Delineation of Efficient Cotton Growing Regions of Tamil Nadu

Rajashree Khatua, S. Panneerselvam, V. Geethalakshmi, M. Kumar and P. Jeyakumar

1Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu, India.

Authors’ contributions

This work was carried out in collaboration among all authors. Author RK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SP and VG managed the analyses of the study. Authors MK and PJ managed the literature searches. All authors read and approved the final manuscript.

ABSTRACT

Cotton is an immensely important crop for the sustainable economy of India and livelihood of the Indian cotton farming community. Identification of potential regions would help in increasing the productivity, ensures better utilization of available resources and avoid wastage of resources in the inefficient zones. Efficient cropping zones of the Cotton crop of Tamil Nadu were keyed out with 30 years data (1985-2015) using Relative Yield Index (RYI) and Relative Spread Index (RSI). The results revealed that in Tamil Nadu, fifteen districts were found for MECZ and three for ECZ. Coimbatore is most essential area for cotton crop. Similarly eight districts are coming under LECZ because RSI were very less compare to RYI. Tiruchirapalli and Ramanathapuram both the district have less RYI and RSI indicating NECZ for cotton crop.

Keywords: Efficient cropping zone; most efficient cropping zone; less efficient cropping zone; inefficient cropping zone; relative spread index and relative yield index.
ABBREVIATIONS

MECZ : Most Efficient Cropping Zone,
ECZ : Efficient Cropping Zone,
LECZ : Less Efficient Cropping Zone,
NECZ : Not Efficient Cropping Zone,
RYI : Relative Yield Index,
RSI : Relative Spread Index,
IPM : Integrated Pest Management

1. INTRODUCTION

Cotton is one of the major Kharif crops grown under both irrigated and rain-fed conditions in India. Although India has the largest area under cotton, the average productivity of Indian cotton is one of the lowest in the world, much lower for the vast production area and this is a cause for concern because millions of people depend on cotton cultivation for their economic wellbeing Ramasundaram and Gajbhiye [1]. More than 50 per cent of the cotton area is covered by cotton hybrids and the hybrids contribute about 60 per cent to national production (Santhy et al., 2008). The area, production and productivity of the cotton are subject to fluctuations depending upon various factors viz., Climate condition, Availability of the technology, Lack of the Government support, Industrial development and the Real estate [2-4].

Cotton is grown in the nine major states in three different zones. Punjab, Haryana and Rajasthan in north zone. Maharashtra, Gujarat and Madhya Pradesh in central zone and Andhra Pradesh, Karnataka and Tamil Nadu in the south zone are the major cotton growing states in India. Tamil Nadu is the tenth largest cotton-producing state in India with a production of 5 Lakh Bales [5-7]. Tamil Nadu accounts for more than 6% in the total cotton production in the country and cotton is grown in 70,000 hectares of land in the state. Tamil Nadu is the state in India with the highest cotton yield, which is 1,214 kilograms per hectare. Coimbatore, Vallalur, Madurai, Ramanathapuram, Salem, and Tiruchirapalli are some of the major cotton producing districts in Tamil Nadu.

In crop production, an efficient zone is an area which has suitable soil and climate to obtain the maximum productivity of a crop Narayanan et al. [8]. The productivity levels of crops can be enhanced and sustained through the identification of efficient locations. Most reliable tools for identifying potential area of crop is calculating Efficient Cropping Zones (ECZ) through Relative Yield Index (RYI) and Relative Spread Index (RSI) of crop. In this context, a study was conducted at Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore during 2018-19 to delineate ECZ for the cotton crop of Tamil Nadu.

2. MATERIALS AND METHODS

Data collection: Efficient cropping zone for cotton was studied for all the districts of Tamil Nadu. Hence the time series data available at district level, from 1985-2015 (30 years) regarding the area, production and productivity of cotton crop were collected from the directorate of economics and statistics, Government of Tamil Nadu, Chennai.

2.1 Method Adopted

The formula propagated by Kanwar [9] was used to find out Relative Spread Index (RSI) and Relative Yield Index (RYI) for each crop to identify efficient crop zone for the selected crops in Tamil Nadu. The details are given here under.

\[ RSI = \frac{\text{Area of crop expressed as per cent of total cultivable area in the district}}{\text{Area of crop expressed as percentage to the total cultivable area in the State}} \times 100 \]

Where in RSI: Relative Spread Index

\[ RYI = \frac{\text{Mean yield of a particular crop in a district (kg/ha)}}{\text{Mean yield of the crop in the State (kg/ha)}} \times 100 \]

Where in RYI: Relative Yield Index

The criteria suggested by Kanwar [9] were used to demark efficient cropping zone as per RSI & RYI values obtained from computation in respect of rice, maize, sorghum, pearl millet, black gram, green gram, groundnut and gingelly.

