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CLIMATE DISASTER CAUSING CATASTROPHIC WEATHER EVENTS IN 2022 IN PAKISTAN, ROBUST ACTIONS TAKEN BY PMD IN THIS REGARD, AND A GLANCE AT STRATEGIES FOR ACHIEVING LONG-TERM RESILIENCE

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By

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Abstract:

Changing climate and a plethora of its manifestations affect almost all sectors in Pakistan directly or indirectly even though the country only contributes 0.49% of the carbon footprint globally. This summer, the erratic monsoon rains battered the country from north to south, with extremely above-average (+175%) Rainfall. On the regional scale, the rainfall during the season remained excessively above average over Sindh (+426%) and in Baluchistan (+450%), largely above average over Punjab (+70%), +104% in Gilgit Baltistan, above the average of +33% in KPK and near average over AJK compared to the 30-year average for the period. According to the Post Disaster Need Assessment (PDNA), developed by the government of Pakistan in collaboration with the World Bank, ADB, EU, and UN agencies, the floods have pushed almost 9.1 million people into poverty and 7 million will fall further behind. An additional 7.6 million will now face food insecurity, 17 million women and children will be at greater risk of preventable diseases, and 4.3 million will face a job loss, the flood-hit agricultural land estimates losses of around $13 billion.

Massive displacements due to disasters, lack of access to safe drinking water and sufficient nutrition, disruption in academics, pollution, disrupted access to healthcare, damage to infrastructure and property, loss of natural ecosystems and habitats have caused major losses in the tourism industry and agriculture sector and threatened the livelihood in the areas which already struggles with everyday resources. Pakistan being the agrarian economy highly depends on its climate-sensitive land, that being so, natural disasters such as the floods of 2022 wreaked havoc on the already struggling economic situation of the country.

With an accuracy level of almost 100% and well-in-time forecasts regarding rainfall during monsoon, Pakistan Meteorological Department played an active role in the management of flood adjacent disasters. Still, there lies a requirement for a climate justice approach (internationally), bottom-up adaption planning and interdepartmental collaborations (nationally), systematic and coordinated development of initiatives and changes in policy planning, infrastructural developments to achieve climate resilience

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and preparedness to help Pakistan brace for the impact of any possible climate disaster in the future.

Keywords: PMD (Pakistan Meteorological Department), Resilience, climate justice, climate-sensitive.

Introduction:

1. Global average temperatures are increasing:

According to all available scientific evidence, the earth's average temperature is changing due to global warming (fig 1). To prevent the worst effects of climate change, scientists advise slowing the increase in average temperatures of the earth. By 2100, global warming must be restricted to 1.5 °C; but, if additional action is not taken, the earth may still warm by more than 2 °C (BBC). According to a report, by the independent Climate Action Tracker group from 2021, the planet will have warmed by 2.4 °C by the end of the century. Scientists believe that if nothing is done, global warming could approach 4 °C in the future, resulting in severe heatwaves, the loss of millions of houses to rising sea levels, and the irrevocable loss of biodiversity (Lindsay and Dahlman, 2022) (Fig 2).

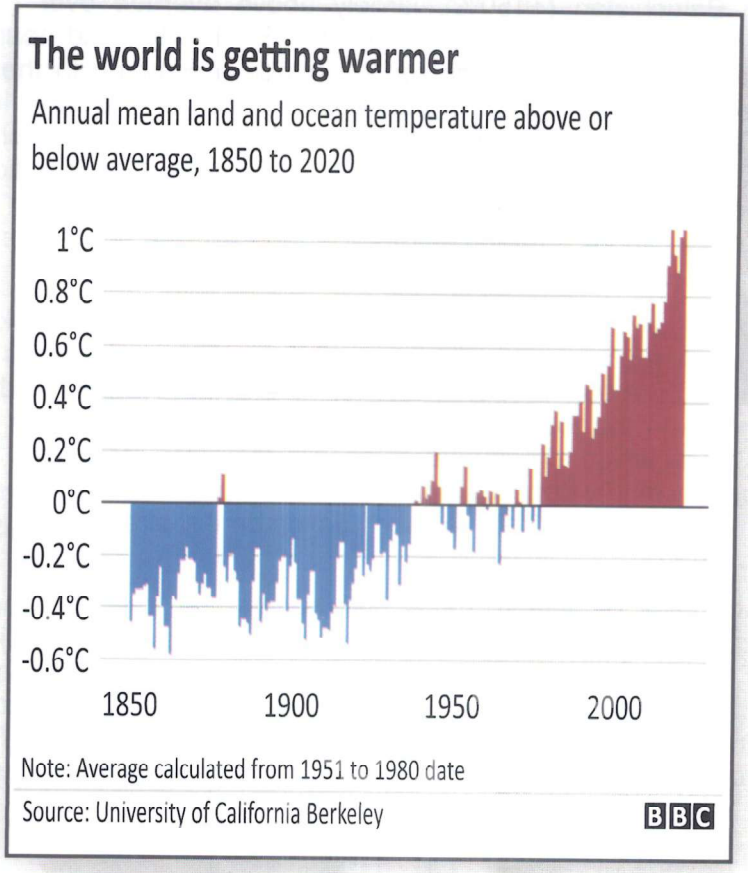


Figure-1: Observed Mean Temperatures above land and ocean from 1850-2020.

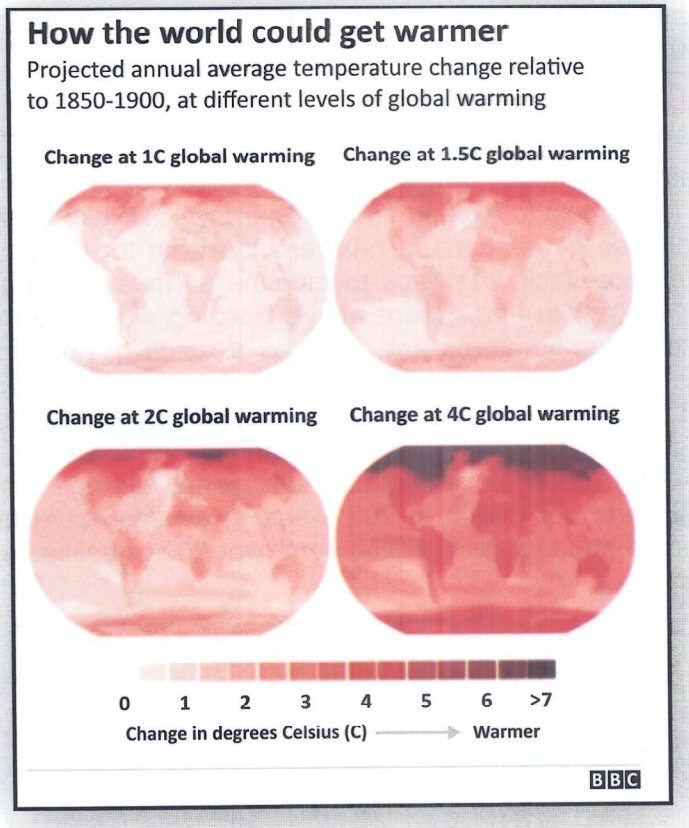


Figure-2: Estimated changes in landscape globally if average temperature of earth rises.

