# CREDIBLE EVIDENCES OF GLOBAL WARMING VIS-À-VIS GLOBAL CLIMATE CHANGE IMPASSES: A CRITICAL REVIEW

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**ABSTRACT**

Global warming and global climate change impasses have dramatically become two of the biggest challenges of the current world. The serious consequences of global warming are on the rise throughout the Northern and Southern hemispheres. For instances, prolonged droughts, catastrophic heatwaves, disastrous forest fires, strong cyclones and storms, tornados, torrential rains, mass flooding events, extreme cold waves and winter conditions, accelerated ice caps melting etc. have seriously come to the fore. Efforts are being made to address these issues at different levels and mitigate the negative impacts on the human population and also on the environment. It is essential for governments, stakeholders, INGOs, and environmental organizations to work together to develop and implement effective strategies that minimize the negative impacts of global climate change impasses. On this context, this global review sheds some lights by demonstrating the credible evidences of global warming and global climate change impasses with recent examples. The study employed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) model to systematically filter and select relevant literature. Following a rigorous process of identification, screening, and inclusion, manuscripts, news articles, and reports published in English were considered for analysis. In line with the study's criteria, inappropriate or unrelated literature was excluded. After the filtering process, a total of 48 literature sources were included in the study, selected from an initial pool of 80 pieces. In accordance with the results, this comprehensive global review illuminates the undeniable evidence of global warming and the critical challenges posed by climate change, supported by recent and pertinent examples. In other words, within the given context, this extensive global review provides valuable insights into the irrefutable proof of global warming and the pressing issues posed by climate change. By examining current and recent examples, the review substantiates the urgency and significance of addressing these global challenges.

**Keywords:** Global Climate Change; Global warming; Hydrometeorological Disasters; Collapse of the Gulf Stream; Loosing Polar Ice Caps.

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## 1. INTRODUCTION

The fluctuation of earth's average temperature yearly is a natural process. Nevertheless, scientists have investigated that the global average temperature has considerably been increasing more rapidly compared to its natural ways what yearly does. The cardinal reason behind this adverse situation is the range of anthropogenic activities that have dramatically been increased over decades. For example, burning out of fossil fuels such as oil, coal and gas etc.; harmful gases emitting via many hundreds of thousands tons of garbage disposal; and of course long term deforestation. This situation has an impact, especially, on flora and fauna and most importantly, the human population. In particular, almost all the developing and developed countries which are located in the northern and the southern hemispheres, have dramatically experienced some unexpected calamities such as prolonged droughts, torrential rains, mass flooding events, heat waves and cold waves etc. due to global climate change impasses for years (see, Helmore, 2021; Mailman, 2021; Watts, 2021; Buckland, 2023). Many hundreds of researchers, scientists, policymakers, government representatives and stakeholders gathered to Glasgow in at the UN climate change summit called "the 26th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP26)" summit that held from end of October to the middle of November 2021 in order to discuss possible policy implementations on the global warming and global climate change crisis. More importantly, COP 27 summit held was held from 6th to 20th November, 2022 in Sharm El-Sheikh, Egypt. According to COP 27 news, altogether over 35, 000 participants recorded in the summit to discuss the climate action around the world (https://www.un.org/en/climatechange/cop27, Accessed: 25/05/2023). In accordance with the UN Secretary-General António Guterres's words, "The world still needs a giant leap on climate ambition". "The red line we must not cross is the line that takes our planet over the 1.5degree temperature limit". He also has emphasized that we must not relent "in the fight for climate justice and climate ambition". According to the UN secretary general's words, *"this is because we have to win this battle for our lives*". In accordance with the above facts, we are yet to be faced a serious consequences plus tremendous treats by the current climate change crisis, if we are not really preparing for the unexpected disasters and catastrophic events.

Additionally, global efforts to combat climate change have been ongoing for many years, with numerous summits and initiatives taking place. These include the UN Conference on the Human Environment in Stockholm in 1972, the Vienna Convention for the Protection of the Ozone Layer in 1985, and the Montreal Protocol on Substances that Deplete the Ozone Layer in 1987. Other key examples include the United Nations Framework Convention on Climate Change (UNFCCC), which was signed at the Earth Summit in Rio de Janeiro in 1992; the Kyoto Protocol, adopted in 1997, which aimed to reduce global greenhouse gas emissions; and the Paris Agreement, signed in 2015, which brought together 196 parties with the goal of limiting global temperature increases to no more than 1.5 degrees Celsius. More importantly, these efforts exemplify that the world leading bodies such as United Nations and Inter Governmental Panel for Climate Change (IPCC) have importantly been

engaged with a range of activities/ways in terms of protecting the environment, reducing the emitting of bad gases and also reducing the global warming. Except for some countries like Australia and India who are among the world leading emitters, other countries still have not agreed to some climate laws and regulations (e.g. dispute arisen about the fossil fuel trading at the COP 26 summit).

On the other hand, some of all around the world have significantly contributed to disseminate the knowledge on the climate change, future impacts and consequences by their seminal works/publications covering several disciplinary approaches. In particular, eminent scholars such as Professor Neil W. Adger (Human Geographer, University of Exeter, UK, Google citation account records at the time of this article is writing, 127, 265), Professor Susan L. Cutter (Human Geographer at University of South Carolina, USA, Google citation account records at the time of this article is writing, 44,263), and Professor Jörn Birkmann (Geographer, University of Stuttgart, Germany Google citation account records at the time of this article is writing, 20,223) have contributed in a number of ways aiming at to scholarly contribute to resolve the climate related impasses of the world. In particular, N. W. Adger, has contributed to reshape the community and disaster resilience aspects for decades by mainly focusing on global climate change. For example, social and ecological resiliency challenges in the face of external stresses (Adger, 2000); social capital and adaptations to climate change (Adger, 2003); social-ecological resilience to costal disasters (Adger, et al., 2005; Graham, 2020); Vulnerability (Adger, 2006); Adaptation to Environmental Change (Nelson, Adger, and Brown, 2007). Susan L. Cutter has also contributed much for the discussion on environmental hazards and disasters, social vulnerability, and community disaster resilience aspects (Cutter, Boruff, and Shirley, 2003; Cutter, Burton, and Emrich, 2010; Cutter, et al., 2008; Cutter, Ash, and Emrich, 2014). There is a strong association in between the ecological resilience and the epistemological development. These geographers have significantly been shaped the epistemologies of disaster science, community disaster resilience, and vulnerability based upon the scholarship of environmental and global climate change. The unfortunate situation is that other scholars of different disciplines who are dealing with such resilience researches are totally dependent on the money-oriented gambles. In particular, a rising trend of climate change induced disasters has been providing a lot of foods for thoughts for everyone.

