



Research Article

DELINEATION OF PROSPECTIVE CROPPING ZONES FOR RICE AND MAIZE IN TAMIL NADU

KOKILAVANI S.* AND DHEEBAKARAN Ga.

Agro Climate Research Centre, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, 64 1003, Tamil Nadu, India

*Corresponding Author: Email - kokilavani.s@tnau.ac.in

Received: May 05, 2019; Revised: May 25, 2019; Accepted: May 26, 2019; Published: May 30, 2019

Abstract: A study was carried out to categorize the prospective zones for cultivation of Rice and Maize in Tamil Nadu at the Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore. The data on area, production and productivity of the study crops for 30 years (1981 to 2010) were collected from the Season and Crop Report, Government of Tamil Nadu. Two indices such as Relative Spread Index (RSI) and Relative Yield Index (RYI) were computed and the potential cropping districts for the test crops were identified. In Tamil Nadu, seven districts were found to be prospective regions for rice and four districts for maize as in these areas both the RYI and the RSI were more than 100 per cent. The decadal analysis indicated that the Virudhunagar district showed a potential shift from In-Efficient Cropping Zone (IECZ) to Yield Efficient Cropping Zone (YECZ) for rice and Tirunelveli and Tutucorin districts showed a potential shift from IECZ to Area Efficient Cropping Zone (AECZ) for maize.

Keywords: Relative Spread Index, Relative Yield Index, Efficient Cropping Zone

Citation: Kokilavani S. and Dheebakaran Ga. (2019) Delineation of Prospective Cropping Zones for Rice and Maize in Tamil Nadu. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 11, Issue 10, pp.- 8545-8547.

Copyright: Copyright©2019 Kokilavani S. and Dheebakaran Ga. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Academic Editor / Reviewer: Dr B. S. Sowmyalatha

Introduction

Rainfall is the key climatic unpredictable component that governs the regional hydrologic cycle and accessibility of water resources [1]. Agriculture and its related sectors ensuring food and energy security of India are crucially dependent on the timely availability of adequate amount of water / soil moisture and well suited climate and weather. During the past, because of the sound soil health and unlimited water availability, farmers have their own set of cropping pattern and succeeded in farming. Over the years, because of variable climate, change in rainfall pattern, depletion of groundwater, reduced length of growing season and shift in cropping pattern brought a spatial shift in crop potential during this era. Increasing nutrient deficiency of soil, introduction of unsuitable new crops and varieties also lead to reduction in native productivity of soil and native crops of that location. Many numbers of climate resilient native crops have been replaced with new one. Advances in the agricultural sciences helped in the development of several techniques for finding out the suitable crops in the specified areas. Delineation of efficient cropping zones for agricultural crop and for horticultural crops was done in earlier studies [2]. Identification of potential crops and zones would help in increasing the productivity, ensures better utilization of available resources and avoids wastage of resources in the inefficient zones. Growing efficient crops of that location are not only gives the higher benefit; also sustain the soil, climate and human resources. Hence, identifying efficient crops at district level and developing crop management technological package for the identified most efficient crops of that district will ensure better return under monsoon vagaries than other crops.

Materials and Methods

The area, production and productivity of major food crops were collected for thirty years period (1981-2010) from Season and Crop Report, Government of Tamil Nadu. The collected data was delineated into decadal period (1981-1990), (1991-2000) and (2001-2010) and the collected data were analyzed to look for the prominent efficient cropping zone.

Criteria for efficient cropping zone

RSI	RYI	Cropping zone
> 100	> 100	Most Efficient Cropping Zone(MECZ)
> 100	<100	Area Efficient Cropping Zone(AECZ)
<100	> 100	Yield Efficient Cropping Zone(YECZ)
<100	<100	In-Efficient Cropping Zone(IECZ)

$$RSI = \frac{\text{Area of the crop expressed as percentage of total cultivable area in the district}}{\text{Area of the crop expressed as percentage of total cultivable area in the State}} \times 100$$

$$RYI = \frac{\text{Mean yield of the crop in the district}}{\text{Mean yield of the crop in the district}} \times 100$$

Results and Discussion

Efficient Zone is an area/region/district, where, with the availability of suitable soil and climate, the concern crop performs well and results in higher productivity. Such areas could be marked for the introduction of hi-tech agricultural technology to enhance the yield. Most efficient cropping zone (MECZ) has higher Relative Spread Index (RSI) along with higher RYI [3]. In Tamil Nadu, RSI is mostly dictated by the availability of inputs like seeds, fertilizers, water, pesticides, availability of labour, technology, Government policies etc., while RYI is mainly dictated by the climate in a particular domain along with prevailing weather within that climate. When all these above stated inputs are available, naturally, the area would come under MECZ. For MECZ, high technology practices for the concerned crops may be introduced to explore higher productivity [4].

