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Full Length Research Paper

Economic analysis of cotton production in Adamawa State, Nigeria

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Cotton production has long been a good contributor to the Gross Domestic Product of Nigeria and this sector provides employment for some of the country's teeming population. Production dates back to the 1960s and 1970s. Poor management and the oil boom period reduced production of both lint and seed. Despite all these factors, production still continues on a small and medium scale among farmers. There is a new trend to revitalize the ailing cotton farming industries and associated business. To achieve this, an understanding of the production potential and economics of production were essential. One hundred and ninety-nine cotton outgrowers randomly selected among cotton farmers from the cotton belt of Adamawa state, Nigeria were interviewed to provide information on production capabilities, constraints and economics of production for duration of three years. Findings indicated that most of the outgrowers are male and married, and have had substantial experience in cotton production. They are registered with one cotton farmers association of their choice. Economic analysis of production cost indicated that of the variable cost of cotton production/hectare, labour alone accounted for 50% of the total. The regression analysis showed that the best fitted model is the double Log function; it recorded a coefficient of determination (R^2) of 0.61. In cotton production the cost of land rent correlated negatively with the cost of ploughing and planting. It was evident from the survey that cotton production in Adamawa state is challenged largely by poor pricing. Fluctuation in the price and cotton yield was noticed during the survey period. The study recommends the provision of input at subsidized price, functional extension services and establishment of a cotton commodity board to stimulate cotton production.

Key words: Cotton production, variable input, outgrowers, demographic studies, Adamawa state.

INTRODUCTION

Cotton is a soft, usually white, fibrous substance composed of cellulose walls. It is the most important vegetable fiber used in textile production. For decades cotton production (lint and cotton seed) has been a driving force for economic development in Nigeria. In north eastern Nigeria, production is recorded on 0.6 to 0.8 million hectares, mostly in Taraba, Adamawa, Yobe, Gombe and Bauchi states. Cotton out-growers in these states are small scale, resource poor farmers, they cultivate between 1 and 3 hectares under rain fed conditions (FOS, 2004). Characteristically most field operations are not mechanized, and farmers are resource poor and illiterate. The total consumption of cotton in Nigeria is about 80,000 MT of lint annually (240,000 MT seed cotton) (FOS, 2004). Production in 2003 was 32000 MT; which was less than half of the total demand (FOS, 2004). Pricing of cotton has been a subject of controversy, since the government deregulated the cotton market, by abolishing the Cotton Marketing Boards (CMD). Consequently, the trading price of cotton is determined in the open market. Between 2002 and 2004, the average price of cotton lint was N135, 000.00/MT (FAO, 2004). The crash in the world market price of cotton has discouraged production, although elsewhere this has since picked up. Deregulation of the price of cotton lint in the international market has led to an unstable, but high, market price. Significant increase in cotton price during 2003 was attributed government policy which removes bottlenecks in export FAO, 2004). There has been cotton production in Adamawa state for decades, and production is restricted to the southern parts of the state, due to favou-

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rable climatic conditions. Cotton production has been a life long business of the farmers in these communities. They have organized themselves into associations that cater for production, management and marketing. These associations are community based and are formed by the farmers or the ginneries in association with the farmers in the communities. The ginneries located in this region provide incentives to farmers and offer other specialized services. Several agronomic activities are involved in production of cotton lint and seeds, suffice that cotton production is labour demanding. In the cotton growing belt few varieties are available for farmers. The cotton farmers often buy seeds of improved varieties from the ginneries in their location. Research geared towards the development and release of improved cotton varieties is limited. This has adversely affected production and yield since these varieties were developed elsewhere, and could not adapt and perform as expected in the new environment. A few cotton varieties are known that are high yielding (for both cotton seed and lint), but these are susceptible to pests and diseases. A high yield of cotton seed and lint is dependent of soil fertility, favourable climatic conditions and timing of cultivation and heavy application of insecticides and fungicides. In the cotton growing belt of Adamawa state there are farmer who are either independent and contract cotton growers. Some improved varieties have been released for farmers use. Both the extension arm of the government and the private ginneries have made available cotton production information packages to cotton farmers. These are communicated largely by the extension agents hired by the private ginneries or by the state government extension services. In addition, the private ginneries provide inputs to the farmers at subsidized price. Despite all of these aids, the cotton yield still falls below the national standard, thus encouraging importation of lint.

