

Cost and Return Analysis of Maize (*Zea Mays L*) Production in Adamawa State, Nigeria

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ABSTRACT ---- *This study evaluated cost and return of maize (*Zea mays L*) production in Adamawa State, Nigeria. Specifically, the objectives of this study were set out to: examine the socio-economic characteristics of sampled maize farmers and to evaluate the costs and returns of maize production in the study area. A simple random sampling technique was adopted and used in selecting one hundred fifty (150) maize farmers in the area of study. Data were analysed using descriptive statistics and gross margin. The study shows that majority 68.7% were full time farmers with average mean of 31 years of age and about 30.96 years of farming experience. Majority (85.3%) were male farmers and only 15.3% of the respondent had no formal education with average land holding of 1.39 hectare. The analysis of farm budgetary technique shows and reveals that maize (*Zea mays*) production in the area of study is a profitable enterprise with a gross margin of ₦72,413.05, and net farm income (NFI) of ₦46,412.25. The coefficient of gross ratio was 0.50; this implies that 50% of gross income of maize went to off-set total farm costs. The net farm income on naira invested was 0.69 and the operating ratio was 0.59. Gross ratio less than 1 is always desirable for farm business. The study recommends among other things that farmers should strengthen themselves financially by forming cooperative groups whereby members could have access to loans at a very low rate and farm inputs could be purchased in bulk to be shared among members at a reduced.*

Keywords--- Cost, Return, Maize (*Zea mays L*), Production, Adamawa, Nigeria

1. INTRODUCTION

Maize (*Zea mays L*) is one of the most important cereal crops in the world, both as food for human beings, feed for animals and other industrial raw materials with great economic significance. Maize production is an enterprise that occupies a significant position in food security and poverty alleviation. It is a cereal crop cultivated in both irrigated and non-irrigated land and it remains an important crop because it has several advantages over other cereals like rice, wheat, millet and sorghum (Macaulay and Ramindyita, 2015). Maize produces a higher output per unit of labour input and is easiest to cultivate, harvest, store, transport and process. It is one of the world's leading crops cultivated over an area of about 142 million hectares with a production of 637 million tonnes of grain, with a per capita consumption yearly of 40kg. It accounts for about (11.2%) of grain produced in Nigeria. The total land area planted to maize in Nigeria is above 2.5 million hectares, with an estimated yield of about 1.4 metric tonnes per hectare (Christopher et al., 2019).

In Northern Nigeria, maize enterprise has a very significant component of the farming system and determines the cropping pattern of the predominantly peasant farmers. Despite the economic importance of maize to the teeming populace in Nigeria, it has not been produced to meet food and industrial needs of the country. This could be attributed to low productivity from maize farms.

Maize production is an enterprise that occupies a significant position in food security and poverty alleviation. In spite of laudable programs by successive governments in the past in the maize enterprise, a significant volume of maize is still being imported annually, and the crop's productivity and profitability have continued to remain low (Ettah and Angba, 2016). This is in spite of the fact that Nigeria no doubt, has a landmass of 924,768 square kilometres and about 98 million hectares of land, with 74 million hectares of arable land (NPC, 2011). Maize production, therefore, is of strategic importance for food security and the socio-economic stability of Nigeria. The food security problem has been an issue of concern for both developed and developing countries. Food security is jointly determined by availability of food and

accessibility to the food. The food produced must be distributed efficiently at minimum costs in order to guarantee continuous availability of the food. Household food security refers to a household’s ability to acquire food. The annual demand for food keeps growing (3.3percent) and may not be matched by the growth in agricultural production.

Food insecurity is generally associated with fluctuation in household own-food production and food prices. Household food security refers to a household’s ability to acquire food. A country and people are food secured when their food system operates in such a way as to remove the fear that there will not be enough to eat.

