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OPTIMIZATION OF FARM RESOURCES IN SMALL-SCALE COTTON PRODUCTION IN NIGER STATE, NIGERIA

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ABSTRACT

Inefficiency in the use and allocation of resources constitute a major problem to increased Agricultural production in Nigeria. The study examines Optimization of resource-use among cotton farmers in Niger State, Nigeria where cotton is predominantly grown. Data collected for the study was for 2012 cropping season. One hundred and twenty farmers were sampled using multi- stage sampling techniques. Pre-tested questionnaire was used to elicit information's for the study. Data collected were analyzed using budgeting technique and inferential statistics. Results indicates mean gross margin of ₦15,320.00, mean net farm income of ₦13,330.00 and net return on investment of 0.27, implying that cotton production is profitable in the study area even though the profit stream is low. The linear functional form gave best fit with R^2 of 75% and it indicated that all variables included in the model significantly influenced cotton output. For the efficiency analysis, all resources used were not efficiently utilized. Generally, inputs such as labour, farm size and seed were over-utilized, while chemical and fertilizer were under-utilized. Opportunities still exists to increase cotton output in the study area by adjusting the level of the productive resources employed.

KEYWORDS: Profit; Optimization; Cotton farmers'; Small-scale; Niger state, Nigeria.

INTRODUCTION

Cotton (*Gossypium spp*) is one of the most important vegetable fibres used in textiles and it plays a very great role in international trade with its exact origin is not known (Daniel *et al*., 2010). Cooper (1990) said it might have its origin in central and South America. The increase in the world cotton production in the 1970s and 1980s has been reported by Yudelma *et al* (1998) as a result of expansion in the use of pesticides, field trials revealed that 50% of the yield of cotton will be lost if not sprayed.

In Nigeria, prior to oil boom cotton was one of the main source of foreign exchange earner and second largest employer of labour after the public sector (Daniel *et al*., 2010). Since the inception of the Nigerian cotton board

(NCB) in mid 70s it has been observed that cotton production has fallen to a very high level, thereby endangering the future of the Nigerian textile industries and causing an un-necessary

drain on the country's foreign exchange following the law establishing structural Adjustment Programme (SAP) in the Nigerian economy and the scrapping of the commodity board by the federal military Government in the mid eighties. The peak period of cotton production in Nigeria was as far back as 1976/77 when about 453,126 bales (183.43kg/bale) were produced (Olukosi and Isitor, 1990). Thereafter production started declining due to price fluctuation, pest infestation and other related problems. By 1983/84 only 69,000 bales was produced while the demand for lint that year was about 531,000 bales which might have been satisfied through importation at the expense of foreign reserves (Olukosi and Isitor,1990). A further study reveals a glaring disparity between cotton production and consumption (Gusau, 1989).

Cotton production in Nigeria is still in the hands of small scale farmers whose average farm size is about 0.5ha and about 0.8 million farmers are growing the crop on an estimated total area of 6 – 700,000ha (Olukosi *et al*, 2008). The farmers average output is still low as reported by USDA (1994), because cultivation is still done mostly with hand tools such as hoes, animal drawn implements and also tractors. Despite their distinctive and critical position, small farmers belong to the poorest sector of population and therefore cannot invest on their farm. The vicious cycle of poverty has led to the unimpressive performance of the agricultural sector. Priority is given to foods crops which results to late planting of cotton, with minimal application of fertiliser and insecticides which give a minimum output of about 300kg/ha. The decline in the cotton production and other related commercial crops lead to the establishment of Raw Materials Research Development Council (RMRDC) by Federal Ministry of Science and Technology. The council was mandated to work out the modalities to improve on the output of specific crops which cotton was one.

In Niger state, cotton is been produced in eight LGAs' with little or no attention given by the government to encourage increased production of these cash crop. Despite the declining trend of cotton share in textile fibres since 1970s, cotton still remains the most important natural fibre of the 20th century and it represent 38% of the fibre market in early 2000s (Horton and Mackay, 2003).

In view of its widespread forward and backward linkages, the cotton crop occupies a unique position in the rural economy of Nigeria. Its performance holds the key not only for the growth and development of agriculture sector but also for the healthy growth in the overall economy. However, still there is huge potential to increase overall cotton production. Therefore, to increase cotton productivity, sound macro and micro-economic farm policies are needed. These require a knowledge of aggregate farm level resource availability and

differences in the productivities of these resources in different farm sizes. This paper tries to provide some useful information in policies towards increasing cotton production. Therefore, it is proper to examine resource productivity in cotton production on small scale farms, and to report evidence related to resource use and farm productivity.

