

## COST-BENEFIT ANALYSIS OF CROP RESIDUE MANAGEMENT PRACTICES ON YIELD OF MAIZE IN MINNA, SOUTHERN GUINEA SAVANNA, NIGERIA.

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### ABSTRACT

The study examined the cost-benefit of crop residue management practices on maize production in Teaching and Research farm of Federal University of Technology Minna, Niger State during 2017 cropping season. The study was a two factorial experiment laid out in Randomized Complete Block Design. Following land preparations, crop residue (sorghum stalk) was applied at 0ton/ha, 10ton/ha, 15ton/ha, 20ton/ha at surface and incorporation method of application replicated four times. The primary data for the study were obtained by keeping records of farm variable and fixed cost of items and farm operations. Gross margin, net farm income, gross ratio and return on capital investment were used to analyse the data. The result of the study showed that incorporation method application and 10ton/ha rates of application of crop residue were more profitable and efficient in maize production than surface method of application and other rates of application with operating ratio, return on capital investment of 0.01 and 70.101Naira (incorporation) and 6.078 and 126.430Naira (10tons/ha) respectively. It is recommended that incorporation of crop residue (sorghum stalk) and 10tons/ha rate of application should be recommended for farmers in the study area for optimum yield and profitable under crop residue management practices.

**Keywords:** maize production, crop residue and cost-benefit.

### INTRODUCTION

Maize (*Zea mays* L.) belongs to the *Poaceae* family. Maize is the third most cultivated cereal after wheat and rice with an average yield of 4.05 t ha<sup>-1</sup> which is lesser than world's potential yield. (Khaliq et al., 2013) and (FAOSTAT 2003). In Nigeria maize is the third most important cereal crop after sorghum and millet (Ojo, 2000). 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 (Ogundari, 2006). Crop residues are defined as the by-products of harvesting annual grain crops therefore; retaining crop residues on a field improves and/or maintains soil quality including moisture status. In sustainable agriculture, one of the most relevant objectives is maintenance and restoration of soil fertility. Increase of the organic matter as the source for humus formation is one of the means to sustain soil fertility.

Erenstein, (2002) reported that crop residues can be helpful in controlling the weeds growth, while Ogbanet *et al.*, (2006) noted that residue-mulch applied on the surface of tilled or no till soils could increase crop growth as well as improve soil properties. Crop residue returned to the soil has been found to be beneficial for maintenance or improvement of physical, chemical, and biological properties of the soil. These edaphic properties enhance easy tillage, crop growth and yield. Crop residue returned to the soil have been found to be beneficial for maintenance or improvement of physical, chemical, and biological properties of the soil that enhances easy tillage, crop growth and yield (Ewulo, 2005). Gross margin technique is referred as the difference between the gross farm income and total variable cost. It is a useful tool where fixed capital is negligible portion of the farming system. It is also used to calculate the profitability of small scale cropping enterprise (Olukosi *et al.*, 2006).

