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Farmers Perception, Economic Viability and Constraints in *Desi* Cotton Cultivation in Dryland Salinity of Gujarat

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Abstract

In Gujarat, the areas where salinity is high and canal irrigation is not available, farmers are left with no choice but to go for cultivation of *desi* cotton. Study was conducted with 70 farmers growing *desi* cotton in *Bara tract* area of Gujarat covering three blocks of Bharuch district. Data collected from personal interview of the farmers revealed that all farmers perceived that cost of cultivation for *desi* cotton is less and input cost for *desi* cotton is less (92%). In environmental benefits, all farmers perceived that *desi* cotton is more suitable to rainfed conditions, it is more tolerant to moderate saline ground water (90%) and water logging conditions (92%). In agronomic benefits, all farmers agreed that *desi* cotton requires less irrigation. In marketing benefits, farmers agreed that fibre quality of *desi* cotton as excellent (76%). Some aspects of *desi* cotton were also negatively perceived by the farmers, like its long duration (82%), availability of quality seeds (80%) and about boll size and number. Economic analysis revealed that gross profit of *desi* cotton under rainfed conditions was Rs. 34,947 per ha with B:C ratio 1.9 while it was Rs. 75250 per ha with B:C ratio of 1.7 in irrigated condition. Irrigation problem (54%), late sowing because of monsoon (36%) and damage because of high rainfall and flooding (36%) were the constraints reported as very severe by the farmers. In conclusion study recommends that, improved varieties of *desi* cotton with short life span need to be developed and made available to the farmers for better livelihood and sustainability of the cotton agro-ecosystem.

Key words: *Desi* cotton, Salinity, Farmers' perception, Constraints, Economic analysis

Introduction

Globally there are more than 50 species of cotton, only four of them are cultivable and India has the unique distinction of being the only country in the world to cultivate all four species viz. *Gossypium arboretum, G. herbaceum, G. barbadense* and *G. hirsutum*. First two are diploid and are called old world cultivated cotton or *desi* cotton while next two are new world cotton (American). In India area under cotton is 12.8 million hectares (25% of global area) and production realized is 6.46 million Mg which is 18 per cent of global production during the year 2014-15 (CCI, 2016). Traditionally, India cultivated *desi* cotton varieties which remained popular with the Europeans and other countries for hand woven and extremely fine muslin. For meeting the need of medium staple length, Britishers introduced the American type of cotton. The area under *desi* cotton in 1947 was 97 per cent of total cotton area, which reduced to 42 per cent in 1990 (Fig. 1) mainly because of introduction and promotion of American cotton and hybrid varieties; and again reduced to three per cent in 2013 with Bt cotton wave that had started in the year 2002 (Pyati, 2013; Kranthi, 2015). Cultivation trend shown under different species is depicted in Fig. 2.

However, this pattern of change could not observe in rain-fed areas of Rajasthan, Gujarat, Karnataka and some areas of Maharashtra state. This may be attributed to the less water requirement of *desi* cotton and its deep tap root system that can absorb deep residual soil moisture. Tolerance of *desi* cotton to biotic and abiotic stresses has been its great strength and factor behind its survival against the wave of Bt cotton

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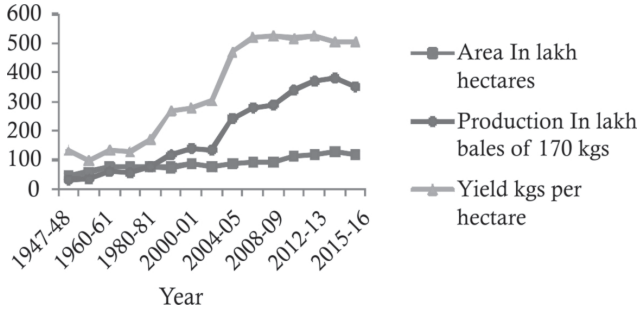

Fig. 1 Timeline of area, production and productivity of cotton in India (Source: Cotton corporation of India, 2016)

