Quest Journals
Journal of Research in Agriculture and Animal Science
Volume 3 ~ Issue 8 (2015) pp:07-14
ISSN(Online) : 2321-9459
www.questjournals.org

Research Paper

Economic Analysis of Herbicides by Sole Maize Farmers in Bosso Local Government Area of Niger State, Nigeria.

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Received 07 December, 2015; **A**ccepted 04 January, 2016 © The author(s) 2015. Published with open access at **www.questjournals.org**

ABSTRACT:- *This study examined the economics of herbicide use by sole maize farmers in Bosso local government area of Niger state. The study identified the various types of herbicides used by maize farmers in the study area and ascertained the extent to which farmers complied with recommended use of herbicides. The study also tested the farmers' knowledge of side effects of herbicides and determined the profitability of herbicide use in the study area. Forty 40 respondents were selected using stratified random sampling technique. The data were collected using structured questionnaire and analyzed using descriptive statistics, farm budgeting and regression analysis. The herbicides used by maize farmers in the study area were Atrazine, Primextra, Paraquat and Gramazone. All of the respondents complied with the recommended use of herbicides and had knowledge of the side effects of herbicides. Fifteen percent of the total cost incurred in maize production using herbicide was accounted for by depreciation on fixed items while 84.99% was the variable cost. The mean gross income was N46, 181.61 and the mean net farm income was N18, 487.2. From the resource use efficiency test, land, hired labour, fertilizer, seed and fixed inputs were underutilized; effort to increase the utilization of these inputs would raise the efficiency and profit in the area.*

KEYWORDS:- *Economic analysis, Herbicides, Resource use, Sole maize farmers.*

I. INTRODUCTION

Agriculture has undoubtedly remained the mainstay of the Nigerian economy since independence. It plays a significant role in the economic development of Nigeria by providing food for the growing population, employment for over 65 percent of the population, raw materials and foreign exchange earnings for the development of the industrial sector (Ojo, 1990[1]).

The country recorded significant improvement in agricultural production through 1990's. The percentage contribution of agriculture to the GDP was 38% in 1994, 38.2% in 1995, 39.0% in1996, 39.2% in1997, 40.4% in 1998 and 41.3% in 1999. The average growth rate during the period 1990-1999 was 4.0%. (CBN, 2000[2a]).Despite the dominance of mineral oil exploitation as the current main stay of the Nigerian economy in terms of foreign exchange earnings, the agricultural sector remains the largest, contributing more than 41% of the GDP and employing 70% of the active labour force (CBN, 2000[2b]). Apart from its pivotal role in meeting the food and fiber needs of a large and growing population of 120 million (2-3% growth rate), it provides the raw materials for the agro-industrial sector. Agriculture accounts for 88% of the non oil foreign exchange earnings. Over 90% of the Nigeria's agricultural output is by small scale (less than 5ha), resource poor farmers who have for ages sustained the national food supply (CBN, 2000[2c]).

Increasing population pressure coupled with traditional crop production systems involving hoe weeding in peasant farming practices have contributed greatly to low productivity, drudgery and food shortage.

Hoe weeding is a common weed control practice by farmers in the sudan savanna, where they weed two or three times for millet-cowpea inter crop (Shetty, 1987[3]; Joshua and Gworgwor, 2000[4]). However, this is labour intensive and time consuming and can lead to yield loss due to lack of timely weed control or management. Rowland and Whiteman (1993[5]) stated that the fundamental reason for the delay of weeding in the semi arid region is related to labour shortage. The task of planting and weeding often overlap and compete for labour.

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Therefore, the possibility of chemical weed control in mixed cropping system has been earlier identified by Akubundo (1998[6]), and Joshua and Gworgwor (2001[7]). Chemical weed control is more adapted to large scale crop production that other weed control methods and it is labour saving (Anon, 1994[8]). Chemical weed control is more adapted to large scale crop production than other weed control methods and it is labour saving. Judicious use of herbicides reduces labour requirements and costs; weed control increased crop yield by reducing weed competition and consequently increased profitability. Chemical weed control is an alternative to manual weeding because it is cheaper, faster and gives better weed control (Chikoye *et. al*., 2005[9]; Chikoye *et. al*., 2007[10]). Also herbicide use has been reported to be more profitable than hoe weeding in the production of various crops in Nigeria (Shrock and Monaco, 1980[11]); Ogungbile et. al., 1982 [12]; Okereke, 1983[13], Osoroh, 1983[14]; Sinha and Lagoke 1984[15]; Ogungbile and Lagoke, 1986[16]; Adigun et al 1993[17]; Joshua and Oni, 2002[18]; Imoloame et al 2010[19]).

