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Cotton Productivity Improvement in India - Technology Targeting at District Level Based on Efficiency

EXPERT's Column

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Cotton is one of the important commercial crops in India that is cultivated in an area of about 130.0 lakh ha with a production of 353.8 lakh bales and a productivity of 463 kg lint/ha (2020-21). Until 2008-09, cotton area in the country was less than 100 lakh ha. The increase in area thereafter, is mainly at the cost of kharif food crops. As per projections of FAO, India needs to produce about 500 and 550 lakh bales of cotton by 2030 and 2050 respectively, to meet the growing demand. Assuming that the current level of productivity continues, this production target may require an additional 50 lakh ha area to be brought under cotton, which is most unlikely. The only other option is to improve productivity of cotton. For this purpose, priority districts for cotton need to be identified and technologies should be dovetailed for implementation to achieve targeted production. Similarly, cotton area in inefficient districts can be diversified to other remunerative crops.

Grouping of Districts Based on Efficiency Criteria

Relative Yield Index (RYI) and Relative Spread Index (RSI) were used to classify and group cotton growing districts of India into Most Efficient, Efficient, Less Efficient and Inefficient districts. The formulae used to derive RYI and RSI are given below.

$$\text{Relative Spread Index (RSI)} = \frac{\text{Percentage of cotton area to total cultivable area of the district}}{\text{Percentage of cotton area to total cultivable area of the country}} \times 100$$

$$\text{Relative Yield Index (RYI)} = \frac{\text{Mean yield of cotton in a district}}{\text{Mean yield of cottonin the country}} \times 100$$

The district level data on area and yield of cotton was obtained from the website of Directorate of Economics & Statistics (DES), Department of Agriculture and Farmers Welfare, Govt. of India (https://eands.dacnet.nic.in) for the period 2016-17 to 2018-19 (latest available). Three year average values were taken for calculating the RYI and RSI. Based on these values cotton growing districts were classified into four groups as per the criteria given below:

Table 1. Criteria for classification and grouping of cotton growing districts based on yield and area spread

Group	Relative Yield Index (RYI)	Relative Spread Index (RSI)
Most Efficient	High (>100)	High (>100)
Efficient	High (>100)	Low (<100)
Less Efficient	Low (<100)	High (>100)
Inefficient	Low (<100)	Low (<100)

Classification of Cotton Growing Districts into Efficiency Groups:

There are 157 districts in the country which have an area of more than 5000 ha under cotton. These districts together cover about 95% of the cotton area in the country. Based on RYI and RSI, these 157 districts were classified into four groups i.e., Most Efficient, Efficient, Less Efficient and Inefficient (Table 2). The group of most efficient districts covers 16.17 % of the cotton area in the country which is spread across 26 cotton growing districts. Cotton yield in this group ranges from 501 to 848 kg lint / ha with an average of 624 kg lint/ha. The Efficient group includes 16 districts which covers an area of 2.83% of cotton area in the country. Cotton yield in this group ranges from 512–711kg lint / ha with an

Table 2. Distribution of cotton growing districts

Category	No. of districts	Area (ha)	% area	Meanlint Yield (Kg/ha)	Yield Range (kg lint/ha)
Most efficient	26	1935089	16.17	624	(501-848)
Efficient	16	338417	2.83	628	(512-711)
Less efficient	75	9043627	75.55	351	(145-497)
Inefficient	40	652896	5.45	334	(118-496)
Total	157	11970029	100.00	402	(118-848)

average of 628 kg lint/ha. Less Efficient group is the largest and it covers 75.55% cotton area in the country which is spread across 75 cotton growing districts in different states. Cotton yield in this group ranges from 145 to 497 kg lint / ha with an average of 351kg lint/ha. Inefficient group covers 5.45% cotton area in the country which is spread in 40 cotton growing districts. Cotton yield in this group ranges from 118 to 496 kg lint / ha with an average of 334 kg/ha.

Table 3. Most efficient districts for cotton cultivation

S.No	State	Districts
1	Andhra Pradesh	Guntur & Krishna
2	Gujarat	Aravalli, Chhotaudepur, Devbhumi Dwarka, Gandhinagar, Jamnagar, Mahesana, Porbandar, Sabar Kantha, Vadodara
3	Karnataka	Yadgir
4	Maharashtra	Amravati
5	Punjab	Bathinda, Fazilka, Mansa, Muktsar
6	Rajasthan	Ganganagar, Hanumangarh
7	Telangana	Bhadradri, Karimnagar, Khammam, Mancherial, Medak, Peddapalli, Rajanna

Most Efficient Districts for Cotton Cultivation

This group is spread in 26 cotton growing districts in the states of Gujarat (27.65%), Telangana (17.27%), Rajasthan (15.24%), Punjab (13.95%), Andhra Pradesh (10.94%), Maharashtra (10.63%) and Karnataka (4.31%) (Table 3). This group is characterised with high relative yield index (RYI) coupled with high relative spread index (RSI). Most of the districts in this group have deep to very deep fertile soils with irrigation facilities or assured rainfall. The major challenge in these districts is to sustain and further increase the productivity levels by enhancing input use efficiency. Technology options/interventions that can be promoted in the most efficient districts include medium duration hybrids to facilitate double cropping, minimising tillage, crop residue management for better soil health, mechanization to reduce cost of cultivation, drip cum mulching technique for higher water productivity and commensurate returns on investment.

