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Climate change and health in Central Asia: a literature review

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ABSTRACT

Countries in Central Asia, which are highly vulnerable to climate change, experience a variety of health-related impacts to which they must adapt. At the same time, climate mitigation interventions in the health sector in the form of reduced greenhouse gas (GHG) emissions may also generate co-benefits. This article briefly outlines current understanding of the relationship between climate change impacts and human health in Central Asia and establishes a scope of inquiry based on climate and health linkages as identified by the Intergovernmental Panel on Climate Change (IPCC). It then identifies and summarizes existing research and reporting on this topic in the region as presented in published literature, country reporting to the United Nations Framework Convention on Climate Change (UNFCCC), and gray literature, including policy literature and documentation of donor-funded development interventions in the region. This review, which attempts to summarize and appraise those efforts, has found that both peer-reviewed and grey literature on this topic must be used with caution. The most frequent problems with peer-reviewed and grey literature resources involved confounding bias, and—to a lesser extent—self-reporting bias. The use of an appraisal framework for grey literature sources can frame these diverse resources in the proper context, identify potential shortcomings, and gain insights into current priorities and future direction for research on climate change and health in the region.

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1. Introduction

A “Health Day” at 28th Conference of the Parties (COP28) of the United Nations Framework Convention on Climate Change (UNFCCC), the first of its kind, called attention to the multivarious linkages between climate change impacts and health. While this event was the first of its kind at a COP, it was informed by many prior years of research into the relationship between climate change and health. Adverse health impacts due to climate change were originally noted in Article 1 of the UNFCCC (UNFCCC, 1992: Art. 1.1). At the meeting of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA) held at COP28, the CMA adopted the UAE Framework for Global Climate Resilience, which establishes a target of “Attaining resilience against climate change related health impacts, promoting climate-resilient health services, and significantly reducing significantly reducing climate-related morbidity and mortality, particularly in the most vulnerable communities…” by 2030 and beyond (CMA, 2023: Art. 8 (c)).

Momentum to action in the area of climate change and health has also come from the global health policy sector. A December 2023 World Health Organization (WHO) report by the Director General to the organization’s Executive Board on climate change and health, noting that “This fundamental threat to human health requires a strong response from the global health community to protect health from increasing climate hazards, ensure access to high quality, climate resilient, environmentally sustainable health services, and improve health, while limiting global warming to the agreed 1.5˚C limit. This will require action on both adaptation (protecting health from the impacts of climate change) and mitigation (limiting emissions of greenhouse gases and other climate pollutants into the atmosphere)” (WHO, 2023). Specifically, the report notes that “There is a need for national health and environment agencies to systematically assess climate-related risks to health systems and health outcomes, and to develop national health adaptation plans to ensure that the health of the population is resilient to climate shocks and stresses” (WHO, 2023).

2. Climate change and health

In discussing the relationship between human health and adaptation to climate change, defining a scope for inquiry can be challenging due to conceptual complexity. Talkuder et al., (2023) present climate change and health as a complex adaptive system, where sub-systems of extreme weather, ecological services, food security, disaster risk reduction (DRR) and clinical public health interact in simple and complex ways. Interaction occurs within these five sub-systems, with adjacent variables, and with all of the five sub-systems interacting with one another.

Current understanding of general conceptual relationships of climate change adaptation and human health is elaborated in the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC) Working Group II and the IPCC Synthesis Report (IPCC, 2022, 2023a). Specifically, the AR6 notes that hazards and associated risks expected in the near term include an increase in heat-related human mortality and morbidity (high confidence), food-borne, water-borne, and vector-borne diseases (high confidence), and mental health challenges (very high confidence)…Cryosphere-related changes in floods, landslides, and water availability have the potential to lead to severe consequences for people, infrastructure and the economy in most mountain regions (high confidence)" (IPCC, 2023: 15). The report also notes that adaptation actions could generate health benefits. As the report concludes, "Deep, rapid, and sustained mitigation and accelerated implementation of adaptation actions in this decade would reduce projected losses and damages for humans and ecosystems (very high confidence), and deliver many co-benefits, especially for air quality and health (high confidence)" (IPCC, 2023: 15). Specific adaptation options to help protect human health identified with high confidence or very high confidence by the report include Heat Health Action Plans, surveillance and prevention of vector-borne and water-born illnesses, early warning systems, and universal access to healthcare. (IPCC, 2023: 107).

The AR6 report also covers the relationship between climate change mitigation and health, noting that "Implementing both mitigation and adaptation actions together and taking trade-offs into account supports co-benefits and synergies for human health and well-being. For example, improved access to clean energy sources and technologies generates health benefits especially for women and children; electrification combined with low-GHG energy, and shifts to active mobility and public transport can enhance air quality, health, employment, and can elicit energy security and deliver equity. (high confidence)" (IPCC, 2023: 31).

3. Climate-Health Relationships and the Central Asian Context

From the perspective of threats to human health as noted by the IPCC, all Central Asian countries experience extreme all Central Asian countries experience extreme heat to varying degrees along with other extreme weather events. Mean temperatures in the region are projected to increase by as much as 6.5 degrees Celsius by 2100, exposing the population of the region to heat waves that are more frequent and longer (Reyer et al., 2017). Infectious diseases with vector-borne and water borne pathogens are also found in the region. The presence of the high-mountain cryosphere in four of the five countries also presents threats in the form of mudslides, avalanches, and glacial lake outburst floods, or GLOFs (Hock et al., 2019).

Secondary effects such as drought have a variety of indirect effects on human health in the region, such as decreased water quality and reduced agricultural yields, which in turn can affect food security and livelihoods.

Vulnerability, as a function of exposure to climate threats and adaptive capacity, varies both across countries in the region and within individual countries (Novikov and Kelly, 2017, Droogers and Lal, 2018). Vulnerability also differs between men and women, as they experience different levels of exposure to climate threats and different levels of adaptive capacity. Other vulnerable groups in the region include infants and children, pregnant women, the elderly, people with pre-existing health conditions, and people residing in areas at risk for climate-related hazards such as floods or mudslides.

Variability across countries should also be seen as influenced by differing conditions in demography, population health, and health services. These factors may influence exposure to climate threats and adaptive capacity. Table I provides an overview of summary indicators by country.