3. RESULTS

Tamil Nadu is one of the biggest centre of textile manufacturing in India. The MECZ considering high RSI and RYI for cotton fell with Vellore, Thiruvannamalai, Salem, Namakkal, Dharmapuri, Sivagangai, Thirunelveli, Theni, Dindigul, Thiruvurar, Karur, Perambalur, Ariyalur, Pudukkottai and Thiruppur (Fig. 4). The reason accredited for superior RSI and RYI values in these districts for the marketing facility which is highly pronounced in these areas and the district Coimbatore is a most potential area for cotton production [10]. Farmers are showing larger
interest in cotton because of normal monsoon, increase in minimum support price and better realization compared to other crops. The districts such as Thoothukudi, virudhanger and Madurai come under ECZ with High RYI and low RSI. Though the yield potential good, the spread is low and hence efforts should be made mainly to increase the area of the crop. Thiruvaliur, Kancheepuram, Cuddalore, Villupuram, The Nilgiris, Kanyakumari, Erode, Nagapatinam and Thanjavur districts come under LECZ. Tiruchirapalli and Ramanathapuram come under NECZ. With respect to Tamil Nadu, fifteen districts fell under MECZ, three districts under ECZ, eight districts under less efficient cropping zone and five districts under NECZ. Since, our farmers are practicing subsistence type of farming, the districts identified as MECZ, for the various crops discussed above has to be continued as MECZ in future also, along with prevailing agro climatic factors, marketing facilities, infrastructural development and remunerative price has to be provided. In order to bring ECZ areas under MECZ for the cotton crop, improved cultivars, advanced cultural practices, better management practices and availability of need based quality inputs at reasonable price must be tried. In order to popularise the crop in the NECZ, farmers are to be trained in innovative technologies to explore higher productivity, which can be done by strengthening the extension services.

### Table 1. Criteria for efficient cropping zone

| RSI   | RYI   | Cropping zone                                                                 |
|-------|-------|-------------------------------------------------------------------------------|
| >100  | >100  | Most Efficient Cropping Zone (MECZ). The zone with good spread and more yield of crop. Sustainability options have to be identified and imposed. |
| <100  | >100  | Efficient Cropping Zone (ECZ). The zone with good spread and low yield. The constraints in area spread have to be identified. The ECZ is renamed as Yield Efficient Cropping Zone (YECZ) in Agro Climate Research Centre’s Crop Scientist unpublished Report, 2018. |
| > 100 | <100  | Less Efficient Cropping Zone (LECZ). The zone with high spread and low yield. The constraints in yield have to be identified. |
| < 100 | < 100 | Not Efficient Cropping Zone (NECZ). The zone with low spread and low yield. Suitability of alternate crops may be assessed. |

### Table 2. District wise efficient cropping zone in Tamil Nadu

**MOST EFFICIENT CROPPING ZONE (MECZ)**

| District          | RSI   | RYI | Cropping zone |
|-------------------|-------|-----|---------------|
| Vellore           | 150.39| 103 | MECZ          |
| Thiruvannamalai   | 122.29| 126 | MECZ          |
| Salem             | 140.1 | 115 | MECZ          |
| Namakkal          | 149.1 | 142 | MECZ          |
| Dharmapuri        | 135.87| 123 | MECZ          |
| Thiruppur         | 228.63| 177 | MECZ          |
| Karur             | 880.96| 121 | MECZ          |
| Perambalur        | 276.72| 101 | MECZ          |
| Ariyalur          | 205.57| 161 | MECZ          |
| Pudukottai        | 220.87| 120 | MECZ          |
| Theni             | 104.84| 150 | MECZ          |
| Dindigul          | 231.4 | 144 | MECZ          |
| Thiruvurur        | 369.46| 120 | MECZ          |
| Sivagangai        | 636   | 108 | MECZ          |
| Thirunelveli      | 169.28| 114 | MECZ          |
EFFICIENT CROPPING ZONE (ECZ)

| District   | RSI  | RYI | Cropping zone |
|------------|------|-----|---------------|
| Madurai    | 196.94 | 74  | ECZ           |
| Virudhunagar | 416  | 78  | ECZ           |
| Thoothukudi | 275.2 | 70  | ECZ           |

