KADUNA JOURNAL OF GEOGRAPHY
2026, VOL. 8, No. 1, 231-236
https://doi.org/10.47514/kjg.2026.08.01.024

Research Article

Potential Effects of Minimum Temperature Trend on Local Crop Production in Ijebu-Ode, Southwest Nigeria

Adebowale Onaopemipo Adeuja [a], Temitope Olusegun Aiyewunmi [b], Oluwabunmi Christianah Baloye [a]

[a] Department of Economics, School of Arts and Social Sciences, Sikiru Adetona College of Education, Science and Technology, Omu-Ajose, Ogun State, Nigeria. [b] Department of Geography, School of Arts and Social Sciences, Sikiru Adetona College of Education Science and Technology, Omu-Ajose, Ogun State, Nigeria.

ABSTRACT

Climate change presents a severe threat to agricultural productivity and rural stability in Nigeria, where the economy is heavily agrarian. This study specifically investigates minimum temperature trends in Ijebu-Ode from 1989 to 2018 to evaluate local environmental shifts, potential impacts on crop production, and the need for adaptation strategies. The study used data collected from the Nigerian Meteorological Agency Ijebu-Ode station and applied Innovation Trend Analysis (ITA) and the Anomaly approach to identify trends in annual minimum temperature and to detect anomalies, both of which are crucial for analysing hydrometeorological data. The results revealed a statistically significant, monotonic increase in minimum temperatures (warming trend) over 30 years, implying a consistent upward and uninterrupted trend where the majority of data points lie above the 1:1(450) diagonal line. Minimum temperatures have risen steadily since 1989, reaching their highest levels between 2004 and 2018, indicating a long-term structural shift in local climate. Heatwaves (positive anomalies) were identified from February to May and in November, while colder spells (negative anomalies) occurred during December-January and June-October (monthly anomaly). This pattern points to a substantial and sustained increase in minimum temperatures, which could be indicative of ongoing climate change impacts in Ijebu-Ode. The observed warming, especially during the dry season, poses a potential direct risk to crop yields. These temperature shifts will continue to disrupt traditional growing seasons and subject crops to chronic heat and moisture stress. To mitigate these effects, this underscores an urgent need for policymakers to design and implement planned adaptation strategies to reduce potential risk. Such measures are critical to enhancing the adaptive capacity and resilience of local inhabitants while safeguarding local crop production.

ARTICLE HISTORY
Submitted 29 February 2026
Accepted 29 April 2026
Published 11 May 2026

GUEST EDITOR
A. M. Ahmed

KEYWORDS
Innovative Trend Analysis; Climate Change Adaptation; Heat Stress; Agricultural Resilience; Ijebu-Ode

1 Introduction

Climate change poses a complex, multifaceted challenge to agricultural productivity and rural economies, particularly in developing nations like Nigeria. As one of Africa's largest agriculture-dependent economies, Nigeria's agricultural sector is notably susceptible to climatic variations, which significantly impact food security, livelihoods, and overall economic stability (Adetunji et al., 2021). According to Ojo et al. (2024), climate change significantly affects agricultural productivity through alterations in temperature, precipitation patterns, and the prevalence of extreme weather events. Climate change is a global phenomenon caused by the emission of greenhouse gases, primarily carbon dioxide, into the atmosphere (Abado, 2022). These dangerous gaseous emissions increase Earth's temperatures, resulting in changes in weather patterns, sea levels, and the availability of natural resources such as water, forests, and food (Abado, 2022). According to WMO (2020), since the 1980s, each decade has been warmer than the previous one; this trend is expected to continue due to record levels of heat-trapping greenhouse gases in the atmosphere.

The World Meteorological Organization's consolidated analysis of leading international datasets reveals that average temperatures for the five-year (2015-2019) and ten-year (2010-2019) periods were the highest on record, with 2019 the second warmest year on record after 2016 (WMO, 2020).

