

Economic Assessment of Organic Manure and Irrigation Intervals on the Growth and Yield of Onion (*Allium cepa* L.) at Lake Alau and Pelachiroma, Borno State, Nigeria

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Abstract – Field trials were conducted in cool dry season of 2012/2013 at Lake Alau and Pelachiroma, Borno State, Nigeria. It viewed the cost and return of organic manure used with different levels of irrigation intervals on the growth and yield of Onion (*Allium cepa* L.). Treatments consisted of four organic manures (cow dung at rate of 20t/ha, goat dung at rate of 20 t/ha, poultry litter at rate of 15 t/ha and no manure) and five levels of irrigation intervals (3, 6, 9, 12 and 15 days). The economic assessment was based on the onion bulb yield obtained. Partial budgets involving the analysis of variable input costs and benefits were drawn for all the treatments. Items considered were the gross benefit (N/ha), total cost (N/ha), net benefit (N/ha) and marginal rate of returns (MRR). Combined analysis of poultry litter (15t/ha) and 6 days irrigation intervals produced the highest net benefit and marginal rate of return in both trials and the combined. It is recommended that onion farmers in lake Alau and Pelachiroma should employ poultry litter at 15t/ha and 6 days irrigation intervals for high yield and maximum cost benefit.

Keywords – Cost Benefit, Gross Benefit, Net Benefit, Total Cost.

I. INTRODUCTION

Onion (*Allium cepa* L.) is a member of the Alliaceae family and its one of the most important vegetables in the world, whose utility is ranked second to tomatoes [1]. According to [2] onion can be grown on a wide range of climatic conditions, it is an important vegetable crop valued for its pungent or mild flavour and for being the essential ingredient of the cuisine of many regions [3] World production of onion is estimated at over 61.6 million metric tons of bulb, and yield per hectare averaged 18.45 tons with Nigeria's average yield put at 14.8 tons [4]. Based on the level of consumption, onion is the major spice in the diet, ranking 5th most important vegetable in Nigeria [5].

The main production period of onion in Nigeria is during the dry season between September and April. The crop is produced in dry areas in the northern parts of the country, and three crops are possible in a year, two rain fed and one irrigated (Anonymous, 1993). Farmers' production practice of onion involved complex mixture of cropping with other vegetables such as lettuce, tomato and pepper among others. Onion is consumed in different ways by different people and forms an essential part of the traditional daily diet. It is a major spice item and ranks among the top 5 vegetables in Nigeria [6]. It can be eaten raw, in salad, fried, boiled or roasted, and also used in

flavouring soups, canned food products and other savoury dishes. It is used in every home virtually on daily basis [7]. The bulb is used traditionally as a medicinal herb for the treatment of Measles, Pneumonia, Cold and Catarrh [8]. Recent studies have confirmed that onion helps in fighting Osteoporosis or bone loss [9]. Onion production is a viable industry that employs plenty of labour and the bulbs are traded in large quantities within and between countries of the world [10].

Today, most farmers engaged in agricultural activities without decision making tools, their main concern is the total yield forgetting the cost benefit analysis which is the backbone of any farming enterprise. In onion cultivation, under-irrigation lead to losses in total yield and market grades, over irrigation on the other hand leads to soil erosion, bulb disease susceptibility, extra-energy cost for pumping, conducive to bulb rotting pathogens, encourage neck rot which reduces marketability at harvest and prone to storage decomposition. Cost benefit analysis is a technique for evaluating an investment by comparing the economic benefit with the economic cost of the activity. In cost benefit analysis farm record is very important which consists of all the farming activities, it entails the basis for day to day management decision, cost and return analysis. It usually form the basis of profitability analysis, which involve itemizing the cost and return of production and using them to arrive at such estimate as return to one unit of resource. This study therefore was conducted to assess the economic implication of using organic manures with different levels of irrigation intervals on growth and yield of onion at Lake Alau and Pelachiroma in Borno State, Nigeria.

