



Effect of Climate Change on Health in Pakistan

Mohammad Perwaiz Iqbal^{1,2,3*}

¹Department of Life Sciences, University of Management and Technology, UMT Road, C-II, Johar Town, Lahore-54770, Pakistan

²Department of Biological & Biomedical Sciences, Aga Khan University, Karachi, Pakistan

³Pakistan Academy of Sciences, Islamabad, Pakistan

Abstract: Climate change has emerged as a global issue that poses a serious threat to life in this world such as a shortage of food and clean drinking water due to global warming, erratic weather patterns, melting glaciers, droughts, etc. This issue has been in the limelight for more than 4 decades and world bodies including the WHO have been quite active in holding international conferences, seminars, and workshops to impress upon the member countries to take concrete steps to mitigate environmental degradation and save future generations from the devastating effects of climate change. While the climate change issue has been highlighted to a great extent, its impact on health has not received appreciable attention of the world community. The initiative of Inter-Academy Partnership (IAP) to address this issue is, therefore, a laudable scientific endeavor. Pakistan, one of the developing countries in South Asia is among the 5 most-affected countries due to climate change. Climate change has resulted in erratic weather patterns, reduction in the availability of clean water per capita, melting of glaciers, desertification of fertile cultivable land, flooding, land sliding, and drought leading to food insecurity. Besides having a drastic effect on the economy, the health of people is also getting adversely affected. According to the United Nations, more than 44% of Pakistani children under the age of 5 years suffer from stunted growth due to malnutrition. Such stunting impairs normal brain and body development. This has been one of the most alarming consequences of poverty and food insecurity. Other ill-effects of climate change (such as unseasonal rains and “smog”) on health include the spread of water and vector-borne diseases such as malaria, dengue, zika virus, typhoid, cholera, asthma, hay fever, allergies, respiratory diseases, and chronic diseases like diabetes, cardiovascular disease, renal disease, obesity, cancers, anxiety, and depression. Moreover, infectious diseases such as hepatitis B and C, COVID-19 are also spreading due to a compromised immune system. It is hoped that the world during the post-pandemic period would be more conscious of the mitigation steps to be taken to prevent future generations from the ill-effects of climate change. The UN Secretary-General, Antonio Guterres in his recently enunciated guiding principles urged the world leaders in the post-pandemic period “to rescue businesses that can create new jobs and enterprises through a clean and green transition based on the decarbonization of the economy and shift fiscal power from grey to green to initiate the resilience of people and communities in a way that is fair and leaves no one behind”. In other words, the world needs a “climate-smart” stimulus to provide a safe and healthy environment to future generations.

Keywords: Climate change, Health, Diseases, Adaptation, Mitigation, Pakistan

1. INTRODUCTION

1.1 Climate Change and Health – a Global Agenda

The last United Nations Climate Change Conference (COP25) was held in Madrid, Spain in December 2019 with the major goal to reduce greenhouse gases (GHG) and help countries facing severe effects of climate change. This occasion was used

by WHO to share its first-ever report entitled, “The WHO Health and Climate Change Survey: Tackling Global Progress” to emphasize the neglected link between climate change and health [1]. This report highlighted that the rising global temperature was seriously affecting the social and environmental determinants of health, and there is an increase in the global burden of disease due to polluted air, polluted drinking water, food insecurity, etc.

Received: July 2020; Accepted: September 2020

*Corresponding Author: Mohammad Perwaiz Iqbal <perwaiz.iqbal@umt.edu.pk; perwaiz.iqbal@aku.edu>

Earlier, IAP (Inter-Academy Partnership), a global network of science academies representing more than 130 academies and AASSA (Association of Academies and Societies of Sciences in Asia) took the initiative of addressing the challenge of climate change impact on health and come up with a comprehensive global consolidated report by the end of 2021.

2. CLIMATE CHANGE AND HEALTH IMPACT IN PAKISTAN

2.1 Pakistan's Geography

Pakistan lies in the world within the latitude and longitude of 30° 00 N and 70° 00 E (mapsofworld.com/lat_long/pakistan). Pakistan is the 33rd largest country by area with 881,913 square km, located in South Asia with a coastline of 1,146 km [2]. Besides Northern Areas, it has 4 major provinces-Khyber Pukhtunkhawa, Punjab, Sindh, and Balochistan. Its Northern highlands include parts of Hindu Kush, the Karakorum Range, and the Himalayas including the second highest peak in the world known as K2. South of Northern highlands is the Indus plain with two major subdivisions corresponding to the provinces of Punjab and Sindh and Balochistan Plateau. Its largest river is the Indus river (3,500 km) which flows through Northern Areas to the South into the Arabian Sea. There are two major deserts, one is the Cholistan desert in Southern Punjab while the other one is the Thar desert in Sindh. Population-wise, Pakistan is the sixth-largest country with a population of around 220 million people. Nearly 40% of the economy is agriculture-based. The country has more than 5,000 glaciers which are the major source of water for its rivers (Pakistangeography.com).

Nearly one-third of the population has income less than \$ 3 per day (poverty threshold). Textile material and rice are the major export items. The total annual exports are in the range of \$ 22-24 billion.

2.2 Previous Academy Publications on Climate Change and Health

Publications on the subject of climate change and health by the Academy have been listed in Table 1 [3].