Minimum temperature refers to the lowest temperature recorded over a specific period, typically within 24 hours, and is crucial for understanding weather patterns. Minimum temperature change is one extreme of climate change that provides a clear understanding of its issues (Adakayi & Ishaya, 2016). An increase in temperature is not only a local phenomenon but also part of a broader global warming trend (Shiru et al., 2020). Temperature changes are notable manifestations of climate change (Kwawuvi et al., 2023). The average temperature of our planet might rise by 1.1 to 5.4^{0}C (2-9.7 F) by the end of the 21st century, according to simulations from numerous climate models (IPCC, 2022). The rate at which the minimum temperature is warming is projected to persist until 2065 (Gemechu et al., 2023). The IPCC (2022) further suggests that this warming is expected to speed up in the next 50 years, potentially resulting in a temperature increase of 1.5-3 °C due to rapid land use change.

Corresponding Author: Adeuja, A. O. adeujaadebowale@gmail.com Sikiru Adetona College of Education, Science and Technology, Omu-Ajose, Nigeria

Climatic variability across spatial and temporal dimensions is usually of long-term observational data of specific climatic elements collected over an average period of not less than thirty years (Asfaw et al., 2018; Rhamstorf et al., 2017). Trends in climate provide a general sense of noticeable changes in historical climatic data and raise concerns about extreme weather events (Verere et al., 2023).

The consequences of these higher temperatures are severe: heat stress on crops reduces agricultural productivity, while increased evaporation rates exacerbate water shortages (Verere et al., 2023). According to Long (1991), warmer temperatures could modify the rates of photosynthesis and respiration, thus affecting crop growth rates. An increase in temperature can cause heat waves, heat-related sicknesses, and even death in affected areas (Verere et al., 2023). Nigeria is grappling with rising temperatures, erratic rainfall patterns, and extreme weather events, underscoring the critical need for effective climate adaptation strategies (Nwafor et al., 2022). Climate adaptation refers to the processes and strategies employed to mitigate the adverse effects of climate change, thereby facilitating resilience and sustainability in vulnerable sectors, particularly agriculture (Adger et al., 2021). Adaptation is crucial for safeguarding food security and enhancing the livelihoods of rural communities, particularly in developing countries like Nigeria. The significance of climate adaptation in Nigeria is underscored by its reliance on agriculture, which employs a large portion of the population and is directly affected by climate change, necessitating effective adaptation strategies to maintain productivity and economic stability (Nwafor et al., 2022). The successful implementation of these strategies not only has the potential to mitigate adverse effects but can also foster resilience and promote sustainable development within agricultural and rural communities (Ogundipe et al., 2023).

While traditional trend tests (like Mann-Kendall) are commonly used, there are limited recent Innovative Trend Analysis (ITA) applications to specifically investigate trends in minimum temperature at the local levels; hence, this advantage is explored in this study. The results of this study are expected to enhance the understanding of climate change in the study area and also provide a resource for planned climate change adaptation strategies.

2 Materials and Methods

2.1 Study Area

This study was conducted in the ancient city of Ijebu-Ode, situated in Ogun State, Nigeria (Figure 1). Ijebu-Ode is one of the 20 Local Government Areas (LGA) that make up Ogun State, with a total area covered of 190.543km (Olayiwola & Salau, 2022) and a population of 233,310 at the 2006 census (National Population Commission, NPC). Ijebu-Ode is located at latitude 6° 28′ N and 6° 44′ N of the equator and longitude 3 ° 10 ′ E and 3 ° 55′ E of the Greenwich Meridian (Olayiwola & Salau, 2022) in Southwest Nigeria, at an elevation of 74 meters above sea level (Figure 1). The city is the third-largest urban centre in Ogun State in terms of infrastructural facilities, and its importance as an administrative headquarters and commercial centre predates the colonial period.

