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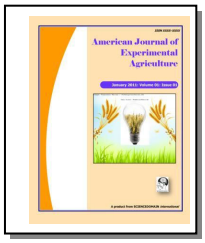

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Economic Advantage of Hybrid Maize over Open-Pollinated Maize in Giwa Local Government Area of Kaduna State

Taiwo Bintu Ayinde[1], Alamu Josiah Fola[1] and U. Ibrahim[2*]

[1]Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria, Kaduna State, Nigeria.
[2]Crop Production Programme, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

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ABSTRACT

This research intends to carry out a comparative study, on the yield of hybrid and open-pollinated maize, with the involvement of farmers in Giwa local government area of Kaduna state. Specifically, it evaluated existing hybrid and open-pollinated maize production technologies by unfolding their most important socio-economic factors, by notably identifying the beneficial distinction between hybrid and open-pollinated maize, with the farm survey data collected from 160 maize farming communities in October-December 2009 for the cropping year 2009-10. Descriptive Statistics; Gross-Margin Analysis were the analytical tools employed for achieving the aim of this study. The average yield per hectare obtained by hybrid maize farmers was 2240.6Kg and 1261.04Kg for open pollinated maize respectively. Hybrid maize and open pollinated maize farmers obtained gross margin US$ 389.29 and US$195.31 per hectare respectively. Z-test was used to test the profitability of hybrid maize versus open-pollinated maize and the result revealed that hybrid maize production was more profitable and the difference was statistically significant at 1% level of significance. As most of the communities had no formal education, the extension program should be targeted to the less educated farmers. This study recommends that credit capability principally the process for obtaining loan ought to be made easy to perk up hybrid and open-pollinated maize production in the study area.

Keywords: Economic advantage, hybrid, open-pollinated maize, Kaduna state;

**Corresponding author: Email: ibrusman2007@yahoo.com*

1. INTRODUCTION

Maize production has become very popular and the crop is widely grown in many countries of the world. Hybrid maize was introduced in the USA in the late 1920s and early 1930s. The hybrid maize, were well received by the farmers and they swiftly substituted open-pollinated maize varieties, in the main, maize growing areas of the country (Duvick, 1999). The earliest maize hybrids yielded merely about 15% greater than the better open pollinated varieties (OPVs), nevertheless they, to a large extent had better resistance to root and stalk lodging. In the 1930s, mechanise farming had began in USA, as such; farmers were starting to make use of mechanical corn pickers (Duvick, 1999). The mechanical pickers were uneconomical at assembling lodged corn, and so farmers repeatedly chose to plant hybrids because the hybrids lodged less, and therefore, were better adapted to machine harvest. Some of the founders of hybrid maize have said that the very first hybrids might not have been accepted so rapidly, if their superior yield had not also been accompanied by better resistance to lodging (Duvick, 1999). Greater drought tolerance of hybrids compared to OPVs also helped sell the next generation of hybrids; they were introduced just at the times of two exceptionally severe drought seasons (1934 and 1936) in the USA Corn Belt (Duvick, 1999).

In recent times, hybrid maize production has been given widespread support among farmers in Nigeria. Although, hybrid maize is renowned for its high demand for plant nutrients as well as additional production inputs (Ayinde et al., 2011). Even though, it is grown extensively in many countries of the world; the farmers, has been taught with the belief that all details, crucial for maximum production of hybrid maize, must be fulfilled, before the realization of the best possible income. As a result, the extra cost of production discourages, a good number farmers engaging in hybrid maize production in the country (Ayinde et al., 2011). They further added that the yield of hybrid maize, differ from species to species, place to place and besides, it relies on the availability of crucial factors such as soil nutrient status and application of fertilizer. But nearly all farmers in developing countries, like Nigeria usually depend on, the natural soil fertility for crop production. However, opening of a long fallow land, may grant sufficient nutrient to hybrid maize, but cropping of such land is only flourishing within few years of opening the fallowed land. Then, the following cropping season, needs supplementary fertilizer inputs (Kogbe and Adediran 2003).

