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**Research Paper**

# Yield estimation and profitability of cotton production in Northern Nigeria

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***Abstract.*** The study estimated the yield and profitability of cotton production in northern Nigeria. Primary data were used for the study using a well-structured questionnaire and experimental plots. Data were collected on the cost of inputs, price and quantity of output as well as constraints facing the enterprise. Crop cut experiment was used to estimate the yield per hectare during a given cultivation cycle. The budgetary technique was used to estimate cost and returns to cotton production and Likert scale was used to identify and rank the constraints facing the enterprise. Random Sampling was employed to select eleven cotton farmers from Anka, Maru and Talata-mafara Local Government Areas to have a sum of thirty-three respondents from which one respondent from each of the three local governments volunteered to host the experimental plot for the crop cut. These selections were done based on their prominence in cotton production. The average estimated quantity of the three plots located in the three local government gives an estimated value of 1183 kg/ha. The study showed that cotton production is profitable with a gross margin of ₦40 while the profit index and benefit-cost ratio were 0.12 and 1.13 respectively. Major constraints facing the production of cotton were insufficient funding, poor/unstable pricing, high cost of inputs, policy summersault, poor linkage with off-takers and pest and diseases. This study recommends that governments at all levels should provide loans with no or very low interest for the farmers to solve the problem of funds and put in place policy measures aimed at regulating the price of cotton to establish a good marketing system. There is a need for research institutes to develop more high yielding cotton seeds for cotton farmers to increase yield for more profit. Cotton farmers need to be introduced to new techniques and innovations for maximum output, hence a need for more extension services.

**Keywords:** Cotton production, crop cut experiment, profitability.

## INTRODUCTION

Cotton (*Gossypium* spp) is a soft fibre shrub, native to tropical and sub-tropical regions around the world including America, India and Africa, as it is one of the most important vegetables natural fibre crops (Idem, 1999). The chemical composition of cottonseed is 30% starch, 25% semi-drying oil, and 16-20% protein (Huseyn, 2014). Cotton-seed contains 30% hulls, 60% kernels or meats, 5% fuzz and 5% waste. Cotton-seed is processed to produce cottonseed oil, one of the most important of the world's nondrying oils used for cooking, in the manufacture of lard substitutes and margarine, for making soap, as a protein supplement in human and animal (cottonseed cake which is somewhat toxic for poultry unless it is treated to eliminate the toxin, gossypol (ICAC, 2013) diet and as nitrogenous fertilizer (Fortucci, 2012).

The main product of cotton is lint. Cotton lint is the soft hair around the seed called floss which is made of cellulose that serves as a raw material in the textile industries to manufacture large proportions of adsorbent fabric for clothing as a natural textile fibre. The lint is also used to produce thread after spinning, this forms the