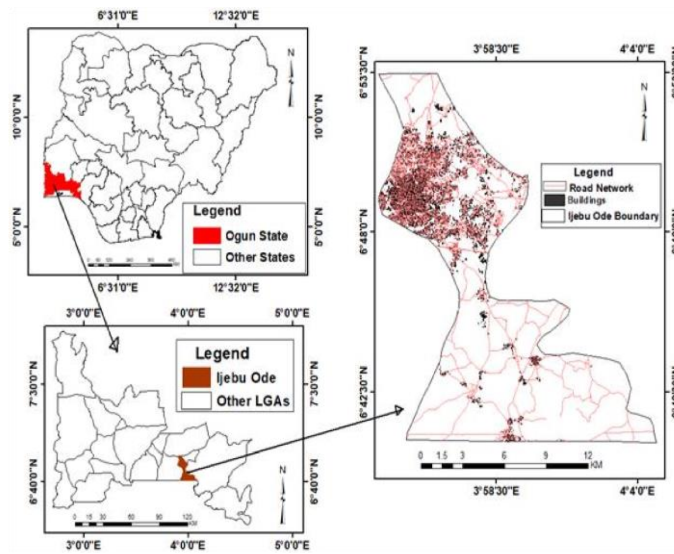

Figure 1: Location of Ijebu-Ode in Ogun State, Southwest Nigeria (Olayiwola & Salau, 2022)

The climate of Ijebu-Ode, SW Nigeria, like other parts of Nigeria, is characterised by distinct wet and dry seasons, enabling the occurrence of lowland tropical rain forest. The region is, on an annual basis, influenced by a hot-wet tropical maritime air mass during the rainy season (April-October) and a hot-dry tropical continental air mass during the dry season (November-March) (Aiyewunmi, 2023). Ijebu-Ode has a humid tropical climate. Annual rainfall is generally intense, with peaks in July and September (double maxima), coupled with high temperatures and relative humidity (Adejuwon & Agundiminegha, 2019). The annual rainfall is between 1575mm and 2340mm, and the average annual temperature is 27.5°C (Oluwatobi & Oluwakemi, 2016; Fayemi, 2020; Onanuga et al., 2022).

2.2 Data Sources

The study used the mean monthly and annual air temperature. The Nigerian Meteorological Station (Ijebu-Ode) provided meteorological data for the last 30 years (1989-2018), which was used to determine the mean monthly and annual minimum air temperature.

2.3 Method of data analysis

The innovative trend analysis (ITA) method is also used in this work to identify trends in annual minimum air temperatures. Sen (2012) introduced the ITA methodology, which does not rely on restrictive assumptions commonly used in the Mann-Kendall trend test and Spearman's rho test. The main advantage of ITA over the MK test and other approaches is that it does not require any assumptions (serial correlation, non-normality, sample size, etc.) or pre-whitening, and provides more information regarding trends, such as low, medium, and peak values (Caloiero, 2020, Caloiero et al., 2018; Dabanli et al., 2016; Sen, 2012). In contrast to MK and Sen slope, ITA approaches can identify monotonic and non-monotonic trends as well as partially sub-trends (Dabanli et al., 2016).

The idea is based on the observation that scatter points for two identical time series will almost always fall along the line 1:1 (45°). First, two equal sections of the hydrometeorological time series are split off and organised individually in ascending order. To create a scatter plot, the first half (i.e., earlier period) is placed on the X-axis and the second (i.e., later period) on the Y-axis. The diagram is divided into two equal triangular pieces by a straight line at a 1:1 (45°) angle, with the upper (lower) triangular region representing the growing (decreasing) trend element. There is no significant trend in the hydrometeorological recordings if the scattering locations are on or near the 1:1 (45°) straight line. The pattern and distribution of the data points on the ITA graph illustrate the existence and direction of trends (Ahmad et al., 2025). An increasing trend is presented when the points are positioned above the 1:1 line, but a decreasing trend is present when the data points are located below the 1:1 line.