In Nigeria, many researchers have found improved production technology to be a major factor in effort to become self-sufficient in maize production (Iken and Amusa, 2004). Furthermore (Duvick, 1999) made several demonstrations on the beneficial qualities of hybrid maize, due to its inbuilt safety measures of hybrids, despite the fact that farmers require to buy seeds for each planting season. Nevertheless, to purchase these seeds annually, can only be booming, if the qualities of the hybrid maize go with most of the vital traits, required by the farmers. And simply being hybrids or exhibiting heterosis is not sufficient. Additionally, the price of the hybrid maize, should be low enough to enable farmers make significant income, from yearly recurring investments in pricey hybrid maize seed, as compared to the open-pollinated maize that can be reused i.e. farmers will hazard venturing into improved hybrid maize production technology, only when assured of a rational price, as well as a reliable market for their crop. Further more government policy, formal and informal, should also give minimum interference to sincere and sensible farmers. As a rule of thumb, the first time use of hybrid maize, must enable the farmer receive an additional income, equal to at least thrice the extra cost of buying the hybrid maize seed. Several types of hybrids are used commercially, in maize production. The yield advantage, of these several type of hybrids over the open-pollinated varieties as sighted in (Correjado and Magulama, 2008) in the work of (Paliwal, 2000) indicating 46% for single cross, 30% for three way cross, 37% for double top cross, 28% for top cross, and 17% for variety cross. This also collaborated with the work of (Jaspe and Magulama, 2007). They recognized hybrid maize (USM var 18) as tolerant to low

nitrogen fertilizer. Recently, it was further supported by (Librando and Magulama, 2007). (Kogbe and Adediran, 2003) produced similar results stating, that the hybrid maize (8516-12, 8321-18 and 8329-5) gave higher yield, and used production inputs (nitrogen and phosphorus fertilizer) more efficiently, than open-pollinated maize (TZSR-W).

Perhaps hybrid maize is being over rated and over published. After all, farming tradition did not ground to a halt all through this period, there has been an improved rate in the application of fertilizer, better plant density, and production inputs like herbicides, insecticides, etc in entirety added to larger yield. Additionally, enhanced technology made it achievable, to time the field operation better. Consequently, enhancing good organization of the operations, and reducing waste. Can we separate these effects, from the use of better genetic strains (i.e., the use of hybrid maize).

These questions necessitated the objective of this study, which is to carry out a relative study, on the economic variation between hybrid and open-pollinated maize, among farmers in Giwa local government area of Kaduna state. Specifically, it will assess recent hybrid and open-pollinated maize production technologies by describing their major socio-economic factors, and most significantly identifying the financial variation between hybrid and open-pollinated maize.

The broad objective of the study is to conduct, a comparative economic difference between the productivity of hybrid and open-pollinated maize varieties.

The specific objectives are to:

1. identify the socio-economic characteristics of hybrid and open-pollinated maize farmers in the study area.
2. determine and compare the input-output level of hybrid and open-pollinated maize production in the study area.
3. estimate and compare the cost and returns of hybrid and open-pollinated maize of farmers in the study area.

2. METHODOLOGY

A cross-sectional sample survey design was used in this study. The targeted populations were farmers involved in hybrid and open-pollinated maize production in Giwa LGA of Kaduna State. On the basis of the list of maize farmers acquired from the Agricultural Development Programme, a multi-stage sampling method was useful to select 80 farmers each of hybrid and open-pollinated maize farmers making a total number of 160 farmers, involved in maize production. At the initial stage, eight wards were purposively selected based on the intensity of maize production in the study area. The analysed wards were Shika, Giwa, Kaya/idosu, Galadima, Yakawada, Fatika, Kidandan, Gangara. Subsequently, a community was also randomly selected from each of the wards. Lastly, 20 hybrid and open-pollinated maize farmers each were randomly selected and questioned from each community to make up a sample size of 160.

