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TOTAL FACTOR PRODUCTIVITY ANALYSIS OF NORTHERN REGION OF GHANA` RICE SECTOR: RURAL INFRASTRUCTURE PERSPECTIVE

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ABSTRACT

This research has adopted Total Factor Productivity model in assessing the impact of infrastructure access to rural rice farmers on rice productivity in Northern region of Ghana. The study used primary data collected from 180 rural rice farmers in three selected districts located in Northern region of Ghana. The findings of the research indicates that, rice farmers have access to road network, electricity, water, storage facilities and mobile network which frequency is seldom. However, most rice farmers never got education from extension agents or agricultural research institutions. The results of the Total Factor Productivity show that, soil conservation practices, amount of credit and visits by extension agents were positive significant infrastructures affecting rice productivity while distance to market significantly but inversely affected rice productivity in the selected districts. The research recommended that, regular access to road network, extension agents and research institutions by rural rice farmers are critical policies for the improvement of rice productivity in the study area.

Keywords: Farmers, Ghana, Infrastructure, Productivity, Rice

1. Introduction

Agriculture is the bedrock of Ghana`s economic development policy. The agricultural sector employed more than 42.7 percent of Ghana`s population, among which over 87 percent of those employed are rural people (Mustapha et al., 2017 from Tanko et al, 2016). Again, the agricultural sector in Ghana dominates in terms of contribution to the GDP (31.8 percent in 2009), which declined drastically due to little attention to the sector to 19 percent in 2015 (Mustapha et al., 2017). Though, Ghana has the potential to increase agriculture production, the capacity needed to exploit and improve the contribution of the agricultural sector to economic growth and sustained rural development is inadequate. The research dwelled on rice production cognisance of the development of rural infrastructure. Notwithstanding the potentials Ghana has, to produce rice sufficiently to feed her people to the condition of surplus, the country is classified as a net importer of rice to a tune of USdollar374 million to supplement the country's deficit of 70 percent (Tanko and Amikuzuno, 2015).

***FAO (2005) and Fakayode *et al.* (2008) asserted that, provision of efficient infrastructure, especially, at the rural area is now widely recognized as indispensable to agricultural progress. Is a well-recognised fact that infrastructure can support economic growth, reduce poverty and make development environmentally sustainable in developing countries. In most developing economies, infrastructure plays a pivotal role in determining the overall productivity and development of a country`s economy as well as the quality of life of its rural people. To mention a few, the role of infrastructure such as electricity, transportation networks, safe water, and accessibly resourced health centres contribute in promoting development that cannot be overemphasized. Infrastructural improvement is not only increasing the efficiency of production, but also aid in improving the living standards of citizens (Jean-Paul, 2009). Rural infrastructure and development have enormous implications on rice production outcomes in the agricultural sector and the overall significant development of Ghana. Rural infrastructure plays a crucial role in poverty reduction, economic growth and empowerment for the African rural poor (Ahmed and Rustagi, 1987). According to Rahji (2007), rural infrastructures are classified under physical, social and institutional forms of capital. The main components of physical infrastructure include transport (road), storage, processing, irrigation and flood control, water resources development and social conservation facilities. Social

infrastructure includes health and educational facilities and rural utilities such as electricity and water supply, while institutional infrastructure includes the cooperative societies, farmers` unions, financial institutions such as banks, microfinance facilities, agricultural research facilities, agricultural extension and trading facilities, marketing / agricultural markets etc.

The insensitivity of the government to provide adequate basic infrastructure may impose additional stress on the available ones which are not regularly maintained, leading to eventual breakdown in many. Most empirical studies are concerned with the measurement of the impact of a discrete element rather than of the components of the infrastructural elements on agricultural production (Rahji, 2007). In view of this, the study examined infrastructure accessibility vis-à-vis rice productivity using three selected districts where rice is cultivated most as case study. The study examined the socio-economic characteristics of rice farm household, identified the components of rural infrastructure available and accessible and examined the effects of these infrastructure components on rice productivity in the areas of study.

2. Methodology

2.1 Study Area and Sampling Techniques

Rice farmers in northern region of Ghana were the unit of study. Farmers were sampled through a multistage sampling approach. Northern region was classified in to three main districts namely; Yendi, Gushegu and Savelugu. The regional capital was however exempted since the study has selected districts with rural rice farmers. From each district, three major rice producing communities were purposively chosen, after which 20 rural rice farmers were randomly selected from each community making a total of 60 rice farmers in each district. The 60 rice farmers were randomly selected from each district to make a total sample size of 180. The main data for the study was primary data, which was collected from the rural rice farmers using semi-structured questionnaires. Data was analysed using descriptive statistic and total factor productivity approach.

