GLOBAL DECARBONISATION
Volume 2 (2026) · ISSN 3050-0230

TECHNICAL ARTICLE

Children at the Frontline of Climate Change: A Vulnerability-Based Assessment of Climate Impacts on Children in Afghanistan

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RECEIVED 16 March 2026 · REVISED 18 June 2026 · ACCEPTED 21 September 2026 · PUBLISHED 12 October 2026

ABSTRACT

Background: Afghanistan ranks among the world's most climate-vulnerable nations, yet rigorous, peer-reviewed analysis of climate change impacts specifically on children has remained severely underexplored. Children in Afghanistan face a convergence of acute physiological vulnerability, structural deprivation, governance failure, and compounding humanitarian crises that render them disproportionately exposed to climate hazards including drought, extreme temperatures, flash flooding, and food insecurity. Methods: This study employs a systematic integrative review combining scoping review methodology with secondary vulnerability analysis. A total of 323 records were identified across PubMed, Scopus, Web of Science, Google Scholar, and major institutional repositories; 145 sources met inclusion criteria (peer-reviewed studies, institutional reports, and official datasets published between 2018 and 2025 that contain empirical data on children in Afghanistan). Vulnerability is operationalized across five interlinked dimensions: biophysical exposure, nutritional and health status, water and sanitation access, educational continuity, and social protection. A Child-Centered Climate Vulnerability Index for Afghanistan (CCVI-Af) is developed and pillar weights are justified against established global indices. Results: Afghanistan registered the highest absolute number of children displaced by climate disasters globally in 2023 (n = 747,094). Newborns face a projected 5.3-times greater drought exposure across their lifetimes compared with individuals currently aged 60. As of 2024, approximately 7.8 million children faced crisis-level food insecurity. An estimated 875,000 children under five required treatments for severe acute malnutrition, while stunting prevalence was 45.0% (95% CI: 43.2–46.8%). Climate-induced water scarcity affected 67% of households, up from 48% in 2021—a 39% deterioration in two years. Compound gender-climate vulnerability has contributed to a child marriage rate of 28.7% and the educational exclusion of over 2.2 million girls. Conclusions: Afghanistan constitutes one of the most extreme intersections of climate vulnerability and child rights deprivation in the world. This article proposes the CCVI-Af as a sub-nationally applicable, gender-disaggregated vulnerability measurement framework and advances a five-pillar policy framework for child-centered climate adaptation. Structural exclusion from international climate finance mechanisms represents a critical, addressable barrier requiring urgent engagement from the global community.

KEYWORDS climate change, child vulnerability, Afghanistan, food insecurity, climate displacement, child rights, malnutrition, gender inequality, WASH, climate adaptation

1. Introduction

The climate crisis is reshaping biophysical systems, disrupting livelihoods, and deepening inequalities across the globe, yet its burdens are distributed with devastating asymmetry. Children occupy a uniquely precarious position in this calculus: they possess greater physiological sensitivity to environmental hazards, less autonomy to enact protective responses, and—most profoundly a temporal horizon that extends far beyond that of the adults whose decisions determine the trajectory

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Published by Caravel Press.

doi.org/10.65582/gd.2026.011

of emissions (Diffenbaugh and Burke 2019) (McMichael *et al.* 2006). UNICEF's Children's Climate Risk Index (CCRI), published in 2021 and supplemented in 2023, documented that one billion children globally live in countries at "extremely high risk" from climate change impacts (UNICEF 2021). Within this global picture, Afghanistan stands apart as the most acute case.

Afghanistan ranks sixth on the Notre Dame Global Adaptation Index (ND-GAIN, 2023) for overall climate vulnerability, while simultaneously ranking among the lowest globally in adaptive capacity (University of Notre Dame Global Adaptation Initiative 2023). The country has experienced a mean annual temperature increase of approximately 1.8°C since 1950 more than double the global average of 0.85°C over the same period (UNFCCC 2016), (ACAPS 2024) alongside intensifying drought frequency and severity, flash flood events of increasing destructive power, and accelerating glacial retreat in the Hindu Kush mountain system that functions as the country's primary freshwater tower (Immerzeel *et al.* 2010) (Stockholm International Peace Research Institute 2022). These biophysical changes are overlaid on a landscape of catastrophic structural fragility: economic collapse following the withdrawal of international development finance equivalent to 40% of GDP after August 2021, the systematic dismantling of governance institutions, and critically for child vulnerability the imposition of gender-exclusionary policies that intersect catastrophically with climate hazards, particularly for girls (World Bank Group 2023) (Goodhand and Mansfield 2021).

Children constitute approximately 49% of Afghanistan's estimated population of over 40 million (Division 2022), and they disproportionately bear the consequences of every dimension of the climate crisis. In 2022, climate disasters not conflict became the primary driver of new internal displacement in Afghanistan for the first time in recorded history (Internal Displacement Monitoring Centre 2024). By year-end 2023, 747,094 children had been displaced by climate disasters, the highest figure of any country in the world (Internal Displacement Monitoring Centre 2024). Nutritional outcomes have deteriorated precipitously: a 75% increase in hospital admissions for severe acute malnutrition (SAM) between 2020 and 2022 is documented in peer-reviewed analysis (Akseer *et al.* 2016), while the 2022–2023 Multiple Indicator Cluster Survey (MICS) records a stunting prevalence of 45% among children under five (UNICEF 2024) (UNICEF 2025b).

Despite the severity and multidimensional character of these intersecting crises, peer-reviewed literature that synthesizes climate change impacts specifically through a child-vulnerability lens in the Afghan context remains remarkably sparse. Existing scholarship tends to treat climate change, child nutrition, displacement, education, and gender as isolated subjects without integrating them within a unified vulnerability framework or advancing contextually adapted measurement tools. The present article addresses this gap. Drawing on a systematic integrative review of 145 sources including peer-reviewed publications, institutional datasets, and normative documents from 2018 to 2025, it provides the most comprehensive vulnerability-based assessment of climate impacts on Afghan children to date. It contributes three specific advances: (i) an integrated multi-dimensional vulnerability synthesis across five domains; (ii) a novel Child-Centered Climate Vulnerability Index for Afghanistan (CCVI-Af) with empirically justified pillar weights; and (iii) an operationally grounded, five-pillar policy framework anchored in the UN Committee on the Rights of the Child (UNCRC) General Comment No. 26 (2023).

The article is structured as follows: Section 2 presents the theoretical framework and methodology, including the systematic search protocol and CCVI-Af construction rationale. Section 3 profiles Afghanistan's bioclimatic context. Section 4 presents the vulnerability assessment results across five dimensions. Section 5 develops and presents the CCVI-Af framework. Section 6 discusses findings in relation to the academic literature and addresses governance and political-economy dimensions. Section 7 presents policy recommendations. Section 8 concludes.

2. Theoretical Framework and Methodology

2.1. Vulnerability as an Analytical Lens

Climate vulnerability scholarship has evolved considerably since the IPCC Third Assessment Report, shifting from exposure-centric risk models toward integrated frameworks that incorporate sensitivity, adaptive capacity, and political-economic context (Adger 2006) (United Nations Office for the Coordination of Humanitarian Affairs 2023). The IPCC AR6 Working Group II defines vulnerability as "the propensity or predisposition to be adversely affected" by climate hazards, shaped by the interacting components of exposure, sensitivity, and adaptive capacity (IPCC 2022). For children, however, standard vulnerability frameworks require substantial adaptation, as children's vulnerability is not merely a function of household poverty or geographic exposure but arises from a distinctive ensemble of biological, developmental, social, and rights-based factors (UNICEF 2021), (Perera 2008), (Sheffield and Landrigan 2011).

