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**Review Article**

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# Invariance of Extreme Hydrologic Events and Climate Change in the Risk Reduction on Environment and Health

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**Abstract:** The expansive challenges, issues and opportunities depicted by shifting climatic spheres as they exert hazardous consequences on humanity due to their emergence. Globally, 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 from risks, such as extreme hydrologic events, heat, diarrhoea, malaria, emerging and reemerging infectious diseases as demonstrated on the clinicopathologic and healthcare spectra. The intricately complex challenge of the climate and hydrologic ambient is how to configure or elucidate the characterisation of the modifications in climate and hydrology, the presenting untoward metamorphoses in configuring extreme instances as the resultant effect of natural and anthropogenic activities. Multiple events have exacerbated research in the spatiotemporal variations of generalized extreme precipitation and temperature. In essence, extreme hydrological events, EHEs, which include droughts and floods, face spatiotemporal variabilities, with gross intensity and enhancement of extreme drought and precipitation. These are not mere weather events but result in extremes as established in declined agricultural produce, infrastructural attenuation, unified natural and anthropogenic disruptions, and unintended consequences. It is projected that intensification of the hydrological cycle may result from global warming because global warming rapidly escalates processes of the hydrologic cycle resulting in intense droughts and wet periods which affect health and sustainability of societies. The recurrence and severity of hydrologic extremes have augmented due to nature and human interference. These have continuously compromised critical natural events. Emerging from climate change, flash floods have heightened, with projections to augment in the future. This review provides current drivers and typologies of extremes in disparate geopolitical arenas with highlights, challenges, constraints, issues and opportunities in inter alia predicting and forecasting hydrological extremes spatiotemporally.

**Keywords:** global warming, morbidity, mortality, cardiopulmonary diseases, food and agriculture, frequency analysis, rivers and floods, precipitation, adaptation, emerging and reemerging infectious diseases.

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## INTRODUCTION

Climate change enhances morbidity and mortality risks resulting from temperature increase, incessant intensive heavy rains and runoff, as well as the impacts of storms. Health effects may include gastrointestinal, neurologic, pulmonary, hepatic and nephrotic anomalies [1, 2]. The extant water, such as groundwater, rivers, lakes, streams and ponds may cover a vast area, culminating in excessive quantity. This depicts the importance of the limited and precious feature of water, especially freshwater. Water constitutes portions of both the Earth surface and depth. Thus, water encompasses a vast extent of the Earth surface in comparison to the land mass. The preponderance of water paves the contour for climate, undergirds vast biodiversity, and sustainable human civilization. The prevailing challenges and issues of pollution, intense climate change, and extreme hydrologic events, make it crucial to take into consideration the conservation and sustainable management of water resources for the future. Extreme hydrological events, such as floods and droughts, impact significantly on health and healthcare. The duration, intensity and frequency of the events may alter due to climate change, thereby, providing opportunities in the management and adaptation of our water resources [1-3]. Contextually, climate change warming the atmosphere, the hydrology of the Earth shifts with capacity to cause floods and droughts in the extreme. It becomes a requisite for policy- and decision-makers to improve prevailing metamorphoses in hydrologic extremes in preparation for aberrant modification of events in health and the environment.

## Features of the hydrological cycle

Hydrologic problems are extreme events [4] 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 [1]. Floods, limnic eruptions, and Tsunami are examples of hydrological perturbations which present as the most inimical climate change disrupting the environment, human lives [5], and health. They are significantly facilitated by wind and water. Hydrologic signifies water or the effect of water on the terrestrial domain with destructive flood as an example of a hydrologic disaster. The hydrologic cycle comprises steady water circulation within the scope of the terrestrial-atmosphere. The water cycle is the upward motion of water from the terrestrial and aquatic domains to the atmosphere, and reversal to the terrestrial sphere. Thus, the hydrological cycle encompasses all processes whereby water travels from the terrestrial and aquatic surface upwards to the atmospheric sphere, with alterations and downward reversal as precipitation. In essence, the hydrological cycle is undergirded by multiple factors, such as atmospheric, terrestrial and aquatic surfaces. Hydrologic function, such as the response, action and effect of water on other natural resources emerged in varied morphological interactions as erosion, freezing, thawing and disaster-prone events, viz tornadoes, severe storms, hurricanes, tropical storms, floods, wildfires, earthquakes and droughts. There are instances whereby hydrologic states determine the spatiotemporal distribution of floral species in wetlands, where water depth and hydrological fluctuations predictably affect interspecies interactions of wetland species. Hydrological mechanisms, such as evaporation, transpiration, condensation, precipitation and runoff constitute the most primordial aspects of the water cycle. Runoff is associated with varied trajectories whereby liquid water meanders across the terrestrial ambient. Snowmelt is an aspect of depicted runoff as snow or glaciers thaw into streams or pools. Since the overall amount of water in the cycle is constant, its dispensing within multiple processes undergoes incessant alterations.