Efficient Cropping Zone for Rice

In respect of rice, Kancheepuram, Thiruvallur, Cuddalore, Villupuram, Madurai, Thirunelveli and Kanyakumari districts were found to be MECZ for the thirty years analysis period (1981-2010). Among the districts of Tamil Nadu, Thirunelveli and Kanyakumari district were found to be MECZ for rice [5].

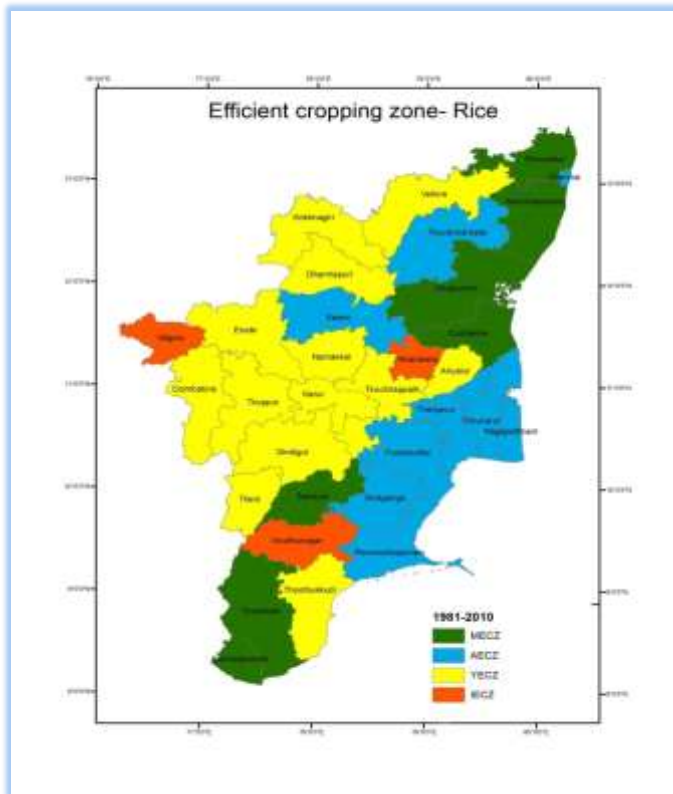


Fig-1 Efficient Cropping Zone for rice

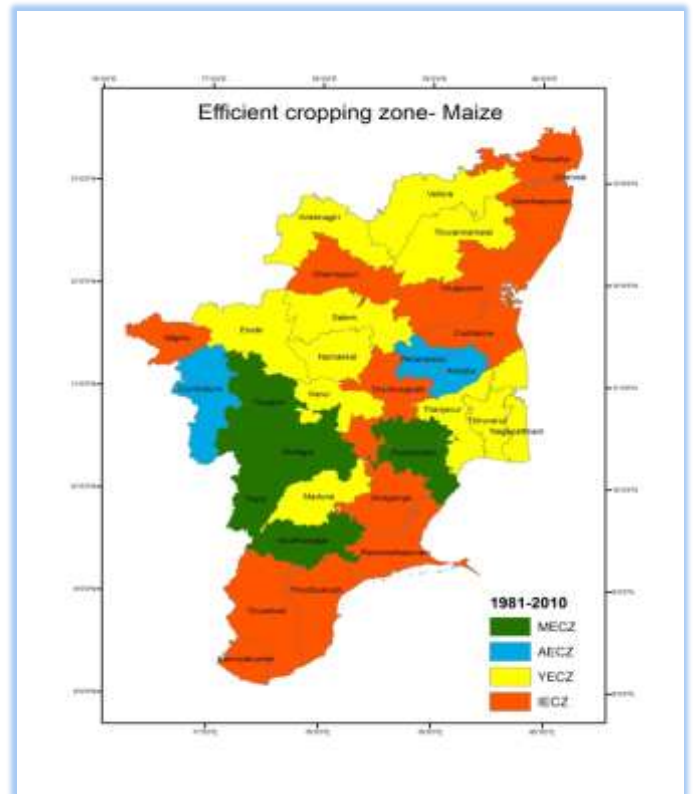


Fig-2 Efficient Cropping Zone for maize

Table-1 Most prominent Cropping Zone for rice

Districts	1981-1990	1991-2000	2001-2010
Kancheepuram	MECZ	MECZ	MECZ
Cuddalore	MECZ	MECZ	MECZ
Thiruvallur		MECZ	MECZ
Villupuram		MECZ	MECZ
Ramanathapuram	AECZ	AECZ	AECZ
Sivagangai	AECZ	AECZ	AECZ
Pudukottai	AECZ	AECZ	AECZ
Thiruvallur		AECZ	AECZ
Nagapattinam		AECZ	AECZ
Vellore	YECZ	YECZ	YECZ
Salem	YECZ	YECZ	YECZ
Dharmapuri	YECZ	YECZ	YECZ
Coimbatore	YECZ	YECZ	YECZ
Erode	YECZ	YECZ	YECZ
Dindugal	YECZ	YECZ	YECZ
Thoothukudi	YECZ	YECZ	YECZ
Namakkal		YECZ	YECZ
Kirshnagiri			YECZ
Ariyalur			YECZ
Perambalur		IECZ	IECZ
The Nilgiris	IECZ	IECZ	IECZ

Table-2 Shift in efficient cropping zone in Rice

Districts	1981-1990	1991-2000	2001-2010
Madurai	YECZ	YECZ	MECZ
Thanjavur	AECZ	AECZ	MECZ
Thirunelveli	YECZ	MECZ	MECZ
Thiruvannamalai		YECZ	MECZ
Thiruchirapalli	YECZ	YECZ	MECZ
Kanyakumari	AECZ	MECZ	MECZ
Virudhunagar	IECZ	IECZ	YECZ
Karur		MECZ	YECZ
Theni		MECZ	YECZ

Table-3 Most prominent Cropping Zone for maize

Districts	1981-1990	1991-2000	2001-2010
Dindugal	MECZ	MECZ	MECZ
Theni		MECZ	MECZ
Coimbatore	AECZ	AECZ	AECZ
Ariyalur			AECZ
Vellore	YECZ	YECZ	YECZ
Thanjavur	YECZ	YECZ	YECZ
Madurai	YECZ	YECZ	YECZ
Thiruvannamalai		YECZ	YECZ
Namakkal		YECZ	YECZ
Thiruvallur		YECZ	YECZ
Nagapattinam		YECZ	YECZ
Kirshnagiri			YECZ
Dharmapuri	IECZ	IECZ	IECZ
Thiruchirapalli	IECZ	IECZ	IECZ
Ramanathapuram	IECZ	IECZ	IECZ
Sivagangai	IECZ	IECZ	IECZ
The Nilgiris	IECZ	IECZ	IECZ
Kanyakumari	IECZ	IECZ	IECZ
Kancheepuram	IECZ	IECZ	IECZ