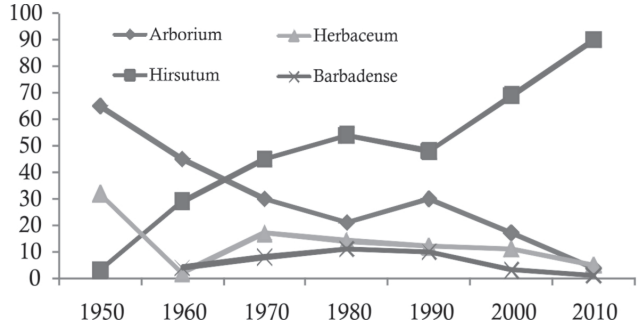

Fig. 2 Trend showing share of area (%) by different species of cotton in India since 1950 (Source: CICR, 2011)

in India. *Desi* cotton has great inherent ability to withstand abiotic stresses like drought/ water stress, salinity/sodicity (Rao *et al.,* 2012); biotic stresses like curly leaves, bacterial blight and comparatively tolerant to bollworm complex.

Saline Vertisols that are quite prevalent in the states of Maharashtra, Gujarat, Karnataka and parts of Rajasthan and Madhya Pradesh, because of their inherent physical and chemical constraints pose serious problems in crop production. India accounts for 6.73 Mha of salt-affected land out of which 22 per cent is present in Gujarat state alone (Mandal *et al.,* 2009). Occurrence of saline ground water and high-water table situation further aggravates the salinity problem. In these areas choice of *desi* cotton is not preferential but obligatory for the farmers. Farmers in the saline Vertisol dominant areas, *i.e.* Bhal area and Bara tract (which receives less rainfall with inadequate irrigation facilities) particularly in the area proximity to the sea coast), do adopt rain-fed farming with cotton as the dominant crop. Since hybrids and Bt lines are water-intensive cotton species, growing low water requiring *desi* lines form an ideal proposition in these areas. Because of their deep-rooted nature and longer life cycle *desi* cotton gets acclimatized to salinity in the vegetative phase, and thus the impact of salinity on boll drop is negligible (ICAR, 2015).

With this background, study was conducted with objectives *viz.* to find out farmers' perception about *desi* cotton in saline Vertisols region, to study the economics of cultivation of *desi* cotton, and to study the constraints faced by the farmers in cultivation of *desi* cotton.

Materials and Methods

Study area

Present study was carried out in Amod, Jambusar,and Vagra Talukas of Bharuch district occurring in the Bara tract area of Gujarat (part of eastern Gujarat plain). This area experiences hot tropical semi-arid climate. Average annual rainfall is 782 mm and length of growing period ranges from 120 to 150 days. Soils of the region are generally very deep (150-200 cm), fine textured with clay content ranging from 45-68 per cent with montmorillonite as the dominant clay mineral. Some inherent physico-chemical characteristics of black cotton soil such as high clay content, low infiltration rates, poor hydraulic conductivity and narrow workable moisture range, pose severe threat to crop growth and productivity even at low salinity. The salt-affected areas of Bara tract, by and large, remain either barren or possess some native hardy bushes and coarse grasses. This problem again exacerbated by the presence of saline ground water in the region, which reduces the possibility of irrigation through tube well and wells. The areas where canal water is not available farmer have no option but to go for the rain-fed farming. This area also characterized by high sub-surface soil salinity (Nayak *et al.,* 2003).

Study approach and sampling methods

A triangulation approach using both qualitative and quantitative methods was used in the study. A multistage sampling procedure was followed. Bara tract area Bharuch district was selected for the study. From Bharuch district Amod, Jambusar and Vagra were selected purposively, as more number of farmers from these blocks cultivate *desi* cotton under rain fed condition. Data were collected from 15 cotton growers to whom *desi* cotton variety G Cot 23 (*G. herbaceum*) was given

for the demonstration, as screening trials conducted showed higher salt tolerance of this variety (Rao *et al.,* 2013). In addition, 35 farmers growing *desi* cotton varieties in rain fed areas were interviewed. Twenty farmers from the areas who had cultivated *desi* cotton in irrigated condition were also interviewed making total sample size to 70.

Method of data collection

Data were collected using a well-structured interview schedule, with both close end and open end questions which were then pilot tested on farmers to ensure proper reliability and validity. Information related to socioeconomic condition elicited by asking questions to farmers with the help of interview schedule. For economic analysis, data about per hectare cost of land preparation, different inputs, inter-culturing operations and picking; per hectare production and unit cost of the cotton produce realized was obtained by recall method. Data about perception of farmers about *desi* cotton was obtained using Likert's five-point rating scale (Libert, 1932) in relation to economic benefits, social benefits, environmental benefits, agronomic characteristics and improvement in quality of output. Different constraints related to production, environmental, labour, economic and marketing were enlisted and farmers' response was obtained on continuum of very severe to less severe.