The focus on maize farmers derives from the fact that maize is one of the important grains in Nigeria both on the basis of the number of farmers who engaged in its cultivation, and also in its economic value. Maize is a multipurpose crop because every part of its plant has economic value. The grain, leaves, stalk, tassel and cob can all be used to produce a large variety of food and non-food products (IITA, 2001). As a result of competition for maize by both man and animal, there is the need to increase the supply level of the grain. Studies in maize production in different parts of Nigeria have shown an increasing importance of the crop amidst growing utilization by food processing industries and livestock feed mills (Khawar et al., 2007; Abdulrahaman and Kolawole, 2008). It is therefore with the hope of detecting relevant factors that could serve as incentives for agricultural households to increase their present level of maize enterprise in an effort to bridge the gap between production and consumption that this study was carried out. In view of these, the study, looked at the cost and return analysis of maize production among the small scale farmers in Adamawa State, and the specific objectives are to examine the socio-economic characteristics of maize growers and to analyse the cost and return of maize production in the study area.

2. METHODOLOGY

Sampling Procedure and Data Collection

The study was carried out in Adamawa State, Nigeria. Adamawa State was selected purposively based on the basis of the state being an agrarian state. The state consists of 21 Local Government areas (LGAs) and for administrative purpose the state is divided into four agricultural areas by the Adamawa State Agricultural Development Program (AD.ADP). This include the south-western zone, the central zone, the north-western zone and the north-eastern zone. The multistage random sampling technique was used in the selection of respondents in these areas. In the first phase, a local government area was randomly selected in each of the AD.ADP zones, to provide a total of four sampled local government areas. In the second phase, random samples were taken from two villages in each of the selected local government areas to provide a total of 8 sampled villages. The sampling of the third phase involved the random selection of 150 farmers in the 8 villages as shown in Table 1.

Table 1: Distribution of sample in the 4 selected Local Government Areas in Adamawa State, Nigeria

AD.ADP Zones	Local Government Areas	Villages	No. of Sample
South West	Mayo Belwa	Sangere	10
		Yolde Gubudo	05
Central	Gombi	Muchalla	20
		Guyaku	15
North West	Lamurde	Gewana	25
		Lafiya	10
North East	Mubi North	Muva	35
		Bahuli	30
Total			150

The study used primary data collected through the administration of the questionnaire to farmers in the sampled villages with the assistance of trained personnel. The main information collected was for the agricultural seasons of 2016 and 2017. The data collected include the socio-economic characteristics of the rural farmers, such as age, gender, educational level, family size, agricultural experience, the method of land acquisition and sources of financing.

Furthermore, data were collected at farm level on agricultural production activities, subsistence strategies and production constraints.

Methods of Data Analysis

Both descriptive and inferential statistics was employed in analysis of the data.

To describe the socio-economic characteristic of the farmers in the study area. Descriptive statistics was employed to describe the socioeconomic characteristic of the respondents which include means, frequency distributions, percentages, mean and Standard Deviation.

To determine the profitability of agricultural production in the study area. Gross margin (GM) was used. Gross margin is the difference between total revenue and total variable cost. This was used to determine the profitability of maize production of the farmers in the study area. It was used under the assumption that fixed cost component is negligible as is the case with subsistence farming, and that the analysis is for a short term. The formula is specified as follows:

$$GM = \sum Q_y P_y - \sum X_i P_{x_i}$$

Where,

GM = Gross margin (rupee /Naira).

Q_y = Output of agricultural produce (kg).

P_y = Unit price of the output (kg)

$Q_y P_y$ = Total revenue from agricultural produce (rupee/ Naira per ha)

X_i = Quantity of the i^{th} input used in kg per hectare

P_{x_i} = Price per kg of the i^{th} (rupee/Naira per kg)

$X_i P_{x_i}$ = Total cost associated the i^{th} input per hectare

\sum = Summation sign

3. RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

Socioeconomic characteristics is the combination of an economic and sociological total measure of a person's economic and social position that is relative to others, based on gender, age, marital status, household size, education, experience, etc. These are discussed below as it relates to the respondents in the study area.