2.2 Data Analysis

The socio-economic factors of respondents were analysed using descriptive statistics such as frequency counts and percentages. A Total Factor Productivity Model as used by Key and McBride (2003) and Rahji (2007) was adopted for the analysis of data. Total Factor Productivity (TFP) is a method of calculating agricultural productivity by comparing an index of agricultural inputs to an index of outputs (Laurits, 1975; Jean-Paul, 2009). This measure of agricultural productivity was established to remedy the shortcomings of the partial measures of productivity (Wikipedia, 2017). Total factor productivity is therefore measured as the inverse of unit cost following Key and McBride (2003). This is the ratio of outputs in grain equivalent to the total variable cost (TVC) of production. This translates to the inverse of the average variable cost (AVC) of production.

$$TFP = \frac{Q}{TVC} \quad (1)$$

The model is therefore written as

$$A + \sum_{i-1}^{6} \alpha_i X_i + \sum_{i-1}^{8} \beta_i Y_i \quad (2)$$

Where TFP = Total Factor Productivity
X_1 = Age of head (Years)
X_2 = Sex (1 for male and 0 otherwise)
X_3 = Farm size (hectares)
X_4 = Household labour (man-days)
X_5 = Number of years in school
X_6 = Farming Experience (Years)
Y_1 = Soil conservation practices (number)
Y_2 = High cost disease (Present = 1, absent = 0)
Y_3 = Household with ill-health (number during the year)
Y_4 = Extension agent visits (number)
Y_5 = Volume of Credit received
Y_6 = Distance to Markets
Y_7 = Membership of Cooperative Society
Y_8= Mobile Network
Where Yi (i = 1 to 8) are the rural infrastructure

3. Results and Discussion

3.1 Descriptive Statistics

The socio-economic characteristics of the respondents is presented below in Appendix 1. Over 70 percent of the respondents in all the three districts were males. Males might dominate not due to sample bias, but due to the roles they play as heads of households and for the physical strength needed for direct farm engagement. About 42 percent of the respondents from Yendi district were age thirty or below, while only 10 percent were over 50 years of age, 32 percent of the respondents from Gushegu district were age thirty or below, while only 15 percent were over 50 years. In Savelugu district, 28 percent of respondents were thirty years or below, while 27 percent were over 50 years. The average age ranged from 42 to 47 years among the districts; this is an indication that most of the farmers were leaving their active age and this has a serious implication for agricultural production. The average household size for respondents were 9, 7 and 5 for Yendi, Gushegu and Savelugu respectively.

This implies that respondents had a large family which could be a source of family labour thereby reducing cost of production. This could also help to boost agricultural production. However, large farms may be costlier to maintain in terms of poor resource availability. The educational level as presented in Appendix 1 reveals that, 15 percent of respondents from Gushegu district had no formal education while 3 percent had above first degree. The average years spent in school were 8.2, 6.6 and 7.3 years for Yendi, Gushegu and Savelugu respectively. By extension, the implementation of the Free Compulsory Basic Education(FCUBE) policy seems to reflect in Yendi and Savelugu districts. Whereas the average respondents in Yendi and Savelugu had 6 years of primary education and some number of years of secondary education, respondents in Gushegu had basically 6 years of primary education with 15 percent of them lacking formal education. The data also shows that, over 50% of the respondents in all the three districts were primarily engaged in farming (i.e 52, 57 and 53 percent respectively for Yendi, Savelugu and Gushegu). Statistics from Appendix 1 shows that, more than half of the respondents in all the three selected districts are married and engaged in the cultivation of small scale land which on the average is less than 5 hectares leading to low income earning. On average, hectares of land used to produce rice in the study districts varied from 3.1, 4.2 and 3.8 for Yendi, Gushegu and Savelugu with a corresponding average income of ¢1,250, ¢1,340 and ¢1,760 respectively.