In this study we seek to evaluate the socioeconomic characteristics of the cotton outgrowers in southern Adamawa state, determine the possibility of association among the variable costs in cotton production, evaluate profitability in cotton production and identify constraints associated with cotton production in the study area.

METHODOLOGY

This study was carried out in cotton growing belt of Adamawa state that is: Numan, Yola south, Lamure, Demsa and Guyuk. They constitute Zone 3 and 4 of the Adamawa state Agricultural Development Project. Geographically the survey area is located in the savannah agro ecological zone. Annual temperature in the cotton belt ranges between 25 and 35^{o}C during the day and between 15 and 20^{o}C at night. Extreme drought is not prevalent in the cotton belt; generally cotton is drought tolerant. Cotton production is a predominant occupation of the farmers in the southern part of Adamawa state. Hence at least four privately owned ginneries are located within the cotton belt. The presence of these companies has intensified production. Most cotton outgrowers are registered with the private ginneries.

For the purpose of this study, a systematic sampling procedure was adopted; Guyuk, Numan, Yola south, Larmurde, and Demsa local government areas were selected due to the preponderance of cotton production activities. From each local government, two districts namely, Savanna/Gyawana and Numan (Numan local Government area), Guyuk and Boshikiri (Guyuk local Government area), Lafia and Larmuede (Lamuede local Government area), Dong and Bali (Demsa local Government area), Yola and Ngurore (Yola local Government area), were purposively selected primarily due to the high cotton production activities and secondly, the preponderance of cotton farmers, which is obviously related to the total cotton production. Field interview took place during the 2005/06, 2006/07 and 2007/08 cropping season. One hundred and ninety-nine registered cotton outgrowers were randomly selected from registered outgrowers with the extension officer of the private ginneries in the cotton belt.

Variables measured

The principal socioeconomic variables measured were age (years), sex, occupation and experience in years of cotton production, educational attainment, farm size, family size and marital status. Information on quantity of seed planted/hectare, seed source, land preparation methods, presence and absence of extension agents and extension schedule among other were sought from the farmers. Production characteristics that are cost of fertilizer, insecticides, ploughing, seeds, transportation, labour (planting, weeding, fertilizer application, spraying of insecticides) were evaluated. Institutional and technological attributes such as membership of social organization and whether there had been an extension visit were evaluated. A random sampling of fifty-eight outgrowers in Numan; seventy outgrowers in Guyuk; thirty-six outgrowers in Yola south, thirty-five and seventeen outgrowers from Larmurde and Demsa local government respectively provided information on cotton production throughout the survey period.

Data analysis

Data collected were analysed using descriptive statistics (frequency, mean and percentages). The following budgetary technique was employed to compute the profit and net profit as follows;

Gross Margin (GM) =Gross revenue (GR)-Total Variable Cost (TVC)
Where Total cost (TC) =Total Fixed Cost (TFC) +Total Variable Cost (TVC)
Profit =Gross Margin (GM) – Total Fixed Cost (TFC) (Alimi and Odogun, 2001).

The variable inputs used in this study include the cost of land rent, labour, planting, seeds, herbicides, insecticides, and transportation. The monetized value of these input were subtracted from the gross revenue (GR) to compute the gross margin. A linear function as specified by Olayide and Heady (1982) was used to test the functional relationship between the input and output in the production process. The implicit form of the production function is presented thus;

$Y= F(X_1, X_2, X_3, X_4,……..U)$

Where Y =income; X_1=Cost of land rent; X_2= cost of ploughing; X_3= cost of seeds; X_4= cost of planting; X_5=cost of ploughing, X_6= cost of fertilizer; X_7=cost of transportation; X_8= cost of fertilizer application.

To facilitate the selection of appropriate functional forms, other functional forms; exponential. Cobb-Douglas and Semi-Log (Yilmaz and Ozkan, 2007) and Double Log function were used. They are explicitly stated as;

Linear Function

$Y = \beta o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + U$ ……..Equation 1

Exponential

$\ln Y = \beta o + \beta 1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + U$ ……..Equation 2

Semi-Log

$Y = \beta o + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + U$ ……..Equation 3

Double Log

$\ln Y = \beta o + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_{4-} + U$ ……..Equation 4

These variables are included in the model were used to determine the extent to which each variation in the income is explained.