Anomaly approach (1998-2018): On a graph, a temperature anomaly is the difference between a recorded temperature and a long-term average or baseline (often a 30-year period). A positive anomaly implies temperatures warmer than the baseline, whereas a negative anomaly indicates cooler temperatures. The world has seen many positive anomalies during the last ten years (WMO, 2024), for example, (for global mean temperature, each of the past ten years, 2015–2024, was individually the ten warmest years *on* record), and these measurements are used to monitor and identify patterns in climate change.

3 Results and Discussion

3.1 Descriptive analysis showing assessment of statistical significance of the air minimum temperature trends

An innovation trend analysis (ITA) method is used in this work to identify trends in annual minimum air temperatures (Figure 2). The idea is based on the observation that scatter points for two identical time series will almost always fall along the line 1:1 (45°). There is no significant trend in the hydrometeorological recordings if the scattering locations are on or near the 1:1 (45°) straight line. Otherwise, it is feasible to confirm a rising (decreasing) trend in the time series if the points are above (below) the 1:1 straight line (45°) (Dabanli et al., 2016; Sen, 2012, 2014). The result of Figure 2 showed an increase in minimum temperatures over the study period. The lowest air temperature shows a "monotonic positive trend" (i.e., an increasing trend) and is statistically significant, as the points lie above the 1:1 straight line (45°) (Figure 2). Overall, the results indicate a significant upward trend in the minimum air temperature over Ijebu-Ode.

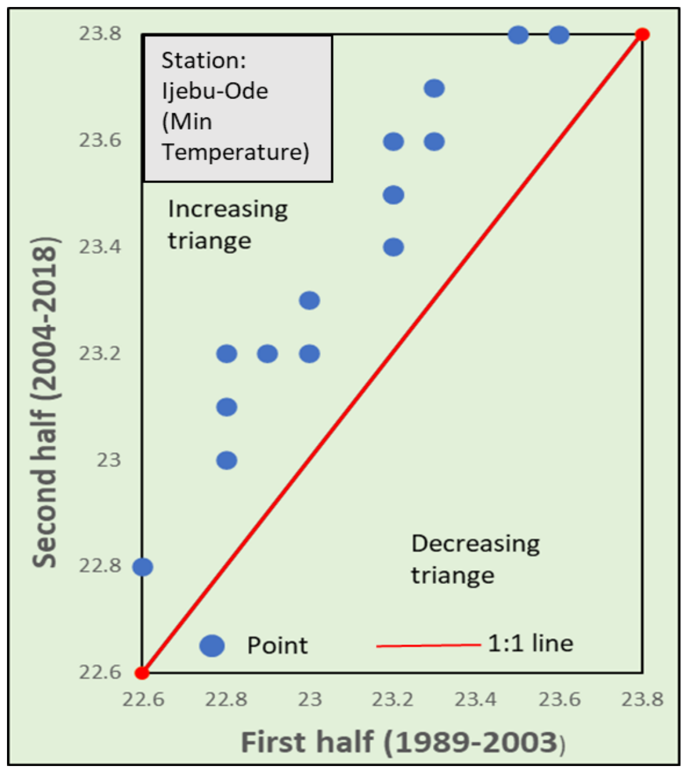

Figure 2: An innovative trend analysis (ITA) of the minimum temperatures in Ijebu-Ode (1989-2018) reveals a significant trend as well as a rising trend.

3.2 Minimum temperature anomaly

The anomaly approach used in Figure 3 demonstrates inter-annual variation between 1989 and 2018. The seasonality, including the highest positive and negative anomalies, respectively above and below the reference normal, indicates extreme variability, high volatility, and a significant departure from the expected long-term stable seasonal pattern, suggesting evidence of local climate change. Positive temperature anomalies observed in February to May and in November indicate warmer-than-average conditions, often associated with and exacerbating heatwaves. According to Adakayi and

Ishaya (2016), when climate fluctuations represent significant departures from normal conditions or become prolonged enough to constitute a new climate state, adjustment problems arise, and the environment, man, and his activities become vulnerable. The anomaly in climate parameters degenerates into climate change, which is one of the greatest environmental, social, and economic threats facing our world today (Chomitz et al., 2006).