There is no doubt that increasing variety and use of crop protection chemicals such as herbicides have played a major role in the growth of the agricultural productivity during the twentieth century. Lever (1990[20]) re-affirmed that herbicides have increased the availability and reduced the cost of food for the geometric population of the world by reducing crop losses and total control of existing weeds. In Nigeria the small scale resource poor farmers use more of hand labour instead of herbicides. The attitude of farmers towards the use of crop protection chemicals has to be considered. Despite the various types of chemicals available, most farmers prefer their indigenous knowledge about farming practices due to lack of agrochemical inputs and the lack of its effective utilization.

II. OBJECTIVE OF THE STUDY

The general objective is to examine the economics of herbicide use by sole maize farmers in Bosso local Government Area of Niger State. The specific objectives are to:

1. determine the socio-economic characteristics of herbicide users in maize production
2. identify the various types of herbicides used by maize farmers
3. ascertain the extent to which farmers comply with recommended use of herbicides
4. test the farmers' knowledge of the side effects of herbicides
5. determine the profitability of herbicide use and
6. determine the economic efficiency of herbicide usage.

2.1 Materials and Methods

Bosso Local Government Area (LGA) was created in 1991. The LGA has a population of 92,203 people (census, 1991[21]). It exist within a range of latitude 09^0 41N and longitude 06^0 28E. The LGA has boundary with Chanchaga, LGA to the North, Shiroro LGA to the North East, Paikoro LGA to the South East and Gboko LGA to the South. The vegetation is predominantly shrubs, grassland to woodland with trees scattered around. The topography is plain lands with interrupted undulations, the soils ranges from sandy loam to clay loam. The climate of the LGA is typical of the guinea savannah region of Nigeria. The wind direction is usually along South West and North East axis. The raining season lasts between 190-200 days (6-7 months) with August recording the highest rainfall of 300mm (11.7inches). The highest temperature is usually around march at 35^0C and lowest in august at 25^0.The area is predominantly inhabited by Gwari and other tribes like Fulani, Nupe and Hausa. Farming is the major occupation of the people. Crops grown are yam, maize, sorghum, cassava, tomatoes, pepper and groundnut.

Data were collected through distribution of structured questionnaire. The filling of questionnaire was done with the assistance of extension agents attached to the area. Other sources of information used include personal interview involving extension agents and staff of Agricultural Department of the study area. Fourty farmers were used for the study. A random sampling method was used in the distribution of questionnaire in four wards/farming districts of Bosso LGA. Two villages were sampled from each ward and five farmers were selected from each village. The wards and villages selected include: Gamu and Nyi villages from Maikunkele central one ward, Rafin Yashi and Maikunkule Low-cost villages from Maikunkele central two ward, Beji and Konape from Beji ward, Pyatta and Sebgye villages from Pyatta ward. Data were analysed with the aid of simple descriptive statistics such as percentage and frequency distribution, net farm income and multiple regression analysis.

2.2 Types of Production Function

(a) Linear Function: This can be specified in its simplest form as $Y= a + bx$. For two variable inputs function, a linear function can be specified as $Y = a + b_i x_i + b_2 x_2 \ldots\ldots b_n x_n$

The linear function assumes that the relationship between the output and input is a straight line. It also assumes that the marginal physical product (MPP) is constant over the entire application of an input. It means that a linear function does not give room for diminishing returns.

(b) Cobb-Douglas Function: The general form is as follows: Y = axb. For a two variable function, it can be represented as: $Y = ax_1^{b1}x_2^{b2}$

(c) Quadratic Function: This can be specified as: $Y = a + b_1x_1 + b_2x_1^2$ for a two variable function, it can be specified as: $Y = a + b_1x_1 + b_2x_2 + b_3x_1^2 + b_4x_2^2 + b_5x_1x_2$

(d) Semi-log function: The function is in this form

$Y = a + b\log_x$ - one variable input.