Similarly, Sri Lanka has also experienced torrential rains and mass flooding events for decades, compared to the other natural disasters (Karunarathne and Lee, 2019; Churchill, and Hutchinson, 1984; Karunarathne and Lee, 2020a; Karunarathne and Lee, 2022). Especially, in accordance with the historical records, Sri Lanka has experienced mass flood disasters in the years of 1913; 1940; 1947; 1967; 1968; 1978; 1992; 2003; 2011; 2016 and 2017 (Churchill, and Hutchinson, 1984; Karunarathne and Lee, 2019; Karunarathne, 2021). More importantly, in accordance with the Author's personal observations and records, the wet-zone catchments of Sri Lanka experienced some torrential rains even after the South-west monsoon period, particularly in the months of November and December in 2021 and 2022. According to my understanding, these events are not relating with the inter monsoon periods and

the North-east monsoon of the country. In the middle of December, 2022, the country again experienced another extreme weather condition (e.g. including low-temperature) which was associated with the depression developed in the Bay of Bengal. Many cows and other animals lost lives during this extreme weather condition in Northern region. These events also imply that the global climate change impasses are at the doorstep of the island of Sri Lanka as well. In this context, this work is seeking to answer the following research questions: (i). What is the actual and current situation/trends of global warming? (ii). What are the credible evidences of global climate change impasses and related disasters? On this background, this paper will shed some lights of demonstrating the credible evidences of global climate change impasses as a systematic literature review. This work will also be helped to policy makers who are engaging with making contingency plans for future climate change related cascading disasters and for the climate-change related disaster management and disaster risk reduction (DRR) discourse of Sri Lanka.

The paper is structured as follows; the next section explains the methodology of this manuscript. The 3rd section engages with examine the current situation/trends of global warming. The 4th section exemplifies the credible evidences of global climate change impasses and related disasters and finally the discussion and conclusion of this work are compiled.

## 2. METHODOLOGY

The study conducted a systematic literature review using various search engines and databases such as Google Scholar, Web of Science, Elsevier, Scopus, PubMed, as well as reports such as those from the Intergovernmental Panel on Climate Change (IPCC) and news articles. Especially, since the author of the current work is an international reviewer, he has free access to ScienceDirect, Scopus, and Reaxys databases even from the Sri Lankan context. The study also used specific search terms and fuzzy search rules to identify relevant articles on environmental change, global climate change, climate crisis, global warming, vulnerability and adaptation. Figure 1 presumably provides an illustration of the article search and filtering process, demonstrating the steps of identification, screening, and inclusion in the study.

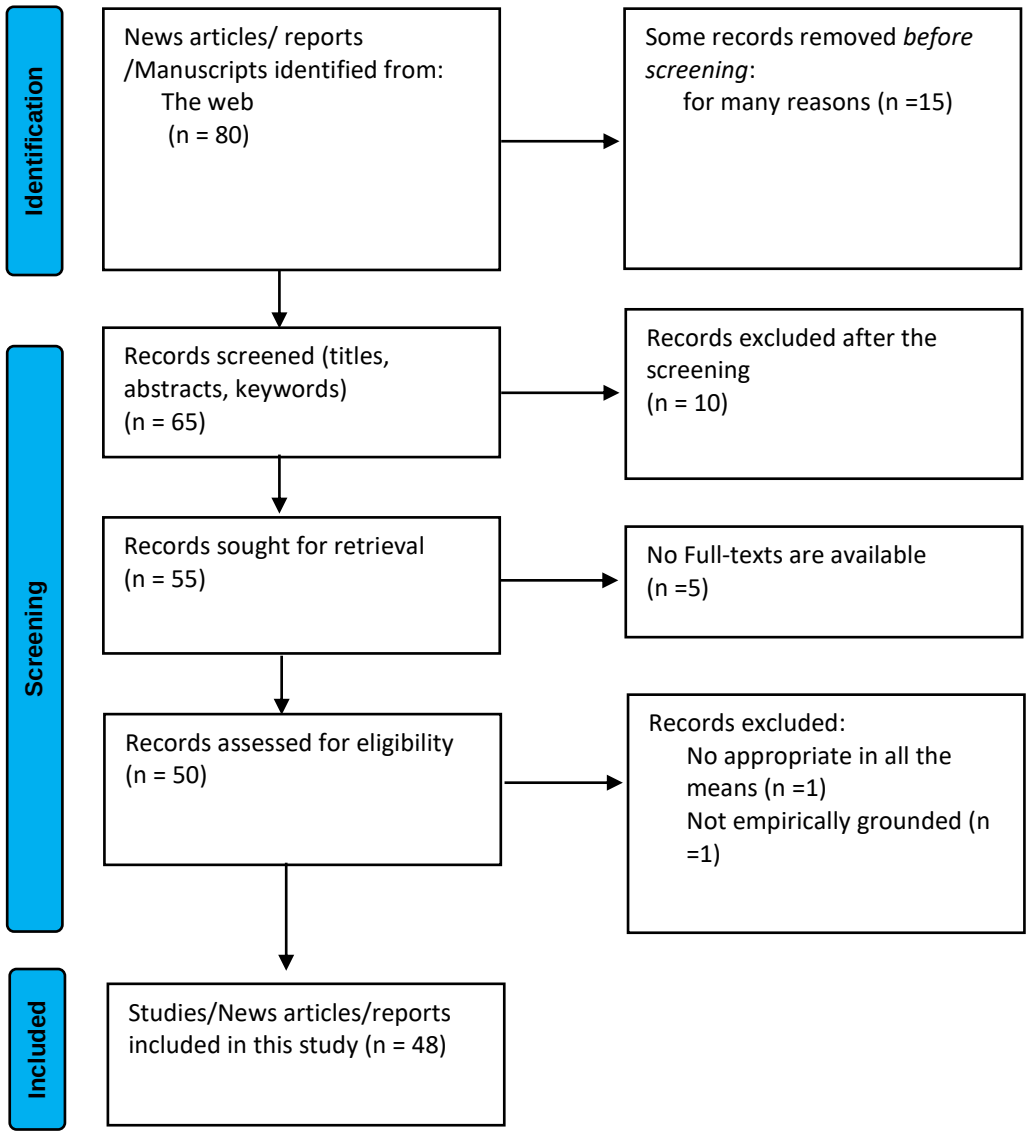


**Figure 1**: Web Searching mechanism of the study

Source: Designed by the author based on the PRISMA model (2020)

The searching mechanism was initiated with an initial pool of articles and an exclusion criterion was adopted. The exclusion criteria included articles written in non-English languages, articles published before the year 2000, and articles for which full texts were not accessible. After applying the exclusion criteria, 80 articles were selected as the final pool for further analysis. In particular, the author read the abstracts of these articles to determine their relevance to the research topic. The study also considered the aspect of global climate change and related facts in the selected articles. Out of the initial selection, the study further narrowed down their choices and considered 48 manuscripts that were deemed most appropriate for this work. The selected manuscripts were published in peer-reviewed,

scholarly, and indexed journals. Additionally, the study included some reports, as indicated in Figure 1. To ensure transparency and adherence to research standards, the study employed the PRISMA (2020) checklist tool developed by Moher et al. (2009) to finalize the compilation of the manuscript.

