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Influence of climatic factors on productivity of major cultivated crops of Perambalur district, Tamil Nadu

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Abstract

Agricultural productivity is significantly influenced by climatic factors, including temperature, rainfall, and seasonal variability. This study analyzes the impact of climate variability on the productivity of major cultivated crops in Perambalur district, Tamil Nadu, over five consecutive years (2015-16 to 2019-20). Perambalur, a predominantly rainfed district, is a major producer of maize and cotton, with agriculture serving as a primary livelihood for the population. The study employs statistical methods such as trend analysis, correlation and regression to assess the relationship between climatic variables and crop yield. This study indicate that annual rainfall in the district varied between 529.44 mm and 1004.73 mm, with an average of 766 mm, while maximum and minimum temperatures exhibited a descending trend over the years. Correlation analysis revealed that rainfall had a greater influence on yield variation than temperature for most crops, accounting for over 50% of the yield variation in crops like rice, red gram, sorghum and pearl millet. However, minimum temperature significantly impacted cotton yield (77.5%), while maximum temperature influenced maize yield (75.7%). The study concludes that climate variability, particularly rainfall distribution, plays a crucial role in determining agricultural productivity. Understanding these climatic influences is essential for developing adaptive strategies to mitigate climate-induced risks and enhance crop resilience in the region.

Keywords: Climate variability, crop productivity, Rainfall and temperature impact

Introduction

Agricultural production is highly perceptive to weather and climate. Temperature, precipitation, timing of frost, growing season length, soil moisture, pest pressures, and numerous other climate and climate-related variables influence agricultural productivity and agricultural management decisions ^[5]. Agriculture is the most predominant segment of the economy of Tamil Nadu. About, 60 - 65% of state's population depends on agriculture and other activities for their livelihood. Agriculture is the main occupation of Perambalur district of Tamil Nadu. Perambalur district occupies 1,75,739 ha of geographical area, of which 93,581 ha is grossed cropped area. Perambalur district receives average annual rainfall of 861 mm. Maize and Cotton is the important crops of Perambalur district which accounts 80% of the total cultivated area. Perambalur district stands first in Maize and Cotton cultivation in Tamil Nadu. Being a rainfed district, Perambalur produces in an average of 4.0 lakh metric tons of food grains per year ^[6]. The district is divided into 4 taluks (Perambalur, Veppur, Veppanthattai and Alathur). Cauvery is the major river flowing in the region (<https://perambalur.nic.in/agriculture/>). Crop production is highly sensitive to climate and often affected by long-term trends in average rainfall and temperature, inter-annual climate variability, shocks during specific phenological stages and extreme weather events.

Crops are most sensitive to high temperatures at the reproductive stage and grain-filling/fruit maturation stage ^[2]. The amount and temporal distribution of rainfall is generally the single most important determinant of interannual fluctuations in national crop production levels ^[1]. The rainfall, one of the most important natural input resource for dryland agricultural production system, is erratic and temporal in nature ^[3]. According to VonBraun, (1991) ^[4] for instance, a 10% decrease in seasonal rainfall from the long-term average generally translates into a 4.4% decrease in the country's food production. Then the analyses that follow show the correlation

and regression between rainfall and crop yield as well as temperature and crop yield. Crop-wise yield data and weather parameters were obtained from the Joint Directorate of Agriculture, Department of Agriculture, Perambalur District of Tamil Nadu.

Review of literature

The study reported that the temperature trend was beneficial for maize yields, but detrimental for sorghum and soybean yields, whereas observed precipitation trend was beneficial for all three crops. Climate change is likely to affect yield and yield quality, not only directly due to impacts on crop physiology but also indirectly due to alterations in nutrient mineralisation and availability for crops, resulting in negative impacts on yield production [7]. The during dry spells, annual crop yield production for maize and beans fall below average of 1.44 tons/ha and 0.78 tons/ha while sorghum and millet were above average of 0.94 tons/ha and 1.61 tons/ha respectively. He also revealed that rainfall variability and dry spells have serious impacts on food security, massive crop failure, reduced livestock production and death [9].

