PROFITABILITY AND RESOURCE-USE EFFICENCY OF MELON UNDER SOLE AND MIXED CROPPING SYSTEM IN NIGER STATE, NIGERIA

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ABSTRACT

This study examined the profitability and resource-use efficiency of melon under sole and mixed cropping systems in Niger State, Nigeria. Data collection involved the use of primary data through structured questionnaire. A multi-stage random sampling technique was used in selecting the respondents for the study and a total of 120 farming households engaging in melon production were used. Data were analyzed using budgetary analysis to determine the profit levels of the farmers, elasticity of production and returns to scale were used to determine the economic of scale while efficiency ratio was used to determine the resource-use efficiency of the farmers. The result of the costs and returns analysis revealed that Gross Margin/Ha was ₦170,304.69 and ₦67,199.39 for sole cropping and mixed cropping systems, respectively. Some of the problems identified were poor yield, water scarcity and non-availability of credit. Governments should organize adult education to educate the farmers on how to effectively utilize the resources at their disposal.

Key words: Melon (*Citrullus colcynthis*), melon production, socio-economic analysis, Ifelodun.

INTRODUCTION

Agriculture in Nigeria is dominated by small–scale farmers who produce about 80% of the total food requirement (Fayinka, 2004 and Mohammed, 2011). Among the crops grown by these farmers is vitamin and mineral rich-vegetable of which melon (*Colosynthis citrullus lanatus*) belongs. Melon, an annual crop, is one of the food crops commonly cultivated under sole and mixed cropping systems. Its production is more popular in the northern parts of Nigeria where there is abundance of cultivable land which has made the practice of sole and mixed cropping possible (Yusuf *et al.,* 2008). Sole cropping is the growing of a single crop on a piece of land while mixed cropping is the growing of two or more crops simultaneously on a piece of land. Research has shown that mixed cropping system leads to better utilization of land, labour and capital. It also ensures food security against total crop failure or with intent to maximize yield and profit making by the use of the same labour operations (Usman, 1997). Conversely, sole cropping ensures better yield as competition for nutrients by other crops is eliminated. Also, it aids the effective use of machineries, and application of chemicals is made easier. In Nigeria, melon is inter-planted with other crops like maize, cassava, pepper and yam. Generally, melon as cover crop provides a fast and good ground cover that suppresses weed, prevents erosion, reduces evaporation of water from the soil as well as increases the nutrient availability in the soil. Oil can be extracted from the seed and the seed kernel can be formed into paste and used as cuisine in many African dishes. Moreover, melon provides employment and generates income and foreign earnings to farmers and government, respectively. Therefore, farmers need to know how to put to use the available resources to maximize its yield as well as knowing the best cropping system to adopt to attain the maximum profit level. In essence, to achieve maximum profit level and efficiency in resource mix, resources have to be optimally and efficiently utilized. Hence, the objectives of this paper are to determine the profitability of melon (*Citrullus lanatus*) under sole and mixed cropping system; determine input and output levels in melon production and determine the resource-use efficiency by melon farmers under sole and mixed cropping patterns.

Theoretical framework

Efficiency is concerned with the relative performance of the process of transforming given inputs into outputs. Productivity of any resources can be defined either in terms of a combination of resources or individual resources used. Efficiency was decomposed into technical and allocative by Farrel (1957). Farrel defined technical efficiency as the physical ratio of output to the factor input. The greater the ratio, the greaterthe magnitude of technical efficiency. On the other hand, allocative

efficiency refers to the ability of a farm to use inputs optimally given their prices. That is, a firm is allocatively efficient when production occurs at a point where the Marginal Value Product is equal to the Marginal Factor Cost (Ojo, 2013). Economic efficiency is a combination of technical and allocative efficiencies. It is an indication that gains could be obtained by the varying of input ratio on certain assumptions about the farms price structure (Xu and Jeffrey, 1995). Measures of technical efficiency give an indication of the potential gains in output if inefficiencies in production were to be eliminated (Lyubor *et al.*, 2000).