3.2 Rural Infrastructure Accessibility

Understanding the effects of infrastructure on rice productivity forms the need to know respondents access to various infrastructure in their respective districts. The distribution of the respondents according to their access and not only by availability of infrastructure in the study area is presented in Table 1 below. Table 1 reveals that access to road network to facilitate transportation of goods to needed market was non-available to 18 and 22 percent of the respondents in Gushegu and Savelugu respectively. On the other hand, water accessibility situation was different among the districts as higher percentages of 27 and 18 percent did not have access to potable water in Yendi and Savelugu districts respectively. Electricity was available in all the districts with 25% of respondents from Savelugu lacking access. Although Yendi and Gushegu have more than 80% of the respondents accessing electricity, some claimed that power supply was either erratic or of low voltage. On the average, only 70 percent of respondents in Gushegu claim to have access to health facility within or outside their localities. Most of the respondents from all the districts indicated that, access to extension service and education about improved seeds is limited. Also, access to institutions of research is limited leading to poor information. More than half of the respondents in Yendi and Gushegu do not have access to agricultural research institution and only 60 percent of the same respondents do not have access to agricultural extension officers. All respondents in Gushegu indicated that, they have access to storage facilities and those in Savelugu indicated they have mobile network. From the results in Table 1, storage facilities and mobile communication network is accessible to over 80% on average in the study areas.

Table 1: Respondents Access to Infrastructural Facilities

Infrastructure	Yendi	Gushegu	Savelugu
Access to road network	55(92)	49(82)	47(78)
Availability of Water	44(73)	53(88)	49(82)
Access to Electricity	55(92)	52(87)	45(75)
Health Facility	54(90)	42(70)	56(93)
Extension Service Education	37(60)	36(60)	44(73)
Agricultural Research Institute	23(38)	26(43)	33(55)
Storage Facilities	56(93)	60(100)	50(83)
Access to Mobile Network	59(98)	44(73)	60(100)
Sample Size	60	60	60

Note: Figures in the bracket is the percentage of respondents having access to the various infrastructure
Source: Field Survey, 2017

3.3 Extent of Accessibility of Rural Infrastructure

Appendix 2 presents the consistency of the infrastructure available to the respondents. In Savelugu, 43 percent of the respondents had regular transportation network whiles 15 and 10 percent had regular transportation network in Yendi and Gushegu respectively. The irregularity of road access to the respondents in Gushegu and Yendi can be attributed to the bad nature of the road especially in the raining season. In Gushegu district, all the respondents indicated that, they do not have regular access to potable drinking water though, 10 percent of the respondents in Savelugu indicated they regularly have water supply. Electricity regularity was also in question leading to a range of 28 to 45 percent of the respondents given affirmative answers. This is not surprise as Ghana is having power shortage problem leading to “on” and “off” popular called in Ghana “Dumsor”. From

Appendix 2, all the respondents in Savelugu district indicated that, they do not have access to regular health facility and when probe further, it was explained that, the district have inadequate health professionals. 38 percent in Yendi, 40 percent in Gushegu and 27 percent in Savelugu posited that, they never had any extension officer visiting them for education. Those in Gushegu who claimed to have access to extension officers, stated that, they do not have regular access. Majority of the respondents from all the selected districts did not have access to research institute. About 62%, 57% and 45% of the respondents in Yendi, Gushegu and Savelugu respectively stated they never had access to agricultural research institution and those who have access were few. The pattern was similar for storage facilities and access to communication network in all districts which seemed to be better-off in terms of regularity of available infrastructures. The poor access to these critical infrastructures and the irregularity would be expected to negatively affect agricultural productivity in the area as most farmers may tend to sell their produce during or immediately after harvesting to prevent spoilage. This pay farmers' unmotivated price leading to low patronage in agriculture as a profit venture. The ranking of infrastructure by inconsistency varied from districts. Access to agricultural research institution was ranked as the most prioritized infrastructure in Yendi and Savelugu while road network (transportation facility) ranked highest in the inconsistency of infrastructures in Gushegu district. The least ranked was access to mobile network connection for all the districts, though is ranked sixth in Savelugu district.

3.4 Effect of Infrastructure on Rice Productivity

Measuring the impact of infrastructure on productivity of farmers was elicited and the result is as presented in Table 2. The adjusted R2 for Yendi, Gushegu and Savelugu were 0.7291, 0.6785 and 0.7032 respectively. This indicates that 72.91 percent, 67.85 percent and 70.32 percent of the variations in the productivity of rice in the study area could be explained by the considered explanatory variables (socio-economic and Infrastructure) in the respective districts. The results in Table 2 shows that, among the socio-economic factors, variables such as; farm size, household labour and the number of years of experience in cultivating rice were all statistically significant and positively influenced productivity in all the three districts. While only number of years spent in school was positively significant factor that influence rice productivity in Savelugu district at 99 percent confident level. The positive contribution of household labour could be attributed to availability and low cost of labour in the selected districts and education as always said is the foundation of the understanding of agricultural practice, hence the control of pest and disease which leads to improvement in productivity.

