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# A Relationship between Climate Finance and Climate Risk: Evidence from the South Asian Region

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**Abstract:** South Asia is the most vulnerable region in the context of global warming, climate change, and climate risk. Climate finance is the most useful tool for combating climate challenges worldwide. The study explores the present picture of climate finance in South Asian (SA) countries. The study uses multilateral development bank (MDB), Green Climate Fund (GCF), and Germanwatch supplied data from 2011 to 2021. Under the theoretical lens of institutional capacity development, the study attempts to correlate climate finance and climate risk. The study indicates an increasing trend of MBDs' and the GCF's climate finance in many countries worldwide. The study finds that MDBs' total global climate finance is USD 446,977 million, while the SA region has received USD 59,301 million since 2011. It also reports that MDBs provide 77% and 23% of the money to the mitigation and adaptation areas. Moreover, the study reports that, after COVID-19, MDBs substantially increased the amount of global climate financing, but this increase was not seen in the SA region. Our climate risk data indicate that most of the SA countries are highly long-term climate risky and lose, on average, 0.378% of GDP. The correlation matrix finds a negative and significant correlation between climate finance and long-term and yearly climate risk. The study identifies that the region's climate financing flow of money is not rationally distributed based on the short-run and long-run climate risks. The study presumes that more climate finance would be the most effective mechanism to mitigate climate risk. Therefore, SA region leadership drastically requires a holistic framework to address the prevailing climate problems and to ensure regional coordination and cooperation toward climate finance and policies. The research findings have significant implications for climate policy and climate finance.

**Keywords:** climate finance; climate risk; South Asia; climate politics



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## 1. Introduction

Climate change and climate risk are closely associated issues as they directly and indirectly affect global warming. Climate risk is a major challenge in developing countries because of limited resources, lack of capability, ineffective institutional atmosphere, and lack of regional and international cooperation [1–4]. Prior studies also reported that poorer (developing) countries are more negatively affected by climate risks than richer (developed) countries because of several reasons, such as (1) insufficient resource capabilities and management, (2) the adversely affected health and productivity that decrease national growth, and (3) financial limitations [1,5–7]. Global warming, climate risks, and environmental problems are challenging to developed economies and developing economies as they create economic inequality globally [1,8]. Climate risk is the impact of the developed countries' higher emission of $CO_2$ while developing countries are the ultimate sufferers. The same

argument is valid in the climate finance mechanism where developed countries' contribution is insufficient, as expected by developing countries. Climate injustice, climate politics, and economic inequality are in the same line of discrimination that is highly affected in developing and climate-vulnerable countries [9,10]. Globally, climate justice is a significant term because developing countries' climate risk burden is due to the developed countries' higher carbon emissions. Hence, climate finance is an essential and most effective mechanism to mitigate global climate risk and establish climate justice and economic equality. Another logical question has been raised as to why do low greenhouse gas (GHG) polluting countries face the highest burden of climate challenges? The International Energy Authority (IEA) states that China, the US, and India's GHG emissions are responsible for 85% of the world's total carbon emissions. It leads to an academic debate on the injustice of carbon emission and economic development [1,8]. For example, the global GHG emission of Bangladesh is less than 0.35% [11,12], while the country is the most vulnerable country due to climate risk driven by extreme weather (global climate risk index is prepared yearly and published by Germanwatch, a Germany-based international organization). It is estimated that the country will lose 2% and 9.4% of its gross domestic product (GDP) by 2050 and 2100 due to climate risks [11].

South Asia (SA) is the most vulnerable to climate change, and most of the countries in the region are highly affected in terms of environment, water, health, and many other public issues [13–15]. Most of the countries in the region are highly affected by climate risk. They face severe problems of air pollution, water pollution, public health, biodiversity, waste, and deforestation. SA region countries are the top climate-vulnerable countries in the long term and short term (most of the top ten countries are from the SA region, see Table 1). Moreover, the region's $CO_2$ contribution is much lower than other developing and developed countries, but the region's countries are paying the most severe damages due to global warming [1,8]. Furthermore, major cities are the most environmentally polluted in terms of air, water, and public health [15]. According to the Economist Intelligence global survey 2021, Dhaka is the world's least livable capital and the US air quality index (AQI) of 2022 reports that Dhaka is the worst city in the world [16,17]. According to the AQI, most of the worst (polluted) cities belonging to the SA region also indicate the environmental vulnerabilities of the region's countries (the world's ten most polluted cities include nine cities in the SA region). Furthermore, Bangladesh faced an extreme heatwave in April 2023 and Dhaka has broken the last fifty-eight years' temperature records [18]. The United Nations Intergovernmental Panel on Climate Change (IPCC) reported that climate crises in the region will be the most challenging issues for the next two decades. According to the IPCC report, Bangladesh, India, Pakistan, and Sri Lanka face rising sea levels and severe flooding while landlocked Afghanistan, Bhutan, and Nepal face higher temperatures and drought [19]. The report also mentions the small island country of the Maldives will be lost in the future. Moreover, the first-ever report of the United Nations International Children's Emergency Fund (UNICEF) on a children's climate risk index reported that children in Afghanistan, Bangladesh, India, and Pakistan are extremely vulnerable because of high temperatures (heatwaves) and natural calamities (extreme flooding) [20]. UNICEF also mentioned this climate crisis will impact children's health, education, and protection. These negative signals strongly pressure regulatory bodies and policymakers to do something for the betterment of these countries. Therefore, policymakers promulgate many policies and rules to inspire and motivate the financial sector to take more action on climate financing.

SA countries received climate finance from MDBs and the GCF, but it is not allocated proportionately despite SA being the most climate-risky region. The region is also highly affected by climate change. However, the magnitude of climate vulnerability and the financial access are not in the same line. Moreover, the eight countries' carbon emissions, climate risk, and climate finance access are also different. Hence, it is necessary to know the region's climate finance distribution and climate risk mitigation mechanisms. Therefore, it is a big question why there is a big difference in climate finance distribution globally and among the SA countries. The study is designed to explore the relationship between climate

finance and climate risk in the region. The study has considered the 2011–2021 MDB joint report on climate finance, GCF project financing data, and the Germanwatch global climate risk index 2011–2021.

