Economic Profitability of Rice Production Systems in Kebbi State, Nigeria

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Abstract

The study was carried out in Kebbi State, Nigeria. Using the Ex-ante Carbon-balance Tool, the carbon footprint of the rice production systems was estimated and used in estimating the economic budget of the rice production systems. The result of the study revealed that economic profits for upland and lowland production systems were positive indicating that the systems are economically efficient. The irrigation system was found to be economically inefficient. That is, the sector is exploiting resources which could have been utilized more efficiently in some other sectors of the economy. The study recommends the use of improved technology such as improved rice seeds and production practices for the system to be economically efficient. It is also recommended that farmers, especially those producing under the irrigation systems should be targeted in the campaigns for climate smart agriculture and the use of improved practices that would reduce the effect of conventional agriculture practices on the environment

Introduction

Climate change has the potential of being a major impediment to economic development, environmental sustainability, and overall human well-being due to its lasting impact on economic activity of a country and the ecosystem (Stern, 2007). This is the reason why in 2015 one hundred and ninety-five countries, including Nigeria, came together and agreed to make strides to limit the effects of global warming by reducing carbon emissions to 26-28 percent below 2005 levels by 2025. Agriculture and land use change sector has been identified as one of the main contributors to anthropogenic GHG emissions. Rice production systems in particular have been shown to contribute to global climate change by emitting carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) gases to the atmosphere and in turn, are also affected by the changed climatic variables (Ali et. al., 2019). Kebbi State is one of fifteen targeted by the Rice Transformation Agenda of the Federal Government in which rainfed and irrigated lowland rice production systems were the main priority.

The Government desires to encourage rice intensification and increase supply response through the expansion of irrigation systems. Considering the implication of such investments to carbon balance, there is need to carefully design such systems so that the negative environmental externalities are minimized.

The basic framework underlying the estimation of a project's development impact rests on three principles one of which is that a project is expected to contribute to development if expected benefits justify the expected cost (World Bank, 2013). These include both tangible and intangible benefits that can be realistically stated in monetary terms or otherwise. Therefore, for a rice production system to be considered efficient, it must be able to give optimum yield with low environmental impacts, such as low greenhouse gas (GHG) emissions and its associated Global Warming Potential (GWP) (Boateng et. al., 2017). This study, therefore, sets to specifically determine the economic profitability of rice production systems considering their environmental impact.

Methodology

Study area

The study was carried out in Kebbi State, Nigeria. Kebbi State's topography which consists of high plains in the south and south east, plain landscape in the north and the riverine lowland of the Niger and lower Rima valleys provides suitable ecologies for the dominant rice production systems found in the country. These are the Lowland and Upland rainfed systems and the Irrigation system. A multistage sampling technique was adopted in the selection of respondents for the study. Primary data was obtained for the 2018 cropping season using a combination of structured questionnaire and interview schedule.

Profitability Analysis

Gross margin (GM) and Net Farm Income (NFI)

Gross Margin (GM) is used as a planning tool where fixed capital forms a negligible portion of the farming enterprise as is the case in subsistence agriculture. Net farm income (NFI) on the other hand is the difference between gross income and total costs of production. It measures returns to naira invested in an enterprise. The GM and the NFI are expressed as:

$$GM = TR - TVC = \sum_{j=1}^{m} P_j Q_j - \sum_{k=1}^{m} P_k Q_k$$

$$NFI = \sum_{j=1}^{m} P_j Q_j - \sum_{k=1}^{m} P_k Q_k - \sum_{1=1}^{1} FL$$

Where: TR = total revenue (gross value of output), TVC = total variable cost, P_j = price of a unit of jth output; Qj = quantity of jth output; P_k = price of a unit of kth input; Q_k = quantity of kth input; FL = cost of fixed inputs.

Economic profitability of rice production systems

Carbon balance of rice production systems

The carbon balance for each of the rice production systems was estimated using the Ex-Ante Carbon-balance Tool (EX-ACT). The result as shown in table 2 indicates that the least net emission of 0.04 tCO_2eq is observed by the lowland rice system. This is followed by the upland rainfed rice system with a net GHG emission of 0.05 tCO_2eq. The irrigation system has the highest net emission of 2.42 tCO_2eq.

Table 1: Carbon Balance of rice production systems expressed in tCO_2eq

Production Systems	Total Emission	Total emission/ha	Total emission per ha per year
Upland Rainfed	37,465.96	0.97	0.05
Lowland Rainfed	29,738.30	0.89	0.04
Irrigation	1,980,927.24	48.47	2.42

Source: Ex-Ante Carbon-balance Tool

The positive values of the net GHG emission indicate that all production systems add more CO_2 equivalent into the atmosphere than it is sequestered. Consequently, all production systems come at a cost to the society. The high value of net GHG emission from the irrigation system may be due to farmers employing higher amounts of farm inputs such as fertilizer than the other rice production systems. As recommended by FAO (2017), the low and high values of the shadow price of carbon was used to get varying estimates of the profitability of the production systems. This is consistent with the presence of uncertainty in agricultural production. Table 2 is the estimates for the shadow price of carbon balance for rice production systems expressed in Naira.

Table 2: Shadow price of Carbon balance for rice production systems

	tCO2eq emitted per ha per year	Low Estimate (₦)	High Estimate (₦)
Upland rain fed	0.05	549.61	1,114.07
Lowland rain fed	0.04	504.58	1,022.80

Irrigation	2.42	27,349.96	55,439.11

Note: The low and high shadow price of carbon recommended for the year 2017 is 37 and 75US$/ t CO2e.

