

## Benefit-Cost and Productivity Analysis of Fonio (*Digitaria Spp*) Cultivation

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### Abstract

This study analyzed the profitability and productivity among fonio famers in Riyom, Plateau state, Nigeria. Multi-stage sampling technique was used in collecting data from eighty (80) respondents. Primary data collected was analyzed using descriptive statistics, farm budgeting model and Total Factor Productivity (TFP) analysis. The result revealed that the estimated gross margin was N 26,727.5/ha; operating ratio (0.33), while the benefit-cost ratio was ₦2.05, implying that fonio production was relatively profitable in the study area. Furthermore, most (50%) of fonio farmers were sub-optimally productive as their TFP indices were below the optimal scale. The major constraints associated with Fonio production includes; inadequate capital (96.3%), lack of improved technology (92.5%), inaccessibility to credit (81.3%) and inadequate land (66.3%), inadequate extension services (60%) and marketing problems (52.5%). Improved access to agricultural credit, agricultural information extension services, cooperative formation, development and adoption of agricultural technology are strongly recommended.

**Keywords:** constraints; fonio; productivity; profitability; smallholder farmers; yield

### 1. Introduction:

Food remains the basic need for Africans where famine is a continuous enemy of peace and stability in the mostly agrarian continent. Fonio (acha) belongs to the family of *granule* and originated in Africa. Gyang and Wuyep (2005) noted that Fonio has been cultivated for over a thousand years in most African countries across the savanna. They particularly identified Mali, Guinea, Burkina Faso and Nigeria as the major producers in West Africa. In West Africa, the two common species cultivated are *Digitaria exilis* or fonio, white fonio, fundi or findi, acha, hungry rice and *Digitaria iburua* or black fonio, ibura, etc. of the two species, white fonio (*Digitaria exilis*) is the most widely grown and used. Fonio is a small herbaceous plant that grows to the height of 30cm-80cm and grain size of 1.5mm length and 0.9mm width giving it an almost oblong shape (CIRAD, 2004). The seed is tiny in nature compared to the seeds of other cereals. Fonio have enormous traditional and technological uses (Jideani, 1999). In Nigeria, Fonio is grown in commercial quantity in various parts of country with an estimated production of about 70,000 metric tones per annum (CBN, 2008). Fonio is extremely tolerant to high rainfall during the growing season, and it does not grow well under drought conditions. The annual rainfall distribution for growing Fonio ranges from 250-1,500mm while the temperature requirement in its cultivation is not specific as it grows in a varied terrain and environment (Philip and Itodo, 2008). Fonio is regarded mainly as crop of the savanna ecological zone and so needs moderate humidity for high performance. This native African grain crop fit perfectly into the low input farming systems of resource poor farmers because of its unique ability to withstand drought and tolerate poor and marginal soils (Aslafy, 2003). Fonio, though one of the oldest and richest cereals of West Africa, is still unknown to many people and neglected by research and extension service, which has led to decline in its cultivation. Consequently, Fonio can no longer compete with crops that have come to dominate the world food supply and are supported by improved seed supply, production and post-harvest technologies and extension services. The crop has received but a fraction of the attention accorded to other cereal crops considering its importance in rural economy and its potentials for increasing food supply. Fonio production and processing have been at a zero-mechanization level and no proper research has been carried out towards its mechanization in Nigeria (Philip 2011). There are no machines for planting, harvesting, threshing and dehulling of Fonio to technologies that can support its mass



production. Raising agricultural productivity, reducing food insecurity and poverty is an important policy goal for concerned government since agriculture plays a major role in the economy of many developing countries, as it is a significant source of nourishment for citizens and a means of livelihood for the most vulnerable members of this country Adewuyi (2006). Therefore, increasing farm productivity requires one or more of the following; an increase in output and input with output increasing proportionately more than inputs; an increase in output while inputs remain the same; a decrease in both inputs and output with input decreasing more; or decreasing input while output remains the same (Adewuyi, 2006; Oni *et al.*,2011). Therefore, this study aims to analyze the profitability and level of fonio productivity, and the specific objectives are to:

1. determine the profitability of fonio production;
2. estimate the productivity of fonio farmers; and
3. identify the constraints of fonio production in the study area.