**Table 1.** The most affected SA countries.

| Year | Most Affected Countries Yearly (Among the Top Ten) | Most Long-Term Affected Countries (20 Years; Among the Top Ten) |
|---|---|---|
| 2011 | Bangladesh; Bhutan; Nepal | Bangladesh |
| 2012 | Pakistan | Bangladesh; Pakistan |
| 2013 | Pakistan; Sri Lanka | Bangladesh; Pakistan |
| 2014 | Pakistan | Bangladesh |
| 2015 | India; Pakistan | Bangladesh; Pakistan |
| 2016 | Afghanistan; Pakistan; Nepal; India | Bangladesh; Pakistan |
| 2017 | India | Bangladesh; Pakistan |
| 2018 | Sri Lanka; India | Bangladesh; Pakistan |
| 2019 | Sri Lanka; Nepal; Bangladesh | Bangladesh; Pakistan |
| 2020 | India; Sri Lanka | Pakistan; Bangladesh; Nepal |
| 2021 | Afghanistan; India | Pakistan; Bangladesh; Nepal |

Source: [21].

Climate finance research from the academic point of view is very limited around the world. Similarly, the academicians, researchers, and policymakers in the SA region have yet to discuss it profoundly. The most recent study by Diaz-Rainey et al. [22] analyzed 21 top finance journals from 1998 to 2015 and found that only 12 studies are somehow related to climate finance. They also crosschecked 29 elite business journals to find only 25 studies that include climate finance. Moreover, several researchers have explored the country- and project-based descriptive studies of green and climate finance (mitigation or adaptation), such as Liu et al. [2] for China, Dörry and Schulz [23] for Luxembourg, Pickering and Mitchell [24] for Australia, Halimanjaya [3] for Indonesia, Tashmin [4] for Bangladesh, Jin and Kim [25] for multiple countries, Steffen and Schmidt [26] for MDB financing in the power generation technologies, Duku [27] and Duku et al. [28] for Sub-Saharan African countries, and many more. However, these studies did not empirically analyze the impact of climate finance on climate risk globally or regionally. Most recently, Bae et al. [29] carried out a firm-level empirical study of climate finance while determining factors influencing climate finance in Bangladesh. They also documented that political connections negatively affected corporate climate decisions. Most of the climate change research activities in the region are in line with climate change science, health, and the environment. Therefore, the impact and influence of climate finance in combating climate risk are still limited. Further, this is the first study that deals with climate finance in the SA region, considering empirical evidence of climate finance with climate risk. The association between climate finance and climate risk provides a logical direction on how much finance can mitigate climate risks. Therefore, the association between climate finance and climate risks is the unique contribution of the study. The study demonstrates regional climate finance mechanisms to reduce climate risks as well as regional cooperation and capacity development. This will help to develop an exponential climate finance model combating climate challenges in this region.

The remainder of this study is as follows: Section 2 focuses on the literature review, Section 3 deals with research methodology, Section 4 presents results and findings, and the last section concludes this study with research implications, limitations, and future research, followed by future directions.

## 2. Literature Review

Generally, climate finance refers to collecting and utilizing money from different sources to better the natural environment and reduce natural and manufactured disasters caused by climate change. Climate finance is defined by the United Nations Framework Convention on Climate Change (UNFCCC) as "local, national, or transnational financing—drawn from public, private, and alternative sources of financing—that seeks to support mitigation and adaptation actions that will address climate change". Climate finance is one of the essential goals of sustainable development. Therefore, many national, international, regional, private, and public organizations provide finance facilities to climate-vulnerable countries [30]. Multilateral development banks (MDBs) are some of the critical institutions in the world that provide climate finance to developing and emerging economies. The MDBs are composed of the African Development Bank (AfDB), the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), the Inter-American Development Bank Group (IDBG), the Islamic Development Bank (IsDB), and the World Bank Group (WBG). Since 2011, MDBs have prepared a joint report on climate finance. Moreover, with the effort of 194 countries of the United Nations Framework Convention on Climate Change (UNFCCC), in Denmark (Copenhagen 2009) the Green Climate Fund (GCF) with the motto of below 2 °C globally was approved at COP15 [31]. The GCF's prime objective is "to support the efforts of developing countries to respond to the challenge of climate change".

Furthermore, Germanwatch has been publishing a global climate risk index since 2003, measuring the risks arising from extreme weather events [32–41]. The report vividly states the impacts of climate risk on the socio-economy of a country. Since 2003, the report has shown a yearly and long-term (last twenty years) global climate risk index. Based on the extreme weather and natural calamities in a particular year, the report provides four kinds of indexes, including climate risk index (CRI) and rank (CRIN), average fatalities rank, average losses in purchasing power parity (PPP) rank, and average losses in GDP rank. Global climate risk reports directly consider extreme weather-related incidents due to climate risk. Moreover, most SA countries are vulnerable according to the long-term and yearly climate risk index. According to the global climate risk report, SA countries are suffering huge losses due to climate risk [33–41]. Table 1 shows SA countries in the yearly and long-term top ten climate risk index.

Generally, climate finance has a significant relationship with financial and non-financial variables because it positively impacts climate risk [32]. Pickering and Mitchell [24] identified that two domestic factors (political government and general public willingness and concern) and two international factors (multilateral agreement and international pressures) are behind climate finance factors in Australia. Prior literature also explained that the levels of green finance and green technology investments raise a country's local and international attention, which leads to receiving more financial opportunities and technical support [23].

Mitigating and adapting to the climate challenge is also a matter of institutional capability and cooperation. Institutional effectiveness ensures the capacity and capability of the organization, helps it identify and formulate climate projects, and helps it receive external monetary and non-monetary facilities. Institutional theory more strongly explains that coercive, mimetic, and normative pressure creates accountability and responsibility for the organization, stakeholders, and society that help to mitigate climate challenges [42,43]. Environmental performance is considered a strategic approach in the institutional environment, which plays a critical role in shaping managers' cognition and implementing business strategies [44,45]. Moreover, the theory best describes the country-level and regional differences among firms because of the different sets of regulations, standards, guidelines, and cultural differences [2,43,44,46]. The most recent study by Duku [27] pointed out the relationship between climate finance and macro-level variables. It documented that climate finance helps to reduce poverty alleviation in Sub-Saharan African countries. Furthermore, Duku et al. [28] showed that climate finance significantly influenced Sub-Saharan African countries' population growth, poverty alleviation, ease of doing business indicators,