Table I. Summary Health Indicators by Country

	Female/ Male Life Expectancy at Birth (2022 est.)	Total Fertility Rate (Live Births per Woman, 2022 est.)	Infant Mortality per 1,000 Live Births (2022 est.)	Current Health Expenditure as a % of GDP (2020)
Kazakhstan	73.0 (F) 65.8 (M)	3.0	8.5	3.8
Kyrgyzstan	74.9 (F) 66.2 (M)	2.9	13.1	5.3*
Tajikistan	71.3 (F) 69.2 (M)	3.1	23.4	8.2
Turkmenistan	72.9 (F) 65.9 (M)	2.6	32.9	5.7
Uzbekistan	74.3 (F) 69.0 (M)	2.8	12.4	6.7

*Estimate

Source: UNSD, 2023: 26-54 (demographic data); 177-186 (expenditure data).

Beyond descriptive literature covering general conceptual linkages, information on health and climate change research in Central Asia can be elusive. A 2022

article entitled "A void in Central Asia research: Climate change," which reviewed the academic research in English-language databases, found that "Anthropology, international relations, and public health are the least active disciplines in the study of climate-related issues in Central Asia." (Vakulchuk et al., 2022: 5). The authors also state that the lack of literature on climate change and health in the region "is one of the major gaps in the literature that needs to be addressed" and "We found only one peer-reviewed publication and one grey literature publication on climate change and health, although the health impacts of climate change are likely to have social, economic, and potentially even political ramifications." (Vakulchuk et al ., 2022: 8, 12). This study represents an important assessment of research as identified in English-language, peer-reviewed sources (although it also cites some studies that are not published in academic journals). It also identifies a gap in the literature and rightly notes its potential implications. However, as the authors note, it does not survey Russian-language publications, which limits its scope in a region where Russian-language journals have been a traditional path for academic publication and where many researchers received their doctoral degrees from Russian-language institutions. As a result, the review excludes a stream of research that has emerged in the previous two decades on climate change, and as a sub-sector, climate change and health.

In a study that builds on this work, Mirzabaev notes that "The scientific literature on climate change in Central Asia has also been growing rapidly, but remains very small." (Mirzabaev, 2022: 23). His bibliometric analysis does not mention health directly, but rather addresses climate change as a whole. The analysis also identifies Russian-language literature, which provides additional information on addresses a – another important step – identifying additional resources. His English-language search identifies 325 publications relevant to the region as a whole, and country-specific publications for Kazakhstan (104), followed by Uzbekistan (69), Tajikistan (65), Kyrgyzstan (35) and Turkmenistan (5). For Russian-language sources, he identifies "indexes 32 publications for Central Asia as a whole. By country, the figures were 51 publications for Kazakhstan, followed by Tajikistan (26), Kyrgyzstan (19), Uzbekistan (14) and Turkmenistan (1) (Mirzabaev, 2022: 27).

He notes that "These results show that publications on climate change in Central Asia have been primarily dedicated to the biophysical impacts of climate change. There have been relatively few studies investigating the socioeconomic impacts of climate change, issues related to people's vulnerability to climate change and the social and economic dimensions of climate change adaptation." (Mirzabaev, 2022: 27). This study broadens current understanding of climate change research related to Central Asia in peer-reviewed publications.

4. Methodological approach

This article aims to cast a broad net across peer-review, grey literature, and video resources for climate change and health in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan in order to provide additional information on the state of research, policy, and understanding in that area. In addition to assessing peer-reviewed articles on climate change and health, it supplants these sources with additional research and reporting through key word searches, referrals from experts in the field, and the author's personal collection, drawing upon the following types of non-peer-review sources in English and Russian:

1) National communications to the UNFCCC;
2) Analytical reports by UN agencies and multilateral organizations
3) Donor-funded project reports and evaluations
4) Press releases and articles in the popular press
5) National policies and strategies
6) Non-print sources (video and film)

For all sources, the author limited review to sources of information that were publicly available in digital format in English and/or Russian.

For the identification of peer-reviewed articles, the author ran a Web of Science Core Collection search using the search terms ["climate change" AND "human health" AND "Central Asia"] and five country-specific searches (e.g. ["climate change" AND "human health" AND "Kazakhstan"]). For Russian-language publications, the author conducted a search on Google Scholar using the query ["изменение климата" "здоровье" "в Центральной Азии"] and five country-specific queries (e.g. ["изменение климата" "здоровье" "в Казахстане"]). Criteria for inclusion were a focus on a specific climate threat or threats and linkages to human morbidity and/or mortality in the five countries under study. For this reason, general review articles with statements on climate change potentially affecting human health were not included, nor were articles that looked broadly at environmental health without focusing on climate variability. The author supplanted this list with three previously-identified sources that met inclusion criteria.

For National Communications to the UNFCCC, the author searched the UNFCCC on-line database of non-Annex I NCs submitted as of February 28, 2024 for each of the five countries (18 results). All 18 reports were deemed to be official NCs and were included in consideration. The topics identified in these reports were then classified by the major health and well-being areas identified by the IPCC Sixth assessment report as having medium, high, or very high confidence regarding adverse impacts: infectious diseases; heat, malnutrition, and harm from wildfire; mental health; and displacement (IPCC, 2023: 7).

Analytical reports by UN agencies and multilateral organizations were compiled by searching the available UNECE Environmental Performance Reports and OSCE Environmental Security Initiative reports for the region. An additional report from the IMF was also included.

For donor-funded project reports and evaluations, the author consulted donor document databases (UNDP, GCF, WHO). Information on other sources of print information consists of selected examples and is not meant to be indicative. For non-print sources, (video and film), YouTube and Vimeo searches conducted for English-language video material [“climate change” “health” “Central Asia”] and for Russian-language video material ["изменение климата" "здоровье" "в Центральной Азии"] were supplanted with two videos available on Vimeo known to the author that did not appear in the search results and with country-specific Russian-language searches on YouTube.

Findings from these sources were compiled and then summarized and appraised critically. The appraisal is modeled on the AACODS framework for assessing grey literature (Tyndall, 2010), which considers authority, accuracy, coverage of content, objectivity, date, and significance. This scope of inquiry is not intended to be exhaustive, but rather to expand the current documentation of literature, describe key types of grey literature, identify diverse sources of information on climate change and health in Central Asia, assess their utility in the current discussion, and identify trends and gaps that should be addressed by future research.