**2.Methodology:**

**2.1. Study Area:**

This study was carried out in Riyom Local Government Area (LGA) of Plateau state, Nigeria. Riyom LGA is lying on latitude 9<sup>o</sup>34N and longitude 8<sup>o</sup>40E. The LGA an estimated land area of about 807km<sup>2</sup> (Nipost, 2009). The annual rainfall is about 131.75cm with varied temperature of between 22°C and 30°C. They people are mainly famers. They produce crops such as acha, maize, Rice, Irish, Potatoes, Cabbage, etc. they also rear Animals like cattle, sheep and goat. This area of study was considered because of the high priority given to Fonio production. The major ethnic groups of the area are Berom and Aten.

**2.2. Sampling Technique:**

Multi-stage sampling technique was employed in the drawing of samples for the study. The first stage involved purposive selection of Riyom LGA due to the prominence of Fonio production in this place. The second stage involved the systematic random selection of four wards in the study area which included Ta-Hoss, Jebu, Makera and Ra-Hoss and the final stage involved the random selection of 20 Fonio famers in each of the selected wards giving a sample size of 80 respondents.

**2.3. Method of Data Collection:**

The data for the study was drawn from the primary sources. Well-structured questionnaires designed in line with the objectives of the study were used for the collection of data. The questionnaire was administered to 80 respondents.

**2.4. Analytical Techniques:**

The data were analyzed using descriptive statistics, farm budgeting model and Total Factor Productivity (TFP) analysis. Descriptive statistics (frequency counts and percentages) were used to identify the constraints of fonio production. The farm budget technique (costs and returns analysis) was used to determine the profitability of fonio production in the area. The Total Factor Productivity (TFP) analysis was used to estimate farm productivity by comparing an index of agricultural inputs to an index of output.

**2.4. Model Specification:**

**2.4.1. Farm Budget Model:**

The farm budgeting model used is expressed in equation 1 as;

$$G.M. I=TR-TVC..... (1)$$

Where; G.M. I=gross margin income, T.R=total returns, T.V.C=total variable costs

To determine the financial success of Fonio production the operating ratio was calculated and presented in equation 2 as;

$$O. R=TVC/TR..... (2)$$

Where; O. R=operating ratio, TVC=total variable cost, TR=total return

While the Benefit-cost ratio is mathematically expressed in equation 3 as;

$$\text{Benefit-cost ratio} =G.M. I/TVC..... (3)$$

Where; GMI=gross margin income, TVC=total variable cost

**2.4.2. Total Factor Productivity:**

Total factor productivity (TFP) is a method of calculating agricultural productivity by comparing an index of agricultural inputs to an index of outputs (Fakayode *et al.*, 2008). This can be computed following Key and McBride (2005) as the ratio of the output to the total variable cost (TVC) and presented in equation 4 as;

$$\frac{TFP}{TVC} = \frac{Y}{\sum PiXi} ..... (4)$$

Where:

Y = quantity of output; TFP = Total Factor Productivity; TVC = total variable cost; Pi = unit price of the i<sup>th</sup> variable input; and Xi = quantity of i<sup>th</sup> variable input.

