Research Article

Evaluating Productive Capacity of Irrigated and Non-Irrigated Farming: A Panacea for Sustainable Rice Production in Patigi, Nigeria

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Abstract | Rice, a staple food in Nigeria is experiencing decrease in yield over the years. This study evaluates the productive capacity of some selected rice farms in Kwara State, Nigeria, with a view to identify farm management practices that enhance sustainable production of rice in the study area. Primary data were obtained through the use interview schedule. Eighty copies of structured interview were purposively employed to obtain individual response of the farmers whose plots fall within the demarcated forty-sampled quadrats from both irrigated and non-irrigated farms. Information on socio-economic activities of the rice farmers, level of rice yield, agricultural practices for rice production and farm management techniques employed in the study area were observed. The study employed simple percentages to analyse the farmers' responses; while regression model established significant relationships between rice yield and farm management methods adopted in this area. Results were presented using charts and tables. The study revealed that; chemical fertilizers, manual weeding and shifting cultivation are essential for rice cultivation in the study area; the regression model established strong influence of farm-size at R-value of 0.64 on the yield of rice in this area; while estimated yields of 101.6tons and 57.9tons from irrigated and non-irrigated field respectively established higher yield from irrigation practice. The study concludes that irrigation system is a catalyst for appreciable rice yield in this area. However, proper application of fertilizer and expansion of existing farmland should be adopted among the rice farmers in the study area and other related environment.

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Introduction

The 2006 population Figure in Nigeria was 140 million and in 2011 it was 167 million (National Population Commission, 2006). According to National Bureau of Statistics (2011), the population Figure represents an annual population growth rate of 3.2%. With this growth rate as reflected in Figure 1, the population in the country is projected to 221 million by 2020 and 356 million by 2025. Little wonder, the former President of Nigeria concluded that the Nigeria's growing population had become a curse instead of blessings. This, according to Obasanjo (2011), is because there is a disconnection between food production and the nation's population; a condition that has made Nigeria to spend about 155 billion naira annually on rice importations.

In the same vein, the overall situation of population growth, rice importation, and local rice production in Nigeria were compared in Figure 2. According to USDA International Database (2012), it is evident

that population growth and rice production grow at almost the same level while the importation of rice is higher. This level of rice importation, as noted by Akande (2002) indicates increasing consumption rate of rice, emanating from rapid urbanization, increased population and per capital income growth, and changes in family occupational structures. Similarly, Food and Agriculture Organization (FAO, 2008) observed that local rice production in the country still accounts for less than 50% of total consumption and the demand gap has been filled by milled rice imported mostly from India, Thailand, and Brazil. This scenario has presented the nation as the second largest importer of rice in the world after the Philippines.

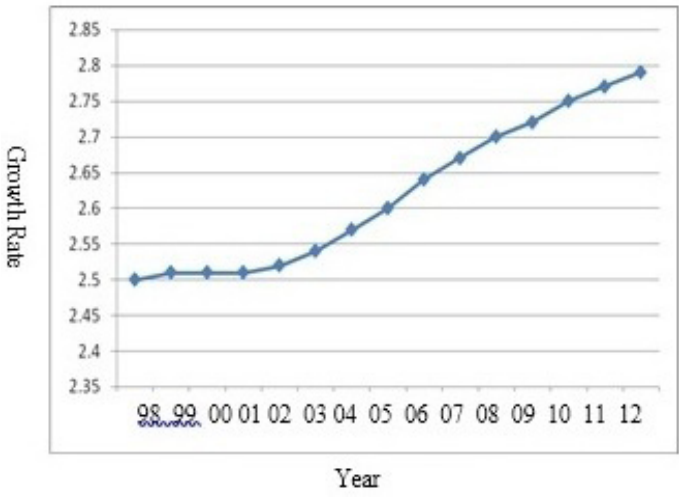

Figure 1: *Nigeria population growth rate (1998-2012)*
Source: *National bureau of Statistics (2011)*