2.1 ANALYTICAL TECHNIQUES

The analytical tools that were used for achieving the objectives of this study includes:

(1) The Descriptive and inferential Statistics i.e the use of measures of central tendency such as the mean, median; measure of dispersion such as standard deviation and percentages were used to achieve objectives 1 and 2.

(2) Gross Margin Analysis was used to achieve objective 3.

By definition, Gross Margin is the difference between the Total revenue and the Total Variable Cost. i.e.,

GM = TR – TVC

Where:
GM = Gross Margin from hybrid and open-pollinated maize product (N/ha)
TR = Total Revenue from hybrid and open-pollinated maize production (unit price in US$/ha) i.e., Yield per hectare multiplied by the unit price.

The prevailing market price during the period of study was used to calculate the cost and returns of hybrid and open-pollinated maize production. Presently a hundred and fifty-two naria makes a dollar at the world market ($1=N 152). TVC= Total Variable Cost (US$/ha) these includes cost of hybrid and open-pollinated maize seeds, fertilizer, insecticides and labour.

(3) Specification of hypotheses testing

The Z-test was conducted to confirm hypothesis i.e., there is no difference in the profitability (gross margin) between hybrid and open-pollinated maize production in the study area.
The formula for the Z-test is given as:

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^{\,2}}{n_1} + \frac{S_2^{\,2}}{n_2}}}$$

Where

Z = The calculated Z value

$\bar{X}_1$ and $\overline{X}_2$ = gross-margin of hybrid and open-pollinated maize farmers respectively.

$S_1^{\,2}$ and $S_2^{\,2}$ = Estimated variance

n_1 and n_2 = are the samples sizes of the hybrid and open-pollinated maize farmers respectively.

3. RESULTS AND DISCUSSION

3.1 SOCIO-ECONOMIC CHARACTERISTICS OF HYBRID AND OPEN POLLINATED MAIZE FARMERS

The first objective of this study is to identify and compare the socio-economic characteristics of hybrid and open-pollinated maize farmers.

Table 1 shows that the farming experience of the respondents in maize production. About 71% of farmers have practiced hybrid maize production for less than 10 years, while about 1% of open pollinated maize farmers have less than 10 years experience. No farmer, has practiced hybrid maize production for between 26-30 years, however 20% of open pollinated maize have an experience of between 26-30 years.
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Table 1. Farming experience of Hybrid and Open-pollinated maize farmers

Farming Expeience	Hybrid		Open pollinated	
	Frequency	Percentage	Frequency	Percentage
≤ 10	57	71.25	1	1.25
11-15	18	22.5	6	7.5
16-20	3	3.75	7	8.75
21-25	2	2.5	8	10
26-30	0	0	16	20
31-35	0	0	15	18.75
≥ 36	0	0	27	33.75
Total	**80**	**100**	**80**	**100**

Source: Field survey data, 2009.

In table 2 the educational levels of both open-pollinated and hybrid maize farmers in the study area shows that about 11% and over 34% of hybrid and open-pollinated maize farmers have quranic and primary education respectively. More than 75% and about 45% of hybrid and open pollinated maize farmers have more than secondary school education respectively**.**

Table 2. Educational qualification of hybrid and open-pollinated maize farmers

Educational qualification	Hybrid		Open pollinated	
	Frequency	Percentage	Frequency	Percentage
No formal education	4	5	1	1
Quranic education	7	9	27	34
Primary school education	9	11	16	20
Secondary school education	17	21	12	15
Adult education	18	23	15	19
Tertiary education	25	31	9	11
Total	**80**	**100**	**80**	**100**

Source: Field survey data, 2009.

Table 3 revealed that the majority of the respondents (90% and over 86%) of hybrid and open-pollinated maize farmers have farm sizes that range between 0.1 and 5.9 hectare respectively. While there are no hybrid maize farmers having greater than 10 hectares, 1% of open-pollinated maize farmers have greater than 10 hectare. This finding shows that hybrid and open pollinated maize production in the study area is practice mainly by small-scale farmers on lands below 10 hectare.

