

ON-FARM ASSESSMENT OF THE AGRONOMIC AND ECONOMIC POTENTIALS OF SELECTED MAIZE HYBRID IN SOUTHWESTERN NIGERIA

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ABSTRACT

This study was carried out in all the agroecological zones (AEZs) in southwestern, Nigeria using a farmer's participatory approach to compare the cost of growing hybrid maize varieties with that of the open-pollinated varieties. Four farmers growing maize were selected from each zone to make a community group. Farmers selected were used as replicates per location. Two maize hybrid and two open-pollinated varieties (OPVs) were supplied to farmers. Experimental sites were ploughed twice and planting was done on a plot with dimensions 5 by 10. Soil samples were taken across the farmer's field and routine analysis was carried out on the collected samples. Results revealed that hybrid, SC 719 had the highest yield of 6670.73 kg/ha, followed by Ife-hyb-3 hybrid (5431.94 kg/ha) and the OPV (DMRLSRY) has the lowest varietal mean of 3716.01 kg/ha in the study area. The economic analysis result showed that the OPVs (DMRLSRY and BR9928-DMR-SR-Y) gave a lower net benefit of N370,881.8 and N502,728, respectively compared with N663,580 and N886,732 from Ife-hyb-3 and SC 719, respectively. This implies that across all agroecologies in Southwest Nigeria, hybrid SC 719 would give the highest economic benefit to farmers followed by Ife-hyb-3 thereby improving farmers' livelihood. From the results, there was an establishment of a greater economic potential of hybrid maize over maize OPVs under the same recommended agronomic practices in southwestern Nigeria. Hence, hybrid maize cultivation is highly profitable in southwestern Nigeria.

Keywords: *Economic potential; farmers; hybrid; maize; open-pollinated variety*

INTRODUCTION

Maize is an important food crop because of the roles it performs in the Nigerian economy. It is the most commonly cultivated among arable crops in Nigeria (Adesoji *et al.*, 2016). Aside from being important in the human diet, it is also an essential component of compounded animal feed as it serves as the main energy source and has low fibre content giving rise to feed with the highest conversion of dry substances to meat, milk and eggs (Olaniyan, 2015). The International

Institute of Tropical Agriculture (IITA) estimates that approximately 60 per cent of maize produced in the country is used for industrial purposes for both human (flour, beer, malt drinks, cornflakes, starch, dextrose, syrup) and animal consumption, mainly poultry (UNIDO 2010). Maize is one of the important grains in Nigeria, as it creates job opportunities for actors along the value chain and contributes to the country's economic development, evidenced by an increase in production of more than 50%

between the years 2010-2020 (FAOSTAT, 2022).

Regardless of this importance, maize yield in Nigeria is low. The average maize yield in Nigeria is 1.6 tonnes/hectare compared with the average yield of 9.3 tonnes/hectare recorded in the United States (Olaniyan, 2015). This low yield could be the reason Nigeria is still a net importer of maize. According to UNCOMTRADE (2020), Nigeria imported 205.38 thousand tonnes and 365.30 thousand tonnes of maize in 2016 and 2017, respectively from the rest of the world. Developing technologies that address the problem of maize low yield is key if Nigeria is to reverse this import trend which is likely to soar more due to the booming population that is projected to double by the year 2050.

Geared towards correcting low yield in maize production, the governments in collaboration with various research institutes as well as private seed companies have developed technologies capable of improving maize yield. One of the technologies developed is certified open-pollinated varieties, which when cultivated by farmers have the potential of improving productivity. More interestingly, hybrid maize technologies were developed with far more productivity potential that even surpasses that of certified OPVs. All of these technologies have been registered and released to the public (NACGRAB, 2017).

However, the yield of maize in Nigeria is still low compared with the potential yield that could be obtainable in Nigeria. This could be due to low awareness which in turn leads to low adoption of maize hybrid. The presence

of a communication gap between the various research institutions, seed companies and potential adopters of hybrid maize technology makes information about the technology scares and farmers are unable to take advantage of the potential benefits associated with its adoption. For example, the study of Phillip (2001) showed that varietal adoption rates among farmers in Nigeria were 7.9 % for local, 82.6% for OPVs and 9.5% for hybrids during the period 1996–1997.