Where b0- intercepts
B_1= regression coefficient
€= Error term

Using the income as the dependent variable, the contribution of other predictor variable to income was done using stepwise multiple regression analysis (Steel and Torrie, 1980), and the correlation among the variable cost of production was done using PROC CORR procedure of SAS (1999).

RESULTS AND DISCUSSION

Demographic studies

The demographic characteristics of the respondents (Table 1) indicated that to a large extent most of the cotton farmers are male, implying that cotton production is gender sensitive to the male sex. The mean age of the respondent was 45 years. Therefore a sizeable proportion of the cotton outgrowers are still in their active age, and will continue to cultivate cotton for years to come. The survey showed that the respondents are well educated, having at least one form of education; this contrasts with the general perception of farmers being illiterate, mentioned earlier. Cotton production is the major occupation of the respondents in the surveyed areas. The majority of the respondents have had experience in cotton production ranging between 6 and 11 years. All of the outgrowers are registered with one cotton farmers association of their choice in their location. The level of involvement of women in cotton production as found in this study is at variance with the reports of Andu (2003).

A total of 199 cotton farmers provided information on cotton production for three consecutive years They indicated that they source their seed from the private ginneries in the cotton belt, The use of ox- drawn plough and tractor-drawn plough are frequent in land preparation (ploughing and harrowing), while zero-tillage was the least practiced. Most of the cotton farmers rented their farmlands, as opposed to lease ownership and family inheritance. The variable cost of cotton production/hectare for three years indicated that labour accounted for 50% of the total variable cost of production (Table 2). This suggests that cotton production is labour intensive, and most farm operations are not mechanized. Our finding is similar with reports on cocoyam production in Abia state, Nigeria (Okoge et al., 2004, Okoge, 2007). As compared with other variable input, the cost of planting cotton was least. Cotton varieties popular in the cotton belt are susceptible to pests, besides the soils are highly degraded, hence the high demand for fertilizers. This accounted for the high cost of purchase and application of fertilizers and insecticides.

The stepwise multiple regression analysis of other variable cost (independent variables) on the total cost of production (response variable) showed that the cost of labour accounted for 77% of variance in the total cost of production (Table 3). The use of fertilizer and fertilizers accounted for 13 and 15% of variation respectively. They altogether accounted for 98% of the variance in the total cost. To increase profit on cotton production, seeds of high genetic potentials (high yielding (tolerance to pests and diseases a) are a necessity and our findings show that inputs should be subsidized.

As shown in Table 4, the best fitted model is the double Log function; it recorded a coefficient of determination (R^2) of 0.61, this was followed by the exponential function. The implication of this is that 61 and 43% of the variation in the response variable is attributed to the predictor variables included in the model. The remaining 39 and 57% can be attributed to error in specification and the exclusion of other factors from the model. Significant at 5 and 1% probability level as found in the analysis suggest that the variables included in the model adequately described the dependent variables. Eight variables were included in the model. Of these, only four were statistically significant. All four had positive coefficients, showing that as their corresponding variables increase, the output increases. These findings are to be expected since the values of economic variables (income and labour costs, for example) vary with the general economic climate. Other variables such as the cost of fertilizer are related to the level of the corresponding agricultural activity, and one expects that increased activity will increase the yield.
Association analysis (Table 5) among the variable costs involved in cotton production showed that the cost of land rent correlated negatively with the cost of plough-ing and planting. This could be explained as an indepen-dent association among these variables. A poor pricing. It was evident during the survey that the ginneries in the cotton belt fix the price of cotton seed and lint at the be-ginning of the season in consultation with the farmers and the village heads. The ginneries in turn provide extension services to farmers who patronize them.

