OPEN ACCESS

Chrysanthus Chukwuma Sr
Greenfort International Journal of Applied Medical Science
Abbreviated Key Title: Grn Int J Apl Med Sci | ISSN 3048-6904(P) | ISSN 2584-2420(O) |
Greenfort International Publisher, Assam, India
Journal homepage: https://gipublisher.com/journals/gijams

Research Article DOI: 10.62046/gijams.2025.v03i03.006

Reflections and Perspectives on the Determinants for Risk Reduction in Biodiversity, Environment and Health Vulnerabilities Due To Climate Change and Extreme Hydrological Events: An Ecological Framework"

Dr Chrysanthus Chukwuma Sr[1*]

[1]Executive Director, The Chrysanthus Centre for Future-oriented Studies CTR Future-oriented Ltd, Abakaliki, Ebonyi State, Nigeria **ORCID:** 0000-0001-9162-6604

***Corresponding Author:** Dr Chrysanthus Chukwuma Sr | **Received:** 18.04.2025 | **Accepted:** 18.05.2025 | **Published:** 29.05.2025

Abstract: A holistic approach is pertinent for risk reduction to biodiversity, the environment and human health resulting from extreme hydrological events and climate change, land use policy, infrastructure, and community resilience. With reliance on adaptive capacity through training and education, economic stability and inclusive governance, there can be proper resilience to incessant disasters. The reduction of greenhouse gas emissions, and prioritising health spheres and disaster risk management are vital. Extreme weather and climate-associated incidents suppress human health with resultant morbidity, mortality and socioeconomic attendant sequelae. This short communication immensely emphasises human health to explicate and elucidate management of the global scourge associated with the determinants and impact of vulnerabilities to extreme hydrologic events and climate change in the absence of risk reduction and their concomitant sequelae. The most effective approach for risk reduction associated with biodiversity, environmental, and health vulnerabilities due to climate change and extreme hydrological events, an ecological framework must take into cognizance exposure, vulnerability, and resilience. This framework emphasises the significance of understanding the inextricable linkage between ecosystems and human communities are exposed and susceptible to hazards, sensitivity to these hazards, and capacity to cope, adapt and recuperate. Risk reduction incorporates structurally attenuating exposure, strengthening resilience, and sustainably enhancing overall vulnerability management. Extreme weather and climate-associated incidents impinge on human health with consequential morbidity, mortality and socioeconomic challenges and constraints.

Keywords: Frequency Analysis, Adaptation, Global Warming, Diseases. Mortality, Comorbidities, Precipitation.

Citation: Chrysanthus Chukwuma Sr. Reflections and Perspectives on the Determinants for Risk Reduction in Biodiversity, Environment and Health Vulnerabilities Due to Climate Change and Extreme Hydrological Events: An Ecological Framework. Grn Int J Apl Med Sci, 2025 May-Jun 3(3): 134-140.

INTRODUCTION

The determinants of health and climate change depict the latter as having greater impact on the health of the elderly, children, women, artisans and other vulnerable individuals due to heat, stress, injury sustained in extreme weather presentations, exacerbated water and vector-borne infectious diseases [1-4]. Health impacts associated with climate change in extreme events include morbidity, mortality and exacerbated underlying medical stance may be attributed to hydrological extremes detected using disparate observation modalities, investigations and modeling datasets. Assessment of climate change and effects on hydrologic extremes, the attendant risks and implications locally, regionally and globally, exhibit incessant disaster and climate risks which are incessantly emerging from climate change, leading to profound frequency and severity in weather events [5]. These risks negatively impact the spheres of human endeavours in varied aspects of biodiversity, health, well-being, welfare, infrastructure, and ecosystems [6-8], with likely exacerbation of the duration of extreme weather events and population exposure. Adaptation strategies, efforts in disaster risk reduction, and risk-informed data are crucial for managing these future risks [9].

Certain Parameters for Determinants and Risk Reduction

The reductions of exposures to hazards, attenuating vulnerabilities of the populace and property, sustainable management practices of land and the environment, as well as improved forewarned preparatory ventures against adverse events constitute disaster risk reduction.