5. Findings

5.1. Published literature

Peer-reviewed articles and books with a discussion of climate change and health are rare. Under English-language resources, the Web of Science Core Collection search ["climate change" AND "human health" AND "Central Asia"] produced 33 results, but all were excluded according to the methodology provided in the previous section. Country searches yielded one journal article:

- ["climate change" AND "human health" AND "Kazakhstan"] (R=8), all excluded.
- ["climate change" AND "human health" AND "Kyrgyzstan"] (R=5), all excluded
- ["climate change" AND "human health" AND "Tajikistan"] (R=4), all excluded
- ["climate change" AND "human health" AND"Turkmenistan"] (R=5), all excluded
- ["climate change" AND "human health" AND "Uzbekistan"] (R=13), all excluded

That said, foundational work, in which relationships between climate and health, particularly as health is impacted by climate change, is common. One recent example is that of a book chapter by Daloz (2023) entitled “Climate Change: A Growing Threat for Central (Asia)". The chapter includes a general description of the

nature of climate change impacts on health in Central Asia, including heat stress and secondary effects, such as threats to livelihoods and potential malnutrition (Daloz, 2023:18).

A number of articles searched that included climate change and health in their titles and/or abstracts did not present health data. For example, Kaimuldinova and Abdimanapov (2013) stated that their study examined "dangerous meteorological phenomena" and their "influence on human health" (p. 390). This study focused on the Jambyl and Almaty provinces and presented the frequency of various extreme weather events. However, no health data were included in the article, making it impossible to see an association between changes in frequency and changes in morbidity and mortality. Isaev et al. (2022), in their article "Impact of Climate Change and Air Pollution...," studied a phenomenon that had an indirect effect on human health: air quality. As the authors stated, "Climate change in Bishkek and the impact on air pollution was assessed via the frequency of days characterized by daytime temperature inversions and air stagnation," and the article also stated that "Atmospheric stability increased from 2015 to 2020 with ongoing climate change leading to more temperature inversions." (Isaev, 2022: 1). While both of these articles were not able to establish a relationship between climate change and health outcomes, they present information that could serve as the foundation for climate-health research in the region if health data and statistics were introduced.

The Russian language search also identified articles that primarily addressed climate-health relationships in a broad conceptual manner. For example, Yunusova (2023) discusses the characteristics of heat islands in Kazakhstan and states that "on average, 1000 people die of extreme heat" but does not cite data sources or the area of coverage of that figure p. 352 in (Russian). A contribution to conference proceedings by Tuktibaeva and Bekturganov (2019), "The Impact of Climate Change, Seasonal Change on the Dynamics of Morbidity of Preschool-Aged children" [in Russian] provides only general climate information and assesses morbidity by using statistics on school absence. While this study comes the closest of those identified to intentionally study an association between climatic phenomena and health outcomes, its use of a proxy for illness (school absence) and assertion that weather is the primary determinant in morbidity leads it open to substantial confounding bias. The study does not discuss limitations of its approach.

In addition to these results, two peer-reviewed articles on climate change and health in Central Asia that were identified as secondary sources from a broader literature review overstated the scope of research in their titles. One "regional" article titled "Failed development and vulnerability to climate change in Central Asia: implications for food security and health" (Janes, 2010), which was identified by Vakulchuk et al., does not study any of the five Central Asian republics in this

review, but rather limits its research to Mongolia. Another, Bhuiyan and Khan (2011), titled "Climate change and its impacts on older adults' health in Kazakhstan," relied on self-reported data from 60 adults in Almaty, 40% of whom were under the age of 50. The authors did acknowledge these limitations in the discussion section of their article, writing "First, the field study of this research was conducted only in five micro-districts in the Almaty region among 16 oblasts (regions) in Kazakhstan; therefore, the empirical results presented here are not representative but indicative in nature. Second, the respondents were asked subjective questions to understand their awareness of the effects of climate change and its impact on health without knowing whether or not the respondents had been suffering from the climatic diseases; more accurate and objective answers would have been recorded if the survey was conducted only among those people who had been affected by climatic health trauma. (Bhuiyan and Khan, 2011: 113).

In another case, a study summarized was not possible to analyze, as only the conference summary proceedings were published. Belov and Filipchenko (2013) described a study they had developed in conjunction with a joint WHO-Ministry of Health project supported by the German Ministry of Environment, Nature Protection, and Nuclear Safety. The summary describes the study as covering climate factors in morbidity and mortality of residents in Bishkek and the Chuy Valley. The study found "Significant associations between incidence and mortality of residents of Bishkek for different classes of diseases in relation to weather conditions, at a more significant level for advanced and senile age were revealed. An increase in the incidence of cardiac and cerebro-vascular diseases is predicted." However, the original study data are not provided, and it is not clear how the study controlled for other factors.

5.2. Country Reporting to the UNFCCC

Country reporting to the UNFCCC in the form of National Communications (NCs) has provided analysis of health and climate change for countries in Central Asia, but these documents are often overlooked. Health and climate change information tends to be included in discrete sections under the prescribed chapter on impacts, vulnerability, and adaptation; however, additional information relevant to human health, such as data on wildfires, floods, mudslides, and glacial lake outburst floods may appear elsewhere. Occasionally health- and healthcare-related information is provided with information on mitigation; education, training, and public awareness; and research.

Kazakhstan has produced five NCs. Its initial NC mentioned the relationship between climate change and health in its description of national circumstances, although specific health data were not provided. Heat stress, infectious disease, and sub-national differences were already identified: "Possible influence of climate

change on human health can be negative because of strengthening heat stress, especially in southern areas, and distribution of many kinds of diseases as well." (RK, 1998: 31). The initial NC also noted that education and public awareness programs could decrease negative health impacts of climate change (RK, 1998: 69). The second NC expanded health coverage in its vulnerability assessment, it and covered a broad variety of health impacts. It also identified vulnerable groups and regions. The 3rd-6th NC (submitted as a single report as Kazakhstan shifted its reporting status under the UNFCCC), summarized a vulnerability assessment that had been carried out for the public health system as part of the compilation of the NC, which identified groups vulnerable to health impacts (MEP, 2013: 23).

The 8th NC reports on health impacts of floods and notes the health impacts of displacement. (MEGNR, 2022: 296). The 8th NC also provides findings from studies cited in the vulnerability assessment. For example, a study for Astana in 2012 an increase in death by suicide and drowning associated with a temperature increase (incidence not known). (MEGNR, 2022: 296). Other studies related to ambulance calls in Nur Sultan, self-reported changes in blood pressure.: and average temperature and coronary heart disease and an inverse relationship between temperature and acute bronchial asthma. (MEGNR, 2022: 300-301; 304; 306). Kazakhstan is the only country in this sample to mention mental illness, stating that "People with mental illnesses and those taking medications to treat various mental disorders, such as depression, anxiety, and other mood disorders, are particularly vulnerable to extreme weather events. Severe heat, as a rule, aggravates existing mental illnesses (impaired mood, increased anxiety, emerging aggression, more intense hallucinations in patients with schizophrenia, dementia, organic brain lesions). As a result, suicides tend to rise during periods of intense heat (MEGNR, 2022: 312).