weaker governance, lower control of corruption, the rule of law, social injustice, inequality, and digital platforms. Rahman et al. [47] defined the government as the most influential stakeholder in the institutional environment because of its law-making and enforcement authority. Any government environmental policy and regulation affects society and organizations. When the government attempts to impose any public policies or guidelines, organizations sometimes react to those policies only if such policies and regulations might affect them directly or indirectly. Thus, organizations' efforts to adopt culturally institutionalized norms, rules, and procedures mainly pursue legitimacy [43,46,48–50]. The theory also argues that social systems and individuals compete for resources and seek legitimacy from society. Therefore, institutional isomorphism enhances organizational capacity-building techniques, negotiation power, cooperation attitudes, and competitiveness, which is urgent in the climate finance mechanism. Moreover, SA is comparatively weak in research and innovation compared to the rest of the globe. From the SA region perspective, little research has been conducted on the policy and regulatory level of climate change, but there is no study on climate finance empirical data [12–15]. The most recent study by Zafarullah and Huque [14] explained the SA countries' policy, regulatory, and cooperative gap. Further, Tashmin [4] explored climate finance in Bangladesh for ecosystem management, while the author limitedly explains the financial scope of climate change.

## 3. Methodology

### *3.1. Data Collection*

The study considered secondary data for the analysis. Climate finance data were collected from the Joint Report on Multilateral Development Banks from 2011 to 2021 and the GCF website [31]. MDBs started publishing the joint report on climate finance in 2011 and individual country financing data from 2015; as a result, we only have SA countries' standalone climate financing data from 2015–2021. Further, climate risk data were collected from the global climate risk index compiled and published by Germanwatch from 2011 to 2021. Germanwatch, a Germany-based non-profit organization, has been publishing a global climate risk index since 2003, measuring the risks arising from extreme weather events [32–41]. Based on the extreme weather and natural calamities in a particular year, the report provides an index, the climate risk index (CRI). The study used the long-term climate risk index (LTCRI), yearly climate risk index (YCRI), long-term gross domestic product loss (LTGDPL), and annual gross domestic product loss (YGDPL) to calculate and analyze climate risk impact on climate finance. Moreover, we used the World Bank yearly GDP growth rate of the eight countries in the region. The World Bank GDP data were collected from its website. We also considered the yearly $CO_2$ emission of the individual countries to measure their relationship with climate finance and climate risk (see Appendix A for data sources).

### *3.2. Methods*

The study considered all eight countries (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka) of the SA region. Therefore, the study used eight countries' climate finance and climate risk, carbon emission, and GDP data for the analysis. This is country-level research; therefore, the study considered analytical and statistical tools for the empirical findings and conclusions, along with different graphs and tables. A correlation matrix was drawn to find the association between climate finance, climate risk, gross domestic product growth (GDPG), and $CO_2$ emission. In the correlation analysis, we considered the 2015–2021 panel data based on the availability of MDB climate finance data, Germanwatch climate risk data, GDPG, and $CO_2$ emissions. The study used SPSS 22 version for the correlation matrix. Figure 1 provides the method of the study.

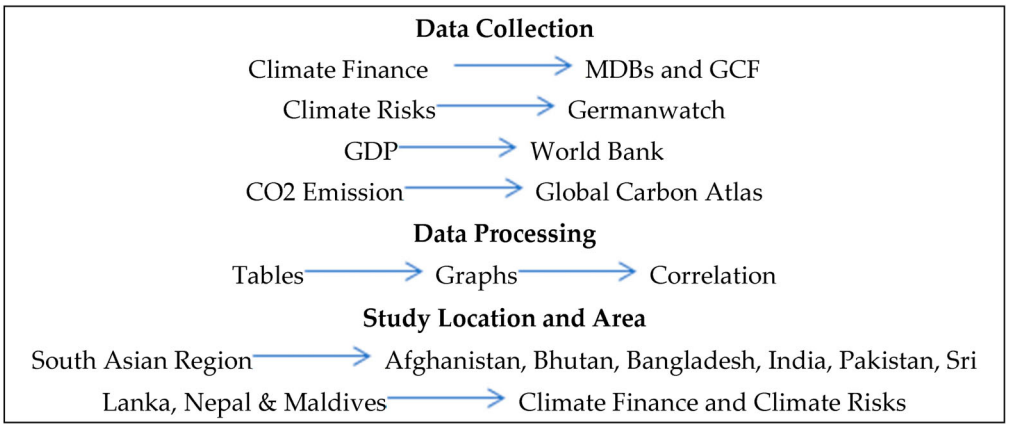


**Figure 1.** Data collection to data analysis pattern.

## 4. Results and Analysis

### *4.1. MDB Climate Finance (Amount in USD Million)*

Figure 2 presents the total climate finance of MDBs from the years 2011 to 2021. The figure also represents the SA region's climate finance by MDBs. The figure shows an upward trend in MDB finance. During the period, the highest and lowest financing levels are in the years 2021 and 2013, respectively. On average, MDBs financed USD 40,634 million. Compared to 2011, MDBs' investment increased by 202% in 2021, revealing a significant contribution to global climate finance. Moreover, MDBs did not disclose regional climate finance data for the year 2011. The figure also exhibits the post-COVID-19 climate finance picture of MDBs, which is very satisfactory. On the other hand, the SA region's financing is also increasing over time while the average climate finance is 13% of total MDBs' climate finance (USD 5391 million). The SA region's access to MDB climate finance increased by 119% compared to 2012 and decreased by 3% compared to 2018. Interestingly, SA region climate financing decreased in 2017 while it increased dramatically globally. Regarding the COVID-19 period, SA region climate finance drastically reduced in 2021; globally, total finance increased by 24% (that of the SA region increased only 1.5% from 2020). The picture vividly expresses that SA countries are enjoying a lower amount of climate finance from the MDBs concerning climate risk and vulnerability. Our analysis is consistent with that of Atteridge and Canales [51] and Carrozza [52].