Another probable reason farmers gave for low adoption of hybrid maize is that it requires higher levels of nitrogen fertilizer for profitable grain yield production (Olaniyan, 2015). However, most studies carried out in Nigeria revealed that hybrid maize cultivation would not always demand very high fertilizer amounts and have a better yield advantage than the open-pollinated varieties of maize (Olaniyan,2005)

Several studies have shown evidence that hybrid seeds can significantly improve agricultural production (Harou *et al.*, 2017) and their adoption has a positive impact on household welfare and food security (Jaleta *et al.*, 2018; Ali *et al.*, 2020). Nigeria needs high-yielding maize hybrids to increase productivity, ensure self-sufficiency and food security. One of the means of achieving self-sufficiency and food security is the promotion and adoption of hybrid varieties because of the huge yield advantage hybrids have over OPVs.

Several previous empirical studies (Awotide *et al.*, 2016; Abdoulaye *et al.*, 2018; and Baiyegunhi *et al.*, 2022) in Nigeria had

pointed to the fact that agricultural technology adoption is an important determinant in increasing farmers' output and economic gain that could in turn, lead to improvement in income and livelihoods and in other farmers' welfare indicators. Specifically, the use of improved maize varieties (IMVs) relates to increased crop productivity, which further improves farmers' livelihoods and fosters economic growth (Asfaw *et al.*, 2012). Empirical observation has revealed that IMVs adoption provide a significant pathway for increased productivity, increases the value of produced crops, generates rural employment, and stimulates cash flow, which is expected to increase farm incomes and household welfare (Ngonkeu *et al.*, 2017). Therefore, the adoption of maize hybrid becomes important if Nigeria is to meet the ever-increasing maize demand. Hence, this study, therefore, seeks to compare the cost of growing hybrid maize varieties with that of open-pollinated varieties.

MATERIALS AND METHODS

Study area

The study was carried out in southwestern Nigeria, which is one of the six geopolitical zones in the country. The zone consists of Ekiti, Lagos, Ogun, Ondo, Osun, and Oyo States as depicted in Figure 1. The zone lies between longitude $2^{\circ} 31^1$ and $6^{\circ} 00^1$ East and Latitude $6^{\circ} 21^1$ and $8^{\circ} 37^1$ N with a total land area of 77,818 km² and an estimated population of 38,257,260 (National Bureau of Statistics, 2016).

The climate of south-western Nigeria is tropical and it is characterized by wet and dry

seasons. The temperature ranges between 25 °C and 35 °C while the annual rainfall ranges between 1300 mm and 2500 mm. The wet season is associated with the Southwest monsoon wind from the Atlantic Ocean while the dry season is associated with the Northeast trade wind from the Sahara Desert (Umar *et al.*, 2015). The ecological condition in Southwest Nigeria is made up of freshwater swamp and mangrove forest at the belt, the low land forest stretches inland to Ogun and part of Ondo States while the secondary forest is towards the northern boundary where derived and southern savanna exists (Bamire *et al.*, 2010). This ecological condition encourages the cultivation of early and/or late crops such as cassava, yam, millet, rice, plantains, cocoa, palm produce, cashew and maize.

This study was carried out in all the agroecological zones (AEZs) (Rainforest, Transition, Derived and Guinea savannas) in Southwestern Nigeria during the wet season of 2021 using a farmer's participatory approach. Four farmers growing maize were selected from each zone to make a community group. Farmers selected were used as replicates per location. Two maize hybrids (SC-719 and Ife-hyb-3) and two Open-pollinated maize varieties (OPVs) (BR9928-DMR-SR-Y and DMRLSR-Y) were supplied to farmers by the Maize Improvement Programmes for Southern Ecology, Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan. Experimental sites were ploughed twice and planting was done on a plot of 5 m by 10 m.