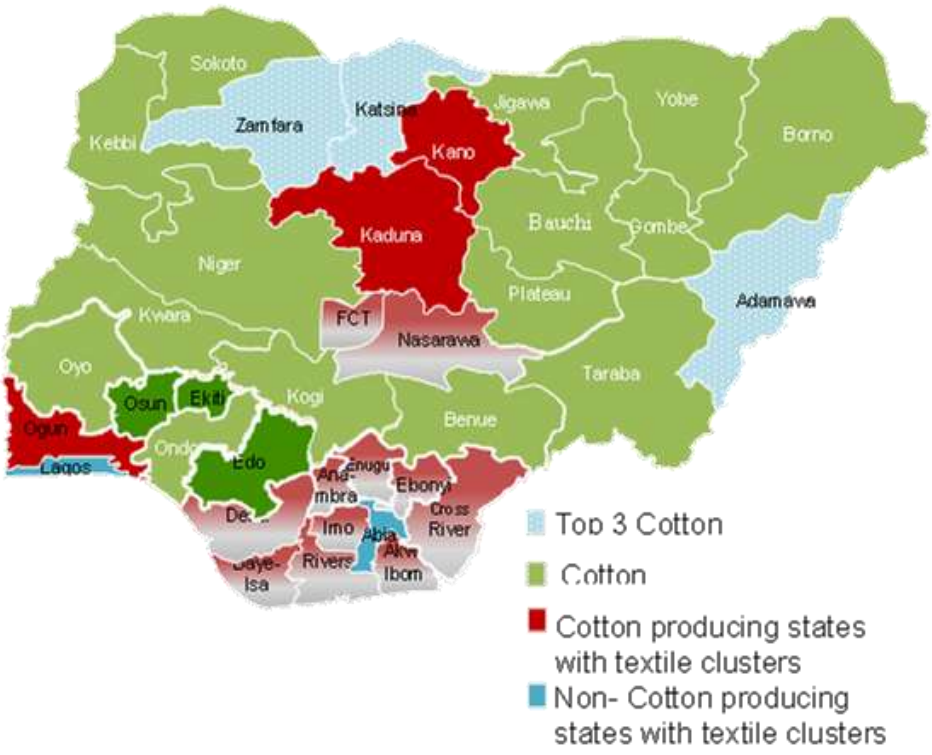


**Figure 1.** The map of Nigeria showing cotton value chain

basis of the textile and fabric industries which depend on mass utilization of thread to weave and produce fabric and cloths (apparel). Cotton lint has numerous economic importance for industrial, domestic and medical usage. Industrially, it is also used to manufacture wears suitable for warm as well as cold weather (Maigizoh, 1981); more than half of the cotton lint produced is used to make clothing and household textiles; others are used in industries to make bag, belts, twins, and tyre-cords (Morse *et al*., 2011); while short lint is used in carpet, batting and as filling materials for pads and cushions. The fuzz (linters) on the seed is used to make felts, upholstery, mattresses, twin, carpets, surgical cotton, and in chemical industries for the production of rayon, plastics, paper and photographic film. Use of cotton lint is not limited to domestic as in bedding and cushioning materials as well as wick when soaked in oil to serve as an illuminant in the rural areas but also used in medically for cleaning and dressing of wounds in surgical operation and other orthopaedic uses. Cotton-seed hulls are used as roughage for livestock and as livestock bedding, fertilizer and fuel. The dried plant is used as fuel.

Also, cotton products have generated many employment opportunities via industries such as tailoring, hospital dressing producers, oil mills, speciality paper mills, insulation and packaging companies and feed mills, which use cotton as their primary raw material. Annual business revenue stimulated by cotton in the Nigerian economy has an excess of one hundred billion Naira and contributed over one million jobs. This therefore, makes cotton one of the major value-added crops in Nigeria (FMARD, 2013).

Cotton is grown in states concentrated around the Savannah belts of Nigeria. The cotton-producing areas in Nigeria are divided into three ecological zones, namely, the Northern cotton zone which comprises, Kaduna, Kano, Katsina, Jigawa, Sokoto, Kebbi and Zamfara States. The North-West zone provides 60 to 65% of the cotton in Nigeria. The Eastern cotton zone comprises of Adamawa, Taraba, Yobe, Maiduguri, Bauchi and Gombe States, and produces 30 to 35% of cotton in Nigeria. The third ecological zone known as the Southern cotton zone is made up of Kwara, Niger, Kogi, Oyo, Osun, Ondo and Edo States and contributes 5% of the total cotton production in Nigeria (Gbadegesin *et al*., 2007; CBN, 2011). (Figure 1)

Presently there are six major varieties of cotton-seed, Samcot 9 is of the short-medium staple variety being grown in the Northwest region comprising Sokoto, Kebbi, Kano, Katsina, Zamfara, Jigawa and Kaduna States. Samcot 10 is also used in this region. Samcot 8 is for the North East, also short-medium variety mainly grown in Adamawa, Taraba, Borno, Yobe, Gombe, and Bauchi States. In 2003, the National Seed Varietal Release Committee (NSVRC) approved the release of samcot 11, 12 and 13, which are of long-staple fibre cotton with excellent fibre quality, moderate resistance to pests and diseases and high- yielding (Gbadegesin *et al*., 2007).

Long-staple cotton is in great demand because of the specific fabrics that can be made with them. Samcot 11 is for the rain-fed southern states where there is adequate rainfall. Samcot 13 is for the Northern ecological zone under irrigation.