Gender Distribution in Adamawa

The findings of the result of the respondents by gender is presented in table 2. Which shows that 85.3% of the respondents were male while 14.7% were female respondents. This implies that male gender dominates maize production in the study area. This may be due to the fact that the responsibility of feeding and catering for the family is mainly the duty of male gender, and socio-cultural factors may be the explanation of low percentage of women participation in the maize crop farming. This is in confirmation with the report of Gwandi (2022) and Atibioke *et al* (2012) that male gender

has always dominate the agricultural activities. Studies have also pointed out that the gender of the household head is associated with the possibility of accessing better livelihoods. This is to say, it has been suggested that the household headed by female gender are poorer and are more food insecure compared to households headed by male gender. This implies that women are more vulnerable than male as a result of lack of support and lack of labor supply. The household head as an important role in the decision making concerning resource allocation that improves the welfare of the household. Gwandi (2020) posit that the core of the decision making in the rural household are made by women and consequently become the principal providers as most of the income generating activities are done by them while the men have freedom of participating in different programs.

Table 2: Respondents base on Gender distribution in Adamawa

Gender	No.	Percentage (%)
Male	128	85.3
Female	22	14.7
Total	150	100.00

Source: Field Survey, 2017

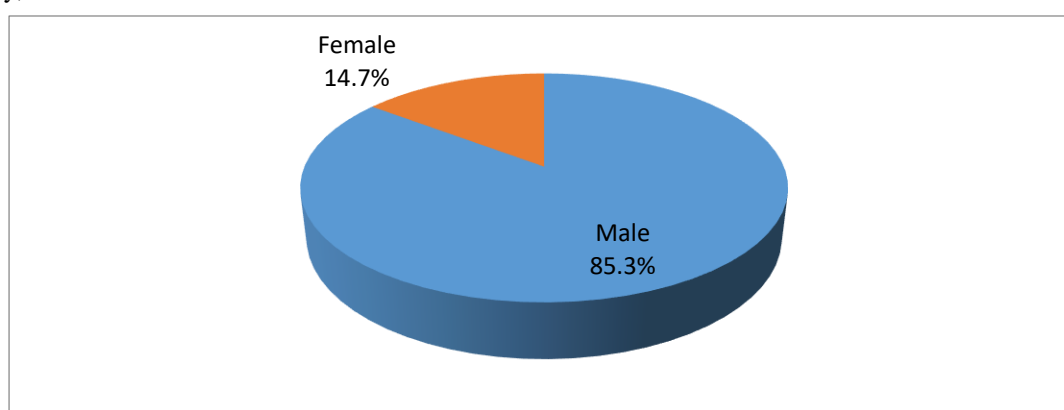


Fig. 1: Respondents base on Gender distribution in Adamawa

Age of Respondents

The result of the age of the respondents in Table 3 reveals that both young and old people are involved in maize production. The distribution shows that only 8.0% were between the ages of 15-30 and 39.3% were between 31 and 45 age group. It also shows that 39.3% were between the ages of 46-60 years. Only about 13.3% were over 60 years of age. The mean age of the respondents is 31 years and 10.67 standard deviation. This implies significant variation in age of the respondents and it shows that they are relatively young and physically active. Gwandi (2012) reported that gender plays a vital role in influencing farmer's adaptive capacity to better farming strategies and also is an important factor in agriculture because of its crucial part in the determination of farming activities.

Table 3: Age distribution of respondents in Varanasi and Adamawa

Age (Interval) Years	No.	Percentage (%)
15-30	12	8.0
31-45	59	39.3
46-60	49	39.3
>60	20	13.3
Total	150	100
Average	30.96	
Standard Deviation	10.66539	

