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GLOBAL RAINFALL SCARCITY AND THE EMERGING EL NIÑO OF 2026: IMPLICATIONS FOR FOOD SECURITY, WATER RESOURCES, SOCIETY, ECONOMIES, AND HUMAN WELLBEING

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Abstract

Rainfall is fundamental to sustaining life on Earth, supporting agriculture, freshwater resources, biodiversity, ecosystems, and socio-economic development. However, changing global climate patterns, particularly the emergence of a significant **El Niño event in 2026**, have raised concerns about increasing rainfall variability and water scarcity across many regions of the world. El Niño, a naturally occurring climate phenomenon characterized by unusually warm sea surface temperatures in the equatorial Pacific Ocean, disrupts atmospheric circulation and significantly alters global precipitation patterns. While some regions experience prolonged droughts and severe water shortages, others are subjected to intense rainfall, flooding, and associated disasters. These climatic extremes pose substantial challenges to food security, water availability, public health, environmental sustainability, and economic stability.

This paper examines the scientific basis of El Niño and its influence on global rainfall distribution, highlighting its implications for agriculture, ecosystems, society, livelihoods, and sustainable development. It explores how rainfall scarcity affects societies at large by crop productivity, groundwater recharge, hydropower generation, biodiversity conservation, and climate-induced migration, particularly in developing countries that are highly dependent on seasonal rainfall. The study also discusses the interconnected relationship between El Niño and anthropogenic climate change, emphasizing how rising global temperatures may amplify the frequency and intensity of extreme weather events. Furthermore, the paper identifies key adaptation and mitigation strategies, including climate-resilient agriculture, integrated water resource management, early warning systems, disaster preparedness, and international cooperation to enhance resilience against climate variability. Recognizing that climate challenges require collective action, the article underscores the critical role of governments, scientific institutions, policymakers, local communities, and youth in promoting sustainable environmental practices and evidence-based policy interventions. The findings suggest that strengthening climate governance, investing in scientific research, and adopting adaptive management strategies are essential for minimizing the adverse impacts of rainfall scarcity and ensuring long-term water, food, and environmental security in an increasingly climate-vulnerable world.

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Keywords

El Niño; Rainfall Scarcity; Climate Change; Water Security; Agriculture; Food Security; Drought; Extreme Weather Events; Environmental Sustainability; Public Health; Biodiversity; Climate Resilience; Sustainable Development; Water Resource Management; Global Climate.

Introduction

Climate change has emerged as one of the most pressing global challenges of the twenty-first century, significantly increasing the frequency, intensity, and unpredictability of extreme weather events. In addition to long-term global warming caused by anthropogenic greenhouse gas emissions, natural climate phenomena such as the El Niño–Southern Oscillation (ENSO) play a crucial role in influencing global weather patterns. El Niño, the warm phase of ENSO, is characterized by unusually high sea surface temperatures in the central and eastern equatorial Pacific Ocean, which disrupt atmospheric circulation and alter rainfall and temperature patterns worldwide. According to the World Meteorological Organization (WMO), El Niño conditions are expected to strengthen during 2026, increasing the likelihood of below-normal rainfall and drought in some regions while causing excessive rainfall and flooding in others. These changing precipitation patterns have far-reaching implications for agriculture, water resources, biodiversity, public health, economies, and sustainable development. Understanding the causes and impacts of El Niño is essential for developing effective adaptation strategies and strengthening global climate resilience.

El Niño is a naturally occurring climate phenomenon characterized by unusually warm sea surface temperatures in the central and eastern equatorial Pacific Ocean. It forms part of the El Niño–Southern Oscillation (ENSO), a recurring climate cycle that influences atmospheric circulation and weather patterns across the globe. During an El Niño event, the warming of ocean waters weakens the easterly trade winds, altering the movement of heat and moisture in the atmosphere. As a result, rainfall patterns shift significantly, causing droughts in some regions and excessive rainfall and flooding in others. The ENSO cycle consists of three phases: El Niño, marked by warmer-than-average Pacific Ocean temperatures; La Niña, characterized by cooler-than-average sea surface temperatures; and ENSO Neutral, when oceanic and atmospheric conditions remain close to their long-term averages. In 2026, international climate monitoring agencies indicate that the climate system is transitioning from neutral conditions toward El Niño, raising concerns about its widespread environmental, social, and economic impacts worldwide.