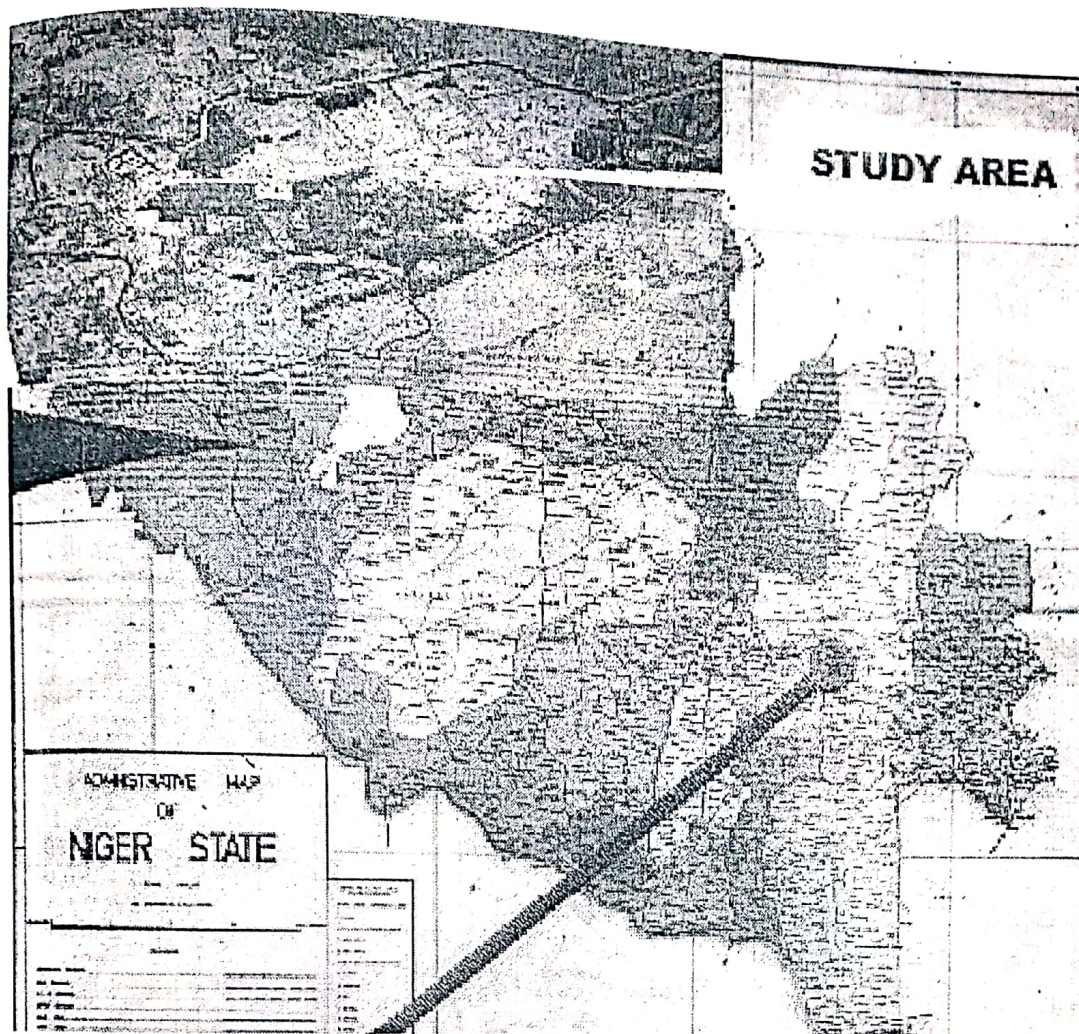
### METHODOLOGY

#### Study Area

The study was carried out in the Teaching and Research farm of the Federal University of Technology, Minna, during 2017 cropping season. Minna lies on Latitude 9° 37'N and longitude 6° 33'E within the Southern Guinea Savanna Vegetation zone with a sub-humid tropical climate with mean annual rainfall of 1200mm with about 90% of it falling between the month of June and August. (Ojanuga, 2006) The temperature rarely falls below 22°C while wet season's temperature on the average is about 28°C on the average with peak 40°C in February to march, 36°C November to December (Ojanuga, 2006). The geology of the area is made up of basement complex rocks found under the interior zone of laterite in the soil map of Nigeria (Herrmann *et al.*, (2007).

#### Description of study site

The Gidan-Kwano campus of the Federal University of Technology, Minna is located along Minna - Bida road which is approximately 12 km from the main town. The campus lies between Latitudes 9°31'15"N and 9°32'30"N and Longitudes 6°26'15"E and 6°28'00"E with an estimated land mass of 10,000 hectares. The details of the study area are shown below in the map.



#### Field of studies

The experiment was a two factorial experiment laid out in Randomized complete block design with four replications. Treatments were applied using two methods of management practices which are rate of application (0, 10, 15 and 20 tons/ha) and methods of application (surface and incorporation)

#### DATA ANALYSIS

##### Cost-benefit analysis

A cost-benefit assessment was carried out for each conservation practice. The costs of production, residue management practices, and impact of crop residue on soil chemical and physical properties in monetary terms were considered in assessing the costs and benefits of crop residue practices. The benefits included the direct yield return and the indirect soil erosion benefit value from reducing soil loss. Gross margin analysis was carried out to determine the cost benefit of crop residue management practices because fixed capital is negligible portion of the farming system. It is also used to calculate the profitability of small scale cropping enterprise. (Olukosi, *et al.*, 2006).

It is expressed as:

$$GM = GFI - TVC,$$

$$NIF = GM - TFC$$

Where, GM= Gross Margin, GIF= Gross farm income, TVC= Total Variable Cost, NIF = Net Farm Income, TFC= Total Fixed Cost.

Gross ratio: this is the profitability ratio that measures the overall success of the farm.

$$GR = TFE / GI$$

Where GR=Gross ratio, TFE= total farm expenses and GI= Gross income.

Operating Ratio (OR): the operating ratio is directly related to the farm variable input usage.

$$OR = TVC / GI$$

Where OR= operating ratio, TVC =total variable cost, GI= Gross income.

Return on a capital invested is defined as gross margin divided by total variable cost.

$$RI = GM / TVC$$

Where RI= Return on Capital invested; GM=Gross Margin and TVC= Total variable cost.

#### RESULTS AND DISCUSSION

Gross margin analysis for surface and incorporation method of crop residue application and management practices is shown in Table1. The table shows that total variable cost 99.98 % of total cost of maize production for surface and incorporation method of

crop residue respectively while the total fixed cost for both management practices constituted 0 % as fixed cost is negligible in the experiment. The confirmation of profitability of maize for both surface and incorporation is shown in the net farm income of 1,122,288.75 Naira and 1,433,570 Naira, respectively. Also, return on a naira invested is 54.879 Naira for surface and 70.101 Naira for incorporation, while the gross ratio for surface was 0.018 and that of in-corporation was 0.01 respectively. This shows that incorporation method of crop residue application management practices was more profitable and successful in maize production than surface method of crop residue application.

