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Assessment of Compound Growth Rate and Economic Analysis of Production of Cotton in Bemetara District of Chhattisgarh, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The study was entitled compound growth rate and economic analysis of cost of production of cotton in Bemetara district of Chhattisgarh, India. Owing to maximum area under cotton cultivation in the district Bemetara were purposefully chosen for study. A multistage sampling was applied and a total 56 cotton farmers were selected for data collection in the year 2021-22. The appropriate tabular and percentage method were the statistical tools used for data analysis. To estimate the growth rate of area, production and productivity of the cotton in Chhattisgarh and Bemetara district was found increasing but non-significantly. The study revealed that average total operational area was 16.68 ha. the average cropping intensity was found to be 198.38 per cent. The total cost of cultivation of cotton was observed highest in case of large farms in compared to marginal farms. The overall cost

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of cultivation was Rs. 97887.50 per hectare. The overall cost of production was Rs. 3322.72 per quintal. Gross returns from cotton was found to be Rs. 274676 per hectare. The net returns of overall farmers was observed Rs. 176788.50 per hectare. Benefit-cost ratio was ranging from 1.73 to 1.83 with respect to the farm size.

Keywords: Cotton; compound growth rate; cost of cultivation.

1. INTRODUCTION

Cotton (white gold) is the leading commercial and cash crop. It accounts for around 23% of total global production. Cotton plays major role in sustaining the livelihood and Indian economy as the country's textiles industry is predominately cotton based. India got 1st place in the world in cotton acreage with 130.61 lakh hectares area under cotton cultivation, around 40% of world area of 324.16 lakh hectares. Approximately 67% of Indian cotton is produced on rainfed area and 33% irrigated areas. In terms of productivity, India is on 39th rank with the yield of 447 kg/ha. source (COCPC- 2023). India, one of the largest exporters of cotton with estimated export of 30 lakh bales (0.51 MM tonnes) and 6% of world export of 528 lakh bales in 2022-23 source (DGCIS Kolkata) [1-4]. The cotton sector directly or indirectly generated more than 40% of rural employment and provide for nearly 50% of the population. According to the national institute of statistics and economics analysis, it contributed 13% to the GDP [5-8]. The major cotton growing states in India are Maharashtra, Gujarat, Telangana, Andhra Pradesh, Karnataka, Madhya Pradesh, Haryana, Rajasthan and Punjab are the major cotton producing states in India [9-11]. Despite the major producing state of India, in Chhattisgarh state Bemetara district has catching maximum area of cotton and recognized as the major cotton producing districts of Chhattisgarh state, which accounted an area of 2008 hectare and producing 702.8 metric ton (4136 Bales) of cotton the productivity 350 kg/ha of cotton of Bemetara district as, which is commentating of cotton to other cotton producing states of India [12-15]. As the Chhattisgarh state is well known for paddy cultivation especially Bemetara district also known for paddy cultivation [16,17]. Farmers of the district and state have diverted to grown other crops through various farmers welfare programs sponsored by the state government the name is Rajeev Gandhi Nyaya Yojana and others.

In the view of this a present study has been conducted seeks to examine the following.

1.1 Objective

1. To find out the compound growth rate of area, production and productivity of cotton instudy area.
2. To examine the cost and returns in production of cotton in study area.
3. To find out the major constraint in the production of cotton faced by cotton grower.

2. MATERIALS AND METHODS

The study was carried out in the Bemetara district of Chhattisgarh. The state was selected purposively for the study in view of the importance attached to the cotton growing state in India, at the second stage, the state consists of 32 districts out of which Bemetara district have been selected purposively, the district has 4 blocks out of which 2 blocks namely Bemetara and Berla was selected randomly. From the list of cotton growers located in village of both sampled blocks among then 56 cotton growers from 22 villages were selected random sampling. The primary data on cost and return of cotton were collected from the cotton grower by personal interviews methods through pre-tested questionnaire and schedule and the secondary data was collected through different government offices such as Department of Agriculture, Directorate of Economics and Statistics, Government of Chhattisgarh and other relevant sources. Keeping in view the objectives and nature of the study, an extensive schedule was prepared to obtain data from the sample farmers. The selected farmers were personally contacted, interviewed and the required information was collected from them. The multi-stage simple random sampling method was followed for the conducted of the study. In order to select sample farmers, all the cotton growing farmers of the selected sample farmers classified into two categories as irrigated and un-irrigated cotton growers. Further, taking into account the landholdings the cotton growers were classified into four groups namely; marginal Farmers (below 1.00 hectares), Small Farmers (1.01 to 2.00 hectares), Medium Farmers (2.01 to 4.00

hectares) and large farmers (Above 4.0 hectares).