Data analysis

In economic analysis, B:C ratio was obtained by dividing cost of inputs to the total value of products per unit. Perception was measured by giving score of 1, 2, 3, 4 and 5 to strongly disagree, disagree, undecided, agree and strongly agree response, respectively. Perception index was developed by dividing maximum score to actual score multiplied by 100. For constraints, score of 1, 2, 3, 4, and 5 was given to response least severe, not so severe, severe, quite severe and very severe, respectively and mean score was obtained for ranking the constraints under each category.

Results and Discussion

Perception of the farmers about *desi* cotton

Farmers' perception about *desi* cotton are presented under the subheadings of economic and social benefits; environmental benefits; agronomic and crop characteristics, and improvement in quality of output and marketing.

Economic and social benefits of desi cotton

About 74 per cent farmers strongly agreed and all farmers agreed that cost of cultivation of *desi* cotton is low as compared to the Bt and hybrid cotton (Table 1). About 92 per cent farmers perceived that input cost for *desi* cotton is low as compared to other varieties of cotton. Less cost of cultivation was perceived by farmers as biggest

Table 1. Perception of the farmers about economic and social benefits of *desi* cotton

Particulars	SD*	D*	U*	A*	SA*	Mean	SD
Cost of cultivation for *desi* cotton is low when compared to Bt and hybrid cotton	0.00	0.00	0.00	26.00	74.00	4.74	0.44
Seed material is cheaper for *desi* cotton	0.00	0.00	0.00	46.00	54.00	4.54	0.50
Input cost for *desi* cotton is low as compared to other varieties	0.00	0.00	8.00	44.00	48.00	4.40	0.64
Seed replacement is not required for *desi* cotton	0.00	0.00	0.00	64.00	36.00	4.36	0.48
Plant protection cost for *desi* cotton is lower than other varieties	0.00	0.00	8.00	54.00	38.00	4.30	0.61
Desi cotton requires less number of labours hence saves labour cost	0.00	0.00	0.00	82.00	18.00	4.18	0.39
In *desi* cotton yield reduction is less in case of pest and disease attack	0.00	0.00	20.00	60.00	20.00	4.00	0.64
Livelihood security of the farmers ensured with cultivation of *desi* cotton	0.00	0.00	20.00	60.00	20.00	4.00	0.64
Weed infestation and management cost in *desi* cotton is less than other two types of cotton	0.00	8.00	28.00	36.00	28.00	3.84	0.93
Cultivation of *desi* cotton helps in increasing income of farmers in salt affected and rain fed areas	0.00	8.00	20.00	62.00	10.00	3.74	0.75
Desi cotton cultivation leads to upliftment of small and marginal farmers in saline and rain fed areas	0.00	10.00	44.00	26.00	20.00	3.56	0.93

*SD-Strongly disagree, D- Disagree, U- Undecided, A-Agree, SA-Strongly agree
*figures show percentage of farmers response for given statement

advantage of *desi* cotton. Many farmers in this region do not apply fertilizers, pesticides to the *desi* cotton. Kranthi (2015) observed that *desi* varieties hardly need any chemical inputs such as fertilizers or insecticides for higher yields, and these are highly tolerant to drought, insects and diseases thus the cost of production is less than half of Bt-cotton hybrids. Rao *et al*. (2013) also indicated lower input costs, primarily due to reduced disease incidence in *desi* cotton coupled with reduced number of irrigations.

All farmers agreed that seed material is cheaper for *desi* cotton and seed replacement is not required for *desi* cotton. Farmers in the area generally maintain their own seed for *desi* cotton, which has been cultivated since long time. Those who are not able to produce their own, purchase it from fellow farmers or some local sources. Farmers perceived (92%) that plant protection cost for *desi* cotton is lower than Bt and hybrid cotton. Kranthi (2015) observed that *desi* cotton is tolerant to biotic stresses like curly leaves, bacterial blight, and comparatively tolerant to bollworm complex and almost all the *Desi* cotton varieties are resistant to whiteflies and leaf hoppers. About 72 per cent farmers perceived that cultivation of *desi* cotton helps in increasing income of farmers in salt affected and rain fed areas. In social benefits of *desi* cotton, 80 per cent of farmers in the saline rainfed areas perceived that livelihood security of the farmers ensured with cultivation of *desi* cotton and 46 per cent perceived that cultivation of *desi* cotton helps in upliftment of small and marginal farmers in saline and rain fed areas.