2.3. Effect of Climate Change in Pakistan

According to the 2020 Global Climate Risk Index report which was released by the Germanwatch (a public policy group), at the United Nations Climate Change Conference (COP25), Pakistan is one of the five most affected countries in the world due to climate change from the year 1999-2018 [4]. The major contribution to this climate change is the Greenhouse Gas (GHG) emissions (CO_2 , CH_4 , N_2O , and H_2O), though Pakistan's contribution to global GHG emissions is negligible and insignificant. In 2010, when the world experienced an unprecedented increase of 5.8% in GHG emission, Pakistan's emissions also showed an increase in the same proportion [5]. The main factors contributing to this rapid increase in GHG emissions were the continuous migration of people from rural to urban areas (urbanization), the rise in transportation and industrial waste, and increased dependence on energy from fossil fuels for economic expansion.

Because of Pakistan's geographical location, the effects of climate change are quite severe. Its more than 5,000 glaciers in the Himalayan range have been melting at a rate faster than ever recorded in history [6]. This has posed a major threat to the country's water resources and could cause a 60% shortage in water, thereby affecting energy and agriculture security [4]. Being an agrarian country, such a shortage of water can have a devastating blow to the economy of the country whose 80% of exports are dependent on agricultural activities. The water supply of two-third of Pakistan's irrigable land originates from snowfall in mountainous Northern Areas and the rise in average temperature due to climate change is turning Pakistan into one of the most water-stressed countries in the world. As indicated by the International Monetary Fund (IMF), Pakistan's per capita annual water availability is 1,017 cubic meters which is very close to the scarcity threshold of 1,000 cubic meters. According to the reports from the United Nations Development Program (UNDP) and Pakistan Council of Research on Water Resources (PCRWR), Pakistan is likely to reach absolute water scarcity in 2025. By 2040, it could be among the most water-stressed countries in the region. Poor water management is further exacerbating the problem. Another effect of climate change in Pakistan has been the erratic weather pattern. There

Table 1. Publications on Climate Change and Health

S. No.	Academy Source	Published output
1	Pakistan Academy of Sciences, 1991	Burney MI. Proceedings of Seminar and Policy Briefings on Environmental Pollution Climate Change, October 21-22, 1991, Islamabad, Sponsored by Climate Change Institute, Washington DC, Pakistan Atomic Energy Commission, Pakistan Council for Scientific and Industrial Research.
2	Pakistan Academy of Sciences, 1998	Proceedings of Seminar on “Emerging Environmental Issues in Pakistan”, Organized by Pakistan Academy of Sciences and Energy and Environmental Society of Pakistan.
3	Korean Academy of Sciences and Technology, Seoul, October 18-22, 2010	Iqbal MP: Pb pollution. Proceedings of the International Symposium on “One Green Asia”, The Associations of Academies, and Societies of Sciences in Asia (AASSA), Korean Academy of Sciences and Technology, Seoul, October 18-22, 2010.
4	Korean Academy of Sciences and Technology, Seoul, October 18-22, 2010	Shinwari ZK, Towards greener Asia: Poverty reduction helps in conservation & sustainable use of biodiversity. Proceedings of International Symposium on “One Green Asia”, AASSA, Korean Academy of Sciences & Technology, Seoul, October 18-22, 2010.
5	Pakistan Academy of Sciences, Islamabad, 2016.	Rashid A. Proceedings of AASSA Regional Workshop on “Challenges in Water Security to meet the Growing Food Requirements”, AASSA, Pakistan Academy of Sciences, Inter-Academy Partnership (IAP), Islamabad, January 19-21, 2016.
6	Turkish Academy of Sciences (TUBA) Turkey, 2016.	Shinwari ZK. Health issues of refugees. Conference Papers on International Symposium on “Refugees and Migrants: A Global Problem or an Asset”, AASSA General Assembly Meeting and the Meeting of the Union of National Academies of Sciences of Turkic World, Ankara, Turkey, October 20-23, 2016.
7	Far Eastern Br. Russian Academy of Sciences, 2018.	Shinwari ZK. Ethics: Ensuring food security in the era of climate change. Journal of Regional Problems, Institute of Complex Analysis of Regional Problems. Far Eastern Br. Russian Academy of Sciences, 21 3(1):101-103, 2018.

has been unseasonal rains, unpredictable flooding, droughts, varying temperature, intense heat waves, a saturation of lakes, storms, hurricanes, landslides, etc. [7, 8]. According to the World Bank, the number of people affected by weather changes has increased since 2010 with the majority of the people being hit by floods, droughts, and extreme temperatures [9]. In 2012 and 2014, over one million people were affected by floods. Deforestation in the country during the last 70 years might have been one of the factors for this climate change. Intense flooding has resulted in the loss of human life, livestock and agricultural produce, soil erosion, silting of dams, and the spread of water and vector-borne diseases.

Heatwaves and natural fires are other consequences of climate change. Valleys in the mountains where normal temperatures used to be

around 30 °C are now having a temperature of 40 °C on several days during the season. In cities too, heat waves have caused deaths. In 2015, in Karachi (South of Pakistan), more than 65,000 people needed hospitalization due to heatstroke resulting in hundreds of deaths [10]. National fires in woods during hot summer are also not uncommon now, and these fires result in the loss of wildlife and natural habitat.