The price distribution of cotton lint between 2005/06, 2006/07 and 2007/08 seasons are presented in Figure 1. In 2005/06 cropping season, the price for grade one cotton lint fluctuates between N28 /Kg (0.25 USD) and N43/kg (0.34

Table1. Demographic study of the cotton outgrowers in southern Adamawa state

Variable	Frequency	Percentage (%)
Sex		
Male	176	88
Female	23	18
Status		
Single	105	51
Married	98	49
Family size (acre)		
2	23	11
3-6	120	60
7-10	34	17
11-14	12	6
15>	10	5
Educational level		
No formal education	68	34
Primary education	49	25
Secondary education	49	25
Tertiary education	33	17
Primary occupation		
Farming	103	76
Civil servant and farming	12	8
Business and cotton farming	17	12
Others	5	4
Experience		
1-5	48	25
6-10	105	53
11>	71	22
Seed source		
Afcott	107	54
Olam	22	11
Wacot	58	29
Open market	12	6
Plough methods		
Ox-drawn	89	45
Tractor	93	47
Manual ploughing	9	5
Zero tillage	5	4
Presence of extension agent		
Yes	182	92
No	17	9
Extension schedule		
Daily	11	8
Weekly	22	11
Twice a week	34	17
Fortnight	94	47
Monthly	34	17
Ownership of farmland		
Rent	150	75
Inheritance	10	5
Lease	30	15
Purchase	0	0
Membership of cotton association		
Afcott outgrowers association	67	34
Cotton farmers club	127	64
Other	5	3

Source: Field survey, 2005-2008.

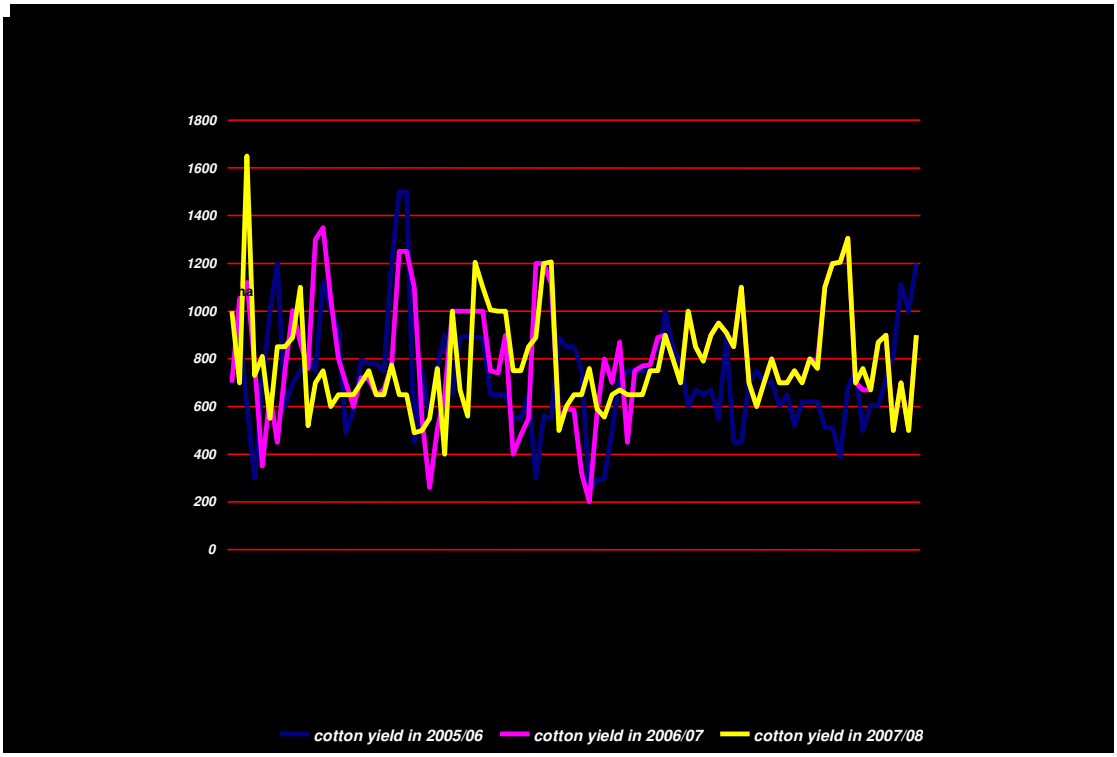

Figure 2. Yield of cotton seed (Kg/ha) on farmers field between 2005/06, 2006/07 and 2007/08.