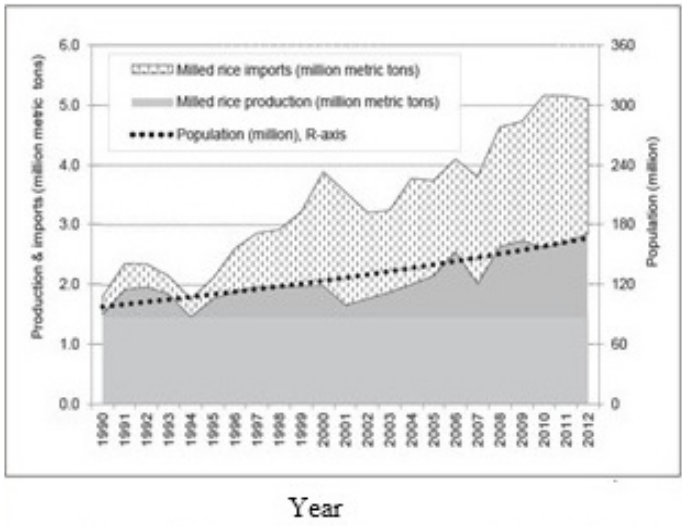

Figure 2: *Trends in rice production, import and population (1990-2012)*
Source: *USDA International database (USDA, 2012)*

Femi (2011) identified Nigeria as one of the 43 African nations among the 86 countries in the world that has low-income and food insecurity. Without major changes in development practices, the International Food Policy Research Institute (IFPRI, 2006) predicts that globally, 1,600 million people will suffer from hunger, 90 million people will live in absolute poverty, and 128 million pre-school children will be malnourished by 2015. The area chosen for this study is not exempted from this prediction.

Patigi Local Government, where this study falls, is a leading rice producing area of Kwara State in Nigeria. Meanwhile, rice production in this location is still done at subsistence level. Production is still through the use of crude implements such as hoes and cutlasses. The age-long impact of this indigenous system of agricultural practice has preconditioned farmers to a one-way approach of farming, which affects soil utilization and techniques of soil management in general. This situation has affected steady and appreciable rice yields in this part of the nation.

Consequently, farmers respond to these by forcefully moving out for alternative farmlands where soil condition is favourable for rice cropping. Thus, the call for this paper on examination of farm management practices by the farmers, which will serve as a way forward by engaging in a sustainable rice production in the study area and other related environment. In order to achieve this goal, the general objectives set for the study include; the examination of socio-economic activities of the rice farmers, identification of System of rice cultivation in Patigi, and Management practice on farmers' farm sizes in the study area.

Materials and Methods

Eighty copies of interview schedule were prepared in this study to elicit information on socio-economic activities of the rice farmers, level of rice yield, farm management techniques, and agricultural practices for rice production in the study area. The use of interview schedule was employed by the researcher to obtain individual responses of the farmers whose plots were within a selected forty-sampled quadrat from both irrigated and non-irrigated rice fields. The study employed simple percentages to analyse the farmers' responses; while regression model established significant relationships between rice yield and the adopted farm management techniques among the farmers. Results for the study were presented using charts and tables.

Results and Discussion

Socio-economic characteristics of Patigi rice farmers

The study revealed that rice farming in the study area is mostly practiced by both the male and female but the proportion of the male farmers has the largest percentage of 87.50 over the female counterpart (Table 1). This situation, as observed by Oriola (2004) is based on the energy requirements of farming activities, which in most cases are behind what women strength could contend with, especially in this part of Nigeria where women are usually regarded as helping hands to their husbands and keepers of homes. It is, therefore, obvious to identify small proportion of women (12.50%) that engaged in rice farming in the study area. Among these women are widows who cultivate the land for the sake of their sustenance.

