The Intersection of Climate Change and Public Health

Tayyba Batool[1,*], Bushra Moon[2], Rabia Bashir[1], Naima Nawaz[3], Lubna Anjum[4] and Irum Waheed[5]

[1]Department of Zoology, Wildlife and Fisheries, University of Agriculture, Faisalabad, Pakistan
[2]College of Life Sciences, Hainan Normal University, China
[3]Department of Rural Sociology, University of Agriculture, Faisalabad, Pakistan
[4]Department of Irrigation and Drainage, Faculty of Agriculture Engineering and Technology. University of Agriculture, Faisalabad, Pakistan
[5]Laboratory of Brain Function and Molecular Neurodegeneration, School of Life Sciences, Henan University (Henu), Kaifeng, China
*Corresponding author: taibaasghar182@yahoo.com

Abstract

This chapter investigates the profound intersection of climate change and public health, offering a comprehensive analysis that bridges environmental science and health policy. The introduction underscores the significance of climate change as a driver of health inequities, with a focus on vulnerable groups such as children and individuals in low-income regions. Statistical data reveal alarming trends, including a 20-30% rise in respiratory illnesses in areas with severe smog and air pollution, as well as increased mortality linked to heatwaves and vector-borne diseases. Prospects proposes actionable strategies, including the development of adaptive healthcare systems, stronger regulatory frameworks for emission reduction, and public awareness campaigns. By prioritizing a sustainable and equitable approach, this chapter envisions a path toward resilience in public health amidst ongoing climate challenges.

Keywords: Climate change resilience, Environmental health equity, Climate-sensitive diseases, Public health adaptation, Anthropogenic climate impacts.

Cite this Article as: Batool T, Moon B, Bashir R, Nawaz N, Anjum L, and Waheed I, 2025. The intersection of climate change and public health. In: Abbas RZ, Akhtar T and Arshad J (eds), One Health in a Changing World: Climate, Disease, Policy, and Innovation. Unique Scientific Publishers, Faisalabad, Pakistan, pp: 157-163. https://doi.org/10.47278/book.HH/2025.126

A Publication of Unique Scientific Publishers

Chapter No: 25-022

Received: 25-Jan-2025
Revised: 08-March-2025
Accepted: 07-May-2025

Introduction

Significant worldwide changes that have occurred over the last several decades include continuous rise in temperature and predicted climatic shifts of the current century. Temperature is rising on many planets due to climate change (Schuurmans, 2021). the widely recognized national and worldwide consequences of changing climate include erratic weather shifts, the disappearance of the worldwide glaciers, and the resulting rise in the level of seawater. Natural processes such as wildfires, earthquakes, and volcanoes are thought to be the primary contributors of greenhouse emissions such as CO_2, CH_4, N_2O, and H_2O in the surrounding environment, before the industrial revolution (Murshed, 2022).

Climate change significantly jeopardizes human health directly and indirectly through heat stress, deteriorating air quality, higher sea levels, food and water insecurity, severe natural disasters (e.g., droughts, floods, earthquakes, volcanic eruptions, tsunamis, hurricanes), inadequate shelter, and population displacement. The degradation of the environment may promote the spread of diarrhea, infectious diseases carried by vectors, cardiac and respiratory diseases, malnutrition, and more. The indirect consequences of climate change, including mental health issues stemming from stress, displacement, economic instability, and compelled migration, are undeniably significant (Abbass et al., 2022). The elderly, poor individuals and children are among the groups most at risk from the negative consequences of climatic fluctuations (Kim et al., 2014).

Levels of Impacts of Climate Change

The problem of climatic variations is complex and will affect individuals in many ways. A three-ringed pyramid of consequences was developed to better comprehend the various manners that which climate change may affect pediatric populations. The primary impacts of climate change, which are related to both direct weather and future climatic changes brought on by human-induced climate change, are included in the bottom tier. Extreme weather events, drought, increasing temperatures, and sea level rise are some of the main repercussions (Trenberth, 2018). The second rung illustrates the secondary consequences, which will be contingent upon the fundamental impacts of climate change that will lead to ecosystem changes, such as disruptions in water and dietary systems and changed pathways for disease transmission. The tertiary consequences and long-term societal changes brought about by climate and environmental changes are covered at the highest level. The complex socio-political, economic, and cultural reactions to climate change will have tertiary repercussions (Rosenzweig and Neofotis, 2013). The "primary," "secondary," and "tertiary" health effect frameworks are conceptually similar to the one shown in Fig. 1.

Impacts of Climate Change on Human Health

The detrimental effects of the changing climate on people's health are widely recognized (Costello et al., 2009). According to WHO

estimation, climate change may be to blame for an extra 250,000 fatalities each year between 2030-2050 (Watts et al., 2015). These deaths have been linked to the global spread of vector-borne illnesses as well as mortality and morbidity brought on by harsh weather. Regardless of the environment, temperature is essential to the existence of nature and life. Therefore, a specific creature, particularly a disease, needs a complicated range of temperatures to thrive on the planet. Another significant component of environmental change is precipitation, which has an impact on the migration and distribution patterns of several harmful organisms (Yang and Usman, 2021).