Finally, the 8th NC notes limitations in research, such as the fact that moribidity and mortality data from institutions are only submitted annually. (MEGNR, 2022: 315). They suggest prospective data collection in cooperation with provincial governments, citing an older study on temperature and strokes (Erkebaevna et al., 2011). They also acknowledge issues with confounding bias, stating "At the moment, it is possible to observe higher incidence of diseases, the occurrence and exacerbation of which may be associated with climate change, but it is difficult to confirm such relationship because the development of diseases can also be influenced by living in an ecologically unfavorable area, harmful habits, heredity, non-participation in existing screening medical programs, remoteness from healthcare institutions, or vice versa, improved quality and accessibility of medical care enable better diagnostics, and, accordingly, increase the number of cases of newly detected diseases." (MEGNR, 2022: 315).

Kyrgyzstan has produced three NCs and submitted its first NC in 2003, which contained a discussion of health in the vulnerability assessment (MEE, 2003: 16).

The communication contains information on emergency room admissions in summer months and a discussion of temperature increase and its impacts. It also recommends measures to adapt to climate change.

In the second NC, health is identified as a priority sector for adaptation. Discussion of health focuses largely on modeling impacts and vulnerability for population health, including chronic disease incidence. The report models climate-related hazards for the Central, South and North regions of the country. The second NC also provides recommendations on adaptation to climate change in the health sector, including expanding research on adverse health impacts, developing a climate and health research plan, increasing public awareness, and providing training for health professionals. (KR, 2009: 24-5). The second NC developed its vulnerability assessment from statistic from sources including the Republican Medical-Information Centre (RMIC); the Department of State Sanitary and Epidemiologic Control, the Ministry of Health (DSSEC); the Center of State Sanitary and Epidemiologic Control (c. Bishkek, Ton and Jety-Oguz rayons of Issyk-Kul oblast (CSSEC); the National Center of Oncology, Kyrgyz Republic Ministry of Health (NCO), the Research and Production Association 'Preventive Medicine,' the Ministry of Health (RPAPM); and the Republic National Statistical Committee (NSC). The second NC mentions lack of data as a problem for the vulnerability assessment, and the discussion of health statistics notes that "Analysis of the data on acute intestinal infections and blood circulation system diseases did not consider the gender aspect" (KR, 2009: 142). The third NC presents climate-sensitive health information, including climate hazards in mountain regions, vector-borne illness (malaria and tic-borne encephalitis) (KR, 2016: 22-3).

Tajikstan has submitted four NCs, with its first in 2002. Its first NC addressed threats to human health and noted that "Alterations in the hydrological cycle will lead to water shortage and an increase of water temperature in the rivers. This fact will favor to the formation of potential choleric and malaria water reservoirs, especially in lower reaches of Syrdarya, Vakhsh, Kafirnigan and Pyanj rivers." (RT, 2002: 16). It also identifies the Kurgan-Tube district of the Khatlon province as particularly vulnerable to heat stress with its effects on health and labor productivity (RT, 2002: 76). It also identifies key themes, such as increased vulnerability to climate experienced by low-income people, the need for improved public health surveillance, the need for further study on climate and health, the need for awareness raising and capacity building in the health sector, and the potential for adaptation measures to "decrease or prevent severe effects of climate change and provide common preparedness" (RT, 2002: 18; 21). The initial NC also provides historical analysis of temperature and malaria incidence in Tajikistan from 1935 to 1995 (RT, 2002: 76). The third NC assesses temperature and reproductive health and reported health risks to pregnant women and infants when the temperature exceeded +37°C, which

is a frequent occurrence in parts of the country (GRT, 2014: 12). The third NC also identified health co-benefits of mitigation in the waste sector.

The fourth NC confirms previous topics and reiterates that the most powerful determinant of vulnerability to health risks associated with climate change appears to be poverty (GRT, 2022: 93). It also puts forward long-term adaptation priorities determined on basis of policy docs, expert review, and consultations, and it reports on education activities, such as a series of lectures for students on human adaptation to climate change and health aspects of climate change, which were delivered in 2000-2012 at the Public Health Faculty of Tajik State Medical University. (GRT, 2022: 134.). Furthermore, the fourth NC identifies co-benefits of mitigation projects that it presents, such as the activities of two NGOs, noting, "The use of energy-efficient stoves and improved insulation of houses enabled a 30% reduction in the consumption of firewood and coal, which, in addition to benefits for the climate system, also lowers the impact of emissions from burning fuel and biomass in or near the premises on the health of the local communities. (GRT, 2022: 137). The fourth NC also describes a microcredit program to improve the efficiency of heating and cooking systems designed to reduce risks to households. (GRT, 2022: 138.)

Turkmenistan has produced three NCs, beginning with its initial NC in 2000. Treatment of health and climate change is brief, although heat stress and water availability are identified as serious issues for the country (MNP, 2000: 37, 38). The second NC mentions the mentions the adverse health impacts of the oil and gas industry (MNP 2010: 18). Some published literature is cited, although very little is related to climate change and health in a way that is specific to Turkmenistan. However, literature cited does reflect a long-standing tradition of research of heat and arid climate on human health, including occupation health, with a number of publications from the 1980s and 1990s cited in the bibliography. The second NC outlines challenges for specialists in the field of medical climatology in Turkmenistan, including the assessment of health impacts of high temperatures in different regions of the country, the identification of populations at high risk of climate-related health problems, the development of prevention programs, the development of climate-sensitive working conditions in the arid region of the country, and the creation of a database on climate change impacts on human health and subsequent preventive measures. (MNP, 2010: 60).

In the third NC, health is identified as a priority sector for adaptation, but the discussion of health and the healthcare sector is very general and not linked to climate, although there is some information on climate-related elements of national health policy. The bibliography repeats some of the same sources from the 1980s and 1990s on heat and health that were cited in the third NC.