Table 2: Results of Total Factor Productivity for Rice Sector

	Yendi		Gushegu		Savelugu	
Variables	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**
Constant	2.0231	3.525	1.0427	2.5674	1.2642	2.7633
Socio-Economics Factors						
Age	0.2925	1.3627	-0.0436	1.0462	-0.2521	1.0753
Sex	0.1483	1.7297	0.1664	2.9642	0.0852	0.8832
Farm size	0.4282***	0.9516	0.5251**	2.9552	0.6217**	2.0831
Household labour	0.2115**	2.6438	1.0683**	1.0663	0.0534*	1.2752
Education	0.1092	1.5228	0.3773	0,8542	0.0852***	1.0843
Farming experience	0.0632**	1.1680	0.0637***	3.7202	0.1472**	1.0442
Infrastructure						
Soil conservation practice	0.0246***	1.0426	0.0427***	1.0542	0.5202***	2.1284
Cost of disease	-0.1824	2.0732	-0.0633	1.6329	-0.3324	1.9435
Household with ill-health	0.1583	1.0268	-0.3932	1.7344	-0.0863	1.0643
Visit of extension agent	0.2491**	1.9543	0.0671**	1.0536	0.0732**	1.2074
Credit volume	0.3923**	1.7405	0.2557	2.8537	0.1623	1.6043
Market distance	-0.0835**	0.8779	-0.1725**	1.1406	-0.5268**	2.0625
Cooperative membership	0.0215	0.9521	1.0541	2.0548	0.0362	2.0617
Mobile network	0.0395	1.0386	0.0169	1.4274	0.0214	1.0528
R^2	0.7943		0.6948		0.7316	
Adjusted R^2	0.7291		0.6785		0.7032	

Note: ***, ** and * represent significant at 1%, 5% and 10% levels respectively
Source: Field Survey, 2017

Also, in Table 2, soil conservation practices, visit of extension agent and volume of credit to rice farmers were significant and positively affected productivity in Yendi district with values of 0.0246, 0.2491 and 0.3923 respectively. In Gushegu and Savelugu, only soil conservation practice and visit of extension agent were positively significant at 1 percent and 5 percent significant levels. Distance to markets with 0.0835 for Yendi, 0.1725 for Gushegu and 0.5268 for Savelugu significantly but negatively affected rice productivity in the various districts. The inverse impact of market distance occurrence could be traced to poor access to feeder roads that could impair farmers` decisions towards increased output and increase the cost of transportation which demotivate farmers in the production of rice. This finding is in conformity to the results derived by Rahji (2007) and Adepoju and Salman (2013). Rice farmers` cooperative membership and access to mobile network

connection could facilitate the flow of information and financial assistance in the selected districts which could lead to improvement in rice productivity, however, these factors were statistically insignificant at even 10 percent levels.

4 Conclusion and Recommendation

This research concluded using average farm size as shown in Appendix 1 as evidence that, most of the rice farmers in Northern region of Ghana were operating on a small-scale basis. Rural rice farmers were still in their productive years, having low educational standard with some lacking formal education. Among the infrastructural facilities the research considered to be critical for the improvement of rice productivity, were transportation, electricity, health care, storage facilities and mobile network connection. These infrastructure were accessible, though were irregular to rice farmers. Extension agents' visits and access to agricultural research institute were never experienced in some farming settlements. By analysis, soil conservation practices, volume of credit and number of extension agents` visits were found to increase rice productivity in the study areas. Cost of controlling disease and distance to market contributed negatively to rice productivity in all districts though was not significant. while membership of farmers` to a cooperative and mobile network access insignificantly increased productivity in the research area.

The research therefore recommended that, policies towards improving the infrastructure in the farming communities with the aim of improving rice productivity should gear towards, essentially, ensuring farmers` regular access to feeder roads, health care services and electricity. Much attention should be given to farmers` access to agricultural research institutions and extension agents in the farming communities as most rice farmers never benefited from these institutions. These institutions should be considered as important prerequisites on which the outcome of other agricultural programs such as fertilizer subsidy, improved seed and credit programs effectively function. Policy makers should consider that, availability of infrastructure is critical to the development of agriculture. Particularly, the production of rice in rural areas ought to be given critical attention by affording rural farmers regular access.