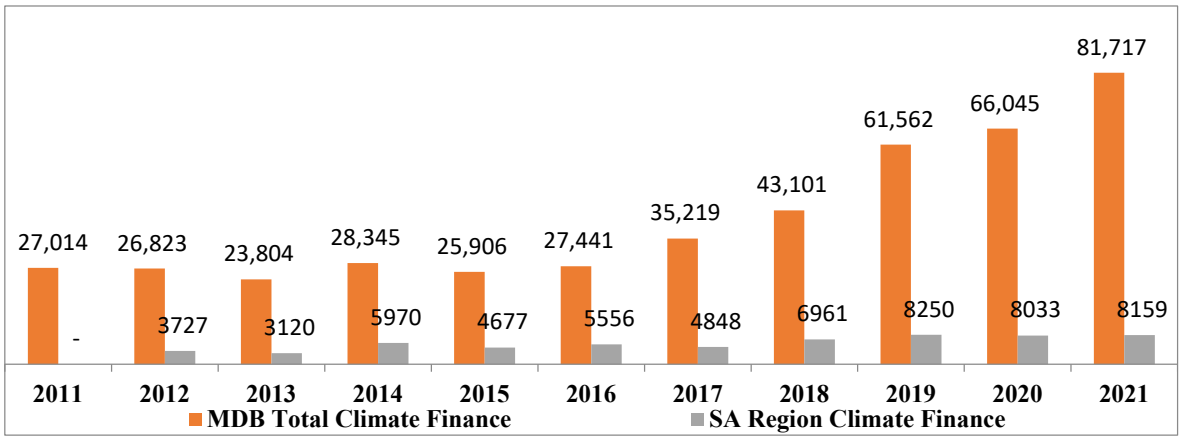


**Figure 2.** MDBs' total and SA region climate finance. Source: [53].

### *4.2. MDB Mitigation Finance (Amount in USD Million)*

Figure 3 shows the mitigation financing of MDBs and the SA region from 2011 to 2021. The figure points out that mitigation finance was higher than other financial mechanisms. MDBs contributed 77% of their total climate finance (USD 341,128 million) to mitigation

projects. MDBs' total mitigation financing increased yearly, with 2021 having the highest contribution. The average mitigation finance was USD 31,012 million. MDBs did not disclose regional mitigation climate finance data for the year 2011. Moreover, the figure shows an increasing trend of mitigation finance after COVID-19 that contributes to the climate risk strategy. During the period, SA region countries received a total of USD 39,843 million, an average of 12% mitigation finance from the total MDBs' mitigation contribution and 9% of total climate finance. SA region mitigation finance changed yearly, and the highest mitigation finance was in 2020. Moreover, mitigation finance had decreasing trend in the SA region since 2019, which is very alarming. The results also show that the maximum amount of climate finance was being used to reduce the region's carbon emissions and vulnerability to the climate. Moreover, mitigation finance directly improves technological innovation, renewable energy production, low-carbon technology, energy efficiency, waste management, and a cross-cutting issue that directly and indirectly mitigates $CO_2$ emissions. The result of this study is consistent with the prior research of Steffen and Schmidt [26] and Carrozza [52].

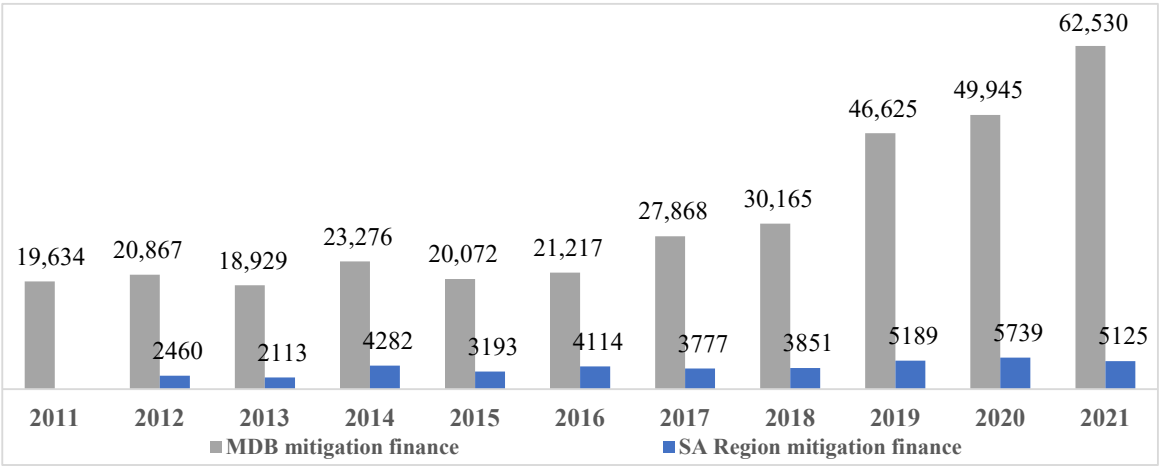


**Figure 3.** MDBs' total and SA region mitigation finance. Source: [53].

### *4.3. MDBs' Adaptation Finance (Amount in USD Million)*

Figure 4 presents MDBs' total and SA region adaptation finance data from 2011 to 2021. MDBs financed a significant amount in the adaptation areas, indicating a promising commitment against climate risk. MDBs' total adaption finance is USD 102,133 million which is 23% of MDBs' total climate finance, and average finance is USD 9285 million. Moreover, MDBs did not disclose regional adaptation climate finance data for the year 2011. MDBs' adaptation finance shows an increasing trend, with 2021 as the maximum financing year. On the other hand, the SA region, on average, received USD 3530 million, which is 33% of total adaptation finance in the SA region and 4% of MDBs' total climate finance. MDBs' adaptation finance in the SA region decreased by 2% compared to 2020. Adaptation finance is used to mitigate physical hazards, including in the built environment and infrastructure, institutional capacity development, agricultural production, coastal infrastructure, and financial services. Since 2012, the SA region received the lowest adaptation financing in 2020 (only 10%). The findings are consistent with the regional climate change reports of Zou and Ockenden [54] and Carrozza [52].