Uzbekistan has submitted three NCs and submitted its first report to the UNFCCC in 1999. The Ministry of Public Health was a member of the national climate change commission that oversaw the first NC. Modeling in the second NC up to 2050 examined thermal discomfort and stress, cerebrovascular diseases, acute intestinal infection, the incidence of leishmaniasis and melanoma incidence, and the frequency and severity of climate hazards. (Uzhydromet, 2008: 108-9). Modeling runs indicated an unfavorable heat wave index for entire territory but with uneven increases depending on region (Uzhydromet, 2008: 110). That report also included an overview with key climate-related threats (heat related diseases, cardiovascular diseases, infectious diseases, malaria, and leishmaniasis) and corresponding recommendations for adaptive measures (Uzhydromet, 2008: 112). The findings and approach of the third NC are very similar to those of the second. Mudflows and GLOFs are mentioned, but not in the health section of the reporting. The report includes a survey of 4,000 people in two provinces on self-reported symptoms related to climate or meteorological conditions, including aggravation of chronic cardiovascular conditions, reduced ability to work, with 50% reporting overheating or sunstroke. (Uzhydromet 2016: 139). It includes a brief collection of secondary sources on climate-related health research, including several articles on cerebrovascular disease, and it reports on training for medical practitioners (Uzhydromet, 2016: 139; 142). Recommended adaptation actions are divided into those that prevent health risks (e.g. EWS, supply of clean drinking water), health monitoring, and studies of climate change risks such as heat for different segments of the population (Uzhydromet, 2016: 158). Finally, the third NC reports on a mitigation/adaptation demonstration project for health care facilities in the Aral Sea region (Uzhydromet, 2016: 139).

Table II provides an overview of topics that have appeared in national communications by country and communication. Numbering in the table refers to the number of the country's national communication in which the topic is mentioned.

Table II. Overview of health topics reported in National Communications in Central Asia, by country (n=5) and report (n=18)

Country	Infectious Disease	Chronic Disease, Heat Stress, Malnutrition, Wildfire	Mental Health	Other Climate-related hazards (mudslides, avalanches, GLOFs)	Other (Mitigation, Public Awareness, CCA and CCM measures)	Vulnerable Groups	Vulnerable Regions
Kazakhstan	General diseases (NC1) Vector-borne illnesses (NC2, NC3-6, NC8) Water-borne illness, water quality (NC2, NC3-6, NC8)	Heat stress (All NCs) heat stroke, burns, (NC2) Water accidents (drowning) (NC2, NC8) Cardiovascular disease (NC2, NC3-6, NC8) Allergies (NC3-6), asthma (NC8) Forest and steppe fires (NC2, NC8)	Death by suicide increase associated with temperature increase (NC8) Impact of extreme heat on chronic mental health conditions (NC8)	Floods, mudflows, landslides (NC2, NC 3-6, NC7, NC8) Icy road conditions due to warm days in winter (NC8) Extreme storms, blizzards, snowdrifts in ski areas (NC8) Unintended injuries (NC8)	Recommends improved public health monitoring, disease control (NC2) Healthcare waste incineration (NC3)	Children (NC2, NC 8) Older people (NC2, NC8) People with pre-existing health conditions (NC2) Rural residents (NC3-6) Urban residents (NC8) Outdoor workers (NC8)	Southern Kazakhstan (NC1, NC2) Aral Sea (NC2) Cities with high levels of air pollution (NC2) Kyzlordinsk Region (NC2) piedmont regions (NC2) Mountain regions (NC8)

Table II. cont.

Krygyzstan	Vector-borne illness (All NCs) Waterborne illness (NC1, NC3)	Heat stress (NC1) Cardiovascular disease (NC1, NC3) Kidney stones (NC1) Malignant neoplasms (NC2) Respiratory disease (NC3)		Mudflows, GLOFs, avalanches (NC2, NC3) Severe wind (NC3)	Reported teaching materials on climate and health (NC1) Health is a priority sector for CCA (NC1) Recommended adaptive measures (research on health impacts, public awareness, education and training) (NC2)	Pregnant women (NC1)	Regional differences in project cardio-vascular impacts (NC2) People living near waterways (NC2) Mountainous areas (NC3) Malaria outbreak risk regions (NC3)
Tajikistan	Vector-borne illness (NC1, NC2) Water-borne illness (NC1, NC2, NC3)	Heat stress (NC1, NC2) Cardiovascular disease (NC1) Respiratory disease (NC1) Low birthweight (NC1) Malnutrition (NC4)		Flooding, droughts as a source of water-borne illness (NC2)	Recommended adaptive measures: research on health impacts (NC1) research on malnutrition (NC2) Public awareness, education and training (NC1, NC4) Calls for improvements in maternal and child health care (NC2) Co-benefits from mitigation measures (NC4)	Low-income population (NC1, NC4) Children and older people (NC2) Pregnant women (NC2, NC3)	Lower reaches of Syrdarya, Vakhsh, Kafirnigan and Pyanj rivers (NC1) Mountain population (NC1) Urban population—Dushanbe, Kurgan-Tube (NC1) Rural population (NC1)

Table II. cont.

Turkmenistan	Diseases (not specified) (NC1) Water-borne illnesses (NC2) Vector-borne illnesses (NC2)	Heat stress (NC1, NC2) Nutritional disorders (NC2)	Neuropsychic conditions, unspecified (NC2)	Drought (NC1)	Mentions that CCA and CCM measures will generate health benefits (NC1) Mentions adverse health impacts of the oil and gas industry (NC2) Mentions climate/health needs, including a health impacts database (NC2) Notes mainstreaming of climate into health policy. (NC3) Calls for research on CC and health (NC3)	People with neurocirculatory dystonia (NC2)	Aral Sea region (NC1)
Uzbekistan	Vector-borne illness (NC1, NC2) Water-borne illness (NC1, NC2)	Heat stress (NC1, NC2) Melanoma (NC1)		Mudflows, floods, avalanches (NC1, NC3)	Climate-health project with training for doctors reported (NC3) Calls for medical early warning systems, territorial action plans, training, public awareness and studies (NC3)		Central desert territories, Aral Sea basin, and Kashkadarya and Surkhandarya provinces (NC1) Older people (NC3) People with chronic cardiovascular conditions (NC3)

5.3. Analytical reports by UN agencies and other multilateral organizations

While reports on environment in Central Asia have been produced since multilateral donors became active in the region in the early 1990s, a rise in donor interest in climate change adaptation that emerged with the 2007/8 Human Development Report, Fighting Climate Change: Human Solidarity in a Divided World (UNDP, 2008) and the World Bank report Adapting to Climate Change in Europe and Central Asia (World Bank, 2009) led to the beginning of "mainstreaming" climate into development work and environmental reporting in the region.