This article adopts a multi-dimensional child vulnerability framework informed by three foundational bodies of work: (1) UNICEF's CCRI and the supplementary "Climate-Changed Child" report (UNICEF 2021), (UNICEF 2023c); (2) the UN Committee on the Rights of the Child's General Comment No. 26 on children's rights and the environment (United Nations Committee on the Rights of the Child 2023); and (3) the IPCC AR6 Synthesis Report's treatment of compounded and cascading climate risks (IPCC 2023). Vulnerability is operationalized across five analytically distinct but empirically interconnected dimensions: (i) biophysical and physiological exposure; (ii) food security and nutritional status; (iii) water, sanitation, and hygiene (WASH); (iv) education and psychosocial development; and (v) social protection, gender, and rights. A cross-cutting Governance and Adaptive Capacity modifier, calibrated using the ND-GAIN sub-indices (University of Notre Dame Global Adaptation Initiative 2023), frames all five dimensions.

2.2. Systematic Search and Selection Protocol

The search protocol follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Tricco *et al.* 2018), adapted to accommodate institutional and gray literature consistent with methodological guidance for vulnerability assessments in complex humanitarian settings (Arksey and O'Malley 2005), (Levac *et al.* 2010). Searches were conducted between January and March 2025.

Databases and repositories searched:

- Peer-reviewed: PubMed/MEDLINE, Scopus, Web of Science (Core Collection), Google Scholar
- Institutional repositories: UNICEF, OCHA, UNDP, FAO, WFP, IPC, IDMC, Save the Children, IFRC, World Bank, Human Rights Watch, ACAPS, SIPRI
- Official datasets: MICS 2022–2023; INFORM Risk Index 2023; ND-GAIN Index 2023; IPC Afghanistan assessments
- Legal and normative documents: UNCRC GC No. 26 (2023); Afghanistan NDC; UNFCCC COP records

Search terms employed in peer-reviewed databases:

("Afghanistan") AND ("climate change" OR "climate variability" OR "drought" OR "flood") AND ("child*" OR "adolescent" OR "infant" OR "malnutrition") AND ("vulnerability" OR "health" OR "displacement" OR "food security" OR "education" OR "gender")

Inclusion criteria:

- Published or released between 2018 and 2025
- Focus on Afghanistan or Afghan populations
- Address climate change, climate variability, or climate-related environmental risk

- Contain empirical or primary data on children (defined as persons under 18) as the primary or a disaggregated sub-population
- Available in English or Dari (with English abstract minimum)

Exclusion criteria:

- Opinion articles, editorials, commentaries, and letters without original data
- Studies without Afghanistan-specific data or with Afghanistan as a secondary case in a multi-country analysis not providing disaggregated country data
- Sources lacking identifiable author or institutional origin (anonymous gray literature)
- News media reports and journalistic sources (used as supporting context only, not as primary evidence)

A total of 323 records were identified across all sources. Following title and abstract screening, 198 records were assessed for full-text eligibility. One hundred and forty-five sources met final inclusion criteria. Table 1 summarises the selection process by source category. The full literature selection process is presented as a PRISMA flow diagram (Figure 1), detailing the number of records identified (n = 323), records removed as duplicates (n = 47), records screened by title and abstract (n = 276), records excluded at screening (n = 78), records assessed for full-text eligibility (n = 198), and final records included (n = 145). Records excluded at full-text stage were primarily excluded for lacking Afghanistan-specific child data (n = 31), absence of empirical primary data (n = 14), or failure to meet the defined publication period (n = 8).

Table 1. Study Selection Summary by Source Category (PRISMA-ScR Protocol).

Source Category	Initial Records Identified	Records Included After Screening	Primary Use in Analysis
Peer-reviewed journal articles (PubMed, Scopus, Web of Science, Google Scholar)	184	47	Theoretical grounding; malnutrition, displacement, health outcomes, climate attribution
UNICEF institutional reports & datasets	31	23	Child nutrition, WASH, education, displacement, humanitarian appeals
UN agency reports (OCHA, UNDP, WFP, FAO, IPC, IDMC, UN Women)	64	39	Food security, displacement, water access, gender, finance
Peer-reviewed gray literature (ACAPS, SIPRI, Save the Children, IFRC, World Bank)	28	21	Drought impact, child protection, socioeconomic vulnerability
Official datasets (MICS 2022–2023, ND-GAIN, INFORM, IPC assessments)	9	9	Quantitative indicators; stunting, water access, child marriage
Legal & normative documents (UNCRC GC No. 26, NDC, UNFCCC)	7	6	Rights framework, policy anchors
Total	**323**	**145**	

MICS = Multiple Indicator Cluster Survey; ACAPS = Assessment Capacities Project; SIPRI = Stockholm International Peace Research Institute; GC = General Comment. All institutional sources used as evidence are produced by organizations with established methodological protocols; peer-reviewed journal articles are additionally subject to independent expert review.

Data were extracted using a structured vulnerability matrix with rows corresponding to the five vulnerability dimensions and columns for: indicator name; data type (quantitative / qualitative);

reported value with confidence interval where available; reference period; source quality rating (peer-reviewed journal article / UN system / peer-reviewed gray literature / official dataset / normative document); and caveats regarding data limitations. Where multiple sources reported the same indicator, the most recent peer-reviewed estimate was prioritized; institutional estimates were used where peer-reviewed data were absent.

2.3. CCVI-Af Construction and Weight Justification

The Child-Centered Climate Vulnerability Index for Afghanistan (CCVI-Af) is constructed as a weighted composite of five pillars. Pillar weights were not assigned arbitrarily; they were derived through the following evidence-based procedure. First, a review of existing composite vulnerability indices including the UNICEF CCRI (UNICEF 2021), the INFORM Risk Index (European Commission Joint Research Centre 2023), the ND-GAIN Country Index (University of Notre Dame Global Adaptation Initiative 2023), and the Hazard of Place model (Cutter *et al.* 2003) identified the relative weighting conventions and empirical justifications used in each. Second, the specific Afghan context was assessed: given that the primary mechanism linking climate change to child harm in Afghanistan is mediated overwhelmingly through agricultural and water system disruption, biophysical exposure and nutritional/health status were assigned the highest equal weights (0.25 each), consistent with the approach used in UNICEF's CCRI exposure and vulnerability sub-indices (UNICEF 2021). WASH was assigned 0.20 in recognition of its direct and proximate role in child morbidity; education and social protection dimensions received 0.15 each, reflecting their importance for long-run adaptive capacity while acknowledging their partial co-determination by non-climate (governance) factors. The composite CCVI-Af score for region r is computed as:

$$\text{CCVI-Af}(r) = 0.25 \times P1(r) + 0.25 \times P2(r) + 0.20 \times P3(r) + 0.15 \times P4(r) + 0.15 \times P5(r) + \gamma \times \text{GACmod}(r)$$

where P1–P5 are normalized pillar scores (0–1 scale) for region r and GACmod(r) is a Governance and Adaptive Capacity modifier (0.5–1.5 range) calibrated from ND-GAIN sub-indices (University of Notre Dame Global Adaptation Initiative 2023), with $\gamma = 0.10$ capturing its cross-cutting amplifying or dampening role.

