

# Economic Returns of Integrated use of Poultry Manure and Inorganic Fertilizers on Maize Yield in Akure, Nigeria

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**Abstract** – An experiment was conducted to determine the economic returns of the use of poultry manure and inorganic fertilizer for maize (TZB-SR) cultivation at the Teaching and Research Farm of the Federal University of Technology, Akure. The treatments consisted of two levels of poultry manure 0 and 5 t ha<sup>-1</sup>, three levels of urea 0, 50 and 100 kg ha<sup>-1</sup> and three levels of phosphorus 0, 30, and 60 kg ha<sup>-1</sup> at both early and late season maize cultivation. The resultant eighteen treatment combination ratio was used as the basis for evaluating economic returns. Poultry manure was applied by broadcasting two weeks before planting. Single Super Phosphate was placed in planting hole and covered with a thin layer of soil before planting the maize seed. Urea fertilizer was applied in ring form to the base of the plant immediately after thinning. Three maize seeds were planted per hole at 75 x 25 cm spacing and later thinned to one at two weeks after planting. The total grain yield (t ha<sup>-1</sup>) was determined at harvest. Total variable costs (TVC), Total revenue (TR) for all sales from the crop were determined. Gross margin (GM) analysis was carried out and Cost of Response of fertilizer input (CRFI) determined. The result showed total variable cost as highest for 0 PM + 100 U + 60 SSP and 5 PM + 100 U + 60 SSP combining ratio in both the early and late season cultivation, 5 PM + 100 U + 30 SSP combining ratio has the highest yield of 4.12 t ha<sup>-1</sup> for early season maize cultivation and highest yield of 2.99 t ha<sup>-1</sup> for late season maize cultivation, it also has the highest Total Revenue (TR) of N288,400 and N209,300 at the early and late season maize cultivation respectively, the highest Gross Margin (GM) and Cost of Response of fertilizer input (CRFI). 5PM + 100 U + 30 SSP combining ratio was recommended for maize cultivation.

**Keywords** – Maize, Poultry Manure, Single Superphosphate, Urea, Economic Return.

## I. INTRODUCTION

Maize (*Zea mays* L.) cultivation has immense potential in the tropics; unfortunately yields are still below 5 t ha<sup>-1</sup> in sub-Saharan Africa. In Southwest Nigeria, yields of maize declined from 5 t ha<sup>-1</sup> immediately after forest clearing to 0.5 t ha<sup>-1</sup> after four years of cropping (Ojeniyi, 1993). In Africa, the bulk of maize produced is used as human food although it is increasingly being utilized for livestock feed. According to FAO data, the area planted for maize in west and central Africa alone increased from 3.2 million hectares in 1961 to 8.9 million hectares in 2001. This phenomenal expansion of the land area devoted to maize resulted in increased production from 2.4 million metric tons in 1961 to 10.6 million metric tons in 2001.

Nutrients naturally found in soil are very essential for the growth of maize, but sometimes these nutrients might not be adequate for maximum and sustainable maize growth and yield. Soil fertility decline has been found to

be an important cause of low soil productivity for most soil (Lal, 1989; Sanchez, 2002). This is where fertilizers come in handy, and a good fertilizer program is a major way of improving yield in crops. Hence this study was conceptualized to evaluate the economic returns accruing from improvement in maize productivity as a result of organic and inorganic fertilizer application. Maize crop requires an adequate supply of nutrients particularly nitrogen, phosphorus and potassium for optimum growth and yield. Whenever poultry manure is added to soil, the bulk of the material undergoes enzymatic oxidation, essential elements are released or immobilized, and compounds resistant to microbial action formed either from materials present in the soil organic matter or synthesized by soil microorganism. The combined use of livestock waste that is available in substantial quantity in Nigeria (Nwajiuba and Chimezie, 2000) with inorganic fertilizer could partially offset the need for mineral fertilizers; improve soil integrity, giving both economic and environmental benefits. Recent research has shown that the best fertilizer mixture for soils of the tropics is a mixture of both organic and inorganic mixture (Agboola and Odeyemi 1972; Sobulo and Osiname 1986).

## II. MATERIALS AND METHODS

The experiment was conducted at the Teaching and Research Farm (TRF) of the Federal University of Technology (FUT), Akure, for early and late maize cropping. TRF in FUT, Akure is in the rainforest zone of Nigeria (lat 7°5', long 5°10'). Mean daily temperature ranged from 25°C and 30°C and maximum temperature of 21.8 °C and 32.3 °C respectively. Annual rainfall varied from 1,900mm – 2,700mm, mean annual evaporation is 2.1mm. The relative humidity ranges between 85% during the rainy season and less than 60% during the dry season. Planting season is about 8 months occurring in April to October/November through February/March.