Table 1: *Age and sex distribution of Patigi farmers*

Age (yrs)	Frequency	Percentage	Sex	Frequency	Percentage
Below 20	0	0	Male	70	87.50
21-30	10	12.50	Female	10	12.50
31-40	35	43.75	Total	80	100
41-50	18	22.50			
51 and above	17	21.25			
Total	80	100			

The description of the farmers' age distribution that ranged between 21 to 40 years in Table 1 reflects the productive levels of the farmers with 56.25% who are involved in farming activities, just a few percentages of 21.25 of the farmers are above 50 years. These age structures depict the level of reliability of the dependent population on rice production. It also shows that rice production is one of the major investments among the people in this area and their personal means of family needs. This means, any negative situation on rice cropping will likely affect their general well-being and as well discourage their enthusiasm for farming activities. Based on this, rice farmers are to be encouraged with proper and effective management strategies to allow more farmers to participate in rice farming.

Table 2 shows the general characteristics of the rice farmers relating to the level of education and their various other occupations. The study observed that over 50 percent of the rice farmers are without formal education, 15 percent has tertiary education (i.e. at graduate level) and 12.5 percent has secondary school education. It was equally observed that greater numbers of these farmers are into farming activities without acquiring any formal training. The low academic standard, especially among the farmers who engaged on non-irrigated rice farm to some extent, has affected their reasoning, which reflects in their methods of farming that is characterised by "one way approach" and their management strategies in general.

Table 2: *Level of education and occupation of Patigi rice farmers*

Education	Frequency	Percentage	Occupation	Frequency	Percentage
Secondary	10	12.5	Trading/ Farming	3	3.75
Tertiary	12	15	Artisan/ Farming	6	7.5
Others	21	26.25	Farming Alone	61	76.25
None	37	46.25	Others/ Farming	10	12.5
Total	80	100		80	100

In terms of occupation, farming is a way of life in this part of Nigeria if not for the whole nation. This study established that 76.25 percent of the farmers rely on farming activities alone in the entire survey (Table 2). The remaining 23.75 percent is shared among other farmers with specialized skills that include civil servants, traders, artisans, and retirees who are also involved in land cultivation especially on part-time basis. Though, this study confirmed that farmers involved in farming activities at different level of management capacity.

For instance, rice farmers in Patigi have different modes of involvement in farming activities as identified in Table 4, where 65% of the farmers on Irrigated Rice Field (IRF) are fully involved in farming activities while 85% are accounted for on Non-Irrigated Rice Field (NIRF). Part-time farmers are few on both cropping systems as reflected in their involvement in some other activities in Table 3. This means that majority of the farmers are on full time basis. Meaning that, these farmers earn their total income from rice production through long term experience in farming.

The experience of rice farmers in the study area was based on the extent of their participation in farming activities. This was particularly focused on the cultivation of existing farmlands by farmers. It is observed

in Table 4 that 30 percent of rice farmers operate on irrigated rice field continuously within the period of 11 and 15 years, where 42.5% occupied a farmland within the period of 16 and 20 years on non-irrigated rice farm. This suggests that majority of the farmers must have gained different agricultural experiences on farm management strategies which could help to increase the level of rice production in this area.

Table 3: *Farmers' mode of involvement in farming activities*

Level of Involvement	IRF		NIRF	
	No	%	No	%
Full time	31	65	34	85
Part-time	9	35	06	15
Total	40	100	40	100

Table 4: *Year of rice farming among rice farmers*

Year	IRF		NIRF	
	Frequency	Percentage	Frequency	Percentage
Less than 1	1	2	1	2.5
1 – 5	8	20	9	22.5
6 - 10	7	18	5	12.5
11-15	13	30	7	17.5
16-20	5	14	17	42.5
Above 20	6	16	1	2.5
Total	40	100	40	100

System of rice cultivation in Patigi

Rice is the most widespread and commonly grown crop in Patigi, Kwara state, Nigeria. Among other minor crops are guinea corn, maize, yam and melon. The observation is that most of the land cultivated for rice might not sometimes be suitable for any other crops because of the nature of the soil rice requires. That is why most often, the land where rice is harvested at the end of every Growing Period (GP) – usually 3 to 4 months - is left without being cultivated until the next production period (usually a month interval). For this purpose, farmers are so meticulous in plot choices where they can have permanent land acquisition for consistent annual rice production. On this ground, this study availed information on farmers' choice of location of rice field, farm-size, rice specie, and Length of Growing Period (LGP) as major determining factors for rice production in the study area.