Theoretical framework: The discipline of economics is related to the maximization of well-being in the face of unlimited wants and limited resources. The primary focus of economics is to allocate resources in such a way that enhance the community well-being. Achieving an optimal allocation of resources, the allocation that maximizes well-being, needs attention to the three fundamental economic questions i.e. what to produce which is commonly known as allocative efficiency? How to produce? To whom should goods and services be distributed?

The current research considered only first fundamental economic equation. Resource allocation and productivity is an important aspect of increased Agricultural production, which is also associated with the management of the farmers, who employ these resources in production. Furthermore, efficiency in the use of available resources is a major pivot for a profitable farm enterprise. Efficiency measurement is crucial because it leads to a substantial resource savings (Bravo- Ureta and Rieger, 1991). One of the strategies for increasing agricultural production is a combination of different measures designed to increase the level of farm resources as well as make efficient use of the resources already committed to the farm. Technical inefficiency arises when less than maximum output is obtained from a given bundle of factors while allocative inefficiency arises when factors are used in proportions, which do not lead to profit maximization i.e. underutilization of resource. Efficient use and allocation of resources imply that a redistribution or re-allocation of resources achieves optimal level of production. Productivity is considered as a measure of the efficiency of all resources employ in any farming operation. It is defined as an indicator of the resource efficiency to its mean increase in optimal allocation and combination of farm resources (Olayide and Heady, 1982). Productivity could as well be measured in terms of marginal physical product (MPP) in which case, the interest is in the addition to total product resulting exclusively from a unit increase in the use of that input i.e., total factor productivity growth. It therefore sufficient to say that productivity or resource use efficiency can only be measure and ascertained from farm-level efficiency (Udoh and Oluwatoyin, 2006).

Daniel *et al*. (2010) used production function analysis to estimate efficiency of resource-use among cotton farmers in the southern part of Adamawa state, Nigeria and determined the optimal resource allocation for adjustment in resource allocation. They reported that there is

inefficiency in the use of resources. Gwandi *et al.* (2010) used production function analysis to estimate efficiency of resource-use in cotton production in Gassol local government area of Taraba state, Nigeria and determined the optimal resource allocation for adjustment in resource allocation. They reported that there is inefficiency in the use of resources. Muhammad *et al* (2011) used production function analysis to analyse efficiency of resource-use in small Bt cotton farmers in Punjab, Pakistan and reported that the resources are not efficiently allocated. Similar results in the same province in Pakistan but on medium sized Bt farmers was reported (Muhammad *et al*., 2012). Hence, Adjustments in resource allocation for economic optimum was required in order to meet the needed percentage change based on the equality of marginal value products and marginal factor costs inputs.

RESEARCH METHODOLOGY

The study area is Niger State of Nigeria. The State is located in North-central Nigeria between Latitudes 8˚20´N and 11˚30´ N and Longitudes 3˚30´ E and 7˚20´E with a total land area of 76,363 square kilometres and a population of 4,082,558 people (Wikipedia, 2008). Annual rainfall is between 1100mm and 1600mm with average monthly temperature hovering around 23˚C to 37˚C (NSADP, 1994). The range of local climatic and soil conditions, resource availability, and markets allows favourable fish farming practices. Both primary and secondary data were used for the study. The main instrument for eliciting the primary data was structured questionnaire. Information was collected on input and output and socio-economic characteristics of cotton farmers through personal interview. Primary data were supplemented with secondary data from journals, books and publications. A multi-stage sampling technique was used to select a total sample size of 120 farmers from the sampling frame obtained from Niger state Agricultural Development Project (NSADP). Summarily, all cotton producing area were purposively selected (Rafi, Mariga, Magama, Borgu, Rijau, Agwara LGAs' respectively), proportional sampling size of each area was determined, and then random selection from each area proportional sampling size was done. Data analysis was done using farm budgeting techniques and inferential statistics.