Desertification is another serious effect of climate change in the country. The country has two major deserts - the Cholistan desert in Southern Punjab and the Thar desert in Sindh province. There can be periods (in years) when there would be no rainfall in these areas. This has led to the migration of people to cities due to decreased vegetation,

hunger, and loss of livestock.

In the Southern region, where the Indus River meets the Arabian Sea, there is the Indus delta that has shrunk by 92% since 1883. The reduced flow of water in the Indus River over 30 years has resulted in the intrusion of the Arabian Sea into the Indus delta. This has affected the lives of nearly 2.5 million people who were dependent on fishing and agriculture. All these climate changes have seriously affected the life and economy of Pakistan who had already been facing the challenges of limited resources, population explosion, and increasing poverty.

2.4. Impact of Climate Change on Human Health

Climate change is seriously affecting human health in Pakistan. Stress, trauma, and diseases result from changing climate and lead to mental disorders, decreased working capacity, and even death. These effects can be divided into direct effects and indirect effects.

Direct Effects

Intense and frequent changes in temperature and precipitation in the form of cold and heatwaves, droughts, storms, floods, land sliding, and natural fires can cause injury, illness, and death.

Indirect Effects

Due to changes in the environment and ecological conditions, there could be a decrease in the quality and yield of crops and the availability of food items. There can be decreased availability of clean drinking water, the spread of water-borne and vector-borne diseases. All these could result in food insecurity, poverty, hunger, and ill-health.

2.4.1. Impact of Flooding on Health

Pakistan experiences inland river floods almost every year in varying proportions due to sea-level rise and silting in water channels. The 2010 data indicate that nearly 714,800 people of Pakistan got affected annually due to seasonal floods [11]. It has been estimated that by 2030, 1.5 million more people are going to be affected by flooding due to climate change and 638,000 people are going to be affected due to change in socio-economic conditions in the country [11]. Moreover,

flooding also causes indirect effects on health due to decreased food production (loss of food crops), an outbreak of infectious diseases, post-traumatic stress, and displacement of people to cities.

2.4.2. Risk of Infectious and Vector-borne Diseases

Changes in temperature, precipitation, and humidity have a very profound effect on the life-cycle and growth of infectious agents and disease vectors. Hence, the transmission of water and food-borne diseases is at its peak after the rainy and flooding season. Water-borne diseases such as cholera, diarrhea, hepatitis A, typhoid are most common in the country [12]. During the years 2010 - 2015, Pakistan has had severe floods causing death to several thousand people, especially those living along the sides of the rivers of the country. These floods not only contaminated the freshwater resources but also resulted in several thousand ponds of stagnant water which became breeding places for disease-causing insects, bacteria, and toxic algae [1].

Pakistan has faced several dengue outbreaks during the last 10 years. In 2011, more than 22,000 cases were reported from Lahore with more than 350 deaths. In 2019, more than 44,000 people in the country got affected by dengue fever followed by scores of deaths [13].

Besides dengue, zika virus is another infection considered to be quite common in Pakistan. Although clinicians concentrate more on the dengue virus and chikungunya virus, the infections due to zika virus are also on the rise in the country. There is a need to include zika virus diagnostic tests in the clinical protocol to determine the prevalence of the disease transmitted by *Aedes aegypti* and *A. albopictus* mosquitoes [14].

Malaria is among the major vector-borne diseases in Pakistan with one million estimated cases each year. *P. falciparum* and *P. vivax* are the only reported major parasitic species. *A. stephensi* and *A. culicifacies* are the known primary vectors in the transmission of this disease [15].

Hepatitis accounts for nearly 50-60% of acute viral hepatitis cases in the pediatric population of Pakistan [16].

In Southeast Asia, Pakistan has the highest incidence of typhoid fever (451.7 persons per 100,000 people per year) [17]. This water-borne and water-washed disease is primarily caused by *Salmonella typhi* and *Salmonella paratyphi* infections. Polluted water is often the source of the organism in many food-borne epidemics of this disease. The emergence of extensively drug-resistant strains of this organism poses a serious threat to the health of the people of Pakistan [18].

2.4.3. Impact of High Levels of Pollens, Allergens and “Smog”

Increased temperatures contribute to higher levels of pollens and allergens in the atmosphere. Transport, industrial emissions, and crop burning residues have become major causes of pollution, especially in central Punjab where “smog” has become almost a regular event at the arrival of autumn and winter seasons. The air quality index can be as high as 600 on certain days. There is a continuous haze with a very poor quality of air. This air pollution increased levels of pollens, and allergens lead to the high incidence of respiratory diseases such as asthma, hay fever, allergies, and eye diseases [19].

2.4.4. Impact of Heat Waves and Natural Fires

Due to climate change, now heat waves are more common in the cities of the country. The extremely hot weather conditions, especially in Sindh and Punjab can cause dehydration, kidney stones, and heatstroke. In Karachi, in 2015, there were more than 1200 deaths due to heatstroke [10]. Natural fires also erupt in woods due to very hot weather leading to loss of wildlife and vegetation.

