Spatial assessment of length of growing period for selected districts in Tamil Nadu

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ABSTRACT

Length of growing period (LGP) provides information for crop suitability of farming systems and to study the climate variability and change. LGP was analyzed and mapped using the FAO (Food and Agricultural Organization) model for extraction of start and end of the season and its variability for three selected districts (Salem, Tiruvarur and Sivagangai) in Tamil Nadu based on the criteria of cropping patterns, agro-climatic zones and rainfall and terrain characteristics. The observed daily weather data for different locations of the three districts were collected from various government agencies and gridded data for the period of 33 years (1981-2012). The results showed that LGPs obtained from the weather station data were found to be 9 to 30 weeks for different districts and the longest period of continuous supply of moisture for crop growth was found in Salem which had a wide range of two to seven months while for Thiruvarur and Sivagangai the LGP was shorter ranging from two to four months. These findings have an important application in cropping systems to ensure a better choice of crops under climate variability.

Keywords: Spatial assessment; growing period; rainfall; crop planning; climate change

INTRODUCTION

The amount of rainfall during the growing season is crucial to the production and yield of crops (Sobowale et al 2016). The main constraint for crop cycle is water requirement from emergence to ripening stage (Odekunle 2004). The favorable weather conditions for growing agricultural crops during the period of availability of water, referred to as the length of growing period and distribution are varies temporally and spatially across the regions. Length of growing period (LGP) has been categorized as a rainy or wet season using historical rainfall database, the date on which the rain starts from the date on which it ends from subtracting for each year (Madeoye 1986, Zargina 1987).

Atedhor (2020) examined the spatial variations of rainfall pattern using 64 years (1951-2014) rainfall data during the onset and cessation of the growing season in the Sudano-Sahelian region of Nigeria. The results revealed the increasing trend during the onset and it was more significant than the date of cessation. The purpose of the research was the spatial distribution of LGP and its heterogeneity for selected districts in Tamil Nadu over the span of 33 years from 1980 to 2012. There is a need to observe rainfall variability at local and regional levels to combat the drastic impact of prolonged dry spells/droughts in order to maximize agricultural productivity (Sathyamoorthy et al 2017). Therefore the present study was carried out for three selected districts (Salem, Tiruvarur and Sivagangai) in Tamil Nadu to delineate the spatial distribution of LGP map and its variability analysis for crop planning.

METHODOLOGY

Study area

The study was conducted in three districts viz Salem, Sivagangai and Thiruvarur representing northwestern, southern and Cauvery delta agro-climatic zones respectively of Tamil Nadu selected for the