There is a significant relationship between rainfall (2020) and Jollu percentage ($r = 0.386$) in robusta coffee. He also stated that the variation in climatic conditions such as excess rainfall and continuous soil moisture led to more vegetative growth than reproductive growth [10].

High temperature stress usually activated heat shock proteins,

mediated by nitric oxide (NO) and reactive oxygen species, decreased electrolyte leakage, relative water content and chlorophyll (chl) levels with reduced activities of antioxidant enzymes (superoxide dismutase, catalase, ascorbate peroxidase and glutathione reductase) [8].

Materials and Methods

The study was conducted under Agriculture Project Work (APW), Tamil Nadu Agricultural University, Coimbatore, Tamilnadu. Crop-wise yield data and weather parameters were obtained from the Joint Directorate of Agriculture, Department of Agriculture, Perambalur District of Tamil Nadu five consecutive years from 2015-16 to 2019-2020. The various statistical methods were used for statistical analysis like mean, Standard Deviation, trend line analysis, coefficient of variation and regression for measuring relationship between climate variability on productivity of major cultivated crops of Perambalur district of Tamil Nadu.

Results and Discussion

Climate is the most important factor influencing the suitability of a crop to a particular region. The yield potential of the crop mainly depends on climate. More than 50 per cent of variation of crops is determined by climate. The most important climatic factors that influence growth, development and yield of crops are solar radiation, temperature and rainfall.

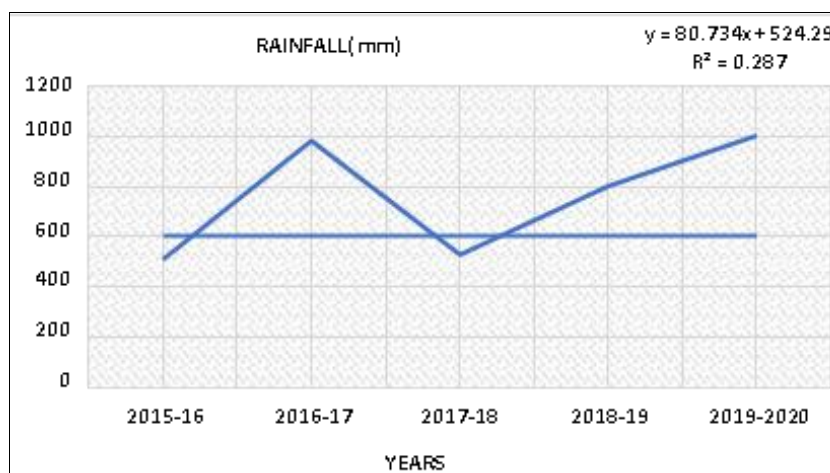


Fig 1: Portrays trend of annual rainfall from 2015-16 to 2019-2020. Total annual rainfall also varied from 529.44 mm (2017-18) to 1004.73mm (2019-20), with the mean rainfall of 766.00 mm and standard deviation of 238.00 mm.