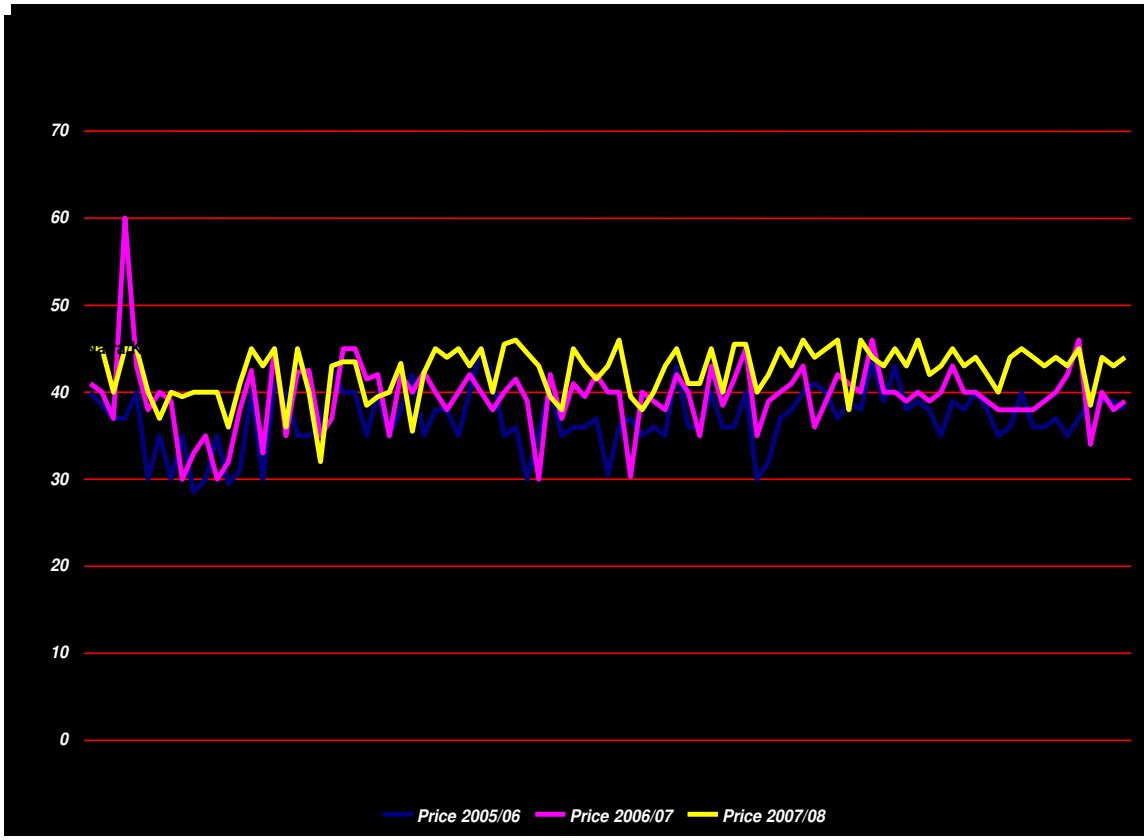

Figure 1. Distribution of the price (USD) of seed cotton between 2005/05, 2006/07 and 2007/08 cropping season in Adamawa state, Nigeria

Table 2. Production cost of some variable cost in cotton production averaged over three growing seasons (n=199).

Variable	Average cost (N.K)/Ha)	USD
Cost of land rent	4,393.83	34
Cost of seeds	5559.71	43
Cost of labour	58, 978.80	453.68
Cost of fertilizer	16, 446.11	126.51
Cost of pesticides	12, 733.08	97.95
Cost of transportation	7,294.34	56.11
Cost of Ploughing	9, 187.06	71
Cost of planting	4,633.93	36

Source: Field survey, 2005-2008
Average over 199 respondents for three years
Exchange rate at the time of study was N120=1USD

Table 3. Stepwise regression analysis of variable cost on the total cost of production for cotton.