Climate change and extreme hydrologic events, such as droughts and floods exacerbate vulnerabilities in biodiversity, the environment and health, precipitating a plethora of risk reduction processes [10]. This ecological framework expounds the pattern of extreme hydrological events and climate change in the alterations of ecosystem services and dynamics, influencing species spread, community aggregation, and consequentially the affect on biodiversity, environment and human health as depicted in water scarcity, food security, and disease dissemination. The determinants of risk reduction concerning environmental and health vulnerabilities to extreme hydrological events and climate change are associated with decreasing exposure, augmenting vulnerability, and creating resilience. Instances of these determinants inculcated land use planning, enhanced infrastructure, improved adaptive capacity, and sustainable disaster risk management enforcement. These determinants pave the practice, capacity, capability and concept of the populace, communities, and ecosystems to confront and survive the untoward impacts of climate change. Climate change and the modifying patterns of extreme weather can expunge or suppress the sustainability of public health.

Extant Challenges for Sustainable Land and Water Resources

Prevailing challenges in sustainable land and water management, such as environmental and land degradation [11], water deprivation [12], and climate change provide opportunities for novel sustainable development. The instant challenges to be focused on are the trade-offs of the cost-benefit analysis in the short-run and long-run, respectively, or sustainable approaches and funding acquisition for projects, especially in the private sector. Opportunities correlate with the development of innovative business models, water resource integration and management within land use planning, and community-dependent strategies promotion. Potable water, food and energy security, climate change, water-borne diseases, water-associated hazard management, sustainable environmental quality and land use management are present and future challenges [12, 13]. The ongoing challenge for sustainable land and water management, climate change adaptation and mitigation projects is proper acquisition of Sustainable Land Management (SLM) concerning land degradation rates, and preventative measures against desertification in coordination for greener and more sustainable future, and aggregated efforts to obviate distortions, such as water unavailability, pollution, ecosystem cadastral [14] degradation and anomalous environmental health trajectories [15].

Understanding the associated characterisations with these extreme hydrological events is pertinent for precise risk assessment in the design and operation of water infrastructures. Inappropriate assessment of design floods leads to material and human life disruption. Thus, extreme weather events incessantly augment, and are correlated to global warming. The dissipation of biodiversity incorporates land-use change, suppressed habitat, excessive exploitation, pollution, species invasiveness or inhibition and climate change. These weather events are ostensibly contributory to, and enhance risks for expansive spectra of vector- and non-vector-borne diseases and infestations to fauna and flora with concomitant anomalous complications. As these pivotal determinants are placed on focus, individuals and communities are positioned to ameliorate vulnerabilities to extreme hydrological events and climate change, with resultant improvement of biodiversity, environment and health.

Hydrological Vulnerabilities, Climate Change and Precipitation

The hydrologic vulnerability correlates with the response of the natural and anthropogenic which depict aspects of geographical precincts to the impact of extreme hydrological phenomena. Hydrologic perturbations are extreme events [9], associated with water occurrence, motion, hazards, flooding, droughts and related events, such as landslides, river scour and deposition. These function as a framework for resourceful and safe drinking water and health in endpoint characterization variables concerning water usage on human health [13]. The hydrological cycle has been profoundly affected by climate change. Climate-induced hydrological extremes, such as floods and droughts, have been overwhelming in past decades, with the trajectory and trend prominently unabated into the future. Droughts and floods are both extreme weather events associated with climate change, presenting extensive repercussions for communities, biodiversity, ecosystems, economies and health. Droughts result in water scarcity, with adverse effects on agriculture, energy production, and ecosystem health. The devastating impacts of floods include contamination and pollution of water sources, infrastructure degradation, and displacement of persons. The World Health Organization (WHO) is concerned that flood is a risk factor in cholera transmission of cholera but drought is not explicitly given due cognizance [13-17].

