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Analysis of Resource Use Efficiency and Constraints of Cotton Production in Odisha, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present study entitled "Analysis of resource use efficiency and constraints of cotton production in Odisha" was undertaken with the major objectives to analyse resource use efficiency in cotton cultivation and to elicit the constraints faced by the farmers in production and marketing of cotton in the study area. This study used both secondary and primary data. Multi-stage random sampling was taken for this study. The districts selected for study were Kalahandi, Balangir and Rayagada of Odisha state. A total number of 120 cotton farmers i.e 71 farmers from small and 49 farmers from large size groups were selected at random based on probability proportion. Analytical tools like Tabular analysis, Cobb-Douglas production function and Garrett's ranking were used for the analysis. Cobb-Douglas production function was used taking Y i.e. yield of cotton as dependent variable and X1, X2, X3, X4, X5, X6 i. e. for total human labour, farm power cost, manure cost, fertilizer cost, cost of pesticides, area under the crop respectively as independent variable. Among

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these variables, fertilizer, pesticide, human labour and machine labour were positive and significant for small farmers and manure, fertilizer, pesticide and machine labour were positive and significant for large farmers. Most of the significant resources were proved to be efficient. The major constraints in cotton yield as reported by farmers were high cost of labour, high cost of seeds, lack of regulated markets etc. in the study area. For the sustainable growth of cotton crop in the state, timely policy interventions were required by promoting contract farming and providing price incentives, so that cotton farmers of Odisha will get better profit for their crop and prosperity of agriculture in the state.

Keywords: Resource use efficiency; constraints; Garrett's ranking.

1. INTRODUCTION

India has approximately 17% of the world's population, 15% of the world's livestock, 2.4% of the world's land area, and 4% of the world's water resources. Agriculture is still the primary source of income for roughly half of the population, and it provides raw materials for many other industries. Agriculture accounts for 14% of the country's GDP and 11% of exports. Agriculture is the primary sector of the Indian economy, accounting for approximately 32% of the country's GDP and employing approximately 65% of the labour force. Additionally, 50% of our exports are made up of agricultural products, while another 20% of India's exports are made up of manufactured goods made with agricultural components (cloth, sugar, and manufactured jute). Agriculture has a significant part in the industrialization of the economy. This industry provides raw materials to agro-based businesses like those that produce sugar, jute, cotton, groundnuts, and oilseeds. Agriculture crop failure will be disastrous for Indian industries.

India, which accounts for around 25% of global cotton production, is the second-largest cotton producer in the world after China. It holds the distinction of having the greatest area under cotton cultivation in the world, making up over 36% of the total area under cotton cultivation worldwide. The yield per hectare is however, the lowest against the world average. Cotton production which was just 103 lakh bales during 1991-92, increased to about 260 lakh bales by the year 2011-12, an increase of more than 150 per cent.

In Odisha, a total of 1.57 lakh ha area was cultivated in 2018-19 which was increased to 1.69 lakh ha in 2019-20. In 2018, 4.55 lakh MT of cotton was produced (Odisha Economic Survey, 2019-20). An average of 3.5 lakhs bales of cotton is cultivated in the state out of which approximately 2 lakhs bales are ginned and pressed in the state and remaining cotton is procured by other states. However, there is the issue of selling the cotton at the right price to the right agent or organisation. Due to lack of efficient marketing system farmers are not getting the return they expect Cotton cultivation being only, the required financial aid is not available this is making farmers demoralized.

2. MATERIALS AND METHODS

The present study is an attempt to study the performance of cotton in selected areas of Odisha by estimating the resource use efficiency of different independent variables used, constraints that exist during the cotton production and marketing and to suggest the ways and means to overcome them.

Odisha is purposively selected for the study. It is the 8th largest state by area, and the 11th largest by population. The state has the third largest population of Scheduled Tribes in India. A multistage random sampling technique was adopted for selecting the sample farmers for the study. From Odisha three cotton growing districts *viz.* Balangir, Rayagada and Kalahandi were selected according to their productivity level. Among these 3 districts Rayagada was selected as high productivity area, Balangir as medium and Kalahandi as low productivity area. At the next stage one block having maximum area under cotton from each selected district was chosen. At the third stage from each selected blocks two villages having maximum area under cotton were selected. And in the final stage from each village small and large farmers were choosen proportionately for the study according to the availability of different category farmers. In all a total of 120 farmers spreads over 6 villages were included in the sample.