The choice of the farmers on where rice should grow is fundamental to the cropping system. The information on this has been related to the farmers' perception and factors that induce the choice on their present rice farm. Such factors include land availability, fertile soil, and abundant water. Little or no farmer gave reference to the choice of rice farming based on no alternative. Larger proportion of 82% responses affirmed that fertile soil and water availability are the major driven forces of the choice of their farmlands. This is more so, because rice is a water-loving crop and must be managed under a condition that supports its nutrient requirements. In respect of this, examination of soil fertility status of rice farm is crucial for identifying soil management requirements for optimum rice production; though, farmers' farm-size is another leading factor that could enhance farmers' productivity.

This study observed that farmers who operate on Irrigated Rice Field were allocated with different farm sizes based on their financial and productive capacities (Table 6). This is to make sure that farmers operate at the level they could efficiently perform. In addition, land allocation to farmers on IRF is strongly associated with their professional skills in farming, which are needed for the effective operation of various farming equipment.

In contrast, farmers that cultivate NIRF operate on the ground of land ownership. Lands were occupied based on the suitable farm plots for rice cultivation and farmers' financial strength. As revealed in Table 5, farmers on Irrigated Rice Field have the highest proportion of 30% operating on 10 to 15 hectares whereby the equivalent highest percentage recorded on IRF was attributed to 1 to 3 hactares for the farmers that occupied non-irrigated rice field. This shows that level at which farmers engaged in land cultivation varies. The variation on their cultivations is subject to the purpose of rice production and to whom the production is made.

Table 5: *Allocation of farm size among the rice farmers*

Farm size (ha)	IRF		NIRF	
	No	%	No	%
Less than 1	0	0	1	2
1-3	01	2	13	30
4-6	03	18	11	26
7-9	08	20	04	17
10-15	13	30	08	20
16-19	08	20	03	5
20 and Above	07	10	0	0
Total	40	100	40	100

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Table 6: *Rice species grown in Patigi*

Rice specie	Irrigated		Non- irrigated	
	No	%	No	%
Faro 52	40	100	32	80
Faro 44	0	0	8	20
Others	0	0	0	0
Total	40	100	40	100

Figure 3 presents the purpose of rice cultivation in the study area. It was revealed that greater proportion of rice farmers (90%) from NIRF are cultivating to feed their families and for local trading. In other words, their occupation in farming serves as major source of income, which is meant for taking care of their basic needs. However, the remaining percentage (10%) is for commercial purposes.

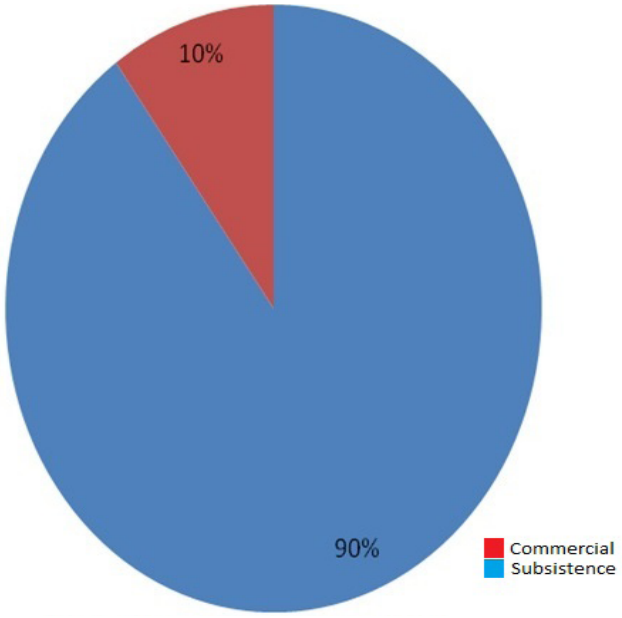

Figure 3: *Purpose of rice cultovation on NIRF*

The purposes of rice cultivation on irrigated farm is indicated in Figure 4 where higher proportion of 60 percent of its rice production is for commercial purposes and 40 percent only is meant for subsistent. It is evidently clear that most farmers on IRF are commercially inclined and produces not only to feed the immediate household but also making their farm produce saleable. This finding indicates that proper management, consistent involvement in farming and improved seedily have immensely contributed to rice production on IRF with positive influence on farmers economic status and their families respectively. It is apparently cleared in the study that improved rice specie could enhance an appreciable rice production in the study area.