Source: Field Survey 2017

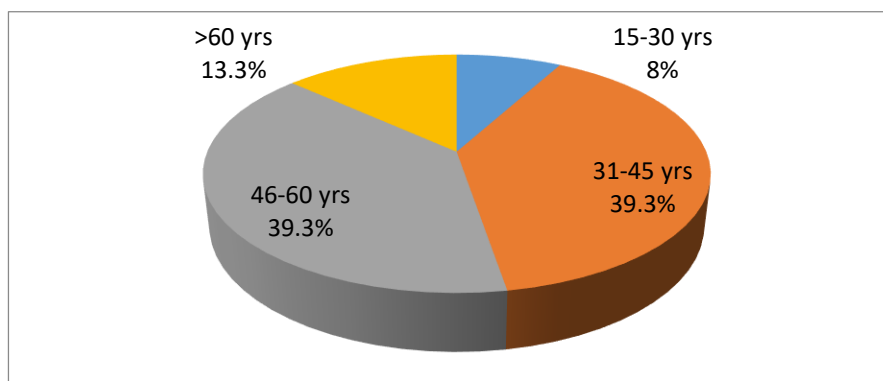


Fig. 2: Age distribution of respondents in Varanasi and Adamawa

Respondents Marital Status

The findings in Table 4 reveals that in Adamawa the married constituted 76.7% Of the respondents while 12% and 8% were single and widow respectively. The involvement of married household farmers in agricultural production can be explained in terms of labor supply for agriculture. The family labour offered would be more when family heads are married.

Table 4: Respondents Distribution by Marital Status in Adamawa

Marital status	No.	Percentage (%)
Married	115	76.7
Single	18	12.0
Widow	12	8.0
Divorce	5	3.3
Total	150	100.00

Source: Field Survey, 2017

Household Size

The findings of the result in Table.5 reveals that about 52% have household size of 1 to 5 people. And 41.3% of the respondents have household size between 6 to 10 people. The remaining 6.7% have household size above 10 people. The mean household size 5.68 which is relatively large, while the standard deviation is 3.06, justifying the fact that majority of the respondents are married. The number of people in families is very important for determining the availability of labour for agricultural work. It also affects household income and household food requirements. Gwandi (2012) reported that greater family size increases efficiency because most farmers are financially constrained and thus, the availability of family labour will ease hiring of labour. It was found by Chedchuchain and Otsuka (2006) that the size of household capture the quantity of human capital. This implies in a practical way that the availability of labor will serve as a basis for a household to decide whether to participate or not to participate in several income generating activities. Machinery are not readily available for rural farmers. Human labor therefor serve as the only substitute and most income generating activities in the rural areas are heavily dependent on family labor because of their inability to buy modern machinery or even higher it.

Table 5: Size of Household in Adamawa

Household size	No.	Percentage (%)
1-5	78	52.0
6-10	62	41.3
>10	10	6.7
Total	150	100
Mean	5.68	
Standard Deviation	3.05941	

Source: Field Survey, 2017

Education of Respondents

This is an important factor that determines the ability of an individual to understand and adopt policies/programmes that affect him/her. The educational distribution of the respondents is presented in Table 6. The finding reveals that 15.3% of the respondents had no formal education, 16% attained primary education, 26% attained secondary education while 42.7% attained tertiary education. Thus, 84.7% of the respondents had some form of formal education. The mean years of formal education is 8.42 years while the standard deviation is 5.18, which indicates that majority of the respondents had attained at least a secondary education. This study reveals that the level of literacy is high among respondents and this could have consequences for agricultural production in the areas. Formal education is a serious element in influencing farmers' ability to adopt new agricultural innovations effectively, as reported by Gwandi (2018). One of the factors that enable farmers to acquire necessary information and process it for effective use is educational attainment. The possibility of educational level to influence the livelihood strategies of household farmers and to determine the income they derive from various activities undertaken by them is high. These collaborate with the suggestion of Yunez and Taylor (2001) that educational attainment by farmers is necessary for raising their economic productivity and efficiency in agricultural production which in turn will go a long way in combating poverty,

Table 6: Respondents Educational Attainment

Educational level	No.	Percentage (%)
No formal education	23	15.3
Primary education (6 yrs)	24	16.0
Secondary education (12yrs)	39	26.0
Tertiary education (15yrs)	64	42.7
Total	150	100
Mean		10.52
Standard Deviation		5.42641