Globally, extreme weather events are already getting more and more dangerous, endangering lives and livelihoods. As cropland transforms into the desert, some areas may become uninhabitable as global temperatures rise. Currently experiencing its fifth season of poor rainfall, East Africa is putting up to 22 million people at risk of being hungry, according to the UN's World Food Programme. As was the case last summer in Europe, extreme temperatures can significantly raise the risk of wildfires. In comparison to the average, France and Germany burned nearly seven times more land between January and the middle of July 2022 due to wildfires. In addition to that, as it becomes warmer, formerly frozen earth will melt in regions like Siberia, releasing greenhouse gases that have been stored there for ages. In recent reports, it was indicated that thousands of year-old viruses are thawing in melting permafrost because of climate change. Extreme rainfall is producing unprecedented floods in other areas, as was recently observed in China, Pakistan, and Nigeria. Given that the developing and underdeveloped have fewer resources to adapt to climate change, people who live in poor countries are predicted to suffer the most. The oceans of the world and their habitats are also in danger. A study financed by the US National Oceanic and Atmospheric Administration, released in April 2022 claims that 10% to 15% of marine species are already in danger of extinction. Land animals will also have a tougher time

locating the food and water they require to survive in a warmer world. If action is not taken, at least 550 species might become extinct this century, according to scientists (Aljazeera).

2. Atmospheric carbon is the culprit:

The most significant greenhouse gas on Earth is carbon dioxide, which both absorbs and radiates heat. In contrast to oxygen and nitrogen, which make up the majority of our atmosphere, greenhouse gases capture heat emitted from the Earth's surface and re-radiate it in all directions, including back toward the surface. The natural greenhouse effect that keeps the Earth's atmosphere above freezing would be insufficient without carbon dioxide. Global temperatures are rising as a result of humanity amplifying the natural greenhouse effect by adding more carbon dioxide to the atmosphere. The NOAA Global Monitoring Lab found that in 2021, carbon dioxide accounted for nearly two-thirds of the total heating influence of all greenhouse gases created by humans. Based on analysis from NOAA's Global Monitoring Lab, the global average atmospheric carbon dioxide was 414.72 parts per million in 2021, setting a new record high. According to NOAA's 63-year record, the increase of 2.58 ppm over 2021 qualified for the 5th-highest annual increase fig (3).

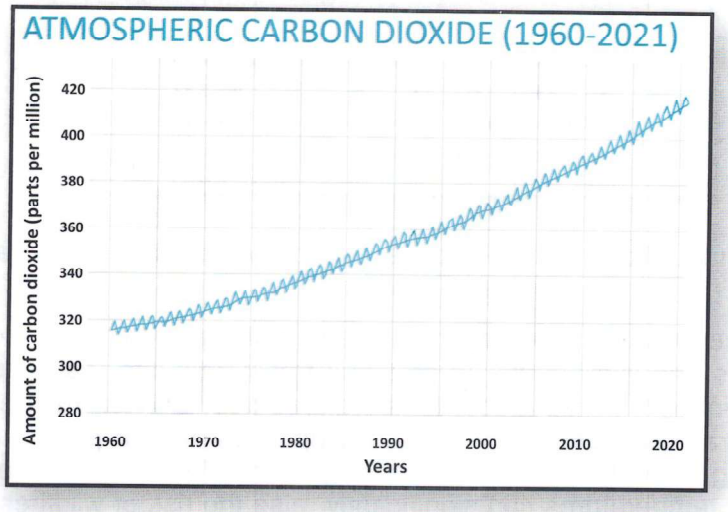


Figure-3: This graph shows the station's monthly average carbon dioxide measurements since 1960 in parts per million (ppm). The long-term trend of rising carbon dioxide levels is driven by human activities. (Source: NOAA Climate.gov image, based on data from NOAA Global Monitoring Lab).

3. Humans are supercharging the Atmosphere with carbon at a fast pace:

The primary driver of the increase in atmospheric dioxide concentrations is the human use of fossil fuels for deriving energy (fig 4). Anthropogenic activities are adding carbon to the atmosphere in only a few years that plants have removed from the atmosphere through photosynthesis over many millions of years and stored in the form of fossil fuels like coal and oil deep into the earth's crust. According to the Global Carbon Update

2021, annual emissions from burning fossil fuels have gone up every decade since the middle of the 20th century, from an average of 3 billion tons of carbon (11 billion tons of atmospheric carbon dioxide) a year in the 1960s to 9.5 billion tons of carbon (35 billion tons of carbon dioxide) (Al-Ghussain, 2018).

Experts on the carbon cycle estimate that over the 2011–2020 decade, "natural sinks" mechanisms that take carbon from the atmosphere from land and the ocean absorbed the equivalent of nearly half of the carbon dioxide humans emitted annually. The amount of carbon dioxide in the atmosphere rises every year because anthropogenic activities release more carbon dioxide into the atmosphere than the natural process's capacity to absorb. The more human's overshoot what natural processes are capable to remove in a given year, the faster the atmospheric concentration of carbon dioxide rises. Around 0.8 to 0.1 ppm of carbon dioxide per year increased in the atmosphere on a global scale in the 1960s. The yearly increase rate tripled during the subsequent 50 years, reaching 2.4 ppm annually in the 2010s. Since 1960, atmospheric carbon dioxide has been rising at a rate that is nearly 100 times faster than prior natural increases, such as those that took place at the end of the last ice age 11,000–17,000 years ago.

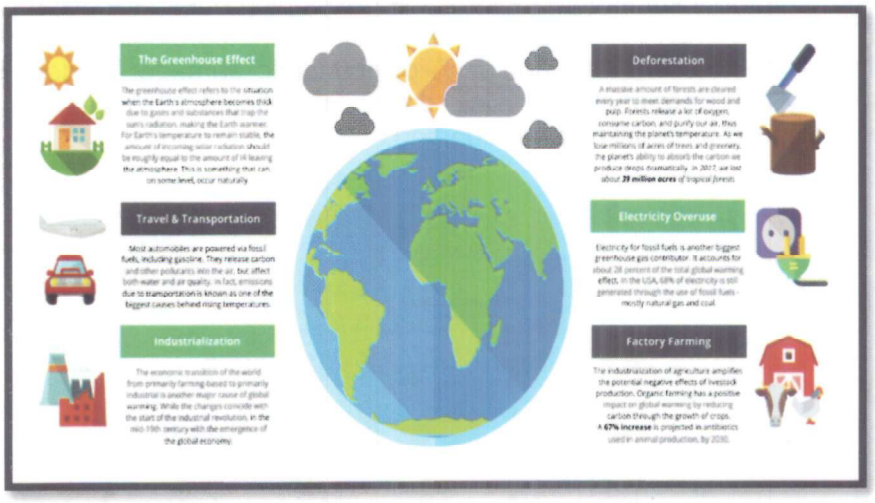


Figure-4: Anthropogenic activities supercharging the atmosphere with carbon (a greenhouse gas).

4. The Wrath of Climate change:

The issue of climate change is now a global one. The repercussions of climate change are prodigious and global in scale, ranging from rising sea levels to extremely warm temperatures and unusual weather patterns (fig 5). According to a group of European researchers, who claim to have discovered 13 previously unknown pathogens that had been trapped in the previously frozen ground of Russia's vast Siberian region, a team of scientists recently reported that they had discovered 5000-year-old Zombie viruses thawing in melting Russia's permafrost due to climate change. One virus was discovered by researchers, who estimated that it had been stuck under a lake more than 48,500 years ago. This virus, which they labeled "zombie viruses," was identified as a potential new threat from a warming planet. The same French, Russian, and German research

team reported its findings in 2015 after obtaining ancient viruses from the permafrost. In a pre-print study they published last month on the BioRxiv website, a portal where many scientists circulate their research before it is accepted in a scientific journal, they suggested that this concentration of fresh viruses suggests that such pathogens are probably more common in the tundra than previously believed (The Washington Post). Additionally, a major factor in the increased frequency and intensity of floods worldwide is climate change. The impact on developing nations is disproportionate. Pakistan experienced one of the worst floods in its history this year (2022). Significant damages occurred in one-third area of the nation geographically, resulting in significant financial losses and deaths. Disasters brought on by climate change have two main effects on communities. First, changes in livelihood, ecological degradation, and a lack of food and water availability make populations more vulnerable to dangers. Second, it makes weather-related threats more severe and frequent (Shah, *etal.*, 2022).