Variables	Variable in	Partial R2	Model R2
Cost of labour	1	0.77	0.77***
Cost of pesticides	2	0.15	0.92***
Cost of ploughing	3	0.03	0.96***
Cost of transportation	4	0.02	0.98***
Cost of planting	5	0.01	0.99***
Cost of seeds	6	0.0005	0.995***
Cost of land rent	7	0.0005	0.998***
R^2 =100			

Source: Field survey, 2005-2008

Table 4. Regression analysis of determinants of income of cotton production.

Variable	Linear	Semi- Log	Exponential	Double-Log
Intercept	24520	-1032057**	4.64	1.09
Cost of land rent	5.25	8169	0.000003	0.07**
Cost of seeds	4.49	71042	0.000007	0.06
Cost of labour	0.85	56957	0.000003	0.34**
Cost of fertilizer	1.16	65957	0.000004**	0.31**
Cost of pesticides	0.11	-41464	0.000002**	0.01
Cost of transportation	0.74	81975	0.0000013	0.16**
Cost of ploughing	-0.36	-9721.52	-7.944E-7	0.004
Cost of planting	-0.77	-6508.01	-0.0000016	-0.0047
R^2	0.11	0.12	0.43	0.61

Source: Field survey, 2005-2008

complementary association was recorded in the association among other variables costs included in the analysis. It was evident from the survey that cotton production in Adamawa state is challenged largely by USD'Kg). While in 2006/07, the prices ranged between 30 to N60 /Kg (0.50 USD /Kg). For 2007/08 cropping season, cotton price ranged between 38 and N45/kg of cotton lint. It was evident that on the average 2006/07 cropping season was best for cotton production in the cotton belt of Adamawa state (Figure 1). With these price disparities recorded over the years of study (Figure 1), realizing a good profit was difficult. The fluctuation and low prices may be associated with absence of cotton commodity board and export restriction. Their presence could assist in fixing the price of the cotton lint, as well as facilitates export. The production of cotton seed lint by the respondents over the period of evaluation is presented in Figure 2. Most farmers in the study area cultivate elite cotton va-

Table 5. Pearson correlation coefficient among variable inputs (N).

	1	2	3	4	5	6	7	8
Cost of Land								
Cost of Seeds	0.10							
Cost of Labour	0.23**	0.41**						
Cost of Fertilizer	0.13	0.42**	0.52**					
Cost of pesticides	0.03	0.43**	0.43**	0.61**				
Transportation cost	0.003	0.26**	0.28**	0.25**	0.45**			
Cost of Ploughing	-0.04	0.21**	0.34**	0.38**	0.49**	0.15**		
Cost of Planting	-0.11	0.18**	0.21**	0.35**	0.38**	0.19**	0.60**	
Total cost	0.19**	0.53**	0.88**	0.74**	0.73**	0.46**	0.50**	0.48**

Source: Field survey, 2005-2008

rieties (Benin, Samaru 77, Samacott 8 and Samcott10) developed by research institute in Nigeria. In the 2007/08 season, cotton lint yield peaked above 1,600 Kg-^{1}. For 2006/07 season the cotton lint yield was widely varying, between low (200 Kg-^{1}) and high (1,300 Kg/-^{1}). The cotton lint yield range of between 300 and 1,500Kg-^{1} was recorded in 2005/06 season. Several reasons may be associated with this pattern; besides poor seed quality, high cost of variable inputs among others might have limited the use of required dosage of insecticides and fertilizer.

The study provided insight into cotton production in Adamawa state, Nigeria. The private ginneries in the state have been a reliable source of good quality seed to registered outgrowers. The private cotton ginneries also provided extension services to registered outgrowers; the out-growers in turn sell cotton lint to the ginneries. The variation in price from one ginnery to the other is negligible. Varieties cultivated in the cotton belt are susceptible to insect pests and high nutrient demanding, hence the high cost of inputs (fertilizers and insecticides) and most soils in the study have low fertility. The high cost of variable inputs in cotton production limits profitability in cotton production. We therefore recommend that research should focus on development of cotton varieties that are high yielding, low nutrient demanding, tolerant to pests and diseases amongst others. And develop an integrated pests and diseases management approaches through the use of biological control, crop diversification and use of biopesticides. The marketing boards should be put in place to ensure regulation of prices and provision of inputs at subsidized rate to cotton farmers. Emphasis on integrated pest management and mechanized farming will reduce the variable cost in production.

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