Chart 1. Area, Yield and Production of cotton in major cotton producing districts of Odisha 2018-19

District	Area	Yield	Production
Balangir	43.96	14.34	128
Kalahandi	58.42	12.41	168.04
Rayagada	35.17	15.26	100.96
Odisha	157.88	14.63	455.07

Area in '000 ha, Yield in q/ha and Production in '000 MT/Bales

2.1 Functional Analysis

After a series of tests on the fitness of the type of production function, the Cobb-Douglas type of production function was fitted to evaluate the resource use efficiency in the production of Cotton.

The general form of production function fitted was as follows:

$$Y = aX_1^{b1}.X_2^{b2}.\ X_3^{b3}.\ X_4^{b4}.\ X_5^{b5}.\ X_6^{b6}.\ X_7^{b7}..e^u \quad \ldots\ldots\ldots \quad (1)$$

Where,

Y = production of Cotton (tons/ha)
a = intercept
X_1 = seeds (Rs./ha)
X_2= Farm yard manure (t/ha)
X_3 = Fertilizers (N, P and K (kg/ha))
X_4 = Plant protection chemicals (PPC) (litres/ha)
X_5 = Human labour (mandays/ha)
X_6 = Machine power (Rs. /ha)
e^u = Error term
bi= Regression coefficients of factor inputs (i.e. = 1 to 7).

The function was translated into linear form by making logarithmic transformation on all the variables as follows:

$$\text{Log } Y = \log a + b_1.\log X_1 + b_2.\log X_2 + b_3.\log X_3 + b_4.\log X_4 + b_5.\log X_5 + b_6.\log X_6 + b_7.\log X_7 + \log eu \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

The results of the analysis were subjected to test by the coefficient of multiple determination and the relevant't' test was carried out.

The regression coefficients (b_1) were tested for their significance using't' test chosen level of significance.

$$t = \frac{b_i}{\text{Standard error } b_i}$$

Marginal value productivities (MVP) of different factor inputs were worked out by using following formula.

$$MVP = b_i \frac{Y_i}{X_i} P_Y$$

Where, Y_i and X_i are the geometric mean values of output and inputs respectively. P_Y = Price of output.

Marginal factor cost was also worked out. Resource use efficiency was studied by comparing the marginal value products of each resource with corresponding factor costs at which each resource could be produced. Wherever the ratio of marginal value product to factor cost was found to be more than the unity resource was assumed to be advantageously used. One MVP and MFC ratio includes optimum use of resources.

Garrett's ranking: Garrett's ranking technique was adopted for studying problems faced by farmers during production and marketing.

In the first stage: Ranking given by respondents for each constraint was analyzed.

In the second stage: Ranks assigned by the individual respondents were counted into percent position value by using the formula.

$$\text{Per cent position} = 100\ (R_{ij} - 0.5)/N_j.$$

Where,

R_{ij} = rank given for the i^{th} factor by the j^{th} individual.
N_j = number of factors ranked by j^{th} individual.

In third stage: For each per cent position scores were obtained with reference to Garrett's Ranking Conversion Table and each per cent position value was converted into scores by reference to Garret's Table (Fisher 1995).

In fourth stage: Summation of these scores for each factor was worked out for the number of respondents who ranked for each factor. Mean scores were calculated by dividing the total score by the number of respondents

In the last stage: Overall ranking was obtained by assigning ranks I, II, III …. VIII etc. in the descending order of the mean score.

3. RESULTS AND DISCUSSION

3.1 Efficiency of Resources used for Production of Cotton

To evaluate the efficiency of resources used for cultivation of cotton in the study area Cobb-Douglas production function was used and the results obtained was presented in Table 1.

The C-D production function is able to handle multiple inputs along with problems of autocorrelation, heteroscedasticity and multicollinearity [1]. Overall, C-D production function has several advantages and most importantly its ease in estimation or use, good empirical fit across many data sets and extreme flexibility are discussed [2]. The functional form of CD model for deriving production function, returns to scale and resource use efficiency can be referred from Karthick et al. [3].