Nigerians started cultivating cotton in non-commercial quantity well before the colonial era when the production hit commercial level, this brought about the establishment of the British Cotton Growers Association (BCGA) in 1903. In 1974 the BCGA was replaced by the cotton marketing board to develop market and gin the produce. Since then, considerable attention and resources have been devoted to the improvement of cotton production and utilization by both public and private organizations. Cotton is grown as a cash crop by about 0.8 million farmers on a total estimated area ranging from 0.6 to 0.8 million hectares (Gbadegesin *et al*., 2007). The major feature of cotton production in Nigeria is that about 80% of total production is by peasant farmers under rainfed conditions with simple tools and animal drawn-implements (Onu and Atala, 1992; Adeniji, 2007). This has resulted in farmers in tropical Africa usually obtaining low yields averaging 300 and 500 kilograms per hectare of seed cotton for July (late) and June (early) sown cotton, respectively (USDA, 2014). This yield figure is very low compared with that of her neighbouring countries. For instance, cotton yield in Ghana is 0.8 tonnes per hectare, that of Benin and Burkina Faso are 1.5 tonnes per ha and 1.3 tonnes per hectare respectively (FAOSTAT, 2010). World average yield of cotton is about 1.5 tonnes per hectare (International Cotton Advisory Committee, 2013). In the year 2014, the average Nigeria yield is about 232 kilogram per hectare (USDA, 2014), which has reduced from the 2010 average yield of 252 per hectare. Furthermore, an average yield of 193 kg/ha and 182 kg/ha was reported in 2015 and 2016 respectively while the average yield was 190 kg/ha in 2019 (USDA, 2019).

Statistics on Nigerian cotton production and yield carried out over the last twenty years showed a fluctuating pattern, but on the average, it exhibits a negative downward trend over the years. The low yield has resulted in low marginal profitability for small scale farmers which often resort to growing alternative cash crops to diversify their business to generate more income (USDA, 2014).

In the 1980s, Nigeria earned over 8.9 billion United States Dollars from cotton. This amount represented more than 25% of the Nation's GDP (Huseyn, 2014). RMRDC (2004) and ICAC (2010) observed that the supply of cotton lint to textile industries in Nigeria is less than 100,000 tonnes per annum whereas the demand is over 215,000 tonnes per annum. Thus, the textile mills were forced to import over 115,000 tonnes to cover up the shortfall in local supply. In 2005, the Cotton Development Committee (CDC) was established by the Federal Government on Nigeria comprising of all stakeholders from both the Cotton Consultative Committee (CCC) and Cotton Revolving Fund Scheme (CRFS) of the organized private and public sector in the cotton/textile/garment value chain aimed at re-establishing a sustainable cotton-seed multiplication/seed supply scheme to improve the production and yield of cotton in Nigeria. Despite all these efforts and awareness of cotton production in Nigeria, both the production and yield status are on a declining downward trend. This might be as a result of some factors such as soil fertility, availability of water, climate and diseases or pests with other constraints facing cotton production have a negative effect on the profit gained at the end of the production season which could be discouraging and dissuade farmers and intending actors in the cotton value chain who are mainly peasant and small-scaled actors (Onu and Atala 1992). Due to low profitability under the traditional system of cotton production and high input cost of quality seeds, fertilizers, chemicals, equipment among others farmers are shifting away from cotton production to food crop production adversely impacting the existing downstream industry by resulting in demand and supply gap. In view of the foregoing, this study was designed to provide a piece of empirical information on yield and profitability as well as constraints facing cotton production enterprise in the study area.

## MATERIALS AND METHODS

The study area is Zamfara State. Thirty-three cotton farmers cultivating an approximate cotton plot of one hectare were selected for this study. Three out of the thirty-three plots were used for the crop cut experiment. On each of the three plots selected, three ten by ten meters (10 by 10 m) rectangular-shaped portions were marked along the diagonal line of the three selected plots making nine (9) marked portions for the cotton crop cut experiment. Wooden pegs and ropes were used for the marking.

The marked portions were closely monitored to have a good/standard representation of the performance of the cotton seeds on the field. The number of cotton plant stands and the weight of the harvested dry cotton lint was taken at the end of the production cycle. Most of the farmers maintained narrower ridges for proper space management. The farmers in the state indicated that it is possible to have a two-cycle production in a year (i.e. wet and dry season) which agrees with the summation of but they are restrained to only one production cycle per year because of the high cost and unavailability of irrigation tools. An average of 2 seeds planted per hole and approximately 1 inch deep, a 25 by 30 cm spacing between plants/holes is the common practice. Eleven cotton farmers were taken from Anka, Maru and Talata-mafara Local Government Areas to have a sum of thirty-three respondents from which one respondent from each

**Table 1.** Experimental yield per hectare.

| Local Government area | Demarcation 1 cotton ball (kg) | Demarcation 2 cotton ball (kg) | Demarcation 3 cotton ball (kg) | Estimated quantity (kg/ha) |
|---|---|---|---|---|
| Anka | 10.5 | 13.1 | 11.2 | 1160 |
| Maru | 9.2 | 12.4 | 10.7 | 1077 |
| Talata mafara | 11.1 | 11.8 | 16.5 | 1313 |
| Average estimated yield (kg) per hectare | | | | 1183 |

Source: Field survey (2019).

of the three local government volunteered to host the experimental plot for the crop cut. These selections were done based on their prominence in cotton production. Data were collected on the constraints facing the enterprise, cost of inputs, price and quantity of output. Likert scale was used to identify and rank the constraints facing the enterprise.