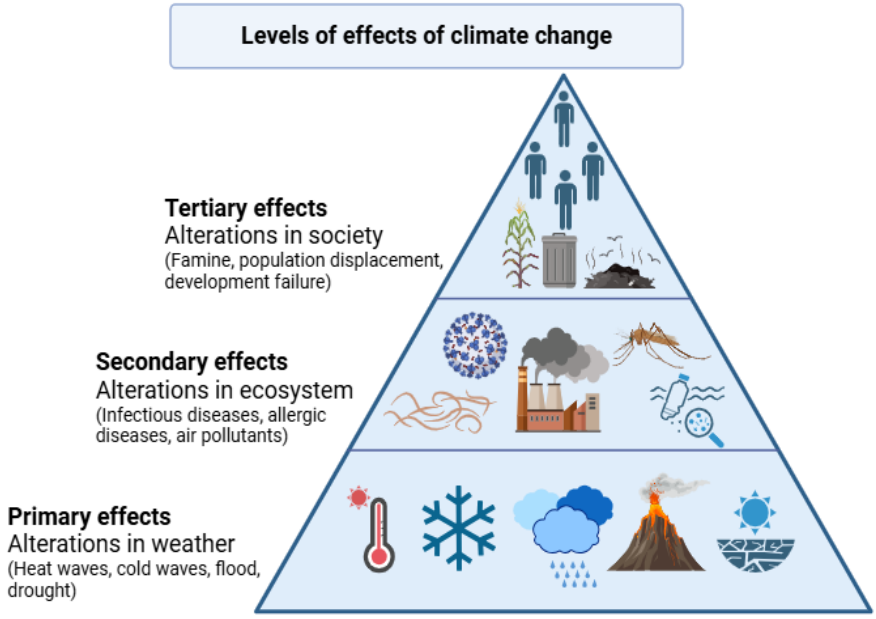

Fig. 1: Levels of the effect of climate change (Parsons et al., 2024)

A major contributing factor to the extinction of many species is the global warming. While some new organisms may thrive because of the warmer climate, various species are possibly becoming extinct due to the changing ambient temperature. In this case, it was clear that certain infections may also become more prevalent when they were previously unknown or unreported (Patz et al., 2000). The Republic of China's recent coronavirus (COVID-19) outbreak, which resulted in pneumonia and serious acute respiratory problems, serves as an example (Song et al., 2021). Many animals, especially snakes and bats, host a huge family of viruses, which may then spread to humans. Consequently, it is crucial to understand that climate change affects the survival of many pathogens and carriers that carry different illnesses (Santos et al., 2021).

Climate change is already influencing human health and well-being, even though its effects and outcomes are probably numerous and intricate. Mortality and disease from high temperatures, extreme cold, floods, or storms, as well as alterations to water and air quality brought on by variations in temperature, precipitation, and other climatic factors, are examples of direct health consequences. On the other hand, health consequences can be indirect as illustrated in Figure 2, including alterations in the ecology of transmissible diseases or effects on landscapes and quality of air that might influence people's health (Semenza and Menne, 2009). The increasing number and prevalence of diseases, in particular, are posing serious risks to human health and are linked to elements of worldwide environmental change. Extreme weather events and fluctuations in the climate both contribute to these challenges to human health by changing the risk of disease (Leisnham and Slaney, 2009).

Direct Health Effects of Climate Change

The direct health implications include variations in heatwave and thermal stress-related mortality and morbidity. According to climatologists, heatwaves will occur more frequently due to a combination of rising mean temperatures and potential increases in weather variability. The ability of human communities to adjust both culturally and physically to such shifts over decades, however, is comparatively poorly understood. Additionally, temperature extremes may not have a significant average influence on life expectancy since they disproportionately harm the elderly and unwell (Patz et al., 2005). Additional direct effects include the health effects on the respiratory system of changed concentrations of aeroallergens (like molds and spores), air pollutants (like ozone) from temperature-sensitive photochemical reactions, and the numerous health effects of a changed pace of severe catastrophic events, such as hurricanes, thunderstorms and overflow of seawater (Kinney, 2008).

Indirect Health Impacts of Climate Change

Many of the indirect health impacts that might arise from the disruption of intricate ecological processes are potentially more serious. These include variations in the spread and activity of infectious vector-borne diseases; altered human-to-human transmission of infections (such as food poisoning and waterborne pathogen transmission); the health and nutritional effects of regional shifts in farming productivity; and the different effects of sea level rise (Haines et al., 2006). Population shifts and regional disputes over food and water shortages brought on by climate change would also have an impact on public health (Myers and Patz, 2009).