2.4.5. Impact on Food Security and Human Nutrition

Since the major component of a country's economy is agriculture, the carbon emissions in the atmosphere and erratic weather patterns lower the nutritional density of food crops. Climate change also induces droughts and thereby disrupts the supply and production of food items. This results in food insecurity and malnutrition [20]. Another threat to food security has been the most recent (May 2020) locust attacks due to changing weather patterns in Africa and Asia. Such attacks

severely damage the crops and cause huge losses to agricultural produce. Moreover, high population growth and widening gap in wealth distribution act as a threat multiplier. In a country where nearly one-third of the population lives below the poverty line, such factors have serious consequences for the people at large that may get further pushed down in terms of meeting their basic food requirements. Therefore, malnutrition is on the rise in the country. By international standards in 2013, 11.2 million people (6% of the total population in Pakistan) were living below the \$ 1.9 per day poverty line, and 68.2 million people were living below the \$ 3.1 per day poverty line [21]. This increase in poverty has a huge impact on the health of the masses and makes them vulnerable to many common diseases.

The most serious impact of food insecurity in the country has been the “growth stunting”, and Pakistan now has one of the highest rates of malnutrition in children among the developing countries. According to the last National Health Survey, 31.5% of children were stunted, 45% were under-weight and 10.5% wasted [22]. The causative factors include food insecurity, inappropriate complementary feeding, low birth weight (due to mothers' inadequate diet during pregnancy), inadequate breastfeeding, low socioeconomic status, and infectious diseases. Such children are likely to have impaired growth development and severely compromised immune function.

2.4.6. Impact on Development of Chronic Diseases

Pakistan is among those countries which have the highest known rates of cardiovascular disease and diabetes mellitus [23]. There are several lines of evidence in the literature which show the association of climate change with the risk of cardiovascular disease. The major climate change factors affecting cardiac function include intense heat and undernutrition [24]. Air pollution in and around the home is primarily due to the burning of solid fuel (biomass or coal) for cooking. Women and children are at a greater risk of household pollution. Deaths among women due to cardiovascular disease and chronic obstructive pulmonary disease are largely due to this pollution. It has been estimated that 52% of 68,200 deaths of children in Pakistan are due to acute lower respiratory infections because of household pollution [11].

International Diabetes Federation in its 2012 report has indicated that food insecurity and malnutrition, higher temperature, heatwaves and pollution, and weakened health systems due to climate change are directly related to the global diabetes epidemics [25].

2.4.7. Impact on Risk of Development of Cancer

Due to climate change, toxic chemicals are abundant in the atmosphere as well as in water. Increased exposure of humans to these toxic chemicals can lead to various types of cancer such as liver cancer, breast cancer, and lung cancer [26]. Moreover, due to the depletion of ozone in the stratosphere, there is increased exposure to UV radiations leading to an increased risk of skin cancer and cataract. Moreover, various air pollutants are causing lung cancer in humans [27].

Pakistani population is quite diverse in terms of ethnicity and geographical location. The prevalence of certain types of cancer could be as high as 31% (breast cancer), 19% (oral cancer), 18% (gastric cancer), and 8.8% (prostate cancer) in certain regions and ethnic groups [28]. These high prevalence values of various cancers, also genetic factors, have been attributed to undesirable changes in the environment [29].

2.4.8. Impact on Mental Health

One of the major health-related fields that have not been sufficiently investigated in Pakistan is the impact of environmental changes on mental health. There is an important saying, “you can’t value that you can’t measure.” This aptly applies to the impact of climate change on mental health. The most common mental health impact of severe climate events include depression, anxiety, psychological distress, post-traumatic stress, aggression, complicated grief, complex psychopathology, sleep disorders, sexual dysfunction, social avoidance, irritability, drugs, etc. [30].

According to the above-referred discussion paper, while it is easier to quantify damages due to floods and droughts in terms of losses to agricultural yield, livestock, damages to infrastructure, and loss of income, it is not possible to measure the impact of such climate events on the mental health

of the affected people, such as loss of autonomy, helplessness, depression, post-traumatic stress and eventual resignation [30]. A couple of case studies by LEAD, Pakistan highlight the changes in attitude and behavior of people affected in Rajanpur, Punjab following the increased frequency of flooding since 2010. “As damages to the livelihood and property became more frequent, the culture also changed, and people have become indifferent towards their neighbors”. “Floods have left farmers despondent and triggered psychological problems such as extreme depression”, said an affected person. In another case study by LEAD, Pakistan, it was shown that in Tharparkar district of Sindh province which had three back to back droughts since 2012, the suicides increased by 75% (24 cases in 2011 vs. 42 cases in 2014) [30]. The Survey also revealed that 57 respondents (31% of the sample) from Tharparkar claimed to suffer from extreme depression while 11 (6% of the sample) said that they felt complete helplessness [30]. Thus, depression and a sense of helplessness are part of the residual impact of climate change on the health of Pakistani people [30]. Recognition of the impact of climate change on mental health in Pakistan is a major challenge. This is further compounded by the fact that mental health services are almost non-existent in this country and limited only to psychiatry departments of teaching hospitals or a few clinics. The ratio of psychiatrists to people is one to one million and most of the psychiatrists are in urban areas while the majority of the population resides in rural areas [30]. The people in the rural areas are generally poor and, therefore, are unable to go to the cities and afford the high treatment cost of psychiatric illnesses.

2.5. Adaptation and Mitigation

According to WHO, Pakistan is currently implementing projects on health adaptation to climate change and is taking steps to build institutional and technical capacities to address the challenges of climate change’s impact on health [11]. Moreover, Pakistan is attempting to develop a national strategy to achieve this objective. However, the adaptation measures are confronted with various challenges which include: economy which is largely agriculture-based, low technological and scientific base, low capacity to adapt to change, limited financial and institutional capacities, and

poor resolve among the policymakers and public at large to address the issue in letter and spirit. The National Climate Change Policy (NCCP) of 2012 is Pakistan's guiding document on climate change. The country's adaptation needs have been identified to range between \$7 billion to \$14 billion per year [31].