2.1 Analytical Tools

Compound growth rate: Annual compound growth rates in the area, production and productivity of cotton. The study area by fitting an exponential function of the following form.

$$Y = aB^t$$

$$\text{Log } Y = \log a + t \log B$$

Where,

Y = Area (ha) / production (tonne) / productivity (Kg/ha)A = Constant
B = Regression coefficient
Compound growth rate (%) = (Antilog B – 1)100

2.2 Cost and Returns of Cotton Cultivation

For estimation of costs and returns of cotton, the standard cost concept method given by the commission for Agricultural Costs and Prices (CACP), was used.

Cost A1= All actual expenses in cash and kind incurred in production.

- Value of hired and family human labour.
- Value of bullock labour (owned & hired).
- Value of machine labour (owned &hired).
- Value of seed (owned & purchased).
- Value of manure, fertilizer and pesticide.
- Irrigation charges, land revenue and depreciation farm implements.
- Interest on working capital.
- Miscellaneouscharges.

Cost A2 = Cost A1 + rent paid for leased in land.
Cost B1= A1 + Interest on value of owned capital (excluding land).
Cost B2 = B1 + Rental value of owned land & rent paid for leased land
Cost C1= Cost B1+ Imputed value of family labour.
Cost C2 = Cost B2+Imputed value of family labour.
Cost C3 = includes managerial cost (Revised C2 + 10% of Revised C2)

Input – output ratio: input -output ratio indicates the efficiency of input. It is computed as under:
Input – output ratio = gross return / total input cost

Map 1. Map of Bemetara district

2.3 Constraints in Production of Cotton

Constraint in the production of cotton in the sampled farms were analyzed and examined using the perception experience of the cotton growing farmers. Measures of constraints by garret ranking.

2.4 Garret Ranking

The Garret ranks were calculated constrains by using appropriate Garret Ranking formula. The based on the Garret ranks, the garret value was calculated.

Percent position =100 (Rij-0.5)/ Nj

Where,

Rij = Rank given for the ith variable by jth respondents.
Rij = Rank given for the ith variable by jth

3. RESULTS AND DISCUSSION

The results and discussion for compound growth rate and cultivation of cotton with respect to the objectives framed for the study in the Bemetara district of Chhattisgarh state, which specifically represented on CGR, costs and returns of cotton, and constraint in production of cotton, respectively.

3.1 Compound Growth in Area, Production and Productivity of Cotton

Table: 2 to be found the area under cotton cultivation in Bemetara has been increased from 10.01 hectare with an annual production of 3.5 MT in the year 2012-13 to 2008 hectare with an annual production of 640.00 MT (3670.59 bales) in the year 2020-21. In case of productivity of cotton has been constant 340 kg in the year 2012-13 to 2021-22. The compound growth rate (CGR) of Chhattisgarh the area (79.26%), production (78.61%) and productivity (0.0%) of cotton was increasing non-significant at 95% confidence interval. The compound growth rate (CGR) of Bemetara district the area (109.22%), production (109.52%) and productivity (0.025 %) of cotton was increasing non-significant at 95% confidence interval.

In the Table 3 show the raw resources are transformed into output throughout the production process. In agricultural production, inputs such as seeds, fertilizer, manures, plant protection chemicals, and water are transformed into grains. Fixed costs/overhead costs and variable costs/operating costs/labour costs are the two major categories of costs involved in this production process.

The cost analysis is presented in the Table 4. According to the table, the overall cost of cultivation in cotton was ₹ 97887.50 /ha the variable cost and fixed cost were determined to be ₹ 61005.10/ha and ₹ 36882.40/ha, respectively, representing 62.32 percent and 37.67 percent of the total cost of cultivation. It was also found that the total cost of cultivation in cotton for marginal, small, medium and large farmers was ₹ 93562.42/ha, ₹ 96288.20/ha, ₹ 98942.20/ha and ₹ 102757/ha, respectively. For marginal, small and medium and large farmers the variable costs account for 63.50 percent, 61.90 percent, 62.39 percent and 61.59 percent respectively. marginal, small, medium and large farmers, are, spend 36.50 percent, 38.10 percent, 37.61 percent and 38.41 percent on overhead costs respectively.

