the formal education sector was 10 years. This indicates that rice farmers had certain level of formal education status, hence, understand vital information regarding rice farming. This outcome corresponds to the findings of Mosha and his colleagues [17].

The findings as presented in Table 1 also disclosed that most (79.17 %) of the rice farmers planted upgraded rice varieties such as ROK 4 and ROK 14 while as few (20.83%) planted local variety such as Pa Koroma, Pa Kandeh and Butter Cup. The average farm size of the farmers was 1.1 hectares. This indicates that they are mostly small holder rice cultivators. This is in accordance with the research work of Ergat and his colleagues [18]. Additionally, studies confirmed that with extension visitations, farmers were better informed about novel technologies which might surge their output. The findings in Table 1 further depicts that on average, extension visitation to the rice farmers took place once per planting season, suggesting that acceptance of new novelty was difficult for rice farmers. Correspondingly, the average years of rice planting experience was 24, this length of time is sufficient for the farmers to specialise in most rice farming activities, and improve on their rice cultivation skills. This finding is in agreement with Lazíková, J. [19].

Table 1: Socio-economic Features of the Respondents

Variables	Frequency	%
Age		
19 – 28	33	5.5
29 – 38	154	25.67
39 – 48	230	38.33
49 – 58	135	22.50
59 – 68	40	6.67
69 – 78	8	1.33 mean = 45
Sex		
Male	480	80.00
Feale	120	20.00
Household size		
2 – 6	200	33.33
7 – 11	320	53.33
12 – 16	60	10.00
17 – 21	20	3.33 mean = 8
Education		
0	103	17.17
1 – 5	167	27.83
6 – 10	290	48.33
11 – 15	40	6.67 mean = 10
Rice variety		
Local	125	20.83
Improved	475	79.17
Farm size		
0.1 – 1.0	391	65.17
1.1 – 2.0	145	24.17
2.1 – 3.0	42	7.00
3.1 – 4.0	15	2.50
4.1 – 5.0	7	1.16 mean = 1.1
Farming experience		
6 – 15	120	20.00
16 –25	315	52.50
26 –35	114	19.00
36 –45	35	5.83
46 –55	16	2.67 mean = 24
Extension visitation		
0	254	42.33
1 – 4	343	57.17
5 – 7	3	0.50 mean = 2

Source: Author`s field survey, 2022.

The findings of the factors influencing output of rice cultivation farms in Bombali district are showed in Table 2. From the findings in Table 2, age, rice farm size, extension visitation, herbicide and household size significantly influenced output of Bombali district rice farms whereas sex, fertilizer, amount spent on illness, seed, duration of formal education, labor and amount of credit did not influence output of Bombali district rice farms[20]. However, if other factors remain constant, the findings also show that a 1% increase in the extension visitation [20] to the Bombali district rice farmers will increase their rice farms output by 0.5%. This might be as a result of suitable application of the information acquired from the extension officials. This results correspond to the finding of van Engelenhoven [21]. The result in Table 2 indicates that size of households had significant and positive influence on output of rice farms. Consequently, if other factors remain constant, a 1% increase in

the size of households of the rice farmers will certainly increase their rice farm output by 0.024 %. In agreement with the a priori expectancy, the size of rice farm had a significant with a P-value of (< 0.01), which has a positive association with the output of rice farms in Bombali district. This result shows that if other factors remain constant, a 1% increase in the size of farm allocated for rice cultivation will certainly increase the output of rice farms to an amount of 0.133 %. This corresponding to the work done by Ouyang [22]. The result in Table 2 reveals further that herbicide and age were significant, but negatively influenced output of rice farms in Bombali district. This suggests that an increase in these factors leads to a decline in output of Bombali district rice farms. Therefore, if other factors remain constant, a further increase in the age of the rice farmers, will reduce their output by 0.009 %. This suggests that rice farms own by younger rice farmers in Bombali district are more prolific than the older rice farmers.

This is consistent with other previous research work done by Khanal [23]. Contrary to the concept, and holding other factors constant, a 1% increase in the amount of herbicide utilised by the rice farmers will drop the output of the rice farms by 0.004 %. This might be that the soil of the farms is not well-suited with the chemicals applied, thus causing damage to the rice crop [24]. Similarly, it might be owing to the adverse effect of counterfeit chemicals being vended in the market as stated by the unlucky farmers who bought, and applied such chemicals in their rice farms.Again, the findings discloses that F (16,311) of 5.82 (at the 1% level of significant), the R^2 of 0.473, in addition to the adjusted R^2 of 0.443 illustrates that the overall model is well fitted and the explanatory variables [25] in the model jointly explain the determinant of output of rice farms in Bombali district. Furthermore, the adjusted R^2 value shows that 44.3% of all the variations in output of the rice farms in Bombali district can be elucidated by the incorporated variables.

Table 2

Variables	Coefficient	Standard error	t	P > (t)
Age	-0.0088322	0.0043232	-1.03	0.084*
Sex	-0.0043457	0.0251141	-0.44	0.621
Rice farm size	0.1332009	0.0411721	3.95	0.0001***
Household size	0.0236743	0.0045231	1.18	0.044*
Rice variety	-0.0100632	0.0203121	-0.29	0.651
Education	-0.0113213	0.0024231	-0.72	0.244
Labour	0.0001013	0.0014501	2.06	0.200
Sick amount	$-1.77e^{-06}$	$2.50e^{-06}$	-0.62	0.654
Fertilizers	-0.0023241	0.0001265	-2.02	0.201
Seed	$2.46e^{-06}$	$3.86e^{-06}$	0.67	0.254
herbicide	-0.0038421	0.0022453	-1.54	0.031**
Credit amount	$-2.14e^{-07}$	$4.02e^{-07}$	-0.64	0.563
Extension visitation	0.5201111	0.161121	2.63	0.002***
Constants	0.407634	0.1401324	2.17	0.023
No of obs.	600			
F (16, 311) = 5.82				
Prob. > F= 0.0002				
R^2 = 0.4732				
Adj. R^2 = 0.4432				
Root MSE = 0.32111				

Source: Authors Field Survey, 2022. Note: ***, **, * is significant at 1%, 5% and 10% respectively.

4. Conclusion

This research studies which focused on the examination of the factors influencing output of rice farms in Bombali district, founds that age, household size, farm size, herbicide and extension visitation were the only significant factors that influenced rice output of Bombali district rice farms. Thus, Agricultural Development Programs of Bombali district, in addition to other agricultural capacity development agencies that have the obligation of training rice farmers should strengthen efforts to train rice farmers on the application of herbicides to avoid abused, as herbicide has negative affect on their rice farms output. Similarly, in-depth soil analysis ought to be conducted in Bombali district to establish the compatibility of soil to the herbicide.

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