Cuddalore	IECZ	IECZ	IECZ
Thiruvallur		IECZ	IECZ

Table-4 Shift in efficient cropping zone in maize

Districts	1981-1990	1991-2000	2001-2010
Salem	YECZ	YECZ	MECZ
Erode	YECZ	YECZ	MECZ
Virudhunagar	YECZ	MECZ	MECZ
Perambalur		IECZ	AECZ
Thirunelveli	IECZ	IECZ	AECZ
Thoothukudi	IECZ	IECZ	AECZ
Villupuram		IECZ	YECZ
Karur		IECZ	YECZ
Pudukottai	MECZ	MECZ	YECZ

The decadal analysis indicated that the North Eastern Zone districts were found to be prominent for rice crop [Fig-1], [Table-1] and [Table-1a]. In the identified MECZ districts, though rice is raised in different seasons like Sornavari (April, May), Kuruvai (June, July), Samba (August), Late samba (September), Navarai (December, January), Kar (June, July) and Pishanam (September, October), water is not the limiting factor. When evapotranspiration is more, the yield also would be more. In respect of rice, the water requirement is 1200 mm, while the yield is around 5 tonnes/ hectare, with water use efficiency of 4.2 kg/mm of water used. Moreover, the rice farmers also highly resourceful and the awareness on rice technology go up to 80 to 90 per cent [6]. The climate with the weather that prevailed during the rice season is always favorable for rice crop. Scientifically, there is a sound crop weather relationship available at these districts for the management of the rice crop. For the other districts, the decadal analysis indicated either the crop fell in the period of Yield Efficient Cropping Zone (YECZ)/ Area Efficient Cropping Zone (AECZ) in the early decade (1981-90), later the crop shifted to MECZ by the introduction of advanced technology like System of Rice Intensification (SRI) in Tamil Nadu. The widespread adoption of SRI showed increasing trend in yield (from 28.3% in 2007-08 to 32.4% in 2010-11)[7]. The decadal analysis further indicated that the Virudhunagar district showed a potential shift from In Efficient Cropping Zone (IECZ) to YECZ.