METHODOLOGY

The study area: Niger State is located between latitude 8^0 20' N and $11^0$30' N and longitudes 3° 30' E and 7° 20' E. The State is bordered to the North by Zamfara State, to the North-west by Kebbi state, to the south by Kogi State, to the South-west by Kwara State, while Kaduna State and the Federal Capital Territory borders the State to the North-east and South-east respectively. Furthermore, the State shares a common international boundary with Republic of Benin at Babanna in Borgu Local Government Area (LGA) (Obi *et al*., 2008). It has twenty-five LGAs and covers a total land area of 86,000 square kilometer which is mainly grassland with scanty trees all year around. It has an annual rainfall of 1000-1600 mm with temperature of 38^0C and the relative humidity of 42^0.C Agriculture is the major occupation in the state with about 80% of the population engaged in farming. The state produce crops like yam, beans, cassava, rice, millet, groundnut, maize and sugar cane. The State Ministry of Agriculture with the State Agriculture Development Projects provides subsidized agricultural inputs such as pesticides, fertilizers and seedling to farmers so as to boost agricultural production and melon in particular.

Sampling procedure: A multi-stage sampling technique was used. The first stage involved random selection of two Local Government Areas (LGAs) from the State. The second stage involved random selection of five villages/towns from each LGA while the third stage involved the selection of ten farmers from each village/town making a total of hundred farmers in all. Farmers involved in melon production (sole and mixed) were used for the study. For the melon under mixed cropping system, inputs were divided in the ratio of the number of crops in the mixture per stand in order to get the cost of melon inputs only. Data for the study were primary data collected with the aid of structured questionnaire.

Analytical Techniques: Profitability analysis was used to determine the costs and returns for melon production in the area. The net farm income (NFI) is the difference between gross income (GI) and the total cost (TC) of production (Olukosi and Erhabor, 1988).

NFI = GI – TC ……..(1)

The model used for estimating net farm income can be expressed by the equation:

$$NFI=\sum_{i-1}^{n} P_{y1}Y_1-\sum_{j-1}^{m} P_{xj}X_j-\sum_{k-1}^{k} F_k$$

Where, NFI = Net Farm Income

Y_1= Enterprise's Product(s) (where i = 1, 2, 3…….n products)

P_{y1}= Unit price of the product

X_j = Quantity of the variable inputs (where j =, 1, 2, 3…… in variable inputs)

P_{xj} = Price per unit of variable inputs.

F_k = Cost of fixed inputs.

Σ = Summation (addition) sign

The linear, semi-log and Cobb-Douglass regression functions were used to determine the input-output level in melon production. The best regression fit was determined by the level of R^2, the level of significance of overall model (F-Statistics), and the level of significance of each coefficient.

The model in its general form is:

$Y = f (X_1, X_2, X_3, X_4, X_5, U_i)$ ..(2)

Where Y = output from production (kg)

X_1 = Farm size (ha)

X_2 = Quantity of seed (kg)

X_3 = Quantity of fertilizer (kg),

X_4 = Labour Input (Man-days)

X_5 = Agro-Chemical (litre)

U*i* = Error term

Resource-use efficiency analysis was computed for each resource input used.

$$r = \frac{MVP}{MFC} \quad \text{.....}$$

Where,

Where, r = Efficiency ratio, MVP = Marginal Value Product of a variable input,

MFC = Marginal Factor Cost

The MVP was estimated as follows:
$MVP = MPP. P_y$
Where, MPP = Marginal Physical Product and, P_y = Price of output.
If r = 1, resource is efficiently utilized, r > 1, resource is under-utilized and r < I, resource is over-utilized.

Economics of Scale: This is the measure of firm's success in producing maximum output from a given set of inputs. The Elasticity of Production (ε_P) and Return To Scale (RTS) was estimated using the formular: $\sum \varepsilon_{Pxi} = RTS$

RESULTS AND DISCUSSION

Estimated Gross margin analysis for melon production under sole cropping system: The estimated gross margin analysis for melon production under sole cropping system is shown in Table 1. The Table shows that cost of hired labor constituted about 16.9% of the total cost of production followed by seed cost, herbicides and fertilizers with 0.9, 2.95 and 6.59% respectively. A confirmation of profitability for sole melon production is shown by a net income of ₦99,792.69. Also, the return on a Naira invested was ₦6.42 while gross and operating ratios were 0.49 and 0.13 respectively. Since all these ratios were less than 1, it is a proof that melon production under sole cropping system is a profitable venture in the study area

Estimated Gross margin analysis for melon production under mixed cropping per hectare: The estimated gross margin analysis for melon under mixed cropping system per hectare is shown in Table 2. The Table showed that cost of hired labor constituted 30.67 % of the total cost of production followed by seed cost, herbicides and fertilizers with 1.27, 20.54 and 10.54%, respectively. The net farm income accounted for ₦44,620.94. Also, the return on a Naira invested was ₦1.84 while gross and operating ratios were 0.57 and 0.35 respectively. All the ratios were less than 1 indicating profitability of melon production under mixed cropping system.