GACmod Clarification: The Governance and Adaptive Capacity modifier (GACmod) is a scalar multiplier applied to the raw composite CCVI-Af score to reflect each region's underlying institutional capacity to respond to climate hazards. GACmod is calibrated from three ND-GAIN sub-indices (University of Notre Dame Global Adaptation Initiative 2023): (i) governance readiness, (ii) social readiness, and (iii) economic readiness. For each region r, raw ND-GAIN sub-index values are averaged and rescaled to a 0.5–1.5 range using a linear transformation, such that a region with the lowest observed governance capacity receives GACmod = 1.5 (amplifying vulnerability) and the highest capacity region receives GACmod = 0.5 (dampening vulnerability). The mathematical assumption underlying this modifier is that governance and institutional capacity operate proportionally across all five vulnerability pillars rather than differentially by sector, consistent with the cross-cutting governance weighting used in the INFORM Risk Index (European Commission Joint Research Centre 2023). The scalar weight $\gamma = 0.10$ was chosen to ensure that GACmod contributes meaningfully to score differentiation between regions with markedly different institutional contexts (e.g., Kabul Central vs. remote Southwest) while avoiding over-dominance of governance over direct empirical indicators. Sensitivity testing with γ values of 0.05 and 0.15 produced no rank reordering among the six regional zones, confirming that the chosen value does not drive the vulnerability hierarchy.

Normalization and Harmonization: All pillar indicators were standardized to a common 0–1 scale using min-max normalization: $\text{Normalized}(x) = (x - x_{min}) / (x_{max} - x_{min})$, applied across the six regional zones. Where indicators were drawn from datasets with different reference years or geographic units, values were harmonized by (a) using the most recent available estimate within the 2022–2024 reference window; (b) interpolating missing provincial values from adjacent provincial or zonal estimates reported by the same institutional source; and (c) expressing all proportional indicators as

percentages of the relevant population denominator to ensure commensurability across regions of different population sizes. Missing data for specific provinces were handled by substituting the regional zone mean calculated from available provincial observations, with this imputation flagged explicitly in Table 4. All normalized scores and raw indicator values are available from the corresponding author upon request.

All pillar indicators are standardized to a common scale using min-max normalization across the six regional zones. Sensitivity analysis was conducted by systematically perturbing each pillar weight by ±0.05 while holding all other weights constant and rescaling to maintain a sum of 1.00. Sensitivity analysis testing ±0.05 variation in each pillar weight produced a maximum rank reordering of one position across the six regions, indicating that the vulnerability ranking is robust to moderate weight uncertainty. Specifically, when Pillar 1 (Biophysical Exposure) weight was increased from 0.25 to 0.30, the Southern zone retained its highest vulnerability ranking while the Northern and Western zones exchanged their second and third positions. When Pillar 2 (Nutritional Status) weight was reduced to 0.20, no rank changes occurred among the top three most vulnerable zones. When Pillar 3 (WASH) weight was varied between 0.15 and 0.25, the regional rank order remained fully stable. These results confirm that the overall vulnerability hierarchy is robust to plausible alternative weighting choices and is not an artefact of the specific weights selected.

3. Afghanistan's Bioclimatic Profile: A Nation at the Climate Frontier

3.1. Temperature Trends and Thermal Stress

Afghanistan's climate is predominantly arid to semi-arid, characterized by extreme seasonal variation and pronounced altitudinal gradients. Mean annual temperature has increased by approximately 1.8°C since 1950 more than double the concurrent global average warming of approximately 0.85°C (UNFCCC 2016), (ACAPS 2024). The warming rate has not been spatially uniform: the Central Highlands and Southwestern provinces show the most pronounced trends, with some stations recording temperature increases exceeding 2.2°C over the same period (ACAPS 2024), (UNDP 2024). Climate projections under high-emission scenarios indicate further mean warming of 2.0–6.2°C by the late twenty-first century, consistent with the CMIP6 ensemble analysis for the region (Rokhan and Wardak 2026) (Almazroui *et al.* 2020). For children, thermal stress is an acute biophysical hazard: infants and young children have immature thermoregulatory systems, higher surface-area-to-body-mass ratios, and proportionally greater metabolic water requirements than adults, making them substantially more susceptible to heat-related morbidity, dehydration, and—in the context of compromised nutrition—lethal hyperthermia (Perera 2008), (Sheffield and Landrigan 2011).

Simultaneously, intensifying cold extremes in the mountainous northern and central regions have created seasonal humanitarian crises of increasing frequency. Road blockages caused by heavy snowfall regularly prevent the resupply of food, medicines, and humanitarian goods to remote communities for periods of weeks. The IPCC AR6 characterizes the simultaneous intensification of heat and cold extremes within the same national territory as a "compound event" (IPCC 2022), and the evidence from Afghanistan is consistent with this characterization: both ends of the thermal spectrum are intensifying, amplifying risk for physiologically vulnerable populations in geographically heterogeneous ways.

3.2. Drought, Glacial Dynamics, and Hydrological Disruption

Afghanistan's water systems are undergoing rapid and destabilizing transformation. The Hindu Kush Himalayan (HKH) region constitutes the country's primary freshwater source, storing precipitation as seasonal snowpack and glacial ice and releasing it as meltwater during spring and early summer. Peer-reviewed assessments document a loss of approximately 14% of glacier coverage in the HKH between 1990 and 2015 (Bolch *et al.* 2012), with projections under high-emission scenarios indicating loss of 50–75% of regional glacier mass by 2100 (Kraaijenbrink *et al.* 2017). This glacial retreat creates

an initial short-term surplus in meltwater the "peak water" phenomenon followed by progressive long-term hydrological deficit, with severe consequences for the approximately 80% of Afghan livelihoods directly or indirectly dependent on irrigated and rain-fed agriculture (Immerzeel *et al.* 2010), (Stockholm International Peace Research Institute 2022).

Since 1969, Afghanistan has experienced eight major drought events, each with documented impacts on agricultural production and child nutrition (ACAPS 2024), (Save the Children International 2024). The 2021–2023 period represented the most severe drought in three decades, affecting 25 of 34 provinces through three consecutive years of substantially below-normal precipitation and above-average temperatures (United Nations Office for the Coordination of Humanitarian Affairs 2023), (UNDP 2024). The Kunduz River Basin has documented a 30% decline in mean annual precipitation since the 1960s, while groundwater tables have declined across multiple major aquifer systems (UNDP 2024), (OCHA 2024). Paradoxically, drought-hardened soils with reduced infiltration capacity have simultaneously amplified the destructive potential of precipitation events: flash floods and mudslides across 25 of 34 provinces in 2024 caused disproportionate harm to the same communities already most affected by drought (United Nations Office for the Coordination of Humanitarian Affairs 2023). Annual flooding incurs estimated economic losses of approximately USD 400 million and affects on average 335,000 people, with children and women disproportionately represented among the affected (OCHA 2024).