Environmental benefits of desi cotton

In environmental benefits, almost all farmers perceived that *desi* cotton is more suitable to rainfed farming situation (Table 2).

Desi cotton varieties are deep rooted and overcome drought with ease (Kranthi, 2015). About 90 per cent farmers agreed that it is more tolerant to water logging conditions. Water logging problem is common in this areas particularly in the month of July to September and farmers perceived that *desi* cotton can survive in water logging condition better than Bt hybrid cotton. About 92 per cent farmers perceived that *desi* cotton grows well in moderate saline ground water. This is also corroborated with the findings of the Rao *et al.* (2013). Farmers also perceived the benefits of *desi* cotton in terms of non-pollution of environment and more compatibility to changing climatic situation. About 72 per cent farmers perceived that land affected by salinity can be effectively brought under cultivation with the help of *desi* cotton.

Farmers perceived that *desi* cotton was better option for them because of harsh environment conditions like soil salinity, ground water salinity coupled with less rainfall. Tolerance of *desi* cotton to biotic and abiotic stresses has been its great strength. It has immense inherent ability to withstand abiotic stresses like drought/ water stress, salinity/sodicity etc. (Rao *et. al.,* 2013). Therefore, in this area choice of *desi* cotton is not preferential but obligatory for the farmers.

Table 2. Perception of the farmers about environmental benefits of *desi* cotton

Particulars	SD*	D*	U*	A*	SA*	Mean	SD
Desi cotton is suitable for rain fed farming situation	0.00	0.00	0.00	26.00	74.00	4.74	0.44
Desi cotton is relatively more tolerant to water logging conditions	0.00	0.00	10.00	46.00	44.00	4.34	0.66
Desi cotton grows well in moderate Saline ground water	0.00	0.00	8.00	56.00	36.00	4.28	0.61
Cultivation of *desi* cotton doesn't pollute environment and contributes to sustainability of the environment	0.00	0.00	20.00	54.00	26.00	4.06	0.68
Desi cotton is more compatible to changing climate situation	0.00	8.00	18.00	36.00	38.00	4.04	0.95
Land affected by salinity is effectively brought under cultivation with the help of *desi* cotton	0.00	8.00	20.00	48.00	24.00	3.88	0.87
Less amount of spraying in *desi* cotton has positive impact on beneficial insects	10.00	16.00	30.00	26.00	18.00	3.26	1.23
Cultivation of *desi* cotton helps in improvement of soil texture	10.00	20.00	44.00	18.00	8.00	2.94	1.06

* SD-Strongly disagree, D- Disagree, U- Undecided, A-Agree, SA-Strongly agree
*figures show percentage of farmers response for given statement

Table 3. Perception of the farmers about agronomic practices and crop characteristics of *desi* cotton

Particulars	SD*	D*	U*	A*	SA*	Mean	SD
Irrigation requirement of *desi* cotton is less	0.00	0.00	0.00	72.00	28.00	4.280	0.454
Deep root system of *desi* cotton helps in water uptake from deeper layer of soil	0.00	0.00	20.00	42.00	38.00	4.180	0.748
In *desi* cotton boll drop is less in saline condition	0.00	8.00	16.00	28.00	48.00	4.160	0.976
Desi cotton is more viable for various cropping system and inter cropping	0.00	20.00	0.00	44.00	36.00	3.960	1.087
Fertiliser requirement for *desi* cotton is less as compared to hybrid and Bt cotton	0.00	18.00	36.00	28.00	18.00	3.460	0.994
Desi cotton requires less weeding management than hybrid and Bt cotton	0.00	20.00	36.00	26.00	18.00	3.420	1.012
Harvesting period in *desi* cotton is extended over long period of time, giving continuous income to farmers	0.00	0.00	82.00	18.00	0.00	3.180	0.388
Size of boll is bigger in *desi* cotton	20.00	26.00	44.00	10.00	0.00	2.440	0.929
Boll formation is more in *desi* cotton when compared to hybrid and Bt	18.00	54.00	18.00	10.00	0.00	2.200	0.857

* SD-Strongly disagree, D- Disagree, U- Undecided, A-Agree, SA-Strongly agree
*figures show percentage of farmers response for given statement

Agronomic practices and Crop characteristics of desi cotton

In agronomic practices and crop characteristics, almost all farmers agreed that *desi* cotton requires less irrigation than Bt hybrid cotton (Table 3).