Table 3. Distribution of farmers based on farm size

Farm size (ha)	Hybrid		Open pollinated	
	Frequency	Percentage	Frequency	Percentage
0.1- 5.9	72	90	69	86.25
06-9.9	8	10	10	12.5
≥ 10	0	0	1	1.25
Total	**80**	**100**	**80**	**100**

Source: Field survey data, 2009.

Table 4 reveals that the highest percentage (over 62%) of hybrid maize farmers grew sole maize; interestingly no open-pollinated maize farmer grew sole maize. Some 16% of hybrid maize farmers grew maize/sorghum combination; but a higher percentage of open-pollinated maize farmers (24%) grew maize/sorghum combination; About 8% of hybrid maize farmers grew maize/soyabean combination, which was much lower than the open-pollinated maize/soyabean combination of about 21%. The highest percentage of open-pollinated farmers (55%) grew maize/cowpea combination as against a mere 14% for hybrid maize farmers. Mixed cropping was the dominate cropping system for open-pollinated maize (100%) as against a meagre 38% for hybrid maize. Possible reasons for growing maize in mixtures especially by open-pollinated maize farmers were; majorly for risk diversification involved with crop failure as a result of biotic and a-biotic constraints such as flooding due to global warming; drought caused by the unpredictable pattern of rainfall, these seriously affects taselling (due to the shallow root system of maize); pest and diseases like striga, stalk and ear rots, leaf spot, and maize streak virus was also a factor. There was also diversification due to cost of production in order to obtain optimum profit. Some farmer also felt it was a tradition inherited from their pre-cessors as such they continued with it.

Table 4. Distribution of farmers based on cropping system

Farm size (ha)	Hybrid		Open pollinated	
	Frequency	Percentage	Frequency	Percentage
Sole	50	62.5	0	0
Maize/Sorghum	13	16.25	19	23.75
Maize/Soyabeans	6	7.5	17	21.25
Maize/Cowpea	11	13.75	44	55
Total	**80**	**100**	**80**	**100**

Source: Field survey data, 2009.

3.2 INPUT-OUTPUT RELATIONSHIP IN HYBRID AND OPEN-POLLINATED MAIZE PRODUCTION

The second objective of this study is to determine and compare the input-output level of hybrid and open-pollinated maize production in Giwa local government area. Table 5 shows that the average yield per hectare obtained by hybrid maize farmers was 2240.6kg. This is obtained by using 16.12 kg of seed, 6.04bags (i.e. 302kg) of fertilizer and 65.12 man-hours. On the other hand, the open pollinated maize farmers realized an average yield per hectare of 1261.04kg, through the use of 38.31kg of seed, 2.23bags (i.e., 111.5kg) of fertilizer and 55.9 man-hours. The

average quantity of insecticide and herbicide used in both hybrid and open pollinated maize production were 1.07lit and 0.79lit, 1.41lit and 1.36lit respectively.

Table 5: Summary of inputs and output for hybrid and open pollinated maize production

Variables	Hybrid Maize			Open pollinated Maize		
	Maximum	Minimum	Mean	Maximum	Minimum	Mean
Seed (kg)	22	14	16.12	85	26	68.32
Fertilizer (50 kg bags)	17	2	6.04	4	1	2.23
Insecticide (litres)	14	0	1.07	5	0	0.79
Herbicide (litres)	29	0	1.41	11	0	1.36
Labour (man-day)	142	48	65.12	95	47	55.9
Yield (kg)	7600	1800	2240.6	3300	800	1261.04

Source: Field survey, 2010.

3.3 COST AND RETURN ANALYSIS

The third objective of this study is estimate and compares the cost and returns of hybrid and open-pollinated farmers in Giwa local government area.

Table 3 revealed that the total cost of production used in hybrid and open pollinated maize was $421.46/ha and $260.97/ha, respectively. The gross-margin during the same period was $389.29 and $195.335 per hectare respectively. The result further revealed that the mean difference in gross margin in hybrid and open pollinated maize is 389.29 and 195.335 per hectare, respectively at 1% level of probability, showing that hybrid maize production is more profitable than open-pollinated maize production.