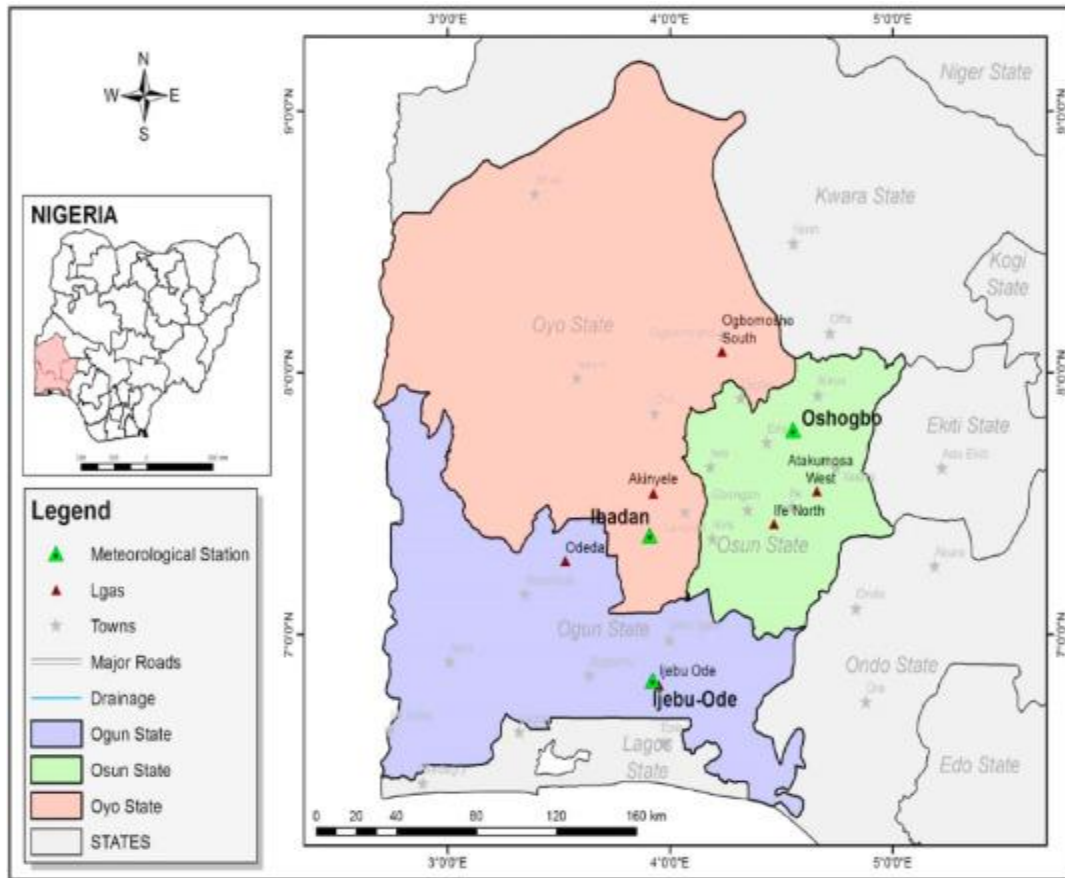


Figure 1: Map of south-western Nigeria

Soil samples were taken across the farmer’s field and analysis was carried out on the collected sample at the Soil Centre of the Institute. Inputs were supplied by the programme and field management practices were carried out according to the Institute of Maize Farmers’ Production guides. Fertilizer applications of 120 kg N, 60 kg of P₂O₅ and 60 kg P were applied in two splits based on the soil sample results across locations. Data were collected on the cost of production and grain yield from the various varieties. Analysis of variance and Farm budget analyses were used to analyze the data collected during the demonstration.

Net benefits

Net Benefit (NB) was calculated using the method described by Olasoji and Egbetokun (2017). Net benefit measures the overall positive impact of the treatments in monetary values. It is the difference between gross benefits (GB) and the total variable cost (TVC). The formula is given as:

$$NB (N/ha) = GB (N/ha) - TVC (N/ha) \dots\dots\dots(1)$$

Incremental net benefit

Incremental Net Benefit was used to determine whether there is a marginal increase among the treatments and was calculated by finding the difference between

successive net benefits. The formula is as stated below:

$$INB = (GR - TC)2 - (GR - TC)I \dots\dots\dots (2)$$

Benefit Cost Ratio (BCR)