3.3. Land Degradation and Environmental Cascades

Desertification has affected more than 75% of land across Afghanistan's northern, western, and southern regions over the past four decades, driven by the interaction of reduced precipitation, overgrazing, deforestation, and agricultural overextraction (United Nations Office for the Coordination of Humanitarian Affairs 2023), (Save the Children International 2024). Deforestation has accelerated land and pasture degradation, contributing to soil infertility, reduced carbon sequestration capacity, diminishing crop yields, and amplified flooding risk through reduced vegetative cover and soil water-holding capacity (OCHA 2024). These environmental cascades translate directly into household food insecurity, income collapse, and forced migration with children suffering acute developmental consequences at every stage, including malnutrition, educational disruption, heightened child protection risks, and psychological trauma (Rahmat *et al.* 2023), (Cuartas *et al.* 2023).

4. Results: Multi-Sectoral Vulnerability Assessment

4.1. Food Security and Child Nutritional Vulnerability

Of all pathways through which climate change harms Afghan children, food insecurity and malnutrition constitute the most immediate and physiologically consequential. The architecture of food insecurity in Afghanistan is structurally complex, reflecting the long-run degradation of agricultural systems by drought and land degradation, acute harvest failures from flood and pest events, economic collapse following the withdrawal of international development finance (World Bank Group 2023), (Goodhand and Mansfield 2021), and entrenched structural poverty. It is important to distinguish between the direct climate drivers of food insecurity (drought-induced crop failure, flood destruction of harvests, glacial melt disrupting irrigation), the climate-mediated drivers (food price inflation following agricultural shocks, seasonal labor income loss), and the structural and political drivers (governance collapse, international aid withdrawal, conflict-related market disruption) that operate independently of but frequently in conjunction with climate change. Climate change functions as a threat multiplier across all these vectors simultaneously, but attribution of specific food insecurity outcomes to climate change alone, as distinct from governance or conflict factors, requires caution given the compound causality operating in the Afghan context.

By the fourth quarter of 2023, approximately 13.1 million people experienced acute food insecurity at IPC Phase 3 or above, projected to rise to 15.8 million between November 2023 and March 2024 (IPC 2023). Save the Children calculated that approximately 7.8 million children one in three entered 2024 facing crisis-level hunger (Save the Children International 2023). These figures reflect structural, not merely cyclical, deterioration: more than a third of the population now faces acute food insecurity as a near-permanent condition.

The nutritional consequences for children are severe and carry multi-generational implications. UNICEF reported 875,000 children under five requiring treatment for SAM and 2.3 million children and 840,000 women with moderate acute malnutrition (MAM) (UNICEF 2021). In a peer-reviewed analysis, Rahmat et al. (Rahmat *et al.* 2023), documented that hospital admissions for SAM rose from approximately 16,000 in 2020 to approximately 28,000 in 2022 a 75% increase attributable to the convergence of drought-induced food insecurity and healthcare system collapse. Stunting prevalence stands at 45.0% (95% CI: 43.2–46.8%) (Jafari *et al.* 2024), among the highest globally. Wasting prevalence is 7.4% (95% CI: 6.5–8.3%) (Jafari *et al.* 2024). The developmental significance of stunting is irreversible when undetected and untreated in the first 1,000 days of life: affected children face permanent impairment of cognitive, neurological, and physical development (Victora *et al.* 2010).

Climate-specific mechanisms exacerbating child malnutrition include: (1) drought-induced crop failure reducing both food availability and household income; (2) flash floods destroying standing crops and stored food reserves; (3) winter road closures preventing food resupply to isolated highland communities; (4) livestock mortality removing animal-source protein from child diets; (5) supply-shock-driven food price inflation; and (6) flood-driven water contamination causing acute diarrheal illness, which compounds malnutrition through nutrient malabsorption and metabolic depletion (Rahmat *et al.* 2023), (Cuartas *et al.* 2023), (Black *et al.* 2013). La Niña weather patterns, associated with below-normal winter precipitation in Central and South Asia, risk further deepening food insecurity through harvest disruption in affected provinces (World Food Programme 2024). Table 2 presents key quantitative indicators.

Table 2. Key Quantitative Indicators of Climate-Linked Child Vulnerability in Afghanistan (2022–2024).

Indicator	Value / Magnitude	Year	Source
Children displaced by climate disasters (cumulative)	747,094 (highest globally)	2023	IDMC (Save the Children International 2024)
Share of all IDPs who are children	~50%	2023	IDMC (Save the Children International 2024)
Children facing crisis-level hunger (IPC Phase 3+)	7.8 million	2024	(IPC 2023), (World Food Programme 2024)
Children under 5 with severe acute malnutrition (SAM)	875,000	2023–24	(UNICEF 2024)
SAM hospital admissions increase (2020–2022)	+75% (16,000 → 28,000)	2020–22	(Rahmat et al. 2023)
Stunting prevalence (children under 5)	45.0% (95% CI: 43.2–46.8%)	2022–23	(Jafari et al. 2024); (Cuartas et al. 2022)
Wasting prevalence (children under 5)	7.4% (95% CI: 6.5–8.3%)	2022–23	(Jafari et al. 2024)
Households reporting barriers to safe water	67% (up from 48% in 2021)	2023	(UNICEF 2024)
Population lacking sufficient clean water	~80%	2023–24	(UNDP 2024)
Girls denied secondary education	≥1.1 million	2023	(UN Women 2024)

Table 2. (continued)

Indicator	Value / Magnitude	Year	Source
Girls aged 15–19 currently married	28.7%	2022–23	(Cuartas et al. 2022)
Child marriage rate increase since 2016	33% → 39%	2016–23	(Akseer et al. 2016)
Provinces with severe/catastrophic drought	25 of 34	2024	(United Nations Office for the Coordination of Humanitarian Affairs 2023)
Mean temperature increase since 1950	+1.8°C (global avg: +0.85°C)	2024	(UNFCCC/UNICEF 2023); (UNDP 2024)
Projected lifetime drought increase (newborns vs. 60-yr-olds)	5.3× more	2024	(Save the Children International 2024)
Annual economic losses from flooding	USD ~400 million	2024	(UNDP 2024)
Under-five mortality rate	60 per 1,000 live births	2016	(Akseer et al. 2016)
Maternal mortality rate	638 per 100,000 live births	2016	(Akseer et al. 2016)
Households reporting barriers to healthcare	91% (up from 77% in 2023)	2025	(UNICEF 2025b)

CI = confidence interval; IPC = Integrated Food Security Phase Classification; IDPs = internally displaced persons; U5MR = under-five mortality rate; MICS = Multiple Indicator Cluster Survey; GLOF = glacial lake outburst flood. Where confidence intervals are not reported by the primary source, they were not estimated by the author to avoid misrepresentation of uncertainty.

4.2. Water, Sanitation, and Hygiene (WASH) Vulnerability

Clean water access is simultaneously a prerequisite for child survival and a direct casualty of climate change in Afghanistan. In 2023, 67% of households reported barriers to accessing safe water, compared with 48% in 2021 a 39% deterioration in two years (UNICEF 2023c). UNDP estimates that approximately 80% of the population lacks sufficient access to clean water (OCHA 2024). OCHA characterizes the situation as "a protection crisis, intensified by climate change-induced water scarcity," noting that the increased unpredictability of precipitation and shifting seasonal distributions have severely eroded communities' ability to adapt using traditional water management practices (United Nations Office for the Coordination of Humanitarian Affairs 2023).

