Analysis of Resource Use Efficiency and livelihood Status of Small Scale Maize Farmers in Biu and Hawul, Borno State, Nigeria

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Abstract

The study analyses resource use efficiency and livelihood status in small scale maize production in Borno State, Nigeria. The specific objectives were to examine the resource use efficiency and livelihood status of small scale maize farmers. One hundred and twenty small scale maize farmers were randomly selected for the study and data were collected using structured questionnaire. Data were analysed using multiple regression and livelihood model. The result revealed that seed, fertilizer and herbicide were positive and statistically significant at 1%, while labour was positive and statistically significant at 5%. The R^2 *was 84.8% and F value was 48.39 and significant at 1%. The result further revealed that fertilizer, herbicide and labour were over utilize while seed was underutilized. The result of livelihood status revealed that all the variables including constant tested positive and statistically significant at 1%. The result revealed that human resource poverty is the highest contributor to livelihood status of the farmers in the study area. The study concludes that fertilizer, herbicide and labour were over utilize while seed was underutilized. Human resources poverty is the highest contributor to the livelihood status of small scale maize farmers in the study area.*

Keywords: Resource Use, Livelihood Status, Small Scale, Maize Farmers, Borno State

INTRODUCTION

Agricultural sector in Nigeria remains the major source of food and raw materials for the teeming population and domestic industries and had sustained the growth of the Nigerian economy for decades. Agricultural sector was the major source of national income, foreign exchange, employment and contributor to the Gross Domestic Product (G.D.P) and it employs about 70 percent of the rural working population (Joshua, 2010). However, Nigerian agriculture is characterized by small scale farm, low farm income, low level of capacity and manual techniques of production (Obadun, 2008; Daniel, 2013). While it is widely recognized that, the development of agriculture is one of the crucial requirement for overall economic growth, there is little consensus with respect to most appropriate strategy for securing increase farm output and productivity in developing agriculture. Moreover, as a result of the seasonal nature of production, government opted to embark upon various strategies that aimed at ensuring continues production of crops (Makama, 2006). Maize (*Zea mays L.*) is a versatile crop with wide adaptations, it can be produced in large volumes in small area, it is easy to grow and harvest, is readily storable over the seasons and has multiple uses. Maize can be suitably intercropped with potatoes and grain legumes, and variety of other vegetables which enhance effective land utilization. Maize has multiple uses and the green Stover is an excellent fodder for cattle in the critical feed storage months. Maize Stover produces an average of 6.89 t/ha of dry matter, which is good enough to feed up to 5 adult cows for about five months (Dukpa and Rai, 2006). Maize by product from processing is also important source of feed for backyard piggery and poultry. Maize is a nutritious crop and a wholesome food. On average maize kernel contains about 71.3% starch, 9.9% protein and 4.45% fat (Watson, 2007).

Recent studies in Nigeria have shown that maize is now ranked second after sorghum as food crop and cash crop in the northern guinea savannah of Nigeria (Ologunde, 2007; Ahmed, 2009). Maize is truly a rural food as the quantities of various maize products consumed by the urban household is small. Most of the processing of maize which is highly labour intensive is done at the household level. The small scale farmers who contribute immensely (over 95%) of the domestic production in Nigeria are faced with the problem of inadequate resources employed in the production process. There is therefore the need for efficient utilization of resources.

A key feature of the Nigerian Agriculture is the dominance of small scale farms, which constitute an important component of the Nigerian economy. It is a known fact that over 12million farmers, scattered in different ecological zones, engage in the production of a wide variety of arable crop and this is done under traditional subsistence agriculture. Individually, while not exerting much influence, they collectively form an important foundation on which the nation's economy rests (Olayemi, 2008 and Okuneye, 2006). Louise (2003), report that 90% of the Nigerian total food production comes from these small scale farms. Therefore, effective economic development strategy will depend critically on promoting production and output growth in the agricultural sector, particularly among small scale producers since they are responsible for the bulk of the nation's agricultural production.

Resource allocation and productivity are important aspect of increased food production which is also associated with the management of the farmers who employ these resources in production. Furthermore, efficiency in the use of available resources is a major pivot for profitable farm enterprise and sustainability. Therefore, inefficiency in the use of resources wrong choice of enterprise combination and cropping system constitute the major constraint to increased food production in Nigeria (Okorji and Obechina, 2005).Thus, this study intend to examine the resource use efficiency and livelihood status in small scale maize production in the study area and

METHODOLOGY

Study Area

The study was carried out in southern part of Borno State, Nigeria. It has an approximated land area of about 20,661 square km and lies between latitude $10^{o}00$ and $11^{o}30$ north of the equator and longitude $11^{0}30$ and $14^{o}00$ East (Bwala, 2019). It is projected to have a population of 1.79 million in 2018 using annual growth rate of 3.6% (National population commission (NPC), 2006). It shares borders with Gombe State to the South, Adamawa State to the east and Yobe State to the west. The average annual rainfall ranges from 600mm – 1200mm and average annual temperature ranges 23-37^{o}C.