### *Experimental materials and design*

Poultry Manure (PM) was sourced from the Teaching and Research Farm (TRF) of the Federal University of Technology, Akure. TZB-SR Maize, a late maturing cultivar was obtained from the International Institute of Tropical Agriculture (IITA), Ibadan. The fertilizers: Urea (U) (containing 45% N) and Single Superphosphate (SSP) (containing 56% P) was sourced from the Agricultural Development Project (ADP), Akure. Experimental design was a Randomized Complete Block Design with three replicates. Treatment comprises two levels of poultry manure (PM) (0 and 5 t ha<sup>-1</sup>), three levels of urea (U) (0, 50 and 100 kg ha<sup>-1</sup>) and three levels of single-

superphosphate (SSP) (0, 30, and 60 kg ha<sup>-1</sup>) fertilizers application.

#### *Land preparation and treatment application*

The land was ploughed and harrowed. Three blocks were established, each with a dimension of 2m x 90m. The blocks were subdivided into eighteen plots of 2m X 5m. The blocks were separated from each other by 1m pathway. Poultry manure was applied by broadcasting at two weeks before planting and completely worked into the soil. Single-superphosphate was placed five (5) cm below maize seed at planting. TZB-SR maize seed was planted at 75 x 25 cm spacing. Thinning of maize seedling to one plant per stand was carried out at two weeks after planting and urea fertilizer was applied in ring form to the base of the plant immediately after thinning.

#### *Grain Yield Determination*

The total grain yield (t ha<sup>-1</sup>) from all the 10 plants in the middle rows of each plot that were carefully harvested and threshed for full yield recovery was used to compute the grain yield (oven-dried at 13 – 14 % moisture content)

#### *Economic analysis*

The profitability from fertilizer use was calculated by deducting the costs of fertilizers and their application from the extra crop yields achieved from fertilizer application. A positive balance indicates the profitability. Gross marginal analysis model was used to calculate economic returns from the application of each treatment. The information used for economic analysis was collected at the specific time of each activity in the course of each season. Costing analysis was done using the current farmer's prices of the various inputs. The poultry manure did not have market prices in the area and was therefore evaluated in terms of labour involved in scooping it from poultry farm site and its incorporation into the soil. Gross marginal analysis model was used to calculate economic returns from the application of each treatment

$$\text{Gross Margin (GM)} = \sum_{i=1}^n PiQi - \sum_{i=1}^n CiXi$$

Where: TR = Total revenue of all sales from all crop enterprise (Maize), TVC = Total variable cost (operational expenses, labour, agro-chemical, transportation etc.).

$Pi$  = Price of the unit enterprise in Naira.  $Qi$  = Output per unit enterprise in Kg,  $Ci$  Price of input in Naira,  $Xi$  = Quantity of variable input.

#### *Variable Factors Used in Determining Marginal Cost*

The marginal cost table (Table 3 and 4) was determined using the variable factors in Table 1. Total variable cost (TVC) was determined as the operational expenses which involve, labor, agro-chemical, application, cost of maize, plowing, harrowing, planting, weeding, fertilizer, harvesting, dehusking/processing, Transport

Total revenue (TR) for all sales from the crop was determined as the multiplication of the maize yield (Y) with the unit selling price (₦ 70/kg). Gross margin (GM) was determined as TR-TVC. Cost of Response of fertilizer input (CRF<sub>i</sub>) was determined as the gross margin of the control minus gross margin of treatment.

Table 1: Total Variable Factors used in determining Marginal Cost

Price Parameter	Average values
Price of Maize Seed	N 200 kg
Price of Fertilizer 50 kg bag	N 5200
Ploughing and Harrowing	N 12000 ha <sup>-1</sup>
Labour (weeding)	N 12000 ha <sup>-1</sup>
Labour (planting maize)	N 10000 ha <sup>-1</sup>
Labour (fertilizer application)	N 5000 ha <sup>-1</sup>
Labour (Harvesting/Transportation)	N 20,000 ha <sup>-1</sup>
Marketing and Miscellaneous	N 20,000 ha <sup>-1</sup>

### **III. RESULT AND DISCUSSION**

Table 2 and 3 showed Marginal Cost Analysis Chart for early and late season maize planting. The total variable cost was highest for 0 PM + 100 U +60 SSP and 5 PM + 100 U +60 SSP combining ratio in both the early and late season planting. The high variable cost is as a result of the purchase of single superphosphate and urea fertilizer and the labour required for packing and transporting poultry manure. The control has the least variable cost of ₦ 84,000 since the cost of fertilizer and manure procurement and application is not reflected. 5 PM + 100 U + 30 SSP combining ratio has the highest yield of 4.12t ha<sup>-1</sup> for early season maize cropping and highest yield of 2.99 t ha<sup>-1</sup> for late season maize cropping, this shows a positive synergy between poultry manure, single superphosphate and urea fertilizer application on maize crop (Bello and Adekunle, 2013). Early season crop performed better than late season crop in terms of grain yield (Shamudzarira and Robertson, 2002). The control yield was 1.9 t ha<sup>-1</sup> and 1.08 t ha<sup>-1</sup> for early and late season maize cultivation respectively indicating the low fertility nature of soils in sub Saharan Africa (Sanchez, 2002; FAO, 2003).