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Table 1. Global Statistics on Climate Change, Rainfall Scarcity, and Water Security

Indicator	Latest Available Data	Source
Global temperature above pre-industrial level (2024)	**≈1.55°C**	World Meteorological Organization (WMO)
Population highly vulnerable to climate change	**3.3–3.6 billion people**	IPCC AR6
Increase in drought events since 2000	**29%**	UNCCD
Global land already degraded	**40% of Earth's land area**	UNCCD
People affected by land degradation	**3.2 billion**	UNCCD
Agriculture's share of global freshwater withdrawals	**70%**	FAO
People lacking safely managed drinking water	**2.2 billion**	WHO/UNICEF JMP
People living under high or critical water stress	**≈739 million**	UNICEF
Additional annual deaths expected due to climate change (2030–2050)	**≈250,000 deaths/year**	WHO
Potential internal climate migrants by 2050	**Up to 216 million**	World Bank

Rainfall Scarcity During El Niño

One of the most significant characteristics of **El Niño** is its ability to disrupt the normal distribution of rainfall across the globe. As atmospheric circulation patterns shift, regions that typically receive adequate seasonal rainfall may experience prolonged dry spells and drought, while others are subjected to excessive rainfall and flooding. Countries that are frequently affected by below-average rainfall during El Niño include **India, Australia, Indonesia, Papua New Guinea, Southern Africa, and parts of Southeast Asia**, where reduced precipitation can lead to water shortages, agricultural losses, and increased wildfire risks. In contrast, **western South America, the southern United States, parts of East Africa, and the central and eastern Pacific regions** often experience above-average rainfall, increasing the likelihood of floods, landslides, and infrastructure damage. Although these patterns vary in intensity from

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one El Niño event to another and are influenced by regional climatic conditions, they significantly increase the probability of extreme weather events, posing serious challenges to livelihoods, ecosystems, and sustainable development worldwide.

Table 2. Global Regions Commonly Affected by El Niño

Region	Likely Impact
India	Below-normal rainfall, drought
Australia	Drought, heatwaves, bushfires
Indonesia	Rainfall deficit, forest fires
Southern Africa	Agricultural drought
Papua New Guinea	Water scarcity
Southeast Asia	Reduced monsoon rainfall
Western South America	Heavy rainfall and flooding
Southern United States	Above-average rainfall
East Africa	Increased seasonal rainfall

Sociological Perspective on Global Rainfall Scarcity and El Niño *(Approximately 250 Words)*

From a sociological perspective, El Niño-induced rainfall scarcity is not merely an environmental or meteorological phenomenon but a complex social issue that influences human relationships, institutions, livelihoods, inequality, and social development. Climate-induced changes in rainfall patterns disproportionately affect vulnerable populations, particularly those dependent on agriculture, forestry, fisheries, and other natural resource-based occupations. Rural communities, small and marginal farmers, indigenous populations, women, children, and economically disadvantaged groups often experience the greatest hardships due to declining agricultural productivity, water scarcity, food insecurity, and loss of income.

Rainfall scarcity can also intensify existing social inequalities by widening disparities in access to water, education, healthcare, and employment opportunities. Prolonged droughts frequently trigger rural-to-urban migration as families seek alternative livelihoods, leading to rapid urbanization, overcrowding, unemployment, housing shortages, and increased pressure on urban infrastructure and public services. Such migration may also weaken traditional family structures and community networks, affecting social cohesion and cultural continuity.