## Hydrological extremes and events in health

Health impacts associated with climate change in extreme events include morbidity, mortality and exacerbated underlying medical state [1] may be attributed to hydrological extremes detected using disparate observation approaches, investigations and modeling datasets. Climate change and effects on hydrological extremes and the attendant risks and consequences have been assessed locally, regionally and globally. The natural consequences of climate on the changes in hydrological extremes need to be explored distinctly apart the impacts emanating from anthropogenic activities as they affect health [6, 7] by employing integrated impact models with ascertainment of the uncertainties in hydrological extremes within datasets and models. Insights into these challenges, issues and opportunities may identify and unravel susceptible communities and develop effective and efficient adaptation modalities of future climate change globally.

Although, technological progress and intensive research has prevailed, the risk of weather-related perturbations has not been expunged, and still persists. Disasters are increasing in frequency and exerting destruction, causing material and pecuniary depreciation, as well as comorbidities, morbidities and mortalities globally. Furthermore, hazardous weather events constitute basis for accelerated upward trend, as the magnitude of material degradation elevates by an unprecedented extreme in inflation-adjusted pecuniary and socioeconomic attributes. Extant planetary climate change or global warming has caused modifications on extreme hydro-meteorological events, with potential outcome in expansive alterations. Changes in extremes are grossly evident, imposing more impact than mean value changes. The rising extremes encompass the resultant hot days and tropical nights, duration, heatwave intensity, as well as precipitation intensity with evidenced floods, landslides and mudflows, drought frequency, severity and duration; thawed glacier and snow, tropical cyclone intensity, as well as surging sea level and storms. There is projected ubiquitous attenuation in cold extremes, such as number of frost days, cool days and nights. Increased climate extremes associated with climate change may trigger physical infrastructural debasement and human displacement, aggravated and adverse impacts on agricultural produce, fresh water quality and availability [8].

## Analysis of droughts and floods

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 [1, 6, 7]. Extreme hydrological events, EHEs, such as droughts and floods display spatiotemporal variations. Increasing events in recent epoch have intensified spatiotemporal variability research of future extreme precipitation and temperature. Investigations of the implications on the EHEs resulting from the uncertainty of predicted climate changes, require spatiotemporal analysis of precipitation and temperature. For optimum planning and decision-making mechanisms to check EHEs, understanding climate changes necessitates to promote understanding of spatiotemporal analysis of extremes [9]. Drought has achieved prominence because of its occurrence on a continental scale with extended decades long duration of decades [10, 11]. Despite certain floods being localized with limited duration, others can preponderate over a basin for a period of a month. Naturally,, these hydrological events oppose one another but they are not excessively mutually exclusive due to their periodic simultaneous occurrence. The statistical polemics of the probability of extreme events in drainage design codes may lead to inchoate capacity of drainage systems. This constitutes a major aetiology of floods frequency, with particular reference to coastal habitats [12].

East Africa exemplifies an intricately-complex hydrologic, climate and socio-economic ambient, amenable to climate change-induced hydrologic extremes. Droughts and floods constitute the main regional challenges. Incessant modifications of droughts and floods have frequently occurred resulting in common concern. Evidenced heterogeneity of extremes, and climate change affect increased intensity and duration of extremes. The significance of local and antecedent views in transforming the features of extremes is pertinent to configure drivers and interactions. Optimum observational and modeling tools must harness the associations and extremes on brief timescales. Although, ,there exist improved forecasting for the extremes, the provision of inter alia expedient information and meteorological variables creates the latitude for future studies [13]. Extreme hydrological events, such as flash floods, droughts, and severe storms strain economic, environmental, and social systems globally [14]. Collating vital and practical data for the planning and management of regional water resources, assess risks of hydrological events, result in the decrease and adaptation to climate change impacts, as nonparametric and parametric. Nonparametric tests attain more application than parametric tests since development of parametric methods depend on assumptions of normality, static, and time series independence, whereas assumptions are not wholesomely utilised in a hydrological time series, but nonparametric methods are convenient in linear and nonlinear time series.

