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Production Performance and Supply Response of Cotton in Karnataka: A Case Study of Dharwad District

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ABSTRACT

A study was conducted to estimate the Production performances and acreage response of cotton in Dharwad district of Karnataka. The Compound growth rate were employed to estimate the trend and it was found that area under cotton decreased but production increased due to increase in productivity in Karnataka. In district, area under cotton was decreased due to subdivision of district but production was also decreased because of high production cost and non-availability of sufficient quantity of farm inputs. The cotton productivity in the district is higher than the state productivity this is mainly due to good rainfall and good management practices. Acreage response was estimated using Nerlovian lag adjustment model and it was found that the cotton acreage was positively influenced by lagged acreage followed by lagged price and lagged yield. The coefficient of adjustment for the district and the state was 0.55 and 0.46 implying farmers of district took 1.82 years and state farmers took 2.84 years in making adjustments in allocating the area under cotton. Long Run Elasticity with respect to price was higher than Short Run Elasticity which indicated that the acreage under cotton in the district was more elastic in long run than short run period.

Key words: *Acreage response, Cotton production, Nerlovian lag adjustment model, Coefficient of adjustment*

INTRODUCTION

Cotton (*Gossypium sp.*), white gold, is an industrial commodity of wide importance and play significant role in economic, political and social spheres of the world. India has the largest area under cotton (117.27 lakh ha) in the world, but occupies second position in global production, with a production of 390 lakh bales during 2013-14 (*www.cotcorp.gov.in*). In India major cotton growing states are Gujarat, Maharashtra, Punjab, Andhra Pradesh and Karnataka, respectively. Country has the distinct advantage of growing four cultivated species of cotton. Almost all the cotton produced is consumed by well-established and modernized spinning industry. Cotton continues to remain the back bone of Indian rural economy, particularly in dry land areas.

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Its cultivation provides 200 man days of employment per hectare. Various processing activities like ginning, yarn and fabric production, textile processing, garment manufacture, marketing, etc., provide employment to several million people across India. Country made remarkable advance in cotton production, especially after the advent of cotton hybrids during the mid-seventies. Consequently, India could not only meet domestic demand in full for its own textile production but could also generate surplus for export[6]. In India, Karnataka is one of the important cotton growing state with acreage of 5.94 lakh hectare and 20.90 lakh bales of production during 2013-14 (*www.cotcorp.gov.in*). In Karnataka, the highest area under cotton was in Dharwad district (51,889 ha) followed by Haveri district (47,319 ha) and Mysore district, respectively during 2011-12 (Government of Karnataka). In Dharwad district major cotton growing taluks were Hubli, Kalgatagi and Dharwad, respectively. Cotton is usually grown in *kharif* season i.e. early June-July and harvested in December-January month within these taluks. The past literatures with respect to cotton crop shows that supply response of cotton in semi-arid tract and sub-humid tract of Gujarat state was estimated. By and large the nature and extent of farmers' response was very location specific and degree of risk taking or varied with agro-climatic conditions[4]. The supply response of cotton was sensitive to price changes while Virginia tobacco and chillies did not exhibit supply response to price changes. However, Virginia tobacco supply responded to price changes continuously for 1976-77 onwards and the chilli crop supply started responding to price changes for 1982-83 onwards[5]. However, the cotton producers in the state are observed to be under distress in recent years with the number of suicide cases increasing in the cotton growing areas of Karnataka. It is therefore, worth examining whether the distress is due to low profitability of cotton cultivation. Farmers also face a number of problems in marketing fronts also. Therefore, the present study aims to investigate the production trend of cotton over the years, the performance and supply responses of cotton in Karnataka.