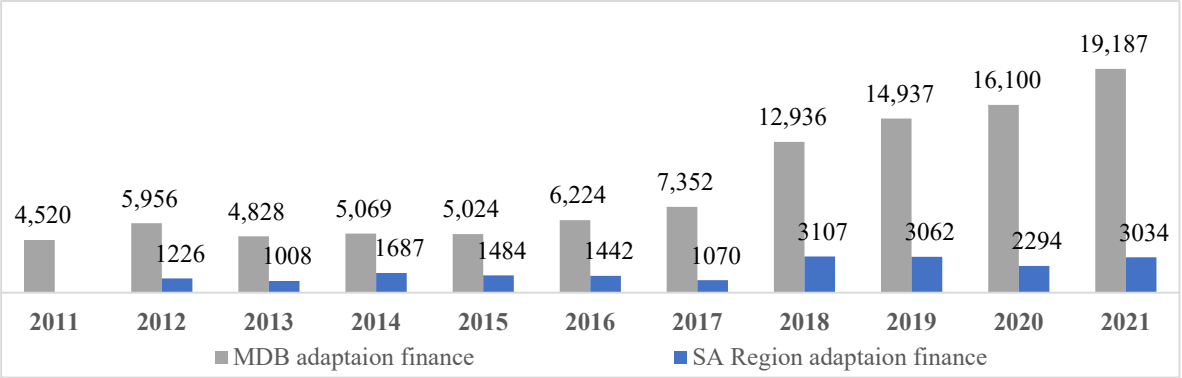


**Figure 4.** MDBs' total and SA region adaptation financing. Source: [53].

### *4.4. MDBs' Country-Wise Climate Finance Rank in the SA Region*

Table 2 describes MDBs' climate finance in the SA region from 2015 to 2021. According to Table 2, India alone received 50% (USD 22,301 million) of total financing in the region, and the remaining seven countries received the remaining 50% (USD 23,044 million). India, Pakistan, and Bangladesh are the top three ranked countries and received USD 39,113 million, 86% of the total SA region climate finance. The table also indicates that the region's remaining five countries received only 14% (USD 6232 million) of climate finance. Moreover, Afghanistan, Bhutan, and the Maldives received less than 3% of the money. The table represents a disproportionate and unequal distribution of MDBs' climate finance in the region where institutional ineffectiveness and climate politics may have played a role. Furthermore, the picture represents a lack of capacity building, technical inefficiency, and incapability to raise climate challenge issues to the regional forum, the international community, and the donor agency of the region. Additionally, it raises the issue of the lack of regional cooperation at the policy level along with multilateral initiatives.

**Table 2.** South Asian region climate finance (amount in USD million).

| Country | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | CF | (%) | Rank |
|---|---|---|---|---|---|---|---|---|---|---|
| Afghanistan | 0 | 173 | 147 | 144 | 281 | 65 | 485 | 1295 | 2.86 | 6 |
| Bangladesh | 899 | 1315 | 200 | 1296 | 2144 | 1127 | 732 | 7713 | 17.01 | 3 |
| Bhutan | 2 | 17 | 7 | 4 | 2 | 20 | 24 | 76 | 0.17 | 8 |
| India | 1948 | 3017 | 2678 | 3703 | 3671 | 3549 | 3735 | 22,301 | 49.18 | 1 |
| Maldives | 5 | 35 | 19 | 2 | 2 | 148 | 83 | 294 | 0.65 | 7 |
| Nepal | 567 | 111 | 204 | 435 | 252 | 1022 | 280 | 2871 | 6.33 | 4 |
| Pakistan | 1161 | 673 | 1018 | 1305 | 1294 | 944 | 2704 | 9099 | 20.07 | 2 |
| Sri Lanka | 84 | 212 | 574 | 72 | 604 | 192 | 87 | 1825 | 4.02 | 5 |
| Total CF | 4666 | 5553 | 4847 | 6961 | 8121 | 7067 | 8130 | 45,345 | | |

Source: [53].

### *4.5. GCF Climate Finance to SA Region*

Table 3 demonstrates GCF finance to the SA countries from November 2015 to June 2021. The GCF approved 173 projects during this period, whereas SA countries approved 20 projects (12%). The GCF approved USD 1019 million to the region, which is comparatively very low. The GCF was established to mitigate climate risk by promoting climate finance in developing and climate-vulnerable countries. SA region countries are developing in nature as well as highly climate vulnerable. Bangladesh approved the most in this region, USD 350 million (34%), and the most projects (five projects, 25%). On the other hand, India and Pakistan ranked second and third, respectively. Sri Lanka, Nepal,

and Bhutan accessed more than 5% of GCF climate finance (less than 10%), whereas the Maldives and Afghanistan had less than 3%. The top three ranked countries approved USD 782 million (77%) of the total GCF finance in the region. According to the GCF finance, SA countries agreed to more mitigation funds than adaptation finance, indicating that SA countries focus more on carbon reduction mechanisms rather than physical vulnerability. The small portion of GCF finance approved in the SA region raises the issues of institutional capability, regional cooperation, and political climate. The table suggests that institutional capacity, technical skills, negotiation power, and regional influences are highly influential in approving climate funds.

**Table 3.** GCF climate financing to SA region (amount in USD million).

| Country | Projects Approved | | | GCF Finance | | | Total GCF Finance | (%) | Rank |
|---|---|---|---|---|---|---|---|---|---|
| | Mitig. | Adapt. | Cross-Cut | Mitig. | Adapt. | Cross-Cut | | | |
| Afghanistan | 1 | 0 | 0 | 17.2 | 0 | 0 | 17.2 | 1.7 | 8 |
| Bangladesh | 1 | 3 | 1 | 256 | 74.7 | 20 | 350.7 | 34.4 | 1 |
| Bhutan | 0 | 1 | 1 | 0 | 25.3 | 26.6 | 51.9 | 5.1 | 6 |
| India | 2 | 1 | 1 | 232.5 | 34.4 | 43.4 | 310.3 | 30.4 | 2 |
| Maldives | 0 | 1 | 0 | 0 | 23.6 | 0 | 23.6 | 2.3 | 7 |
| Nepal | 0 | 0 | 2 | 0 | 0 | 66.7 | 66.7 | 5.4 | 5 |
| Pakistan | 1 | 2 | 0 | 49 | 72 | 0 | 121 | 11.9 | 3 |
| Sri Lanka | 0 | 2 | 0 | 0 | 77.9 | 0 | 77.9 | 7.6 | 4 |
| Total | | 20 (173) | | 554.7 | 307.9 | 157 | 1019.3 | 100 | |

Source: [31].

### *4.6. Long-Term Climate Risk in the SA Region*

Table 4 presents long-term climate risk in the SA region from 2012 to 2021 (Germanwatch prepares a long-term climate risk index based on the last twenty years of physical damage due to weather and natural disasters. For example, the 2012 climate risk index measures the damage between 1991 and 2010). According to Eckstein et al. [21], the long-term climate risk index indicates that countries with a lower score are highly climate risky in terms of physical damage due to weather/natural disasters. Among the eight countries, Bangladesh is in the most vulnerable and dangerous position in terms of the long-run climate risk, whereas Pakistan and Nepal are ranked second and third, respectively. Afghanistan and India are fourth and fifth in terms of long-term climate risk, and their average scores are 38 and 46, respectively. Interestingly, the Maldives received the highest score and ranked eighth in the region, meaning less climate risk due to physical damage.