Floods made up about one-third of all reported global disasters. More than half of the casualties associated with the tragedy in previous years are attributable to it, as are one-third of the monetary losses. Floods resulted in 960,000 fatalities and an $1193 billion economic loss. The most vulnerable nations, the developing ones, are disproportionately impacted. Most disasters in recent years were either meteorological or hydrological, which resulted in 45% of fatalities and 79% of economic damage. Evidence suggests that flood severity and frequency are rising, despite significant advancements that have been achieved in flood forecasting and reporting.



Figure-5: Changing climate and its repercussions

5. Floods: a cost of changing climate:

Among hydrometeorological disasters, floods have been the most frequent, causing significant economic damage and fatalities. The Organization for Economic Cooperation and Development (OECD) estimates that floods cost the global economy $40 billion in damages each year. 3,062 flood incidents occurred in the world between 1995 and

2015, affecting 2.3 billion people, killing 157,000 people, and resulting in a $662 billion economic loss. According to UNISDR, flood intensity has also changed in recent years. Flash floods, riverine flooding, and coastal flooding have all increased in frequency. Malnutrition issues were caused by flood damage to agriculture and food in poor nations. More than 90% of people were impacted by water-related disasters in Asia, making it the region most at risk (Sanjrani, *etal.*, 2022).

5.1 The monsoon of 2022 in Pakistan:

This year monsoon season set on 30th June 2022 over Pakistan, a day earlier than its normal date (1st July), and withdrew during the third week of September 2022. However, significant continuous rainfall occurred from 4th July onwards. Total area-weighted rainfall for the whole country remained extremely above average (+175%) during the period (fig 6). On the regional scale, the rainfall during the period has also been excessively above average over Sindh (+426%) & Baluchistan (+450%), largely above average over Punjab (+70%) & GB (+104%), above average over KP (+33%) and near average over AJK. The torrential rain triggered enormous devastating flash floods in eastern & Southern Baluchistan, Sindh, southwest Punjab, and Khyber Pakhtunkhwa (KP) wreaking human & monetary loss (PMD).

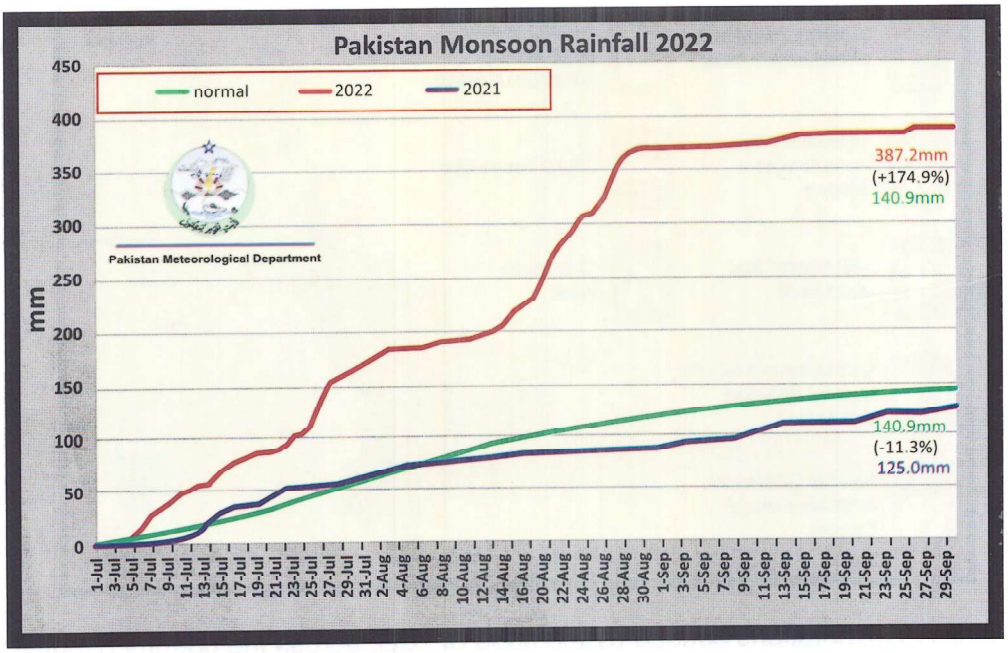


Figure-6: Graph showing observed area-weighted rainfall during the monsoon of 2022 in contrast with the rainfall of 30 years' normal and last year's observation (Source: PMD).

Monsoon 2022 rainfall, being record high and incomparable was caused mainly due to unusual regional and global atmospheric conditions such as Persistent triple-dip La Nina (previously such situation was observed during 2010-2012 which were incidentally extreme monsoon years), neutral IOD (Indian Ocean Dipole), deepened Heat/seasonal-

low pressure area, resulted by exceptionally high temperatures during April to June 2022, over south Pakistan which caused vigorous monsoon currents pulling towards the heat low centers, the monsoon axis remained tilted in the south (Lat. 22-24°N) compared to its normal/average position (Lat. 28°N or above), three low-pressure areas (LPAs) & four Depressions formed over Bay of Bengal moved towards Sindh-Baluchistan due to northeast-southwest oriented Tibetan /Sub-tropical High-pressure area. Also, Extreme weather events like floods, droughts, heatwaves, cyclones, sea-level rise, and glacier melting (GLOF) have become more frequent as a result of climate change. This year 16 GLOF events in Gilgit Baltistan and Khyber Pakhtunkhwa have been witnessed against the normal 5 to 6 events per year observed previously.

5.2 Flooding during the Monsoon of 2022:

The monsoon appeared to be on steroids, flooding nearly one-third of the country, killing approximately 2000 people, destroying thousands of communities, and displacing millions of others. Direct property damages are estimated to reach 43 billion dollars, and indirect economic losses could be substantially greater. Additionally, animals, infrastructure, livelihoods, and crops were all destroyed. (Figure-7).

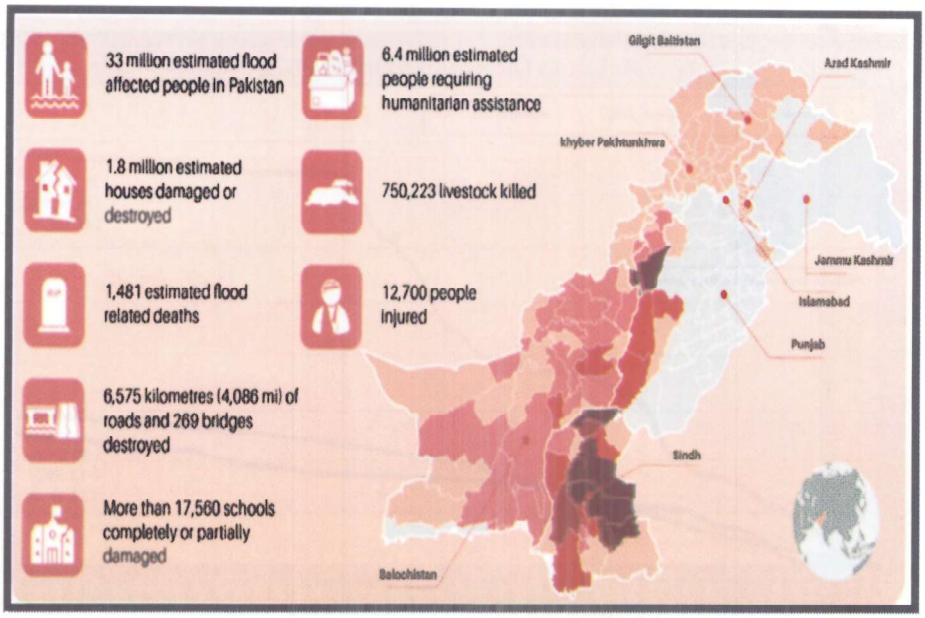


Figure-7: Devastations caused by the flood of 2022 across the country (Source: Community world service Asia)

