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***Short communication***

# Effect of climatic parameters on tomato production in Nigeria

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Tomato (*Solanum lycopersicum*) is an important crop of Nigerian playing significant role in different agrifood sectors such as in food security, farmers' income and employment opportunities in the country. It is also pertinent to note the spatial heterogeneity of Nigeria's agro-ecological zones. For instance, the Northern Guinea Savannah and Sudan Savannah belts, which dominate Nigeria's tomato producing belt (e.g., Kano, Kaduna, Katsina, and Plateau states), have disparate rainfall and temperature regimes compared to those of the humid rainforest belts in the south. Hence, localized adaptation policies, and not a one-fit-all national approach, are called for to realize maximum tomato productivity under varied climate conditions (Fadairo *et al.,* 2020).

Goodlife *et al.,* (2024) reported that the early-maturing and disease-tolerant types offer promising intervention measures against climate-caused yield uncertainties. Microclimatic modification such as mulching, use of polyhouse, water stress management helped to improve the yields of tomatoes (Kumari *et al.,* 2014; Chavan and Bodake, 2023). Shades have been reported affect the quality of cherry tomato in Indonesia (Abror *et al.,* 2025). While moderate amounts of rain favor seed germination, vegetative growth, and fruiting, excessive rains can lead to root rot and nutrient leaching. High heat stress especially coupled with drought stress affects the yields of tomato through the alteration of vital development processes including pollination, flowering and fruit set (Knapp *et al.,* 2024). High humidity, especially above 70%, encourages the development of fungal and bacterial diseases that greatly affect the yield and quality of tomatoes (Oladitan and Akinseye, 2014; Mukherjee *et al.,* 2018).

The present study is aimed at examining the effects of three climatic variables which are rainfall, temperature and relative humidity on tomato yield of Nigeria using 36-year (1988 - 2023) data. Rainfall, temperature and relative humidity data were sourced from Nigeria Meteorological Agency (NiMet) whereas tomato production statistics were from Food and Agriculture Organization Statistical Database (FAOSTAT). Analytical methods employed are multiple regression, Johansen cointegration tests, and an error correction model (ECM), thus having robust conclusions regarding both short- and long-run relationships (Aberji *et al.,* 2025).

The cointegration test (Table 1) confirmed that there exist two cointegrating relationships among rainfall, temperature, relative humidity, and tomato production. This finding highlights the interconnected and dynamic nature of these climatic variables and their collective long-run contribution to farm productivity. It also highlights the imperative need for adaptive measures centered not just on separate climatic variables but on their interaction effects.

### *Regression analysis*

Regression analysis (Table 2) indicated that rainfall significantly and positively influenced tomato production in Nigeria ($\beta = 1241.5$, $p < 0.01$). This finding concurs with existing studies like Karienye *et al.,* (2018), which indicated that sufficient rainfall enhances tomato yields through enhanced availability of soil moisture, essential for vegetative growth, flowering, and fruiting. In Nigeria's context, moderate and well-distributed rainfall helps in generating conducive growth conditions, reducing irrigation needs and facilitating healthy plant development. Nevertheless, too much rainfall, especially when tomato plants are at the reproduction stage, can lead to adverse effects such as increased incidence of diseases, blossom-end rot, and waterlogging stress, as noted by Oladitan and Akinseye (2014).

The relative humidity had a statistically significant and negative effect (Table 2) on tomato yield ($\beta = -182941.3$, $p < 0.05$). High humidity promotes favourable microenvironments for fungal pathogens such as *Phytophthora infestans,* the causative agent of

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**Table 1:** Johansen cointegration test results

| Hypothesized no. of CE(s) | Eigenvalue | Trace statistic | Critical value (5%) | Probability |
|---|---|---|---|---|
| None * | 0.507 | 49.4 | 47.9 | 0.006 |
| At most 1 * | 0.394 | 25.3 | 29.8 | 0.046 |
| At most 2 | 0.189 | 8.32 | 15.5 | 0.432 |
| At most 3 | 0.034 | 1.18 | 3.8 | 0.278 |

*Trace test indicates 2 cointegrating equations at the 5% level.

**Table 2:** Regression analysis results for tomato production in Nigeria (1988–2023)

| Variable | Coefficient | Standard Error | t-Statistic | Probability |
|---|---|---|---|---|
| Rainfall (mm) | 1241.5*** | 190.9 | 6.50 | 0.000 |
| Temperature (°C) | -169524.0 | 334041.2 | -0.507 | 0.616 |
| Relative humidity (%) | -182941.3** | 71870.7 | -2.55 | 0.021 |
| ECM | -0.504*** | 0.109 | -4.62 | 0.000 |

$R^2$ = 0.580; Adjusted $R^2$ = 0.524; F-statistic = 10.3; DW stat. = 1.91
Where *** is significant at 1%

late blight, and bacterial wilt. Shravika *et al.,* (2021) showed that morning relative humidity significantly reduces tomato fruit set and increases disease incidence, thereby affecting yield quality and quantity. Temperature, however, showed a negligible effect on the yields of tomatoes throughout the period of study (β = -169524.0, p = 0.616). While certain research (Onyeneke *et al.,* 2023) points to high temperatures as negative for tomato cultivation through elevated evapotranspiration and moisture stress, the outcome of this research indicates that temperature fluctuations in the past in Nigeria have been within a level that does not negatively affect tomato development.

The ECM results (Table 2) confirmed a strong and significant adjustment towards the long-run equilibrium (β = -0.504, $p < 0.01$). This indicates that around 50.4% of the climatic shocks-induced departures from the long-run tomato production equilibrium are corrected every year. The significant value of $R^2$ value of 0.580 and the adjusted $R^2$ value of 0.524 show that over half the variations in the production of tomatoes during the time period were explained by the climatic variables being considered. The global model importance is also defined by the presence of an F-statistic of 10.3 and also that the Durbin-Watson statistic is close to 2.0 (DW = 1.91), thus confirming the validity of no autocorrelation and homoskedasticity of the residuals, thus verifying the validity of the findings. The complete regression coefficients appear in

Based on the findings of this study, Nigerian farmers should therefore be encouraged to adopt climate-smart practices like the use of shade nets, heat-tolerant tomato variety and real-time weather-based irrigation scheduling, step by step. Practices such as greenhouse production with humidity-regulated environments, use of resistant varieties, adoption of mulching to control the rate of soil moisture evaporation, and early use of bio-fungicides or chemical treatment can greatly minimize the risks of humidity. While temperature impact appeared statistically insignificant in this study, it would be premature to rule out its future impacts, particularly under more severe global warming conditions. Policy interventions should be key in stimulating resilience among the tomato crop to climatic conditions. Extension programs would be required to target educating farmers about optimal planting time with regard to favorable climatic windows such that the risk of exposure to surplus rain and long duration of high humidity would be eliminated. If there is development of infrastructures, particularly irrigations, drainage and climate informants, farmers would make adequate decisions since they would be able to adjust at appropriate time. Furthermore, more effort should be made in research centers to develop and spread disease, heat stress, and drought-tolerant varieties of tomatoes. Local indigenous knowledge systems would be synthesized with scientific innovations for further augmenting adaptation strategies.

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***Data Availability:*** Climatic data: https://nimet.gov.ng/datarequest; Tomatoes output: https://www.fao.org/faostat/en/#data/QCL]

***Authors contribution:*** **V.A. Chuks-Okonta:** Conceptualization and typesetting; **J.O. Abojei:** Data procurement, data analysis and funding; **F.N. Odum**: Proof reading and funding

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