## The association of precipitation and climate change

Invariably, alterations in precipitation or climate influence human health. Augmented temperatures and wildfires, and decrement in precipitation may give rise to rising ozone and particulate matter, with exacerbated cardiovascular risks. However, certain populations exhibit more vulnerability to the health challenges of climate [1]. Precipitation is a vital aspect of the hydrological cycle and a pivotal climate change indicator [15]. Climate change has been an aetiology of extreme precipitation events which have increased globally and regionally in frequency and intensity, ostensibly to greater natural disasters [16]. The frequency and severity of extreme rainfall and floods has increased due to climate change and urbanization, enacted from the estimation and ascertainment of the probable maximum precipitation, PMP [17]. Climate theory stipulates that core ingredients of the climate system, such as precipitation, evapotranspiration, and reservoirs of atmospheric and soil moisture, metamorphose as the climate warms, taking means and extremes into consideration There is projected intensification of hydrological cycle with global warming, associated with the propensity aggravate the intensity of extreme precipitation events and flood risk. The changes usually present distinctly from proposed enhancement in the atmospheric water-holding capacity of warmer conditions, with special emphasis in restricted water availability and affordability. The associated changes in extreme precipitation and flood intensities, considering termination of the 21st Century with quantification of spatiotemporal water availability [18]. Intensity of extreme precipitation and flood events in climate ambients increase simultaneously with enhanced water availability from dry to wet regions. Concomitantly,, elevated intensity in extreme precipitation and flood with the seasonal cycle of water availability pertains. The association of extreme precipitation and flood intensity alters, whereas spatiotemporal water availability persists with decreased extreme events [19].

The ascertainment of an extreme hydrological event, such as, a rare abated flow or drought, and the extant reverse phase connected to the event are crucial for water resource design, management, prediction and projection. Frequency analysis of erstwhile events is a determined tool for severity assessment of an extreme event and the future probability in the occurrence of the event. Estimate of a design event is focused on the lower or upper tail of the probability distribution, where observations are occasionally determined, indicating expansive uncertain estimation, with limited options in operational practice,and ostensible constraints in the procedure [20]. Climate susceptibility has ostensibly focused on induced anthropogenic activities on climate change and global warming, with frequent exclusion of superimposed threats, such as carbon dioxide emissions, population growth and energy sources as stressors accrued from emerging global affluence [21, 22] and deplorable health. It is indispensable to evaluate the overall range of threats using the bottom-up approach on sustainable resources of food, ecosystems [23], energy, human health [24, 25], water configuring the threats, exploring preventive modalities and adaptations.

## Adaptation, extreme hydrological events, risk management and health

Climate change is the aetiologic agent for significant modifications in the hydrologic cycle, alterations in precipitation patterns, increase in frequency and intensity of extreme weather events and rising sea levels. Adaptation processes are important for the assurance of sustainable water resources, protection of human and natural systems with the entire biodiversity from adverse impacts of these metamorphoses.The disaster risk management approach for climate change integrates the management of extreme and slow-onset events by means of near-, medium-, and long-run risk amelioration and adaptation trajectories in collaboration with stakeholders, such as public and private sectors of production. The involvement in health and disaster management inculcates critically emerging and reemerging health and developmental threats which ostensibly excoriate organizational potentialities and sustainability [24, 25]. The significance of coping, coping with adaptive capacity, and the coping range [26] as well as climate change adaptation impacts have been intensively assessed. Indubitably, it is significant to assess the disparities in practices, options, challenges, issues, opportunities and capacity for effective, efficient and sustainable adaptation [27].