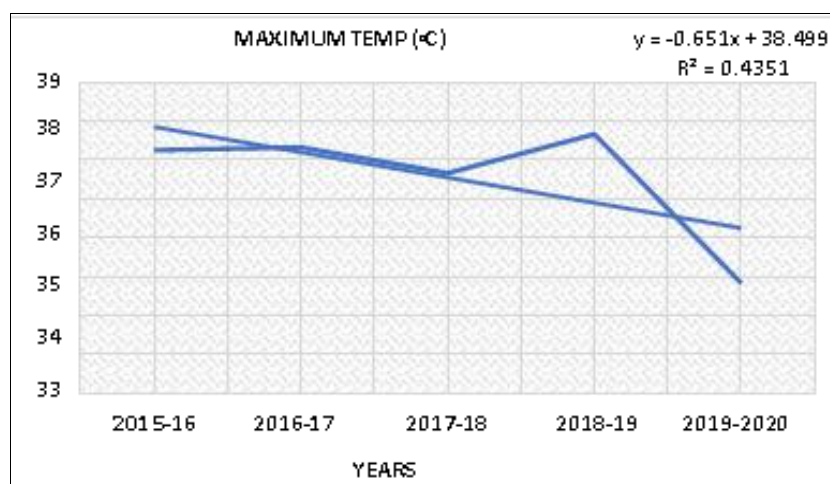


Fig 2: Revealed descending trend line for maximum temperature over the year 2015-16 to 2019-20. For five years, the highest mean maximum temperature of 37.66°C occurred in 2018-19 and the lowest maximum temperature of 33.83 recorded in 2019-2020 with the mean maximum temperature of 36.55 °C and the standard deviation of 1.56 °C.

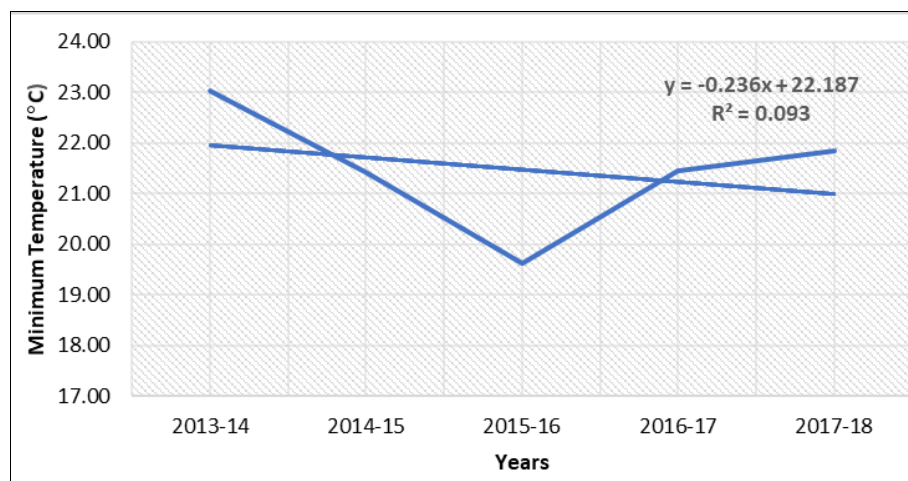


Fig 3: Revealed descending trend line for minimum temperature for 2015-16 to 2019-20. During 2017-18, the lowest minimum temperature (22.50°C) observed, whereas higher minimum temperature (23.00 °C) was observed in 2018-19 with the mean minimum temperature of 22.45°C and the standard deviation of 0.21 °C.

Temperature and rainfall correlation and regression on crop yield of Perambalur district

The analyses of correlation and regression between rainfall and crop yield as well as temperature and crop yield has shown the following results.

The correlation analysis indicated coefficient of:

- Cotton (Rainfall = -0.456), (Max. Temperature = -0.389) and (Min. Temperature = -0.880)
- Maize (Rainfall = 0.129), (Max. Temperature = -0.870) and (Min. Temperature = 0.796)
- Paddy (Rainfall = -0.818), (Max. Temperature = -0.021) and (Min. Temperature = -0.562)
- Sugarcane (Rainfall = -0.652), (Max. Temperature = 0.349) and (Min. Temperature = 0.029)
- Groundnut (Rainfall = -0.477), (Max. Temperature = -0.269) and (Min. Temperature = -0.451)
- Sorghum (Rainfall = -0.831), (Max. Temperature = 0.446) and (Min. Temperature = -0.383)
- Pearl millet (Rainfall = -0.50), (Max. Temperature = 0.052) and (Min. Temperature = -0.583)
- Red gram (Rainfall = -0.913), (Max. Temperature = 0.100) and (Min. Temperature = -0.520)