$Y = a + b_1\log x_1 + b_2\log x_2$ - Two variable inputs

(e) Exponential function: This can be specified as: Y =ae

2.3 Net Farm Income

This measures the return to unpaid family labour, hired labour, operator's land, capital and management. The net farm income is determined by subtracting the total fixed cost (TFC) and total variable cost (TVC) from the total gross margin (TGM), NFI = GM – TFC – TVC

2.4 Return on Investment

RInv. = Net Farm Incorm/Total Costs
= 18,487.20/27,694.41
= 0.67 %

2.5 Model Specification

In analyzing the determinants of economic analysis of herbicide use by maize farmers, the multiple regression model that were used is specified in the explicit form as:

$Y = f(x_1, x_2, x_3, x_4, x_5 \ldots\ldots\ldots\ldots x_n + e)$

Where:
Y = output of farmers in Kilogram
X_1 = Size of land in hectare
X_2 = Family labour in man/day
X_3 = Hired labour in man/day
X_4 = Fertilizer in Kilogram
X_5 = Seed in Kilogram
X_6 = Herbicide in litre
X_7 = Fixed cost in naira

Various functional forms such as linear, cobb-douglas, quadratic, semi-log and exponential functions were experimented with, and the lead equation was chosen based on the normal statistical economic criteria.

III. RESULTS AND DISCUSSION

3.1 Socio-Economic Characteristics of Respondents

Table. 1 show that labour force for land clearing, harvesting and transportation of produce home were carried out by both men and women. 77.5% of the respondents were men while 22.5% were women. This statement is in accordance with the findings of Chinyere (1993[22]) who reported that rural female farmers are not statistically identified as an active population in farm operations. As a result, their productive economic roles are regarded as part of their domestic and reproductive roles. According to established gender roles, women are not responsible for feeding the family (Paola, 2003[23]).Age distribution of the respondents is presented in table 1. The result shows that 15% of the respondents were within 20-30 years of age and 25% were age 31-40 years. However, the largest proportions 35% were within age range 41-50 years. Thus, 75% of the respondents were within the economically active age (20-60 years) and as Rahman *et. al.* (2002[24]) indicated, this group category will respond positively to any intervention aimed at improving their productivity. There were both Christians and Muslims living in the study area, with the Muslims slightly dominating as shown in table 1. Farming business in the area is predominantly carried out by the Gwari people, 95% of the respondents were Gwari, 2.5% each were Nupe and Yoruba table 1. Farming is the major occupation of the respondents in the area and they spent a greater portion of their time on farm business as shown in table 1. 82.5% of the respondents have no formal education while 17.5% have different levels of education as distributed in table 1.

3.2 Herbicides use by Farmers

Table 2, shows the various types of herbicides used by farmers in the study area, with 35% using Atrazine, 27.5% Primextra, 22.5% Paraquat, and 15% Gramazone respectively. As can be seen from table 3, 45% of the respondents have been using herbicides for less than 10 years, 25% and 20% of the respondents have been using herbicides for 10-14 and 15-19 years respectively. The local markets (80%) serves as the main source of herbicides in the study area, followed by the Agricultural Development Programme (ADP) stores (20%) as shown in **table 4**. This is at variance with the findings of Illo, A.I. (1991[25]), and Gulma et. al. (2015[26]) who reported that the input unit of the ADP, is the farmers major source of inputs in Sokoto, Kebbi and zamfara States. This variation may not be unconnected with the continuing deteriorating situation of ADPs in Nigeria, due to inadequate funding by the government, after the World Bank financing had ceased at the end of the project lifespan.

From **table 5**, precisely 52.5% of the respondents claimed that herbicides have led to increase in output, 42.5% reported increase in profitability of farm business, while 5% agreed that the use of herbicides helps to produce healthier farm produce. This is in line with the findings of Pamplona *et. al.,* (1990[27]) who reported that yield increased because the crop was free from weeds during its critical period of weed interference which is 40days after emergence in maize. Vashney (1990[28]) also reported a negative correlation between crop yield and field weediness.