Empirical model

1. ***Budgeting Technique***

*T*he specific type of budgeting technique used was the gross margin analysis as well as the Net Farm Income. The model is stated thus:

GM = GI – TVC …….(1)

Where: GM = Gross Margin

GI = Gross Income

TVC = Total Variable Cost

NFI = GM – TFC …….(2)

Where: NFI = Net Farm Income

GM = Gross Margin

TFC = Total Fix Cost

2. *Regression Model*

The production response function model was expressed implicitly according to Mbanasor and Obioha (2003) thus:

$Y = f(X_1, X_2, X_3, X_4, X_5, Ui)$..... (3)

Linear, Exponential, Double-log and Semi-log forms of the production function were fitted to the data. The linear function form gave the best fit and was chosen as the lead equation on the basis of the number of significant variables, magnitude of R^2, F-statistics, standard error and the signs of co-efficients.

The explicit form of the lead equation is given as:

$Y= b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + Ui$ … …….(4)

Where:

Y = Output in kilogram (kg);

X_1 = labour (man-days);

X_2 = Farm size (hectares);

X_3 = Seeds (kg);

X_4 = Chemical (litres); and

X_5 = Fertilizer (kg);

U_i = Error term.

b_0 = Intercept.

b_1-b_5 = Regression co-efficient.

Efficiency of resources use was determined by the ratio of marginal value product (MVP) to marginal factor cost (MFC) of inputs based on the estimated regression coefficient. Following Iheancho *et al*. (2001) efficiency of resource r is given as:

R=MVP/MFC…… (5)

The rule provides that when r =1, there is efficient use of a resource, r>1 indicates underutilization of a source. The values of MPV and MFC were estimated as follows:

MVP=MPP. Py

MPP = b (regression co-efficents)

MFC = P_x

Where:

R=Efficiency ratio.

MVP =Marginal value product.

MPP =Marginal physical product.

MFC =Marginal factor cost, Pxi (unit price of input Xi).

Py=Unit price of output.

Elasticity of production was used to measure the response of output to change in the variable input. Based on

the function of fit the elasticity of various inputs was determined by this formally.

Ep = b* Xi/Y…….(6)

Where:

E_P = Elasticity of production.

b = Co-efficient.

Y=Arithmetic mean value of output.

Xi =Arithmetic mean value of input considered.

RESULTS AND DISCUSSION

Cost and returns in cotton production: An estimated net income per hectare per annum was analysed. Olukosi and Erhabor (2008) stated that gross margin analysis enables the estimation of the total expenses (costs) as well as various receipts (revenue or returns) within the production period. Table 1 revealed that farmers incurred an average variable cost of ₦47,180.00 per hectare; an average total costs of ₦49, 170.00 and an average estimated return of ₦62,500.00 per hectare. This implies that the farmers made a gross margin of ₦15, 320.00 per hectare and a profit of ₦13, 330.00 per hectare. The farm Gross Ratio (GR) was 0.79 and an operating ratio of 0.75 which showed that 79% of the gross income was accounted for by total cost. A ratio less than 1 is always desirable for any farm business. The lower the ratio the higher the returns on naira invested (Olukosi and Erhabo, 2008). In addition, net returns on investment was 0.27 for the farmers, indicating that they returned on

the average ₦0.27 for every ₦1.00 naira invested in the business, thus further confirming the profitability of catfish production in the study area. Production efficiency index (1.27) per hectare indicates that returns exceed cost by 27% which adjudged the profitability of the enterprise in the study area. The farmers are therefore encouraged to continue in the business because it is profitable.

Table 1: Costs And Return structure per hectare

Costs items	Cost (₦)
Variable costs	
Labour	10,350.00
Seeds	5,600.00
Fertilizer	14,000.00
Chemicals	3,200.00
Transportation	11,230.00
Rent on land	2,800.00
Total variable cost	47,180.00
Fixed cost	
Depreciation on capital items	1,240.00
Interest charge on loan	750.00
Total fixed cost	1,990.00
Total farm expenses	4,9170.00
Returns	
Gross income/ha	62,500.00
Gross margin/ha	15,320.00
Net farm income/ha	13,330.00
PE=ATR/ATC	1.27
Percent profit	27%
Gross ratio	0.79
Gross operating ratio	0.75
Return on naira invested	0.27

Source: Field survey, 2012

Model estimation and resource use efficiency

The influence of production inputs on output was determined with the aid of production function. On the basis of *a priori* expectations, the statistical significance of the coefficients and the coefficient of determination the linear functional form was chosen as the lead equation (Table 2a).