The study area is made up of 27 Local Government Areas (LGAs) spread over three Agro-Ecological Zones (AEZs), namely: Sahel in the north, Sudan in the middle and Guinea Savannah in the Southern part of the State (Joshua and Teli, 2007). Borno State is hot climate for most part of the year especially in the Northern part of the State, while the southern part is slightly milder in climatic temperature. The rainy season varies from the extreme north to the southern part of the State with the former having about 450mm per annum while the later records about 1000mm per annum (Daura, 2001; Odo and Oleghe,1998)

On the basis of rainfall and vegetation, States in Nigeria have more than one AEZ. Borno State is divided into three major AEZs; namely the Sahel Savannah, the Sudan Savannah and the Guinea Savannah (Joshua and Tile, 2007). There is however, no clear cut boundary; rather, the zones gradually merge into the next.

Agriculture is the main stay of the economy of Borno State. Crops grown reflect the nature of the agro-ecological zones. The major crops cultivated include Millet, Sorghum, Groundnut, Maize, Cowpea, and Vegetable (onion, pepper, tomatoes etc) through irrigation. The major livestock reared in the area are cattle, camel, sheep, goats and poultry.

Sampling Procedure

Multi-stage sampling technique was used to select the farmers for this study. Borno State comprises 27 LGAs which are spread among fairly distinct AEZs, namely the Sahel Savannah, the Sudan Savannah and the Guinea Savannah. Thus, the State was stratified based on the prevailing AEZs. The first stage of the sampling was a purposive selection of guinea savannah due high production of maize grain in the area. At second stage a random selection of Biu and Hawul. The third stage involves random selection of 4 villages from each L.G.A making a total of 8 villages that were sampled. The villages were Yawi,Galdimare, Dugja and Zarawuyaku from Biu L.G.A, while Shafa, Marama, Kida and Kwajafa from Hawul L.G.A. At the final stage, 10% from the number of registered farmers from the villages were randomly selected. Therefore, a total of 120 farmers were selected to serve as the total sample size for the study.

Table 1 Sample selection from sampling frame

Selected LGA	Selected villages	No of registered farmers	Ten (10) % of the No of registered farmers
Biu	Zarawuyaku	181	18
	Dugja	140	14
	Yawi	160	16
	Galdimare	150	15
Hawul	Shafa	147	15
	Kida	152	15
	Marama	98	10
	Kwajafa	172	17
Total		1200	120

Data Collection

Data for the study were collected from primary source. Primary data were collected with the aid of questionnaire which was administered to the selected farmers. The data were collected by the researcher with the assistance of trained enumerators. Resource use efficiency in maize production and contributions of maize production to the livelihood of small scale farmers.

Multiple regression model

The multiple regression models were used to determine the resource use efficiency in the production function.

The model is specified as:

$Y=f(X_1, X_2, X_3, X_4, X_5)$

Where,

Y = quantity of maize produced
X_1 =quantity of seed (kg)
X_2 = quantity of fertilizer used (kg)
X_3 = farm size (ha)
X_4 = labour (man day)
X_5 = herbicides (litres)

However, in order to ensure an appropriate functional form. The study must be tested with different regression models which are specified as follows:

Linear Function

$Y = a+B_1X_1+B_2X_2+B_3X_3+B_4X_4+B_5X_5+e$

Where

a = constant term
B_1............B_5 = regression coefficient in respect to each variable
e = error term

Semi-log Function

$Y = a+B_1\log X_1+B_2\log X_2+B_3\log X_3+B_4\log X_4+B_5\log X_5+e$

Double-log Function

$\log Y = a+B_1\log X_1+B_2\log X_2+B_3\log X_3+B_4\log X_4+B_5\log X_5+e$

Resource use Efficiency

The resource use efficiency is used to determine how well the farmers employ the resources at his disposal. Based on the regression coefficient estimate of the selected lead equation, marginal value product (MVP) of resource use will be computed. The MVPs are determined using the formula:

MVPxi=Bi-Yi/Xi-Py

Where:

MVPxi= marginal value products of the resources Xi(i=1,2,3,4,5)
Bi=regression coefficient of resources Xi
Xi=geometric mean of farmers production input (kg)
Yi=geometric mean of farmers output (kg)
Py=unit price of farmers output (naira)

The acquisition cost of each variable resource used is the marginal factor cost (MFC).following Umoh (2006); Khandaker, *et al.* (2013), the MFC is equated to the MVP to determine the resource efficiency of the inputs.