Extreme events in extant climate conditions may be ubiquitous or scarce within future climate occurrences. Unravelling the indicators of vulnerability and adaptive capacity are of importance in implementing conducive adaptation strategies [28]. Adaptation in systems correlates to the adjustment to actual or expected climate with impacts to attenuate hazard or configure realistic opportunities. The adjustment trajectory to the real climate, its impact and anthropogenic intervention [29-31] can propagate adjustment to the climate expected within natural systems. With regard to local, regional or global scales, the extant inequitable influence on coping strategies and adaptive capacity may depict more adaptation challenges and obstruction to disaster risk management. Climate change adaptation approaches are invaluable and sustainable for both attenuation and management of risks caused by extreme hydrological events. As regards adaptation [32], the adjustment mechanisms to actual and expected impacts of climatic extremes entail adaptation. This is the scenario as these modalities are expressed to mitigate, moderate and ensure beneficial exploitation of opportunities. The understanding of exposure and vulnerability parameters is a cardinal aspect for effective adaptation to climatic extremes as risk management to taper vulnerability. In essence, adaptive procedures invariably entail both short- and long-run advantages and opportunities.

Despite the evidence of climate change adaptation modalities, adaptation in the risks of hydrological extreme pertains because adaptation is an intricately complex process [33]. This is attributed to the pertinence of adaptation as droughts and floods increasingly distort innate complexity and uncertainty of systems. This ostensibly explicates the confounding adaptation stance attributed to cases which are frequently perturbed by broad variations of local vulnerabilities and differentials in policies and economic variables and shifts. Another explanation for the confounding adaptation concerns the mode of adaptation within both policy and institutional mechanisms aligned for the realisation of adaptation trajectories. Amelioration is directed at global phenomena but adaptation initiatives are concentrated on local responses to issues which are ubiquitous and evidenced globally. Variations persist in climate change adaptation locally, regionally and globally. These increasingly depend on the vulnerability and sensitivity to environmental influences. Adaptation is expedient due to the increasing extremity of floods and droughts enhancing socio-economic depreciation [34]. An integrated approach for flood risk management employing adaptation will be more sustainable. A combined adaptive approach of, for instance, flood control infrastructure, insurance risk financing scheme, and nature-based remediation may create essential integration. Spatial variations exist in the integration of disparate adaptation modalities, which are influenced by prevailing risk levels, political and pecuniary potentialities and benefits [35]. Flood control infrastructure ostensibly constitute strategies for adaptation to extreme flood events, whereas conventional structural regulations on floods have not been successful, in particular, as extreme and rare events are hazardous to increasing magnitude in association with subversive impact on the flood control structures. Residual risks due to inadequacies in flood control of dams are evidenced globally; thereby exposing the limitations of using structural risk impaired procedures which aggravate the issues during extreme events.

Adaptation to climate change embraces optimistic procedures on the preparation and adjustment for present and future extreme events, and the resultant environmental effects. Adaptation of droughts and floods as the major hydrological extreme events opines that both formal and informal institutional arrangements are available to prosecute the adaptive mechanisms, in which the informal institutional arrangements have reasonably conducted community collective actions in contrary to formal procedures [36]. Furthermore, the facilitating roles in adaptation characterisations and implementation, as well as policy frameworks are formidable operations by governments as feasible milieu for functional institutional arrangements. Adaptation approaches on droughts include augmented water supply and demand mechanisms for water efficiency. The essence and integrity for incremental adaptation initiatives correlates with system maintenance. The transformational adaptation strategies target the fundamental characterisations of a system in response to climate change and the resultant hazardous aspects. Drought and flood early warning systems display as adaptation mechanisms, prognostically arraigned to drive or mobilise extreme adaptation procedures.