Extent to which Farmers Comply with Recommended use of Herbicides

From Table 6, 37.5% of the respondents used boot during chemical application, 12.5% used gloves and 100% used mask. Similarly, the breakdown of quantity of chemicals used per hectare is shown in Table 7. All the farmers that used the four types of chemicals, applied them within the range of 2.0-3.0 litres per hectare

Farmers Knowledge of the Side Effects of Herbicides

As presented in Table 8, 100% of farmers agreed that herbicides improve quality of farm produce, increase profitability of farm business and does not alter the natural characteristics of farm produce

3.3 Cost and returns Analysis

Table 9, indicates that 15.01% of the total cost incurred in the cultivation of 1ha of land used for maize production using herbicide was the depreciation on fixed items while 84.99% was the variable cost, 6.34% of the total cost was the depreciation on sprayer and 8.73% was the cost of herbicide used on the field. The total fixed cost was N4, 155.86 and the variable cost was N23, 538.55. The total cost of production was N27, 694.41. The gross income was N46, 181.61, while the net farm income was N18, 487.2. According to the estimated value obtained as the net farm income of 1ha of land used for maize production using herbicide, herbicide use is profitable in maize production.

3.4 Regression Estimates

Of the five functional forms tried namely: the linear, quadratic, exponential, semi-log and double log production functions. The linear function was chosen as the lead equation based on the conformity of sigh of estimated coefficient, with a priority expectation, relative magnitude of the coefficients of multiple determinations (R^2), F- statistics, significance of regression coefficients using t- test. As presented in the results of the estimated functional forms in Table 10, the estimated coefficient for land was 621.677 and statistically significant at 5%. This implies that, if land resource is increased by 5% holding other variables constant, the output of maize will increase by 621.67%. The estimated coefficient for fertilizer was 1.705 and statistically significant at 10%. This also implies that, if fertilizer is increased by 10% holding other variables constant, the output of maize will increase by 1.705. The adjusted R^2 value of 0.997, implies that about 97.7% of the variation in maize output is explained by the independent variable included in the model and remaining 2.3% is as a result of errors in estimation. The F-statistics was found to be significant at 1%, which means that the independent variable adequately explained the dependent variable.

3.5 Allocation Efficiency of Resources

To determine the efficiency of the use of each resource, marginal analysis is adopted. The marginal factor cost (MFC) refers to the cost of an extra unit of input. It is either measured at the prevailing market price in a perfectly competitive market or as the annual depreciation occurring on a durable asset. The opportunity cost of capital can be use for a capital asset like land. The marginal value product (MVP) is the addition to total output as a result to unit change in input. For linear function, MVP is the product of the estimated regression coefficient (bi) and the unit price of output (py).

MVP = bi py

Where MVP = marginal value product
bi = estimated coefficient of the ith input
py = unit price of output (N) taunt

To determine the resource use efficiency, the allocation efficiency index was used. From the table 10, family labour and herbicides were over utilized since their allocation efficiency index value which are -0.130 and -1995.5 respectively are less than 1. While the rest of resources were underutilized since their allocation efficiency index values are more than 1. Efficient utilization of resources occurs when the ratio of MVP to MFC is 1. The over utilization of resources means that the farmer is operating in stage III of classical production function which is an irrational stage. The farmer should reduce the level of utilization of family labour and herbicide. The under utilization of resources implies that the farmer is operating in stage I of classical production function which is also irrational stage. The farmer should therefore, increase the level of utilization of land, hired labour, fertilizer, seed and fixed inputs.

IV. CONCLUSION

From the results of the study, it can be concluded that the use of herbicide has significant effect on yield and income of maize farmers. From the result of net farm income, herbicide use is profitable in maize production. Resource use efficiency shows that family labour and herbicide were over utilized, while land, hired labour, fertilizer, seed and fixed inputs were underutilized. This invariably indicates that there is room for increase in crop yield with better management of the underutilised fixed inputs.

The findings from the concluded study revealed that more space had been provided for further research in this field.