The table revealed that fertilizer, pesticide, human labour and machine labour were significantly contributing in obtaining higher yield in small farm group as well as in overall scenario of study area, whereas in large farm group manure, fertilizers, pesticides and machine labour contributed significantly. R^2 obtained was 0.8155, 0.8493 for small and large farm group respectively.

Resource use efficiency of various inputs were calculated and presented in Table 2. The table revealed that MVP and price ratio is more than one for all the significant inputs in all size groups that means the resources are underutilized and there is an ample scope of improvement in use of resources. By adding more quantity of resources, the farmer can obtain higher yield.

The similar results for labour use in yield increase in cotton have been reported by Shelke et al. [4] from Maharashtra, Manjunath et al. [5] from Karnataka and Chatterjee et al. [6] from Haryana. Chatterjee et al. [6] reported significant impact of fertilizers on cotton yield in all major cotton growing states. However, coefficient for nitrogenous fertilizer was found to be negative (-0.142) and significant at 10% level, and infers that farmers are using excess dose of nitrogenous fertilizers in cotton fields. Shelke et al. [4] have observed excess use of nitrogen impacting negatively on yield of cotton. This excess dose of nitrogen is interpreted in terms of imbalance use of fertilizers.

3.2 Problems Faced by the Farmers in Production and Marketing of Cotton in Study Area

An opinion survey was conducted to identify the problems faced by the farmers at different stages of production and marketing of cotton in the study area. Problems were analysed using Garrett's Ranking Techniques. The factors were considered in the analysis of the production and marketing problems faced by the growers *i.e.* involvement of large number of intermediaries in marketing, expensive and more labour required, occurrence of pest and diseases, lack of efficient marketing information system, unpredictable fluctuations in the pries, high seed cost and timely unavailability of labour. Results of Garrett Ranking Technique analysis are presented in Table 3. The major constraints in cotton yield as reported by farmers were high cost of labour, high cost of seeds, lack of regulated markets etc. in the study area.

Table 1. Result of Cobb-Douglas production function for different size groups

Sl. No	Particulars	Small	Large	Overall
1	Constant	8.5900	3.01795	2.5665
2	Seed	0.2049	0.3408	0.6279
3	Manures	0.0193	0.3685***	0.0345
4	Fertilizer	0.4608**	0.1597**	0.0348**
5	Pesticide	0.2141***	0.0742**	0.2106**
6	Human labour	0.0422**	0.0182	0.0580**
7	Machine labour	0.0587***	0.0386**	0.0342**
8	R^2	**0.8155**	**0.8493**	**0.8426**

****-Significant at 1% level, **- Significant at 5% level, *- Significant at 10% level*

Table 2. Resource use efficiency of various inputs

Input	Particulars	Small farmers	Large farmers	Overall
Manures	**MVP**		1.31	
	Price		1.07	
	MVP-Price ratio		1.22	
	Difference		0.22	
	Standard error of difference		0.17	
Fertilizer	**MVP**	1.18	1.11	1.16
	Price	1.07	1.04	1.05
	MVP-Price ratio	1.1	1.07	1.1
	Difference	0.1	0.07	0.1
	Standard error of difference	0.23	0.06	0.14
Pesticide	**MVP**	1.14	1.15	1.12
	Price	1.07	1.04	1.05
	MVP-Price ratio	1.07	1.11	1.07
	Difference	0.07	0.11	0.07
	Standard error of difference	0.03	0.09	0.08
Human labour	**MVP**	1.13		1.08
	Price	1.04		1.03
	MVP-Price ratio	1.09		1.05
	Difference	0.09		0.05
	Standard error of difference	0.04		0.06
Machine labour	MVP	1.67	1.11	1.42
	Price	1.04	1.02	1.05
	MVP-Price ratio	1.61	1.09	1.35
	Difference	0.61	0.09	0.35
	Standard error of difference	0.19	0.012	0.16