Efficient Districts for Cotton Cultivation

Districts with high RYI and low RSI come under this group. There are 16 districts in this group occupying relatively less area (1.84% of total cotton area) (Table 4). Despite high productivity of cotton in these districts, the area under cotton is

Table 4. Efficient cotton growing districts in India

S.No	State	Districts
1	Andhra Pradesh	Srikakulam
2	Gujarat	Banas kantha, Gir, Somnath, Kachchh, Kheda, Panch mahals, Tapi
3	Karnataka	Gulberga
4	Maharashtra	Gadchiroli
5	Punjab	Sangrur
6	Rajasthan	Ajmer, Bhilwara, Chittorgarh, Jhunjhunu, Jodhpur, Pali

Table 5. Less efficient cotton growing districts in India

S.No	State	Districts
1	Andhra Pradesh	Kurnool
2	Gujarat	Ahmadabad, Amreli, Bharuch, Bhavnagar, Botad, Junagadh, Morbi, Narmada, Patan, Rajkot, Surendranagar
3	Haryana	Bhiwani, Charkidadri, Fatehabad, Hisar, Jind, Mahendragarh, Palwal, Rohtak, Sirsa
4	Karnataka	Bellary, Dharwad, Gadag, Haveri, Mysore, Raichur
5	Madhya Pradesh	Barwani, Burhanpur, Dhar, Khandwa, Khargone
6	Maharashtra	Ahmednagar, Akola, Aurangabad, Beed, Buldhana, Chandrapur, Dhule, Hingoli, Jalgaon, Jalna, Nagpur, Nanded, Nandurbar, Parbhani, Wardha, Yavatmal
7	Odisha	Bolangir, Kalahandi, Rayagada
8	Tamil Nadu	Perambalur, Virudhunagar
9	Telangana	Adilabad, Jagitial, Jangoan, Jayashankar, Jogulamba, Kamareddy, KomaramBheem, Asifabad, Mahabubabad, Mahbubnagar, Mulugu, Nagarkurnool, Nalgonda, Narayanapet, Nirmal, Rangareddi, Sangareddy, Siddipet, Suryapet, Vikarabad, Warangal, Warangal urban, Yadadri

less. Districts in this group also have better agro-climatic conditions suitable for cotton production as indicated by the higher relative yield index. There may be adverse factors or competing crops which are limiting the cotton area in these districts. Priority should be given to these districts for any potential area expansion under cotton.

Less Efficient Districts for Cotton Cultivation:

This group occupies the highest cotton area (75.55%) of the country. There are 75 districts which fall in this group which have high RSI and low RYI. These are the districts which need to be given highest priority, in terms of research and infrastructure development for improving the cotton yields. A large proportion (43.71%) of this group is in Maharashtra followed by Gujarat (20.72) and Telangana (15.62). Yield level is low ranging from1 45 to 497 kg lint /ha with an average of 351 kg lint /ha. Even a small improvement in yield level will translate into a significant improvement in the national average. An improvement of yield by 20% in these districts will add about 55 kg lint/ha to the national average.

Cotton in this group of districts is cultivated on shallow to medium deep soils, predominantly under rainfed conditions. In most of these districts less than 30% area is irrigated. Technological options for these districts include short duration cotton varieties/hybrids under high density planting system (HDPS), timely sowing with

Table 6. Inefficient cotton growing districts in India

S.No	State	Districts
1	Andhra Pradesh	Anantapur, East Godavari, Kadapa, Prakasam, SPSR Nellore,Vizianagaram
2	Gujarat	Mahisagar
3	Haryana	Jhajjar, Kaithal, Rewari
4	Karnataka	Belgaum, Bijapur, Chamarajanagar, Chitradurga, Davangere, Koppal
5	Madhya Pradesh	Alirajpur, Chhindwara, Dewas, Jhabua, Ratlam
6	Maharashtra	Nashik, Osmanabad, Washim
7	Odisha	Nuapada
8	Rajasthan	Alwar, Banswara, Bharatpur, Nagaur
9	Tamil Nadu	Ariyalur, Cuddalore, Dharmapuri, Dindigul, Madurai, Salem, Thiruvarur, Tiruchirappalli, Tuticorin, Vellore, Villupuram

pneumatic planters, avoiding mono cropping and improving soil health through crop rotation preferably with legumes, higher system returns with inter cropping, residue management of cotton stalks, drip cum mulching technique for higher cotton productivity in irrigated pockets.

Inefficient Districts for Cotton Cultivation:

This group is characterised with low RYI and low RSI. There are 40 districts in this group contributing 5.45 % of cotton growing area of the country. Average cotton yield in this group of districts is 334kg lint / ha. This group is spread out in all cotton growing states except Punjab and Telangana. Cotton production in these districts is not sustainable due to lower yield and the reasons could be biophysical and socio-economic limitations. Cotton area in each district is also comparatively low; hence there is scope for crop diversification to remunerative crops and intercropping systems.

The Way Forward:

The above analysis clearly indicates that there are large variations in the cotton production scenario. This study is based on an analysis of secondary data. However, there is a need to conduct a Landscape Diagnostic Survey to obtain primary data based evidence on cotton production practices in representative districts in each of these groups of districts and analyse the relationship between the performance of the cotton production system in terms of yield, net returns and the cotton production practices in an agro-ecological context. This evidence will enable targeting of technologies tailored to the bio-physical endowments at the district level. There is also a need for product (variety/hybrid) and technology profiling based on the agro-ecological conditions and socio-economic profile for higher adoption and yield realisation. Appropriate strategies can then be dovetailed on a large scale along with the needed policy support.

(The views expressed in this column are of the author and not that of Cotton Association of India)