According to kay (1986), and Olukosi and ogungbile (1989), a firm maximizes its profit with respect to an input if the ratio of its MVP to its MFC is unity.

The decision rule, according to Amaza and Anumah (2003) is:

MVP>MFC Underutilization of resources

MVP<MFC Over utilization of resources

MVP=MFC optimal utilization.

Livelihood Model

The livelihood status of maize producers was examined by estimating the livelihood index (LI).The model for livelihood index involved set of identified livelihood indicators to construct a weighted livelihood index. The model of Kutigi *et al* (2013) was adopted for this study.

The sum of the weight of IP, IFP, and HRP will be equal to 1.0 (assuming equal weight among the indices). Thus;

K_1= weight of income poverty status =0.33
K_2= weight of infrastructural poverty status=0.33
K_3= weight of human resources poverty status=0.33
Total weight = 1.0

Weight of income poverty index

K_{11} = weight of income generated from maize production represented by average daily income per day in relation to the poverty line (1.25 dollar per day per head) = 1.00, since income from maize production is the only component of the income poverty

Weight of infrastructural poverty index

The sum of the weight of the indices that make up infrastructural poverty will be equal 1.00, thus; assuming equal weight each index has a weight of 0.17.

Table 2: Weight of Infrastructural Poverty by social services of the producers

S/N	Item	Description	Weight
1	K_{21}	Accommodation	0.17
2	K22	Healthcare	0.17
3	K23	Transportation	0.17
4	K24	Household facilities	0.17
5	K25	Water	0.17
6	K26	Electricity	0.17

Accessible =1, Not accessible = 0

Weight of human resource poverty index

The sum of weight of the indices that make up the human resources poverty will also be equal to 1.00. Thus; assuming equal weight, each index has as a weight of 0.50.

Table 3: Weight of human resource poverty index based on parent capacity

S/N	Item	Description	Weight
1	K_{32}	Capacity to sponsor children's education	0.5
2	K32	Capacity to feed own household members	0.5

Table 4: Infrastructural poverty indicators

S/N	Item	Description	Weight
T1	Poverty status	Below poverty line	0
		On the poverty line	1
		Two times above poverty line	2
		Three times above poverty line	3
		Four times above poverty line	4
		Five times above poverty line	5
		Six times above poverty line	6
T2	Type of accommodation	mud house with thatched roof	1
		mud house with zinc roof	2
		concrete house with zinc roof	3
		concrete house with aluminium zinc	4
T3	Health care services	Affordable	1
		Not affordable	0
T4	Transport	None	0
		Bicycle	1
		Motocycle	2
		Car	3
T5	House hold material	Television, radio, refrigerator, handset	1
T6	Portable drinking water within 1km distance or 1 hour walk	Pipe bone water	1
		Well water at home	2
		Community borehole	3
		Community well	4
T7	Electricity from National grid	Accessile	1
		Not accesible	0
T8	Schools	Primary, secondary and tertiary levels	1
T9	Ability to feed family per day	Once	
		Twice	2
		Thrice	3

Estimated maize production function

Regression analysis was used to determine the nature and magnitude of the relationship between inputs and outputs in small scale maize production. Based on the analysis, double log regression was selected as the best fitted as shown in table 4.

RESULT AND DISCUSSION

The lead equation was chosen based on the value of the coefficient of multiple determination (R^2), the signs and significance of the regression parameters, t- statistics and f- ratio. Double log function provided best line of fit and was selected. The regression result indicated that about 84.8% (R^2) of the variation in the output of maize is jointly explained by the explanatory variables included in the model. The remaining 15.2% not explained by the variables which could be attributed to the error or random disturbance in the model. The F ration of 48.39 was significant at 1% level, implying that the explanatory variables included in the model have strong explanatory power. The regression coefficient with respect to most of the explanatory variables were positive except for herbicide which was negatively signed.

Table 5: Estimated Double Log Function of Maize Production.