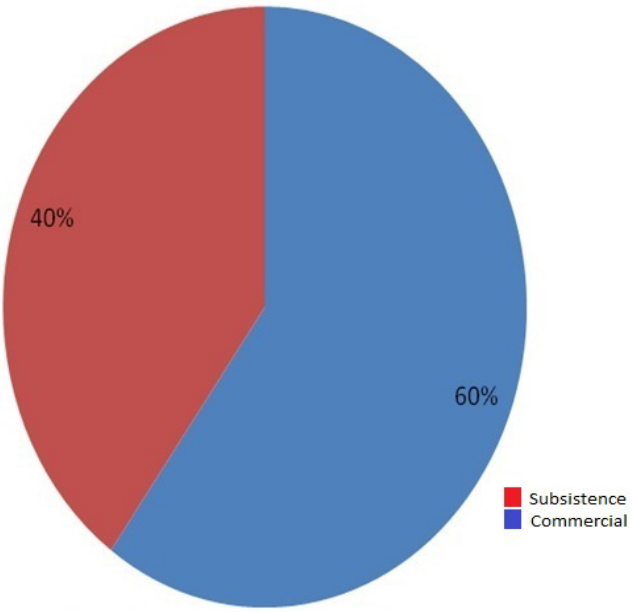

Figure 4: *Purpose of rice cultovation on IRF*

The description of the available rice species grown in Patigi and their respective Length of Growing Period (LGP) is an effort to establish one of the identified problems in the study area where many of the rice species have gone into extinction. The study observed in Table 6 that Faro 52 dominates the most grown rice specie of the study area. The identified rice specie has the largest proportion of 80 percent while Faro 44, other rice specie in this area, has been recorded with 20 percent among the farmers who operate on NIRF. For instance, the dominance of Faro 52 as presented in this study indicates that farmers find it easier to grow. In relation to this, Abo and Abdullahi (2004) confirmed that Faro 52 is commonly grown in most of the lowlands of Nigeria. The observed rice specie also has ability to develop and produce in a short period of 3 months with maximum response to the soil.

This study observed that rice cultivation takes 2 to 3 months as Length of Growing Period (LGP) on irrigated farms with 92.5% response in the study area. This situation confirmed that irrigated farms have a faster growing capacity for rice production in this study (Table 7). However, non-irrigated farm produces highly within the growing period of 3 and 4 months. This observation could be based on farm management practices that irrigation system offers which, among others, include regular water supply that stimulates increase in rice production all year round.

Management practice and farmers' farm size in Patigi

Rice farmers in Patigi have embarked on different management methods to increase rice yield and to

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facilitate continuous production. These methods include application of agro-chemicals, manual weeding, and system of land cultivation with shifting method and crop rotation (see Table 8). It is observed that farmers apply these methods at different levels of farming activities with the aim at improving their farming system.

Table 7: *Length of growing period for rice*

LGP (month)	Crop Response			
	IRF		NIRF	
	No	%	No	%
2-3	37	92.5	12	30
3-4	2	5	25	62.5
Above 4	1	2.5	3	7.5
Total	40	100	40	100

Table 8: *Farming techniques employed in Patigi rice farms*

Farming Techniques	Response (IRF)		Response (NIRF)	
	No	%	No	%
Bush Fallowing	8	20	11	27.5
Crop Rotation	0	0	7	17.5
Chemical Application	16	40	12	30
Regular Weeding	16	40	10	25
Total	40	100	40	100