MATERIALS AND METHODS

Site Description

Field trials were conducted in two location of Borno State from November, 2012 to March, 2013 (multi-locational) the first location was at lake Alau in Konduga Local Government Area (11^o44' N, 13^o 10' E) which fall under the Sudan savannah agro ecological vegetation zones with an altitude of 354m above sea level. The second location was at Pelachiroma (Hill *Hawul*) of Hawul Local Government Area of Borno state (10^o35' N, 12^o27' E) which fall under Northern Guinea savanna Agro ecological zone of Borno State with an altitude of 574m above sea level.

Treatments and Experimental Design

The treatments consisted of four organic manures (cow dung, goat dung, poultry litter and no manure) and five levels of irrigation intervals (3, 6, 9, 12 and 15 days) laid out in a Split-plot design with three replications. This gave a total of 60 net plots in each location, measuring 4m² with 1m inter-row path and watering channels. The total area was 305m; seeds of Bama red variety were obtained from local farmers of Bama village. Nursery bed of 1.0 x 2.0m were marked out and cleared, and then seeds drilled into row at 15cm apart. The field was cleared, ploughed and harrowed manually using hoe, then 60 plots of 2x2m (4m) were measured, demarcated and laid out. Irrigation drainage channel of 1m were also made for conveyance of water.

Agronomic Practices

At fifth week after sowing, the seedlings were transplanted on 29th November, 2012 in Lake Alau and on 3rd December, 2012 in Pelachroma with inter-row/intra – row spacing of 15cm x 20cm apart. A three day irrigation interval was maintained for the first week and then continued in respective plots according to the sub-plot treatment (irrigation intervals) and maintained until two weeks to harvest. First weeding was done at 3WAT and second at 6WAT. Organic manure was incorporated into the soil at land preparation with the following rates; poultry litter 15tons/ha, cow and goat dung at 20tons/ha (split application) the second half was applied at 6WAT. Yield parameters measured were bulb diameter, cured bulb weight, percentage of marketable bulb and non marketable bulb and total yield in tons per hectare.

III. RESULTS AND DISCUSSION

Economic Analysis:

In each location the economic assessment was based on the onion bulb yield obtained. Partial budgets involving the analysis of variable input costs and benefits were drawn for all the treatments. Items considered were the gross benefit (₦/ha) calculated as yield of onion (kg/ha) multiplied by market price (₦/ha), total cost (₦/ha) of all inputs and labour used, and the net benefit (₦/ha)

calculated as gross benefit less total cost. The marginal rate of return (MRR) was the net benefit divided by total cost.

Cow dung and irrigation intervals

At lake Alau the economic benefit of using cow dung with different irrigation intervals shows that using cow dung with 6 days irrigation intervals gave the highest net benefit (₦ 30,834.50/ha) and marginal rate of return (₦0.70) thus (Table i), every one N1 expended it yielded ₦ 0.70 as profit, however irrigation intervals of 15 days was at loss with ₦ 4,233.00/ha, thus losses of N0.20 was incurred for every N1 spent. In Pelachroma however using cow dung with 6 days irrigation intervals gave the highest net profit of ₦34,823.00/ha and marginal rate of return(₦ 0.90). Irrigation interval at 15 days was at loss with N 8,369.00/ha. Thus for every ₦1.00 spent loss of ₦0.40 was incurred. Result from the combine analysis of the two location showed that using cow dung with 6 days irrigation intervals yielded a net benefit of ₦32,829.75/ha with marginal rate of return of ₦ 0.80. But using cow dung with 15 days intervals were at loss with ₦6, 301.00/ha and -₦ 0.30 as marginal rate of return, there was loss of N0.30 for every N1 spent.