## Dryland Rivers and streams associated with food web dynamics

Climate change is 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 [20, 30, 31]. 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 [37, 38]. 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 [39]. The biomass preponderance can result in high quantities of secondary production. Consumers in dryland systems are generalists having adaptations for pulse exploitation in resources with concurrent modifications in resources.. An enormous proportion of dryland river consumers exhibit characteristics which alternatively allow them to regulate an expansive extent of resources or persist in expecting favourable prognosis and resources. The interactions in Dryland Rivers are stringently bonded because of adaptations to variable flow regimes characterized by nadir flow and drying. Organisms in perennial streams are vulnerable to fauna and flora dissipation during droughts resulting in trophic rewiring [40]. Contrariwise, organisms in Dryland Rivers adapt to protracted drying times. Evidentially, food webs in these systems are constricted within these periods, however, core ecological interactions pertain, leading to the same topologies as food webs consumers [41] in the ambient. Also,, aquatic consumers in dryland rivers exhibit relatively stringent trophic interactivity with terrestrial food webs; in part, as a consequence of intensive production of linkages with terrestrial systems. There is probability that aridity promotes terrestrial consumer responses to water proliferation, therefore, in drylands alluding to water as a trophic currency [42, 43], a unit of value to define species interactions in terrestrial food webs. It is suggestive that dryland river food webs depict resistant multiscale backbones [44] which undergird the persistence of the primordial and pivotal ecological functionalities in these systems in drought.

## Plant tolerance to Flooding and Submergence

The health of the root is important for crop survival and yield during flooding. 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 [45] 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 [46]. The accumulation of ethylene retards cytokine-mediated senescence and instigates dormancy in submergence.

Climate impacts and concurrent environmental debilities are limned as multifarious species. Instances of multiple environmental stresses are excessive heat, flooding, drought, and soil salinity increase [47]. Heightened frequency of these stresses impacts crop yields unfavourably greater than the impacts of metamorphosis in mean temperature and precipitation, as well as exacerbate agricultural produce when competing with numerous and diverse stresses. Agriculture will not supercede the future metamorphoses of crop species with tolerances to choose abiotic stress variables correlated with climatic events. Plant breeders are enmeshed with the constraints of integrating or piling varied abiotic stress tolerance traits or ingredients into novel cultivars to provide tolerance to a broad spectrum of adverse climate spheres. These constitute daunting tasks as stacking multiple genes into a sole preferred cultivar requires aggregating the time for the essential breeding cycles, information, knowledge and understanding of trait interaction to have optimum productivity.

## Challenges for sustainable land and water management

Potable water, food and energy security, climate change, water-borne diseases, water-associated hazard management, procurement of sustainable environmental quality and land use management include present and future challenges[1, 2, 6, 7]. Land use change has introduced actual impacts on hydrological extremes, such as excoriating dry or wet transects, and an unsavoury future that may superimpose on the risk [48]. A progressive pattern of soil sealing emanating from urban sprawls, megacities and mega industries has become all encompassing,, and Its hydrologic impact on flood frequency is evidenced [49]. Furthermore,, soil sealing induces the disappearance of ecosystems important for lowland communities, such as biodiversity, agricultural produce, water absorption, soil filtering and buffering capacity. There emerges spread of environmental challenges, issues and opportunities of cities, such as atmospheric- or light-pollution expansive presence in diverse areas distorting effective impact.

Future land use plan must target enhanced resilience of lowland communities to hydrologic extremes. Due to increasing unpredictable and intense climate presentations in dryness and wetness, it is pertinent to improve landscape buffering functionality. Improved retention of rainwater and surface water in the course of a catchment, regulated peak flow is tenable while water supply is enhanced during drought. Sustainable land and water management [50] must encompass the landscape to advance water storage in agricultural areas [51] and ditches, as well as infiltration in urban communities, or retention in the course of principal rivers for the protection of the distinct, precious, and delicate lowlands. The extant challenge for sustainable land and water management, climate change adaptation and mitigation projects is principled attainment of Sustainable Land Management (SLM) as pivotal to land degradation rates, and curbing desertification for greener and more sustainable future, and concerted effort to obviate distortions, such as water unavailability, pollution, ecosystem cadastral [23] degradation and untoward environmental health processes [31].

## Patterns of hydrological frequency analysis

Hydrological frequency analysis (HFA) depends on certain assumptions on the data series, specifically, independence, homogeneity and stationarity. Severe economic and social consequences may emerge from extreme hydrological events, such as floods, droughts and storms. Research identifies with either event with distinct trajectories and particular regions. Water resources management promotes the prominence of drought, whereas estimates of extreme precipitation and flood formulate hydraulic and hydrologic structures. 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. An overestimation results in over-sizing of hydraulic structures involving supplementary costs. A fundamental undertaking of the warranted models for appropriate and accurate prediction of these events is necessary [52]. Hydrologic extreme events cannot be estimable, predicted, or merely conducted on deterministic data with adequate skill and lead time [53]. Contrarily, a probabilistic approach pertains to incorporate the impacts of such events into decisions and agreements. On the ascertainment that successive events are not constrained in timing and magnitude because hydrologic frequency analysis is functional as a decision tool via estimable determined event or a correlation of events. Certain engineering tools employ hydrologic frequency analysis,(HFA) such as hydraulic and municipal structure design, culverts and storm sewers as well as evaluation of landslide hazard.