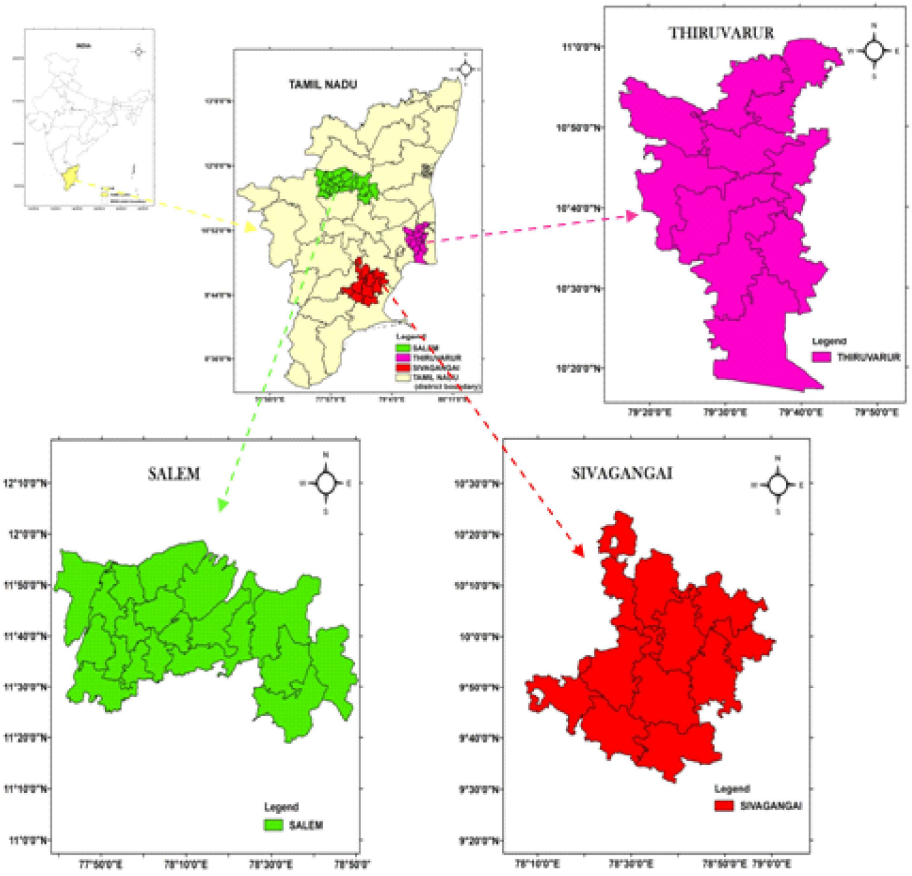

Fig 1. Districts of Tamil Nadu selected for the study

present study (Fig 1). The criteria considered while selecting the study districts were 1) the districts were selected to represent unimodel (southern) and bimodel rainfall (northwestern) and one for deltaic zone, 2) the selected districts fell under different agro-climatic zones of Tamil Nadu, 3) the districts chosen largely differed in their cropping pattern and 4) the districts had different terrain characteristics.

Weather data

The observed daily weather data for different locations of the district available with India Meteorological Department, Tamil Nadu and Surface Ground Water Department and Department of Economics and Statistics, Tamil Nadu were collected for a period of 33 years from 1980-2012. The daily rainfall gridded data at 0.25 degree resolution for the period up to 2007 were downloaded from APHRODITE and Water Resources website (http://www.chikyu.ac.jp/precip/) and added to the observed data.

The climate research unit (CRU) of University of East Angelia, UK developed monthly potential evapotranspiration (PET) at 0.5 degree resolution was downloaded from British Atmospheric Data Centre (https://badc.nerc.ac.uk). For filling the gaps, the data hosted by National Aeronautics Space Administration (NASA) on their website (power.larc.nasa.gov/), Prediction of Worldwide Energy Resource (POWER) and Climatology Resource for Agroclimatology were downloaded and used. In addition data sets available with various research stations of Tamil Nadu Agricultural University were added to the weather data repository for this study.

Calculation of length of growing period (LGP)

The LGP was calculated following the FAO (Food and Agricultural Organization) model proposed by Higgins and Kassam (1981). In this method the growing period starts when precipitation exceeds 0.5 RF/PET (rainfall/potential evapotranspiration) continuously without break and ends with the utilization of assured quantum (100 mm) of stored soil moisture.

In the calculation RF/PET ratio, the PET component used was monthly climatology of CRU data at 0.5 degree resolution while for RF component which

is the assured weekly rainfall was derived using 50 per cent probability from the weather database created for this study. The initial probability indicates the expected minimum quantity of rainfall for any period (week, month, season and annual). To find out the assured week rainfall from the time series data the following formula and procedure was followed:

$$IP = \frac{n \times P}{100}$$

where IP= Initial probability (n^{th} value), n= Sample size (number of years taken for analysis), P= Probability required in percentage (50% used)

The rainfall of different weeks was first arranged in descending order. The value from the above formula was used to pick the assured rainfall from the time series data. The 33 years of rainfall data were used and the value of initial probability was 16.5. The mean of 16^{th} and 17^{th} value of the time series data arranged in descending order was taken and was used as assured weekly rainfall and then used for LGP calculation.

Creation of LGP map

The calculated LGP in weeks was grouped into four categories for covering both unimodel and bimodel rainfall regions and are presented in Table 1 and it was therefore necessary to examine the amount of moisture needed to crop selection in the soil.