Climate change substantially alters the pattern of precipitation, resulting in both elevated intensity and frequency of extreme precipitation events and modifications in total quantities of precipitation. The augmentation of the atmospheric water holding capacity due to warming leads to exacerbated intense storms and enhancing flooding risk. Concomitantly, warming culminates in elevated evaporation, leading to drier states in certain ambients with drought intensification. The scenario of respective superimposed wetness and dryness are evidenced in the effects of climate change on precipitation [18]. Invariably, alterations in precipitation or climate impact on health. Expansive wildfires tending to extreme temperatures, and

decrement in precipitation can lead to rising ozone and particulate matter, exacerbating in cardiovascular threats or risks. However, certain populations exhibit more vulnerability to climatic health challenges [19].

Crop Growth, Soil Quality, and Agricultural Productivity

Extreme precipitation events may induce aberrant effects on crop growth, soil quality, and agricultural productivity [20, 21]. On the other hand, climate change leads to higher temperatures, accelerated water evaporation, and decreased soil moisture, and subsequently affects the water use efficiency of crops. Dryland rivers and streams contribute significantly in the dynamics of dryland ecosystem food web, with impact on biodiversity and food security. Hydrologic variability that characterises dryland precincts, critically impacts these systems, by regulating both terrestrial and aquatic food webs and the dependent organisms. Climate change constitutes a veritable influence in the availability, quality and diversity of food, and nutritional crises. There are standard strategies to explicate and understand indicators for river health in variable systems [22-24]. Due to the extreme hydrological variability and opportunistic biotic responses to flood pulses, dryland rivers are accommodating to specific food webs. In these systems, primary productivity and heterotrophy are important for food web sustainability [25, 26]. Flows provide rewetting and upstream delivery, accompanied by episodic particulate and dissolved resources, with frequent autochthonous formation, within a short period generating an expansive biomass [27]. The biomass preponderance can result in high quantities of secondary production. It is suggestive that dryland river food webs depict resistant multi-scale backbones [28] which undergird the persistence of the primordial and pivotal ecological functionalities in these systems in drought.

The tolerance of plants to flooding and submergence broadly varies, with certain species depicting high sensitivity, whereas other species exhibit thriving adaptability in flood-prone ambients. The health of the root is important for crop survival and yield during flooding [29]. Pivotal adaptations incorporate structural and functional alterations, such as aerenchyma development, that propagates oxygen transport, and physiological adaptations as aggravated hypoxia tolerance. For instance, rice is a highly tolerant species, whereas a vast majority of crops exhibit elevated sensitivity. In rice, enhanced flooding tolerance requires a combined tolerance of submergence and stagnant flooding. Agricultural ambients are susceptible to flooding and ponding due to the excessive precipitation and hydrologic extremes. Within this milieu, plant breeders profoundly identify and develop genetic technologies to augment crop productivity. Rice maintains a veritable position in breeding as regards crop tolerance [29], to flooding. Numerous rice cultivars merely tolerate flooding for circa a week. However, a class of ethylene-response-factor-like genes is associated in flooding/submergence tolerance [30]. The accumulation of ethylene retards cytokine-mediated senescence and instigates dormancy in submergence. In addition, climate change aggravates the frequency and intensity of these events, culminating in elevated challenges for agricultural systems and production. Extreme weather events caused by the ENSO cycle or El Niño-Southern Oscillation can affect health via associated droughts, floods, heat waves, and distortions in food supply [31]. Thus, extreme weather events associated with the El Niño-Southern Oscillation (ENSO) can remarkably affect public health. ENSO-related droughts, floods,, elevate the risk of exacerbating extant health vulnerabilities. The health risks of climate change emerge from interactions of the dangers associated with a changing climate, for instance, increased frequency and intensity of extreme weather events, the susceptible communities exposed to the hazards, the vulnerability of regions to adverse health impacts on exposure, and the potential to be aware against these events, and cope with the hazard [31].