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Furthermore, climate-related disasters have significant implications for mental wellbeing. Economic uncertainty, crop failures, indebtedness, displacement, and livelihood insecurity contribute to psychological stress, anxiety, depression, and social conflict. Competition over scarce natural resources, particularly water, may also increase tensions between communities and regions, emphasizing the need for equitable resource management and inclusive public policies.

Sociology highlights that the impacts of climate change are not experienced equally across society but are shaped by social class, gender, occupation, geography, and governance. Consequently, addressing rainfall scarcity requires not only scientific and technological solutions but also socially inclusive policies, community participation, environmental justice, climate education, and strengthened institutional support. Integrating sociological perspectives into climate adaptation strategies can enhance resilience, promote social equity, and contribute to achieving sustainable development in an increasingly climate-vulnerable world.

Table 4. Major Impacts of Rainfall Scarcity

Sector	Major Consequences
Agriculture	Lower crop yields, livestock losses
Water Resources	Reservoir depletion, groundwater decline
Economy	Food inflation, reduced purchasing power
Environment	Biodiversity loss, wildfires, desertification
Public Health	Heat stress, malnutrition, respiratory diseases
Society	Migration, poverty, resource conflicts
Energy	Reduced hydropower generation

Impact on Agriculture

Agriculture is one of the sectors most vulnerable to rainfall scarcity, particularly in countries where farming is heavily dependent on seasonal monsoon precipitation. Reduced or erratic rainfall disrupts the agricultural cycle by delaying sowing, limiting soil moisture, and increasing water stress in crops during critical stages of growth. Consequently, crop yields decline, farm productivity decreases, and the quality of agricultural produce may deteriorate. In addition to affecting crop cultivation, prolonged dry conditions reduce the availability of fodder and drinking water for livestock, resulting in lower milk production, increased livestock mortality, and significant economic losses for farming households.

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Major food and cash crops vulnerable to rainfall shortages include **rice, wheat, maize, soybean, sugarcane, and cotton**, all of which require adequate water for optimum growth and productivity. Farmers often incur higher irrigation costs to compensate for reduced rainfall, increasing the cost of cultivation and reducing profitability. Lower agricultural production also disrupts food supply chains, contributing to food shortages and rising market prices, thereby affecting food security, particularly among economically vulnerable populations. In countries like India, where a substantial proportion of agriculture remains rain-fed, even a modest decline in seasonal rainfall can have far-reaching consequences for rural livelihoods, national food production, employment, and overall economic stability.

Water Crisis

Rainfall scarcity has profound implications for the availability, accessibility, and sustainability of freshwater resources. Reduced precipitation limits the replenishment of rivers, lakes, reservoirs, and aquifers, leading to declining water levels and increasing the risk of water shortages. One of the immediate consequences is the depletion of reservoir storage, which affects the supply of drinking water, irrigation, and industrial use. Inadequate rainfall also reduces groundwater recharge, causing a decline in water tables and increasing dependence on unsustainable groundwater extraction. As freshwater availability decreases, governments and local authorities may be compelled to implement water rationing and conservation measures to meet essential needs. Furthermore, lower water levels in reservoirs adversely affect hydropower generation, leading to energy shortages and increased reliance on fossil fuels. Rainfall scarcity also intensifies competition among domestic, agricultural, and industrial sectors for limited water resources, often creating social, economic, and environmental conflicts. Rapid urbanization and population growth have already placed significant pressure on water resources in many cities worldwide. Prolonged rainfall deficits, compounded by climate change, are likely to exacerbate water stress, emphasizing the urgent need for integrated water resource management, rainwater harvesting, groundwater conservation, and sustainable water-use policies to ensure long-term water security.