## Mechanisms of hydrological extremes and agricultural productivity

Extreme weather events caused by the ENSO cycle can affect health via associated droughts, floods, heat waves, and distortions in food supply. 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 and climate 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 and cope with the hazard. There is increasing incidence of hydrological extremes and variability; and from top-bottom predictions of multi-decadal model, the future climate will present elevated moisture content. The increasing water-holding capacity of the atmosphere may heighten the frequency of heavy precipitation events due to extreme precipitation restriction by atmospheric moisture content. The trend for increased dry seasons between rainfall events pertains but models may be irreconcilable in this regard [54]. A long-term projection of climate models for increased dry summer in the mid-latitudes, with a probability of drought is predictable [55, 56]

The projected aridity increase in soybean-growing regions in the Americas exclusive of northeast Argentina and Uruguay including Southeast Asia from impacts of regional warming are proportionally attributable to human greenhouse gas emissions, with global net primary crop production reduced by 10%, and by 2050, the climate is ascertained using the SRES A2 emission scenario due to decrement in regional precipitation and elevated temperatures leading to increasing agricultural water restriction and unrestrained crop deterioration [57]. Elevated carbon dioxide offsets [58] the disruptive impacts, but the magnitude of the impact is not precise. Elevated atmospheric moisture content may mitigate the warming effect on vapor pressure lowering that increases exponentially with temperature and drives transpirational water evaporation from plants, although, rise in evapotranspiration may perspicuously transpire. Simulation studies ostensibly exaggerate high temperature impact on crop water usage by ignoring vapour pressure increase [59]. Furthermore, reduced tillage and cover crops are used to enhance bulk density, organic matter content [60] and augment soil volumetric water level as well as soil moisture conservation [61]. Indepth rooting assisted by osmotic root adjustment to promote cell turgor during tissue water potential depletion, is naturally placed to improve transpiration and yield. Heightened tolerance to aluminum, detected in toxic concentrations in lower soil horizons, corresponds with drought tolerance in a slow-wilting genotype. Tolerance to aluminum correlated with citrate concentration in root tips, indicating that citrate release is associated with aluminum discrimination in tolerant genotypes [62]. Breeding and genetic transformations for this trait may be beneficial. Improved water use efficiency may lead to elevated atmospheric carbon dioxide content due to higher net photosynthesis than transpiration due to reduced stomata conductance [63]. Both are contributory factors to yield proficiency in soybean, but diminished transpirational cooling culminates in higher leaf temperatures and deficiency in leaf-to-air vapor pressure, accompanied by enhanced transpiration and respiration, thereby depreciating net profitability of crop biomass.

Nitrogen fixation demonstrates higher sensitivity to water deficiency more than other processes, such as photosynthesis, biomass production, transpiration, and nitrogen soil uptake. Elevated concentrations of nitrogen compounds in water-stressed plants suggest that nitrogen fixation is restricted in the nodule via regulated feedback of nitrogenase activity [64]. Protracted nitrogen fixation during water stress suppresses premature senescence [65] and promotes HI, with resultant augmented yield [66, 67] and proficient beneficial improvement in trait and trend.