Variable	Coefficient	Standard error	t- value	*p*- value
Constant	1.679	0.247	6.799	0.000*
Seed (X1)	0.402	0.067	5.963	0.008***
Fertilizer (X2)	0.329	0.063	5.255	0.000***
Farm size (X3)	0.055	0.122	0.452	0.652NS
Labour X4	0.335	0.176	1.907	0.059**
Herbicide X5	-0.079	0.040	-4.254	0.006***
R^2	84.8			
R^2 adjusted	82.4			
F value	48.39			0.000***

NS= not significant,***p<0.01, **P<0.05 *P<0.1

Implying that one unit increase in any of the positively signed inputs would increase maize output by proportion corresponding to the regression coefficient of the variable in question, all other inputs held constant. However, most explanatory variables X_1, X_2, X_5 including constant were statistically significant at 1% were X_4 was statistically significant at 5% and X3 was not statistically significant and need no explanation. In various studies conducted by Yusuf, *et al*. (2010) in Kaduna State, oluwatayo, *et al.* (2008) in Ekiti State, farm size, seed, fertilizer were found to have positive coefficients. But the negative sign of herbicide is contrary to the findings of oluwatayo, *et al.* (2008), who reported positive relationship of herbicide. However, unit increase in any of the negatively signed inputs would decrease maize output by a proportion corresponding to the regression coefficient of the variable in question. *Ceteribus paribus*.

Estimation of efficiency ratio in small scale maize production

Based on the level of relationship between the used of inputs and output, efficiency of resource use was further ascertained by equating the marginal value product (MVP) to the productive marginal cost (MFC) of resources. A resource is said to be optimally utilized if there is no significant difference between MVP and MFC that is if the ratio of MVP to MFC is equal.

The result in table 5 revealed that the ratios of the MVP to the MFC were less than unity (1) for all the inputs except seed which is greater than unity. This implies that fertilizer, chemical and labour were over utilized while seed is underutilized. This means that maize output was likely to increased and hence revenue if more of seed is used, and decrease in the use of labour, fertilizer and chemical, thereby attaining optimal allocative efficiency. The underutilization of seed correspond with the finding of Yusuf e*t al*. (2010), while the over utilization of fertilizer, chemical and labour contradicts the finding of Ahmed (2009), in which fertilizer, labour and chemical were underutilized.

Table 6: Efficiency Ratio of Small Scale Maize Production in the study area

Variable	MVP	MFC	R
Seed	3015	2600	1.13
Fertilizer	2467.2	18750	0.13
Chemical	3000	5000	0.05
Labour	1320	25650	0.6

Relationship between Maize Production and Livelihood Sustenance of the Producer

The livelihood status (dependent variable) was regressed against the independent variables which are income poverty (IP), infrastructure poverty (IFP) and human resource poverty (HRP) indices to the contribution of each of the index on the livelihood status of the producers.

The result of regression analysis measuring the relationship between the LS, IP, IFP, and HRP of small scale maize producer is shown in table 6 below.

Table 7: Estimated Livelihood Status of Small Scale Maize Producer

Variables	Coefficient	T – value	*P* – value
Constant	2.806	120.223	0.000***
Income poverty status IP	0.774	22.447	0.0080**
Infrastructural poverty status IFP	1.547	14.258	0.0003***
Human resources poverty status HRP	2.623	27.225	0.000***
R^2	0.842		
R^2 adjusted	0.837		
F value	174.1		0.000***

***P<0.01, **P<0.05, *P<0.1.

The result of regression analysis for small scale maize producers revealed that the best fitted model among three functional forms (linear, semi – log and double log) tried was the semi- log model. The result revealed that all the variables including constant tested positive at 1% level of significant. This implies that all the variables (income, infrastructure and human resources poverty) have significantly contributed to the livelihood status of the small scale maize producers, with the human resource poverty having the highest contribution of 2.623 that is to say income from maize production adequately feed their families three times a day and sponsor their children to school. Income poverty status has the least contribution of 0.774. This is implying that the human resources poverty and infrastructural poverty contributed to the livelihood status of maize producer more than the income poverty.

The R^2 value of 0.842 implies that the variables included in the model explained 84.2 variations in the livelihood status of the small scale maize producer, the remaining 4.2% may be attributed to error. That is, income poverty, infrastructural poverty and human resource poverty adequately explained the livelihood status of small scale maize producers in the state.

This result tallies with the findings of Kutigi e*t al*. (2013), which reported that the leading contributing factor in livelihood status of popcorn processors in Niger state is human resources poverty and infrastructure poverty while income poverty is the least, and also reported the adjusted R^2 value of 88.9%.

CONCLUSION

The result revealed that small scale maize farmers are inefficient in the use of Seed, fertilizer, and chemical and labour. This implies that those inputs are over utilized with exception of seed which was underutilized. The result revealed that human resource poverty is the highest contributor to the livelihood status of the producer. It is further recommended that; a) farmers should be encourage to use improved seeds for maximum profit, b) engage in extra income generation to reduce level of poverty, c) timely provision of agricultural incentives by government and other stakeholders to enhance productivity and income of the farmers.

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