Benefit Cost Ratio (BCR) is an indicator, used in the formal discipline of cost-benefit analysis, which attempts to summarize the overall value for money of a project. This is the ratio of benefits versus costs. It involves summing the total benefits and dividing it over the total costs of the project or technology. The explicit functional form of BCR used is given as:

$$BCR = NB/TVC \dots\dots\dots (3)$$

RESULTS AND DISCUSSION

The results of agronomic characteristics as shown in Table 1 revealed that maize hybrid (SC 719) has the highest day to maturity as well as plant height while Ife-hyb-3 has the shortest days to maturity as well as plant height. The plant heights of the two open-pollinated varieties (OPVs) were taller than that of Ife-hyb-3. In terms of shelling percentage, the two maize hybrids have more shelling percentages than the OPVs. Hundred kernel weights were the highest in SC 719 followed by Ife-Hybrid 3. The average value of the hundred kernel weight ranged from 28.67 g (SC 719) to 21.33 g (DMRLSR-Y). All agronomic characters recorded were higher for the two hybrids when compared to OPVs. This result partly corroborates the finding of Pearl (2012). He reported that hybrids record high yield advantages over OPVs with increasing fertilizer rates. In contrast, the result negates the finding of Min (2009) who reported insignificant variation between hybrids and OPVs. In his finding, OPVs and hybrids were comparable for grain

yield and yield-related attributes and they are agronomically and physiologically similar in maturity and yield attributes.

The analysis of variance results of yield is shown in Table 2 and it revealed that maize hybrid (SC 719) has the highest varietal mean of 6670.73 kg/ha, followed by Ife-hyb-3 hybrid (5431.94 kg/ha) and the OPV (DMRLSR Y) had the lowest varietal mean of 3716.01 kg/ha in the study area. This observation supports Luis *et al.* (2001) findings who reported that hybrids enhanced their grain yield linearly when the N dose was raised from 0-200 kg/ha. According to SeedCo Maize Catalogue (2018), SC 719 is late maturing (120 days), a 3-way hybrid universally adapted variety with long and fat cobs excellent rooting system which makes it tolerant to lodging, resistant to most maize diseases including maize streak and larger grain size (Table 1).

Furthermore, hybrid SC 719 had grain yield ranging from 7518.99kg/ha in Kishi to 4931.26 kg/ha in the Ikenne location. Hybrid SC 719 recorded the best yield in all the locations where the experiments were carried out. Ife-hyb-3 yield ranged from 6586.85 kg/ha in Kishi to 3653.67 kg/ha in Ikenne. BR9928-DMR-SR-Y yield ranged from 6086.37 kg/ha in Ilora to 2406.63 kg/ha in Ikenne; DMRLSR Y yield ranged from 4820.24 kg/ha in Ibadan to 2095.09 kg/ha in Ikenne.

The varietal mean showed the highest yield of 6670.73 kg/ha in SC 719 and the least yield of 3,716.01 kg/ha was recorded on DMRLSR Y. The two hybrids maize (SC 719 and Ife-hyb-3) had a higher yield performance in all five locations than the two

OPVs (BR9928-DMR-SR-Y and DMRLSRY). It is worth noting that the varietal mean yield of the SC 719 hybrid almost doubled that of DMRLSRY. From the above results, all the genotypes used were improved and the least yield among the four varieties outperformed the average farmer's yield of 1.6 tonnes/ha. The above results proved that the majority of farmers in southwest Nigeria wrong in the belief that hybrid maize cultivation requires more than twice the fertilizer requirement for OPVs (Olaniyan, 2015). This brought the idea of on-farm demonstration trials established on

the farmer's field to compare hybrid maize with other varieties. The same quantity of fertilizers (120 kg N, 60 P and 60 K) was applied according to the soil sample results throughout the locations and the performance of the hybrids was superb according to some farmers used in the trial. During harvesting, farmers around showed their readiness to adopt hybrid maize cultivation to boost their income. This is consistent with studies by Van-Asselt *et al* (2018) who reported that farmers are ready to adopt new high-yielding maize technologies when exposed to demonstration trails,

Table 1: Agronomic characteristics of hybrids and selected open-pollinated maize varieties

Genotypes	Source	Grain colour	Days to maturity	Plant height	Maturity Group	Shelling percentag e	100 Kernel Weight (g)
SC 719	Seedco	White	135-150	210a	Late	84.6a	28.67a
Ife-hyb-3	IAR&T	Yellow	105-120	170d	Early	82.5b	24.54ab
BR9928-DMR-SR-Y	IAR&T	Yellow	110-120	200b	Intermediate	80.8c	22.67b
DMRLSRY	IAR&T	Yellow	110-130	185c	Late	78.9c	21.33b

Means with the same letter in each row are not significantly different at P<0.05 using Duncan's