Table 1: Gross margin analysis for melon production under sole cropping system

Items of Costs and Returns (₦)	Cost/Ha	% of Total Cost
Variable cost		
Hired labour	16,380.91	16.88
Seed cost	900.76	0.93
Herbicides	2,863.64	2.95
Fertilizer	6,400.00	6.59
Total variable cost	26,545.31	27.35
Fixed cost		
Cost of renting land	20,000.00	20.61
Depreciation on farm tools	2,511.81	2.59
Interest on loan	48,000.00	49.46
Total fixed cost	70,511.81	72.65
Total cost	97,057.21	100.00
Returns		
Gross income	196,850.00	
Gross margin	170,304.69	
Net Farm Income	99,792.88	
Return on Naira invested	6.42	
Operating ratio	0.13	
Gross ratio	0.49	

Source: Data Analysis, 2011

With these findings, it is clear that sole farming with return on Naira invested as ₦6.42 is more profitable than mixed farming system with return on Naira invested as ₦1.84. This result is also in line with the findings of Yusuf (2005) that the more the number of crops in the mixture the less the yield and the less the profitability, which he attributed to the competitive effects of the various crops for water, sunshine and nutrients.

Input-output analysis: Table 3 shows the regression analysis indicating the input-output

levels in melon production. The F-Ratio shows that the whole model is significant at 1%

Table 2: Estimated Gross margin analysis for melon production under mixed cropping system

Items of costs and returns (₦)	Cost/ha	% of Total cost
Variable cost		
Hired labour	18,145.31	30.67
Seed	757	1.27
Fertilizer	12153.19	20.54
Herbicides	6235	10.54
Total variable cost	36,590.50	61.84
Fixed cost		
Cost of renting land	20000	33.80
Depreciation on farm tools	2578.45	4.36
Total fixed cost	22,578.45	38.16
Total cost	59,168.95	100
Returns		
Gross income	103,789.89	
Gross margin	67,199.39	
Net Farm Income	44,620.94	
Return on Naira invested	1.84	
Operating ratio	0.35	
Gross ratio	0.57	

Source: Data Analysis, 2011

while the value of Coefficient of Determination (R^2) indicated that about 57.5% of the variation in output is explained by the inputs included in the regression model while the remaining 42.5% is as a result of non-inclusion of some explanatory variables as well as other factors outside the control of the farmers. The regression coefficients of farm size (X_1) and labor (X_4) are positive at 5% and 1% levels of probability indicating that a unit increase in these variables holding other factors constant will lead to increase in the gross output of melon. Conversely, the coefficient of fertilizer (X_3) is negative at 10% level of probability indicating that a unit increase in this input holding others constant will lead to decrease in the gross output of the melon. In essence, these significant input variables are the main factors affecting the output level of melon production in the study area.

Table 3: Estimated semi log production function (lead equation)

Variables	Regression coefficients	T-value
Farm size (X_1)	126.035	2.147**
Quantity of seed (X_2)	-42.366	-0.575^{NS}
Fertilizer (X_3)	-122.962	-1.857*
Labor Input (X_4)	763.519	10.990***
Agrochemical (X_5)	11.751	0.193 NS
Constant	-2442.255	-5.436 NS
$R^2 = 0.575$	F ratio=27.814***	

*** Significant at 1%, ** at 5% and * at 10% level of probability, NS- Not significant

Resource-use efficiencies: The resource-use efficiency of the various production inputs employed in this study is as indicated in Table 4. It was discovered that farm size, fertilizer and labor inputs with efficiency ratios of 0.223, 0.00728 and 0.00028 respectively were under-utilized. This result is consistent with the findings of Ugwumba (2010) on allocative

efficiency of 'Egusi' production inputs in Owerri West Local Government Area of Imo State who reported that labor input was over-utilzed. Chiedozie (2010) in his work on resource use efficiency in arable crop production among smallholder farmers in Owerri Agricultural zone of Imo State also reported that arable crop farmers over-utilized the resources of labour and fertilizer but under-utilized the resources of land. Though, the various inputs combination were not at optimum utilization level, yet optimization is possible under the existing level of technology if the inputs can be reduced by 77.7%, 99.27% and 99.97% respectively .