From the Table 4, it is clearly demonstrated that hired Human Labour comprises the largest proportion (20.38%) of overall cost among the variable costs, followed by machine power (12.21%), fertilizers (7.57%), and Insecticides (5.49%). Seeds, owned human labour, bullock labour, and irrigation expenses are less prominent among operational expenditures. The cost of family labour reduced as farm size increased, but the cost of machine labour increased.

3.2 Different Cost on the Basis of Cost Concept at Sample Farm

The total amounts of the different cost of cultivation components are shown in Fig. 1. The foregoing numbers make it evident that cost C3 had the highest cost amount, followed by cost C2, B2, C1, B1, and A1, A2 with sums of Rs. 107676.20, Rs. 97887.45, Rs. 89574.83, Rs. 65331.15, Rs. 57018.52, and Rs. 53665.85, in that order. Due to the farmer's managerial duty, Cost C3, which comprises Cost C2 and 10% of C2, reached its maximum. Large farms experience this same maximum, followed by medium-sized, small, and marginal farms. The lowest cost was found in Costs A1 and A2, which comprise all actual costs; however, large farms also have the highest cost, followed by medium, small, and marginal farms.

Table 1. General status of sample households

S. No.	Particulars	Farm size				
		Marginal	Small	Medium	Large	Overall
1.	Total number of sample households	4	8	14	30	56
2.	Average family size	6	5.12	5.28	5.73	5.55
3.	Average holding size (ha.)	0.65	1.58	6.33	25.94	15.39
4.	Irrigated area (ha.)	0.94	1.9	3.45	25.67	14.93
5.	Un-irrigated area (ha.)	0	0	0.5	3.03	1.75
6.	Area irrigated through tube well (ha.)	0.94 (100)	1.4 (73.68)	2.15 (62.31)	17.52 (68.25)	10.3 (68.89)
7.	Area of cotton in Kharif season (ha.)	0.65 (66.33)	1.58 (83.15)	3.25 (82.27)	25.94 (90.38)	14.98 (89.80)
8.	Area of cotton in Rabi Season (ha.)	0.65 (65.33)	1.58 (83.15)	3.25 (82.27)	25.94 (90.38)	14.98 (91.28)
9.	Total cropped area	1.88	3.8	7.9	56.89	33.09
10.	Net cropped area	0.94	1.9	3.95	28.7	16.68
11.	Cropping intensity (%)	200	200	200	198.2	198.38

Table 2. CGR in Area, Production and Productivity of cotton in Bemetara district and Chhattisgarh (2012-13 to 2021-22)

S. No.	Particulars	items	Area	production	productivity
1.	Chhattisgarh	CGR %	79.26	78.61	0
		P-value	0.00016***(0.087)	0.00018***(0.089)	0.1215*(9.81)
2.	Bemetara	CGR %	109.21	109.51	0.28
		P-value	0.0001***(0.106)	0.0001***(0.106)	0.025**(0.010)

*Note:- *** indicate significant at 1% and 10% level of significance and parenthesis shows standard error*

Table 3. Material inputs used for cultivation of cotton

(Lit./Kg/ha)

		Farm size				
S. No.	**Particulars**	**Marginal**	**Small**	**Medium**	**Large**	**Overall**
A.	**Material input use**					
1	Seed	1.5	1.5	1.5	1.5	1.5
2	Manure					
	FYM (ton/ha)	10.3	12.5	5.5	4.7	8.25
	Compost	0	150	350	400	225
3	**Fertilizer**					
i)	Urea	129.68	128.03	128.05	130.65	129.55
ii)	DAP	128.35	129.60	132.56	134.20	131.17
iii)	MOP	122.63	118.95	125.74	126.25	127.10
iv)	Ammonium sulphate	119.37	122.47	122.20	125.06	123.53
4	**Herbicide (Lit./ha.)**					
i)	2-4D	1	1	1	1	1
ii)	Other	0.85	0.83	0.75	0.90	0.83
5	**Insecticide/ Pesticide**					
i)	Thiamethoxam (Spike FS+)	0.10	0.10	0.10	0.10	0.10
ii)	Imidachloropid	0.22	0.22	0.22	0.22	0.22
iii)	Confidor	0.25	0.25	0.25	0.25	0.25
iv)	Safins	1	1	1	1	1
v)	Other	0.35	0.35	0.35	0.35	0.35
B.	**Human labour used (day/ha)**					
i)	owned	102.5	54.37	36	28.8	55.4175
ii)	Hired	89.75	131.87	149.21	161.36	133.0475
C.	**Machine power (hrs./ha)**	11.57	11.34	12.44	12.43	11.945