The coefficient of multiple determinations (R^2) was 0.75. This implies that about 75% of the farmer's output was determined by the exogenous variables, while the remaining 25% were factors that were not captured. The F-value of 81.23 indicates that the overall equation is statistically significant at 1% level. From the result it is evidence that all the variables included in the model have significant influence on the farmer's output. Except for chemical and fertilizer that were significant at 5% and 10% level respectively, other variables are significant at 1% level. With the exception of labour, all the coefficients of other variables

were positively related to farmers' output, which implies that a unit increase in any of this input will lead to an increase in the output, while labour which is negative implies that a unit increase will result in a decrease in the output. Farm size been significant at 1% probably explains the importance of land as a factor of production. Other factors of production may be available but in the absence of land production cannot take place; Labour been significant at 10% also revealed how critical labour is needed in cotton production especially during picking. According to Lagoke and Dadari (1995), the manual weeded cotton field out yield the herbicides controlled field by 816kg/ha of seed cotton at Samaru, Zaria. This showed how important manual labour is to cotton production; lastly seed been significant at 10% proved that the quality of seeds determine the output level obtained. The 5% and 10% significance level of chemical and fertilizer respectively, shows the important role of chemicals to control pests on cotton and also fertilizer to augment soil fertility. The sum of elasticity (0.672) shows a positive increasing decreasing returns to scale (stage II), which implies that the farmers' are within the economic region of production, that is, if inputs are increased by 100 % then there will be less than 100 % increase in output (Table 2b). This suggests that the cotton farmers' in the study area can increase their output by reducing the use of some of these resources. The marginal contribution of production resources in terms of physical and value products, the use of an extra unit of land inputs has the highest contribution of 85kg and N3400.00 additions to cotton output and revenue, respectively. This was followed by chemical, seed, fertilizer use and labour respectively.

Table 2a: Linear regression co-efficients

Variables	Co-efficients	t-value
Constant	26.32	-0.02**
Labour (manday)	-0.42	0.12***
Farm size (ha)	85.00	2.32***
Seed (kg)	5.00	1.42***
Chemicals (ltr)	75.32	1.50**
Fertilizer (kg)	3.01	3.53*
R^2	**0.75**	
F-statistics	**81.23*** **	

Source: Field survey, 2012

Table 2b: Elasticity of Production

Variables	Co-efficients
Labour	-0.046
Farm size	0.122
Seed	0.150
Chemical	0.230
Fertilizer	0.216
Sum of elasticity (Ep)	**0.672**

***Resource-use efficiency*:**

The efficiency of the various inputs used such as labour, farm size, seed, chemical and fertilizer are presented in Table 3. The marginal value of productivity of input was compared with it respective marginal cost. Results reveals that the ratios of the MVP to the MFC for labour, farm size and seed were less than unity (1), while chemical (herbicides) and fertilizer were greater than unity. This implies that labour, farm size and seed were over-utilized, while chemical (herbicides) and fertilizer were under-utilized. This means that cotton output was likely to increase and hence revenue if less of such inputs (labour, farm size and seed) and more of these inputs (chemical and fertilizer) had been utilized. The result showed that the resources were not optimally utilized in cotton production, implying that farmers need education on input application/usage.

Table 3: Resource-Use Efficiency estimates

Variables	MPP	MVP	Efficiency ratio
Labour	-0.42	-16.8	-0.0336
Farm size	85.00	3400	0.68
Seed	5.01	200	0.1
Chemical	75.32	3000	2.14
Fertilizer	3.01	120	1.85

CONCLUSION AND RECOMMENDATIONS:

Results in this study showed that cotton production is a profitable venture in the study area, knowingly that, the market for cotton also is different from other food crops and is prone to price fluctuations. The resources at farmers' disposal for cotton production are not efficiently utilised. Adjustments in resource use are required in order to improve farm profit at the present level of technology employed by cotton farmers. Seed is a critical factor in cotton production as such sufficient availability of it should be done.

The following recommendations are therefore proffered based on the findings of this work:

The market of cotton which has been left to market forces should be revisited by the government, i.e government agencies should be involved in declaration of market price based on average cost of production for each season.

Legislation that will regulate the sales of cotton seed by ginnery to oil mill industry should be enacted thereby reducing incidence of seed scarcity.

Extension workers should intensify campaign to farmers because it is a viable cash crop which require so much awareness especially the genuine marketers.

Farmers should be assisted by providing them with subsidised inputs such as chemicals and fertilizers either from the NGOs or from the government.

High yielding, pest and diseases resistant cotton seed varieties reported in some parts of the world should be introduced to our environment accordingly to minimise the use of chemicals that are costly.

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