Human Diseases in Association with Climate Change

Rising temperatures can raise the quantities of pollen, smog, harmful air pollutants, and ash as a result of wildfire burning. Numerous

symptoms, such as headaches and migraines, inflammation of the eyes, nasal congestion, difficulty breathing, itchy skin, coughing, and chest discomfort might be brought on by these variables. Particularly susceptible to the consequences of climate change are young ones, elderly people, and those with breathing issues (such as bronchitis, emphysema, and asthma (D'Amato et al., 2014). Changes in the climate would also have an impact on several directly transmissible illnesses, particularly those brought on by contaminated food and drinking water. (Sharma et al., 2013).

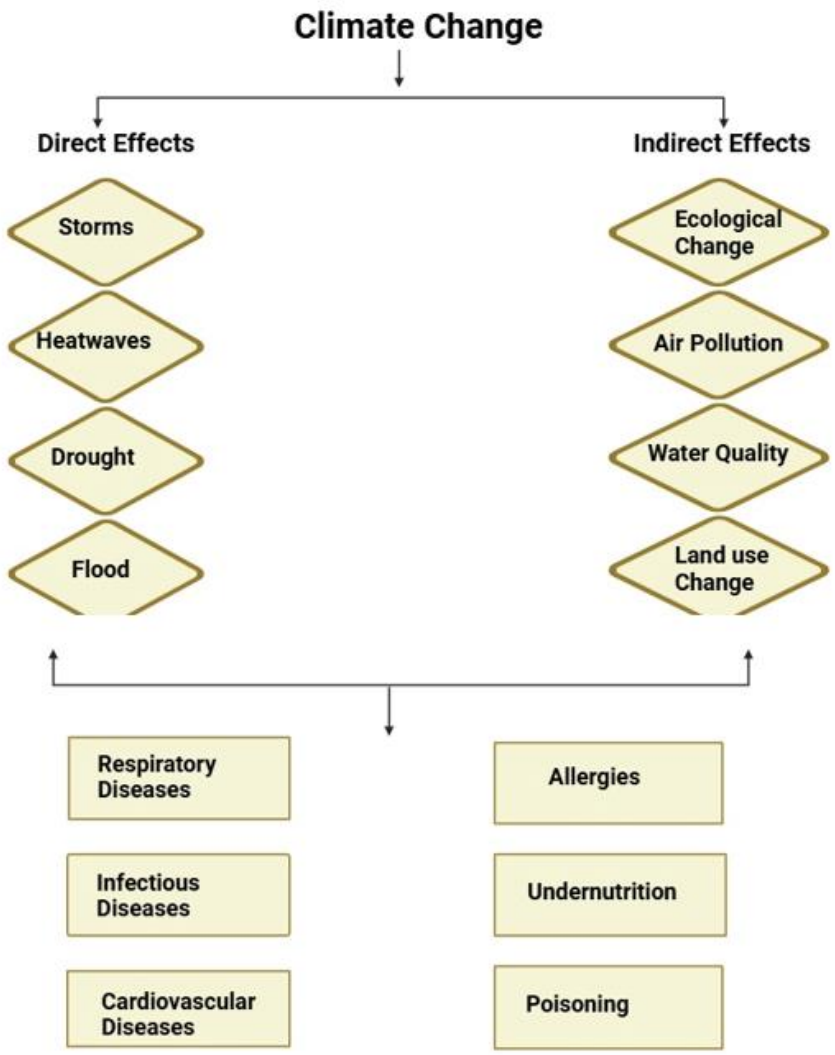

Fig. 2: Direct and indirect effects of climate change (Ashrafuzzaman, 2019)

Climate-related changes in the vector organisms of diseases including schistosomiasis, dengue fever, trypanosomiasis, malaria, and viral encephalitides (even those in temperate zones) will result in changes in the probabilities of infectious diseases. The range, development, and behavior of pathogenic organisms, along with the survival and developmental phases of the pathogenic organisms, would all be impacted by rising temperatures and altered rainfall patterns. In subtropical and tropical countries, inhabitants on the outskirts of endemic areas might be more vulnerable to vector-borne illnesses, even though wealthier, developed nations could be likely to maintain public health defenses against their spread (Jones et al., 2018).

Psychological Impacts of Climate Change

Climate change may have psychological consequences on vulnerable civilizations in addition to its obvious effects on agriculture, forestry, health, and other areas. This is exemplified by the most recent COVID-19 epidemic in several countries throughout the world (Pal, 2021). In addition, those with symptoms of this viral infection have made unaffected people more afraid and anxious. After such epidemics, those who have high temperatures or the flu are likewise scared and have to follow certain rules. People who live in such circumstances are constantly terrified and become accustomed to stress, which ultimately weakens their mental health (Doherty and Clayton, 2011).