Food Inflation and Economic Consequences

Rainfall scarcity has significant economic implications, particularly for countries where agriculture constitutes a major component of the national economy. Reduced agricultural production caused by prolonged droughts and inadequate rainfall often results in lower food supplies, leading to rising food prices and increased inflation. As the prices of essential commodities such as cereals, vegetables, fruits, and livestock products increase, household purchasing power declines, particularly among low-income families that spend a substantial proportion of their income on food. Governments may also face increased fiscal pressure as they expand expenditure on drought relief, food subsidies, crop insurance, employment support programmes, and emergency water supply measures. In addition, countries experiencing production deficits may rely more heavily on food imports, increasing import costs and

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widening trade imbalances. Reduced agricultural output can also affect agro-based industries, transportation, and rural employment, resulting in slower economic growth and declining incomes in farming communities. Previous major **El Niño** events have been associated with substantial global economic losses due to disruptions in agriculture, infrastructure, energy production, and supply chains. These economic consequences highlight the importance of investing in climate-resilient agriculture, effective disaster risk management, and sustainable resource planning to reduce vulnerability and strengthen long-term economic resilience.

Environmental Consequences

Rainfall scarcity has profound consequences for natural ecosystems, threatening environmental sustainability and ecological balance. Reduced precipitation limits the availability of surface and groundwater resources, leading to declining river flows, shrinking lakes and wetlands, and the deterioration of aquatic ecosystems. Forest ecosystems become increasingly vulnerable to moisture stress, resulting in reduced vegetation cover, forest degradation, and a heightened risk of wildfires, particularly during prolonged dry seasons. Wetland shrinkage also affects migratory birds and aquatic species that depend on these habitats for survival and reproduction. Furthermore, reduced river discharge and rising water temperatures disrupt fisheries by altering breeding cycles, reducing fish populations, and affecting the livelihoods of communities dependent on inland and coastal fisheries. Rainfall deficits also contribute to soil degradation through the loss of soil moisture, reduced fertility, erosion, and declining organic matter, ultimately lowering land productivity. Biodiversity is severely affected as many plant and animal species struggle to adapt to changing climatic conditions, increasing the risk of habitat loss and species extinction. In arid and semi-arid regions, prolonged droughts can accelerate desertification, transforming fertile land into barren landscapes. Protecting ecosystems through sustainable land management, afforestation, water conservation, and climate adaptation measures is therefore essential for maintaining ecological resilience and environmental sustainability.

Public Health Risks

Rainfall scarcity poses significant challenges to public health by affecting access to safe water, adequate nutrition, sanitation, and healthy living conditions. Prolonged droughts and rising temperatures increase the incidence of heat-related illnesses such as heat exhaustion, heatstroke, dehydration, and cardiovascular complications, particularly among children, older adults, and outdoor workers. Reduced agricultural productivity resulting from inadequate rainfall contributes to food shortages and malnutrition, especially in vulnerable populations. Water scarcity also compromises the quality and availability of drinking water, increasing dependence on unsafe water sources and heightening the risk of waterborne and hygiene-related diseases. Inadequate water supply further affects sanitation and personal hygiene, facilitating the spread of infectious diseases in densely populated and resource-poor communities. Additionally, dry conditions generate dust storms and increase the frequency of wildfires, leading to respiratory illnesses such as asthma, bronchitis, and other pulmonary disorders due to poor air quality. Beyond physical health, rainfall scarcity has profound

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psychological consequences. Crop failures, loss of livelihoods, financial insecurity, displacement, and uncertainty about the future contribute to stress, anxiety, depression, and emotional distress among affected populations. Strengthening public health infrastructure, ensuring safe water access, promoting nutrition security, and integrating mental health services into disaster response are essential for building resilient communities in the face of climate-induced rainfall scarcity.