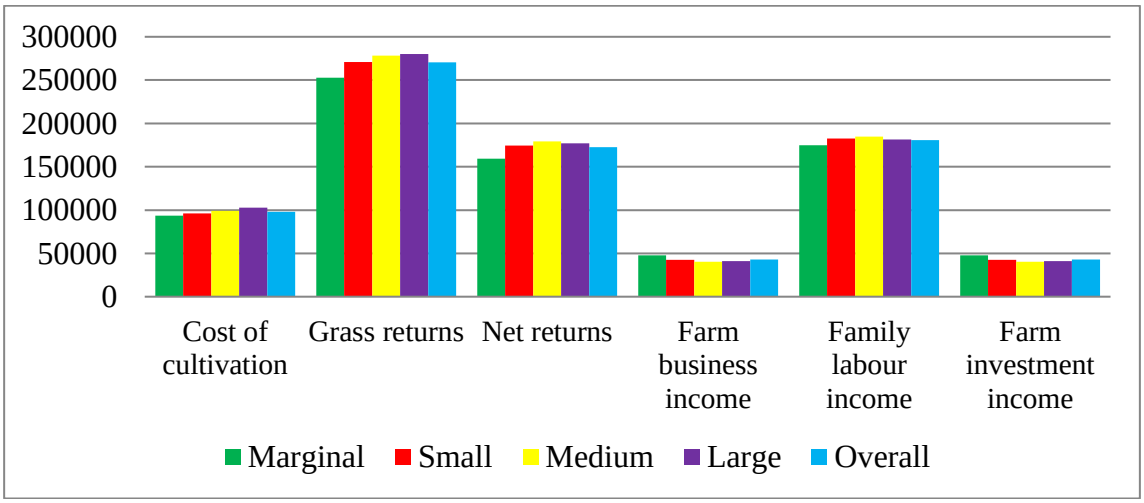

Fig. 1. Graph depicting costs and returns of cotton in the study area of Different Farmers

Table 4. Cost of cultivation in cotton

(₹/ha)