## 3. RESULTS AND DISCUSSION

### 3. 1 The current situation/trends of global warming

According to the latest IPCC's (which is the leading international body for assessing climate change), AR6 synthesis report has provided extensive evidence that human activities, particularly the burning of fossil fuels and deforestation, have significantly contributed to the warming of the planet (IPCC, 2022). The report urges that the existing level of global heating is at the irreversible levels and this is because the world can experience catastrophic impacts inevitably. All the countries have to play very responsible roles in order to stave off the upcoming disasters and calamities. Especially, the slogan of limiting the global warming to 1.5°C by the end of this century has importantly come to the fore. Figure 2 very clearly exemplifies the rising trend of global average temperature relative to the 1961-1990 average. This crucial situation will make a tremendous impact on both humans and the environment.

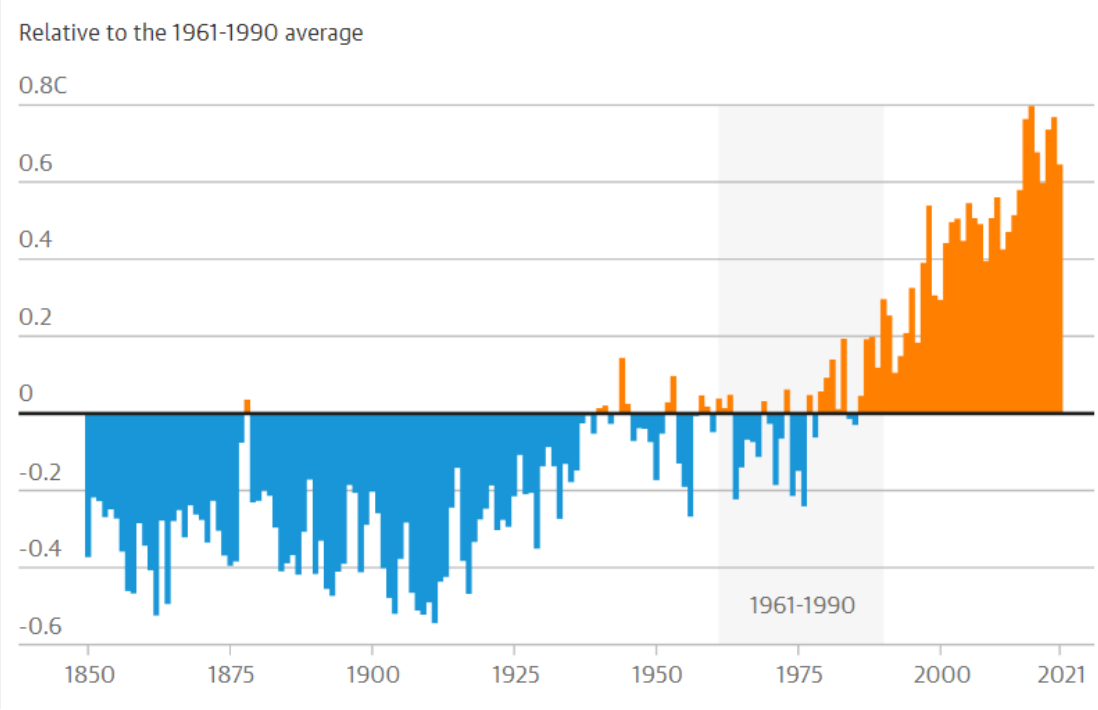


**Figure 2**: Rising trend of global average temperature

Source: Harvey, 2023

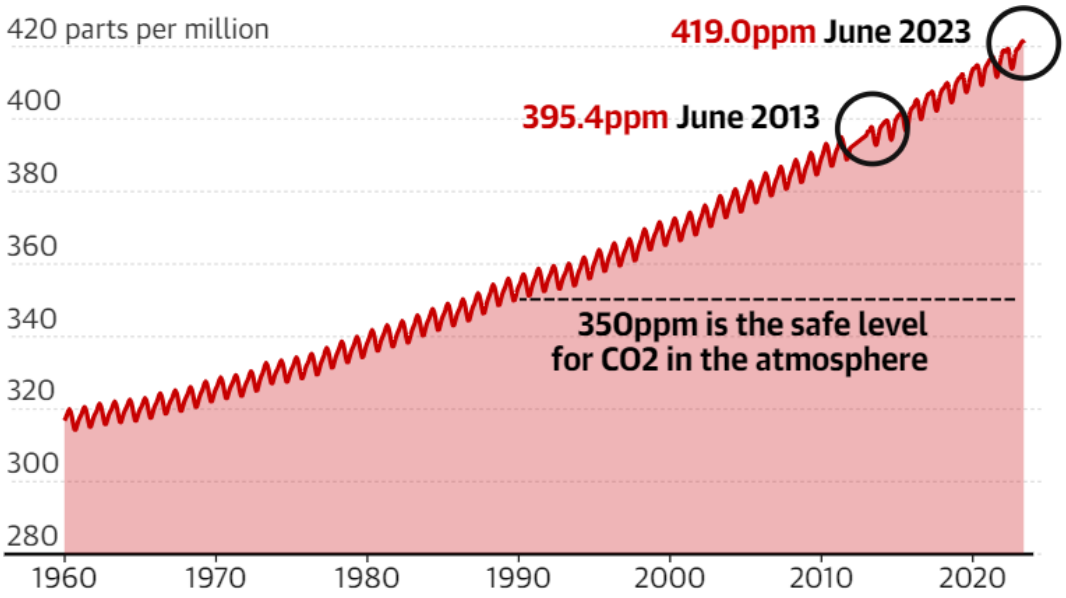


**Figure 3**: Atmospheric CO2 currently measures 419.0 parts per million

Source: Harvey, 2023 (based on the NOAA, global CO2, updated on 5 June 2023. Chart baseline is 280ppm - the preindustrial average. Label number is the trend, not cycle, value.