Implications for India

India's **southwest monsoon** is the lifeline of the country's economy, providing nearly 70–80% of its annual rainfall and supporting agriculture, drinking water supplies, hydropower generation, and rural livelihoods. Since a large proportion of India's agricultural land remains rain-fed, the performance of the monsoon directly influences food production, employment, and economic growth. Historically, several El Niño years have been associated with weaker-than-normal monsoon rainfall, although the intensity and geographical distribution of rainfall vary depending on the interaction of multiple climatic factors. During a strengthening El Niño event, there is an increased likelihood of below-normal rainfall over parts of the Indian subcontinent, raising concerns about drought conditions in vulnerable regions. Reduced rainfall may lead to lower agricultural productivity, water shortages, declining groundwater recharge, increased irrigation demand, heat stress, and reduced hydropower generation. These impacts can contribute to food inflation, rural distress, and increased pressure on government resources for drought relief and water management. Given the regional variability of monsoon behaviour, preparedness through improved weather forecasting, efficient water resource management, climate-resilient agriculture, and effective disaster risk reduction strategies remains essential to minimize the socio-economic impacts of El Niño in India.

Table 3. India: Rainfall Dependency and Climate Vulnerability

Indicator	**Statistics**
Annual rainfall received during Southwest Monsoon	**75–80%**
Net sown area dependent on rainfall	**≈52%**
Agriculture's share of freshwater use	**80–85%**
Population dependent on agriculture for livelihood	**45–50%**
Drought-prone districts	**More than 250**
Major crops affected by rainfall variability	Rice, Wheat, Maize, Soybean, Sugarcane, Cotton

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Global Humanitarian Concerns

Rainfall scarcity poses significant humanitarian challenges that extend far beyond environmental degradation, affecting the social, economic, and human development of communities worldwide. Prolonged droughts and declining agricultural productivity contribute directly to **food insecurity**, leaving millions of people vulnerable to hunger and malnutrition, particularly in developing countries where livelihoods depend heavily on rain-fed agriculture. The loss of crops, livestock, and employment opportunities often results in **rural unemployment** and declining household incomes, forcing many individuals and families to migrate in search of better economic prospects. Such climate-induced migration places additional pressure on urban infrastructure, housing, healthcare, education, and employment systems. Scarcity of essential natural resources, particularly water, may also intensify **resource conflicts** among communities, regions, and even nations, threatening social stability and peace. Furthermore, reduced agricultural production and persistent economic hardship can increase poverty levels, making vulnerable populations more dependent on government assistance and humanitarian aid. In severe cases, prolonged rainfall deficits may trigger **humanitarian emergencies**, requiring large-scale interventions to ensure food, water, healthcare, and shelter. Developing countries with limited financial resources, inadequate infrastructure, and lower adaptive capacity are disproportionately affected, highlighting the urgent need for international cooperation, climate resilience, sustainable development policies, and equitable disaster preparedness strategies.

Climate Change and El Niño

Although **El Niño** is a naturally occurring climate phenomenon within the **El Niño–Southern Oscillation (ENSO)** cycle, its impacts are increasingly being intensified by anthropogenic climate change. Rising global temperatures caused by greenhouse gas emissions increase atmospheric and oceanic heat content, creating conditions that can amplify the severity of El Niño-related weather extremes. Higher temperatures accelerate evaporation from land and water bodies, reducing soil moisture and intensifying drought conditions in regions already experiencing rainfall deficits. At the same time, a warmer atmosphere can hold more moisture, leading to heavier and more intense rainfall events in areas affected by storms and flooding. Climate change also contributes to more frequent and severe heatwaves, prolonged dry spells, increased wildfire risk, and greater pressure on water resources, agriculture, and ecosystems. Scientists emphasize that while El Niño is a natural climate cycle, its interaction with human-induced global warming can produce more severe environmental, social, and economic consequences than in previous decades. This growing interaction underscores the need for enhanced climate monitoring, greenhouse gas mitigation, climate-resilient infrastructure, sustainable resource management, and international cooperation to strengthen global resilience against future climate-related disasters.