MATERIAL AND METHODS

This study includes both primarily and secondary data, which were collected from the purposively selected and representative district of Dharwad of Karnataka. The pre tested schedule was employed to estimate primary data on acreage, price and yield etc. were collected from the farmers of Dharwad district. Secondary data on area, production and productivity of cotton were collected from various published sources for a period of twenty years from 1992-93 to 2012-13. The monthly rainfall data was collected from "Department of Economics and Statistics, Government of Karnataka. The data on farm harvest price were collected from Directorate of Agricultural Marketing, Government of Karnataka. Three stage random sampling was employed to collect primary data on cotton from purposively selected Dharwad district of Karnataka, wherein taluk, village and farmer represent the first, second and third stage unit, respectively.

Estimation of growth rate

Growth rates are worked out from growth curve of character (Y) over the time (t) to see the tendency of the data to increase, decrease or stagnate over time. Growth rates of cotton worked out with respect to area, production and productivity to examine the trend in cotton production in Dharwad district and state as a whole. To see the historic pattern of growth, many alternative forms of growth functions *viz.* ,linear, Cobb-Douglas type, exponential and trend equations etc. have been used by the researchers. For agricultural data, the log-linear equation is found to be superior over the other forms, particularly over the linear form[2]. In the present study therefore, only log-linear functions were estimated in order to find out the growth rates of area, production and productivity of cotton. The log-linear function can be expressed as

$$\ln Y = \ln A + b*t \quad \text{……(1)}$$

where, A is intercept and b is the slope of curve

Compound growth rate (CGR) from the log-linear equation is calculated as

$$CGR = e^{b} - 1 \quad \text{…….. (2)}$$

Acreage Response Analysis

To estimate the acreage response function, Nerlovian lag adjustment model was adopted. It intends to examine and identify important price and non-price factors which effects farmers' decision making process regarding area allocation in cotton cultivation. Area under cotton one of the two components besides productivity which has direct bearing on total production or supply. Nerlovian lag adjustment model is combination of two behavioral equations. In which, first equation indicates a behavioral relationship stating that the desired area under the crop depends on farm harvest price and yield of cotton, lagged area, rainfall under cotton while second equation is partial acreage adjustment equation suggesting the farmers do not adjust their area allocation fully to the change in price and non-price factors. The extent of adjustment to change in price and/ or non-price factors is measured in terms of "coefficient of adjustment" and is denoted by λ. The final estimation equation of the Nerlovian acreage adjustment model can be written as follows:

$$A_t = b_0 + b_1 (A_{t-1}) + b_2 (P_{t-1}) + b_3 (Y_{t-1}) + b_4 (R) + V_t \quad \text{.....(3)}$$

$$\text{In this equation } b_i = a_i\lambda; b_1 = 1-\lambda ; V_t = U_t\lambda \; 0 \leq \lambda \leq 1$$

Where,

A_t =Area under cotton crop for the current year t , A_{t-1}=Area under crop lagged by one year, A_t^* = Desired area under crop in the year t, P_{t-1} = Price of crop lagged by one year, Y_{t-1} = Yield of crop lagged by one year, R_t = Pre sowing rainfall in the year t, U_t= Error term, λ = coefficient of adjustment, a_i = Coefficient, where i = 0,1,2,3,…….n

The above equation in log linear form can be written as:

$$\log A_t = b_0 + b_1 \log (A_{t-1}) + b_2 \log (P_{t-1}) + b_3 \log (Y_{t-1}) + b_4 \log (R) + U_t \quad \text{.....(4)}$$

For studying the area response, both linear and log-linear forms were tried with different combinations of explanatory variables in Dharwad district of Karnataka. The area under crop which responds to the changes in prices and/ or non-price factors that causes fluctuation in total output was used as the dependent variable for regression analysis and as a proxy for its supply or output. The explanatory variables incorporated in the model are discussed under two broad categories namely, price variables and non-price variables. Price variable included the Farm harvest prices (FHP) which influence area allocation decision by the farmer. Non price variables included the total area under the crop in hectares over years lagged by one year, yield per hectares of crop determines production and profitability and precipitation received during the pre-sowing period. Short run elasticity (SRE) and long run elasticity (LRE) with respect to price are calculated as follows