The study revealed that farmers on Irrigated Rice Field (IRF) have significant yield increase based on the farm management practices employed except for crop rotation, which is not applicable to the system of rice farming in this area. In addition, the proportion of chemical application of 40% revealed in Table 8 is similar to the proportion of weeding activities carried out on farms. This is more so based on the significant impact of weeding and chemical application on crop growth and development, of which, chemical application and weeding are essential at every stage of rice development, while Chemical application portraits similar mode of practice on Irrigated Rice Field (IRF) and Non-Irrigated Rice Field (NIRF). The highest proportion (30%) of chemical application, among others, by the farmers operating on NIRF further shows the importance of this practice in rice farming. It is important to note that rice farmers in this area are meticulous about improving rice yield at all cost, especially through weeds removal and improving soil nutrient for optimum rice production.

However, farmers could not ascertain positive impact of crop rotation on rice yield. To them, crop rotation is just a way of alternating the available farm plot for growing different crops and without attaching any significant value to it as a means of yield increase. This notion is especially common among the irrigated farmers, since their farmland is mostly maintained for rice cropping alone, though, farmers engage in different farm size as another major determinant of rice yield.

Over the years, Patigi rice farmers have been occupying lands of different sizes. The available farm size sometimes determines their level of productivity. Nevertheless, rice yield depends on the ability of the soil to support continuous production. This study determined the quantity of rice production based on bag size of 50kg. This measurement was converted to give a unit of yield in tons (i.e., Yield *50/1000) within a Growing Period (GP). It was observed that 101.6 tons (2,119 bags) and 57.9 tons (1,123 bags) of rice yield in the entire sampled area were recorded on both irrigated and non-irrigated farms respectively (Table 9). The study further established that farmers on irrigated farms realize 10 bags of rice on a hectare of land, while 3 to 6 bags of rice are harvested on rein fed (non-irrigated) rice farm of the same farm-size. The reason for this wide range difference in production is based on various ranges of management techniques which irrigation system facilitates. Generally, the overall production of rice could be best sustained on this irrigated farm if consistent farm management practice is maintained and improved upon from time to time. These findings are supported by Rosegrant et al. (2002), shows that rice production on rain fed farming is always below the irrigated where rain fed grains yields are on average of 1.5t/ha, compared with 3.1 t/ha for irrigated yields in most of the developing countries. More importantly, it should be noted that the yield increase through the increase in farm sizes is subjected the required fertilizer for crop production.

Farm-size allocated to rice farmers and rate of fertilizer application are essential factors that determine the available nutrient level in soils and level of rice production in the study area. The results presented in Table 10 identify rate of fertilizer application, size of rice farm and the frequency at which other chemicals are applied on the farm. The sizes of farmlands by rice farmers as observed in the study ranged between 0.5 ha and 2 ha for irrigated rice farm, while 1ha and