Source: Field Survey, 2017

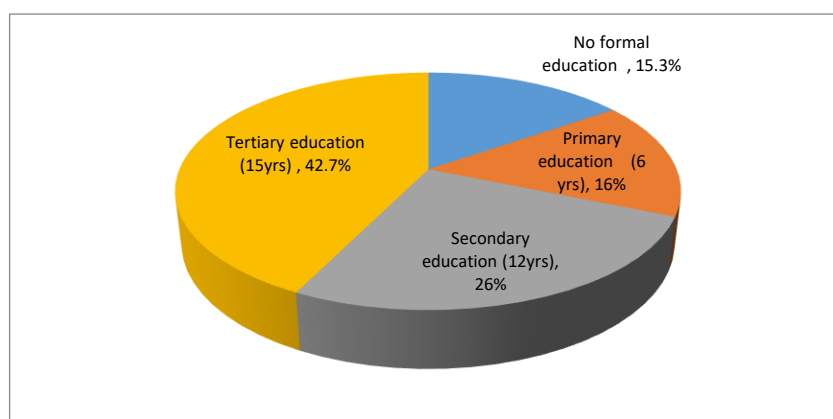


Fig. 3: Respondents Educational Attainment

Respondents Primary Occupation

The main occupation of the respondents in the Study area is presented in Table 7. The result from the table shows that 68.7 of the respondents indicated farming as their primary occupation. The remaining 31.3% were in to other occupation other than farming. This shows farming activities is the most common occupation in the study area. This implies that the respondents the study area depend on agriculture for their livelihood.

Table 7: Respondents Main Occupation

Types of occupation	No.	Percentage (%)
Farming	103	68.7
Other Occupation	47	31.3
Total	150	100.0

Source: Field Survey, 2017

Respondents Experience of Farming

Presented in Table 8 is the farming experience of the respondents in the study area. From the result it can be seen that 4.7% of the respondents had between 1 to 10 years of experience in food crop production, while 18.7% had between 11-20 years of farming experience. About 76.7% of the respondents had farming experience of more than 21 years and above. The mean years of farming experience is 30.96 years while the standard deviation is 10.67.

Table 8: Respondents Farming Experience

Farming experience (years)	No.	Percentage (%)
1-10	7	4.7
11-20	28	18.7
21-30	60	40.0
>30	55	36.67
Total	150	100.0
Mean	30.96	
Standard Deviation	10.66539	

Source: Field Survey, 2017

Respondents Size of Farm

Table 9 reveals that 27.3% of the respondents cultivated less than 1 hectares of farm land, while about 59.3% cultivated 1.01-2 hectares. However, only about 13.3% of the respondents cultivated above 2 hectares respectively. The

mean farm size of the respondents is 1.39 hectares. Farm size or land holding is possibly the most important single resource as it is a base for any economic activities especially in rural and agricultural sector. Farm size influence household's decision to partake or not to participate in different livelihood expansion activities.

Table 9: Respondents Farm Size

Farm size (ha)	No.	Percentage (%)
≤ 1.0	41	27.3
1.01-2.0	89	59.3
≥ 2	20	13.3
Total	150	100
Mean	1.39	
Standard Deviation	0.46149	