$$SRE = [\text{Coefficient of lagged price X (Average price/Average area)}] \quad \text{..... (5)}$$

$$LRE = [SRE/\lambda] \quad \text{..... (6)}$$

RESULTS AND DISCUSSION

Trend and Production Performance of Cotton

In Karnataka state as a whole, it was found that area under cotton has decreased from 521.33 thousand hectares during Triennium Ending (TE) 1993 to 436.33 thousand hectares during TE 2013. This was mainly due to severe drought in the states after 1997 onwards. Production has increased from

513.33 to 589 thousand bales during the same period. Increase in production is largely due to increase in productivity and good management practices. The productivity increased from 170 kg per hectare during TE 1993 to 253.67 kg/ha during TE 2013. However, the productivity of the state was low as compared to that of other states (Table 1).In the Dharwad district, it was found that area under cotton has decreased from 172.99 thousand hectare during Triennium Ending (TE) 1993 to 79.39 thousand hectares during TE 2013. This decrease in area under cotton was mainly due to sub division of district. Production has decreased from 122.22 thousand bales to 143.62 thousand bales during same period. This decrease in the production was mainly due to high cost of production and lack of availability of sufficient quantity of farm inputs especially seed, fertilizer and plant protection materials at assured prices and also due to poor marketing facility, unavailability of credit at lower rates, unstable prices. Increase in productivity from 154.67 kg per hectare during TE 1993 to 686.00 kg per hectare during TE 2013. This increase in yield per kg per hectare was mainly due to good rainfall and assured irrigation facility and management practices. The productivity of Dharwad district was comparatively higher than the Karnataka state productivity (Table 1). Compound Growth Rate (CGR) of area, production and productivity in Dharwad district was estimated and the results showed that during 1993-03 area under cotton increased at the rate of 3.28 per cent per annum but it declined at the rate of -9.05 per cent per annum during 2003-2013. Compound Growth Rate of production decreased marginally from 6.95 per cent during 1993-03 to -5.60 per cent during 2003-13. In case of productivity, due to technological advancement, growth rate increased from 7.31 to 6.29 per cent (Table 2). However, state as whole area, production and productivity of cotton decreased during the same periods.

Acreage Response Analysis of Cotton

Acreage response analysis was conducted to examine and identify the important price and non-price factors which affects farmers' decision making process regarding area allocation under different crops within given area of farmer i.e., by analyzing previous year prices and yield of different crops farmer can allocate more area to those crop whose price as well as yield is high. In this way farmer can realize more profit from his farm business and also utilize his farm business activity more efficiently. The regression results of the area response functions of cotton with respect to various price and non-price factors in Dharwad district are presented in this section. The acreage response function was estimated by Nerlovian lag adjustment model. The model was fitted for the acreage, price, yield data of cotton and rainfall data in the selected district. Both linear and log-linear forms of area response functions were fitted, but only linear form has been presented for discussion as it was seen as the best fit for the data. The result of acreage response analysis of cotton in Dharwad and Karnataka are presented in the Table 3**.**The variables incorporated to explain variability in acreage under cotton included lagged area, lagged yield, lagged price of Cotton and pre-sowing rainfall. In all the equations, the variables explained more than 66 and 81% of total variability for Dharwad and Karnataka, respectively as indicated by the coefficient of multiple determinations (R^2). The inclusion of lagged price did not depict any significant influence on acreage response in case of cotton in Dharwad district. The inclusion of pre-sowing rainfall did not show any significant influence on acreage response in case of cotton in Karnataka.