After the release of NCCP, the Government of Pakistan released other important documents such as "Framework for Implementation of Climate Change Policy (2013), and "Work Program on Climate Change Adaptation and Mitigation in Pakistan" to steer cumulative actions towards achieving climate resilience at the national and subnational levels [31]. The Ministry of Climate Change is the main institution for climate change in Pakistan. It evolved in 2010, from the Ministry of Environment after the 18th Amendment in the Constitution. The National Disaster Management Authority (NDMA) is another important institution that serves under the Ministry of Climate Change. While identifying the major climate change effects such as reduced river flows, declining availability of water for hydropower generation, increasing temperatures and mortality due to heatwaves, high floods due to unseasonal rains, sea intrusion into Sindh delta, and food insecurity due to erratic weather patterns, various adaptation options have been identified. These include the development of crop varieties which are more tolerant to droughts and pest attacks, modernizing the irrigation infrastructure to conserve water, integrated watershed management, reforestation of catchment areas, construction of additional water storage system, a renewed focus on renewable energy rather than the fossil fuel, construction of dykes or sea walls, etc. [31]. However, there is hardly any strategy for adaptation for health in this report. WHO recommends developing a national strategy for climate change that considers the health implications [11]. This should include the implementation of activities to increase the climate resilience of health infrastructure and the collection of information in an integrated disease surveillance and response system [11]. Regarding the implementation of climate change adaptation, there are many challenges. For example, there are no blueprints for successful climate change adaptation; the work related to adaptation is largely underfinanced, not optimally coordinated and

managed; limited capacity to generate resilience among the poorest population. Moreover, there is limited international funding for projects related to climate change and health. Another pressing problem is little collaboration between the health sector and climate change mitigation work, e.g., power generation [1]. Moreover, the lack of coordination between the federal government and the provincial governments on climate change matters makes the implementation even more challenging. For a successful course of action, all the stakeholders including the local governments must join hands to meet the climate change and health challenges in the country.

2.5.1. Adaptation and Mitigation Efforts by non-Government Sector

The private sector within the country despite its limited resources is also engaged in rendering services to the affected masses due to climate change. There are numerous examples that after the massive 2005 earthquake in the North Punjab, Azad Kashmir and Khyber Pukhtunkhwa, and the 2010 flood in the country scores of non-governmental organizations (NGOs) joined hands with NDMA in its efforts to mitigate the ill-effects of those traumatic events in the country. Several relief camps were installed in the affected areas to meet the immediate health needs of the traumatized people. Challenges related to mental health which, as mentioned above, is one of the most neglected health sectors in the country were also addressed by Pakistani psychiatrists following the floods of 2010. They aimed to regenerate hope, renew trust, promote social cohesion, and lessen hopelessness and depression among the flood-affected masses [30].

However, there is a need to expand such activities to other climate hazards as well, such as droughts. One approach that has been successfully implemented in some of the countries is, "building of social capital" by strengthening processes that help communities to work towards public good that is otherwise lost in the aftermath of disasters and climate stress. The approach should be, "community and family-oriented" to improve the mental health practices in rural communities confronting drought [32].

2.5.2. What Needs to be Done Regarding Adaptation and Mitigation

Despite poor coordination among various institutions related to climate change in Pakistan, there is an urgent need to address the problem as one of the top priority agenda items. Some adaptation measures for the government include:

- Create awareness among farmers to conserve water and provide essential training to cope up with the changing weather pattern.
- Build a system to timely provide weather information to farmers.
- Use of digital technology for innovations to combat weather changes and increasing crop output.
- Build alarm systems to inform citizens about incoming calamities such as heatwaves, storms, and floods.
- Build a private-public partnership for investment in taking measures to combat climate change effects, especially on health. For example, new seed varieties for crops should be developed which can grow in extremes of temperature and have improved yield.
- Climate change impact on health should be made part of curricula from primary to the graduate level of education.
- Organize campaigns through media creating more awareness and taking essential measures for building the capacity of institutions to combat climate change's effect on health.
- Involve the policymakers in seminars, campaigns, and discussions so that they become well aware of the urgency of the matter.

2.6. Recent Initiatives by the Government of Pakistan for Climate Change Mitigation and Adaptation

2.6.1. Clean Green Pakistan Index (CGPI)

This program was launched on November 25, 2019, by the Prime Minister of Pakistan to rank cities based on their cleanliness and greenery. The major performance indicators were safe drinking water, total sanitation, liquid waste management and hygiene, solid waste management, and tree plantation (www.cleangreen.gov.pk). The Government has initiated another program to plant

10 billion trees across the country within the next 5 years (2019-2023). Such a large number of trees besides releasing oxygen in the atmosphere would protect the fast-eroding landscape of Pakistan by reducing the risks of floods from melting glaciers in the mountainous Northern Areas.