According to the IPCC, the temperatures are now about 1.1C above pre-industrial levels (IPCC, 2022). The unfortunate situation is that it is still rising dramatically which does not demonstrate any decrease. The cardinal reason behind the rising trend of global temperature is the rapid emission of greenhouse gases for decades. It is very much dangerous to observe the existing levels of the atmospheric carbon dioxide (Figure 3).

In theory, it is very clear that the safer level for the $CO_2$ in the atmosphere (e.g. 350ppm) has already been surpassed at the current moment (figure 3). A considerable increase is observed in comparison to the year 1960 within six decades. The main reason behind this situation is a range of anthropogony activities following the fossil fuel consumption such as emission from vehicles, and factories. In addition to that, forest fires also have contributed much to this situation. According to the records, heatwaves have seriously been sweeping the Europe for years (see, Weston and Watts, 2021). The city of Sicily has experienced its highest ever-recorded temperature as 48.8 C, and this record appears to be the highest recorded temperature in the European history too. The Mediterranean area, Tunisia, Algeria, and even high latitude countries like Italy, Turkey, and Greece have experienced fierce heatwaves and devastating conflagrations by series of wildfires (Weston and Watts, 2021). This situation has also impacted much on the agricultural lands, food productions, and ecosystem services as well.

As a result of prolonged global heating, the hot areas will get hotter while the wet areas will get wetter including other cascading disasters. According to a report of Oliver Milman (2021), *"July was the world's hottest month ever recorded, US government scientists have confirmed, a further indication of the unfolding climate crisis that is now affecting almost every*

*part of the planet…". ""July is typically the world's warmest month of the year, but July 2021 outdid itself as the hottest July and month ever recorded. This new record adds to the disturbing and disruptive path that climate change has set for the globe".* In addition to that, the Asia was experiencing its hottest July on record similar to the Europe (Milman, 2021). This is because the July, 2021 has recorded as the watershed month for the heating earth planet. Seemingly, this trend would follow the rest of the world soon. Following the IPCC' 2021 report on Climate Change 2021: The Physical Science Basis, Professor Mark Howden and Dr. Morgan Wairiu stressed that *"If emissions do not start to decline significantly before 2050, the world will likely exceed 2°C warming this century"* (Howden and Wairiu, 2021). They further urged that it is widely recognized that greenhouse gas emissions need to be significantly reduced to limit global warming to well below 2 degrees Celsius above pre-industrial levels. Despite many of the world leading countries have shot-down the climate laws by emitting a high proportion of bad gasses (Figure 4).

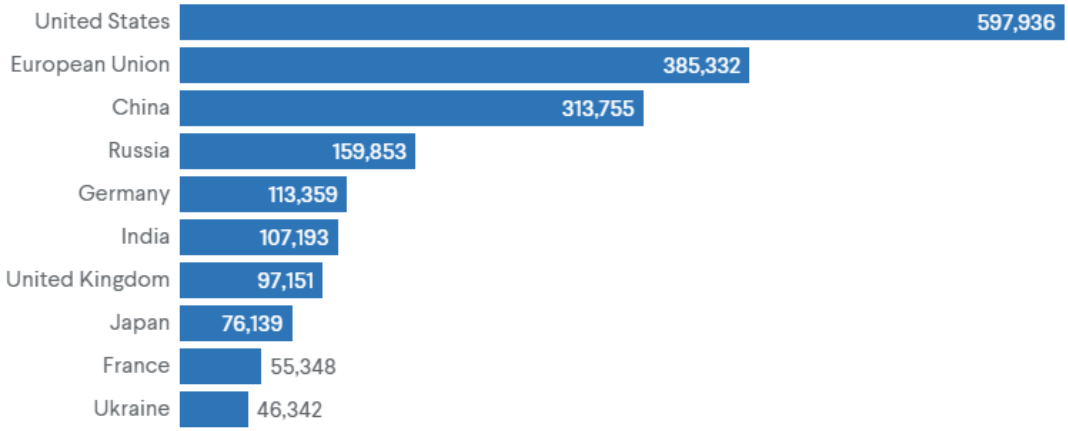


**Figure 4:** Top Greenhouse Gas Emitters Since 1850 (emissions in metric tons of carbon dioxide equivalent, as of 2018)
Source: Climate Watch, 2023.

According to the historical records, more rigorous contribution of greenhouse gas emission has been made by USA, EU, China, Russia, Germany, and India. Compared to the rest of the countries and regions of the world, South and Eastern Asian region has contributed to this by a lesser amount. The key reason for this may be that many countries of this region are developing nations. During the world environment protection regulation history, USA has often breached and shot-down the environment protection treaties. Nina Lakhani (2023) reports that *"Rich countries with high greenhouse gas emissions could pay $170tn in climate reparations"*. The concept of climate reparations, where rich countries with high greenhouse gas (GHG) emissions compensate poorer nations for the damages caused by climate change, is a topic of ongoing discussion and debate. Moreover, various factors, such as historical responsibility, cumulative emissions, and the capacity to pay, are considered when discussing the financial contributions of wealthy nations. The UNFCCC as mentioned earlier,

which aims to prevent dangerous anthropogenic interference with the climate system, acknowledges the principle of "common but differentiated responsibilities." This principle recognizes that developed countries, which historically have contributed the most to GHG emissions, have a greater responsibility to address climate change and support developing nations. The Green Climate Fund (GCF) was established under the UNFCCC to assist developing countries in climate adaptation and mitigation efforts. However, the funding provided by developed countries to the GCF has fallen short of the $100 billion per year target agreed upon in international climate negotiations.

If emissions continue to rise or decline at a slower pace, the world is likely to exceed the 2°C threshold, leading to more severe climate impacts. In other words, to avoid the more extreme future climate scenarios, substantial and sustained reductions in greenhouse gas emissions are necessary. This involves transitioning to cleaner and renewable sources of energy, improving energy efficiency, implementing sustainable land-use practices, and making changes in various sectors such as transportation, industry, and agriculture. The urgency to act on climate change is underscored by the need to limit temperature rise and mitigate the associated risks, such as more frequent and intense heatwaves, extreme weather events, sea-level rise, and disruptions to ecosystems and human societies. As mentioned earlier, some international efforts like the Paris Agreement aim to facilitate global cooperation and coordinate actions to mitigate climate change, with the objective of keeping the temperature increase well below 2 degrees Celsius and pursuing efforts to limit it to 1.5 degrees Celsius. Damian Carrington (2023) reports that "*a research shows that 90% of the melting is the result of human-caused global heating, with natural factors accounting for the rest*". "*Since satellite records began in 1979, summer Arctic ice has shrunk by 13% a decade, in one of the clearest signs of the climate crisis. Arctic sea ice reaches its annual minimum at the end of summer, in September, and in 2021 it was at its second lowest extent on record*." Carrington (2021). This is because one of the fundamental needs for reducing/controlling the global warming is cutting down of mass scale greenhouse gas emissions.