S. No.	Particulars	Farm Size Group				Overall
		Marginal	Small	Medium	Large	
1. Variable Cost						
A.	**Material input Cost**					
1	Seed	2025.65 (2.16)	2173.6 (2.25)	2240.64 (2.26)	2318.5 (2.25)	2189.6 (2.23)
2	Manure FYM/Compost	2556.25 (2.17)	2937.5 (3.05)	3378.57 (2.26)	3851.66 (3.74)	3181 (3.24)
3	Fertilizer	7310.25 (7.81)	7297.61 (7.57)	7397.34 7.47)	7660.22 (7.45)	7416.36 (7.57)
	Urea	700.25 (0.74)	691.37 (0.71)	691.5 (0.69)	705.5 (0.68)	697.155 (0.71)
	DAP	3208.75 (3.42)	3240.62 (3.36)	3314.14 (3.34)	3355.03 (3.26)	3279.64 (3.3)
	MOP	2207.50 (2.35)	2141.25 (2.22)	2263.35 (2.28)	2349.06 (2.28)	2240.29 (2.28)
	Ammonium sulphate	1193.75 (1.27)	1224.37 (1.27)	1128.35 (1.14)	1250.63 (1.21)	1199.28 (1.22)
4	Insecticide/herbicide and pesticide	4883.75 (5.21)	5338.75 (5.54)	5699.92 (5.76)	5612.63 (5.46)	5383.76 (5.49)
5	Irrigation Charge	531.25 (0.54)	584.12 (0.60)	615.35 (0.62)	609.5 (0.59)	585.055 (0.59)
B.	Human Labour (day/Rs. /ha)	28837.5 (30.82)	27936 (29.01)	27781.5 (28.07)	28524 (27.75)	28269.8 (28.87)
1	Owned	15375 (16.43)	8155.5 (8.46)	5400 (5.45)	4320 (4.20)	8312.63 (8.49)
2	Hired	13462.5 (14.38)	19780.5 (20.54)	22381.50 (22.62)	24204 (23.55)	19957.10 (20.38)
C.	Machine power used Charge	11579.25 (12.37)	11349.10 (11.78)	12444.10 (12.57)	12439.10 (12.10)	11952.90 (12.21)
D.	Interest on Working Capital (IOWC)	1693.95 (1.81)	1978.45 (2.05)	2166.30 (2.18)	2267.83 (2.20)	2026.63 (2.07)
	Total Variable Costs	59417.86 (63.50)	59595.20 (61.90)	61723.80 (62.39)	63283.50 (61.59)	61005.10 (62.33)
B. Fixed Costs						
1	Depreciation	527.51 (0.56)	838.52 (0.87)	1037.27 (1.04)	1439.29 (1.40)	960.648 (0.98)
2	Land Revenue	12.50 (0.00)	12.50 (0.00)	12.50 (0.00)	12.50 (0.00)	12.50 (0.00)
3	Rental Value of Owned Land	30500.50 (32.59)	32506.30 (33.75)	32785.10 (33.13)	34433.30 (33.50)	32556.30 (33.25)
4	Interest on Fixed Capital (IOFC)	3104.051 (3.31)	3335.73 (3.46)	3383.49 (3.14)	3588.51 (3.49)	3352.95 (3.42)
	Total Fixed Costs	34144.56 (36.50)	36693 (38.10)	37218.40 (37.61)	39473.60 (38.41)	36882.40 (37.67)
	Total Costs	93562.42 (100)	96288.20 (100)	98942.20 (100)	102757 (100)	97887.50 (100)

3.3 Returns from Cotton Cultivation

The Table 6, shows the productivity, cost of cultivation and cost of production of cotton for different types of farmers. There have average gross profits from cotton cultivation at per hectare were computed using the total market price of ₹ 9322.89 per quintal and total gross return from cotton was found to be ₹ 274676 The total farm business earnings, family labour income, and farm investment in come was estimated to be ₹ 221010/ha, ₹ 185101/ha, and

₹ 212697/ha. It is concluded that as farm size increases, so does the net return. The average cotton yield per hectare was 29.46 quintal/hectare.

From the Table 7 show the income over Cost A1, A2 was maximum in large farms followed by medium, small and minimum in marginal farms with Rs. 230567.74, Rs. 222009.47, Rs. 220507.32 and Rs. 211134.43 respectively. Income over Cost B1 also follows similar trend with Rs. 226979.23, Rs. 218625.98, Rs. 217171.60 and Rs. 208030.38 in large, medium, small and marginal farms respectively. The overall income over Cost A1, A2, B1, B2, C1, C2 and C3 was Rs. 221010.41, Rs.221010.42, Rs.217657.47, Rs.185101.16, Rs.209344.54, Rs. 176788.54 and Rs. 166999.79 respectively.

Table 5. Cost of cultivation in terms of cost concepts

(Rs/ha)

S.No.	Categories	Marginal	Small	Medium	Large	Overall
1.	Cost A1 (all actual expenses)	44582.86	52290.67	57373.52	60415.25	53665.58
2.	Cost A2 = Cost A1+rent paid for leased in land	44582.86	52290.67	57373.52	60415.25	53665.58
3.	Cost B1= Cost A1 + interest on value of owned capital	47686.91	55626.39	60757.01	64003.76	57018.52
4.	Cost B2=Cost B1+ Rental value of owned leased in land	78187.41	88132.64	93542.15	98437.09	89574.83
5.	Cost C1= Cost B1+ imputed value of family labour	63061.91	63781.89	66157.01	68323.76	65331.15
6.	Cost C2 = Cost B2+ imputed value of family labour	93562.41	96288.14	98942.15	102757.09	97887.45
7.	Cost C3= Cost C2 + 10% of cost C2 on account of managerial function performed by farmer	102918.65	105916.96	108836.36	113032.80	107676.20

Table.6. Yield and income from cotton cultivation

(q/₹/ha)