2.6.2. Prevention of Sea Intrusion in Thatta, Sindh

The Federal Government in consultation with Sindh Provincial Government has initiated a project for the construction of a barrage on River Indus, 45 km upstream from the Arabian Sea. It is going to be a 12-m high barrage. Two canals from the reservoir would provide clean drinking water to people in Sindh, especially in the Thar region and Karachi. The feasibility of the project is expected to be completed by December 2020, while the engineering design should be ready by the end of 2021. The work on the project is expected to start in January 2022 and complete by December 2024. The storage of water is likely to be 2-3 MAF and would enable land acquisition of more than 80,000 acres.

2.6.3. EHSAAAS Program

The Government of Pakistan, under the Poverty Alleviation and Social Safety Division, has initiated this program for the uplift of the marginalized people of this country. These are the people (approximately 24.4% of the total population) who do not have enough money for food and non-food items. The key features of this program include:

- Supporting economic empowerment of women
- Scholarships and homes for the needy
- Insaf Insurance Health Card for 3.3 million people
- Scholarships for 50,000 undergraduate students covering 100% tuition fee and stipend
- The program has provided the largest cash support (US \$ 900 million) to more than 12 million people affected by the COVID-19 lockdown in the country.

2.7. Covid-19 Pandemic and Climate Change

The first Covid-19 case was identified in Karachi on February 26, 2020. During the last 8 months, after a near 8-week of complete lockdown in the

country which was relaxed on May 10, 2020, more than 300,000 positive cases of Covid-19 have been identified. By the end of the year 2020, more than 10,000 deaths are resulting from this infection. The complete lockdown in highly populated and industrialized zones of some of the cities and towns has severely affected the economy of the country. However, it had a positive influence on GHG emissions and the environment. The air quality index in major cities of the country was over 200 in December 2019, however, it has decreased to below 100 in March 2020. The Health System in the country has been severely challenged and exposed its shortcomings such as shortages of personal protective equipment, testing kits, medicines, wards for isolation of suspected cases, etc. Moreover, people suffering from non-COVID diseases were not able to get proper treatment in many healthcare facilities. The Government of Pakistan has now moved to selected lock down in areas where there are high incidences of corona positive cases to contain the spread of this disease. Due to these measures, the peak of new corona positive cases has already occurred during the 3rd week of June 2020. Healthcare facilities, during June and early July 2020, had almost reached their saturation point. Infected people now go for self-isolation in their homes and seek some treatment over there. Because of budgetary constraints, the Government is unable to provide any further financial help to poor families affected by this lockdown. However, it aims to provide some kind of stimulus to the affected businesses. Environmentalists have been urging the Government to provide a stimulus for a “green economy”. The response to the pandemic could also inform efforts to cut emissions, control effluents, and protect water, forests, and other natural resources. These recommendations are based on the fact that the most-pollution heavy industries have contributed towards weakening our immune system. Moreover, the fossil fuel industry has made the pandemic deadlier for the poor who are most susceptible to disease [33]. A climate-smart approach is likely to provide better health for future generations in this country.

3. CONCLUSIONS AND RECOMMENDATIONS

Pakistan being a developing country with a poor economic base has been most severely affected

by climate change and its subsequent traumatic events and this is seriously affecting the health of the people. To address the challenge of climate change’s impact on health, it is imperative to take measures towards mitigation.

The Lancet Commission report in 2019 has indicated that there are 3 pandemics- obesity, undernutrition, and climate change which are seriously affecting human health worldwide [34]. Since they all co-occur in time and place and interact as well, the Commission termed it as a “global syndemic”. The report has emphasized adopting a multi-pronged approach to mitigate the ill-effects of this syndemic. The key messages in this report include: strengthening national, provincial, and municipal governance to fully implement the policy actions according to national/international guidelines; strengthening the engagement of civil society so that it could put pressure on governments to implement policies in letter and spirit; reduce the influence of large commercial interests in the public policy development process. It also emphasized focusing on research on determinants of the syndemic including the indigenous and traditional approaches to address the problem. All these recommendations aptly apply to Pakistan which has been a victim of this syndemic. All government departments, civil society, and scientific organizations including the Pakistan Academy of Sciences (PAS) and AASSA must join hands to mitigate this huge challenge.

Unhealthy children grow up to become unhealthy adults. Thus, promoting children’s health is of paramount importance. Poverty reduction is a key step to be taken by the policymakers to promote the health of future generations of this country. Growth stunting has been a major health problem in Pakistan as indicated in previous sections. In the recent past, low income and high food prices have been shown to have a strong association with child stunting in developing countries [35]. The Government of Pakistan while attempting to increase agriculture production must keep an eye on rising prices of food items to stem the alarming increase in stunting in children. According to the Year 2020 data, 29% of the Pakistani population is between 15 years to 29 years and is termed as a youth (www.google.com). While this youth can be an asset to the country in driving the economy, their mental health status could be seriously impacted

by climate change [36]. Studies have shown that compared to adults, young people are more vulnerable to environment-related trauma and are more likely to be depressed if their family members are injured [37]. Therefore, it is incumbent upon the scientific community to identify ways to fortify the societal structures necessary for mental health that climate change threatens to destroy.

Another challenge that needs to be addressed is the impact of climate change on the human immune system. This impact has been well documented [38]. Major pathways that are sensitive to climate change include undernutrition, psychological stress, and exposure to UV light. These pathways are likely to weaken the immune system and make the population, especially children, more susceptible to recurring infections, allergies, and the development of autoimmune diseases and cancer. Floods and seasonal rains lead to the spread of water-borne and vector-borne diseases. People of Pakistan with a compromised immune system would be most vulnerable to these infectious diseases.