Climate change may induce disruptive healthcare access, and risk vulnerabilities to physical and mental health well-being and hygiene. The health impacts of the disruptions, such as increased cardiopulmonary disorders, wounds and premature mortality-associated extreme weather events, alterations in demographics of food- and water-borne morbidities and comorbidities, the emergence and reemergence of infectious diseases [32, 33] unravel expansive interventions in public policies and administration [34]. Climate change may disorient cardiovascular health via multiple pathways. Environmental stressor exposure causes physiological alterations, such as accelerated heart rate and altered plasma viscosity in association with extreme heat, local and systemic inflammation exposures from airborne particulate matter inhalation [35, 36]. Environmental temperature constitutes the most intensively researched phenomenon. The association between mortality, cardiovascular disorder incidence, and temperature depicts graphically as the "U" alphabet. The invariable association of cold, heat and heat wave exposures with elevated risk of acute coronary syndromes has been documented [37]. Extreme temperature exposure poses a significant impact on food intake and nutrient composition. Extreme temperatures impact on eating habits through enhancing the tendency to imbibe high-fat diets, although, the total calorie consumption is relatively unperturbed. This shift presents adverse health risks in obesity, diabetes, and cardiovascular diseases [38, 39, 40]. It was observed in both hot and cold weather, persons are induced to consume more fat, especially with more impact on vulnerable groups, such as rural dwellers and the low-educated populace. As cooling fans and heating systems as adaptation resources, tend to ameliorate the effects, broader policy interventions are pertinent. In essence, short-run

exposure to extreme temperatures modifies dietary patterns by augmenting fat consumption, even with total calorie intake is constant. Driven by physiological appetite regulation, this shift augments the risk of high-fat diets and diet-associated disorders, particularly within the vulnerable population. These findings may correlate with short-term dietary modifications, and further research is pertinent to understand longer-run implications [40].

The intensification of the hydrological cycle could result as global warming instantaneously escalates mechanisms associated with the hydrologic cycle with resultant intense droughts, floods and wet periods which impact health, environment, biodiversity and societal sustainability. Warmer temperatures and shifting weather patterns disrupt air quality which precipitate to cardiopulmonary health deficits and asthmatic presentations. Predictable increased severity, quantity and extent of wildfires with the concomitant smoke alongside climate change, including aberrant or health debilitating atmospheric pollutants. Extreme weather events invariably affect human health by causing injuries, dissipation of human lives, diseases, psychiatric disorders and comorbidities. There are geopolitical trends and convergence in health and environment of countries on the scientific parameters of climate change but variance and divergence sustain on which country is the most culpable, the ways and means to predict and track the decrement of the emissions regarding risk reduction, and the rationale for the compensation of vulnerable geopolitical areas.

Considering climate-driven dietary modification is pertinent to safeguard long-run public health in a global accelerating warming ambient. Climate vulnerabilities have ostensibly been principally induced by anthropogenic activities on climate change and global warming, with incessant exclusivity of superimposed threats due to carbon dioxide emissions, population growth and energy sources from stressors accrued from the emergence of global affluence [43, 44], and deplorable health conditions. It is crucial to evaluate all encompassing threats by employing the bottom-up model on sustainable food resources, ecosystems [14], energy, human health [45, 46], through configuring water threats, exploring preventive measures and adaptations [5]. The adaptation to extreme events necessitates a multi-dimensional approach by addressing risk management, health and hydrological issues. This requires investment in infrastructure, implementation of early warning systems, and promotion of community-based adaptation procedures. Health impacts of these events, necessitate cooperation between stakeholders, such as governments and communities, with appropriate healthcare facilities. Essentially, extreme weather events constitute health hazards [5].

DISCUSSION

This article provides current drivers and typologies of extremes in disparate geopolitical arenas with highlights, challenges, constraints, issues and opportunities in inter alia predicting and forecasting spatiotemporal hydrological extremes. Risk reduction pertains to choices or inalienable rights of reducing exposure to hazards, abating vulnerability of people and property, sustainable management of land and the environment, as well as improving awareness and early warning systems against deranging events in disaster risk reduction. Elevated severe storms, droughts, warming and rising oceans, species dissipation, deficient food availability, exacerbated health risks [31], poverty and displacement, and extreme hydrological events, such as floods and droughts, elevate the risk of water disasters, which constitute resultant preponderant challenges and issues for human survival [47]. Frequency analysis is pertinent in the design and modelling of hydrological systems but is frequently statistically restricted by the entire spatiotemporal observation [48]. Universally, climate change pertains to the long-run invariant alterations of temperature trajectories and weather presentations from seasonal averages. Climate change exerts an expansive impact on global technology due to a warmer climate culminating in arduous morbidity and mortality [49], from risks, such as extreme hydrologic events, heat, diarrhoea, malaria, emerging and reemerging infectious diseases as demonstrated on the clinicopathologic and healthcare spectra. Hazard risk management and adaptation strategies need to be conceived on spatiotemporal analysis of inter alia trends and future climate change and extreme hydrologic events in biodiversity, environment and health including projections and predictability of disaster risk reduction.