Extreme hydrological events and global warming

Warmer temperatures and shifting weather patterns disrupt air quality which precipitates 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. The multifactorial extreme hydrologic events ostensibly (i) predominate on strategies to establish hydrological extremes and to accommodate spatiotemporal trajectories; (ii) explicate newfangled observations, datasets, and modeling tools to unravel hydrological extremes; (iii) ascertain estimation and assessment of modifications in hydrological extremes, including droughts and floods; (iv) elucidate attributes and features of disparities in hydrological extremes; and (v) make projections, predictions and forecasting of hydrological extremes and societal effects during global warming. Global warming superimposes on normal precipitation and evaporation, resulting in the frequency of extreme climate and hydrological events [68]. Contextually, global warming, extreme climate and hydrological events frequently take place [69]. Global warming augments the hydrological cycle and enhances normal precipitation and evaporation [70]. Simultaneously, precipitation variation may change, exerting direct impacts on evaporation, runoff, and soil humidity., There is geopolitical convergence [71] of countries on the scientific parameters of climate change but divergence sustains on which country is the most culpable, the way and means to predict and track emissions-decrement objectives, and the rationale for the compensation of vulnerable geopolitical ambients. Governments must curb the global average temperature from rising by 1.5°C.

### The concerns of climate change in human health

Climate change may induce disruptive access to healthcare, and vulnerability to risks of physical and mental health hygiene. The health impacts of the disruptions, such as increased cardiopulmonary disorders, wounds and premature mortality-associated extreme weather events, alterations in the demographics of food- and water-borne morbidities, emerging and reemerging infectious diseases [72, 73] pose expansive interventions in public policies and administration [74]. Climate change may perturb cardiovascular health via multiple pathways. Environmental stressor exposure causes physiological alterations, such as accelerated heart rate and plasma viscosity, accompanied by exposure to extreme heat, local and systemic inflammation due to airborne particulate matter inhalation [75, 76]. Environmental temperature constitutes the most researched phenomenon. The association between mortality, incidence of cardiovascular disorders, and temperature depicts graphically as the alphabet "U". Cold, heat and heat wave exposures are invariably associated with elevated risk of acute coronary syndromes [77]. Globally, extreme weather events constitute health hazards [73].

## DISCUSSION

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 [78]. Frequency analysis is pertinent in the design and modelling of hydrological systems but is frequently statistically restricted by the entire spatiotemporal period of observation [79]. In this context, observing, understanding and modelling the hydrological extremes in a changing climate remain a daunting expedition. Hydroclimatic observations are extant due to accelerated technology development to acquire land surface parameters which facilitate the elucidating and modelling of hydrological extremes. On the contrary hydrologists strive to elucidate extreme events by improving physically-based models for a promising assessment of local, regional and global impacts of hydrological extremes. Determination and establishment of hydrological extreme events are tenable via aggregated datasets and hydrological models for the future. Extreme weather and climate-associated incidents impinge on human health resulting in morbidity, mortality and socioeconomic problems. Climate change has altered extreme event frequency, intensity, and geographic dissemination, and propensity as a driver for change in the future. These events include heat waves, droughts, wildfires, dust storms, flooding rains, coastal flooding, storm surges, and hurricanes. The pathways linking extreme events to health outcomes and economic dissipation are inexplicably diverse and complex. It is difficult to predict these due to their emergence from local societal and environmental factors which impact disease encumbrance [80].

## CONCLUSION

Climate change and the modifying patterns of extreme weather can expunge the sustainability of public health systems.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. Precipitation is a primordial aspect of the hydrological cycle and a pivotal indicator of climate change. Climate change has expansively impacted extreme precipitation events with highly driven intensity and frequency, concomitantly with an augmented magnitude for natural disasters. Thus, hydrological extremes as floods and droughts are critical natural and anthropogenic hazards. Extreme hydrometeorological events are drivers of hazardous hydrological and geomorphical reactions, such as floods, landslides, and debris flows which are predominant global health threats and require technological inputs. Hydrologic change emanate from an array of drivers which are stressors and transformers of hydrologic systems and water cycle. The invariable stress on hydrologic systems extends over widespread alterations of land-cover, urbanization, industrialization and engineering interventions. These hydrological extremes are the pivotal drivers of multiple natural disasters, with resultant health and economic declinations and infrastructural degradations as well as unpredictable future threats to anthropogenic activities caused by climate change. It is, therefore, imperative to be completely aware of hydrological extremes, the rationale for risk management and strategic adaptation for the future. Thus, extreme weather events incessantly elevate, and are correlated to global warming. These weather events are ostensibly contributory to and elevate risks for expansive spectra of vector- and non-vector-borne diseases and infestations to animals, humans, and plants with concomitant aberrant sequelae.

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