Goat dung and irrigation intervals

Table ii shows that goat dung used at Lake Alau and 6 days irrigation intervals had the highest net benefit of ₦40,584.50/ha and marginal rate of return of 0.90. Goat dung and 15 days irrigation interval was at loss with ₦1, 383.00/ha and marginal rate of return -₦ 0.06. In Pelachroma using goat dung and 6 days irrigation interval gave the highest net benefit of ₦ 44,575.00 /ha and 1.10 marginal rate of return, thus for every N1 expended a gain of N1.10 was incurred. 15 days irrigation interval was at loss with ₦ 1,769.00/ha and marginal rate of return -0.08. Result from the combined analysis of the two locations showed that application of goat dung on 6 days interval gave the highest net benefit of ₦42,579.75/ha and marginal rate of return at ₦ 1.00) closely followed by 9 days irrigation interval with net benefit of ₦ 18,890.25/ha and marginal rate of return ₦0.60. Goat dung with 15 days irrigation interval was at loss with ₦1, 576.00/ha and - ₦0.07 marginal rate of return.

Table I: Economic assessment of Cow dung and irrigation intervals on the growth and yield of onion in Lake Alau and Pelachroma during 2012/2013 dry cropping season

Treatments	Lake Alau					Pelachroma					Combine				
	Total Yield (Kg/ha)	Total Cost (₦/ha)	Gross Benefit (₦/ha)	Net Benefit (₦/ha)	MRR ²	Total Yield (Kg/ha)	Total Cost (₦/ha)	Gross Benefit (₦/ha)	Net Benefit (₦/ha)	MRR	Total Yield (Kg/ha)	Total Cost (₦/ha)	Gross Benefit (₦/ha)	Net Benefit (₦/ha)	MRR
CD ³ + 3 II ⁴	847.50	82,393.00	84,750.00	2,357.00	0.03	782.50	68,407.00	78,200.00	9,843.00	0.14	815.00	75,400.00	81,500.00	6,100.00	0.08
CD+ 6 II	782.50	47,415.50	78,250.00	30,834.50	0.70	752.50	40,425.00	75,250.00	34,825.00	0.90	767.50	43,920.25	76,750.00	32,829.75	0.80
CD+ 9 II	557.50	35,070.50	44,600.00	9,529.50	0.30	527.50	30,549.00	42,200.00	11,651.00	0.40	542.50	32,809.75	43,400.00	10,590.25	0.35
CD+ 12 II	462.50	28,898.00	37,000.00	8,102.00	0.30	360.00	25,611.00	28,800.00	3,189.00	0.12	411.25	27,254.50	32,900.00	5,650.00	0.21
CD+ 15 II	322.50	24,783.00	20,550.00	-4,233.00	-0.20	232.50	22,319.00	13,950.00	-8,369.00	-0.40	287.50	23,551.00	17,250.00	-6,301.00	-0.30

¹Naira (Nigerian currency), ²Marginal rates of returns, ³Cow dung, ⁴Irrigation intervals

Table II: Economic assessment of Goat dung and irrigation intervals on the growth and yield of onion in Lake Alau and Pelachiroma during 2012/2013 dry cropping season

Treatments	Lake Alau					Pelachiroma					Combine				
	Total Yield (Kg/ha)	Total Cost (₦/ha)	Gross Benefit (₦/ha)	Net Benefit (₦/ha)	MRR ²	Total Yield (Kg/ha)	Total Cost (₦/ha)	Gross Benefit (₦/ha)	Net Benefit (₦/ha)	MRR	Total Yield (Kg/ha)	Total Cost (₦/ha)	Gross Benefit (₦/ha)	Net Benefit (₦/ha)	MRR
GD ³ + 3 II ⁴	877.50	82,393.00	87,750.00	5,357.00	0.10	920.00	68,407.00	92,500.00	24,093.00	0.40	898.75	75,400.00	90,125.00	14,725.00	0.25
GD+ 6 II	880.00	47,415.50	88,000.00	40,584.50	0.90	850.00	40,425.00	85,000.00	44,575.00	1.10	865.00	43,920.25	86,500.00	42,579.75	1.00
GD+ 9 II	677.50	35,070.50	54,200.00	19,129.50	0.60	615.00	30,549.00	49,200.00	18,651.00	0.61	646.25	32,809.75	51,700.00	18,890.25	0.60
GD+ 12 II	542.50	28,898.00	43,400.00	14,502.00	0.50	475.00	25,611.00	38,000.00	12,389.00	0.50	508.75	27,254.50	40,700.00	13,445.50	0.50
GD+ 15 II	390.00	24,783.00	23,400.00	-1,383.00	-0.06	342.50	22,319.00	20,550.00	-1,769.00	-0.08	366.25	23,551.00	21,975.00	-1,576.00	-0.07