The Environment and Security initiative (ENVSEC) of OSCE, which produces climate change and security regional assessments. The 2017 report considers vulnerability and "security implications and risks related to climate change." They note that four sub-regions: high mountain areas, remote areas on the Afghan border, the Syr Darya River basin, and the Aral Sea and coastline were areas of human health insecurity, which could exacerbate climate risks. (Novikov and Kelly, 2017: 46, 47, 49).

The 2023 ENVSEC report notes that earlier that year, "adverse winter conditions across Central Asia, including the coldest temperatures ever recorded in the region, had severe impacts on the countries' infrastructure and economy (with gas, electricity, and water supply outages, and major roads blocked by snow), as well as on people's livelihoods and health (as some households resorted to burning waste to fuel their stoves, a practice that causes severe air pollution)" (Imanaliyeva, 2023 in Mosello 2023: 14). The report also notes the "severe environmental and health impacts" of the continued use of coal in the region (OSCE, 2022 in Mosello, 2023: 15).

A recent report that addresses Central Asia as a region, albeit as of two regions, is an 2023 IMF assessment, Feeling the heat: adapting to climate change in the Middle East and Central Asia (Duenwald et al., 2023). The report describes dual factors of high exposure, such as in land-degraded areas or close to rivers and snowmelt flows, aggravated by dependence on rain-fed agriculture; and high vulnerability, marked by "inadequate infrastructure and investment," including in the healthcare sector (Duenwald et al., 2023: 12). The report also notes that employment levels of women and youth in the regions are low and could be disproportionally affected by climate change. Duenwald et al., 2003: 29-30).

For specific countries, UNECE environmental performance reviews provide reporting with information compiled by multidisciplinary teams. The 3rd Environmental performance review for Kazakhstan, which was conducted in 2019, did not mention health information related to climate change adaptation, but it found that an increase in moribity from non-communicable disease in children may be linked to environmental quality. (UNECE, 2019: xli). It also provided information on mitigation in the healthcare sector, noting that "Medical institutions are a

significant consumer of energy, and the reduction of their energy consumption is a policy priority. However, actions to improve the energy efficiency of the health sector are not funded through the national programmes. In the majority of cases, the replacement of equipment is done through international projects or using hospitals' own budgets." (UNECE, 2019: xli).

The 3rd Environmental Performance Review of Uzbekistan specifically mentions the health hazards related to climate change, noting that "Owing to intense precipitation and increase in temperature in the mountainous areas in March-April, snow avalanche hazards occur, threatening the lives and livelihoods of the population…. The high-risk areas are located in Tashkent, Namangan, Kashkadarya and Sukhandarya Oblasts" (UNECE, 2020: 355). The review also provides health statistics and data for the Aral Sea region.

As good practice, these reports may mention data-related challenges, as the authors of the Third Environmental Performance Report for Uzbekistan did. When reporting on a variety of chronic diseases in the Aral Sea regional, and they also noted, "Even if the routinely reported morbidity data have limitations for assessment of the population's health status in the Aral Sea Region, very limited statistics were published but they are rather difficult to access, especially at the subnational level" (UNECE, 2020: 369).

6. Other Sources of Information

In addition to country reporting and international environmental reviews, there are several other types of information in Central Asia on climate change: donor-funded project reports and evaluations; press releases and articles in the popular press; national policies and strategies; and non-print sources (video and film).

6.1. Donor-funded project reports and evaluations

While project reports and evaluations may also be drafted or published by international organizations, they differ from analytical reports described in the previous section of this article. The purpose of reporting is generally not related to research to advance the general state of knowledge, and but rather research in support of a technical assistance project or an evaluation of its performance and/or impact. For example, a project evaluation of the WHO-UNDP project "Piloting Climate Change Adaptation to Protect Human Health" in Uzbekistan, a program that was unique in the region, was thoroughly summarized in a terminal evaluation that is available through UNDP's Evaluation Resource Center (Ebi, 2015).

Many climate change projects and many health projects have associated project documentation. Two reports, which are not necessarily typical, are good

examples of relevant contributions. One is a brochure describing a climate change mitigation and adaptation project in the health care sector of Uzbekistan (UNDP). That project piloted energy efficiency and renewable energy measures in four rural health clinics in the Republic of Karakalpakstan. Project documentation also provides insight into policies and programs that are under development, such as the proposal for support from the Green Climate Fund for the National Adaptation Plan for Kyrgyzstan; a readiness proposal to the GCF provides an overview of the scope of the plan and its intended content (GCF, 2020).

6.2.Press releases and blogs and articles on websites and in the popular press

Popular coverage of climate change and health in the region, while plentiful, is difficult to characterize. It varies widely across the region, ranging from NGO websites to press releases from international organizations and articles in national and regional news outlets. The following examples, which are not necessarily typical, are good examples of relevant contributions. One press release that touches on both climate change adaptation and health is an article covering UNICEF's children's climate risk index, entitled "Children in Kyrgyzstan at 'high risk' of the impacts of the climate crisis." (UNICEF, 2021). Press releases also cover mitigation-related health issues, such as "Changing the primary energy use for 26% of the urban population will help Bishkek to combat air pollution," a UNICEF press release (UNICEF, 2022).

In the case of web portals, information may be curated, such as the Central Asia Climate Portal, which has a health topic section (CAREC, 2024). Finally, these sources of information can give an indication of draft policies or strategies that may be under development but are not available publicly. One example of this is the draft Heat Health Strategy for Turkmenistan (Altyn Asyr, 2021).

6.3.National policies and strategies

Countries in Central Asia have enacted a variety of policies and programs that directly and indirectly address climate change and health. These include national development strategies, climate change strategies, adaptation strategies, and health strategies. These include the Concept of Kazakhstan on Transition to a Green Economy (2013), the National Strategy of Adaptation to Climate Change of the Republic of Tajikistan for the period till 2030 (2019), the National Strategy on Climate Change 2030 of Turkmenistan (2019), and the Strategy for the transition of the republic to a "green" economy for the period 2019-2030 for Uzbekistan (2019).

There are also a few selected examples of policies and programs that explicitly address both climate and health.

• The Government of Kyrgyzstan introduced a national program for climate change adaptation in the health sector for 2011-2015 (Belov and Filipchenko, 2013).

The program was developed under a joint project with the European Office of the WHO and a working group at the Ministry of Health. It was designed to protect human health against extreme weather events, including temperature extremes, reduce the threat of food-borne and water-borne illness, to reduce the impacts of climate-related natural disasters, to improve the public health system, to strengthen the capacity of healthcare providers, to increase public awareness, and to strengthen the role of local communities to address climate threats. The policy also included mitigation targets, such as adopting alternative energy technologies and resources in the healthcare sector.