Gross margin analysis for various rates of application is shown in Table 2. The total variable cost of production constituted 80.32% for 0ton/ha, 99.99% for 10tons/ha, 99.99% for 15tons/ha and 100% for 20tons/ha of the total cost of production for the various rates of application, respectively, while the total cost was 0% for all the various rates of application, respectively, while the total fixed cost was 0% for all the various rates of application, respectively. The cost-benefit of maize production for the various rates of crop residue application is shown by the net farm income of 19.657 % (0 ton/ha), 0.06% (10 ton/ha),

**TABLE 1: Enterprise under surface and in-cooperation of crop residue as a management practices.**

Variable cost	surface		Incorporation	
	Cost in N/Ha	% Total Cost	Cost in N/Ha	% Total cost
Land preparation	3000	14.67	3000	14.67
Cost of sowing seed	500	2.44	500	2.44
Cost of residual application	1500	7.33	1500	7.33
Cost of weeding	3000	14.67	3000	14.67
Fertilizer application cost	500	2.44	500	2.44
Cost of cutting crop residues	6250	30.56	6250	30.56
Cost of seed	450	2.20	450	2.20
Cost of fertilizer	3000	14.67	3000	14.67
Cost of harvest	2250	11.00	2250	11.00
Total variable cost	20450	99.98	20450	99.98
Fixed cost	0	0	0	0
Total fixed cost	0	0	0	0
Total cost	20450	99.98	20450	99.98
Returns	1,142,738.75	193.478	1,454,020	100.001
Gross income	1,142,738.75	193.478	1,454,020	100.001
Gross margin	1,122,288.75	93.498	1,433,570	0.021
Net farm income	1,122,288.75	93.498	1,433,570	0.021
Return on naira	54.879	0.935	70.101	0.0021
Operating ratio	0.018	0.517	0.01	0.999
Gross ratio	0.018	0.517	0.01	0.999

**Table 2: Enterprise under rate of application of crop residue management practices**

Variable cost	0ton/ha		10ton/ha		15ton/ha		20ton/ha		% total cost
	Cost of 0ton/ha	%total cost	Cost of 10ton/ha	%total cost	Cost of 15ton/ha	%total cost	Cost of 20ton/ha	% total cost	
Land preparation cost	1500	23.62	1500	14.39	1500	12.75	1500	12.21	
Sowing cost	250	3.94	250	2.49	250	2.12	250	2.03	
Cost of residual application	0	0	666.67	6.64	1000.05	8.50	133.34	1.09	
Cost of fertilizer application	250	3.94	250	2.49	250	2.12	250	2.03	
Cost of weeding	1500	23.62	1500	14.93	1500	12.75	1500	12.21	
Cost of cutting crop residue	0	0	2777.78	7.65	4166.67	35.41	5555.56	45.21	
Cost of buying seed	225	3.54	225	2.24	225	1.91	225	1.83	
Cost of fertilizer	1750	27.56	1750	17.42	1750	14.87	1750	14.24	
Cost of harvest	1125	17.56	1125	11.20	1125	9.56	1125	9.15	
Total variable cost	6350	80.32	10,044.45	99.99	11,766.72	99.99	12,288.9	100	
Fixed cost	0	0	0	0	0	0	0	0	
Total fixed cost	0	0	0	0	0	0	0	0	
Returns	700,625	99.995	1,279,957.5	99.996	1,068,125	100.00	616,250	99.99	
Gross income	700,625	99.995	1,279,957.5	99.996	1,068,125	100.00	616,250	99.99	
Gross margin	694,275	19.675	1,269,913.05	0.06	1,056,358.28	0.01	603,961.1	-0.01	
Net farm income	694,275	19.675	1,269,913.05	0.06	1,056,358.28	0.01	603,961.1	-0.01	
Return on naira	109.335	0.245	126.430	0.006	89.775	0.001	49.550	-0.0001	
Operating ratio	0.091	0.803	0.078	0.990	0.011	0.999	0.020	1.00	
Gross ratio	0.091	0.803	0.078	0.990	0.011	0.999	0.020	1.00	

0.01%(15 tons/ha) and – 0.01%(20 ton/ha) respectively. Also return on a naira invested is 109.335Naira for 0ton/ha 126.430Naira for 10ton/ha, 87.775Naira for 15ton/ha and 49.550Naira for 20ton/ha respectively. While the gross ratio for 0ton/ha was 0.09, 10tons/ha was 0.078, 15ton/ha was 0.011 and 20ton/ha was 0.020 respectively. This shows that 10ton/ha rate of application was more profitable and successful under crop residue management practices in maize production followed by 0ton/ha of application of crop residue and followed by 0ton/ha rate of application, 15ton/ha and 20ton/ha gave the least return on a naira invested under rates of application of crop residue in maize production.

#### CONCLUSIONS AND RECOMMENDATIONS

The study examined the cost benefit of various rate of crop residue application, surface and incorporation method of application of crop residue management practices. The profitability analysis revealed that incorporation method of application and 10/ha rate of residue application was more profitable in maize production under crop residue management practices than other counter parts. It is recommended that incorporation of crop residue at 10ton/ha should be encouraged and practiced by farmers in the study area so as to obtained maximum yield and return on a naira invested.

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