¹Naira (Nigerian currency), ²Marginal rates of returns, ³ Goat dung, ⁴Irrigation intervals

Table III: Economic assessment of Poultry Litter and irrigation intervals on the growth and yield of onion in Lake Alau and Pelachiroma during 2012/2013 dry cropping season

Treatments	Lake Alau					Pelachiroma					Combine				
	Total Yield (Kg/ha)	Total Cost (₦/ha)	Gross Benefit (₦/ha)	Net Benefit (₦/ha)	MRR ²	Total Yield (Kg/ha)	Total Cost (₦/ha)	Gross Benefit (₦/ha)	Net Benefit (₦/ha)	MRR	Total Yield (Kg/ha)	Total Cost (₦/ha)	Gross Benefit (₦/ha)	Net Benefit (₦/ha)	MRR
PL ³ + 3 II ⁴	1,050.00	82,498.50	105,000.00	22,501.50	0.30	1,295.00	68,512.50	129,500.00	60,987.50	0.90	1,172.50	75,505.50	117,250.00	41,744.50	0.60
PL+ 6 II	1,125.00	47,523.00	112,500.00	64,977.00	1.40	1,345.00	40,530.00	134,500.00	93,969.50	2.32	1,235.00	44,026.75	126,000.00	81,973.25	1.86
PL+ 9 II	810.00	35,175.50	64,800.00	29,624.50	0.84	875.00	30,654.50	70,000.00	39,345.50	1.30	842.50	32,915.00	67,400.00	34,485.00	1.05
PL+ 12 II	605.00	29,003.50	48,400.00	19,396.50	0.70	562.50	25,716.50	45,000.00	19,283.50	0.75	583.75	27,360.00	46,700.00	19,340.00	0.70
PL+ 15 II	440.00	24,888.50	26,400.00	1,511.50	0.06	470.00	22,424.50	28,200.00	5,775.50	0.30	455.00	23,656.50	27,300.00	3,643.50	0.15

¹Naira (Nigerian currency), ²Marginal rates of returns, ³Poultry Litter, ⁴Irrigation intervals

Table IV: Economic assessment of No manure (control) and irrigation intervals on the growth and yield of onion in Lake Alau and Pelachiroma during 2012/2013 dry cropping season

Treatments	Lake Alau					Pelachiroma					Combine				
	Total Yield (Kg/ha)	Total Cost (₦/ha)	Gross Benefit (₦/ha)	Net Benefit (₦/ha)	MRR ²	Total Yield (Kg/ha)	Total Cost (₦/ha)	Gross Benefit (₦/ha)	Net Benefit (₦/ha)	MRR	Total Yield (Kg/ha)	Total Cost (₦/ha)	Gross Benefit (₦/ha)	Net Benefit (₦/ha)	MRR
NM ³ + 3 II ⁴	332.50	81,943.00	3,325.000	-4,869.300	-0.60	37.000	67,957.00	37,000.00	-30,957.00	-0.50	35.125	74,950.00	35,125.00	-39,825.00	-0.53
NM+ 6 II	272.50	46,965.50	2,725.000	-1,971.550	-0.42	30.000	39,975.00	30,000.00	-9,975.00	-0.25	28.625	43,470.25	28,625.00	-14,845.25	-0.34
NM+ 9 II	207.50	34,620.50	1,660.000	-1,604.050	-0.50	23.000	30,099.00	18,400.00	-11,699.00	.040	21.875	32,359.75	17,500.00	-14,859.75	-0.50
NM+ 12 II	130.00	28,448.00	1,040.000	-1,804.800	-0.63	13.750	25,161.00	11,000.00	-14,161.00	-0.60	13.375	26,804.50	10,700.00	-16,104.50	-0.60
NM+ 15 II	95.00	24,333.00	570.000	-1,863.300	-0.80	10.500	21,869.00	6,300.00	-15,569.00	-0.71	10.000	23,101.00	6,000.00	-17,101.00	-0.74