In essence, preservation and safeguarding of biodiversity, environment, improved development, prevention and eradication of prevalent and endemic diseases and disabilities, including reduction in both severe and moderate malnutrition are essential for human welfare and well-being. The health of vulnerable persons, elderly or aged individuals [50], women and children reflects the general health of the population. Simultaneously, the environmental climate dictates the socio-economic and health status or indices as well as the living conditions of the inhabitants [51]. Numeral factors must be critically acclaimed in the reduction of risks to biodiversity, environment and health from extreme hydrological events and climate change. These factors are associated with convergence in land use planning, adaptation and mitigation modalities, as well as elucidation of social determinants of health, exposure, vulnerability and adaptive capacity within defined or specific populations and cultures [41, 42]. The adverse impacts on human health due to climate change are expansively more appreciated or evidenced in urban precincts, with invariable and deferred pathways. An

integrated systemic strategy to obviate health risks due climate change provides encompassing beneficial results for adaptation in addressing diverse health risks. It is pertinent that each sphere of urban planning takes into cognizance aspects of policy and planning decisions as well as intricate complexity of urban areas [52], or conurbations.Extreme weather and climate-associated incidents infringe human health resulting in morbidity, mortality and socioeconomic problems [49]. Climate change has altered extreme event frequency, intensity, geographic patterns, and propensity as a driver for impending change. These events include hydrological extremes and temperatures and global warming. The inextricably linked pathways to extreme events associated with health outcomes and economic loss are diverse, complex with impact on disease encumbrance.

CONCLUSION

Climate change and extreme event have altered the frequency, intensity, geographic distribution, and propensity as drivers for change in the future. The indicted variables include hydrological events, such as precipitation, floods and droughts as well as heat waves, wildfires, global warming, extreme temperatures, and hurricanes. The pathways inextricably-linked with extreme events to economic dissipation, human health prognosis and outcomes remain inexplicably diverse and complex; and thus, difficult to predict due to their emergence and reemergence from local, societal and environmental factors which influence disease burden.

A holistic approach is pertinent for risk reduction to biodiversity, the environment and human health resulting from extreme hydrological events and climate change, land use policy, infrastructure, and community resilience. With reliance on adaptive capacity through training and education, economic stability and inclusive governance, there can be proper resilience to incessant disasters. The reduction of greenhouse gas emissions, and prioritising health spheres and disaster risk management are vital. Extreme weather and climate-associated incidents suppress human health with resultant morbidity, mortality and socioeconomic attendant sequelae.