In contrast to the extreme floods of 2010, the floods of 2022 were not limited to riverine flooding. This time, five climate change-fueled meteorological disasters occurred simultaneously and at the same time in different parts of the nation. Among them are unprecedented torrential downpours in the center of Sindh province, flash floods in southern Punjab and lower Sindh brought on by the Koh-e-Suleiman Mountain range in Baluchistan, urban flooding, primarily in Karachi, Hyderabad, Sukkur, and other urban areas, glacial outbursts in the upper Indus basin that caused flooding downstream, and

cloud outbursts at the upstream of the Kabul River catchment areas, a tributary of the Indus river (Ahmad and Afzal, 2022).

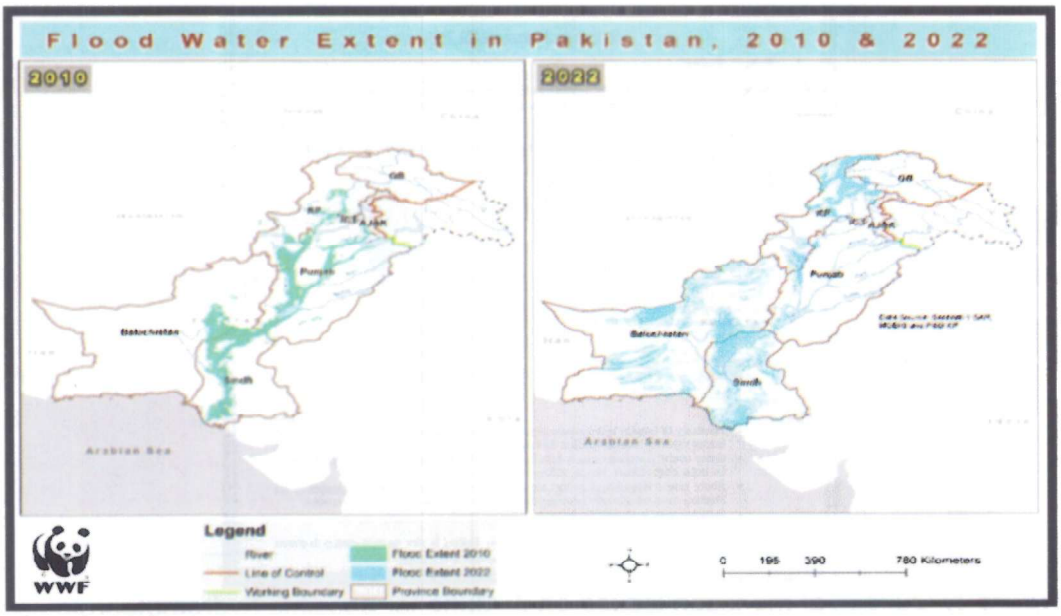
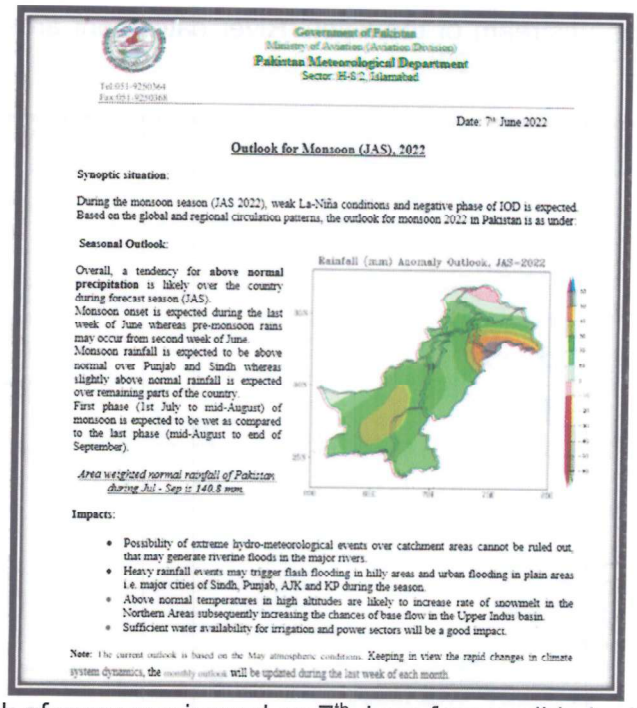


Figure-7a: Comparison of 2022 and 2010 Floods in Pakistan (Source: WWF).

5.3 Services provided by the Pakistan Meteorological department:

World Meteorological Organization (WMO) has always acknowledged the Pakistan Meteorological Department for accurate and timely forecasts regarding updates of any possible hydrometeorological disasters. Keeping the situation of meteorological parameters observed across the network of PMD, and after taking the hydrometeorological models' analysis into consideration, an accurate seasonal forecast stating the above normal Rainfall (expected at that time) with the synoptic situation, seasonal outlook, and detailed probable impacts on all possible regions was issued in the starts of June 2022 (fig 8). Accurate and well before the occurrence, hydrological forecasts were also issued for the catchments of all rivers specifically Kabul and Indus and their tributaries, in this regard Flood forecasting division has performed a detailed study which involved the expected lag time required for flood peaks to reach from one point to another during its course in a river. This comprehensive study used data of more than 30 years approximately and devised a time lag model which is significantly helpful to many departments involved in disaster management practices (fig 9), Chief Engineer at Tarbeela dam has mentioned that due to the provision of the real-time and accurate guidelines to dam operation by Flood forecasting division (PMD), the flawless operation of the dam infrastructure was made possible. The study of time lag was completed in 2021 by the research team of the flood forecasting division and this current year's observation has benchmarked its accuracy for the rivers of the Indus and Chenab (fig 10) (FFD).



Government of Pakistan
Ministry of Aviation (Aviation Division)
Pakistan Meteorological Department
Sector H-8/2, Islamabad

Date: 7th June 2022

Outlook for Monsoon (JAS), 2022

Synoptic situation:

During the monsoon season (JAS 2022), weak La-Niña conditions and negative phase of IOD is expected. Based on the global and regional circulation patterns, the outlook for monsoon 2022 in Pakistan is as under:

Seasonal Outlook:

Overall, a tendency for **above normal precipitation** is likely over the country during forecast season (JAS).
Monsoon onset is expected during the last week of June whereas pre-monsoon rains may occur from second week of June.
Monsoon rainfall is expected to be above normal over Punjab and Sindh whereas slightly above normal rainfall is expected over remaining parts of the country.
First phase (1st July to mid-August) of monsoon is expected to be wet as compared to the last phase (mid-August to end of September).

Rainfall (mm) Anomaly Outlook, JAS-2022

Area weighted normal rainfall of Pakistan during Jul - Sep is 140.8 mm.