¹Naira (Nigerian currency), ²Marginal rates of returns, ³No manure, ⁴Irrigation intervals

Poultry litter and irrigation intervals

Poultry litter on 6 days irrigation intervals at Lake Alau gave the highest net benefit of ₦ 64,977.00/ha and marginal net of return 1.40 Table iii followed by 9 days irrigation interval (₦ 29,624.50/ha) and marginal rate of return 0.80. However poultry litter with 15 days interval gave the lowest net benefit of ₦1,511.50/ha and marginal rate of returns ₦ 0.06. In Pelachiroma, using poultry litter with 6 days irrigation interval gave the highest net benefit ₦ 93,969.50/ha and marginal rate of return (₦ 2.32, thus for every ₦1.00 spent a gain of ₦2.32 was incurred. However using poultry litter with 15 days irrigation interval gave the lowest profit of ₦ 5,775.50/ha and marginal rate of returns ₦ .030. In the result of combined analysis for the two location Irrigation interval with 6 days gave the highest net benefit (₦ 81,973.25/ha) and marginal rate of return ₦= 1.86) at the other hand

irrigation interval with 15 days gave the lowest net benefit (₦ 3,643.50/ha) and marginal rate of return ₦ 0.15.

No manure (control) and irrigation intervals

As shown on table iv using no manure for the production of onions in Lake Alau and Pelachiroma with different irrigation intervals has no any economic benefit rather than loss. In Lake Alau the highest loss was at 3 days irrigation with ₦— 48,693.00/ha, equally in Pelachiroma and the combined location which were ₦ 30,957.00/ha and ₦ 39,825.00/ha respectively.

From the fore going results of cow dung, goat dung, poultry litter and no manure with various irrigation intervals, it was seen that poultry litter produced the highest mean net benefit (N 81,793.25/ha) and marginal rate of return ₦ 1.86 with 6 days irrigation intervals. This is as a result of the poultry litter used coupled with optimum irrigation intervals that led to maximum yield

and good bulb quality, most of the onion under this treatment had bulb with the widest bulb diameter, large marketable sizes and perhaps contributed to high net benefit after selling, this is in line with the report of [11] that selling price determines the gross benefit. [12] also reported that poultry manure appears to be the most important and cost effective organic manure on the yield of onion at Kumasi, Ghana. [13] Confirmed the superiority of poultry manure over the other plant nutrients source with respect to bulb size and yield as a result of high nutrient content of the poultry litter and its ability to release adequate nutrient to the plant leading to high yield. In onion production larger bulb sizes is associated to high yield which in turn resulted to good market price. [14] reported that the use of poultry litter completely waived off external cost incurred due to investment in chemicals, nutrient run off and a number of health issues that resulted from agro chemicals residues. [15] Reported that farmers could substitute NPK fertilizer with poultry manure to reduce the cost of inorganic fertilizers and their damaging effect to soil. Based on water consumption as stated by [16], *Optimum* irrigation leads to maximum yield, good bulb quality and market grades.

IV. CONCLUSION

Poultry litter at application rate of 15t/ha and irrigation intervals of 6 days is the most suitable in onion production at lake Alau and Pelachiroma economically, this is as the result of the highest net benefit/ha obtained. In view of these overwhelming potentials of poultry manure used in the study, it is therefore worthy to recommend that onion farmers will utilize organic manure, especially for high economic returns, soil improvement and environment sustainability.

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