**Table 4.** Long-term climate risk and ranks.

| Country | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | Avg. LT CR Score | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Afghanistan | 37 | 38 | 38 | 37 | 35 | 36 | 44 | 44 | 42 | 38 | 39 | 4 |
| Bangladesh | 8 | 21 | 20 | 21 | 23 | 25 | 27 | 27 | 30 | 28 | 23 | 1 |
| Bhutan | 82 | 85 | 84 | 81 | 39 | 98 | 96 | 98 | 97 | 95 | 86 | 7 |
| India | 38 | 41 | 39 | 40 | 97 | 38 | 37 | 37 | 39 | 39 | 44 | 5 |
| Maldives | 138 | 171 | 174 | 167 | 176 | * | 169 | 169 | 169 | 167 | 167 | 8 |
| Nepal | 37 | 36 | 35 | 40 | 41 | 44 | 46 | 34 | 32 | 31 | 38 | 3 |
| Pakistan | 31 | 31 | 32 | 32 | 31 | 31 | 31 | 30 | 29 | 29 | 30 | 2 |
| Sri Lanka | 80 | 72 | 65 | 64 | 63 | 64 | 59 | 48 | 40 | 40 | 59 | 6 |

* There is no climate risk index score for the Maldives in that year. Source: [21].

### *4.7. GDP Losses Due to Climate Risk*

Figure 5 presents GDP losses by long-term climate risk in the SA region from 2012 to 2021. The figure indicates the GDP losses of SA countries due to physical damage from extreme weather. The figure expresses GPD losses by percentage. Bangladesh lost an average of 1% of GDP in the last eight years due to climate risks driven by extreme weather events and ranked first among the eight countries. The figure also shows Pakistan and Afghanistan's losses of 0.678% and 0.336% of annual GDP because of climate damage and they ranked second and third, respectively. Due to extreme weather, Nepal and India lost 0.325% and 0.274% of their annual GDP and were positioned fourth and fifth, respectively. The Maldives' position is the best, suffering GDP losses of only 0.024%. The figure also illustrates that Bangladesh, Pakistan, and Afghanistan had the highest GDP losses among the eight countries. Moreover, Bangladesh lost more than three times the GDP than India.

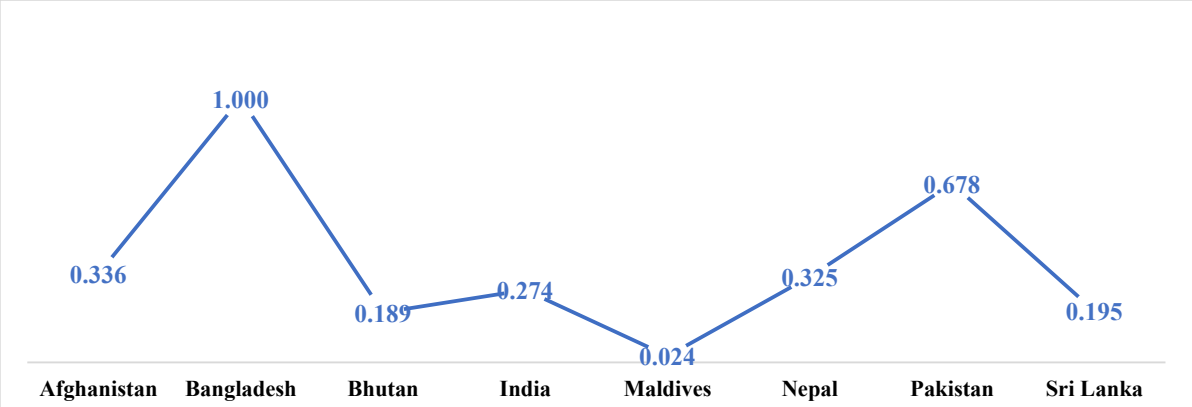


**Figure 5.** GDP losses from climate risk in the SA region. Source: [21].

### *4.8. Comparative Analysis of Climate finance, Climate Risk, and GDP Losses*

Table 5 presents a comparative picture of climate finance, climate risk, and GDP losses in SA countries. The table vividly shows that India received the highest funding from MDBs and the GCF for mitigating climate risks, whereas its position is fifth in both long-term climate risk and GDP losses. On the other hand, Bangladesh is the most climate-vulnerable country regarding long-term climate risk and GDP losses, but its position is third in climate financing. Interestingly, Pakistan ranked second in all indicators, including climate finance, long-term climate risk, and GDP losses. Nepal's position is fourth in the long-term climate risk, fourth in GDP losses, and fifth in climate finance. Afghanistan is highly climate risky in the long-term and regarding GDP losses while it has an inferior position in climate finance (sixth). Sri Lanka ranked sixth in long-term risk and GDP losses and fourth in finance. The table also posits that Bhutan and the Maldives' positions almost match in terms of long-term climate risk, GDP losses, and climate finance. Moreover, the table raises the issue of climate politics in the SA region due to discrepancies among climate finance, climate risk, and GDP losses. Unequal money distribution, higher climate risk, and higher GDP losses suggest issues in terms of the regional politics and lack of cooperation among the eight countries. Moreover, the comparative analysis also demonstrates a lack of institutional capacity and capability, regional influences and conflicts, and insufficient regional and international cooperation.

**Table 5.** Comparative analysis of climate finance, climate risk, and GDP losses.

| Rank | Climate Finance (2015–2021) | LT Climate Risk (2012–2021) | GDP Losses (2012–2021) |
|---|---|---|---|
| 1 | India | Bangladesh | Bangladesh |
| 2 | Pakistan | Pakistan | Pakistan |

**Table 5.** *Cont.*

| Rank | Climate Finance (2015–2021) | LT Climate Risk (2012–2021) | GDP Losses (2012–2021) |
|---|---|---|---|
| 3 | Bangladesh | Nepal | Afghanistan |
| 4 | Nepal | Afghanistan | Nepal |
| 5 | Sri Lanka | India | India |
| 6 | Afghanistan | Sri Lanka | Sri Lanka |
| 7 | Maldives | Bhutan | Bhutan |
| 8 | Bhutan | Maldives | Maldives |

Source: Authors' own work.