Impacts:

- Possibility of extreme hydro-meteorological events over catchment areas cannot be ruled out, that may generate riverine floods in the major rivers.
- Heavy rainfall events may trigger flash flooding in hilly areas and urban flooding in plain areas i.e. major cities of Sindh, Punjab, AJK and KP during the season.
- Above normal temperatures in high altitudes are likely to increase rate of snowmelt in the Northern Areas subsequently increasing the chances of base flow in the Upper Indus basin.
- Sufficient water availability for irrigation and power sectors will be a good impact.

Note: The current outlook is based on the May atmospheric conditions. Keeping in view the rapid changes in climate system dynamics, the monthly outlook will be updated during the last week of each month.

Figure-8: Outlook of monsoon issued on 7th June for possible hydrometeorological events during the season (Source: PMD)

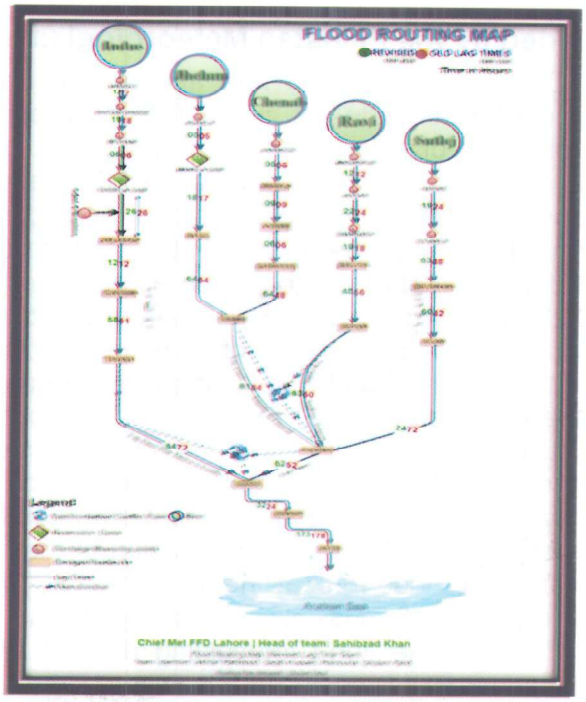


Figure-9: Flood Routing Model (revised in 2021) for all the rivers indicating lag time for all stations.

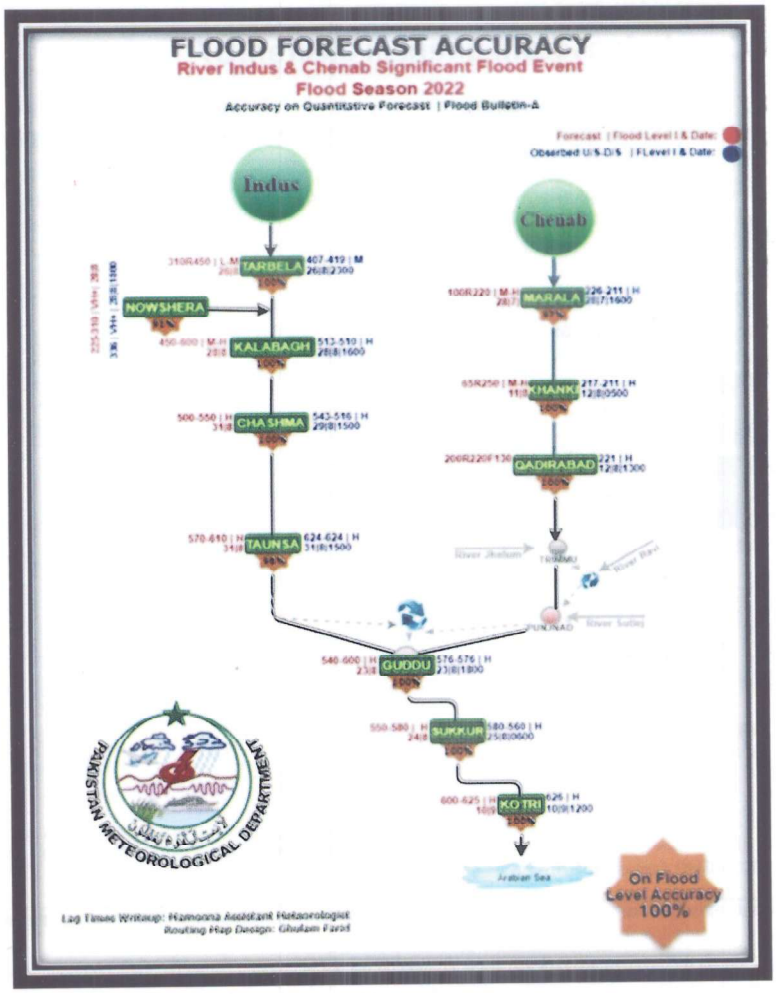


Figure-10: 100% forecast accuracy achieved after the interpretation of observed peaks during the year 2022.

6. Perils of climate change for the Global South:

The terrible floods in Pakistan (2022), which have resulted in 1,739 fatalities, 12,867 injuries, and 33 million displaced people, provide a stark illustration of the significant humanitarian costs the Global South is bearing as a result of the North's high carbon emissions. The victims of a terrible calculation of climate injustice are the people of Pakistan. Pakistan contributes less than 1% of the world's greenhouse gas emissions, but it is nevertheless suffering greatly from the effects of global warming. History shows that rich nations have consistently surpassed poorer nations in terms of cumulative GHG emissions. According to an IEA analysis, the G7 was responsible for 34.5% of all global greenhouse gas emissions from the energy sector between 1971 and 2020. The US accounts for 20% of the world's total, which is almost 56 times higher than Pakistan (fig 11) (Shah *etal.*, 2022).