Table 4: Estimated Resource-use efficiency of melon production in the study area

Variables	MPP	MVP	MFC	Efficiency ratio
Farm size (X_1)	52.345	335.06	1500	0.22300
Fertilizer (X_3)	0.008	0.051	70	0.00728
Labor Input(X_4)	0.022	0.14	500	0.00028

Source: Data analysis, 2011

Elasticity of production and return to scale: The elasticity of the various production inputs mix which is explained in terms of return to scale is presented in Table 5. The return to scale value of 7.701 showed an increasing return to scale for melon producers in the State. In other words, a 1% increase in any of the inputs will lead to a corresponding increment of the melon output by 7.7%. The result is consistent with the findings of Ajibefun (2002) and Uchegbu (2001).

Table 5: Estimated elasticity of factor inputs and return to scale

Variables	Elasticity of production
Farm size (X_1)	12.389
Quantity of seed (X_2)	-2.131
Fertilizer (X_3)	-0.165
Labor Input (X_4)	0.504
Agrochemical (X_5)	-2.896
Return to scale	**7.701**

Source: Data analysis, 2011

CONCLUSION AND RECOMMENDATION: The profitability analysis revealed that sole cropping system is more profitable than mixed cropping system. Also, the input-output level analysis revealed that farm size, fertilizer and labor were the main factors affecting the output level of melon production in the study area. In addition, most of the production inputs were not at optimal usage but the farmers were operating at an increasing return to scale which was an indication that they were successful in their chosen enterprise. Based on these findings, extension efforts should be directed into educating the farmers on sole cropping system through field demonstrations, workshops and seminars. Also, Governments should organize adult education to educate the farmers on how to effectively utilize the resources they under-utilized during the period.

REFERENCES

AchiganDako, G. E, Vodouhe, S. R. & Sangare, A. (2008). Caracterisation morphologique des cultivars locaux de Lagenaria siceraria collectes au Benin *et au* Togo. *Belgium Journal Botswana*, 141: 21-38.

Alamu, J. F. (2002). Comparative Analysis of Maize –Legumes intercropping System in Sabon Gari Local Government Area, Zaria, Kaduna State, Nigeria'. *Journal of Sustainable Tropical Agricultural Research*, 4: 87-93.

Chiedozie, E. C. (2010). Resource Use Efficiency in Arable Crop Production Among Smallholder Farmers in Owerri

Agricultural Zone of Imo State,Nigeria. *Researcher* 2(5): 6-7.

Farrel, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society*, 120, Part III: 253-290

Fayinka, F.A. (2004). Food Security in Nigeria: Challenges under Democratic Dispensation. Paper presented at the 9th ARMTI Annual Lecture held on March 24.

Olukosi, J. O. & Erhabor, P. O. (1988). Introduction to Farm Management Economics; Principles and Applications. AGITAB Publishers, Zaria, Nigeria. pp 48-56.

Usman, A. (1997). Effects of Nitrogen Rates and Period of Weed Interference on Maize/Rice Mixture. M.Sc Thesis. Agronomy Department, Ahmadu Bello University, Zaria. pp. 1-2.

Mohammed, B. T. (2011). Socio-economic analysis of melon production in Ifelodun Local Government Area, Kwara State, Nigeria. *Journal of Development and Agricultural Economics*, 3(8): 362-367.

Ugwumba, C. O. A. (2010). Allocative Efficiency of 'Egusi' Melon(*Colocynthis citrullus lanatus)* Production Inputs in Owerri West Local Government Area of Imo State, Nigeria. *Journal of Agricultural Science*, 1(2): 95-100

Xu X. & Jeffrey, S. R. (1995). Efficiency and technical progress in traditional and modern agriculture: evidence from rice production in China, University of Alberta, Department of Rural Economy, Staff Paper. Pp 56

Yusuf, O. (2005). Economic Analysis of Melon Production in Okehi Local Government Area of Kogi State. M.Sc Thesis. Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria. pp 40-41.

Yusuf, O., Sanni, S. A, Ojuekaiye, E. O. & Ugbabe, O. O. (2008). Profitability of melon (*citrullus lanatus thunb. mansf*) production under sole and mixed cropping systems in kogi state, nigeria Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria, Nigeria pp 14-18