Table 3. Constraints in production and marketing of cotton

Sl. No	Particulars	Total score	Mean score	Rank
1	Involvement of large number of intermediaries in marketing	5941	49.51	V
2	Expensive and more labour required	6507	54.23	I
3	Occurrence of pest and diseases	6036	50.3	IV
4	Lack of efficient marketing information system	5736	47.8	VI
5	Unpredictable fluctuations in the prices	5504	45.87	VII
6	High seed cost	6184	51.53	II
7	Timely unavailability of labour	6092	50.77	III

Some of the important constraints expressed by the farmers in the study area are discussed in detail in this section. It is hoped that such a measure would be of greater help for the policy makers in formulating the plans and strategies.

The major constraints in cotton yield as reported by farmers were high cost of labour, high cost of seeds, lack of regulated markets etc. in the study area. Non-availability of quality seeds was the other important constraint hindering the production technology as opined it was important constraint for the farmer respondents. Farmers are finding it difficult to get quality seeds from any seed company. Wherever quality seeds were available, quantity was the limiting factor in the sense, required quantity of seeds was not available. Similar finding was observed by Kiresur et al. [7] and Hosmath et al. [8] though, it was Bt cotton it was not free from pest incidence. Farmers have to take up plant protection measures in Bt cotton also. The major marketing problem was lack of regulated markets. Because of high margins of the middleman and more number of intermediaries in the marketing of cotton price received was, low findings these match with the findings of Sindhu et al. [9].

They mix some quantity of first grade produce with the second and third grades and quote the price which is usually lower than the first grade produce. The high commission charges, as

reported by the farmers are another major problem. As per the bye laws, who should get 2 per cent of the value of produce from the traders as their commission and the farmers need not have to pay anything as commission. But in reality the commission agents are receiving commission from both the farmers as well as traders.

As reported by the farmers, they have paid commission which ranged from 2 to 4 percent. This was because of linking of credit with marketing *i.e.* majority of the farmers get the credit facilities from the commission agents both in the form of cash and inputs like, seeds, fertilizers and pesticides with an agreement of selling their produce to them only. The high price fluctuation especially during peak and lean arrival months coupled with the immediate cash needs of farmers made them to go for distress sale. In marketing of cotton, there will be lot of intermediaries between the producer to consumer *viz.*, commission agents, wholesale trader; village trader because of this multiplicity of middlemen the price spread will be larger.

The marketing margin taken away by each intermediary cropped up and affected the producer's share in consumer rupee. Some of the farmers opined that lack of transportation facilities to regulated markets is the major constraint since the roads from their villages to regulated markets were not good and moreover, all the regulated markets are located far away from the cities. Unauthorized deductions were also one of the marketing problems which were expressed by 100 per cent of farmers in selected markets. The cleaning charges which are fixed by the respective market committees were not being followed in the markets.

4. CONCLUSION

Clothing has been recognised as an essential need of man since time immemorial, and cotton has been the base for textile manufacturing in a hot country like India. Cotton productivity and production in the country have increased significantly since the start of the green revolution. Cotton is the backbone of textile industry, which consumes 70 per cent of the country's total fibre production accounts for 38 % of the country's export and fetches over Rs. 80, 000 crores annually to the exchequer. Along with the industry it supports, it has an impact on the country's economy in a variety of ways, including employment and export earnings. India annually cultivates around nine million hectares, the largest in the world. In fact, one out of every four hectares planted to cotton in the world is in India. About four million farmers grow the crop in about 13 states. Around 60 million people are estimated to depend on it one way or the other to eke out their living.

Cotton is being cultivated in 70 countries of the world with a total coverage of 32.30 m ha. Area wise, India ranks first in global scenario (about 33 per cent of the world cotton area). However, in production it ranks second next to China. The important cotton growing states in India are Maharashtra, Gujarat, Andhra Pradesh, Madhya Pradesh, Punjab, Haryana, Karnataka, Rajasthan and Tamil Nadu. The main cotton growing districts in Odisha are Kalahandi, Balangir, Rayagada and Nuapada. Hence, the present study has made an attempt to analyse the performance of cotton crop in these major cotton growing areas, thereby showing guidelines for their reforms and reorientation through appropriate policy options.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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