Rao *et. al.* (2013) observed that unlike *hirsutums*/hybrids which have shallow root system and shorter duration (July to October) with high water requirement, *desi* cottons have deep root system and longer duration (July to March). About 80 per cent farmers perceived that because of tap root system, *desi* cotton uptakes water from deeper layer of soil. Benefits of drop in cotton boll is less, was perceived by 76 per cent of the farmers. Features of *desi* cotton like deep tap root system and longer life cycle helps it to get acclimatized to salinity in the vegetative phase; hence impact of salinity in boll drop is negligible as compared to Bt hybrid (Rao et al, 2016). *Desi* cotton has found to possess higher salt tolerance and showed lowered yield drop at salinity more than 6 dS/m (Rao *et al.,* 2013). Farmers also agreed that fertilizer requirement and weed management is less in *desi* cotton.

Very less farmers (18%) agreed that extended period of harvesting gives more income to the farmers. Picking operation starts in the month of February, continues till the month of May. Long life cycle of *desi* cotton brings multiple problems to farmers. First, long duration leads to late harvesting of cotton (up to April-May months), when weather is more hot, resulting in loss of weight of cotton and sometimes yellowing of the lint. Second, at this time market price goes down and farmers get less price for their produce in the market. Third, because of more heat in the months of April and May, labourers refuse to work in field or demand more money for picking (picking charges in the month of November-December are ₹ 4 kg^{-1} while in April and May month are ₹ 7 kg^{-1}) increasing cost of cultivation of the *desi* cotton (Nikam *et al.,* 2016).

Farmers did not perceive that in *desi* cotton boll formation is more and size of boll is bigger in *desi* cotton. Though *desi* cotton is endowed with many good qualities, certain aspects like low yield, long duration, small boll size, absence of well-established seed production system etc. are the limiting factors in its adoption on larger scale. Agronomic characteristics like small size of boll in case of *desi* cotton was negative aspect reported by the farmers, moreover bolls do not open completely causing difficulty in separating seed lint from the dried boll.

Improvement in quality of output and marketing of desi cotton

Fibre quality of *desi* cotton was perceived by 76 per cent of the farmers as excellent (Table 4). About 56 per cent of farmers agreed that *desi* cotton fetches more price in the market.

Kranthi (2015) also observed that market price of *Desi* Kapas (seed-cotton) was 15-20% more than the kapas of Bt-cotton hybrids. Only 32 per cent

Table 4. Perception of the farmers about Improvement in quality of output and marketing of *desi* cotton

Particulars	SD*	D*	U*	A*	SA*	Mean	SD
Fibre quality of *desi* cotton is excellent	0.00	0.00	26.00	64.00	10.00	3.84	0.58
Desi cotton fetches more price in the market than hybrid cotton	0.00	20.00	18.00	46.00	16.00	3.58	0.99
Demand for *desi* cotton is more than hybrid	0.00	20.00	48.00	24.00	8.00	3.20	0.86
Nutritional value of cotton seed oil for *desi* varieties is high	0.00	10.00	54.00	18.00	0.00	3.10	0.58
Quality seed of *desi* cotton is available to the farmers in the market	10.00	34.00	36.00	20.00	0.00	2.66	0.92

* SD-Strongly disagree, D- Disagree, U- Undecided, A-Agree, SA-Strongly agree
*figures show percentage of farmers response for given statement

of farmers agreed that demand for *desi* cotton is more than hybrid. More number of farmers (54%) were not sure about benefits of nutritional value of cotton oil seeds of *desi* cotton. Only 20 per cent farmers agreed that quality seeds of *desi* cotton are available to the farmers in the market. Farmers use seed available them in village which has been handed down from generation to generation resulting into admixture of seed varieties resulting in to quality deterioration. Many experts believe that it is one of the major reasons behind low yield of *desi* cotton. Therefore, it demands efforts for quality seed production from government institutions with participation of the farmers.

Economic analysis of *desi* cotton

In Bara tract area of Gujarat, most of the farmers cultivated *desi* cotton under rain fed condition. However, the areas where water is available through canal, *desi* cotton is cultivated in irrigated condition also. Field preparation is mostly carried by tractors by the farmers either of their own on hired with average cost of Rs. 3350 and Rs. 3750 for rain-fed and irrigated conditions, respectively (Table 5).