### 3.2 Credible evidences of global climate change impasses and related disasters

Human-induced climate change is indeed a significant global challenge that has resulted in various adverse impacts and losses to both nature and people, going beyond what can be attributed to natural climate variability. The scientific consensus has made it clear that greenhouse gas emissions from human activities, such as burning fossil fuels and deforestation, are the primary drivers of the observed climate changes. One of the most noticeable consequences of climate change is the increase in the frequency and intensity of extreme weather events. Heatwaves, droughts, floods, hurricanes, and wildfires have become more frequent and severe in many parts of the world. These events have led to significant economic and social damages, including the loss of lives, displacement of communities, damage to infrastructure, and disruption of ecosystems.

Moreover, climate change has widespread impacts on ecosystems and biodiversity. Rising temperatures, changing precipitation patterns, and ocean acidification affect ecosystems such as forests, coral reefs, and Arctic ecosystems (see, IPCC, 2022). These changes disrupt the delicate balance of ecosystems, leading to extinction of species, reduced biodiversity, and altered ecological functions. The evidences of current climate change impasses can be discussed as follows, in accordance with their importance.

### 3.2.1 Signs that have been investigated on the collapse of the Gulf Stream

The Atlantic Ocean circulation is completely underpinned by the Gulf stream which starts from the Gulf of Mexico. This has been identified as one of the cardinal tipping points of the planet earth. It is of course a worrying news that, scientists have prudently been investigated that the credible signs of the collapse of the Gulf stream system (see Figure 5), for decades due to the global warming impasses (Harvey, 2021). The sea currents circulation system called the Atlantic Meridional Overturning Circulation (AMOC) is largely governed by the Gulf stream. In other words, AMOC is also known as the Gulf Stream System, academically cited as the *"conveyor belt"* that brings warm water from the equator. According to L. Caesar and colleagues' words, *"The Atlantic Meridional Overturning Circulation is one of Earth's major ocean circulation systems redistributes heat on our planet and has a major impact on climate…", "The AMOC is a sensitive nonlinear system dependent on subtle thermohaline density differences in the ocean, and major AMOC transitions have been implicated, for example, in millennial climate events during the last glacial period1. There is evidence that the AMOC is slowing down in response to anthropogenic global warming as predicted by climate models and that the AMOC is presently in its weakest state for more than 1,000 years"* (Caesar et al., 2021; Rahmstorf, 2002).

More importantly, the Gulf stream governs the total weather systems of Europe in particular bringing their warm and mild weather conditions. Moreover, *"The AMOC is one of the world's biggest ocean circulation systems, carrying warm surface water from the Gulf of Mexico towards the north Atlantic, where it cools and becomes saltier until it sinks north of Iceland, which in turn pulls more warm water from the Caribbean. This circulation is accompanied by winds that also help to bring mild and wet weather to Ireland, the UK and other parts of western Europe*" (Harvey, 2021).

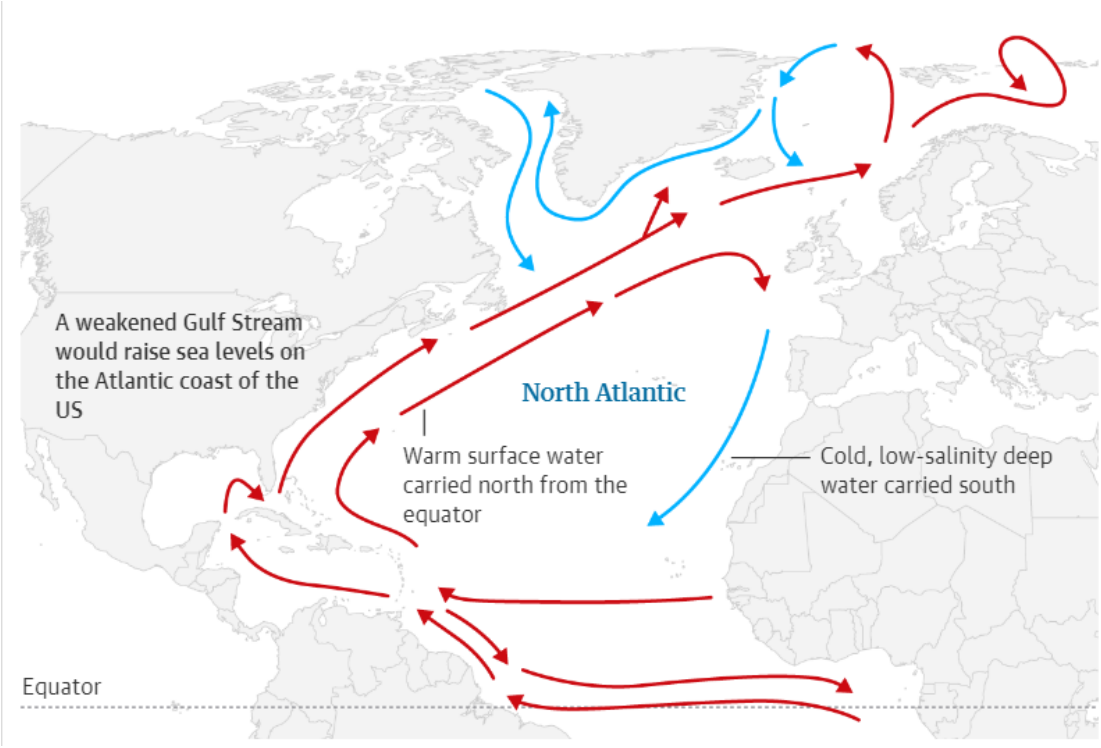


**Figure 5**: The Atlantic Meridional Overturning Circulation is at its weakest for a millennium, according to new data. Source: Harvey, 2021 (based on Noaa, S Rahmstorf et. al. from the Potsdam Institute for Climate Impact Research (PIK)c

The collapse of this system will have adverse impacts on the west and north European region. More importantly, this situation could result in more and severe storms impacting much of the UK, while severe winter conditions, prolong droughts and intense heat-waves will impact the Europe. Furthermore, the Atlantic coast of the US will also experience huge impacts by raising sea levels because of the weakened Gulf stream. Scientists have further stressed that *"If we continue to drive global warming, the Gulf Stream System will weaken further – by 34 to 45 percent by 2100 according to the latest generation of climate models…"This could bring us dangerously close to the tipping point at which the flow becomes unstable."*, (Caesar et al., 2021). This collapse can be identified as a key danger for our planet earth forever.