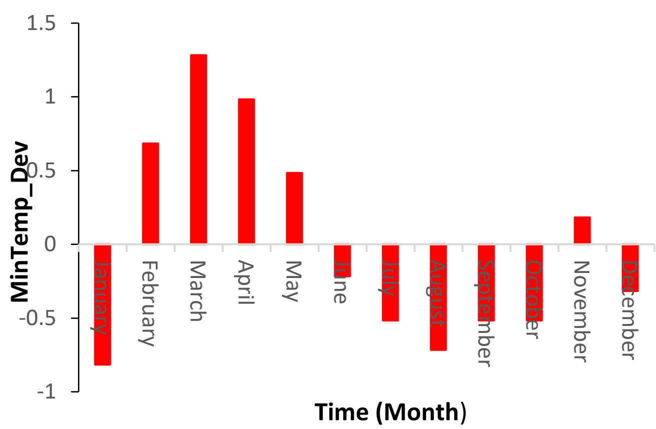

Figure 3: Minimum air temperature anomalies: 1989-2018

4 Discussion

This study examined minimum air temperature trends in Ijebu-Ode from 1989 to 2018 and found a statistically significant monotonic increase. The "monotonic positive trend" suggests that minimum temperatures in Ijebu-Ode have been continuously rising over time. The data suggest a persistent, structural change in the local climate rather than random or unpredictable weather events. Findings of this study are corroborated by recent research in Türkiye that utilized ITA and demonstrate a clear monotonic increase in annual minimum temperatures, with an average rise of 0.027^{0}C/year (Omer et al., 2025). Türkiye is consistent with the global warming effects confirmed by the IPCC AR6. According to Omer et al. (2025), the observed warming rate of 0.02 °C/year for mean annual temperature aligns with the enhanced warming signal identified for the Mediterranean region (IPCC, 2021). Another important finding in our study is that the minimum temperature is increasing faster than the maximum temperature (Omer et al., 2025). This indicates an increasing risk to crop yields due to increased moisture loss from soil and plants. Furthermore, the rapid warming of minimum temperature has significant implications for agriculture and water resources, potentially leading to increased evapotranspiration and moisture stress (Asseng et al., 2011).

Evidence of local climate change is suggested by the seasonality, which includes the biggest positive and negative anomalies above and below the reference normal, respectively. These anomalies show severe unpredictability, high volatility, and a major divergence from the long-term, stable seasonal pattern. High temperatures are a critical environmental factor that impacts crop growth and yield by influencing various mechanisms (Chaudhary et al., 2025). This issue is alarming because it directly affects yield at a time when there is a pressing need to increase agricultural output to alleviate global hunger and ensure food security (Chaudhary et al., 2025). Warmer-than-normal temperatures, which are frequently linked to and exacerbate heatwaves, are indicated by positive temperature anomalies observed in Ijebu-Ode from February through May and in November.

According to Chaudhary et al. (2025), extremely high temperatures have a significant impact on vital physiological functions like leaf chlorophyll concentration and carbon uptake. Higher growing season temperatures have been linked to global yield losses in important crops, including wheat and maize (Lobel & Gourdji, 2012). Due to rising atmospheric C02 from anthropogenic emissions driving climate change, global land surface temperature is rising (Chaudhary et al., 2025). This presents a problem for supplying the need for food and fuel under more demanding crop-growing conditions. Asfaw et al. (2018) noted that rising temperatures are among the manifestations of global climate change. Climate change and global warming have emerged as pressing environmental issues that significantly impact human health (Akinnubi et al., 2024). According to Akinnubi et al. (2024), the effects of surface temperature on health are the subject of growing global research. The result of the Lancet Countdown on Health and Climate Change 2020 report demonstrates that global ambient temperatures are rising along with the frequency and intensity of heatwaves, which are harming human health and labour productivity globally (Watts et al., 2020). Adelekan et al. (2017) found that high temperatures were associated with an increase in the incidence of malaria, a disease that is already prevalent in West Africa.