Table 1. Category-wise length of growing period

Category (LPG)	Period	
	Weeks	Months
L1	9-13	2-3
L2	14-17	3-4
L3	18-21	4-5
L4	22-30	5-7

RESULTS and DISCUSSION

Length of growing period inventory

Length of growing season map was delineated for starting and end of the period from standardized meteorological weeks in three selected districts of Tamil Nadu. The continuous supply of moisture in a region decides the length of growing period (LGP). In this study LGP was categorized into four classes (Figs 2a, 2b and 2c). Longest period of continuous supply of moisture for crop growth was found in Salem which had wide range of two to seven months while for Thiruvarur and Sivagangai the LGP was shorter ranging from two to four months. The more categories of longer LGP in Salem district were due to its getting equal amount of rainfall in both southwest and northeast monsoon season as reported by Jegankumar et al (2012).

This showed that in Salem district diverse crops could be grown as the moisture availability period was more. In case of Thiruvarur and Sivagangai districts, short and medium duration crops could be grown due to shorter LGP. Among the categories, L2 occupied larger area where only short duration crops could be grown. The shorter LGP in respect of Sivagangai and Thiruvarur could be attributed to the receipt of rains mainly during northeast monsoon season compared to the bimodal distribution in case of Salem. This is indicated that there was a great variation in LGP depending on the elevation, rainfall, agro-climatic zones and cropping pattern.

Length of growing period categorization

The length of growing period varied among the selected districts. In general the moisture availability period ranged from 9-30 weeks for the districts studied and is presented in Table 2. The weekly moisture availability period for Salem ranged from 9 to 30 weeks while for Thiruvarur and Sivagangai districts the period of moisture availability was between 9 to 17 weeks. These ranges were divided into four categories (Table 3) as described as L1 (9-13 weeks), L2 (14-17 weeks), L3 (18-21 weeks) and L4 (22-30 weeks).

Table 2. District-wise range of parameters observed

District	LGP (weeks)
Salem	9-30
Sivagangai	9-17
Thiruvarur	9-17

The length of growing period (LGP) was categorized based on the normal growing period of crops and cultivars in the state. The LGP categorization