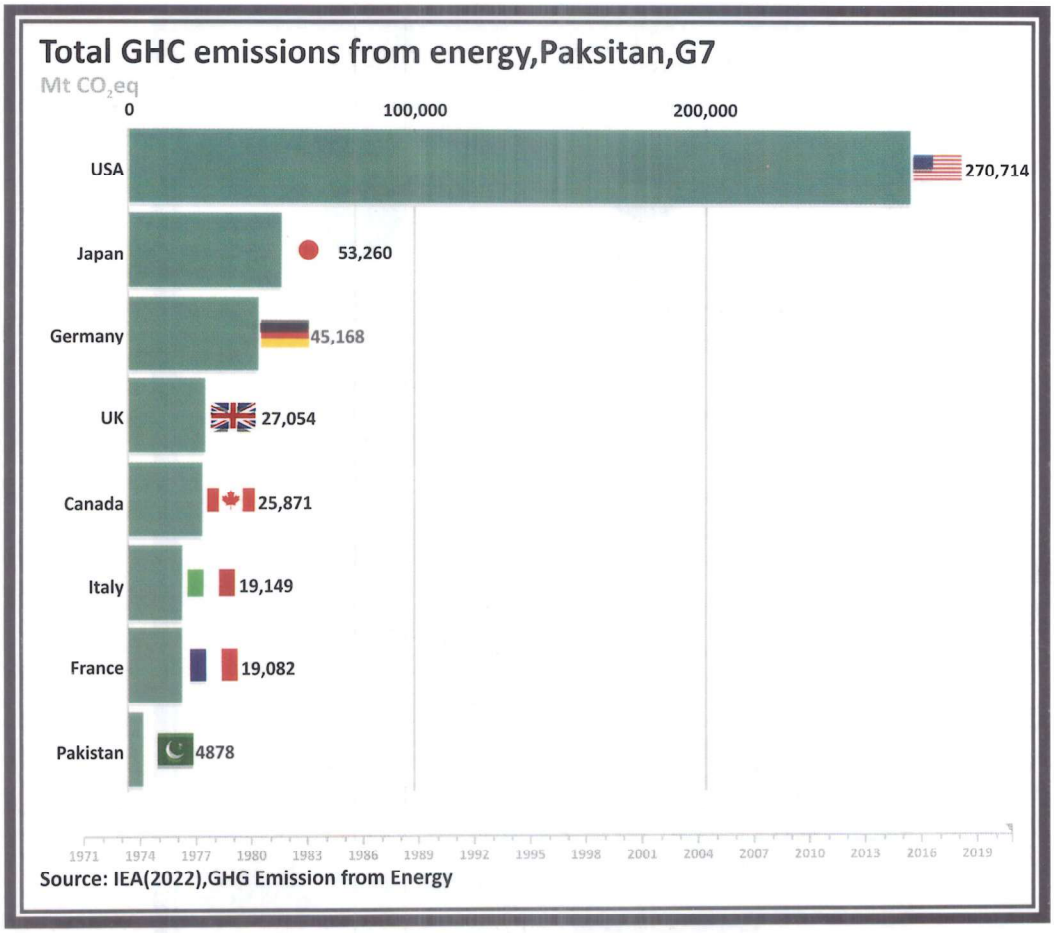


Figure-11: *Total cumulative emissions from the US are nearly 56 times more than those from Pakistan (Source: IEA)*

Since rich countries have benefited from being first on the growth ladder, they should shoulder more responsibility for combating climate change. There is an urgent need for more technical and financial help to address climate change, with 2022 already estimated to be among the ten warmest years on record. The predicted cost of climate adaptation was determined to be 5–10 times higher than the current public adaptation financial flows, according to the UN Adaption Gap Report. The world anticipates that the US and EU will deliver their pledge of $100 billion in climate funding to developing nations and lead the charge in reducing emissions to protect other nations' right to economic development. Additionally, a fair and acceptable lowering of emission requirements is required. The US has set a goal for reducing carbon emissions by 50–22% from 2005 levels by 2030. However, even a 50% reduction means that US per capita emissions in 2030 will be roughly 2.2 times higher than the global average, according to the Emission Database for Global Atmospheric Research (EDGAR). According to an article in the Guardian, a relatively small group of fossil fuel producers—just 100 businesses—and their investors hold the key to combating climate change.

These corporations are responsible for 71% of the world's emissions. A relatively small group of fossil fuel producers may hold the key to solving the global debacle, according to the (Carbon Majors Report, produced in partnership with the Climate Accountability Institute). Traditionally, large-scale greenhouse gas emissions data is collected at a national level but this report focused on fossil fuel producers specifically which are actually the cause of the problem.

7. Climate Justice:

The premise that affluent and powerful people historically enjoyed most of the development which is responsible for climate change, which ultimately has disproportionately affected the most vulnerable and disadvantaged, gave rise to the concept of climate justice. It has mostly been used to draw comparisons between industrialized nations, which have used copious amounts of fossil fuels without restriction for centuries, and the suffering of less developed areas, which are more vulnerable to global warming and climate change. Therefore, Pakistan's argument at COP27, which was held in Egypt from November 6 to 20, 2022, was for seeking climate justice. Pakistan contributed less than 1% (fig12) of the global greenhouse gases that sets off shocks of hazards, so why is financial relief categorized has always been categorized as disaster aid? (World Economic Forum).

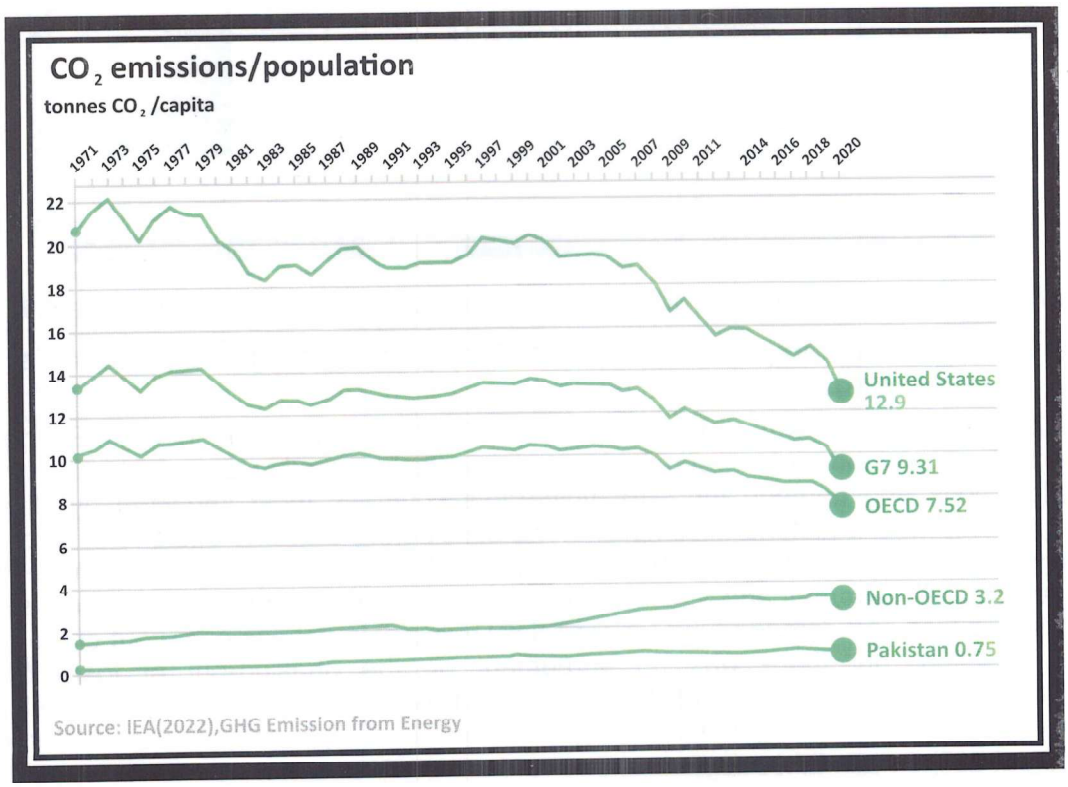


Figure-12: *US per capita GHG emissions from energy outpaced Pakistan by 17times (Source: IEA)*

Actually, there isn't much of a classification of available money for disaster relief, much less for climate-resilient recovery. The economical buffer for nations already under financial stress should be publicly allocated and distributed and made easily accessible. The wealthiest nations with minimum population size but the biggest polluters must take responsibility for their actions as the poorest 3.5 billion who are contributing very little (fig 13) towards global emissions are paying the price of someone else's doings.