Crop cut experiment is an assessment method employed by researchers to accurately estimate the yield of a crop commodity in a particular area/region during a given cultivation cycle. The approximate assessment of the average weight of the commodity in concern is used by both the government (in planning agricultural policy formation and implementation) and insurance companies (as a ground-level data point based on which they can grant insurance to farmers for crop failure and poor harvest).

The budgetary technique was used to estimate the costs and returns to cotton production for the cotton production cycle (Onyenweaku *et al*., 2004).

The equation can be expressed as:

$$TR = P \times Q \quad (1)$$
$$GM = TR - TVC \quad (2)$$
$$TC = TFC + TVC \quad (3)$$
$$\text{Profit } (\lambda) = TR - TC \quad (4)$$

Where:
GM = Gross Margin (₦)
TR = Total Revenue (₦)
TVC = Total Variable Cost (₦)
TR = Total Revenue (₦)
TFC = Total Fixed Cost (₦)
P = Price of cotton/kg (₦) and
Q = Output of cotton (kg)

## RESULTS AND DISCUSSION

The cotton ball output per kg of the 10 by 10 m demarcations made on the three plots used for the crop cut experiment are as stated in Table 1, the estimated quantity (kg/ha) for each local government is the summation of the outputs of the demarcations 1, 2 and 3 divided by 3 multiplied by 100 (because 100 ten by ten-metre square equals to 1 ha). {[(1+2+3)/3]×100}

To have an estimated quantity (kg/ha) for the state, the average estimated quantity of the three plots located in the three local government gives an estimated value of 1183 kg/ha.

The result of costs and returns to cotton production is presented in Table 2. It was found that about 90.75% of the total cost of production was on variable inputs of which cost of labour accounts for 26.68%. This suggests that the respondents incurred more cost on labour which increases their total cost of production and thereby reduce their profit. This finding agrees with that of Babangida (2016), Odedokun (2014) and Sabo *et al*. (2009) that labour contributed immensely to the cost of cotton production and hence a reduction in net farm income if not properly managed. The mean value of the total variable and fixed costs were ₦161,900 and ₦16,500 respectively while the mean value of the total cost was ₦178,400. Net farm income was ₦23,680 which was measured by subtracting the total cost from total revenue indicating that the enterprise is profitable. Subtracting the total variable cost from total revenue, the gross margin equals ₦40,180. Profitability ratios included in this study are profit index which gives a value of 0.12 indicating that from every ₦1.00 generated from the enterprise, a net income of ₦0.12 is earned; the rate of return gives 0.13 which implies that from every ₦1.00 invested into the enterprise, a net income of ₦0.13 is realizable and the operating expenses ratio whose value is 0.8 shows that from every ₦1.00 generated from the enterprise ₦0.8 is invested as a running cost into the investment. Also, there is a benefit-cost ratio of 1.13, implying that for every ₦1.00 invested on cotton production, ₦1.13 is realizable as income. All these ratios confirm that cotton farming is a profitable enterprise, putting in mind that the estimated outputs of this research area for the production of a hectare plot of cotton so an increase in the plot of land will lead to an increase in the returns gained from the enterprise based on the economies of scale principle. This result agrees with Alam *et al.* (2013) and Gwandi *et al.* (2010) in Taraba State, Nigeria and Daniel *et al.* (2010) in Adamawa State, Nigeria who all reported that cotton production was profitable.