### *4.9. GDP Growth and Carbon Emission in the SA Region*

Tables 6 and 7 shows GDP growth and carbon emission in the SA countries from 2015 to 2021. GDP growth increases carbon emissions which are highly responsible for climate risk. Among the eight countries, Bangladesh, India, and the Maldives are the countries with the highest GDP growth. On the other hand, India, Pakistan, and Bangladesh produced the greatest $CO_2$ in the region. India produced 88% of $CO_2$ (17,471 Mt), while the remaining seven countries' $CO_2$ emission is only 12% (2351 Mt). India is the greatest $CO_2$ emitter in the region, while its average GDP growth is similar to Bangladesh. Bangladesh is in a comparatively better position regarding GDP growth and $CO_2$ emission. Moreover, the Maldives and Bhutan are the least $CO_2$-responsible countries in the region. Bangladesh's highest GDP growth and lower $CO_2$ emission suggest the country uses clean energy rather than fossil fuel. The table also posits that GDP growth and $CO_2$ emission are increasing in most of the countries in the region.

**Table 6.** GDP growth in the SA region.

| GDP Growth (%) | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| 2015 | 1.45 | 6.55 | 6.64 | 8 | 2.89 | 3.32 | 4.73 | 5.01 |
| 2016 | 2.26 | 7.11 | 8.13 | 8.26 | 6.34 | 0.59 | 5.53 | 4.49 |
| 2017 | 2.65 | 7.28 | 4.65 | 7.04 | 7.21 | 8.22 | 5.55 | 3.58 |
| 2018 | 1.19 | 7.86 | 3.06 | 6.12 | 8.13 | 6.7 | 5.84 | 3.31 |
| 2019 | 3.91 | 8.15 | 5.47 | 4.18 | 6.99 | 6.99 | 0.99 | 2.28 |
| 2020 | −2.4 | 3.4 | −10.1 | −6.6 | −33.5 | −2.4 | −1.6 | −3.6 |
| 2021 | NA | 6.9 | NA | 8.9 | 31 | 4.2 | 6 | 3.7 |
| Avg. | 1.51 | 6.75 | 2.98 | 5.13 | 4.15 | 3.95 | 3.86 | 2.68 |
| Rank | 8 | 1 | 6 | 2 | 3 | 4 | 5 | 7 |

Source: [55].

**Table 7.** Carbon Emission in the SA region.

| $CO_2$ (Mt) | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| 2015 | 10 | 73 | 1 | 2271 | 1 | 7 | 167 | 20 |
| 2016 | 9 | 76 | 1 | 2384 | 1 | 10 | 196 | 23 |
| 2017 | 10 | 81 | 1 | 2435 | 2 | 12 | 217 | 23 |
| 2018 | 11 | 82 | 1 | 2600 | 2 | 15 | 205 | 21 |
| 2019 | 11 | 92 | 1 | 2626 | 2 | 13 | 206 | 22 |
| 2020 | 12 | 91 | 1 | 2445 | 2 | 14 | 210 | 22 |

**Table 7.** *Cont.*

| $CO_2$ (Mt) | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| 2021 | 12 | 93 | 2 | 2710 | 2 | 14 | 230 | 21 |
| Avg. | 11 | 84 | 1 | 2496 | 2 | 12 | 204 | 22 |
| Rank | 6 | 3 | 8 | 1 | 7 | 5 | 2 | 4 |

Source: [56].

### *4.10. Statistical Analysis*

Table 8 displays the correlation matrix between climate finance and climate risk-related variables from 2015–2021. Climate finance is negatively and significantly associated with LTCRS and YCRS, consistent with Duku [27], Doku et al. [28], and Huang et al. [32]. On the other hand, CFin is positively and significantly associated with LTGDPL, YGDPG, and $CO_2$, consistent with Duku [27], Doku et al. [28], Huang et al. [32], Aye et al. [57], Azam et al. [58], and Mikayilov et al. [59]. The climate finance correlation results show that higher climate finance is negatively and significantly correlated with long-term and yearly climate risk. The results show that climate finance could be an essential and emerging tool to mitigate short- and long-term climate risks.

**Table 8.** Correlation matrix.

| Variables (Appendix A) | CFin | LTCRS | YCRS | LTGDPL | YGDPL | GDPG | $CO_2$ |
|---|---|---|---|---|---|---|---|
| CFin | 1 | −0.743 ** | −0.674 ** | 0.630 ** | 0.659 ** | 0.032 | 0.869 ** |
| LTCRS | | 1 | 0.539 ** | −0.882 ** | −0.633 ** | 0.046 | −0.560 ** |
| YCRS | | | 1 | −0.533 ** | −0.858 ** | 0.159 | −0.609 ** |
| LTGDPL | | | | 1 | 0.659 ** | −0.020 | 0.532 ** |
| YGDPL | | | | | 1 | −0.196 | 0.540 ** |
| GDPG | | | | | | 1 | 0.155 |
| $CO_2$ | | | | | | | 1 |

** indicate 1% level of significance (2-tailed). Variables: CFin means annual MDBs' climate finance, LTCRS indicates long-term climate risk score of Germanwatch, YCRS means yearly climate risk score of Germanwatch, LTGDPL means long-term GDP losses according to climate risk index of Germanwatch, YGDPL means yearly GDP losses according to climate risk index of Germanwatch, GDPG means yearly GDP growth rate, and $CO_2$ means annual $CO_2$ emission of each country.

## 5. Discussion and Conclusions

Climate risk is a very crucial part of sustainable development and SA countries are in a vulnerable position due to climate change and global warming [12,13,29]. To mitigate climate risk and ensure sustainable development of the region, climate finance is very important. The study was designed to explore the extent of climate finance in the SA region along with climate risk and GDP growth. The study first made an attempt to explore climate finance mechanisms in the SA region. The study also brought forward issues of institutional capabilities along with climate politics as possible influencers in terms of unequal distribution of money among the eight countries in the regions. The research documented MDBs' climate finance data along with the Germanwatch climate risk index from 2012 through 2021.