Many times, sowing operations are also carried out mechanically using seed drill *desi*gned for cotton purpose or with the help of labour with average cost of Rs. 1000 per hectare for rain fed situation and Rs. 1250 for irrigation condition. Farm yard manure is added once in three years with average cost of Rs. 1550. For *desi* cotton in rain fed condition, very less amount of chemical fertilizers was used viz. 50 kg ha^{-1} Urea and 37 kg ha^{-1} DAP with average cost of Rs. 2152 in rain-fed areas. However, under irrigated Rs. 6450. On an average two inter-culturing operations were carried out by the Farmers with average cost of

Table 5. Economic analysis of *Desi* cotton under rainfed and irrigated condition

Particulars	Cost (Rs. ha^{-1})	
	Rainfed	Irrigated
A. Cost components		
Field preparation	3350	3750
Manures	1550	2000
Seed and sowing	1000	1250
Chemical fertilisers	2152	6450
Irrigation	00	8750
Interculturing	4014	4500
Weeding	2938	5000
Plant protection	00	2500
Harvesting (picking)	3350	8750
Total	18353	42950
B. Production		
Yield of main produce (kg ha^{-1})	807	175
Value (Rs 42000-43000 Mg^{-1})	34947	75250
C. B:C ratio	1.90	1.75

Rs. 4013 in rainfed condition and 4500 in irrigated situation. Farmers believed that more number of inter-culturing operations helps in reducing weed problem and increasing the yield. Expert recommends 2 to 3 inter-culturing because though more number of inter culturing helps in increasing yield of the cotton, it adds additional cost to farmers, increasing cost of cultivation and reducing the net profit.

Number of weeding ranged from 0 to 3 with average cost of Rs. 2937 and Rs. 5000 ha^{-1} respectively under rain fed and irrigated condition. Noteworthy thing observed was that no weedicide was used by the farmers. In surveyed area it was observed that farmers had not applied any insecticides and pesticides for the *desi* cotton under rain fed condition, however in irrigated condition average plant protection cost was Rs. 2500 ha^{-1} (Table 5). This is the main reason behind less cost of cultivation of *desi* cotton, unlike Bt hybrid

where it forms major chunk of high cost of cultivation. Thus, for *desi* cotton under rain fed condition, total cost of cultivation (input and operational cost) was Rs. 18353, total value of product realized was Rs. 34947 with BC ration of 1.9. Under irrigated condition total cost of cultivation (input and operational cost) was Rs. 42950, total value of product realized was ₹ 75250 with B:C ration of 1.75 and B:C ratio of 1.8 to 2.0 was also observed for *desi* cotton in other studies (ICAR, 2015).

Constrains analysis of farmers cultivating *desi* cotton

While analyzing different constraints faced by the farmers, most of the farmers (54 per cent) perceived problem of irrigation as very severe problem in the study area (Table 6). Canal water irrigation is not available in most of the areas. Area where canal available, frequency of water supply is not regular was perceived as second most important constraint by the farmers. Next major constraint was the delay in sowing because of late monsoon. Ramasundaram (2001) in his study also identified the problem of late sowing because of late monsoon as nearly 55 per cent of the sample farms, sowing was decided totally on onset of monsoon. Damage to the crop because of high rainfall and flooding mostly in the months of July and August and high cost of the labour were the next important constraints faced by the farmers in the Bara tract areas of Gujarat. Most of the