People are more likely to experience worry, distress, and other problems as a result of climate change, which also encourages the development of several mental health conditions. Posttraumatic disorder is also impacted by repeated exposure to extreme weather events, such as geological disasters, and their frequent occurrence can lead to the development of long-lasting mental health issues. Additionally, media use regularly raises a person's stress level. Communities in food-prone places also live in continual fear of flooding and food-related deaths. One particular factor contributing to the strain on these communities is the devastation of physical infrastructure brought on by hunger, in addition to the loss of human life (Ogden, 2018).

Climate Change Impacts on the Agricultural Sector

Since over two-thirds of the people of Pakistan live in rural regions and depend on agriculture for their survival and livelihood, the agricultural sector's resilience to changing climates is one of the most crucial issues for the country's economic development (Abid et al., 2011). Furthermore, Pakistan's local food security, which mostly depends on cereal crops, may be seriously impacted by climate change due to negative effects on cereal output and food costs (Table 1). Sustainable adaptation at the level of agriculture is necessary to protect livelihoods in rural areas and assure food safety from the negative effects of climate change (Abid et al., 2015).

Nevertheless, a significant obstacle at the regional level is the fact that farmers, who are the main beneficiaries, will have to shoulder the majority of the adaptation responsibilities themselves. In an ideal market, farmers may still benefit from rising prices, which would compensate for the greater expense of production, but in developing nations like Pakistan, where rates are mainly determined by external factors (imperfect conditions), farmers may experience lower returns and higher production costs. Governmental adaptation strategies that take into account farmers' goals and ability to adapt are therefore desperately needed. Understanding the variables that influence farmers' adaptation choices and how their actions affect agricultural productivity—which might differ between areas and scales—is therefore essential from a policy standpoint (Niles et al., 2015).

Table 1: Impact of climate change on Pakistan's agriculture sector

Impact area	Statistics	Reference
Projected productivity decline	Climate change could reduce agricultural productivity by 8 to 10% by 2040, particularly the wheat mostly affected.	Sommer et al., 2013.
Economic losses	An approximate loss of US$19.5 billion in rice and wheat production by 2050.	Agriculture Department Punjab
Extreme weather events	50% of crops were destroyed in the 2022 floods, affecting 33 million people and causing food shortages	Qamar et al., 2023
Heatwaves	2022 heatwaves saw temperatures rising 49.5, severely affecting crops and water availability	Ali, 2022

Climate Change Impacts on Socio-Economic Status

Climate change has profound implications for socioeconomic status, as it disrupts livelihoods, exacerbates inequality, and hampers economic development (Table 2). Rising temperatures, extreme weather events like floods and droughts, and shifting rainfall patterns have a direct impact on key sectors such as agriculture, fishing, and tourism. Concerns about a particularly catastrophic impact on economies in emerging nations, which have very little ability to adjust to the negative consequences of climate change, are among these concerning tendencies of growing climate change impacts generally (Symanski et al., 2021). Despite being present in all finances, areas societies, and fields the effects of climate change are not uniform Compared to established economies, developing economies with little adaptation ability are more likely to be affected (Mihiretu et al., 2021). Climate change might put millions of people in poverty in emerging nations with inadequate supplies of food, water, medical care, and infrastructure systems.

For certain crops, a regional rise of 1-3 °C (1.8-5.4 °F) may result in a slight gain in agricultural output in temperate areas; however, greater warming will often result in a decline in productivity. Models indicate that even little increases in local warming will result in lower agricultural productivity in tropical and subtropical regions. In certain instances, it is anticipated that adaptations like modified planting techniques will lessen productivity losses for mild warming. Further declines in agricultural productivity and livestock output, especially among subsistence farmers in tropical countries, would probably result from an increase in the frequency of drought and flood occurrences (Huang et al., 2022).

Vulnerable Populations

The catastrophic consequences of climate change have had a significant impact on vulnerable groups, and these impacts are being exacerbated by wide socioeconomic divides, unbalanced power dynamics, inadequate governance, and elevated risks with few and inefficient adaptation and mitigation measures (Kosanic et al., 2022). During and after climate-related catastrophes, women and children experienced extraordinary abuse, including sexual violence, loss of security and safety, and mental trauma, while the offenders were shielded (Desai and Mandal 2021). These vulnerable populations are well-shown in Figure 3. According to Ronoh et al., (2015), there are an estimated seven million children with disabilities worldwide who are prone to natural hazards and impacted by catastrophes.

Climate change and fluctuations have a significant influence on women, who are among the most vulnerable groups. This is especially true for rural women who depend heavily on agriculture. For rural women, agriculture is the only way to maintain their families, communities, and livelihoods in the face of poverty (Akerlof et al., 2015). The majority of climate casualties in Asian nations are impoverished women. Food insecurity has influenced resilience as well as vulnerability among groups susceptible to climate-induced catastrophes, and thus women are more susceptible than males in both rural and urban settings, which are made worse by gender inequality (Tanjeela and Rutherford, 2018).