Source: Field Survey, 2017

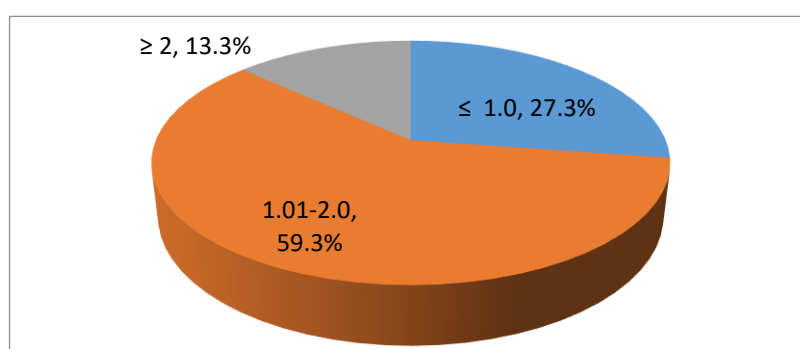


Fig. 4: Respondents Farm Size

Extension Services

The distribution of the respondents based on extension services is presented in Table 10. Extension service is one of the main tools through which innovations are transferred to practicing farmers and generally has a significant effect on farmers' level of economic efficiency. The result from the Table reveals that majority (93.3) per cent of the farmers in Adamawa indicated no extension service while 6.7% indicated the availability of extension service. According to Gwandi (2022), low level of extension service affects the awareness and use of adaptation strategies against efficient agricultural production. It is believed that the use of agricultural technologies normally provided by the expertise of extension workers is a necessary strategy to make small farmers economically viable. This implies that the efficiency level of food crop farmers in the study area could be static because of lack of extension service. It can be concluded that there is great potential for the service that should be extended for the efficient deployment of new technologies.

Table 10: Distribution of the respondents by Extension Visits

Extension visit	No	Percentage (%)
Yes	10	6.7
No	140	93.3
Total	150	100

Source: Field Survey 2017

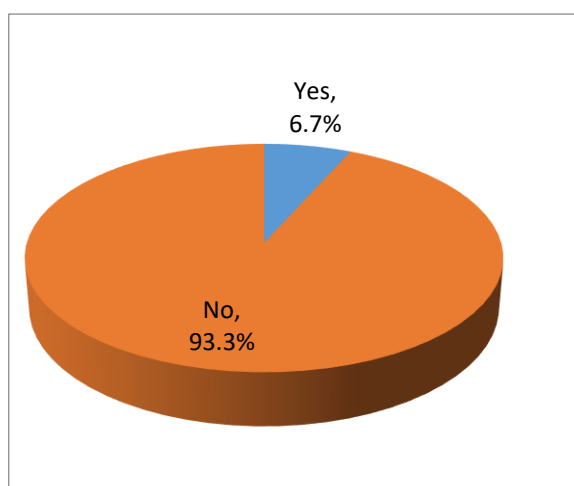


Fig. 5: Distribution of the respondents by Extension Visits

Method of Land Acquisition

One of the most important socio economic characteristics of farmers that affect their productivity is land holding. Land is an important factor of production which helps in the production of goods and services. The mode of land acquisition could determine to a large extent the scale of farm operations undertaken by farmers. The distribution for Adamawa shows that 64.0% of the farm lands were inherited, while 23.3% were rented or leased, land given as gift and purchased accounted for about 6.6% and 6% respectively. Adamawa State Nigeria, rental payments for the use of farmlands by farmers are usually done in the form of cash or by farm produce after harvesting, and this depend on the farm size. Fragmentation is very common in the study area due partly to increase demands of farmlands by farmers and partly to land tenure system.

Table 11: Distribution of Respondents by Mode of Land Acquisition

Land acquisition	Adamawa	
	No	Percentage (%)
Purchase	9	6.0
Rented/Leased	35	23.3
Gift	10	6.6
Inherited	96	64.0
Total	150	100

Source: Field Survey 2017

Source of fertilizer by the Respondents

The distribution of respondents by mode of source of fertilizer is presented in table 12. The distribution shows that in majority (53.7%) indicate that their source fertilizer is from government/market while 44.7% obtain fertilizer from market source. The remaining 7.3% and &% from government agencies and cooperative respectively.

Table 12: The Distribution of the respondent by Fertilizer Source

Fertilizer Source	No	Percentage (%)
Government agencies	11	7.3
Cooperative	1	7
Market	67	44.7
Government/market	71	53.7
Total	150	100

Source: Field Survey 2017

Labour used in Farm Operations by Respondents

The primary factor of production that involves the physical and mental effort accomplished to perform a task for a monetary reward is labour. It is necessary for important agricultural operations ranging from land preparation to harvesting. The distribution of labour used in farm operations in the study area is presented in Table 13. The result shows that in Adamawa about 6.0% of the respondents used only family labour, while about 9.3% used only hired labour. The combination of both family and hired labour formed the majority (82%) of the labour used in farm operations by the respondents. The predominance of family labour in farm operations in the study area is attributed to high cost of hired labour, and this, among other factors, has limited the production of small farmers, as agricultural production requires a lot of labour. Furthermore, mechanization and other farm operations needed to raise farmers' scale of production cannot be practiced.