Table 6. Constraints faced by the farmers in cultivation of *desi* cotton

Constraints	Least severe	Not so severe	Severe	Quite severe	Very severe	Mean score	Overall rank
A) Production constraints							
Non-availability of seeds of *desi* cotton	27.27	63.64	9.09	0.00	0.00	1.82	16
Non-availability of information/ package of practices for *desi* cotton	18.18	45.45	18.18	18.18	0.00	2.36	11
Non-availability of manures/fertilizer in time	9.09	54.55	27.27	9.09	0.00	2.36	11
Non-availability of insecticides and pesticide in time	18.18	72.73	9.09	0.00	0.00	1.91	15
B) Environment Constraints							
Delayed sowing because of late monsoon	0.00	18.18	18.18	27.27	36.36	3.82	2
Damage to the crop because of high rainfall and flooding	0.00	18.18	27.27	18.18	36.36	3.73	3
Lower yield because of non-availability of ter after rainy season	18.18	27.27	27.27	27.27	0.00	2.64	8
Damage to the crop because of cyclone and high wind speed	0.00	54.55	36.36	9.09	0.00	2.55	9
C) Labour constraints							
Non-availability of labour during peak period	9.09	18.18	18.18	45.45	9.09	3.27	4
Lack of technical skill to the labour	36.36	27.27	18.18	18.18	0.00	2.18	12
High cost of labour	0.00	9.09	18.18	63.64	9.09	3.73	3
D) Economic constraints							
High cost of plant protection chemicals	27.27	36.36	27.27	9.09	0.00	2.18	12
High cost of fertilizers	27.27	54.55	18.18	0.00	0.00	1.91	15
High cost of seed material	63.64	36.36	0.00	0.00	0.00	1.36	18
Unawareness of credit facilities	0.00	90.91	9.09	0.00	0.00	2.09	13
Crop insurance scheme is not available for cotton	0.00	63.64	27.27	9.09	0.00	2.45	10
E) Marketing constraints							
Problems of transportation	9.09	54.55	27.27	9.09	0.00	2.36	11
Heavy fluctuation in prices every year	9.09	18.18	45.45	27.27	0.00	2.91	7
Poor procurement policy of government	9.09	18.18	27.27	36.36	9.09	3.18	5
Lower price at the harvesting stage	9.09	9.09	54.55	18.18	9.09	3.09	6
Inadequate physical facilities in market	9.09	45.45	27.27	18.18	0.00	2.55	9
E) General constraints							
More incidence of pest and disease	27.27	36.36	27.27	9.09	0.00	2.18	12
Irregular supply of electricity	27.27	45.45	27.27	0.00	0.00	2.00	14
Lack of mechanization	27.27	72.73	0.00	0.00	0.00	1.73	17
Fragmentation of land holdings	36.36	54.55	0.00	9.09	0.00	1.82	16
Lack of irrigation facilities	0.00	9.09	18.18	18.18	54.55	4.18	1
Lack of soil and water testing facilities	0.00	18.18	54.55	27.27	0.00	3.09	6
Irregular supply of canal water	0.00	18.18	27.27	9.09	45.45	3.82	2

*figures show percentage of farmers response for given constraint

labour in this area prefer jobs in the nearby industries as they get more payment and better working condition than the working in the field.

Non-availability of the labour during peak period was next important constraint faced by the farmers. As harvesting of the *desi* cotton continues till April, labour showed hesitation for working in the field at high temperature and moreover they charge higher chargers per kilogram for picking of cotton. Unlike in Bt cotton, lint in *desi* cotton cannot be easily detached from the boll, making it difficult for the labourers. This demand the development of varieties of *desi* cotton which are short duration and in which boll opens completely after maturity for easy pocking of the lint. Market related constraints like poor procurement policy of the government, less produce to the cotton and heavy fluctuation in the price of cotton were important constraints faced by the farmers. Farmers ranked the constraints like mechanisation, seed availability, fertiliser and pesticide problem as less severe in case of *desi* cotton.

Conclusions

Farmers perceived that cost of cultivation for *desi* cotton is less mainly because of less inputs. Majority of them perceived that *desi* cotton is more suitable to rainfed conditions, more tolerant to moderate saline groundwater and water-logging conditions. Farmers agreed that *desi* cotton requires less irrigation, has good quality fibre fetch more prices in market. However, farmers also evinced some negative aspects of the *desi* cotton like its long duration, which increases labour cost, and reduces the weight in scorching heat. They were also not satisfied with the boll size and numbers in *desi* cotton. Economic analysis revealed that gross profit of *desi* cotton under rainfed conditions was Rs. 34,947 per ha with BC ratio 1.90 while it was Rs. 75250 per ha with B:C ratio of 1.70 in irrigated condition. Present study suggests that high yielding, short duration varieties of *desi* cotton with more number of boll and bigger boll size, which opens completely after maturity (for easily detachment of lint from boll) needs to be developed. At the same time efforts can be made for participative seed production program of *desi* cotton to meet the quality seed requirement of the farmers in rainfed and saline areas to ensure and improve livelihood of farmers and sustainability of the cotton agro-ecosystem.

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