5 PM + 100 U + 30 SSP nutrient combining ratio gave the highest Total Revenue (TR) of ₦288,400 and ₦209,300 at the early and late season maize cultivation respectively, this shows that the high cost of fertilizer application results in high revenue to the farmer as it stimulates high and consistently high farm yield that translates into profit. 5 PM + 100 U + 30 SSP nutrient combination also has the highest Gross Margin (GM) and Cost of Response of fertilizer input (CRF<sub>i</sub>). It is therefore recommended for maize cultivation in Akure.

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**Table II: Marginal Cost Analysis Chart Early Season Akure**

Code	Treatments	T V C (ha <sup>-1</sup> ) (₦)	Y (t ha <sup>-1</sup> )	TR @ (₦70/kg)	GM (₦)	CRF <sub>i</sub> (GMc – GMc <sub>T</sub> ) (₦)
T1	0 PM + 0 U + 0 SSP	84000	1.9	133000	49000	0
T2	0 PM + 0 U + 30 SSP	87120	2.05	143500	56380	7380
T3	0 PM + 0 U + 60 SSP	90240	2	140000	49760	760
T4	0 PM + 100 U + 0 SSP	94400	2.8	196000	101600	52600
T5	0 PM + 100 U + 30 SSP	97520	3.6	252000	154480	105480
T6	0 PM + 100 U +60 SSP	100640	3.62	253400	152760	103760
T7	0 PM + 50 U + 0 SSP	89200	2.22	155400	66200	17200
T8	0 PM + 50 U + 30 SSP	92320	3.73	261100	168780	119780
T9	0 PM + 50 U + 60 SSP	95440	2.92	204400	108960	59960
T10	5 PM + 0 U + 0 SSP	84000	2.44	170800	86800	37800
T11	5 PM + 0 U + 30 SSP	87120	3.3	231000	143880	94880
T12	5 PM + 0 U + 60 SSP	90240	3.58	250600	160360	111360
T13	5 PM + 100 U + 0 SSP	94400	3.18	222600	128200	79200
T14	5 PM + 100 U + 30 SSP	97520	4.12	288400	190880	141880
T15	5 PM + 100 U + 60 SSP	100640	4.02	281400	180760	131760
T16	5 PM + 50 U + 0 SSP	89200	3.93	275100	185900	136900
T17	5 PM + 50 U + 30 SSP	92320	3.67	256900	164580	115580
T18	5 PM + 50 U + 60 SSP	95440	3.76	263200	167760	118760

T V C, Total Variable Cost; Y, Yield; TR, Total Revenue; GM, Gross Margin; CRF<sub>i</sub>, Cost of Response of fertilizer input

**Table II: Marginal Cost Analysis Chart Late Season Akure**

Code	Treatments	T V C (ha <sup>-1</sup> ) (₦)	Y (t ha <sup>-1</sup> )	TR @ (70 ₦ /kg)	GM (₦)	CRF <sub>i</sub> (GMc – GMc <sub>T</sub> ) (₦)
T1	0 PM + 0 U + 0 SSP	84000	1.08	75600	-8400	0
T2	0 PM + 0 U + 30 SSP	87120	1.9	133000	45880	54280
T3	0 PM + 0 U + 60 SSP	90240	2.1	147000	56760	65160
T4	0 PM + 100 U + 0 SSP	94400	2.16	151200	56800	65200
T5	0 PM + 100 U + 30 SSP	97520	2.1	147000	49480	57880
T6	0 PM + 100 U +60 SSP	100640	2.02	141400	40760	49160
T7	0 PM + 50 U + 0 SSP	89200	1.87	130900	41700	50100
T8	0 PM + 50 U + 30 SSP	92320	1.84	128800	36480	44880
T9	0 PM + 50 U + 60 SSP	95440	1.99	139300	43860	52260
T10	5 PM + 0 U + 0 SSP	84000	1.71	119700	35700	44100
T11	5 PM + 0 U + 30 SSP	87120	1.76	123200	36080	44480
T12	5 PM + 0 U + 60 SSP	90240	2.85	199500	109260	117660
T13	5 PM + 100 U + 0 SSP	94400	2.78	194600	100200	108600
T14	5 PM + 100 U + 30 SSP	97520	2.99	209300	111780	120180
T15	5 PM + 100 U + 60 SSP	100640	2.93	205100	104460	112860
T16	5 PM + 50 U + 0 SSP	89200	2.13	149100	59900	68300
T17	5 PM + 50 U + 30 SSP	92320	2.76	193200	100880	109280
T18	5 PM + 50 U + 60 SSP	95440	2.28	159600	64160	72560

T V C, Total Variable Cost; Y, Yield; TR, Total Revenue; GM, Gross Margin; CRF<sub>i</sub>, Cost of Response of fertilizer input

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