Table 9: *Rice yield response to farmers' farm size and fertilizer application*

S/N	Total Farm-Size		Sampled Farm-Size		Rice Yield (50kg)		Rice Yield (tons)		Fertilizer (Kg)	
	IRF	NIRF	IRF	NIRF	IRF	NIRF	IRF	NIRF	IRF	NIRF
1	4	3	1.5	0.5	90	15	4.5	1	20	10
2	3	2	1	1	60	45	3	2	12	12
3	2.5	3	1	1	60	28	3	1	9	19
4	2.5	2	1	0.5	60	15	3	1	15	15
5	2	2	0.5	1	30	30	1.5	1.5	30	30
6	2	2	1	1	60	30	3	1.5	36	36
7	3	3	1.5	1	90	30	4.5	1.5	48	48
8	2.5	2.5	1	1	60	30	3	1.5	40	40
9	2	2	1	1	60	30	3	1.5	24	24
10	3	3	0.5	2	30	30	1.5	1.5	30	30
11	2	2	1	1	60	30	3	1.5	20	20
12	2	2	1	1	29	29	1.5	1.5	24	24
13	2.5	2.5	1	1	29	29	1.5	1.5	30	30
14	2	2	1	1	30	30	1.5	1.5	39	39
15	2.5	2.5	1	1	28	28	1.4	1.4	30	30
16	1.5	1.5	1	1	60	30	3	1.5	24	24
17	1	1	0.5	0.5	30	15	1.5	0.8	42	42
18	2	2	1.5	1.5	90	45	4.5	2	28	28
19	1	1	0.5	0.5	30	15	1.5	1	24	24
20	1.5	1.5	0.5	1	30	30	1.5	1.5	30	30
21	2	2	1.5	1.5	90	45	4.5	2	42	42
22	1.5	1.5	1	1	60	30	3	1.5	39	39
23	2	1	1.5	1	90	28	4.5	1.8	36	36
24	1	1	1	1	28	28	1.4	1.8	48	48
25	2	2	1	1	28	28	1.4	1.8	48	48
26	1.5	1.5	1	1	60	30	3	1.5	30	30
27	2.5	2.5	1	1	28	28	1.4	1.4	54	54
28	2	2	1	1	60	30	3	1.5	24	24
29	2.5	2.5	1	1	60	30	3	1.5	16	16
30	1	1	0.5	0.5	30	15	1.5	1	39	39
31	1	1	1	1	60	30	3	1.5	36	36
32	2	2	1	1	90	30	4.5	1.5	39	39
33	2.5	2.5	1.5	1.5	29	29	1.5	1.5	26	26
34	1	1	0.5	0.5	30	15	1.5	1	51	51
35	1.5	1.5	1	1	60	28	3	1.4	24	24
36	3.5	3.5	2	2	120	30	1.5	1.5	30	30
37	1	1	0.5	0.5	30	15	1.5	1	24	24
38	2	2	1	1	60	30	3	1.5	40	40
39	2	3	1.5	1	60	30	3	1.5	36	36
40	1	3	0.5	1	30	30	1.5	1.5	30	30
Total	80	80	40	40	2119	1123	101.6	57.9	1267	1267

3.5ha for non-irrigated. Farmers were allocated with different farm-sizes based on their financial and productive capacities.

This shows that yield increase, in most cases, corresponds to farm-sizes and method of farming adopted. To this, Rosegrant et al. (2002) observed that increase

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in production from rain fed agriculture has mainly originated from land expansion. The rate of fertilizer application on farmlands in this study is at the control of available cropping area. That is, the larger the farmland, the more fertilizer it requires for managing the soil fertility. The rate of fertilizer application based on the farmland size ranged between 9 bags and 54 bags within a period of production. This forms ways by which farmers in this location enhance soil nutrients for optimum rice yield. In accordance with the findings of Anikwe et al. (2015), soil nutrient-enhancing strategies involve the wise use and management of inorganic and organic nutrient sources in ecologically sound production systems. However, the common practice of applying chemicals on the rice field before planting is an essential part of successful rice cropping in this area.

Responses from rice farmers show that chemicals have to be applied three times within a specific growing period of 3 months. This indicates that it is adequate to apply chemicals on farmlands before planting rice and subsequently, at every growing stage. The initial application of chemicals has to be done at the preparatory stage of rice planting, while the other periods of chemical application have to take place when rice plant is growing up, especially, at the flowering stage. All these are to make sure the soil has potential nutrients to support continuous growth, and getting rid of any other contingences that are harmful to proper growth and development of rice crop.