Table 3 is the economic budget of rice production systems in the study area. Two values of net farm income were estimated for each of the production system. One indicated the low value of the shadow price of carbon, while the other was estimated using the high values of shadow price of carbon as recommended by FAO (2019).

Results and Discussion

The result of the economic profitability of the production systems shows that upland and lowland rain fed systems recorded positive values for the net farm income while the irrigation and system had negative values. The net benefit for the upland rainfed system were ₦30,325 (using low carbon estimate) and ₦29,761 (using high carbon estimate). For the lowland rainfed, the net benefit was ₦32,721 (using low carbon estimate) and ₦32,203 (using high carbon estimate). In case of the irrigation system, a net benefit ₦-58,388 was recorded using low carbon estimate while ₦-86,477 was recorded using high carbon estimate. The result of both analyses indicates that the economic efficiency of the irrigation system is the most affected by the economic value of GHG emitted into the atmosphere. This could be attributed to the use of water pumps, and higher levels of fertilizer.

Conclusion and Recommendation

Economic profits for upland and lowland production systems were positive indicating that the systems are economically efficient. That is the country uses scarce resources efficiently. The irrigation system was found to be economically inefficient. In other words, the sector is exploiting resources which could have been utilized more efficiently in some other sectors of the economy. This implies under the irrigation system would need government support through distorting policies to survive. Yield and production costs have a direct effect on the profitability of a production system. It is imperative that yield must increase significantly to offset any increase in production costs as is the case with irrigation systems. Therefore, attention should be paid to improved technology such as improved rice seeds and production practices for the system to be economically efficient.

Table 4.12a: Economic budget of rice production systems

Item	Unit price	Upland rain fed		Lowland rain fed		Irrigation	
		Number	Economic value	Number	Economic value	Number	Economic value
TOTAL OUTPUT (₦/75kg bag)	**6,191**	**61**	**377,677**	**55**	**340,529**	67	414,826
FIXED INPUTS USED/ HECTARE							
Rental Value of Land			15,361		15,318		10,166
Borehole	3,525					3	8,813
Submersible Water pump	4,849					1	4,849
Handheld hoes	183	2	367	2	367	2	367
Sickle	67	2	133	2	133	2	133
Cutlass	250	2	500	2	500	2	500
Axe	367	1	367	1	367	1	367
Knap sack sprayer	999	1	999	1	999	1	999
Total Fixed Cost			17,727		17,684		26,193
VARIABLE INPUTS							
Agro-chemicals							
Insecticides/litre	1,715	2	3,945	2	3,877	4	7,479
Herbicides/litre	1,319	5	6,263	4	5,762	8	9,889
total		7	10,208	7	9,639	12	17,368
Inorganic fertilizer							
NPK (50kg)	6,019	8	46,045	7	39,424	11	66,208

Urea(50kg)	4,338	5	21,863	4	17,829	6	26,027
total		13	67,907	11	57,252	17	92,235
seed (Kg)							
Local seed	150	36	5,409	49	7,422	46	6,957
Improved seed	660	27	17,978	11	7,372	32	20,896
total seed		63	23,387	61	14,794	78	27,853
Bagging	113	61	6,863	55	6,188	67	7,538
Transportation cost	176		10,736		9,680		11,792
Fuel/liter	773					52	40,213
Labour cost							
family labour		31	63,196	39	76,435	49	90,925
Hired labour		72	146,778	59	115,632	71	131,748
Total Labour		103	209,974	98	192,067	120	222,673
Shadow price of carbon							
Low estimate (tCO_2eq			550		505		27,350
High estimate			1,114		1,023		55,439
Total Variable Cost (low)			329,625		290,124		447,021
Total Variable Cost (high)			330,190		290,642		475,110
Net benefit (low CO_2 estimate)			30,325		32,721		-58,388
Net benefit (high CO_2 estimate)			29,761		32,203		-86,477
Average net benefit			30,043		32,462		-72,433

Source: Field survey, 2018

Farmers, especially those producing under the irrigation systems should be targeted in the campaigns for climate smart agriculture and the use of improved practices that would reduce the effect of conventional agriculture practices on the environment such as adhering to the recommended doses of agro-chemicals, site-specific soil-crop fertilizer use and solar powered irrigation technologies.

References

Ali, M. A., Inubushi, K., Kim, P. J., & Amin, S. (2019). Management of Paddy Soil towards Low Greenhouse Gas Emissions and Sustainable Rice Production in the Changing Climatic Conditions. Centre for Policy Modelling, Manchester Metropolitan University Business School

Boateng, K. K., George Y. Obeng, G. Y. & Mensah, E. (2017). Rice Cultivation and Greenhouse Gas Emissions: A Review and Conceptual Framework with Reference to Ghana. Agriculture 2017, 7, 7; doi:10.3390/agriculture7010007

Food and Agriculture Organisation (FAO) (2017) Productivity and Efficiency Measurement in Agriculture. Literature Review and Gaps Analysis. Technical Report Series GO-19-2017. The Global Strategy to Improve Agricultural and Rural Statistics. Statistical Division, Food and Agriculture Organization of the United Nations (FAO).

Food and Agriculture Organisation (FAO) (2019). Investment Learning Platform (ILP). Investment Themes and Tasks. Financial and Economic Analysis. Retrieved from: http://www.fao.org/investment-learning-platform/themes-and-tasks/financial-economic-analysis/en/#c325441

Stern, N. (2007). The Economics of Climate Change: The Stern review. Cambridge University Press, Cambridge.

World Bank (2013). Investment Project Financing Economic Analysis Guidance Note.