Table 13: Distribution of Respondents by type of Labour used in Farm Operations

Labor Type	No	Percentage (%)
Family labor	13	6.0
Hired labor	14	9.3
Both family and Hired labor combined	123	82.0
Total	150	100

Source: Field Survey 2017

Sources of Finance by Respondents

Finance has been recognized as the livewire that stimulates the extent and tempo of agricultural production. The distribution of the respondents by sources of finance for agricultural production is presented in Table 14. Table 14 also shows the result of the distribution of the respondent's sources of finance for food crop for Adamawa farmers. The result shows that most of the respondents (about 84.7%) utilized only personal savings to finance their agricultural production, while 2% received support from individual and relatives. The table also shows that only about 2% and 0.7% of the respondents used loans obtained from banks and contribution respectively. It also shows that 10.7 per cent of the respondents in the study area indicated other sources which could be finance from wages and salaries as source of finance for agricultural operations. The over-dependence on personal savings by the respondents to finance agricultural production might be responsible for their involvement in small-scale production (as revealed in Table 13), and is a characteristic feature of peasant agriculture. Farmers who have access to finance tend to be more productive due to enhanced ability to practice mechanization, finance the purchase of inputs, especially fertilizer and agrochemicals, and hire labour. This agrees with comparable findings by Amaza *et al.* (2006) who reported positive relationship between credit accessibility and productivity of farmers. According to Davis (2003) inadequate access to finance can serve as a hindrance to investment

and entrepreneurship. Access to affordable agricultural credit for poor farmers who have small or nothing at all as capital or savings to invest in other income generating activities is a significant part in starting a little business to improve living standard.

Table 14: Distribution of Respondents by Sources of Finance for Food Crop Production

Source of finance	No	Percentage (%)
Personal savings only	127	84.7
Individual and friends	3	2.0
Loan from bank	3	2.0
Loan from Adashe (contribution)	1	0.7
Others	16	10.7
Total	150	100

Source: Field Survey 2017

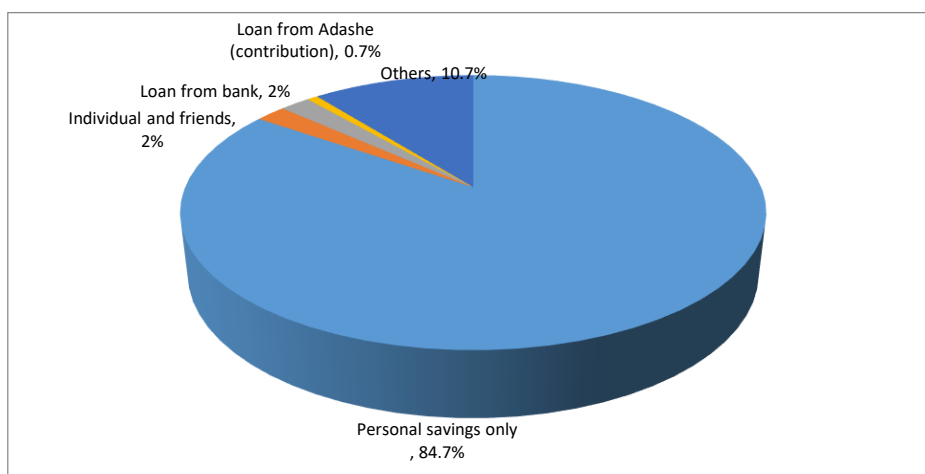


Fig. 6: Distribution of Respondents by Sources of Finance for Food Crop Production

Gross Margin (Gm) Analysis

The profitability of food crop production in the study area was computed using the gross margin. The results is presented in Table 15. The table shows the gross margin/ha of Maize crop enterprises. Operational cost and fixed cost incurred in the production of maize farm for Adamawa State is presented in table 14. It is revealed that, the average total cost of production per hectare was found to be `85,991.10 out of which `72,996.95 was total variable costs accounting for 8.72% of the total cost for maize production in Adamawa State. This was majorly (50.51%) attributed to the high cost of labor using the converted cost of labour at prevailing market price rate in the study area. This finding is in agreement with Gwandi (2012), who reported that labour cost is a major component of the total cost of production. The second highest operational cost was agrochemicals (25%). Fertilizer cost was the third in the study with 16.80%. The fixed costs were 12,994.15 which accounted for 15.11 % of the total cost of maize production. The average output of the respondents was 950kg per hectare.