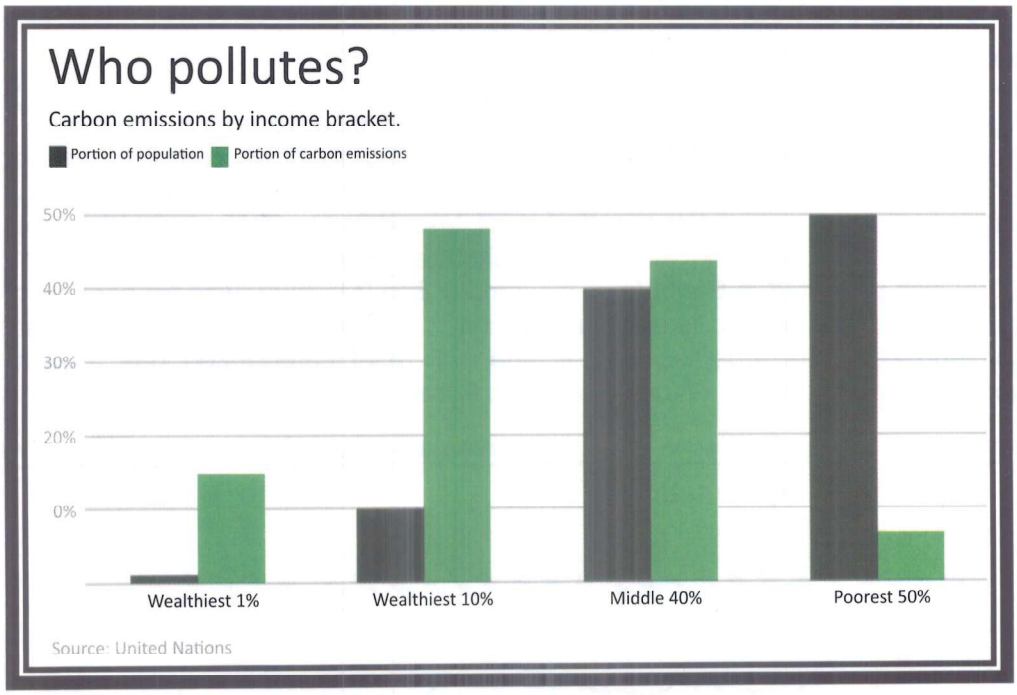


Figure-13: Population vs carbon emissions comparison of global north and south.

8. COP 27: A step forward towards Climate financing and Pakistan's powerful advocacy:

COP27 was the 27th United Nations Climate Change conference, held in Sharm El Sheikh, Egypt. A landmark agreement has been made in regard to Climate Justice which entails a loss and damage fund, for vulnerable countries most impacted by climate change. This was a historic accomplishment, considering that any effort to secure this facility has resulted in disappointment in the past 30 years. Also, 150 nations have now committed to cutting methane emissions by 30% by the end of the decade. The historic pledge to a loss and damage fund for especially vulnerable nations came out of the two-week meeting, but there was no agreement on the phasing-out of fossil fuels, threatening humanity's hope of keeping global warming to 1.5 degrees Celsius. However, Pakistan's delegation's strong advocacy and diplomacy at the conference stood out as the main takeaway.

The Pakistani delegation at COP27 was able to successfully convey the country's suffering due to climate catastrophe brought on by this year's massive floods despite having few resources at their disposal. The mission sought out nations experiencing

comparable climatic and economic risks, stressing that "What happens in Pakistan will not stay in Pakistan." In our participation's history, nothing like the organized advocacy, diplomacy, and negotiations that came out of the Pakistani pavilion has been seen before. Pakistan pushed for loss and damage to be included on the COP27 agenda while serving as the chair of the G77 plus China. This was a significant victory coming into the negotiations because wealthy nations have generally avoided discussing the topic of loss and damage in order to avoid culpability for past emissions many times before. 22 activities, including several sessions with a packed house, were held at the Pakistani pavilion during COP27. Several leaders from Bangladesh to the EU recognized Pakistan's leadership and strong voice for the cause of vulnerable developing countries.

The Minister for Climate Change participated in a number of bilateral and international panels. Additionally, it was revealed that Pakistan would serve as a "pathfinder" nation for the Global Shield Against Climate Action, a multimillion-euro initiative to safeguard vulnerable nations against climate-related catastrophes. The program will be used for the first time by Pakistan to collect information in order to make quick responses in case of a climate-related event occurs.

Unfortunately, COP27 was unable to reach an agreement on phasing out fossil fuels, and the text was not an improvement from COP26. This has disturbed researchers who believe that there may be less time left to hold global warming to 1.5°C. Also, there is a lot to be apprehensive of, even if Sharm El Sheikh promised a facility for loss and damage. The likelihood of the operationalization and distribution of such a fund being successful is, based primarily on historical experience, less optimistic. One has every reason to worry that this fund will suffer a destiny similar to that of the Adaptation Fund promised in 2001, which sadly provided far less funding than the promised amount. The operationalization of this fund, as well as ensuring that the commitments are sufficient and are distributed transparently where they are most needed, will need a lot of continuous effort from Pakistan and other vulnerable nations in the next months and years. Although Pakistan's performance at COP27 was commendable, it is only the first step in a difficult battle. Because for the global south climate change is nothing short of an existential threat.

9. Energy transition to renewables:

How we obtain energy has seen significant development in the previous 200 years. Innovations like the steam engine, oil lamps, internal combustion engines, and the widespread use of electricity were responsible for these alterations. The transition from a predominantly rural to an industrialized global economy required new sources to supply more effective energy inputs (Bocca and Ashraf, 2022). The knowledge that a reduction in greenhouse gas emissions is necessary to prevent the catastrophic effects of climate change is what is driving the present energy transition (fig14). For instance, Just 1.1% more renewables were used in the United States in the ten years between 2000 and 2010. But the rate of use is accelerating since it was 3.5% between the years 2010 and 2020 (World Economic Forum).

Year	Traditional Biomass	Renewables	Fossil Fuels	Nuclear Power
2000	10.2%	6.6%	77.3%	5.9%
2005	8.7%	6.5%	79.4%	5.4%
2010	7.7%	7.7%	79.9%	4.7%
2015	6.9%	9.2%	79.9%	4.0%
2020	6.7%	11.2%	78.0%	4.0%

Renewables has see their contribution to the energy mix grow Image: Visual Capitalist

Figure-14: share of renewables in the global energy mix changed over the last two decades.

In addition, the pace and size of the current energy transformation are unprecedented given that till 2050 net-zero emissions are required to meet climate goals. In essence, this indicates that fossil fuels will completely disappear in less than 30 years and that the production of renewable energy will inevitably rise quickly. After a record year in 2020, the addition of renewable energy capacity was on track to establish an annual record in 2021. Additionally, in 2021, investments in the global energy transition reached a new high of $755 billion. History, however, demonstrates that merely increasing generation capacity is insufficient to support an energy transition. Similarly, a full transition to low-carbon sources necessitates enormous expenditures in natural resources, infrastructure, and grid storage, along with changes in our energy consumption habits (world economic forum).

It becomes obvious that managing a successful energy transition is a very difficult endeavor. Along with guaranteeing energy availability and security and promoting economic development, it must also put a strong emphasis on decarbonization. Furthermore, there is no "one size fits all" approach to the energy transition. Finding scalable solutions, such as solutions that are technically, economically, socially, and politically viable, requires the participation and satisfaction of a sizable group of stakeholders, which adds to the complexity of the situation. The energy transition has a finite amount of time to be completed, the objective is to complete it in about 30 years till 2050. A successful energy transition needs to balance the energy triangle (fig 15), even though the current energy transition is primarily motivated by environmental sustainability concerns, it needs to ensure energy security and access while also promoting economic growth and development.