Though, fertilizer is one of the most widely used chemicals in replenishing the lost nutrient in soils; it is observed that NPK fertilizer is the major type of fertilizer that enhances yield increase in this area. The study identified that the amount of fertilizer needed by the rice farmers vary in relation to farm size. Table 9 presents the quantity of fertilizer applied on both Irrigated and Non-Irrigated Rice Field (NIRF). The Table 9 further indicates that 1,297 bags of fertilizer were applied on the entire selected rice farm. This amount of fertilizer gives an equivalent yield of 101.6 tonnes and 57.9 tonnes on both irrigated and non-irrigated farms respectively. In a general term, it is understood that despite the same level of fertilizer was observed in both irrigated and non-irrigated farms, yet with different output levels. This observation may not be separated from the fact that rice farmers are diverse in their knowledge of rice farming, which formed the basis for the application of fertilizer on their farms. Also, soil responds to fertilizer differently as reflected in the work of White et al. (1997), who opined that rain fed lowland rice areas typically have sandy soils with low fertility. These are soils that respond poorly to fertilizer application. The result therefore shows that irrigated farming has higher yield over non-irrigated in the study area. Also, Abeysiriwardena (2000) confirmed this in one of his previous studies that approximately 80 percent of rice is irrigated while the remaining 20 percent is rainfed in Sri Lanka.

Another factor encouraging insufficient yield on non-irrigated farms is the poor education background of the farmers. These rice farmers on NIRF lack quality knowledge on how much of the fertilizer to be applied. This situation is reflected on their level of farming operation, which often times, subject to indigenous approach that leads to excess/deficit application of fertilizer. In most cases, this indigenous approach in farming leads to crop damage and thereby impedes optimum yield as in the case among the rice farmers in this area.

Relationship of fertilizer application and farm size with rice yield

Table 10 presented a level of significance (at 0.58) between a sampled data from rice yield (dependent variable) and fertilizer (independent variable). The significant value observed in this study explains that fertilizer application has to be carefully carried out based on the result of the regression analysis of R-value with 0.091. The result further implies that fertilizer alone does not necessarily contribute to yield increase in this area.

The contribution of fertilizer to rice growth and development signifies 0.8% control over the yield of rice while the remaining 99.2% is left to other factors of rice production. However, the 0.58 significant level in Table 10 further shows that fertilizer application and other management strategies should be improved upon in order to enhance significant increase in rice yield in the study area. Generally, the study established strong relationship of R-value (0.77) between fertilizer and recorded rice yield. This indicates that, apart from carefully application of fertilizer on farms, it should be identified as a major factor visa Vis increase farm size for proper rice production in the study area.

This study equally examined the existing farmers' farm-size and its influence on rice yield using regression

Table 10: *Summary of fertilizer and rice yield regression model*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.091[a]	0.008	-0.018	1.10483	0.008	0.320	1	38	0.575

a. Predictors: (Constant), fertilizer; **b**. *Dependent Variable: yield; Significant @ 0.05 level*

Table 11: *Summary of farm-size and rice yield regression model*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.638[a]	.406	.391	.85476	.406	26.022	1	38	.000

a. Predictors: (Constant), fertilizer; **b**. *Dependent Variable: yield; Significant @ 0.05 level*

analysis. The regression model presents farm-size as one of the determining factors that either increasing rice output or reducing production in the study area (Table 11). For instance, it was observed in the study that farm-size is significant at 0.05 level, which implies that yield increase comes primarily from opening out more farmland for rice cultivation. This observation depicts the relevance of this parameter for attaining yield increase in the area of study. This same knowledge was given through the work of Bardhan (1973) who noted a negative relationship between output per acre and farm size in both rice and wheat fields in India. He attributed the observed relationship, to the "inverse correlation between farm size and other inputs rather than of scale diseconomies".

For instance, it was established that farm-size has strong influence at R-value of 0.64 on the yield of rice in this area. Rice farmers are, therefore, encouraged to expand their farmlands in order to increase level of rice production, which is capable of ameliorating food insecurity in the nation. Further, the correlation coefficient of 0.406 signifies that farm-size has 40.6% as coefficient of determination on rice yield while other factors of rice production, such as climate, available soil nutrients among others are responsible for the remaining 50.94% variation in the yield of rice in the study area.

Conclusions and Recommendation

This study has examined the productive status of irrigation and non-irrigation rice farms based on the management techniques adopted. It was observed that; irrigated farming had significant yield increase over non-irrigated; farm-size had strong influence on rice production level. The study therefore recommended that rice farmers should increase their farm sizes with intensive agricultural practices, which was capable of enhancing food production in the study area.

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