Short- run and long-run elasticities

The analysis of short-run as well as long run price elasticities for the district and for the state as a whole is presented in Table 4. The area adjustment coefficient and complete adjustment period have been computed for the supply response functions for cotton in Dharwad district and Karnataka. For estimating short run and long run elasticity of cotton area, the lagged price of cotton was chosen as explanatory variable for the area response function of Dharwad. The coefficient

of adjustment turned out to be comparatively high for Dharwad district, implying that farmers adjusted acreage swiftly to the changes in various price and non-price factors. The supply response of farmers of Dharwad district to lagged price of cotton with Short Run Elasticity (SRE) and Long Run Elasticity (LRE) were 0.03 and 0.04, respectively. Long Run Elasticity with respect to price was 0.04, which means one per cent increase in lagged price would result in 0.04 per cent increase in the acreage in the long run. Short run elasticity of 0.03 means one per cent increase in lagged price by one year would result in increase of 0.03 per cent in the acreage in the short run. In Karnataka Short Run Elasticity and Long Run Elasticity were 0.09 and 0.19, respectively. Long Run Elasticity with respect to price was higher than Short Run Elasticity which indicated that the acreage under cotton in Dharwad district as well as in Karnataka was more elastic in long run than in the short run period. Due to high coefficient of adjustment the rate of acreage adjustment was quick in both Dharwad and Karnataka i.e., farmers took only one year and eight months and two years and eight months, respectively to adjust their area to the changes in lagged prices.

Table 1: Area, production and productivity trends of cotton in Karnataka and Dharwad district

SI. No.	Triennium Ending	Area ('000 ha)		Production ('000 bales)		Yield (kg/ ha)	
		Karnataka	Dharwad	Karnataka	Dharwad	Karnataka	Dharwad
1	1993 TE	521.33	172.99	513.33	122.22	170.00	154.67
2	1998 TE	603.93	200.68	783.47	194.11	220.00	208.00
3	2003 TE	620.07	228.64	914.37	238.03	256.67	356.00
4	2008 TE	520.40	97.89	815.87	199.33	204.00	528.33
5	2013 TE	436.33	79.39	589.00	143.62	253.67	686.00
6	2013 TE	436.33	79.39	589.00	143.62	253.67	686.00

Table 2: Compound Growth Rate of Area, Production and Productivity of cotton in Dharwad district of Karnataka (CGR in per cent)

Particular	Area		Production		Productivity	
	1993-03	2003-13	1993-03	2003-13	1993-03	2003-13
Dharwad	3.28	-9.05	6.95	-5.60	7.31	6.29
Karnataka	0.48	-5.22	2.82	-6.79	2.48	0.49

Table 3: Regression estimates of supply response function of cotton in Dharwad district and Karnataka

Particulars		Dharwad		Karnataka
Intercept		8.195		149.26
A_{t-1}		0.450		0.540
P_{t-1}		0.001		0.050
Y_{t-1}		0.683		0.320
R_t		0.007		0.020
R^2		0.664		0.810

Table 4: Long run and short run elasticities of supply response function of cotton in Dharwad district and Karnataka

Particulars	Dharwad	Karnataka
Short- Run elasticity	0.03	0.09
Long- Run elasticity	0.04	0.19
Coefficient of adjustment	0.55	0.46

CONCLUSION

The present study emphasized on the production trend, performance and acreage responses of cotton over the years in Dharwad district as well as Karnataka state as a whole. It was found that area under cotton was decreased due to severe droughts after 1997 onwards in Karnataka. However, production was increased due to increase in productivity and good management practices. In Dharwad district, area under cotton was decreased due to subdivision of district but production was also decreased because of high cost of production and lack of availability of sufficient quantity of farm inputs and also due to poor marketing facility. The productivity of cotton in Dharwad district is higher than the state productivity this is mainly due to good rainfall and good management practices. Cotton acreage was positively influenced by lagged acreage followed by lagged price and lagged yield. The coefficient of adjustment for Dharwad district was turn out to be relatively high than state implying that farmers of district took less time period in making adjustments in allocating area under cotton. Long run elasticity with respect to price was higher than short run elasticity which indicated that the acreage under cotton in the district was more elastic in long run than short run period.

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