### 3.2.2 Unexpected Torrential Rains and Mass flooding events/catastrophic flood disasters

Many developing and developed countries have adversely experienced torrential rains and mass flood disasters as a consequence of climate change related catastrophes. Intense raining have contributed to generate mass rushing floodwaters (e.g. Rivers overflows), flash floods, and coastal floods in many areas of the world. Figure 6 exemplifies the impacts and risks to a range of sectors.

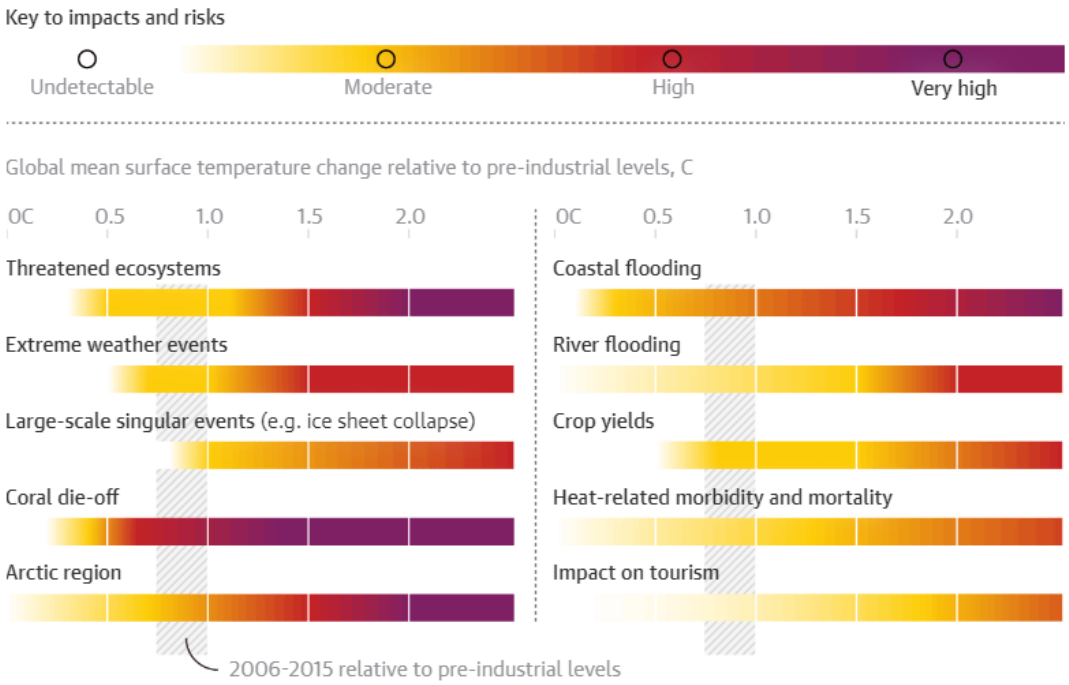


**Figure 6**: Rising temperatures and rising risks
Source: Harvey, 2018 (based on the IPCC Special Report on Global Warming of 1.5C)

One of very recent is the Pakistan mass flooding event occurred in August, 2022, which impacted around 33 million people there, which is recorded as the worst catastrophe that they ever experienced (Baloch, 2022). It was reported that over 1,000 people were killed by unexpected mass flood disaster. The situation become worse since nearly 220,000 houses were destroyed amid nearly 500,000 homes were seriously damaged. More than 800,000 hectares (2 million acres) of croplands were wiped out. Moreover, their climate change minister has said that the flooding event was *"a catastrophe of epic scale"*. Regarding Pakistan's vulnerability on the extreme weather, the country has been ranked at 8$^{th}$ by the Long-term Global Climate Risk Index (Baloch, 2022). DRR and management practices of Pakistan had faced a range of difficulties on that severe situation, following country's bad economic situation and hardships. On the other hand, Germany which is a developed European country, faced a severe catastrophic situation, after mass flood disaster experienced in July, 2021. In the western Europe, especially, Germany and also Belgium, experienced unexpected record heavy rains and this is because many hundreds of casualties, injured and displaced people reported (Cuddy, 2021). According to the report, *"Friederike Otto, associate director of the Environmental Change Institute at the University of Oxford, said "urgent education" was needed on the risks of flooding. I think people are really not aware that weather can actually be deadly,"..."The fact that so many soils are sealed also leads to more dramatic impacts than would be the case if the water could go somewhere,". ..."Extreme rainfall events will intensify and the most extreme ones will become more frequent,"* (Cuddy, 2021). In particular, due to the climate change and global warming impasses, even developed countries like Germany have experienced serious damages in many sectors.

From a practical point of view, German's flood alert system (including an App) which many of residents had installed in their mobile phones, was criticized for its "monumental failure". According to Oltermann (2021), *"Even though the European Flood Awareness System (Efas) sent out specific warnings for the worst-hit German regions four days before the start of the downpour, the ensuing flash floods still appeared to have taken the majority of residents by surprise"*. This catastrophic flooding event implies that even though most developed countries had installed sophisticated early warning systems, those systems are yet poor and powerless in the face of extreme climatic events. Sri Lanka also experienced a mass flooding event in the year 2017 impacting hundreds of thousands of people (Karunarathne and Lee, 2020a; Karunarathne and Gress, 2022). Following abovementioned examples, the need of early warning mechanisms and disaster preparedness plans with state-of-the-arts technologies has been come to the fore in the face of adverse climate change crisis.

### 3.2.3 Prolong droughts, Extrema Heat waves, and Wild/Forest fires

Many of regions of the world have dramatically been impacted by prolong droughts, extreme heatwaves, and forest fires for decades losing natural forest covers, habitats and niches, ecosystem services, and inland waterbodies etc. The western USA, particularly the California region, can be recognized as one of the seriously impacted areas by a prolonged drought. According to Canon's words, *"The American west has spent the last two decades in what scientists are now saying is the most extreme mega-drought in at least 1,200 years. In a new study, published on Monday, researchers also noted that human-caused climate change is a significant driver of the destructive conditions and offered a grim prognosis: even drier decades lie ahead"* (Cannon, 2022). In particular, the California region has experienced very serious, record-setting heatwaves, exacerbated wildfires, and the recession of inland water bodies over the last two decades. According to Williams, Cook, and Smerdon (2022), soil moisture deficits have doubled in the past 22 years compared to levels in the 1900s, with 42% of the increase in severity attributed to human-caused warming. The same researchers argue that this prevailing situation will be very rapid and steep. Williams and his colleagues further expressed that, *"We are watching our bank account of water decline,"*…"*and we know that eventually we need to slow our expenditures before the account runs out".* Figure 7 depicts the cumulative area burned by wildfire in the western USA.