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Strategies for Adaptation

Addressing the challenges posed by rainfall scarcity and El Niño requires a comprehensive and integrated approach involving governments, scientific institutions, local communities, and international organizations. Strengthening **seasonal climate forecasting** and early warning systems can help governments, farmers, and disaster management agencies prepare for extreme weather events and minimize potential losses. Sustainable **water conservation practices**, including efficient irrigation technologies, rainwater harvesting, watershed management, and groundwater recharge, are essential to ensuring long-term water security. Promoting **climate-resilient agriculture**, the adoption of drought-resistant crop varieties, and improved soil and water management practices can enhance agricultural productivity under changing climatic conditions. Effective reservoir management and integrated water resource planning are equally important for balancing domestic, agricultural, industrial, and ecological water demands. Public awareness campaigns can encourage responsible water use, environmental conservation, and community participation in climate adaptation initiatives. Furthermore, expanding renewable energy sources can reduce greenhouse gas emissions and mitigate climate change, while international cooperation in climate research, technology transfer, capacity building, and financial support remains crucial for strengthening global resilience. A coordinated, science-based, and inclusive approach is therefore essential to reducing vulnerability and promoting sustainable development in the face of increasing climate variability.

Despite substantial advancements in climate science, significant research gaps remain in understanding the complex relationship between **El Niño, rainfall scarcity, climate change, and their socio-economic consequences**. Most existing studies primarily focus on meteorological and environmental dimensions, while comparatively limited attention has been given to the long-term social, psychological, economic, and policy implications of changing rainfall patterns. Future interdisciplinary research integrating climate science, sociology, economics, public health, and environmental studies is therefore essential.

There is a need for **longitudinal studies** examining the cumulative impacts of repeated El Niño events on agricultural productivity, food security, rural livelihoods, migration, poverty, and public health. Research should also investigate how rainfall scarcity disproportionately affects vulnerable populations, including women, children, indigenous communities, smallholder farmers, and marginalized social groups. Greater emphasis is required on the mental health consequences of climate-induced livelihood insecurity, displacement, and resource scarcity.

Another important research gap concerns the application of **Artificial Intelligence (AI), remote sensing, Geographic Information Systems (GIS), big data analytics, and predictive climate modelling** for improving rainfall forecasting, drought monitoring, early warning systems, and disaster preparedness. Comparative studies evaluating the effectiveness of climate adaptation policies across different countries would provide valuable evidence for policymakers.

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Furthermore, limited research has examined the role of **youth participation, community-based adaptation, climate education, and behavioural change** in strengthening societal resilience to climate variability. Future studies should also assess the effectiveness of integrated water resource management, climate-resilient agriculture, and sustainable development policies under varying climatic conditions. Addressing these research gaps will contribute to evidence-based policymaking, enhance climate resilience, and support the achievement of the **Sustainable Development Goals (SDGs)** in an increasingly climate-vulnerable world.

Conclusion

The strengthening **El Niño conditions expected during 2026** underscore the urgent need for enhanced climate preparedness and adaptive governance at local, national, and global levels. Although El Niño is a natural climatic phenomenon, its interaction with human-induced climate change has intensified the frequency and severity of extreme weather events, resulting in prolonged droughts, erratic rainfall, floods, and rising temperatures. These climatic disruptions threaten agricultural productivity, freshwater availability, biodiversity, public health, energy security, and economic stability, particularly in developing countries with limited adaptive capacity. The resulting impacts extend beyond the environment, influencing livelihoods, migration, food security, poverty, and social wellbeing.

Addressing these multifaceted challenges requires a coordinated and multidisciplinary approach involving governments, scientific institutions, policymakers, businesses, civil society organizations, and local communities. Investments in climate science, advanced forecasting systems, sustainable water resource management, climate-resilient agriculture, ecosystem restoration, disaster risk reduction, and public awareness are essential for strengthening resilience against future climate-related risks. Equally important is the active participation of youth and communities in promoting sustainable environmental practices and climate action.

Ultimately, rainfall is far more than a meteorological phenomenon; it is the foundation of ecosystems, food production, economic development, and human survival. Protecting water resources and preparing societies for increasing climate variability must therefore become a global priority. Through evidence-based policies, international cooperation, and sustainable development initiatives, humanity can reduce vulnerability, enhance resilience, and safeguard the wellbeing of present and future generations.

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