For children, inadequate water access generates rapid cascading consequences: dehydration, heightened susceptibility to waterborne diseases including cholera, acute diarrheal disease, typhoid, and hepatitis A; nutrient deficiency exacerbated by gastrointestinal illness; and time poverty as children disproportionately girls are required to walk increasingly long distances to collect water from shared sources. Peer-reviewed evidence from comparable dryland contexts documents a strong dose-response relationship between distance to water sources and childhood stunting, with each kilometer increase in water collection distance associated with measurable deterioration in child nutritional status (Pickering and Davis 2012). In Kandahar Province, hundreds of wells and water sources have dried up entirely due to drought-induced groundwater depletion, forcing mass internal displacement (Save the Children International 2023).

The deterioration of WASH infrastructure amplifies climate impacts: aging karez systems (traditional underground irrigation channels), depleted aquifers, and flood-damaged municipal water supply networks are unable to buffer against the increased variability of precipitation. UNICEF's

solar-powered water system program, which installed 1,855 systems in 2022, has demonstrated that decentralized, renewable-energy-based water solutions can meaningfully reduce vulnerability in high-risk provinces; systematic expansion of this model is both technically feasible and urgently needed (UNICEF 2023c).

4.3. Educational Disruption and Cognitive Development

Climate change disrupts children's education through multiple direct and indirect pathways: physical destruction of school infrastructure by floods, landslides, and earthquakes; forced displacement that interrupts enrollment continuity; climate-induced income shocks that push children into labor or early marriage; and temperature extremes that render classroom attendance physiologically unsafe. Globally, UNICEF estimates that 40 million children annually experience education disruption attributable to climate-exacerbated disasters (UNICEF 2023c). Afghanistan represents the most severe national manifestation of this phenomenon, compounded by gender-restrictive governance policies.

UNICEF reported in 2025 that 11% of households deprioritized schooling due to economic challenges, up from 4% in 2023 (UNICEF 2025b) a trajectory directly attributable in significant part to climate-driven agricultural income shocks. Since September 2021, girls have been progressively excluded from secondary, university, and as of December 2024 medical and midwifery education (Ahmad *et al.* 2025). An estimated 2.2 million girls are currently denied formal education (UNICEF 2025b). While this gender-based exclusion is primarily governance-driven rather than climate-driven, it interacts with climate vulnerability in a documented compounding manner: educated women demonstrate significantly greater adaptive capacity to climate shocks, higher health-seeking behavior for children, and measurably improved child nutritional outcomes (Muttarak and Lutz 2014), meaning that the elimination of girls' education directly erodes the adaptive capacity of the next generation.

The psychological and developmental toll of concurrent educational exclusion and climate disruption deserves explicit recognition. Peer-reviewed literature on children in conflict-climate nexus settings documents elevated rates of post-traumatic stress disorder (PTSD), anxiety, and depression among climate-displaced children (Cuartas *et al.* 2022), with effects that compound across the climate-trauma-cognitive development pathway. The loss of educational structure as a source of psychological stability and routine amplifies these psychosocial harms, particularly for girls whose social networks are most severely disrupted by both Taliban restrictions and climate-induced displacement.

4.4. Displacement, Child Protection, and Psychosocial Wellbeing

Climate-induced displacement represents one of the most devastating and least studied mechanisms of harm to Afghan children. The Internal Displacement Monitoring Centre (IDMC) reported that in 2022, climate disasters surpassed conflict as the primary driver of new internal displacement in Afghanistan for the first time on record (Internal Displacement Monitoring Centre 2024). By year-end 2023, Afghanistan registered the world's highest number of children displaced by climate disasters 747,094 followed at substantial distance by Pakistan (515,378) and Ethiopia (403,855) (Internal Displacement Monitoring Centre 2024). Approximately 50% of all internally displaced persons in Afghanistan are children (Internal Displacement Monitoring Centre 2024). Cumulatively, an estimated 6.3 million people approximately one in seven Afghans are experiencing long-term displacement, the largest figure in South Asia and the second highest globally (United Nations Office for the Coordination of Humanitarian Affairs 2023).

Climate displacement intersects with child protection risks through well-documented pathways. Displaced families facing acute income loss frequently resort to "negative coping strategies" including child marriage, child labor, early asset liquidation, and irregular migration (United Nations Office for the Coordination of Humanitarian Affairs 2023), (Brides 2024). Child marriage rates have increased from 33% in 2016 to 39% in 2023 (Ahmad *et al.* 2025), (UNICEF 2023a), with 28.7% of girls

under 18 currently married, including 9.6% married before the age of 15 (UN Women 2024). The economic crisis—substantially driven by climate shocks to agricultural livelihoods has been documented in humanitarian fieldwork as a driver of increased rates of daughters being placed in marriage as a financial survival mechanism (Brides 2024), (Akseer *et al.* 2025). (Cuartas *et al.* 2022) demonstrate in a systematic review that climate change functions as a "threat multiplier" for violence against children, including through displacement mechanisms.

For returnee children a rapidly growing population as mass deportations from Pakistan and Iran accelerate climate vulnerability is doubly acute. Approximately 1.4 million Afghans were forcibly returned from Pakistan and Iran in 2023–2024, many arriving in receiving communities already severely stressed by multi-year drought (Save the Children International 2024), (Climate Diplomacy Institute 2024). Returnee children, many born in host countries and lacking direct familiarity with Afghan rural environments, face heightened exposure to extreme weather events combined with barriers to community-based adaptation planning and support networks (Save the Children International 2024).

4.5. Health, Disease Burden, and Physiological Vulnerability

Children's physiological characteristics render them categorically more vulnerable than adults to a wide range of climate-related health threats. Infants and young children possess immature thermoregulatory capacity, higher surface-area-to-body-mass ratios, greater metabolic water requirements per unit body weight, and less developed immune systems, increasing their susceptibility to heat stress, dehydration, hypothermia, vector-borne disease, waterborne pathogens, and respiratory infections (Perera 2008), (Sheffield and Landrigan 2011). Their rapid developmental trajectory means that environmental exposures during critical windows gestational, infant, and early childhood carry irreversible consequences for cognitive, neurological, and physiological development (Victora *et al.* 2010).

Afghanistan's health system has been catastrophically weakened: approximately seven million women and children under five are acutely malnourished (International Federation of Red Cross and Societies 2024), the under-five mortality rate is 60 per 1,000 live births (Climate Diplomacy Institute 2024), and maternal mortality stands at 638 per 100,000 live births (Climate Diplomacy Institute 2024). These health system parameters create a situation of double jeopardy in which children suffer both the direct physiological effects of climate change and the consequences of a health system unable to treat those effects. By 2024, 91% of households reported barriers to health services, up from 77% in 2023 (UNICEF 2025b). For children with climate-exacerbated conditions SAM, acute diarrheal disease, respiratory infections, heat-related illness these access barriers are frequently fatal.

Climate change is intensifying specific disease burdens in Afghanistan. Flood contamination of water sources drives cyclical cholera and acute diarrheal disease outbreaks; rising temperatures are expanding the geographic range and seasonal duration of malaria and cutaneous leishmaniasis transmission; dust storms driven by drought and desertification increase children's risk of respiratory illness and eye disease (ACAPS 2024) (UNDP 2024). Children under five bear approximately 40% of the global burden of climate-attributable ill health despite constituting only approximately 10% of the global population (World Health Organization 2018). Psychosocial health consequences of climate disruption including elevated rates of PTSD, anxiety, and depression among climate-displaced children are only beginning to be systematically studied in conflict-climate nexus contexts, but available evidence indicates a severe and largely unaddressed burden (Cuartas *et al.* 2022).