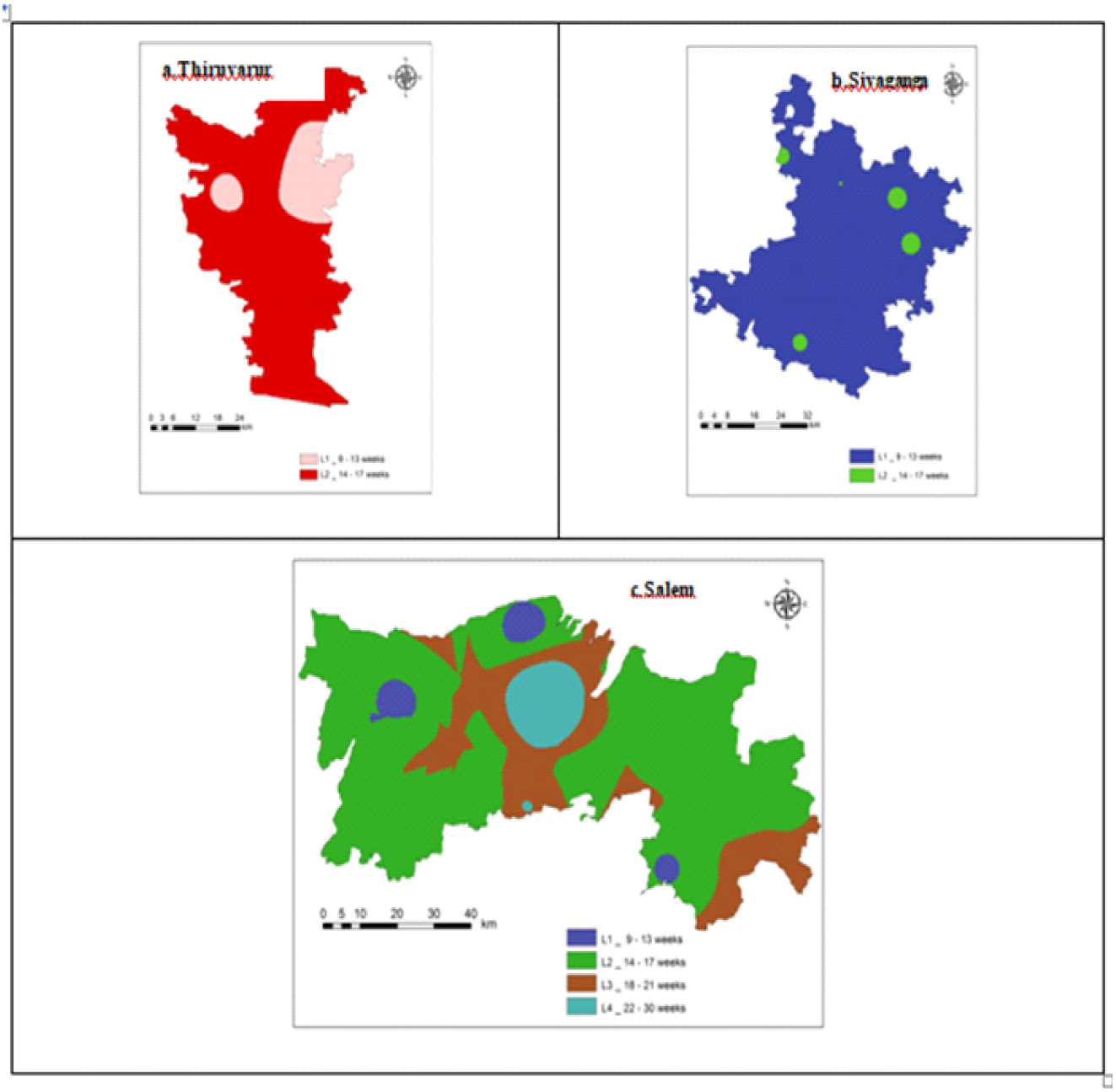

Fig 2. Spatial distribution of LGP for selected districts (a) Thiruvarur, (b) Sivagangai and (c) Salem

Table 3. District-wise area (ha) covered under each LGP category

District	LPG				Total
	L1	L2	L3	L4	
Salem	9,643	2,34,438	65,200	7,919	3,17,200
Sivagangai	3,05,494	5,719	-	-	3,11,213
Thiruvarur	30,075	1,57,906	-	-	1,87,981
Total	3,45,212	3,98,063	65,200	7,919	8,16,394

revealed that Sivagangai and Thiruvarur fell under only two categories (L1 and L2) while Salem district had all four categories. In respect of Salem district, the area covered in the LGP of 14-17 weeks (L2) was the highest (2,34,438 ha) among districts while Sivagangai had the highest area (3,05,494 ha) under LGP of 9-13 weeks (L1). However Thiruvarur had the highest area under LGP of 14-17 weeks (L2). Vengateswari et al (2020) also stated that the LGP ranged between 91 and 126 days (13-18 weeks) during El Nino and La Nina year. Of the total agricultural area in three selected districts the per cent coverage under each category was 42.28, 48.76, 7.99 and 0.97 for L1, L2, L3 and L4 respectively. Comparing the area under different LGP categories, L2 occupied the highest cover (3, 98, 063 ha) while the L4 category had the lowest area (7,919 ha) coverage.

CONCLUSION

From this study it was concluded that Salem had more length of growing period due to the bimodality of rainfall whereas other two districts (Thiruvarur and Sivagangai) had shorter LGP because of unimodel rainfall. Wide variations were observed in Salem district with occurrence of all four classes of LGP extending two to seven months. Sivagangai and Thiruvarur had LGP classes of L1 and L2 which had a period of two to four months. This could be attained by efficient planning and utilization of available natural resources.

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