The comprehensive data analysis of Nigeria, Mali, and Niger from 1985 to 2015 provides critical insights into the interplay between climate variables and malaria transmission indices (Akinnubi et al., 2024). Across most land areas, projections indicate an increase in the magnitude and frequency of hot days in the late 21st century (IPCC, 2013), and that negative heat effects are alarming as global warming is expected to raise mean global temperatures (IPCC, 2013).

4.1 Potential implications of study findings

According to Ijebu-Ode's study, a long-term structural change in the local climate indicates that the environment is not just going through a short-lived "hot spell" but is heading toward a permanent new baseline. Predictable but inevitable pressures arise from a structural shift: a continuous temperature rise may lead to increased evaporation and altered precipitation patterns, directly affecting the availability and quality of water for Ijebu-Ode residents; and consistently higher minimum temperatures will cause chronic heat stress for crops, which may eventually reduce yields. A structural change implies that the environment is no longer cooling down as efficiently as it once did and that persistent warmth prevents people and crops from recovering from daytime heat, leading to an increase in heat-related illnesses (Heat Stress). These anomalies showed that the signal of climate change is stronger and rising annually.

5 Conclusion

The findings of this study indicate that monitoring significant changes in temperature series over time is crucial. This study provides a great insight into minimum temperature trends over a period of 30 years from 1989 to 2018. The results showed a monotonic positive trend signalling increasing warming in the study area**.** The findings emphasize the need for climate change adaptation measures to address potential consequences, including heat stress and public health hazards. Because the warming trend is "statistically significant and increasing," residents and local farmers cannot rely on short-term solutions. This study advocates for deliberate climate change adaptation methods that target the specific structural vulnerabilities revealed in the research. Since rising minimum temperatures may lead to heat-related illnesses and night-time heat stress for crops, the study suggests:

i. Climate-Smart Agriculture: Use heat-tolerant and early-maturing crop cultivars to resist higher "floor" temperatures.
ii. Adjusted planting calendars to avoid high heat times, which are becoming increasingly frequent.
iii. Improved Irrigation: Using water-harvesting technologies to counteract rising evaporation rates due to climate change.
iv. Promoting tree planting and "green spaces" in Ijebu-Ode to offer natural cooling and lessen the "urban heat island" effect.
v. Retrofitting existing buildings with reflective roofing and ventilation can improve internal thermal comfort and reduce the need for costly air conditioning.
vi. Educating residents about staying hydrated and recognizing early indications of heat stress through mass media and local extension organizations.
vii. Using techniques like "Innovation Trend Analysis" to inform local urban and agricultural policy.
viii. Strengthening local institutions, such as agricultural extension offices, to deliver timely climate information and loans for adaptation technologies.

References

Adetunji, A. O., Adebayo, E. F., & Adeyemi, R. A. (2021). The effects of climate change on agriculture in Nigeria: Past, present, and future. Journal of Climate Change Economics, 12(4), 1–16.

Abado, A. L. (2022). Investigating the effect of climate change and water scarcity on the conflict between Herders and farmers in Nigeria: A case study of Benue State, Nigeria. International Journal of Social Science And Human Research, 5, 12. https://doi.org/10.47191/ijsshr/v5-i12-38

Adakayi, P. E., & Ishaya, S. (2016). Assessment of annual minimum temperature in some parts of northern Nigeria. Ethiopian Journal of Environmental Studies and Management, 9(2), 220. https://doi.org/10.4314/ejesm.v9i2.9

Adejuwon, J. O., & Agundiminegha, Y. G. (2019). Impact of climate variability on cassava yield in the humid forest agro-ecological zone of Nigeria. Journal of Applied Sciences and Environmental Management, 23(5), 903–908. https://doi.org/10.4314/jasem.v23i5.21

Adelekan, I. O., Ologunorisa, T. E., Oluseyi, T. O. (2017). Impacts of climate variability on malaria transmission in Nigeria. Geographia Technica, 12(1), 1-3

Adger, W. N., Barnett, J., Benjaminsen, T. A., Brown, K., & Svarstad, H. (2021). Agricultural adaptation to climate change: A matter of equity. Environmental Science & Policy, 41, 172–183.