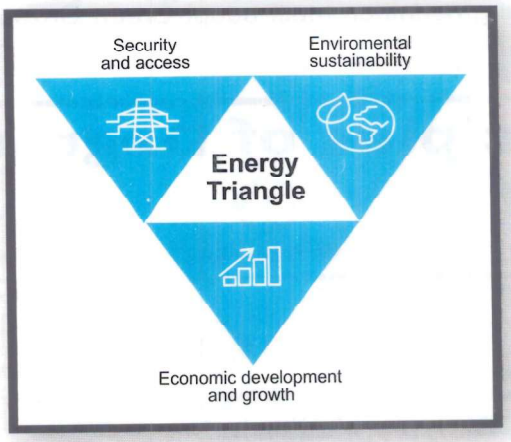


Figure-15: The energy triangle (source: World Economic Forum Energy Transition 101 Briefing Paper)

10. Degrowth and Green growth:

The IPCC Working Group III report, "Mitigation of Climate Change (Sixth Assessment Report of the Intergovernmental Panel on Climate Change IPCC)" released in early April 2022, mentioned the concept of degrowth, which emphasizes that prosperity and the Good Life are not immutably tied to economic growth and degrowth is an opportunity to recenter our economies on what really matters. It was challenged in the report by the authors that the widely accepted story that endless economic growth is an increase in the number of goods and services and is essential to reducing poverty and improving the quality of life around the world is actually not correct.

Degrowth offers the world a new story, one that acknowledges the role economic growth has in climate change and identifies alternatives. Degrowth means transforming societies to ensure environmental justice and a good life for all, within planetary boundaries. It pushes for the downscaling of harmful industries and the flourishing of helpful ones that address social needs, justice, care, and sustainability, broadly meaning the shrinking rather than growing economies, so the use of the world's energy and resources are minimized and well-being is put ahead of profit (fig 16). The idea is that by pursuing degrowth policies, economies can help themselves, their citizens, and the planet simultaneously by becoming more sustainable.

A report on climate change published by KASB Securities on climate change Given stresses that with the disproportionately high cumulative greenhouse gas (GHG) emissions from developed countries in history, developing countries should not face undue pressure from developed nations to take drastic steps in reducing Green House Gas emissions. A paper (Tomlinson, C. 2022) mentioned two alternative economic systems to the status quo, with the goal of mitigating the negative effects of the climate crisis. The two systems in question are Green Growth (a policy change from our current system) and Degrowth (a systemic/cultural Change). The finding of the paper was that wealthy countries have grown past a sustainable level of output and must adopt a Degrowth strategy to find a sustainable balance between production and environmental

limitations while developing countries must adopt Green Growth to reach a sustainable equilibrium balance.

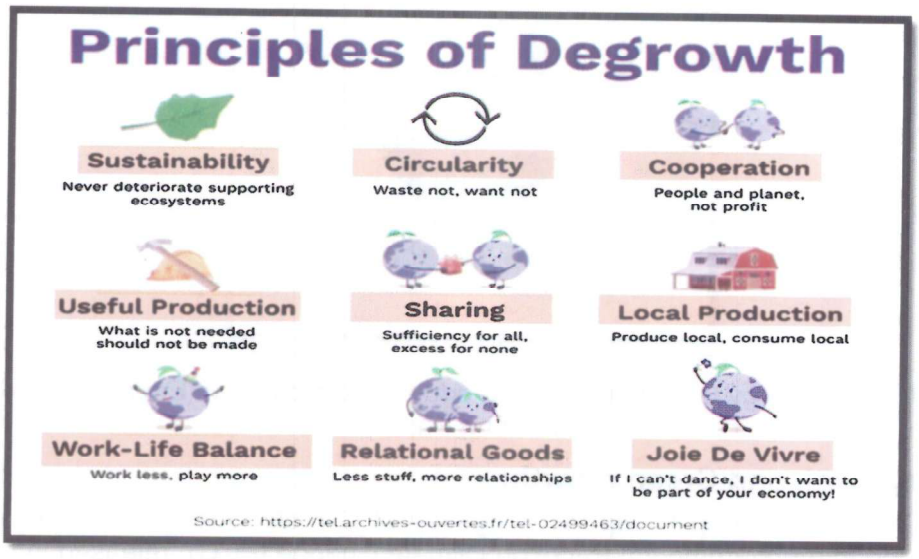


Figure-16: Principles of Degrowth with the approach of need-based economic development.

11. Ways for Bracing the impacts of climate change and enhancing Resilience at the National level:

- Local Government empowerment via bottom-up adaption planning and interdepartmental collaborations must be enhanced. The Planning Commission together with the provincial planning boards can spearhead the process, but this cannot be meaningfully delivered without constitutional amendments that would ensure that Local Government institutions financing, and given clear mandates without interruptions. The foundation of climate justice in Pakistan needs to be laid in local government institutions in order to strengthen inclusion and equity (Khan *etal.*, 2022).
- Pakistan has always been struggling to have a risk-informed development. Pakistan, being exposed to several natural and human-induced hazards, has been hit by several catastrophic events in recent years that set back decades of developmental progress within days. Increased disaster events have forced Pakistan to focus on preventive, mitigation, and preparedness strategy from a traditional response-centric approach, bringing about a paradigm shift in its overall disaster risk management (DRM) agenda. Despite having three-tiered structures (National, Provincial, and District Levels), a lack of effective coordination among the stakeholder is a loop to be filled (Rasool *etal.*, 2022).
- Policymakers must focus on building climate Resilient, and adaptation standards for mega infrastructure before construction. It ensures a risk-informed developmental process that realizes public safety, critical facilities, and the

natural environment. Development issues can only be tackled by pursuing climate-smart agriculture, water, energy, and urban planning.

- In addition to developing a Climate Adaptation Plan to ensure our community is prepared to withstand and recover from the effects of climate change, the country needs to work on ways to use energy more wisely and reduce our carbon emissions to fight climate change. This is called climate mitigation. Adaptation and Mitigation are intrinsically and shrewdly linked and inseparably tied (fig 17). Actions on each result in climate and economic co-benefits and contribute towards resilience. In fact, Pakistan's first official submission to the UN in 2016 of Nationally Determined Contributions specifically committed to adaptation. However the Nationally Determined Contributions are being updated every year, successive governments really need to develop national adaptation and mitigation plans for their implementations before deadlines (Yusoff and Yusoff, 2022).
- Climate change dystopia will only increase exponentially unless climate-induced disasters are prioritized as the non-traditional security threat for the country. Apart from mitigation measures, societal transformations can play a vital role in combating this global issue. Thus, it is imperative to understand climate change and risk perception for designing risk reduction and climate change adaptation strategies.

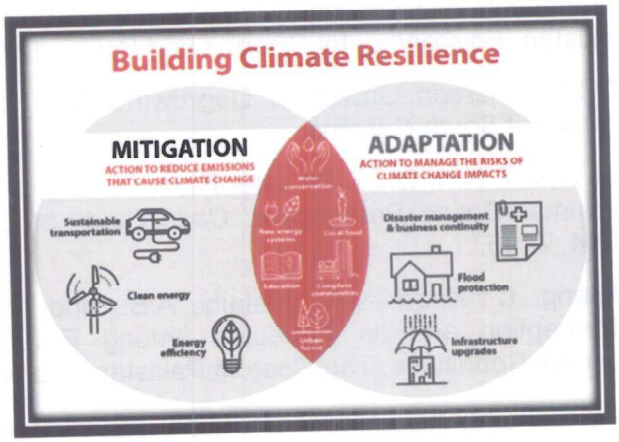


Figure-17: Mitigation and adaptation are intertwined for the long-term building of climate Resilience.

- Risk perception and psychological distance to climate change play a vital role in ascertaining community readiness to adapt themselves against climate and flood risks. These concepts can help bridge and integrate the philosophies of disaster risk reduction and climate change adaptation.
- Nature-based solutions have a lot of scope as green infrastructure strategies that work in harmony, supporting the community's well-being, generating benefits for the environment, making progress on Sustainable Development Goals (SDGs), and strategically conserving or restoring nature. The solutions can reduce

disaster risk and produce more resilience with lower-cost services in developing countries.

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