Due to the threats that climate change poses to their growth, safety, family security, and survival, as well as the possibility of illnesses such as diarrhea, dehydration, and heat stress, children and newborns are particularly negatively impacted (Goldhagen et al., 2020). The catastrophic consequences of the changing climate and the resulting variations affect different populations, and in certain nations, they cause large-scale migration. Serious incidents of physical assault against young girls have been recorded following the 2005 Kashmir earthquake (Memon, 2020). Ten years later, the World Bank issued a warning in which it stated that women were at greater risk of suffering from physical and sexual harassment during and after catastrophes, as well as a rise in domestic abuse and its severe consequences (WHO, 2015).

Table 2: Impact of climate change on Pakistan's socio-economic status

Impact area	Statistics	Reference
Poverty and livelihoods	Over 60% of the population of Pakistan depends on agriculture for livelihoods, which is increasingly at risk due to climate-induced disasters.	Farah et al., 2023
Food security	In 2022, over 4 million acres of crops were destroyed due to the floods, leaving 33 million people facing food shortage and food insecurity.	Ahmad et al., 2022
Health challenges	Malaria and dengue, both of which are linked to climate change, have become much more prevalent; in 2022 alone, over 75,000 cases of dengue were documented.	Iqbal, 2020
Migration and displacement	Over 8 million people were displaced by the floods in 2022, making it one of Pakistan's worst climate-related migration disasters.	Farah et al., 2023
Economic losses	Pakistan loses over $3.8 billion a year due to climate-related disasters, which include losses in infrastructure, health, and agriculture.	Shah et al., 2021
Infrastructure damage	Over $30 billion was damaged in the 2022 floods, which had an impact on public services, transportation, and housing.	Khan et al., 2022
Gender inequality	According to reports, as families face financial difficulties, the number of forced marriages in flood-affected areas has increased by 30%.	Iqbal et al., 2023

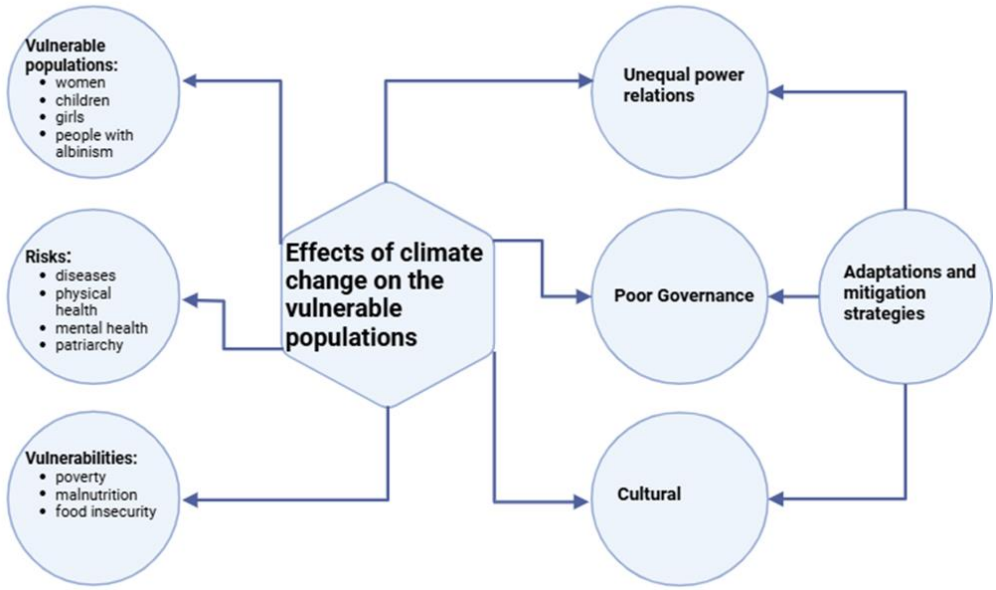

Fig. 3: Effects of climate change on vulnerable populations (Ngcamu, 2023)

Climate Change and Health Inequity

Inequitably, the negative consequences of human-caused climate change fall disproportionately on already vulnerable groups. BIPOC (Black, Indigenous, and People of Color) communities, women, and those with lower incomes are among the groups most in danger from the negative consequences of climate change. Compared to previous generations, kids and subsequent generations will bear a disproportionate amount of the burden of climate change. Numerous variables, including local topography, regional climates, and colonial disparities, will increase susceptibility to climate change (Carey, 2012).

The world's inhabitants are increasingly at risk from adverse weather conditions, drought, elevated sea levels, extreme temperatures, food insecurity, resource shortages, and illness, even while certain communities may experience small benefits like prolonged growing seasons and mild weather (Huppert et al., 2006). Indigenous communities, residents of the Global South, which includes the continent of Africa and South Asia, and residents of several island governments are among the groups most at risk.