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APPENDICES

Appendix 1: Summary Statistics of Respondents

	Yendi			Gushegu			Savelugu		
Variables	**Frequency**	**%**	**Mean**	**Frequency**	**%**	**Mean**	**Frequency**	**%**	**Mean**
Sex									
Male	47	78		43	72		45	75	
Female	13	22		17	28		15	25	
Total	**60**	**100**		**60**	**100**		**60**	**100**	
Age (Years)									
30 and below	25	42		19	32		17	28	
31-50	29	48		32	53		27	45	
51 and above	6	10		9	15		16	27	
Total	**60**	**100**	**42**	**60**	**100**	**45**	**60**	**100**	**47**
Household Size									
10 and below	37	62		39	65		37	62	
11-20	16	27		19	32		21	35	
21 and above	7	11		2	3		2	3	
Total	**60**	**100**	**9.8**	**60**	**100**	**7.4**	**60**	**100**	**5.2**
Marital Status									
Single	27	45		18	30		13	22	
Married	33	55		42	70		47	78	
Total	**60**	**100**		**60**	**100**		**60**	**100**	
Education									
None	0	0		9	15		0	0	
10 and below	21	35		31	52		28	47	
11-20	28	47		18	30		29	48	
21 and above	11	18		2	3		3	5	
Total	**60**	**100**	**8.2**	**60**	**100**	**6.6**	**60**	**100**	**7.3**
Primary Occupation									
Farming	31	52		34	57		32	53	
Trading	8	13		14	23		16	27	
Civil Service	16	27		12	20		9	15	
Driving	5	8		0	0		3	5	
Total	**60**	**100**		**60**	**100**		**60**	**100**	
Income (¢)									
1000 and below	18	30		16	27		19	32	
1001-2000	27	45		28	46		17	28	
2001 and above	15	25		16	27		24	40	
Total	**60**	**100**	**1,250**	**60**	**100**	**1,340**	**60**	**100**	**1,760**
Farm Size (Hectares)									
Less than 2	4	7		7	12		11	18	
2 – 5	42	70		32	53		39	65	
Greater than 5	14	23		21	35		10	17	
Total	**60**	**100**	**3.1**	**60**	**100**	**4.2**	**60**	**100**	**3.8**

Source: Field Survey, 2017

Appendix 2: Respondents Consistent Access to Rural Infrastructural Facilities

Infrastructure	Yendi				Gushegu				Savelugu			
	Regular	Seldom	Never	Rank	Regular	Seldom	Never	Rank	Regular	Seldom	Never	Rank
Access to road network	9 (15)	46 (77)	5 (8)	1.76 (5)	6 (10)	43 (72)	11 (18)	2.98 (1)	26 (43)	21 (35)	13 (22)	1.17 (4)
Availability of Water	13 (22)	31 (51)	16 (27)	2.01 (4)	0 (0)	53 (88)	7 (12)	2.34 (3)	6 (10)	43 (72)	11 (18)	1.11 (5)
Access to Electricity	17 (28)	38 (64)	5 (8)	1.27 (6)	25 (42)	27 (45)	8 (13)	1.27 (7)	17 (28)	28 (47)	15 (25)	1.42 (2)
Health Facility	28 (47)	26 (43)	6 (10)	1.12 (7)	16 (27)	26 (43)	18 (30)	2.21 (4)	0 (0)	56 (93)	4 (7)	1.27 (3)
Extension Service Education	2 (3)	35 (57)	23 (38)	2.89 (2)	0 (0)	36 (60)	24 (40)	1.78 (6)	9 (15)	35 (58)	16 (27)	1.01 (8)
Agricultural Research Institute	2 (3)	21 (35)	37 (62)	3.12 (1)	0 (0)	26 (43)	34 (57)	2.75 (2)	0 (0)	33 (55)	27 (45)	2.63 (1)
Storage Facilities	19 (32)	37 (62)	4 (6)	2.41 (3)	38 (63)	22 (37)	0 (0)	2.06 (5)	17 (28)	33 (55)	10 (17)	1.07 (7)
Access to Mobile Network	11 (18)	48 (80)	1 (2)	1.06 (8)	7 (12)	37 (62)	16 (26)	1.19 (8)	29 (48)	31 (52)	0 (0)	1.09 (6)

Note: Figures in the bracket under regular, seldom and never are the percentages while the figures in bracket under ranks indicate the rank of the infrastructures as perceived by respondents.
Source: Field Survey, 2017.