5. The Child-Centered Climate Vulnerability Index for Afghanistan (CCVI-Af)

Existing global composite indices including the ND-GAIN Country Index (University of Notre Dame Global Adaptation Initiative 2023), INFORM Risk Index (European Commission Joint Research Centre 2023), and UNICEF's CCRI (UNICEF 2021) provide essential country-level benchmarks but lack the

sub-national, child-specific, and gender-disaggregated granularity required for targeted policy and resource allocation in Afghanistan's heterogeneous geographic and social landscape. The CCVI-Af, whose weighting rationale is developed in Section 2.3, operationalizes vulnerability across five empirically specified pillars. Table 3 presents the full framework including composite indicators and weight justifications.

Table 3. CCVI-Af Framework: Pillars, Indicators, Weights, and Justifications.

Pillar	Domain	Composite Indicators	Weight Rationale
1	Biophysical Exposure (0.25)	Drought frequency/severity; flood recurrence; temperature anomaly (°C/decade); glacial melt rate; land degradation index	Highest weight: primary trigger of all downstream vulnerability cascades; aligns with IPCC AR6 exposure weighting (ACAPS 2024).
2	Child Nutritional & Health Status (0.25)	Wasting (%); stunting (%); SAM prevalence; U5MR; maternal mortality; healthcare access barriers; vaccine coverage	Equal weight to Pillar 1: health/nutrition constitute the most immediate, measurable child harm pathway (UNICEF 2024), (Rahmat et al. 2023), (UNICEF 2023b).
3	WASH Access (0.20)	Households with water access barriers (%); groundwater depletion rate; distance to clean water (km); WASH infrastructure score	High weight: WASH directly mediates between climate exposure and child morbidity/mortality (United Nations Office for the Coordination of Humanitarian Affairs 2023), (IPCC 2022).
4	Education & Psychosocial Resilience (0.15)	School enrollment rate by gender; climate-induced attendance disruption (%); psychosocial support availability	Lower weight reflects co-determination with gender policy (non-climate factor); critical for long-run adaptive capacity (Perera 2008), (UNICEF 2023a).
5	Social Protection & Child Rights (0.15)	Child marriage rate (%); child labor incidence (%); gender movement restrictions index; birth registration (%); legal protection access	Lower weight: primarily mediated by governance; included as structural amplifier of climate harm (UN Women 2024), (Akseer et al. 2025).

Table 4. Regional Child Climate Vulnerability Profile for Afghanistan (2022–2024).

Regional Zone	Primary Climate Hazard	Child Wasting (%) [Range]	Water Barrier (%) [Range]	Climate Displacement Risk	Stunting (%) [approx.]	Key Source
South (Kandahar, Helmand, Zabul)	Drought / Desertification	12–16	75–85	Very High	47–50	(United Nations Office for the Coordination of Humanitarian Affairs 2023), (Save the Children International 2024), (Cuartas et al. 2022).
North (Balkh, Faryab, Kunduz)	Drought / Flash Flood	10–14	65–75	High	42–46	(United Nations Office for the Coordination of Humanitarian Affairs 2023), (Cuartas et al. 2022), (World Food Programme 2024).

Table 4. (continued)

Regional Zone	Primary Climate Hazard	Child Wasting (%) [Range]	Water Barrier (%) [Range]	Climate Displacement Risk	Stunting (%) [approx.]	Key Source
Central (Kabul, Wardak, Ghazni)	Flash Flood / Earthquake	9–12	60–70	High	40–44	(UNICEF 2024), (United Nations Office for the Coordination of Humanitarian Affairs 2023), (Brides 2024).
Northeast (Badakhshan, Takhar)	Landslide / GLOF	8–12	50–65	Moderate–High	38–43	(United Nations Office for the Coordination of Humanitarian Affairs 2023), (Jafari et al. 2024), (Cuartas et al. 2022).
East (Nangarhar, Kunar, Laghman)	Flash Flood / Heat	10–14	60–72	High	41–45	(United Nations Office for the Coordination of Humanitarian Affairs 2023) (Save the Children International 2024), (World Food Programme 2024).
West (Herat, Farah, Nimroz)	Drought / Dust Storm	11–15	65–78	Very High	44–48	(United Nations Office for the Coordination of Humanitarian Affairs 2023)

GLOF = glacial lake outburst flood; SAM = severe acute malnutrition; U5MR = under-five mortality rate; CHW = community health worker. Pillar weights are derived from the evidence-based procedure described in Section 2.3. Sensitivity analysis (±0.05 weight variation) produced a maximum rank reordering of one position across six regions, confirming robustness.

Table 4 presents a regional vulnerability profile synthesized from available institutional and peer-reviewed data, organized according to the five CCVI-Af pillar domains. Regional boundaries correspond to the six zones described in Section 2. Indicator values are expressed as ranges reflecting the within-region heterogeneity of available provincial estimates; the limitations of sub-national data availability are explicitly noted.

GLOF = glacial lake outburst flood. Values represent ranges from available provincial-level estimates synthesized from cited sources. Wasting and stunting percentages are drawn from MICS 2022–2023 (UNICEF 2023b) and Jafari et al. (2024). Water barrier percentage from UNICEF WASH assessments (UNICEF 2023c). Displacement risk is a qualitative composite of IDMC displacement data (2024) and OCHA risk assessments (2024). The South, West, and North zones exhibit the highest composite CCVI-Af scores based on available indicator data.

The Southern zone (Kandahar, Helmand, Zabul) receives the highest composite CCVI-Af score, driven by catastrophic drought severity, the highest wasting prevalence (12–16%), the most severe water access barriers (75–85% of households), and very high displacement risk. The Western zone (Herat, Farah, Nimroz) receives the second-highest score, characterized by severe drought, active desertification, and dust storm exposure. The Central zone, while displaying lower biophysical

severity scores than the South, scores particularly high on psychosocial and educational vulnerability dimensions due to earthquake exposure, dense urban displacement, and the concentration of gender restrictions enforcement. These regional differentiation patterns carry direct implications for geographic targeting of adaptation resources.

6. Discussion

6.1. Compound Vulnerability Entrapment: Situating Afghanistan in the Literature

The findings of this assessment establish Afghanistan as a paradigmatic case of what climate vulnerability scholars term compound or cascading risk a condition in which multiple, mutually reinforcing vulnerability drivers interact to produce outcomes that no single-sector intervention can adequately address. For Afghan children, this compounding operates across at least four interacting domains simultaneously: biophysical (intensifying drought and flood frequency), nutritional (SAM, stunting, and wasting at among the world's highest rates), governance (collapsed institutional adaptive capacity and systematic gender exclusion), and financial (structural exclusion from international climate finance). The food-water-health nexus is particularly potent: climate-driven water scarcity intensifies disease burden, which worsens nutritional absorption, which increases health-seeking behavior, which confronts a health system operating at critically reduced capacity (International Federation of Red Cross and Societies 2024).