Efficient Cropping Zone for Maize

For Maize crop, Pudukkottai, Theni, Dindigul and Virudhunagar districts from the southern zone came under MECZ for the thirty years analysis period(1981-2010) while the decadal analysis indicated Dindigul and Theni districts were found to be the prospective zone for maize [Fig-2], [Table-2] and [Table-2a]. The area under rain fed / dryland is more at this southern zone where the maize crop is being cultivated during North east monsoon (NEM). Since, maize may not tolerate water logging at knee high stage, farmers wisely and widely cultivate dryland / rain fed maize crop in up- dryland as compared to sloppy dryland and this made the crop to obtain optimum soil moisture throughout its crop duration to give with higher productivity [8]. The seeds of high yielding maize varieties and hybrids are being supplied to the farmers either by the State Department of Agriculture or by the private corporate companies. Farmer's interest, timely availability of inputs and favorable weather made the maize crop came under MECZ in these districts. Coimbatore, Dindigul, Erode, Salem, Theni and Virudhunagar in Tamil Nadu were identified as the efficient cropping zone for maize [9]. For Virudhunagar, the decadal analysis indicated the crop were found to be Yield Efficient Cropping Zone (YECZ) in the early decade (1981-90), later the crop shifted to MECZ by the adoption of improved and sustainable maize technologies. This holds the key to ensure both sustainability and increased maize production. Maize and maize based cropping systems are becoming important food and nutritional security in Tamil Nadu. The decadal analysis further indicated that the Tirunelveli and Tutucorin districts showed a potential shift from In Efficient Cropping Zone (IECZ) to AECZ where the area under rain fed / dryland is more and maize grain becomes an input to poultry industry and hence, with greater demand and higher price, larger farmers are interested to cultivate maize in these districts while Villupuram and Karur districts showed a probable shift from IECZ to YECZ wherever the technological interventions created awareness among farmers to shift towards profitable crops.

Conclusion

Efficient Zone is an area/region/district, where, with the availability of suitable soil and climate, the concerned crop performs well and results in higher productivity. In Tamil Nadu, seven districts were found to be prospective regions for rice, four districts for maize as the RYI and the RSI in these areas were high. The decadal analysis indicated that the Virudhunagar district showed a potential shift from In Efficient Cropping Zone (IECZ) to Yield Efficient Cropping Zone YECZ for rice and Tirunelveli and Tutucorin districts showed a potential shift from IECZ to Area Efficient Cropping Zone (AECZ) for maize. The results of the above study could be efficiently used by the farming community in deciding the cropping options in their respective zones.

Application of research: This research results would give an insight for the researchers to use the natural resources in an efficient way. Moreover, these results would help the stakeholders to fix the subsidy rates for the identified crops.

Research Category: Efficient Cropping Zonation

Abbreviations: RSI- Relative Spread Index, RYI- Relative Yield Index, MECZ- Most Efficient Cropping Zone, AECZ- Area Efficient Cropping Zone, YECZ- Yield Efficient Cropping Zone, IECZ- Inefficient Cropping Zone

Acknowledgement / Funding: Authors are thankful to the Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore, 641 003, Tamil Nadu

***Research Guide or Chairperson of research: Dr S. Kokilavani**

University: Tamil Nadu Agricultural University, Coimbatore, 641 003, Tamil Nadu
Research project name or number: DCM/CBE/AMT/2016/001/

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Tamil Nadu

Cultivar / Variety / Breed name: Nil

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

- [1] Lakshmipriya R. and Manimannan G. (2014) *Journal of Mathematics*.10, 5-12.
- [2] Thavaprakash N., Babu C. and Jagannathan R. (2008) *Madras Agricultural Journal* 95, 418-424.
- [3] Kanwar J. (1972) *Proc. Symp, on Cropping Pattern in India*, ICAR, New Delhi, 11-32
- [4] Narayanan A.L., Balasubramanian T.N. Chellamuthu V and Senthil Kumar J. (2003) *Madras Agricultural Journal* 90, 729-731.
- [5] Senbagavalli S., Rohini A. Ganesan K. and Balasubramanian T. N.(2002) *Indian Journal of Agricultural Research* 36, 227-233.
- [6] Sathyapriya E. (2016) *M.Sc. Thesis, TNAU, Coimbatore*.
- [7] Pandian B.J., Sampathkumar T. and Chandrasekaran R. (2014) *Irrigation and Drainage System Engineering*, 3(1),1-6.
- [8] Elias Meskelu, Mulugeta Mohammed and Tilahun Hordofa (2014) *International Journal of Recent Research in Life Sciences*. 1, 12-21
- [9] Kokilavani S. and Geethalakshmi V. (2013) *Indian Journal of Science and Technology*, 6, 5298-5301.