Therefore, masses should be encouraged to drink boiled water. Moreover, proper handwashing should become a routine exercise.

Control of air pollution is another important area that can bring significant benefits to human health. As mentioned in the 2019 report of the Lancet Countdown on Health and Climate Change, air pollution is mainly driven by fossil fuels. However, it gets exacerbated by climate change and would bring significant damage to the heart, lungs, and other vital organs of the body from adolescence and beyond [39]. These damaging effects further accumulate in the body over time into adulthood and would lead to various diseases. It has been estimated that the deaths attributable to these fine particulate matter ($PM_{2.5}$) could be about 2.9 million [40]. Air pollution has been ranked as the sixth major risk factor for mortality in Pakistan in 2017. Almost all the population of this country lives in areas with $PM_{2.5}$ concentrations above the WHO's least-stringent air quality target of 35 micrograms per cubic meter. As per estimates, there have been 128,000 deaths due to air pollution in Pakistan in 2017 with percentages of mortality due to chronic

obstructive pulmonary disease (47%), lung cancer (32%), diabetes mellitus (22%), heart disease (22%) and stroke (14%) [41]. With a mortality rate of this magnitude, control of air pollution by switching from fossil fuel to renewable sources of energy (wind, solar) is necessary for the health and wellbeing of the Pakistani population.

For protection against airborne diseases including COVID-19, masks should be worn all the time when going out or working at a place where the risk of infection or pollution is high. Vector-borne diseases have become a regular annual event after the rainy season. Preventive measures should be taken to avoid puddles and accumulation of stagnant water in ponds and other small open reservoirs. Commercial availability of vaccines against malaria and dengue at an affordable cost should be ensured. There can be no significant improvement in the health of the people of Pakistan unless there is an effective Population Control Program in the country. A division on "Climate Change and Health" in the Ministry of Health should be created so that the climate change impact on health could be appropriately addressed. Civil society should be involved in implementing adaptation and mitigation strategies. Impact on mental health which has been neglected so far could have devastating consequences. This area should receive maximum attention.

4. ACKNOWLEDGEMENTS

I gratefully acknowledge the Pakistan Academy of Sciences for nominating me to represent the Academy in the Inter-Academy Partnership (IAP) project on Climate Change and Health. The kind support provided by the leadership in the Association of Academies and Societies of Sciences in Asia – AASSA (Prof. Yoo Hang Kim, President AASSA, South Korea, and Prof. Dato' Dr. Khairul Anuar Abdullah, MAHSA University, Malaysia) to participate in regional meetings of AASSA is also thankfully acknowledged. I express my sincere gratitude to Prof. Dr. Zulfiqar A. Bhutta, Robert Harding Inaugural Chair in Global Child Health, Hospital for Sick Children, Toronto, Canada, and Founding Director, Center of Excellence in Women and Child Health, Aga Khan University, Karachi, Pakistan, for critical review of this manuscript/report.