REFERENCES

1. Haines, A., and Ebi K., The imperative for climate action to protect health. N Engl J Med. 2019;380(3):263-273. doi:10.1056/NEJMra1807873.
2. Josey, KP., Delaney SW, Wu X, Nethery RC, DeSouza P, Braun D, and Dominici F., Air pollution and mortality at the intersection of race and social class. N Engl J Med. 2023;388(15):1396-1404.
3. Goldman, A., and Sommers BD., Climate-Informed Patient Care as a Social Determinant of Health. Goldman A, Sommers BD. JAMA Health Forum. 2024; 5(1):e240095. doi:10.1001/jamahealthforum.2024.0095.
4. Chukwuma Sr. C., Invariance of Extreme Hydrologic Events and Climate Change in the Risk Reduction on Environment and Health. Greenfort International Journal of Applied Medical Science. 2025. DOI: 10.62046/gijams.2025.v03i02.011.
5. Chukwuma Sr. C., Exploring the repositioning of health, extreme Hydrologic events, and global change. International Journal of Medical Research and Medical Case Reports, 2024 1(2).
6. Yenew, C., Bayeh, G.M., Gebeyehu, A.A. et al. Scoping review on assessing climate-sensitive health risks. BMC Public Health. 2025; 25,: 914. https://doi.org/10.1186/s12889-025-22148-x.
7. Abbas, H.W. and Guo X., Climate-Related Vulnerability Assessment Toward Disaster Risk Reduction: Insight from Pakistan. Journal of Homeland Security and Emergency Management. 2023; 20(3), DOI: 10.1515/jhsem-2021-0046.
8. Kassaye, S.M., Tadesse T., Tegegne G. et al., Quantifying the climate change impacts on the magnitude and timing of hydrological extremes in the Baro River Basin, Ethiopia. Environ Syst Res, Vol. 13, No. 2, 2024. https://doi.org/10.1186/s40068-023-00328-1.
9. Katz R.W., Hydrological Extremes. In book: Wiley. Richard W. Katz. 2014. Wiley StatsRef: Statistics Reference Online. Richard W. Katz. DOI: 10.1002/9781118445112.stat07712.
10. Bolan, S., Padhye LP, Jasemizad T, Govarthanan M, Karmegam N, Wijesekara H, Amarasiri D, Hou D, Zhou P et al. Impacts of climate change on the fate of contaminants through extreme weather events, Science of The Total Environment. Volume 909, 2024, https://doi.org/10.1016/j.scitotenv.2023.168388.
11. Chukwuma Sr. C., Environmental impact assessment, land degradation and remediation in Nigeria: current problems and implications for future global change in agricultural and mining areas. International Journal of Sustainable Development & World Ecology, Vol. 18, No. 1, pp. 36-42, 2011. https://doi.org/10.1080/13504509.2011.543837.
12. Chukwuma Sr. C., Development and implementation of environmental monitoring and information systems for water resources. Env Manage & Hlth, Vol. 9, No. 4, pp. 153-9, 1998. DOI: 10.1108/09566169810228908.
13. Chukwuma Sr. C., Environmental and social consequences of metals and mines on water. Int J Env Studies, Vol. 54, No. 1A, pp 73-81, 1998. https://doi.org/10.1080/00207239808711140.
14. Chukwuma Sr. C., Ecosystem cadastre of plant-soil interactions with nonferrous metals. IJCRCPS, Vol. 8, No. 6, pp. -26, 2021. http://dx.doi.org/10.22192/ijcrcps.2021.08.06.003.
15. Nguma R.K. and Kiluva V.M., Management of extreme hydrological events, Editor(s): Victor