### Constraints to cotton production

A list of constraints facing the cotton production

**Table 2.** Cost and returns to cotton production.

| Variables | Unit | Qty | Rate/unit | Total (₦) | % of TC |
|---|---|---|---|---|---|
| Revenue | Ton | 1.263 | 160,000 | 202,080 | |
| | | | | | |
| Variable inputs | | | | | |
| Seed | Kg | 20 | 130 | 2,600 | 1.46 |
| Herbicides | Lt | 5 | 1,300 | 14,700 | 8.24 |
| Fertilizers | Kg | 7 | 6,233 | 45,100 | 25.28 |
| Insecticides | Lt | 2 | 3850 | 7700 | 4.32 |
| Empty bags | Bag | 28 | 150 | 4200 | 2.35 |
| Land preparation | Ha | 1 | 30,000 | 30,000 | 16.82 |
| Labour | No | 20 | | 47,600 | 26.68 |
| Aggregation fee | | | | 10,000 | 5.60 |
| Total variable cost | | | | 161,900 | 90.75 |
| | | | | | |
| Fixed input | | | | | |
| Land renting | | | | 8,500 | 4.76 |
| Tool | | | | 8,000 | 4.48 |
| Total fixed cost | | | | 16,500 | 9.25 |
| Total cost | | | | 178,400 | 100 |
| Net Farm Income (NFI) = (TR – TC) | | | | 23,680 | |
| | | | | | |
| Rate of return on investment (ROI) | | | | 0.13 | |
| | | | | | |
| Operating Expenses Ratio (OER) | | | | 0.8 | |
| Benefit-Cost Ratio | | | | 1.133 | |
| Profitability index | | | | 0.12 | |

Source: Field survey (2019)

**Table 3. The constraints facing cotton production**

| S/N | Constraints | Mean value | Rank |
|---|---|---|---|
| 1 | Insufficient funding | 3.72 | 1st |
| 2 | Poor/unstable pricing | 3.06 | 2nd |
| 3 | The high cost and low quality of inputs (mostly seeds) | 2.54 | 3rd |
| 4 | Policy summersault | 1.84 | 4th |
| 5 | Poor linkage with off-takers | 1.52 | 5th |
| 6 | Pest and diseases | 1.18 | 6th |

Source: Field survey (2019)

enterprise was given to the respondents (i.e cotton producers) to rank in the order of importance i.e. from 1 to 5, 5 being the most important value and one being the least important value. The mean value used in the ranking is derived by dividing the sum of the values allocated to the particular constraint divided by the number of respondents that allocate values to the constraint.

Table 3 shows the profile of constraints facing the production of cotton in Zamfara State, with the aid of Likert scale, this research rank insufficient funding as the first constraint inhibiting the expansion of cotton production in the state. The farmers indicated their inability to access formal and informal credits as a major constraint. Poor/unstable pricing of cotton output in the market is the second constraints identified by the farmers involved in cotton production in the state. This result is in agreement with Adeniji (2007) who reported that 40% of the farmers had marketing and poor pricing of cotton as the major constraint to cotton production. The farmers ranked the high cost of input especially fertilizer as the third constraint, they also indicated that there are lots of adulterated seeds, chemicals and fertilizers in the state. The Likert scale ranked Policy summersault as the fourth

major constraint facing the cotton production enterprise. The farmers indicated the inability of the government to enforce laws that prohibit the importation of substandard cotton products (i.e. policy summersault) as another important constraint facing the cotton production enterprise. Poor linkage with off-takers of the cotton products which have led to the dominance of the middlemen was ranked as the fifth major constraint. Pest and diseases were ranked as the sixth major constraint facing the cotton production enterprise, as this reduces their yield significantly. Alam *et al*. (2013) and Adeniji (2007) noted that pest and disease infestation constituted major yield reduction among constraints affecting cotton production. These among many other constraints are the list of constraints facing the cotton production enterprise in Zamfara state.

## CONCLUSION AND RECOMMENDATION

Cotton production is a profitable business in the study area even though the yield is low compared to the international average and problems identified by most of the farmers which include insufficient funding as the major problem followed by poor/unstable pricing, high cost of input, pest and diseases, poor linkage with off-takers and so on. Therefore, timely and adequate supply of fertilizer should be made available to farmers at a subsidized rate to enhance the production of this crop. The low price of cotton does not encourage most farmers to venture in cotton production. Policy measures aimed at regulating the price of cotton are hereby recommended. There is need for research institutes to develop more high yielding cotton seeds for cotton farmers to increase yield for more profit. There should be improved extension linkages to sensitize cotton farmers on the need to adopt the recommended practices for cotton production. Cotton farmers need to be introduced to new techniques and innovations for maximum output. Non-governmental organizations should assist in organizing workshops and pieces of training for cotton farmers. This will increase the potentials of farmers and bridge the gap between potential and actual yield and hence improve the level of efficiency and productivity. The government should provide a loan with no or very low interest for the farmers to solve the problem of funds and also a good system of marketing should be established.

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