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Table 1. Socio-Economic Characteristics of Respondents

Sex	Frequency	percentage
Male	31	77.5
Female	9	22.5
Total	**40**	**100**
Age Range		
21-30	6	15
31-40	10	25
41-50	14	35
50 and above	10	25
Total	**40**	**100**
Religion		
Christianity	19	47.5
Islam	21	52.5
Total	**40**	**100**
Ethnic Group		
Gwari	38	95
Nupe	1	2.5
Other (Specify) Yoruba	1	2.5
Total	**40**	**100**
Occupation/status		
Full time	33	82.5
Part time	7	17.5
Total	**40**	**100**
Level of Education		
No formal education	33	82.5
Primary school	2	5.00
Secondary school	3	7.50
Tertiary institution	2	5.00
Total	**40**	**100**

Table 2. Distribution of respondents according to types of herbicide used by maize farmers

Type of Chemicals	frequency	percentage
Atrazine	14	35
Primextra	11	27.5
Paraguat	9	22.5
Gramozone	6	15
Total	**40**	**100**

Source: Field Survey, 2006

Table 3. Distribution of respondents according to years of experience in the use of herbicide

Range of years	frequency	percentage
Below 10	18	45
10-14	10	25
15-19	8	20
20 and above	4	10
Total	**40**	**100**

Source: Field Survey, 2006

Table 4. Distribution of respondents according to source of herbicides

Sources of Herbicides	Frequency	Percentage
ADP Stores	8	20
Market	32	80
Total	**40**	**100**

Table 5.Distribution of respondents according to benefits derived from the use of herbicides

Benefits	Frequency	Percentage
Increased output	23	52.5
Increased profitability	17	42.5
Healthier produce	2	5
Others (specify)	0	0
Total	**40**	**100**

Table 6. Distribution of Respondents According to safety measures adopted

Protective Gear	Frequency	Percentage
Boot	15	37.5
Gloves	5	12.5
Mask	40	100
Total	**60**	**150**

Table 7. Distribution of Respondents According to Quantity of Chemical Applied per Hectare

Chemical and Recommended dosage	Respondents' Dose per Hectare	Frequency	Percentage
Atrazine 2.0-3.0 Litre/ha	2.0-3.0	14	35.00
Primextra 2.0-3.0 litre/ha	2.0-3.0	11	27.50
Paraquat 2.0-3.0 litre/ha	2.0-3.0	9	22.50
Gramazone 2.0-3.0 Litre/ha	2.0-3.0	6	15.00
Total		**40**	**100.0**

Table 8. Distribution of Respondents According to Perception of Herbicides

Farmers perception of Herbicide	Agree		Disagree	
	Freq	Per	Freq	Per
a. Herbicides improve the Quality of farm produce	40	100	0	0
b. Herbicides constitute Hazard to man and his Environment	10	25	30	75
c. Herbicides use is against my culture	0	0	40	10
d. Herbicide does not alter the natural characteristics of farm produce.	40	100	0	0
e. Herbicides increase the profitability of farm business	40	100	0	0

Table 10. Regression Estimates of the Determinants of Herbicides used by Maize Farmers in the Study Area, 2006

Variables	Linear	Quadratic	Exponential	Semi log	Double log
Constant	-2.720	141.298	6.273	-3981.335	4.66
(-0.021)	(0.429)	(59.338)***	(-1.407)	(3.084)**	
Land (Ha)	621.677	-220.447	0.557	580.304	0.396
X1	(-0.021)**	(-0.310)	(4.149)***	(1.265)	(1.644)
Family labour	-0.806	2.458	1.244 E-03	-110.977	-2.970 E-02
(Mandays)X2	(-0.570)	(0.428)	(0.959)	(-0.708)	(-0.355)
Hired labour	2.332	6.563	-9.339 E-06	137.355	4.177 E-02
(Mandays) X3	(1.465)	(0.880)	(-0.009)	(1.516)	(0.863)
Fertilizer	1.705	3.163	1.808E-04	590.198	0.447
(kg) X4	(2.655)*	(1.210)	(0.342)	(1.440)	(2.043)*
Seed (kg)	101.122	164.011	0.111	159.627	0.118
(X5)	(1.206)	(0.405)	(1.606)	(0.293)	(0.405)
Herbicide	-45.613	65.449	-7.540E-02	84'614	2.558E -02
(Litre) X6	(-0.685)	(0.254)	(- 1.373)	(0.140)	(0.079)
Fixed Cost	7.151 E-03	-5.799E -02	-2.149E-05	242.847 – 1	426E-002
(naira) X7	(0.174)	(-0.319)	(-0.636)	(0.924)	(-0.102)
R2	0.981	0.983	0.952	0.922	0.941
Adjusted	0.977	0.973	0.942	0.983	0.919
F – ratio	235.288	103.115	91.401	32.029	43.083