This analysis contributes to a growing body of literature on the differential climate vulnerability of children in fragile and conflict-affected states (FCS). Diffenbaugh and Burke ([56]) establish that historically, climate change has significantly increased economic inequality between countries, and that the most severe impacts are concentrated in already low-income, high-temperature nations, a pattern that Afghanistan exemplifies. The Lancet Countdown on Health and Climate Change annual reports (Romanello *et al.* 2024) have progressively documented the escalating climate-health burden globally, and the findings reported here for Afghan children are consistent with the most extreme projections in that literature for South and Central Asia. What distinguishes Afghanistan is not simply the severity of any single indicator but the systemic co-occurrence of virtually every identified vulnerability pathway in a single national context.

The proposed CCVI-Af advances an established tradition of child-specific vulnerability index development while adding contextual specificity that global indices cannot provide. The empirically justified weighting procedure distinguishes this framework from earlier Afghan vulnerability assessments, which have typically relied on equal weighting or expert elicitation without reported sensitivity analysis. The robustness of the regional vulnerability ranking to ±0.05 weight perturbation strengthens confidence in the geographic priority ordering for resource allocation.

6.2. Gender as a Structural Amplifier of Climate Vulnerability

A particularly significant contribution of this analysis is the systematic documentation of gender-based governance policies as structural amplifiers of climate vulnerability. The standard climate vulnerability literature, including the IPCC AR6, addresses gender as a vulnerability modifier but does not typically analyze the specific mechanism by which education bans on girls directly reduce a society's adaptive capacity to climate change. UN Women (UN Women 2024) characterizes the cumulative effect of Taliban gender policies as a "compound vulnerability trap" that deepens intergenerational poverty and climate exposure—a framing consistent with the empirical evidence presented here. The exclusion of women from agricultural labor, healthcare provision, and education has demonstrably reduced the human capital base upon which climate resilience depends (Muttarak and Lutz 2014).

The literature on education-climate adaptation linkages is increasingly robust: Muttarak and Lutz demonstrate in cross-national analysis that female educational attainment is among the strongest predictors of national adaptive capacity to climate hazards, operating through pathways including

health-seeking behavior, dietary diversification, disaster preparedness, and reduced fertility rates. The Taliban's educational exclusion of girls therefore constitutes not merely a human rights violation but a quantifiable reduction in Afghanistan's climate adaptive capacity, a framing that situates gender equity explicitly as a structural climate adaptation investment, not merely a parallel humanitarian concern.

6.3. Afghanistan's Exclusion from Climate Finance: A Structural Barrier

One of the most structurally significant aspects of Afghanistan's climate vulnerability is its de facto exclusion from international climate finance mechanisms. Following the Taliban's assumption of power, the UNFCCC COP Bureau decided in 2022 not to recognize any Taliban institution as the country's focal point, effectively preventing Afghanistan from accessing the Green Climate Fund, the Adaptation Fund, and other multilateral climate financing instruments (The Diplomat 2024). Afghanistan's pre-2021 Nationally Determined Contribution identified adaptation needs of USD 20.6 billion between 2021 and 2030, including at minimum USD 2.5 billion for watershed management and USD 4.5 billion for irrigation rehabilitation (UNDP 2024) (Food and Agriculture Organization of the United Nations 2020). The National Environmental Protection Agency (NEPA) has appealed for resumption of 32 climate projects worth USD 824 million suspended by donor institutions.

Recent scholarship and practitioner analysis has converged on the position that climate finance must be channeled through NGO intermediaries and UN agencies rather than state structures, ensuring resources reach vulnerable communities without legitimizing the Taliban (The Diplomat 2024), (Forum 2025). As of 2024, UNDP has implemented community resilience programs in 18 districts across 12 provinces, and the EU has funded a three-year climate adaptation project via the Norwegian Afghanistan Committee but these initiatives collectively reach only a small fraction of the population (Watch 2025). UNICEF's 2023 Humanitarian Appeal for Afghanistan was funded at only 31% of required levels (Watch 2025). For children specifically, only 2.4% of climate finance from key multilateral funds globally supports child-responsive activities (UNFCCC/UNICEF 2023), compounding country-level exclusion into near-total financing absence for Afghan children.

6.4. Limitations

Several important limitations constrain the conclusions of this study. First, child-specific, climate-disaggregated data for Afghanistan are severely constrained by the partial collapse of national statistical systems, restricted humanitarian access in many provinces, and the Taliban’s active impediments to independent data collection, particularly regarding women and girls. The MICS 2022–2023 (UNICEF 2024), while representing the most comprehensive recent dataset, was conducted under significant methodological constraints and with partial geographic coverage. Second, the vulnerability assessment presented here is substantially cross-sectional; longitudinal data on climate-exposed children’s developmental outcomes are essentially nonexistent for Afghanistan. Third, the attribution of specific child outcomes to climate change as distinct from conflict, economic collapse, or governance failure is difficult to disentangle with currently available methods. Future research should prioritize climate attribution studies adapted to the Afghan context, building on methodological advances in extreme event attribution (Attribution 2024) and leveraging remote sensing datasets that are not subject to access restrictions. Fourth, the CCVI-Af, as presented here, relies on indicator ranges rather than precise point estimates for several sub-national dimensions, reflecting genuine data scarcity rather than methodological imprecision; future iterations of the index should prioritize primary data collection at the provincial level. Fifth, humanitarian reporting bias is a structural concern: international agencies systematically over-report from provinces with better access (e.g., Kabul, Herat) and under-report from conflict-affected or remote areas, potentially understating vulnerability in the most isolated communities. Sixth, many indicators included in the CCVI-Af are drawn from sources produced by organizations with an institutional mandate to advocate for affected populations, which may introduce advocacy framing into quantitative

estimates; where alternative estimates from independent peer-reviewed sources exist, these are preferred and noted. Seventh, temporal inconsistencies between datasets some indicators drawn from 2022, others from 2024 mean that the CCVI-Af captures a time-averaged vulnerability state rather than a single-point cross-section; users of the framework should account for rapid changes in humanitarian conditions when applying or updating the index.

7. Policy Recommendations: A Five-Pillar Framework for Child-Centered Climate Adaptation

The evidence synthesized in this article points to a profound and widening gap between the scale of children's climate vulnerability in Afghanistan and the resources, institutional frameworks, and political will mobilized to address it. The following five-pillar framework is proposed for the international community, humanitarian actors, and research institutions. It is grounded in existing evidence and aligned with the UNCRC General Comment No. 26 (2023) (UNICEF 2023c), UNICEF's CCRI recommendations (UNICEF 2021), and the IPCC AR6 guidance on climate-resilient development (IPCC 2022). Table 5 summaries the framework.

Table 5. Five-Pillar Framework for Child-Centered Climate Adaptation in Afghanistan.

Pillar	Focus Area	Priority Actions	Primary Actors	Timeframe
I	Humanitarian-Climate Finance Nexus	Establish NGO/UN-mediated climate finance channels; apply Loss and Damage Fund to Afghanistan via civil society; scale EU-NAC model	UN agencies, EU, GCF, bilateral donors	0–12 months
II	Child-Specific Early Warning & DRR	Develop province-level drought/flood warning with child-specific triggers; pre-position SAM stocks; expand UNICEF community DRR networks	UNICEF, OCHA, national NGOs	1–2 years
III	Climate-Resilient WASH & Health Infrastructure	Rehabilitate karezes; expand solar water systems (≥5,000 units); establish climate-proof health centers in drought-endemic provinces	UNICEF, WHO, IFRC, World Bank	1–3 years
IV	Girls' Education & Women's Agency as Adaptation Investment	Fund community-based and digital education platforms; support female CHW networks; frame gender equity explicitly as climate adaptation	UN Women, UNICEF, AKDN	2–5 years
V	Research, Data & Child Rights Accountability	Implement annual CCVI-Af monitoring; conduct longitudinal cohort studies; prioritize Afghan-authored climate-child research	Academic institutions, UNICEF, IDMC	Ongoing

CHW = Community Health Worker; AKDN = Aga Khan Development Network; GCF = Green Climate Fund; DRR = Disaster Risk Reduction; NAC = Norwegian Afghanistan Committee.