Ongoma, Hossein Tabari, Climate Impacts on Extreme Weather, Elsevier, Chapter 16, pp. 271-286, 2022. ISBN 9780323884563, https://doi.org/10.1016/B978-0-323-88456-3.00009-5.
16. Chukwuma Sr. C., The impacts of mining operations in Nigeria with particular reference to the Enyigba-Abakaliki area. Int J Env Edu & Inf, Vol. 12, No. 4, pp. 321-36. 1993.
17. Chukwuma Sr. C., The Impacts of Non-Ferrous Metal Mining Operations: Pollution, Sustainable and Geopolitical Dimensions. Journal of Geotechnical Studies, Vol. 9, No.1, pp. 31-41, 2024.
18. Xiong, J., Guo S, Abhishek, Chen J, Yin J. Global evaluation of the "dry gets drier, and wet gets wetter" paradigm from a terrestrial water storage change perspective. Hydrology and Earth System Sciences. 2022; 26(24):6457-6476. DOI: 10.5194/hess-26-6457-2022.
19. Taye M.T. and Dyer E., Hydrologic Extremes in a Changing Climate: a Review of Extremes in East Africa. Curr Clim Change Rep, Vol. 10, pp. 1–11, 2024. https://doi.org/10.1007/s40641-024-00193-9.
20. Tabari, H., Climate Change Impact on Flood and Extreme Precipitation Increases with Water Availability. Sci. Rep. 2020, 10, 13768.
21. Thackeray, C.W.; Hall, A.; Norris, J.; Chen, D. Constraining the Increased Frequency of Global Precipitation Extremes under Warming. Nat. Clim. Change 2022, 12, 441–448.
22. Kovats, R.S., El Niño and human health. Bull World Health Organ. 2000; 78(9):1127-35.
23. Chukwuma Sr. C., Environment and Development: Approaches to strategies for the improvement of human well-being in Abakaliki area, Nigeria. Environmental Conservation, Vol. 21, No. 4, pp. 359-61, 1994. https://doi.org/10.1017/S0376892900033695.
24. Chukwuma Sr. C., Latent constraints for improved environmental health management in non-industrialised countries. Env Manage & Hlth, Vol. 6, No. 4, pp. 9-14, 1995. https://doi.org/10.1108/09566169510091912.
25. Compson Z.G., Monk W.A., Sarremejane R., DelVecchia A.G., Burrows R.M., Gao S., Ruddell B.L., Hong Y. and Allen D.C., Dryland Rivers and Streams. Editor(s): Thomas Mehner, Klement Tockner. Encyclopedia of Inland Waters (Second Edition), Elsevier, pp 616-627, 2022. https://doi.org/10.1016/B978-0-12-819166-8.00156-0.
26. McIntosh A.R., Leigh C., Boersma K. and García-Berthou E. Food Webs and Trophic Interactions in Intermittent Rivers and Ephemeral Streams. In book: Intermittent Rivers and Ephemeral Streams. 2017. DOI: 10.1016/B978-0-12-803835-2.00012-7.
27. Bunn S.E., Thoms M.C., Hamilton S.K. and Capon S., Flow variability in dryland rivers: Boom, bust and the bits in between. River Research and Applications, Vol. 22, No. 2, 2006. DOI: 10.1002/rra.904.
28. Serrano M.A., Boguñá M. and Vespignani A., Extracting the Multiscale Backbone of Complex Weighted Networks. Proceedings of the National Academy of Sciences, Vol. 106, No. 16, pp. 6483-8, 2009. DOI: 10.1073/pnas.0808904106.
29. Chukwuma Sr. C., Contamination of soils and rice by heavy metals in the Enyigba-Abakaliki lead and zinc mine, Nigeria. Toxicol & Environ Chem, Vol. 41, pp. 125-30, 1994. https://doi.org/10.1080/02772249409357967.
30. Hasanuzzaman M., Masayuki F. M. and Biswas J.K., Advances in Rice Research for Abiotic Stress Tolerance. Book. Edited by: Hasanuzzaman M., Fujita M., Masayuki F.M., and Biswas J.K., 2019.
31. Rony, M.K.K., Wahiduzzaman, M., Rahman, M.M. et al. Impact of El Niño on public health and its preparedness measures. Bull Natl Res Cent. 2024; 48:4. https://doi.org/10.1186/s42269-023-01160-4.
32. Rocha, J., Oliveira S, Viana CM, Ribeiro AI. Chapter 8 - Climate change and its impacts on health, environment and economy. Editor(s): Joana C. Prata, Ana Isabel Ribeiro, Teresa Rocha-Santos. One Health, Academic Press, 2022. Pages 253-279, ISBN 9780128227947. https://doi.org/10.1016/B978-0-12-822794-7.00009-5.
33. Chukwuma Sr. C., Perspectives in the emergence and re-emergence of infectious diseases, geopolitics and gain-of-function research. Scholars international Journal of Biochemistry.2022. DOI: 10.36348/sijb.2022.v05i01.001.
34. Chukwuma Sr. C., Whither the Trends, Innovations and Expertise of the New Public Administration. Innovation in Economy & Policy Research. MAT Journals. 2024; 5(1): 7-16.
35. De Vita A., Belmusto A, Di Perna F, Tremamunno S, De Matteis G, Franceschi F, Covino M., on behalf of the CLIMPS Group. The Impact of Climate Change and Extreme Weather Conditions on Cardiovascular Health and Acute Cardiovascular Diseases. Editors: Nathan Wong, Rita Pavasini. Clin Med. 2024; 13(3):759. DOI: 10.3390/jcm13030759.
36. Awuni S, Adarkwah F, Ofori BD, Purwestri RC, Bernal DCH, Hajek M., Managing the challenges of climate change mitigation and adaptation strategies in Ghana. Heliyon, 2023; 9(5). https://doi.org/10.1016/j.heliyon.2023.e15491.
37. Abrignani MG, Lombardo A, Braschi A, Renda N, Abrignani V. Climatic influences on cardiovascular diseases. World J Cardiol. 2022; 14(3):152–169. doi: 10.4330/wjc.v14.i3.152.
38. Syndemics of chronic and acute diseases in vulnerable populations. Acta Medica Scientia. 2017; 04(01). www.asdpub.com/index.php/ams.
39. Nigeria Climate Change and Health. National Vulnerability and Adaptation Assessment Report, October, 2024.