Table 6. Average gross margin per hectare for hybrid and open-pollinated maize production

Variables	Hybrid Maize			Open pollinated Maize		
	Mean quantity/ha	Unit price ($)	Value($)	Mean quantity/ha	Unit price ($)	Value($)
1. Inputs						
Seed (kg)	16.12	1.32	21.21	68.32	0.36	24.72
Fertilizer (50 kg bags)	302	32.89	198.81	111.58	32.89	73.40
Labour (Man-hour)	65.12	2.63	171.37	55.95	2.63	147.15
Insecticide (litres)	1.07	6.25	6.68	0.79	6.25	4.94
Herbicide (litres)	1.41	7.23	10.20	1.36	7.23	9.83
Other	-	-	13.16	-	-	13.16
2. Total variable cost	-	-	421.44	-	-	273.28
3. Mean yield (kg)	2240.6	0.36	-	1261.04	0.36	-
4. Gross returns	-	-	806.62	-	-	456.30
5. Gross margin (1-3)	-	-	385.18	-	-	183.02
6. GM/N (ARR)	-	-	0.92	-	-	0.67

3.4 THE GROSS MARGIN STATISTICAL TEST FOR SIGNIFICANCE

Table 7 revealed that the calculated Z-statistic was 5.16 whereas the tabulated Z-statistic for a two tailed test at 0.0 for the mean difference of hybrid maize and of open-pollinated maize at 1 level of significance was -1.96 to 1.96. The calculated Z-value of 5.16 lies outside the range of -1.96 to 1.96, hence we reject the null hypothesis that says the gross margin of hybrid maize is less than the gross margin of open-pollinated maize and accept the alternative hypothesis that hybrid maize is more profitable than open-pollinated maize. The null hypothesis was rejected and the alternative hypothesis accepted, we conclude that there was statistical significant difference in the profitability of farmers using hybrid maize seed and those using open-pollinated maize seed at 1% level of significance.

Table 7. Means and standard deviation of gross-margin of the two groups of farmers

Farmers group	N	Mean	SD	Z-value	Z-table	LOS
Hybrid maize	80	59171.62	18527.01	5.16	1.96	0.01*
Open-pollinated maize	80	27819.06	9405.92			

Source: Field survey, 2010; SD: Standard Deviation; LOS: Level of significance

4. CONCLUSION AND RECOMMENDATIONS

This study has shown that both hybrid and open-pollinated maize production are all practically beneficial, but the use of hybrid maize was found to be more cost-effective than the open-pollinated maize by farmers in the study area, although its productivity is still small. Likely rationale behind the drop are climate change, lack of funds and access to credit, Improper education as well as the inability of proper visit by extension agents. Z-test was used to test the profitability of hybrid maize versus open-pollinated maize and the result revealed that hybrid maize production was more profitable and the difference was statistically significant at 1% level of significance. Based on the results of this study, the following recommendations were made:

1. The farmers should organize co-operative society amongst themselves in other to obtain loans from such co-operatives and such co-operatives can serve as collaterals in obtaining loans from banks for production inputs like fertilizer, labour, insecticides and herbicides are accessible amongst the farmers at the start of the planting period at affordable rates.

2. The national research institute and organization such as UAC, Alheri seeds and Premier seeds which are interested in improvement and production of hybrid maize should be encouraged to generate drought resistant and new stable, superior yielding hybrid varieties that can survive under minimum inputs like fertilizer, herbicides, insecticides etc at affordable prices;

3. In view of the fact that the production of hybrid and open pollinated maize is labour and capital intensive, mechanised farming with the use of tractors for ploughing, harvesting and threshing should be enhanced to encourage farmers, through adequate training by extension agents and cooperatives.

4. Government plan should grant precedence to storage in order to build up and boost the maize reserve levels of farmers, thereby creating food sufficiency and security in maize production.

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