• Tajikistan also adopted (as of 2017) a national climate change and health strategy (Novikov and Kelly, 2017: 23). In addition, the Medium-term Development Program of the Republic of Tajikistan for 2021-2025 includes specific tasks and indicators related to the gender aspects of climate change (Section 5.8.), and the program includes gender-sensitive indicators for health and will establish them for disaster risk management (GRT, 2022).

• The state program “Health” in Turkmenistan for 2015-2025 includes measures to prevent and reduce climate impacts on human health, such as raising awareness of the public, health professionals, and policy makers on climate impacts; strengthening the health system, and research related to health and climate change. (TUK NC3: 69). Turkmenistan also has a National Action Plan for the Adaptation of the Health of Turkmenistan’s Population to Climate Change and its Negative Impact for 2020-2025, and a donor-funded project is supporting the development of a Heat Health Strategy for Turkmenistan (Altyn Asyr, 2021).

6.4. Non-print sources

While the review of non-print sources is not neither systematic nor comprehensive, a YouTube search was conducted for English-language video material [“climate change” “health” “Central Asia”], which yielded 6 results, and for Russian-language video material, a similar query ["изменение климата" "здоровье" "в Центральной Азии"] yielded 6 results, which were distinct from the English-language results. Similar searches on Vimeo yielded no results. A YouTube search for country-specific material yielded thousands of videos that ranged from news programs to awareness-raising videos related to climate change and its impacts; a complete examination was beyond the scope of this report.

The 2009 film Pamiri women and the melting glaciers of Tajikistan (Goluvnev 2009) featured several women discussing the effects of climate variability and climate change on their daily lives. Health is mentioned in relation to reported effects of temperature extremes. Another film from the same series shows mountain community members collecting scrub bushes due to reduced water level and

subsequent hydropower shortages and burning that biomass in cookstoves (Patrón, 2009), which is identified in the literature as a source of poor air quality.

Videos may also provide an opportunity to present information collection and analysis in donor-funded climate policy projects. For example, a webinar was organized to discuss the methodology behind the health research that informed the country's updated Nationally Determined Contribution (NDC) under the Paris Agreement (Climate Learning Portal, 2022).

More recently, a video virtual panel on climate and women's well-being in Tajikistan described the stress that compounds health issues for women in Tajikistan who are overseeing farms and households due to men's labor migration (Pulatova , 2023). The discussion notes additional burden of climate change on collecting cooking fuel and water, particularly for women, which is mentioned in only one other source covered in this article, and remarks also discuss breastfeeding and temperature extremes and identify women as agents of climate change adaptation. (Abt Global , 2023). These are views are not included in the printed literature surveyed.

7. Discussion

Peer-reviewed literature. Peer-reviewed research on climate change and health in Central Asia is rare, and the existing literature has serious limitations that do not merit the development of an evidence table. These limitations include confounding bias and limited sample size. The literature search did not identify research findings relevant to advancing the understanding of relationships between climate change and health, although there were sources (Kaimuldinova and Abdimanapov, 2013; Isaev et al., 2022) that provided data that could be used in observational studies moving forward.

Country reporting to the UNFCCC. The NCs reviewed reflected the output of multiple researchers and were validated by working groups and subsequently by their respective country governments. When compared to the major topics presented for health and human well-being by the IPCC's 6th Assessment Report, information in the region from NCs focused primarily on infectious diseases and heat. Other topics identified in the IPCC reports (malnutrition, harm from wildfire, mental health, and displacement) were mentioned on infrequently. That said, a variety of resources consulted emphasized climate-related hazards significant to the region such as floods, mudslides, and GLOFs. Table II provides an overview of the incidence of climate and health topics that appeared. As the table indicates, health was mentioned predominantly in the context of adaptation, although there were instances where mitigation was mentioned in individual NCs.

Analytical reports by UN agencies and other multilateral donors. These reports by nature were focused on the synthesis of existing data, but they represented positive contributions to regional understanding of health and climate by using a systematic approach to documenting different levels of exposure to health/climate threats, be it by vulnerable group or sub-region. Certain reports (UNECE, 2020) also documented data limitations, an acknowledgement that was unusual for both peer-reviewed and non-peer-reviewed sources.

Donor-funded reports and evaluations. This large source of potential information is not often used by the research community. There were examples of project activities supported research on health and climate change, such as in Uzbekistan, where preparatory studies indicated “strong evidence that climate-sensitive diseases exert a large health toll” and project studies addressed cardiovascular disease, diarrheal disease, respiratory illness, and health effects from dust storms, each of which “showed high sensitivity to climate variability.” (Ebi, 2015: 19). This type of source also addressed mitigation-related health topics, which are less common generally (UNDP undated).

National policies and strategies: "Climate may or may not be mainstreamed into health strategies and vice versa. Many strategies are accompanied by a governmental action plan that assigns a budget and responsibilities for the various activities proposed. These policies do not cite supporting research directly, but they are at times accompanied action plans, which mention specific steps, and they identify priority areas for government activity. Certain policies account for gender differences in vulnerability" (Belov and Filipchenko, 2013).

Non print sources (video): "Non-print sources have been able to provide first-hand documentation of the experience of climate change in the region for some time, and they include instances of documentation of health effects by those directly affected" (Goluvnev, 2009; Abt Global, 2023). Videos also provide an opportunity to present information collection and analysis in donor-funded climate policy projects, such as in the presentation on the climate and health research that contributed to the updated NDC of Kazakhstan, which reiterated and expanded on climate threats to human health reported in the country’s NCs (Climate Learning Portal, 2022).

To summarize non-peer-review sources of information, Table III presents an overview of their advantages and disadvantages as sources of information on climate change and health in Central Asia.