The total revenue (TR), gross margin (Gm) and Net farm income (NFI) per hectare were `145,410, `59,406.4, and `59,418.9 respectively. The gross margin on naira invested (R.O.I) was 0.99. This shows that maize production is profitable in the study area since return to naira invested is positive.

The farm gross ratio (GR) was 0.50 while the operating ratio 0.59. According to Olukosi and Erahbor (1988) that gross ratio less than 1 is always desirable for farm business.

Table 15: Average costs and returns per Hectare associated with maize in Uttar Pradesh and Adamawa

Variable Inputs	Adamawa Average variable cost (₦)	% Share in average total variable cost
A. Variable cost		
Seeds	2,831.80	3.879
Labour	36,873.35	50.51
Fertilizer	12,261.75	16.797
Herbicide	18,250.40	25.00
Transportation	1,148.05	1.57
Empty sacks	631.60	0.865
Storage	1000	1.369
TVC	72,996.95	100
B. Fixed Cost		
Depreciation	4,358.10	
Rent on land	8,636.05	
TFC	12,994.15	
Total cost of production(A+B)	85,991.10	
C. Returns		
Average output	950	
Average price (₦/kg)	153.05	
Total revenue (₦)	145,410.00	
Gross margin (TR -TVC)	72,413.05	
Net farm income (Gm -TFC)	46,412.25	
Gross margin on naira Invested (Gm/TVC)	0.99	
Net farm income on naira Invested (N F1/TCC)	0.54	
Farm gross ratio [GR(TVC/TR)	0.50	
Operating ratio (OR) (TC/TR)	0.59	

Source: Field Survey, 2017

4. SUMMARY AND CONCLUSION

Data for the study were randomly collected from 150 crop farmers. A structured questionnaire was the primary tool for collecting data, and the structured questionnaire was administered with the help of trained personnel in 2016/2017 cropping season. The aggregated data were analyzed using both descriptive statistics and farm budgeting technique

The results of the study revealed that male farmers constituted the majority (85.3%) of the respondents who were mostly married, with an average age of 30.96 years. This indicates that most of the respondents were relatively young and physically active. Majority 84% had formal education majority (68.7%) of the respondents were full-time farmers with an

average agricultural experience of 30.9 years. Most farmers did not have an extension visit and use personal savings as a source of funding.

The analysis of the gross margin used as a proxy for the analysis of profitability revealed a large variation in the gross margin per hectare of the maize enterprises. The gross margin on naira invested (R.O.I) was 0.99. This shows that maize production is profitable in the study area since return to naira invested is positive. The farm gross ratio (GR) was 0.50 while the operating ratio 0.59. According to Olukosi and Erahbor (1988) that gross ratio less than 1 is always desirable for farm business.

5. RECOMMENDATION/POLICY IMPLICATION

Based on the findings of the study, the following recommendations are proffered:

- Since most of the farmers in the study area depended on their meagre personal savings in financing maize production, this study recommends that farmers should strengthen themselves financially by forming cooperative groups whereby members could have access to loans at a very low rate and farm inputs could be purchased in bulk to be shared among members at a reduced.
- The need for support for the extension training of farmers for better subsistence strategies cannot be underestimated. Therefore, it is recommended that extension services be modernized and strengthened through appropriate governmental and non-governmental funding. This will help and encourage extension workers to educate farmers about the allocation of critical resources and managerial skills that will enable farmers to plan and evaluate commercial activities on farms for better standard of living.

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