7.1. Pillar I: Humanitarian-Climate Finance Nexus

International donors and multilateral institutions must develop financing modalities that channel climate adaptation resources to Afghan communities without requiring engagement with Taliban governance structures. NGO-mediated and UN-administered climate finance, modeled on existing EU-NAC and UNDP community programs, should be dramatically scaled. The Loss and Damage Fund agreed at COP27 and formalized at COP28 must include Afghan communities as eligible beneficiaries through civil society intermediary mechanisms. UNICEF's proposal for a Global Goal on Adaptation

incorporating child-responsive resilience measures should be adopted and applied to Afghanistan as a priority case (UNFCCC/UNICEF 2023).

7.2. Pillar II: Child-Specific Early Warning and Disaster Preparedness

Current early warning systems in Afghanistan are inadequate for the child-specific hazard profiles documented in this article. Investment is required in province-level drought and flood early warning systems that trigger child-specific response protocols: rapid nutrition screenings, pre-positioned therapeutic food stocks, emergency WASH deployment, and school-based shelter. Community-based disaster risk reduction (DRR) programs, designed in partnership with children and youth where safe to do so, should be expanded using UNICEF's existing provincial networks and adapted to Afghanistan's specific compound hazard profile.

7.3. Pillar III: Climate-Resilient WASH and Health Infrastructure

The collapse of water infrastructure is both a consequence of climate change and a primary driver of child mortality and morbidity. Emergency rehabilitation of karezes, expansion of solar-powered water pumps, and construction of community water storage facilities must be prioritized in the most drought-affected provinces. UNICEF's solar water system program should be substantially expanded beyond the 1,855 systems installed in 2022. Investment in health infrastructure resilient to climate shocks including solar-powered health centers capable of operating independently of the electricity grid and pre-positioned with nutrition therapeutic supplies is critical for sustained climate-health resilience.

7.4. Pillar IV: Girls' Education and Women's Agency as Climate Adaptation Imperatives

The evidence reviewed in this article is unambiguous: the exclusion of girls from education and women from economic participation does not merely constitute a human rights violation; it measurably and directly diminishes Afghanistan's adaptive capacity to climate change (Muttarak and Lutz 2014). The international community must sustain principled advocacy for girls' education and women's rights as structural components of climate adaptation, not merely as parallel humanitarian concerns. Programming should support community-based education initiatives, digital and mobile learning platforms for girls, female community health worker networks, and women-led climate resilience projects such as those implemented by the Aga Khan Development Network (Forum 2025). Resources directed at girls' education and women's economic empowerment should be explicitly framed and funded as climate adaptation investments.

7.5. Pillar V: Research, Data, and Child Rights Accountability

A critical constraint identified throughout this article is the shortage of child-disaggregated, climate-specific empirical data for Afghanistan. The international research community should prioritize: (1) province-level CCVI-Af assessments using primary data collection, where access permits; (2) longitudinal studies of climate-exposed children's developmental outcomes in Afghan refugee and returnee populations; (3) gender-differentiated attribution analyses of climate impact pathways; and (4) evaluation studies of climate finance modalities that bypass governmental structures. Annual child-climate monitoring using updated MICS and IDMC data should be instituted as a standard element of humanitarian reporting. Academic journals should prioritize Afghan-authored climate-child research to support epistemic sovereignty in a country whose academic infrastructure has been severely degraded.

8. Conclusion

This article has presented the most comprehensive peer-reviewed vulnerability-based assessment of climate change impacts on children in Afghanistan to date. Drawing on a systematic integrative review of 145 sources meeting defined inclusion criteria including peer-reviewed journal articles,

institutional datasets, official surveys, and normative documents it has synthesized evidence across five vulnerability dimensions, proposed and empirically justified the CCVI-Af framework, and advanced an operationally grounded, five-pillar policy framework.

The quantitative picture is stark in isolation and sobering when understood as an interconnected system: 747,094 children displaced by climate disasters in 2023 (the world's highest figure); 7.8 million children facing crisis-level hunger; 875,000 children requiring SAM treatment; 45.0% stunting prevalence (95% CI: 43.2–46.8%); 67% of households without safe water access; 2.2 million girls denied education; and newborns projected to face 5.3 times more drought across their lifetimes than today's elderly all in a country contributing approximately 0.06% of global greenhouse gas emissions and currently excluded from the major international climate finance mechanisms designed to support the most vulnerable nations.

The CCVI-Af offers a contextually adapted, sub-nationally applicable, and robustness-tested framework for monitoring, research, and resource allocation in the Afghan context. The five-pillar policy framework provides a roadmap grounded in institutional feasibility, rights-based obligations under UNCRC General Comment No. 26 (United Nations Committee on the Rights of the Child 2023), and the IPCC AR6's guidance on climate-resilient development (IPCC 2022). But frameworks require political will and financial commitment to generate outcomes. The Loss and Damage Fund must reach Afghan communities through civil society channels. Climate adaptation finance must flow to children without normalizing the Taliban. Girls' education must be sustained and expanded as a structural climate adaptation investment.

The broader global significance of Afghanistan’s case is also a question of distributional equity in climate outcomes. Findings suggest that Afghan children experience disproportionate climate-related vulnerability relative to Afghanistan’s global greenhouse gas emissions contribution (approximately 0.06%), a pattern consistent with the broader literature on climate vulnerability concentration in historically low-emitting nations (Romanello *et al.* 2024). The UN Committee on the Rights of the Child has explicitly characterized this pattern as a violation of children’s rights under the UNCRC (United Nations Committee on the Rights of the Child 2023). The international community has a normative obligation under international human rights instruments and a strategic interest in preventing further deterioration of humanitarian conditions to respond at a scale commensurate with the documented vulnerability. The evidence compiled in this article indicates that current response levels remain substantially insufficient relative to the scale and severity of child climate vulnerability in Afghanistan.

Declarations

Author contributions. Meena Wardak, the sole author, was responsible for conceptualization, methodology, validation, formal analysis, investigation, writing (original draft) and writing (review and editing). The author has read and agreed to the published version of the manuscript.

Funding. This research received no external funding.

Conflicts of interest. The author declares no conflict of interest.

Data availability. This study is based entirely on secondary analysis of publicly available peer-reviewed publications and open-access institutional databases cited throughout the manuscript. The compiled CCVI-Af dataset, indicator matrix, and scoring framework are available from the corresponding author upon reasonable request.

Ethics. Not applicable. This study is a systematic integrative review of publicly available secondary data and published literature. No primary data collection involving human participants was conducted.

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HOW TO CITE THIS ARTICLE

Wardak, M. (2026). Children at the Frontline of Climate Change: A Vulnerability-Based Assessment of Climate Impacts on Children in Afghanistan. Global Decarbonisation, 2, 207-227. https://doi.org/10.65582/gd.2026.011

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