Ahmad, A. A., Sadik, A., Eyǜp, S (2025). A new framework for innovative trend analysis: integrating extreme precipitation indices, standardization, enhanced visualization, and novel classification approaches (ITA-NF). Vol 121, pages 13543-13575

Aiyewunmi, T. (2023). Challenges and potential solutions to pluvial flood risk in urban tropical African communities: a case study of Ijebu-Ode, South West Nigeria. Doctor of Philosophy thesis, University of Liverpool.

Akinnubi, R. T., Adegbo, K. J., Ojo, M. O., Ajakaiye, M. P., Sabejeje, A. J., Aramide, J. O., & Akinnubi, T. D. (2024). The Analysis and the Impact of Surface Temperature Anomalies on the Health of Residents in the River Niger Basin Development Authority Area, West Africa. GeoHealth, 8(12), e2024GH001069. https://doi.org/10.1029/2024GH001069

Asfaw, A., Simane, B., Hassen, A., & Bantider, A. (2018). Variability and time series analysis of rainfall and temperature in northcentral Ethiopia: A case study in Woleka sub-basin. Weather and Climate Extreme Vol. 19; 29–

41.

Asseng, S., Foster, I., Turner, N.C: The impact of temperature variability on wheat yields. Glob. Chang. Biol, 1, 997-1012

Caloiero, T., Caloiero, P., Frustaci, F (2018). Drought analysis in Europe and in the Mediterranean basin using the standardized precipitation index. Water 10 (8): 1043.

Caloiero, T. (2020). Evaluation of rainfall trends in the South Island of New Zealand through the innovative trend analysis of rainfall anomalies in Southern Italy. Water Resource Management 32 (15), 4971-4983. https://doi.org/10.100/s11269-018-2117-z.

Chaudhary, K. B., Trivedi, A. P., Macwan, S. J., Barvaliya, P. P. (2025). Effect of temperature rise on crop growth and productivity. International Journal of Environment and Climate Change Vol 15(1), pp. 167-177

Chomitz, K.M. Buys, P DeLuca, G., Thomas, T. S Wertz-Kanounnikoff, S (2006). "At Loggerheads? Agricultural expansion, poverty reduction, and the environment in the tropics". (The World Bank, Washington 2006), Book p. 308.

Dabanlı, İ., Şen, Z., Yeleğen, M. Ö., Şişman, E., Selek, B., & Güçlü, Y. S. (2016). Trend assessment by the innovative-Şen method. Water resources management, 30(5), 5193-5203. https://doi.org/10.1007/s11269-016-1478-4

Fayemi, J. A. (2020). Effects of Climate Change and Global Warming on Sustainable Development and Socio-Economic Life of Ijebu-Ode Indigenes of Nigeria. Journal of sustainable Development in Africa, 22(1), 95-103

Gemechu, F. A., Ebenezer, O.S., Dzigbodi, A.D (2023). Temperature and precipitation trend analysis using the CMIP6 model in the Upper East region of Ghana Vol 36 (1). https://doi.org/10.1080/27660645.2023.2290966

IPCC. (2013): Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge, United Kingdom and New York, NY, USA.

Intergovernmental Panel on Climate Change (2021). The Physical Science Basis; Cambridge University Press: Cambridge, UK, 2023; ISBN 981009157896

IPCC. (2022). Climate change 2022: Impacts. Adaptation and Vulnerability.