This methodology ignores the role of total fixed cost (TFC) as it does not affect either the profit maximization or the resource-use efficiency conditions (Fakayode *et al.*, 2008)

Therefore, equation 4 can be rewritten and presented in equation 5 as;

$$TFP = \frac{Y}{AVC} ..... (5)$$

The interpretations of TFP index are as follows;

- (< 0.1) = Sub-optimal;
- (1.0 – 1.09) = Optimal; and
- (≥ 1.10) Super-optimal

**3.Results and Discussion:**

**3.1. Farm Budget Analysis:**

Cost/Revenue/Ratios	Amount(₦/ha)	Percentage
<b>Variable cost(V.C):</b>		
<b>Labour</b>	8,397.50	64.5
<b>Seed</b>	1,428.30	10.9
<b>Farm tools and implements</b>	2,168.75	16.7
<b>Agrochemical</b>	1,028.70	7.9
<b>Total Variable Cost(TVC)</b>	13,023.25	
<b>Total cost</b>	13,023.25	100
<b>Total revenue</b>	39,750.75	
<b>Gross margin income</b>	26,727.50	
<b>Operating ratio</b>	0.33	
<b>Benefit-cost ratio</b>	2.05	

**Table 1:** Costs and Return of Fonio Production per Hectare Source: Field survey 2016



Table 1 revealed that labour cost constituted 64.5% of the total cost of Fonio production followed by farm tools (16.7%). Cost of seed and agrochemical accounted 10.9% and 7.9% respectively of the total production cost. The result also reveals that the gross margin income for Fonio farmers in the study area was N26, 727.50/ ha. The operating ratio was 0.33, while benefit-cost ratio was ₦2.05, implying that fonio production in the study area was relatively profitable.

### 3.2. Fonio Productivity:

Index	Frequency	Percentage (%)
Sub-optima (<1.00)	40	50
Optima (1.00 - 1.09)	29	36.3
Super-optima (>1.10)	11	13.7

**Table 2:** Distribution Based on Total Factor Productivity  
Source: Field survey 2016

The summary statistics of the TFP result in table 2 revealed that most (50%) of fonio farmers were sub-optimally productive as their TFP indices were below the optimal scale, which indicated sub-optimal input mix allocation in the production process; 36.3% were found to be optimally productive as indicated by their TFP indices and 13.7% were super-optimally productive as their TFP indices were above the optimal scale. The low productivity could be attributed to the sub-efficient practices adopted by the fonio farmers and utilized in their input mix, which yielded low fonio output in their respective farms in the study area. This corroborates with the findings of Fakayode *et al.*, 2008 who also reported similar results in their study on Agricultural Productivity Profiles in Nigeria.

### 3.3. Constraints of Fonio Production:

Constraints	Frequency*	Percentage
Inadequate capital	77	96.3
Inaccessibility to credit	65	81.3
Inadequate land	53	66.3
Lack of improved technology	74	92.5
Inadequate extension services	48	60
Marketing problems	42	52.5

**Table 3:** Distribution Based on the Constraints of Fonio production

Source: Field survey 2016; \* = multiple responses

The result presented in table 3 revealed that inadequate capital (96.3%), lack of improved technology (92.5%), inaccessibility to credit (81.3%) and inadequate land (66.3%) were the major constraints limiting Fonio production in the study area. Other constraints were inadequate extension services (60%), marketing problems (52.5%). All the constraints identified were economically important and critically affected fonio production in the study area.

## 4. Conclusion and Recommendations:

In view of the findings of this study, it can be concluded that Fonio production in the study area was relatively profitable. The low productivity could be attributed to the sub-efficient practices adopted by the fonio farmers, which yielded low fonio output. All the constraints identified were economically important and critically affected fonio production in the study area; hence effort should be made to minimize the constraints faced by the farmers in the study area to further increase their output using available resources. Based on the findings of this study, the following recommendations are made for policy actions to improve farm output and incomes derivable;

1. Formulation of policies that will make credit facilities accessible and affordable to the farmers.
2. Formulation of policies that will improve formation of farmers group or cooperatives; that will handle the supply of farm input and marketing of their produce.
3. Development and provision of modern storage and processing facilities to famers so as to boost fonio production in the study area.
4. Extension activities in the study area should be intensified for delivery of improved farming techniques to the famers.
5. Dissemination of practices that will enable farmers maximize and efficiently utilize available resources to optimize output and hence profit.

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