Table III. Advantages and Disadvantages of Sources of Climate and Health Information for Central Asia

Type of Source	Advantages	Disadvantages
National communications to the UNFCCC	Overview of in-country thinking related to climate change and health over time (the first NC in the region was submitted in 1998, and the most recent was in 2022). Useful point of departure for additional research. Sections on impacts and adaptation are often compiled by senior researchers in their fields. They include citations and/or bibliographies. They are significant, as country reporting is often used as a reference point by multilateral climate funds when determining whether proposals for projects reflect national priorities.	Lack of access to supporting research. The limited research commissioned for the NCs on climate change and health is not generally published in full, and it may not reach a peer-review or grey literature audience. This practice represents a lost opportunity. Incomplete source citations. NCs may not distinguish between published research and expert judgment, and statements in them may not be clearly labeled as one or the other. Research may be relatively old (the oldest citation noted was from the 1970s), and published resources cited may not have been digitized. Confounding bias. NCs show repeated instances of presenting negative health data against the backdrop of climate change without controlling for other socio-economic factors in the region. While approach is understandable given the lack of targeted studies, the limitations are not always clearly stated, and they do not support conclusions on these relationships.
Analytical reports by UN agencies and multilateral organizations	Frequently edited and reviewed by the agencies that fund them. May contain helpful information on topics that are directly or indirectly related to climate change and health impacts, and they provide some discussion on mitigation. May draw attention to policies, measures, and statistics and analysis that might be otherwise overlooked. May note challenges in data collection and analysis.	Information may be incidental, as the focus of broader environmental reports is not necessarily on climate change. May lack empirical data for climate and health, may lack supporting research, may be subject to confounding bias.

Table III. Cont.

Donor-funded project reports and evaluations	May provide information on good practice that is not available elsewhere. May provide insight into policies and programs that are under development. , such as the proposal for support from the Green Climate Fund for the National Adaptation Plan for Kyrgyzstan; the readiness proposal to the GCF provides an overview of the scope of the plan and its intended content (GCF 2020). In addition, project evaluations can be detailed and may include community information and interviews with community members, which are not common in country reporting.	Reporting may be old when there are few documented interventions, and publication dates may not be provided on project literature. Scope issues: Evaluations and reports for projects in the region seldom have the scope and budget to determine a significant correlation between climate change and changes in health. Limitations are not necessarily mentioned. Objectivity issues: For materials that are written in-house, review procedures vary widely. Evaluations may or may not involve an external, independent evaluator. For reports other than evaluations, lists of sources and references may not be provided.
Press releases and articles in the popular press	May catalogue demonstrated adaptation and mitigation measures and provide learning. May give an indication of potential research directions and some indication of public interest in topics related to health and climate change that have not yet been addressed formally. In the case of web portals, may provide a curated source of information. May give an indication of draft policies or strategies that may be under development but are not available publicly.	These sources of information do not provide research findings.
National policies and strategies	The underlying analysis that has informed policy development is not generally available publicly. Furthermore, performance monitoring of the action plans that often accompany policies and strategies in the region is not available publicly. This can make it difficult to track implementation / enforcement, and therefore difficult to ascertain relationships between policy implementation and health outcomes, even when the relevant morbidity and mortality data are available. Researchers have also drawn attention to the limited ability of governments in the Central Asian republics to monitor and assess the effectiveness of adaptation measures in laws and regulations (Liu et al., 2020: 1449). Furthermore, national climate change policies and strategies may not explicitly mention health measures.	Reviews of policies and strategies may provide an indication of national priorities, and there may be some available underlying data and analysis that could also guide further research. The few policies that relate directly to climate and health may also serve inspiration as other country policies and strategies are updated and introduced.

Table III. cont.

Non-print sources (video and film)	The visual element of these resources conveys messaging in a different way and can provide visual documentation of certain phenonomena, complementing printed or electronic literature. May identify issues that could benefit from further study. May introduce voices that are not directly represented in other literature, such as women in rural areas.	Funded content or institutional affiliations may raise issues with objectivity May be limited in scope or overly general if directed towards a public audience. Livestreamed discussions at regional conferences and meetings are not necessarily archived.

7.1. Strengths and limitations of the approach taken

Expanding to Russian-language sources increased the available citations, and moving to grey literature and non-print resources has expanded previous estimates of climate-health literature (Vakulchuk, 2023) significantly.

The approach was limited by the availability of source material. It is difficult to draw conclusions or establish association between climate and other factors given the primary research available, which often consists of conceptual statements or observational study designs with serious challenges to validity. In addition, this review did not consider publications or video in languages other than English and Russian, which is a limitation in the five countries studied. The exclusion of non-digitized print literature may have also limited the yield of sources, as some materials, particularly older work and academic publications such as theses may not be available in digital format in the region.

The following recommendations are provided for future study:

• Promote regional scholarship drawing on donor-funded projects and reports with a view to publishing findings related to development interventions. These interventions provide an opportunity to assess the health benefits of climate change mitigation and adaptation measures. Government initiatives, such as reporting under the UNFCCC and Paris Agreement and health and climate policy action planning, also provide opportunities to evaluate the efficacy of climate/health policies and measures

• Consider some of the traditional areas of regional literature as a starting point for future research. These disciplines include climate medicine, mountain health and communities, and occupational health research in hot climates. In addition, ongoing research on climate change mitigation may also serve as a foundation for the analysis of health-related benefits of mitigation measures. Countries should also consider pooling research efforts across countries; current cooperation on the high-mountain cryosphere and regional studies on air pollution are two examples of ongoing efforts.

• For study design in areas of high interest for countries (heat-related morbidity and mortality, infectious disease, and cardiovascular disease), control for factors other than climatic conditions to the extent possible and state study limitations clearly.

• Consider the heterogeneity of vulnerable populations when designing research studies. Groups that have been identified in previous research include children, older people, women, pregnant women, people with existing chronic health conditions, rural residents, urban residents, low-income groups, high-mountain communities, areas with severe ecological problems (the Aral Sea region), and areas with low health security or other factors contributing to low adaptive capacity.

8. Conclusions

While peer-reviewed literature on climate change and health in Central Asia is sparse, there are also a variety of additional sources of information that reflect more than two decades of data collection, analysis, and scholarly effort on the part of many individuals to move the state of knowledge forward in this area. Grey literature is broader and richer than previously depicted in reviews of climate change literature in the region, and this review attempts to summarize and appraise those efforts.

This review finds that both peer-reviewed and grey literature on this topic must be used with caution. That said, grey literature has a variety of contributions to make to the evolving understanding of climate change and health in Central Asia. Topics also varied in different types of grey literature, with media resources providing unique perspectives on the intersection between health, climate, and gender.

Research and understanding of climate change and health in Central Asia is at a well-developed state conceptually, with supporting work on vulnerability, but there is a lack of evidence-based analysis. The next step in a causal inquiry is more rigorous study that goes beyond anecdotal or general associative relationships between climate variability and chronic and acute morbidity and mortality. In short, there is an urgent need for observational studies that will confirm and increase understanding of climate-health interactions in the region. Governments should also support this research in support of the policies they are currently developing and the reports they submit as parties to the UNFCCC and Paris Agreement, and they should draw on existing research to identify vulnerable sub-regions and groups that may face disproportionate climate-related health risks.

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