Mitigation and Adaptation Strategies for Climate Changes

Despite the rise in emissions from 1990 to 2019, many mitigation measures have facilitated emission reductions in the battle against climate change (Waheed et al., 2021). These include the establishment of a plantation development support to promote plantation development in the private sector, the execution of an agricultural plantations development initiative aimed at establishing plantations on degraded forest lands, and a government policy prohibiting the shipment of round wood to improve native timber handling (Jahanzad et al., 2020). Other measures include the industry's efforts to reduce greenhouse gas emissions, which have reduced emissions by approximately 11.8% between 1990 and 2019, the oil and gas sector's efforts to recover and use natural gas and limit gas flaring, the expansion of renewable energy, clean cooking and lighting, energy efficiency in homes, businesses, and industries, and creative management of waste through reduce, reuse, and recycle (Botzen et al., 2021).

Conclusion

Climate change has the potential to have a substantial impact on human health, with direct consequences like heat stress and floods as well as indirect ones like altered disease transmission and starvation as a result of increased competition for water and food resources. Exposure to natural disasters has led to increased levels of psychological, emotional, and physical fatigue among those who are most susceptible to the consequences of adverse weather conditions, such as the impoverished, the elderly and crippled, children, prisoners, and drug abusers. As the earth heats, it alters the incidence of disease transmission, increases the prevalence of vector-borne illnesses, and affects mortality via poor health, especially in the summer months for the elderly. Furthermore, the significance of the cooperation between adaptation and mitigation is underlined. Research to determine the ideal balance between adaptation and mitigation is likewise becoming more and more demanded. Focusing on adaptation or mitigation alone is insufficient; the best durable effects come from combining the two.

References

Abbass, K., Qasim, M. Z., Song, H., Murshed, M., Mahmood, H., & Younis, I. (2022). A review of the global climate change impacts, adaptation, and sustainable mitigation measures. *Environmental Science and Pollution Research*, *29*(28), 42539-42559.

Abid, M., Ashfaq, M., Hassan, S., & Fatima, N. (2011). A resource use efficiency analysis of small Bt cotton farmers in Punjab, Pakistan. *Pakistan Journal of Agricultural Sciences*, *48*(1), 65-71

Abid, M., Scheffran, J., Schneider, U. A., & Ashfaq, M. J. E. S. D. (2015). Farmers' perceptions of and adaptation strategies to climate change and their determinants: the case of Punjab province, Pakistan. *Earth System Dynamics*, *6*(1), 225-243.

Ahmad, D., Shah, S. Z. A., & Afzal, M. (2022). Flood hazards vulnerability and risk of food security in Bait community flood-prone areas of Punjab Pakistan: In SDGs achievement threat. *Environmental Science and Pollution Research*, *29*(59), 88663-88680.

Akerlof, K. L., Delamater, P. L., Boules, C. R., Upperman, C. R., & Mitchell, C. S. (2015). Vulnerable populations perceive their health as at risk from climate change. *International Journal of Environmental Research and Public Health*, *12*(12), 15419-15433.

Ali, M. A., Hassan, M., Mehmood, M., Kazmi, D. H., Chishtie, F. A., & Shahid, I. (2022). The potential impact of climate extremes on cotton and wheat crops in Southern Punjab, Pakistan. *Sustainability*, *14*(3), 1609.

Ashrafuzzaman, M., & Furini, G. L. (2019). Climate change and human health linkages in the context of globalization: An overview from global to southwestern coastal region of Bangladesh. *Environment International*, *127*, 402-411. https://doi.org/10.1016/j.envint.2019.03.020

Botzen, W., Duijndam, S., & Van Beukering, P. (2021). Lessons for climate policy from behavioral biases towards COVID-19 and climate change risks. *World Development*, *137*, 105214. https://doi.org/10.1016/j.worlddev.2020.105214

Carey, M. (2012). Climate and history: a critical review of historical climatology and climate change historiography. *Wiley Interdisciplinary Reviews: Climate Change*, *3*(3), 233-249.

Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., & Patterson, C. (2009). Managing the health effects of climate change: lancet and University College London Institute for Global Health Commission. *The lancet*, *373*(9676), 1693-1733.

D'Amato, G., Bergmann, K. C., Cecchi, L., Annesi-Maesano, I., Sanduzzi, A., Liccardi, G., & D'Amato, M. (2014). Climate change and air pollution: effects on pollen allergy and other allergic respiratory diseases. *Allergo Journal*, *23*, 32-38. https://doi.org/10.1007/s15007-014-0484-1

Desai, B. H., & Mandal, M. (2021). Role of climate change in exacerbating sexual and gender-based violence against women: A new challenge for international law. *Environmental Policy and Law*, *51*(3), 137-157.