5. REFERENCES

1. A. Azad. Climate & Health. *Dawn*. January 21 (2020).
2. A. Neelam, M.A. Khan, Omm-e-Hany, F.S. Hussain, K. Abid, and F.A. Khan. Repercussions of climate change on human health in Pakistan. A mini-review. *Journal of Chemical, Biological and Physical Sciences Sec D*, 7(1):008-013 (2016).
3. Pakistan Academy of Sciences. Year book 2016-17, Pakistan Academy of Sciences, Islamabad, Pakistan (2018).
4. Germanwatch. *Global Climate Risk Index 2020*. Germanwatch, COP25, Madrid, December 4 (2019).
5. Hussain, M., A.R. Butt, F. Uzma, R. Ahmed, T. Islam, and B. Yousaf. A comprehensive review of sectorial contribution towards greenhouse gas emissions and progress in carbon capture and storage in Pakistan. *Greenhouse Gases*, Wiley Online Library May 21 (2019). <http://doi.org/10.1002/ghg.1890>.
6. Malik, S.M., H. Awan, and N. Khan. Mapping vulnerability to climate change and its repercussions on human health in Pakistan 1-10 (2012).
7. Government of Pakistan. Pakistan Economic Survey. *Pakistan Economic Survey 2013-14*, 23-41 (2014).
8. Government of Pakistan. *Pakistan Economic Survey 2017-2018*. Economic Advisor's Wing, Finance Division, Government of Pakistan, Islamabad (2017-2018).
9. World Bank. World Bank Group. *Climate Change Knowledge Portal, Country Pakistan* (2019). <http://climateknowledgeportal.worldbank.org/country/Pakistan/climate-sector-health>.
10. J. Glum. Pakistan heat wave 2015: death toll exceeds 1200 as Karachi struggles with continued extreme weather during Ramadan (2015). <http://www.ibtimes.com/pakistan-heat-wave-2015-death-toll-exceeds>.
11. World Health Organization (WHO). *Climate and Health Country Profile*, 2015, Pakistan (2015). <http://apps.who.int>.
12. T. Ahmed, M. Scholz, F. Al-Faray, and W. Niaz. Water-related impact of climate change on agriculture and subsequently on public health: A review for generalists with particular reference to Pakistan. *International Journal of Environmental Research and Public Health* 13:1-16 (2016).
13. I. Junaidi. Dengue outbreak sets new record in Pakistan, *Dawn*, November 19 (2019).
14. A.M. Butt, S. Siddique, L.M. Gardner, S. Sarkar, R. Lancelot, and R. Qamar. Zika virus in Pakistan: the tip of the iceberg? *The Lancet Global Health* Nov 1 (2016).
15. A. S. Butt. Epidemiology of viral hepatitis and liver diseases in Pakistan. *Euroasian Journal of Hepatogastroenterology* 5(1):43-48 (2015).
16. World Health Organization. *Pakistan: Malaria and other vector-borne diseases*. World Health Organization Regional Office for the Eastern Mediterranean (2020).
17. R. L. Ochial, C.J. Acosta, M.C. Danovaro-Holliday, D. Baiqing, and S.K. Bhattacharya. A study of typhoid fever in five Asian countries: disease burden and implications for control. *Bulletin of World Health Organization* 86: 260-268 (2008).
18. World Health Organization. *Typhoid fever, Islamic Republic of Pakistan*. World Health Organization, Dec 27 (2018).
19. X. Jalil. Pakistan's own pollution causes smog, *Dawn*, Nov 1 (2019).
20. M. Hussain, A.R. Butt, F. Uzma, R. Ahmed, S. Irshad, A. Rehman, and B. Yousaf. A comprehensive review of climate change impacts, adaptation, and mitigation on environmental and natural calamities in Pakistan. *Environmental Monitoring and Assessment* 192: 48 (2020).
21. A. T. Sheikh. Climate-smart stimulus. *Dawn*, May 9 (2020).
22. World Bank. *Pakistan. Poverty & Equity Data Portal*. url: <http://povertydata.worldbank.org/poverty/country/PAK>.
23. A.Misra, N.Tandon, S.Ebrahim, et al. Diabetes, cardiovascular disease and chronic kidney disease in South Asia: current status and future directions. *British Medical Journal* 357: j1420 (2017). <http://dx.doi.org/10.1136/bmj.j1420>.
24. M. Asim, and Y. Nawaz. Child malnutrition in Pakistan: Evidence from literature. *Children (Basel)* 5(5):60 (2018).
25. J. DeBlois, T. Kjellstorm, S. Agewalls, J.A. Ezekowitz, P.W. Armstrong, and D. Atar. The effect of climate change on cardiac health. *Cardiology* 131:209-217 (2015).
26. Y.Zhou, C.Li, M.A.J. Huijbregts, and M.M. Mumtaz. Carcinogenic air toxics exposure and their cancer-related health impacts in the United States. *PLoS One* 10(10), e0140013(2015).
27. International Diabetes Federation. *Diabetes and Climate Change Report*. International Diabetes Federation, June 12 (2012).
28. National Institute of Environmental Health Sciences.

- Cancer: Climate and Human Health* (2019). <http://www.niehs.nih.gov/research/program/geh/climatechange/healthimpact/cancer/index.cfm>.
29. Minnesota Department of Health. *Cancer and the Environment*. www.health.state.mn.us.
 30. R. Idrees, S. Fatima, J. Abdul Ghafar, A. Raheem, and Z. Ahmed. Cancer prevalence in Pakistan: metaanalysis of various published studies to determine variation in cancer figures resulting from marked population heterogeneity in different parts of the country. *World Journal of Surgical Oncology* 16:129 (2018).
 31. Q. U. Z. Chaudhary, *Climate change profile of Pakistan*, Asian Development Bank, Manila, Philippines (2017).
 32. LEAD, Pakistan. *Non-economic loss and damage: Exploring the mental health impact of climate change. 2017.35 Discussion paper, Leadership for Environment and Development (LEAD)*, Pakistan (2017).
 33. H. Berry. Pearl in Oyster: climate change as a mental health opportunity. *Australasian Psychiatry* 7(6):453-456 (2009).
 34. B. A. Swinburn, V.I. Kraak, S. Allender, et al. The global syndemic of obesity, undernutrition and climate change: The Lancet Commission report. *Lancet* 393:791-846 (2019).
 35. S. J. Lloyd, M. Banglore, Z. Chalabi, et al. A global-level model of potential impact of climate change on child stunting via income and food price in 2030. *Environmental Health Perspectives* 126(9): 097007-1 – 15 (2018).
 36. H. Majeed, and J. Lee. The impact of climate change on youth depression and mental health. *The Lancet* Volume 1, e94-e95 (2017). www.thelancet.com/planetary-health.
 37. F. H. Norris, M. J. Friedman, P. J. Watson, et al. 60,000 disaster victims speak: Part 1. An empirical review of the empirical literature 1981- 2001, *Psychiatry* 65:207-239 (2002).
 38. A. Swaminathan, R. M. Lucas, D. Harley, and A. J. McMichael. Will global climate change alter fundamental human reactivity: implications for child health. *Children (Basel)* 1(3):403-423 (2014).
 39. N. Watts, M. Amann, N. Amell, et al. The 2019 report of The Lancet Countdown on health and climate change: ensuring that health of child born today is not defined by a changing climate. *Lancet* 394:1836-78 (2019).
 40. WHO. *Ambient air pollution: a global assessment of exposure and burden of disease*. World Health Organization, Geneva, Switzerland (2016).
 41. State of Global Air/2019, Health Effects Institute (2019). www.stateofglobalair.org.