On the other hand, the California region has lost many hundreds of acres of historic forests due to the climate change related wildfires (figure 7), compared to the wildfires without climate change. Records demonstrate that, California has lost around 23,000 acres of forests, including fired 15 buildings, and 5 homes (Cannon, 2021). Due to large-scale wildfires, the USA has experienced significant losses in wildlife habitats, niches, biodiversity, and a decline in ecosystem services, resulting in a substantial economic cost.

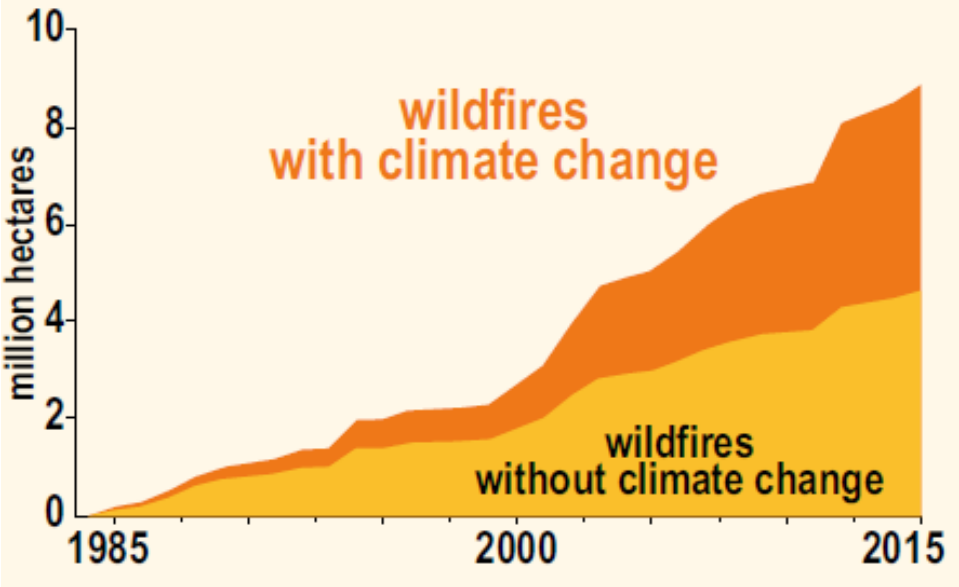


Figure 7: Cumulative area burned by wildfire in the western USA, the increased heat and aridity of climate change.
Source: IPCC, 2022.

Not only in the western United States but also in Algeria, Siberia, Turkey, and numerous European countries, as well as Australia, thousands of acres of natural forests have been lost over the years due to wildfires, which have been exacerbated by severe heatwaves. Climate change has become an increasingly formidable enemy for the human population worldwide. Before the aforementioned mass flooding event, a significant portion of Pakistan had already experienced a severe drought and heatwave quite earlier in the year 2022. Temperatures soared to 51°C (124°F) in Jacobabad, Sindh province (Baloch, 2022). This occurrence illustrates how the same area can endure two distinct types of disasters: prolonged droughts on one hand and torrential rains along with mass flooding events on the other, similar to what occurred in Pakistan and also in Turkey before its catastrophic earthquake.

**3.2.4 Signs that have been observed on the collapse of the polar Ice covers/sheets**

A huge body of literature has revealed a range of credible signs indicating the potential collapse of the polar ice caps for decades, in particular due the extreme global heating impasses. The IPCC's recent reports have strongly emphasized the ongoing process of glacier melting (IPCC, 2022; IPCC, 2021). According to Carrington's report, *"…it is too late to Since satellite records began in 1979, summer Arctic ice has shrunk by 13% a decade, in one of the clearest signs of the climate crisis. Arctic sea ice reaches its annual minimum at the end of summer, in September, and in 2021 it was at its second lowest extent on record…". "Unfortunately it has become too late to save Arctic summer sea ice," said Prof Dirk Notz, of the University of Hamburg, Germany, who was part of the study team. "As scientists, we've been warning about the loss of Arctic summer sea ice for* decades…" (Carrington, 2023). In particular, other climate scientists stated in 2022 that the world was on the verge of facing multiple disastrous tipping points.

Prof Seung-Ki Min, from Pohang University in South Korea, stated that the primary consequence for human society will be the heightened occurrence of current weather extremes, such as heatwaves, wildfires, and floods (Kim et al., 2023). It is crucial that we adopt more ambitious measures to decrease $CO_2$ emissions and simultaneously prepare for adapting to the accelerated Arctic warming and its effects on human society and ecosystems. Even though the IPCC (2021) has concluded that the Arctic would not lose its summer ice if emissions were significantly reduced and global temperature rises were limited to 2C, they predicts the loss of summer sea ice in the 2050s even under the low emissions scenario is serious (Kim et al., 2023). More importantly, Professor Kim and his colleagues had considered 41 years' (from 1979 to 2019) calendar months' data to observe the Arctic Ice decrease. On the other hand, the faster heating of the Arctic also accelerates the melting of the Greenland ice cap, leading to rising sea levels, and the thawing of permafrost regions, resulting in the release of additional greenhouse gases. Sea ice is crucial for the survival of polar bears, other wildlife in the Arctic, and the Indigenous people of the region, as they depend on it for their livelihoods.