The study further revealed that in about 6 of the 8 cases (75%) of the regression analysis, rainfall influences the yield than temperature. For instance,

- Rainfall explains (66.97%), Min. Temperature (31.59%) and Max. Temperature (0.4%) of rice yield.
- Rainfall explains (45.21%), Min. Temperature (0.08%) and Max. Temperature (12.24%) of sugarcane yield.
- Rainfall explains (22.76%), Min. Temperature (20.36%) and Max. Temperature (7.27%) of groundnut yield.
- Rainfall explains (69.1%), Min. Temperature (14.7%) and Max. Temperature (19.9%) of sorghum yield.
- Rainfall explains (34.9%), Min. Temperature (34%) and Max. Temperature (0.27%) of pearl millet yield.
- Rainfall explains (83.3%), Min. Temperature (27%) and Max. Temperature (1%) of Redgram yield.

In about (12.5%) of the analysis, minimum temperature showed higher influence in the explanation of variation in crop yield than rainfall and maximum temperature.

- Minimum Temperature explains (77.5%), Maximum

Temperature (15.1%) and rainfall (20.7%) of the cotton yield.

In about (12.5%) of the analysis, Maximum Temperature showed higher influence in the explanation of variation in crop yield than rainfall and minimum temperature.

- Maximum Temperature explains (75.7%), Minimum Temperature (63.45%) and rainfall (1.67%) of the maize yield.

Conclusion

The study concluded that the rainfall explains the larger portion of crop yield variation than the other climatic factors of minimum and maximum temperature. However, in the case of cotton, minimum temperature holds higher influence in yield whereas maximum temperature influenced the yield of maize. The fluctuating climatic factors occur within the favorable basic climatic requirement for the production of cotton, maize, rice, sugarcane, groundnut, sorghum, pearl millet and redgram. Increase in climate variability affects the net crop production by influencing biochemical and metabolic processes.

References

1. Bewket W. Rainfall variability and crop production in Ethiopia: Case study in the Amhara region. In: Proceedings of the 16th international conference of Ethiopian studies; 2009; Trondheim, Norway. Norwegian University of Science and Technology. p. 823-36.
2. Hatfield JL, Prueger JH. Temperature extremes: Effect on plant growth and development. *Weather Clim Extremes*. 2015;10(Part A):4-10.
3. Makwana JJ, Deora BS, Patel CK, Parmar BS, Saini AK. Analysis of rainfall characteristics and moisture availability index for crop planning in semi-arid region of north Gujarat. *J Agrometeorol*. 2021;23(4):409-15.
4. Von Braun J. A policy agenda for famine prevention in Africa. 1991.
5. Walsh M, Backlund P, Buja L, DeGaetano A, Melnick R, Prokopy L, *et al*. Climate indicators for agriculture. 2020.
6. Iizumi T, Ramankutty N. Changes in yield variability of major crops for 1981–2010 explained by climate change. *Environ Res Lett*. 2016;11(3):034003.
7. Kukal MS, Irmak S. Climate-driven crop yield and yield variability and climate change impacts on the US Great

- Plains agricultural production. *Sci Rep.* 2018;8(1):1-18.
8. Maryam A, Hadiza US, Aminu UM. Characterization and determination of antibiotic susceptibility pattern of bacteria isolated from some fomites in a teaching hospital in northern Nigeria. *Afr J Microbiol Res.* 2014;8(8):814-8.
 9. Ogenga JO, Mugalavai EM, Nyandiko NO. Impact of rainfall variability on food production under rainfed agriculture in Homa Bay County, Kenya. 2018.
 10. Patil SG, Devasia J, Rao NS. Influence of elevation and rainfall on leaf growth, bean characteristics and yield components of arabica and robusta coffee under changing climatic conditions in Karnataka state, India. *J Plant Crops.* 2022;50(2):78-84.