Table 2: Mean grain yield of hybrid and OPV across different locations in southwestern Nigeria

Genotypes	IBADAN Transition	KISHI Guinea savanna	ORIN-EKITI High Rainforest	IKENNE Rainforest	ILORA Derived savanna	Varietal Mean
SC 719	6754.20a	7518.99a	6959.35a	4931.26a	7189.99a	6670.73
Ife-hyb-3	5608.41b	6586.85a	5325.81a	3653.67b	5984.98b	5431.94
BR9928-DMR-SR-Y	5072.52c	4142.45b	4534.49b	2406.63c	6086.37b	4448.49
DMRLSRY	4820.24c	3617.46b	4001.02b	2095.09c	4046.26c	3716.01
Location Mean	5563.84	5466.32	5205.16	3271.66	5826.9	

Means with the same letter in each row are not significantly different at P<0.05 using Duncan Multiple Range Test

The economic analysis result shown in Table 3 revealed that there is an increase in the net benefit of maize varieties across the ecologies. From the result, the cost of

producing hybrid maize gave a total of N314,000.00 while that of OPVs production cost gave a total of N298,000. The difference in the cost was just N16,000.00 which

happened to be the cost incurred in purchasing hybrid seeds. The OPVs (DMRLSR-Y and BR9928-DMR-SR-Y) varieties gave on average the lower net benefit of N370, 881.8 and N502, 728, respectively compared with N663, 580 and N886,732 from Ife-hyb-3 and SC 719, respectively. This implies that across all agroecologies in southwest Nigeria, hybrid SC 719 maize gave the highest economic benefit followed by Ife-hyb-3 to farmers thereby improving farmers' livelihood. The gross revenue realized from the two hybrids was greater than the two OPVs as shown in Table 3. The difference in revenue may be a result of the high nutrient use efficiency of hybrid over OPVs. Both net benefit and incremental net benefit were the highest for

SC.719. The result agreed with the findings of Olasoji and Egbetokun (2017) who reported increase in net benefits when improved maize varieties were planted by farmers over farmer's saved seed. This signifies that on marginal basis, SC 719 would give the highest returns to farmers. In sustainability of benefits that would accrue to maize farmers in the area, this study would rather advise farmers to adopt SC 719 and Ife-hyb-3 hybrids for both short and long-run economic benefits. The reason for the above was that every N100 invested in maize production gave a mean benefit-cost ratio (returns on investment) of 211% (Ife-hyb-3) and 282% (SC 719). The OPVs gave 124% (DMRLSR-Y) and 169% (BR9928-DMR-Y) as return on investment.

Table 3: Economic analysis of hybrid maize versus OPV across different locations in southwestern Nigeria

Gross Benefit	DMRLSR-Y	BR9928-DMR-SR-Y	Ife-hyb-3	SC 719
Average yield (kg/ha)	3716.01	4448.49	5431.94	6670.73
Adjusted average yield (kg/ha)	3344.41	4003.64	4887.90	6003.66
Price (N/kg)	200	200	200	200
Revenue (N/ha)	668,881.8	800,728	977,580	1,200,731
Variable Input cost (N/ha)				
Cost of Labour	80,000	80,000	80,000	80,000
Cost of other inputs	218,000	218,000	234,000	234,000
Total variable cost	298,000	298,000	314,000	314,000
Net Benefit	370,881.8	502,728	663,580	886,732
Incremental benefit	—	131,846.2	160.852	223,152
Benefit-cost ratio	1.24	1.69	2.11	2.82

CONCLUSION

From the results of this study, hybrid maize production was more profitable and financially rewarding than the improved OPVs at the current market price of maize

input and output. The majority of the farmers and others in their surrounding accepted the two hybrids used. The only difference between the cost of production in this study was the cost of hybrid seed procurement. The

high cost of yearly replacement of seed, which is many times more expensive than the OPVs, is considered the major constraint to hybrid maize production. The results established the greater economic potential of hybrid maize over open-pollinated maize under the same recommended agronomic practices in southwestern Nigeria.

ACKNOWLEDGEMENTS

We are profoundly grateful to the Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan, Nigeria for the research grant. Special thanks also go to all the farmers selected across agroecological zones in southwestern Nigeria for the trial.

FUNDING

The work was funded by a research grant from the Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan.

COMPETING INTERESTS

The authors declare that they have no competing interests

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