Very recent study conducted by Christine L. Batchelor and colleagues revealed that Researchers stated that the findings demonstrate that certain ice sheets in Antarctica, including the "Doomsday" Thwaites glacier, could experience periods of rapid collapse in the near future, intensifying the sea-level rise. The escalating sea levels are one of the most significant long-term consequences of global heating, as numerous major cities worldwide are situated along coastlines and becoming increasingly susceptible to storm surges and flooding. It is possible that the West Antarctic ice sheet has already surpassed the threshold beyond which substantial losses are inevitable, ultimately resulting in several meters of sea-level rise (Batchelor et al., 2023). More surprisingly, they further urged that Ice sheets have the potential to disintegrate rapidly, with a staggering pace of 600 meters per day. Another record-breaking weather event reported from the Greenland in the year 2021 was historic raining. In accordance with Damian Carrington's report, for the first time in recorded history, rain has descended upon the summit of Greenland's immense ice cap (Carrington, 2021). Typically, temperatures on the 3,216-meter (10,551-foot) peak remain well below freezing, making this precipitation a striking indication of the climate crisis. Observations from scientists stationed at the US National Science Foundation's summit facility on 14th August revealed the presence of rain, catching them off guard as they lacked the necessary equipment to measure such unexpected precipitation. Approximately 7 billion metric tons of water were estimated to have been released from the clouds across Greenland. The report further added that during an unusually scorching three-day period in Greenland, the rain descended amidst temperatures that soared 18 degrees Celsius above the average in certain areas. Consequently, widespread melting was observed across a region approximately four times larger than the United Kingdom.

According to Carrington's (2023) report, research indicates that 90% of the melting is

attributed to human-caused global heating, while natural factors account for the remaining portion. This is because, if the world is not ready to cut down on drastic carbon emission practices, the consequences will be very serious for the human population throughout the world. The rapid melting of polar ice caps will have a significant impact on low-lying areas and various archipelagos. According to the IPCC (2022), "*…these hazards and cascading risks also trigger tipping points in sensitive ecosystems and in significantly and rapidly changing social-ecological systems impacted by ice melt, permafrost thaw and changing hydrology in polar regions (high confidence)*". Given the circumstances and in accordance with my understanding, it is incumbent upon everyone to assume responsibility and minimize the emission of greenhouse gases to the greatest extent possible.

### 3.2.5 Sri Lankan discourse: Implications for the community disaster resilience

In Sri Lanka, the challenges of community disaster resilience have become prominent in light of the global warming and climate change crises. Prior research has emphasized the challenges arising from recurring episodes of massive flooding in Sri Lanka (Churchill and Hutchinson, 1984; Karunarathne and Lee, 2020a; Karunarathne, 2021). In accordance with my investigations and filed observations, the 2017 mass flooding event in Sri Lanka had a profound impact, resulting in adverse consequences and significant damages for hundreds of thousands of people. Similarly, in the near future, a variety of unexpected calamities related to climate change crisis, particularly extreme Hydrometeorological events, are anticipated to occur. This is because the community disaster resilience in Sri Lanka will face increasingly challenging aspects due to climate change. Specifically, households of impoverished individuals and their means of livelihoods are highly vulnerable to the adverse impacts of ongoing extreme climate events induced by climate change. As mentioned earlier, one profound example from the recent history of Sri Lanka is the occurrence of extreme weather conditions (low-temperature) in the middle of December 2022. This event serves as a striking illustration of the challenges posed by climate change on the country's climate system. All in all, according to Damian Carrington, we are seriously on the dangers of five disastrous climate tipping points. They are the collapse of Greenland's ice cap, eventually producing a huge sea level rise, the collapse of a key current in the north Atlantic, disrupting rain upon which billions of people depend for food, and an abrupt melting of carbon-rich permafrost (Carrington, 2022). In addition to that, Matt McGrath reports that the El Niño and its planet-warming weather phase has already begun (McGrath, 2023). This will bring an additional heating to the Pacific Ocean and to the planet which has already been warming by climate change. This combination will also have severe impacts the vulnerable people who are living in very dangerous areas throughout the world.

In this context, there is a growing need for collaborative research efforts focused on understanding and addressing the future challenges that may be triggered by climate change-related crises in Sri Lanka. By undertaking such research, it becomes possible

to develop effective strategies and solutions to mitigate the impacts of climate change and ensure the resilience of communities in the face of these challenges. One crucial and promising aspect to be considered is the utilization of social reciprocal support networks and social capital (see, Karunarathne and Lee, 2019; Karunarathne and Lee, 2022; Karunarathne and Lee, 2020b; Karunarathne and Gress, 2022), which are deeply ingrained traditions in countries like Sri Lanka. Leveraging these resources can empower community disaster resilience and aid in revitalizing vulnerable communities in the face of future climate change catastrophes. By strengthening social networks and capitalizing on existing support systems, communities can better prepare, respond, and recover from climate-related challenges. This review study contributes to the existing body of literature by addressing certain gaps and providing insights into the credible evidence surrounding global warming, climate change impacts, and the associated challenges that the human population may potentially encounter.

## 4. CONCLUDING REMARKS

This systematic literature review considered many of published research papers, reports and news articles to understand and to analyze the credible evidences of Global warming vis-à-vis Global Climate Change issues. This work revealed that the global warming has reached alarming levels beyond what the planet earth can tolerate, in accordance with the current climate-change related issues that have occurred. In addition, this work demonstrates that the severity and the fostering nature of climate change induced natural disasters such as Hydrometeorological events, extreme temperature, heat waves, prolong droughts, forest fires, melting down of North latitudinal and polar Ice caps, torrential rains, mass flooding events, extreme winter conditions, cold-waves, etc. have dramatically been accelerated. On the other hand, Sri Lanka as an island country, has adversely been faced many climates change related challenges and impasses for years. In theory, these crises are inevitable and can be considered as inextricable traps in her development trajectory. On the one hand at global level, policy reforms and mitigation practices need to be renovated and re-established. On the other hand, individual country-level policy reforms and sophisticated contingency planning process need to be implanted.

More importantly, in case of responding to the unforeseen climate challenges, the existing efforts to mitigate climate change by reducing greenhouse gas emissions need to be accelerated. Many developed countries have adopted renewable energy sources in order to increase energy efficiency and implemented policies to transition to a low-carbon economy. Additionally, concerning about adaptation has importantly come to the fore. This is because efforts need to be focused on reducing vulnerability and building resilience to the impacts of climate change. In particular, this includes measures like improving infrastructure, implementing early warning systems, and enhancing community preparedness to minimize the impacts of extreme events. More importantly, international agreements like the Paris Agreement aims to limit global warming and provides support for

adaptation and mitigation in developing countries. Nevertheless, sustained and accelerated efforts from all sectors of society are crucial to effectively address the challenges posed by climate change and minimize the associated losses and damages. The potential research foci behind above-examined challenges, (of course, I would suggest here) is fostering of social capital and social support network metaphors/legacies of societies in terms of improving the disaster resilience of human population in face of current climate change crisis. In contrast, poor and developing countries are the mostly vulnerable nations compared to the rest of wealth nations. This may because the Cop 27 summit agreed to mobilize more funds for the developing countries on their loss and damages.

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