LESS EFFICIENT CROPPING ZONE (LECZ)

| District   | RSI  | RYI | Cropping zone |
|------------|------|-----|---------------|
| Kancheepuram | 1.26 | 111 | LECZ          |
| Cuddalore  | 0.82 | 109 | LECZ          |
| Villupuram | 51.53 | 120 | LECZ          |
| Krishnagiri | 30.05 | 104 | LECZ          |
| Coimbatore | 87.54 | 116 | LECZ          |
| Erode      | 45.55 | 144 | LECZ          |
| Thanjavur  | 22.2  | 139 | LECZ          |
| Nagapatinam | 69.31 | 124 | LECZ          |

NOT EFFICIENT CROPPING ZONE (NECZ)

| District   | RSI  | RYI | Cropping zone |
|------------|------|-----|---------------|
| Tiruchirapalli | 96.09 | 94  | NECZ          |
| Thiruvallur | 0.04  | 56  | NECZ          |
| Ramanathapuram | 38.75 | 57  | NECZ          |
| The Nilgiris | 11.48 | 80  | NECZ          |
| Kanniyakumari | 0.028 | 62  | NECZ          |

Fig. 1. Efficient cropping zone for cotton (1985-1994)
Fig. 2. Efficient cropping zone for cotton (1995-2004)

Fig. 3. Efficient cropping zone for cotton (2005-2015)
Fig. 4. Efficient cropping zone for cotton (1985-2015)

4. CONCLUSIONS

In the context of Tamil Nadu, Thoothukudi, Virudhunagar and Madurai was found efficient cropping zone for cotton crop. The identified MECZ and ECZ of cotton crop could be focused for further improvement for surmounting the demand – supply gap and changes in cost structure in cotton production. The districts that fall under high rainfall and hilly zones i.e. Kanyakumari and The Nilgiris as well as Ramanathapuram that is a coastal regions were found to be inefficient zone for cotton crop and alternate crops must be promoted in these districts. Some micro level constraints like seed, soil, timely sowing, varietal multiplicity, spacing and plant density, plant protection and IPM adoption are the main cause for less production of cotton in Tamil Nadu. Considering these factors, we need to focus on new technology and crop insurance promoted for efficient cropping zone for cotton crop.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ramasundaram P, Gajbhiye H. Constraints to cotton production in India. CICR Technical Bulletin No. 19. Central Institute for Cotton Research, Nagpur. 2001;27.
2. Kokilavani S, Geethalakshmi V. Identification of efficient cropping zone for rice, maize and groundnut in Tamil Nadu. Indian J. Sci. Technol. 2013;6:5298-5301.
3. Otung IA, Akpaeti AJ. Identification of Efficient Cropping Zones for Cassava Production in Nigeria. Journal of Agriculture and Ecology Research International. 2016;8(2):1-7. Article no.JAERI.26821. ISSN: 2394-1073
4. Poomima S, Kokilavani S, Thavaprakaash N, Babu C, Geethalakshmi V, Jagannathan R. Examining the prospective cropping zone of important field crops of Tamilnadu, The Madras Agricultural Journal. 2008; 95(7–12):364–370.
5. Subrahmanian K, Balasubramanian TN, Kalaiselvan P. Efficient cropping zone for Groundnut (Arachis hypogaea L.) in TamilNadu. Legume Research.
6. Thavaprakaash N, Babu C et al. Identifying potential cropping zones for important horticultural crops of Tamil Nadu, The Madras Agricultural Journal. 2008;95(7–12):418–424.

7. Veeraputhiran R, Kathikeyan R et al. Crop planning climate atlas – principles, Relative spread index and relative yield index, A.E. Publications, Coimbatore, 156–158.

8. Narayanan AL, Balasubramanian TN et al. Identification of efficient rice cropping zone for union territory of Pondicherry, The Madras Agricultural Journal. 2003;90(10–12):729–731.

9. Kanwar J. Cropping patterns, scope and concept, In. Proc. Symp. on Cropping Pattern in India, ICAR, New Delhi. 1972;11–32.

10. Sanbagavalli S, Rohini A, Ganesan K. and Balasubramanian T.N. Efficient cropping zones - decadal analysis for major crops in Tamilnadu, Indian Journal of Agricultural Research. 2002;36(4):227–233.