Doherty, T. J., & Clayton, S. (2011). The psychological impacts of global climate change. *American Psychologist*, *66*(4), 265.Farah, N., Siddiqui, S., Afzal, S., Gillani, S. M. A., Bakhsh, A., & Touseef, M. (2023). Climate-induced migration and associated risks in Pakistan: a systematic review. *Russian Law Journal*, *11*(12S), 785-796.

Goldhagen, J. L., Shenoda, S., Oberg, C., Mercer, R., Kadir, A., Raman, S., Waterston, T., & Spencer, N. J. (2020). Rights, justice, and equity: a global agenda for child health and wellbeing. *The Lancet Child Adolescent Health*, *4*(1), 80-90.

Haines, A., Kovats, R. S., Campbell-Lendrum, D., & Corvalan, C. (2006). Climate change and human health: impacts, vulnerability and public health. *Public health*, *120*(7), 585-596.

Huang, Y., Haseeb, M., Usman, M., & Ozturk, I. (2022). Dynamic association between ICT, renewable energy, economic complexity and ecological footprint: Is there any difference between E-7 (developing) and G-7 (developed) countries? *Technology in Society*, *68*, 1-16. https://doi.org/10.1016/j.techsoc.2021.101853

Huppert, H. E., & Sparks, R. S. J. (2006). Extreme natural hazards: population growth, globalization and environmental change. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *364*(1845), 1875-1888.

Iqbal, M. P. (2020). Effect of Climate Change on Health in Pakistan: Climate Change and Health in Pakistan. *Proceedings of the Pakistan Academy of Sciences: B. Life and Environmental Sciences*, *57*(3), 1-12.

Iqbal, J., Sarwar, S., Ashraf, A., & Zulfiqar, Z. (2023). Socioeconomic Vulnerabilities, Capacities and Solution for Women with Disabilities and their Families in the Face of Floods 2022. *Global Journal of Humanities and Social Sciences Research*, *3*(1), 54-64.

Jahanzad, E., Holtz, B. A., Zuber, C. A., Doll, D., Brewer, K. M., Hogan, S., & Gaudin, A. C. (2020). Orchard recycling improves climate change adaptation and mitigation potential of almond production systems. *PLoS ONE*, *15*(3), 0229588. https://doi.org/10.1371/journal.pone.0229588

Jones, R. T., Tusting, L. S., Smith, H. M., Segbaya, S., Macdonald, M. B., Bangs, M. J., & Logan, J. G. (2018). The impact of industrial activities on vector-borne disease transmission. *Acta Tropica*, *188*, 142-151. https://doi.org/10.1016/j.actatropica.2018.08.033 Khan, Q. A., Jan, A., Iram, S., Haider, I., Badshah, A., Khan, A., & Verma, R. (2024). Impact of 2022 flood on socio-economic and health status of people residing in flood-stricken areas of Pakistan: a cross-sectional survey. *Annals of Medicine and Surgery*, *86*(11), 6465-6471.

Kim, K. H., Kabir, E., & Ara, J. S. (2014). A review of the consequences of global climate change on human health. *Journal of Environmental Science and Health, 32*(3), 299-318.