Yield and Income	Marginal	Small	Medium	Large	Overall
Cost of cultivation	93562.42	96288.20	98942.20	102757	97887.50
Yield	27.57	29.30	29.96	31.02	29.46
Price	9275.20	9310.50	9325.35	9380.50	9322.89
Gross return	255717.30	272798	279387	290983	274676
Net Return	162154.80	176509	180445	188226	176788.50
Farm business income	211134.40	220507	222014	230568	221010
Family labour income	177529.90	184665	185845	192546	185101
Farm investment income	195759.40	212351	216614	226248	212697
Cost of production	3393.63	3286.29	3302.48	3312.60	3322.72
B.C. ratio	1.73	1.83	1.82	1.83	1.81
Input - Output ratio	1:2.73	1:2.83	1:2.82	1:2.83	1:2.81

Table 7. Returns over different costs

(Rs. /ha)

S.No.	Categories	Marginal	Small	Medium	Large	Overall
1.	Income over cost A1	211134.43	220507.32	222009.47	230567.74	221010.41
2.	Income over cost A2	211134.44	220507.33	222009.48	230567.75	221010.42
3.	Income over cost B1	208030.38	217171.60	218625.98	226979.23	217657.47
4.	Income over cost B2	177529.88	184665.35	185840.84	192545.90	185101.16
5.	Income over cost C1	192655.38	209016.10	213225.98	222659.23	209344.84
6.	Income over cost C2	162154.88	176509.85	180440.84	188225.90	176788.54
7.	Income over cost C3	152798.64	166881.03	170546.63	177950.19	166999.79

Table 8. Constraints in Production of cotton

S. No.	Problems reported by the farmers	Respondent	Total	Average	Rank
1	Lack of latest technical Knowledge	56	2132	38.07	VIII
2	Non-availability of high yielding var.of seed	56	2292	40.92	VII
3	Lack of resources like Money,equipment	56	2564	45.78	V
4	Deep Ploughing make the soil more lose and is not economical	56	2827	50.48	III
5	Damage due to pest and disease	56	4005	71.51	I
6	Timely unavailability of labour	56	3363	60.05	II
7	Timely unavailability of input	56	2747	49.09	IV
8	Less agronomic practices	56	2470	44.10	VI

3.4 Constraints in Production of Cotton

In the Table – 8 show the most significant production constraint was identified as pest and disease damage (Rank 1), followed by labour shortages (Rank -2), Deep ploughing make the soil more lose and is not economical (Rank -3), and Unavailability of input in time. (Rank -4) In general, the large farmers reported that damage due to pests and diseases, as well as a lack of available manpower, were the significant production restrictions, while marginal farmers cited low technical expertise and pest and damage as the main production constraints. Finance was cited as the main barrier to performance for medium farms.

4. CONCLUSIONS

The above study it was observed that the average cropping intensity was 198.37% in the study area. In Chhattisgarh, compound growth rate of area, production and productivity of cotton were 79.26%, 78.61% and 0%, and Bemetara, compound growth rate of area, production and productivity of cotton were 109.22%, 109.52% and 0.25% respectively. The overall total cost of cultivation per hectare of cotton is found to be ₹ 97887.50/ha. The cost of cultivation for marginal, small, medium and large farm were ₹ 93562.42/ha, ₹ 96288.20/ha, ₹ 98942.20/ha and ₹ 102757/ha respectively. The overall yield of cotton is 29.21 qt/ha. Overall cost of production has been estimated ₹ 3350.88 qt. Overall value of net income of cotton has been estimated ₹ 172536 /ha. The overall input-output ratio and B-C ratio were 2.76 and 1.76 respectively.

The major constraints on production of cotton were damage due to pest and disease -I followed by unavailability of labour in time -II, lack of irrigation water-III, unavailability of input in time-IV, lack of resources like money and equipment-V, less agronomic practices-VI, availability of seed high yielding varieties-VII and lack of latest technical knowledge-VIII.

SUGGESTIONS

- Extension service should be improved for the seed sector including the fertilizer provision, pest management and irrigation service etc.
- Such farmers who growing cotton by taking land on rent should also be given the benefits of crop insurance and government schemes.
- Lack of cotton mill was seen, so establishment of cotton mill are recommended.
- Fiber crop is quite risky due to the perishable nature of the produce, seasonal production and bulkiness. An awareness of storage of cotton for reduces the losses.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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