Nigeria_Climate_and_Health_VA_assessment_report_-_FINAL.pdf.
40. Ding MA, Shuo Li, Xi Chen, Jintao Xu. Extreme Temperatures Promote High-Fat Diets. medRxiv 2025.04.08.25325375; DOI: 10.1101/2025.04.08.25325375.
41. Eb,i K.L., Vanos J.K, Jane W, Baldwin J.W et al., Extreme Weather and Climate Change: Population Health and Health System Implications. Annual Review of Public Health. 2021; 42(1). DOI: 10.1146/annurev-publhealth-012420-105026.
42. Chukwuma Sr. C., Monitoring trends and determinants of type 1 diabetes in geographically-determined populations. Clinical Research Communications. 6(1):3. DOI: 10.53388/CRC2023003, 2023.
43. Pelke Sr. R.A., Climate Vulnerability Understanding and Addressing Threats to Essential Resources. 1st Edition -Editor: Roger A. Pelke Sr. 9 7 8 - 0 - 1 2 - 3 8 4 7 0 4 - 1, 2013.
44. Chukwuma Sr. C., Geopolitics of the nature and crises of the environment, economics and health in a sustainable society for human progress and survival. Journal of Scientific and Innovative Research, Vol. 13, No. 1, pp. 16-21, 2024. DOI: 10.31254/jsir.2024.13103.
45. Chukwuma Sr. C., Gain-of-Function Research and Geopolitics in the Emergence and Reemergence of Infectious Diseases and Microbiome Variants. International Journal of Chemical and Life Sciences, Vol. 10, No. 8, pp. 2197-2205, 2021. DOI: 10.2.1746/ijcls.2021.10.8.2.
46. Chukwuma Sr. C., Human hepatocytes response to pathological shifts in liver fibrosis. The Journal of Medical Research, Vol. 10, No. 1, pp. 37-41, 2024. DOI: 10.31254/jmr.2024.10108.
47. Sillmann J., Thorarinsdottir T, Keenlyside N. et al., Understanding, modeling and predicting weather and climate extremes: challenges and opportunities. Weather and Climate Extremes, Vol. 18, pp. 65–74, 2017.
48. Andersen C.B., Wright D.B. and Thorndahl S., Sub-Hourly to Daily Rainfall Intensity-Duration-Frequency Estimation Using Stochastic Storm Transposition and Discontinuous Radar Data. Water, Vol. 14, No. 24, pp. 4013, 2022. https://doi.org/10.3390/w14244013.
49. Bell, J. E., Brown, C. L., Conlon, K., Herring, S., Kunkel, K. E., Lawrimore, J., Uejio, C., Changes in extreme events and the potential impacts on human health. Journal of the Air & Waste Management Association. 2018; 68(4), 265–287. https://doi.org/10.1080/10962247.2017.1401017.
50. Chukwuma Sr, C. Ageing, Cellular Senescence, and Diabetes, Exploring the Connections Between these Processes and their Implications for Treatment and Management. Journal of Clinical & Biomedical Research. 2025; 7(2):1-5.
51. Chukwuma Sr. C., Social welfare and population dynamics in Egypt, with particular reference to the status of women. Environmental Education and Information. 1995; 14(1):45-62.
52. Jurgilevich A., Käyhkö J, Räsänen A, Saara Pörsti S, Lagström H, Käyhkö J, Juhola S., Factors influencing vulnerability to climate change-related health impacts in cities – A conceptual framework. Environment International. 2023; Volume 173. https://doi.org/10.1016/j.envint.2023.107837.