Kinney, P. L. (2008). Climate change, air quality, and human health. *American Journal of Preventive Medicine*, *35*(5), 459-467.
Kosanic, A., Petzold, J., Martin-Lopez, B., & Razanajatovo, M. (2022). An inclusive future: disabled populations in the context of climate and environmental change. *Current Opinion in Environmental Sustainability*, *55,* 101159. https://doi.org/10.1016/j.cosust.2022.101159
Leisnham, P. T., & Slaney, D. (2009). Invited review—Urbanization and the increasing risk from mosquito-borne diseases: linking human well-being with ecosystem health. *Focus on Urbanization Trends*, (pp. 47-82). Nova Publishers, New York, USA.
Memon, F. S. (2020). Climate change and violence against women: study of a flood-affected population in the rural area of Sindh, Pakistan. *Pakistan Journal of Women's Studies: Alam-E-Niswan*, *27*(1), 65-85.
Mihiretu, A., Okoyo, E. N., & Lemma, T. (2021). Awareness of climate change and its associated risks jointly explain context-specific adaptation in the Arid-tropics, Northeast Ethiopia. *Social Sciences*, *1*(2), 1-18.
Murshed, M. (2022). Pathways to clean cooking fuel transition in low and middle income Sub-Saharan African countries: the relevance of improving energy use efficiency. *Sustainable Production and Consumption*, *30*, 396-412. https://doi.org/10.1016/j.spc.2021.12.016
Myers, S. S., & Patz, J. A. (2009). Emerging threats to human health from global environmental change. *Annual Review of Environment and Resources*, *34*(1), 223-252.
Ngcamu, B. S. (2023). Climate change effects on vulnerable populations in the Global South: a systematic review. *Natural Hazards*, *118*(2), 977-991.
Niles, M. T., Lubell, M., & Brown, M. (2015). How limiting factors drive agricultural adaptation to climate change. *Agriculture, Ecosystems & Environment*, *200*, 178-185. https://doi.org/10.1016/j.agee.2014.11.010
Ogden, L. E. (2018). Climate change, pathogens, and people: the challenges of monitoring a moving target. *Bioscience*, *68*(10), 733-739.
Pal, J. K. (2021). Visualizing the knowledge outburst in global research on COVID-19. *Scientometrics*, *126*(5), 4173-4193.
Patz, J. A., Campbell-Lendrum, D., Holloway, T., & Foley, J. A. (2005). Impact of regional climate change on human health. *Nature*, *438*(7066), 310-317.
Patz, J. A., Graczyk, T. K., Geller, N., & Vittor, A. Y. (2000). Effects of environmental change on emerging parasitic diseases. *International Journal of Parasitology*, *30*(12-13), 1395-1405.
Qamer, F. M., Abbas, S., Ahmad, B., Hussain, A., Salman, A., Muhammad, S., & Thapa, S. (2023). A framework for multi-sensor satellite data to evaluate crop production losses: the case study of 2022 Pakistan floods. *Scientific Reports*, *13*(1), 4240.
Ronoh, S., Gaillard, J. C., & Marlowe, J. (2015). Children with disabilities and disaster preparedness: a case study of Christchurch: Kotuitui. *New Zealand Journal of Social Sciences Online, 10*(2), 91-102.
Rosenzweig, C., & Neofotis, P. (2013). Detection and attribution of anthropogenic climate change impacts. *Wiley Interdisciplinary Reviews: Climate Change*, *4*(2), 121-150.
Santos, W. S., Gurgel-Gonçalves, R., Garcez, L. M., & Abad-Franch, F. (2021). Deforestation effects on Attalea palms and their resident Rhodnius, vectors of Chagas disease, in eastern Amazonia. *PLoS ONE*, *16*(5). https://doi.org/10.1371/journal.pone.0252071
Schuurmans, C. (2021). The world heat budget: expected changes Climate Change (pp. 1-15). CRC Press.
Semenza, J. C., & Menne, B. (2009). Climate change and infectious diseases in Europe. *The Lancet Infectious Diseases, 9*(6), 365-375.
Sharma, S. B., Jain, S., Khirwadkar, P., & Kulkarni, S. (2013). The effects of air pollution on the environment and human health. *Indian Journal of Research in Pharmacy and Biotechnology*, *1*(3), 391-396.
Shah, A., Naveed, R., Khalid, I., & Khan, A. (2021). A review on consequences of climate change in Pakistan. *International Journal of Engineering Research Updates*, *1*(01), 026-042.
Sommer, R., Glazirina, M., Yuldashev, T., Otarov, A., Ibraeva, M., Martynova, L., & De Pauw, E. (2013). Impact of climate change on wheat productivity in Central Asia. *Agriculture, ecosystems & environment*, *178*, 78-99. https://doi.org/10.1016/j.agee.2013.06.011
Song, Y., Fan, H., Tang, X., Luo, Y., Liu, P., & Chen, Y. (2021). The effects of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on ischemic stroke and the possible underlying mechanisms. *International Journal of Neuroscience*, *133*(2), 176-185.
Symanski, E., Han, H. A., Han, I., McDaniel, M., Whitworth, K. W., McCurdy, S., & Delclos, G. L. (2021). Responding to natural and industrial disasters: partnerships and lessons learned. *Disaster Medicine and Public Health Preparedness*, *16*(3), 885-888. https://doi.org/10.1017/dmp.2020.467
Tanjeela, M., & Rutherford, S. (2018). The influence of gender relations on women's involvement and experience in climate change adaptation programs in Bangladesh. *Sage Open*, *8*(4), 2158244018812620. https://doi.org/10.1177/2158244018812620
Trenberth, K. E. (2018). Climate change caused by human activities is happening and it already has major consequences. *Journal of Energy & Natural Resources Law*, *36*(4), 463-481.
Waheed, A., Fischer, T. B., & Khan, M. I. (2021). Climate Change Policy Coherence across Policies, Plans, and Strategies in Pakistan—implications for the China-Pakistan Economic Corridor Plan. *Environmental Management*, *67*(5), 793-810.
Watts, N., Adger, W. N., Agnolucci, P., Blackstock, J., Byass, P., Cai, W., & Cooper, A. (2015). Health and climate change: policy responses to protect public health. *The Lancet*, *386*(10006), 1861-1914.
World Health Organization (WHO) (2015). Weekly epidemiological record: Cholera 2014. World Health Organization, pp: 517-544.
Yang, B., & Usman, M. (2021). Do industrialization, economic growth and globalization processes influence the ecological footprint and healthcare expenditures? Fresh insights based on the STIRPAT model for countries with the highest healthcare expenditures. *Sustainable Production and Consumption*, *28*, 893-910. https://doi.org/10.1016/j.spc.2021.07.020