IPCC. (2023). Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, pp. 35-115

Kwawuvi, D., Mama, D., Agodzo, S. K., Bessah, E., Issoufou, Y. G., Wisdom, A. S. (2023). Potential catastrophic consequences for rising temperature trends in the Oti River basin, West Africa. Frontiers in Climate, 5, 1184050. https://doi.org/10.3389/fclim.2023.1184050

Lobell, D. B., & Gourdji, S. M. (2012). The influence of climate change on global crop productivity. Plant Physiology, 160(4), 1686-1697.

Long, S. P. (1991). Modification of the response of photosynthetic productivity to rising temperature by atmospheric CO2 concentrations: Has its importance been underestimated? Plant Cell Environ., 148): 729–739.

Nwafor, M., Asogwa, B. C., & Ogundipe, O. (2022). The role of irrigation in adapting to climate variability in Nigeria: A case study. Climate and Development, 14(1), 56–67.

Ogundipe, A. A., Abidemi, T. O., & Ihemba, E. A. (2023). Assessing the economic impact of climate adaptation practices on rural livelihoods in Nigeria. International Journal of Climate Change Strategies and Management, 15(2), 158-175.

Ogundipe, O. A., Ojo, J. A., & Olatunji, A. O. (2023). Enhancing agricultural productivity through climate adaptation: The case of Nigeria. Agricultural Systems, 188, 102-115.

Olayiwola, A. & Salau, W. (2022). Evaluation of Land Cover Dynamics and Landscape Fragmentation in Ijebu-Ode, Nigeria. Published Online: https://doi.org/10:38094/jgier30249 Vol 3 (2).

Oluwatobi, A. & Oluwakemi, O. (2016). Analysis of Trend and Variability of Atmospheric Temperature in Ijebu-Ode. Southwest Nigeria, 6, 25-31.

Omer, L. A., Harun, A., Ibrahim, T., Pegah, K (2025). Examination of long-term temperature change in Türkiye: Comparative evaluation of an advanced quartile-based approach and traditional trend detection methods, Atmosphere, 16(11), 1225; https://doi.org/10.3390/atmos16111225

Onanuga, M. Y., Eludoyin, A.O., & Ofoezie, I. E. (2022). Urbanization and its effects on land and water resources in Ijebuland, southwestern Nigeria. Environment, Development and Sustainability, 24(1), 592-616.

Ojo, J. A., Adebayo, O. J., & Ismail, M. O. (2024). Climate change impacts on crop yields in Nigeria: A meta-analysis. Food Security, 16(2), 287–304.

Sen, Z. (2014). Trend identification simulation and application. Journal of Hydrologic Engineering, 19(3), 635-642.

Sen, Z. (2012). Innovative trend analysis methodology. J Hydrol Eng 17 (9): 1042–1046.

Shiru, M. S., Shahid, S., Dewan, A., Chung, E.S., Alias, N., Ahmed, K., Hassan, Q.K. (2020). Projection of meteorological droughts in Nigeria during growing seasons under climate change scenarios. Sci. Rep, 10, 10107.

Verere, S. D., Emmanuel, K., Beauty, E. (2023). Spatiotemporal Trends and Variability Analysis of Rainfall and Temperature Over Benin Metropolitan Region, Edo State, Nigeria, Geography Environment Sustainability 16(1):6-15

Watts, N., Amann, M., Arnell, N., Ayeb-Karlsson, S., Belesova, K., Berry, H. (2020). The 2020 report of the Lancet Countdown, on health and climate change: Responding to converging crises. Lancet, 396(10254), 1295-1314. https@//doi.org/10.1016/s0140-6736(20)32290-x

WMO. (2020). WMO confirms 2019 as second hottest year on record. Available Online: public.wmo.int/en/media/press-release/wmo-confirms-2019-second-hottest-year-record.

WMO. (2024). State of the Global Climate. Available Online: wmo.int/sites/default/files/2025-03/WMO-1368-2024_en.pdf