The study revealed that MDBs' climate finance has a very significant influence on world climate finance initiatives. From 2011–2021, MDBs' climate finance rapidly increased, especially since 2015. Moreover, in the last ten years, MDBs financed USD 446,977 million in the world, whereas SA countries received USD 59,301 million, which is 13% of the total MDB finance [53]. The GCF contributed USD 1019 million to the region, which is less than 10% of the GCF's total project funding [31]. According to the climate risk

index, the SA region is the most vulnerable, and most of its countries are at the top of the list. India received the most money in the region; Bhutan and the Maldives received the least. On the other hand, Afghanistan is also a climate risky country but accesses the least climate finance (see Tables 3 and 4). Bangladesh is top in terms of the long-term risk and GDP losses, while the country is in the third position in terms of total climate finance. Moreover, India's position in terms of climate risk and GDP loss is fifth, but in terms of climate finance it is first. Regarding GDP growth and $CO_2$ emission, India exceeded all countries in the region; while Bangladesh's GDP growth is almost the same as India's, $CO_2$ consumption is 30 times less than India's. This is also the case for Pakistan, as India's $CO_2$ consumption is more than 20 times that of Pakistan. The study also explored the unequal distribution of climate finance in the region and among the eight countries. The SA region is suffering extremely from climate risk and there needs to be more institutional and stakeholder initiatives to overcome the severe problem. The result could indicate a need for more institutional capabilities in SA countries. Moreover, SA countries' lack of capacity development and resources raises issues internationally, although the region produces the least $CO_2$ globally [14].

SA countries mainly used mitigation finance to combat climate risk, and the portion is very high compared with adaptation financing. Technological improvement is significant for climate risk reduction [14] and mitigation finance is an important mechanism. SA countries are very vulnerable to climate risks caused by natural disasters. On average, about 1% of yearly GDP losses are due to weather-related risks. Furthermore, it is believed that climate politics plays an exciting role in the region's climate finance as it has a significant role in world climate politics (e.g., the US's withdrawal from the Paris Agreement during President Donald Trump's administration and some world leaders being reluctant to deal with climate change and global warming issues). India is the most dominant country in the region; as a result, it is using the best possible opportunities to receive climate finance using regional and international cooperation and influences. Afghanistan is clearly behind in terms of access to climate finance concerning climate risk, which also suggests its national and institutional impediments on policy and capability. The overall pictures show a need for more regional cooperation among the counties in the region. The South Asian Association for Regional Cooperation (SARRC) is almost silent on climate issues because of political conflicts among the countries, particularly between India and Pakistan [14]. There needs to be more multilateral cooperation among the SA countries. The region is highly affected by global warming, but there needs to be a political willingness, mutual agreement, and cooperation among the countries to deal with it. The cities of this region are under a big threat of environmental hazards, and some of them could also be destroyed by the sea level rising within the next 50 years. However, political leadership has no concern about the issues [8]. Cooperation, pressure on the developed world, formulating a standard set of regulations, and raising climate funds would be the main challenges in these countries. The region needs to build a mutual leadership that can pressure the responsible countries for more climate financing and investing in carbon technology and management. Further, political conflicts in some countries in the region also lead to institutional failures when facing climate challenges.

SA countries' political commitment is crucial for combatting climate risk and capacity development. All the countries should now work together to ease regional climate politics and conflict to increase climate resilience. Bhutan, the Maldives, Afghanistan, and Sri Lanka received the least money from international financial organizations. At the same time, Bangladesh, Pakistan, Afghanistan, and Nepal lost the most in GDP due to climate risk, showing a considerable regional policy and regulatory gap. Moreover, Bangladesh, India, and Pakistan received almost all benefits (more than 77%) from the MDBs and GCF financing, meaning other countries are reluctant and unable to ask for climate justice. Furthermore, India received the highest amount of money, and the fact that it is subject to less climate risk shows India's better position in the SA region regarding capacity development and national policy. The region leadership could consider climate finance

as an essential mechanism to tackle climate challenges, and receiving money is their right and should not be dependent on the willingness of others. Our discussion and findings are consistent with the institutional theoretical understanding, according to which the region's institutions have failed to raise the issues as much as possible and to press for access to more climate finance from various sources. Finally, based on the empirical analysis and descriptive discussion, this study recommends the following for future directions:

- Mutually exclusive and strong political leadership is required at the regional level for climate justice.
- It is crucial to share and exchange information among the eight countries to determine the possible common threats and how they can cooperate to solve them.
- Institutional efficiency, capacity building, technical efficiency, and resource mobilization are essential for the region's countries to combat climate challenges.
- The regional cooperation forum SARRC needs to address climate risk vigorously.
- The region should establish a climate risk fund for all eight countries to access climate finance.

### *5.1. Theoretical Implications*

Climate finance is a significant part of sustainability management research; it is also known as sustainable finance, environmental finance, or green finance. However, to date, there is a considerable research gap in the climate finance literature. Most research on climate finance is based on descriptive analysis of climate finance and project finance rather than empirical analysis [3,14,22,32,60]. Therefore, an urgent area of research is to explore the relationship between climate finance and country-level indicators. This study contributes significantly to climate finance literature in SA countries by providing an empirical analysis of the links between climate finance and climate risk.

### *5.2. Practical Implications*

The current research shows that lack of regional cooperation and political conflict weaken the existing financing facility reflected in yearly climate finance projects. Climate harmony is essential in the region. Thus, this study has significant implications for climate finance, climate politics, and climate policy in the context of the SA region. The study vividly pointed out the unequal distribution of climate financing, lack of resources, and lack of regional cooperation and agreements. As such, this study will assist policymakers in dealing with accumulating climate funds from developed nations and developing agencies. The study found that more climate finance will help reduce long-term and short-term climate risks. It also evidenced that the SA region has lost more than 1% of GDP due to natural calamities. Therefore, the region's countries will be in big trouble due to climate risks that will produce inequality in income distribution [1]. It is high time for regional policymakers to enhance voices against higher $CO_2$ emissions and for higher climate and green investment. The region must establish an integrated approach to the mitigation policy that will contribute to long-term carbon reduction. Moreover, in daily life, the region's people's policy level should consider cross-cutting (adaptation and mitigation finance) approaches to climate and green funds. India must take a more proactive strategy and financing approach in the region as a top global $CO_2$ emitter. As climate issues and climate finance continue to unfold worldwide, different ideas and approaches for climate financing and policies are required. Therefore, to address the prevailing climate problems and ensure regional coordination and cooperation toward climate finance and policies, SA region leadership requires a holistic framework.

Despite significant findings and implications, the study is limited by its small coverage (only the SA region), qualitative description, and unavailability of data. Only eight countries are a very limited sample to draw attention to the complete climate finance and climate risk picture. Methodological issues limited the study because of data constraints. It failed to propose a hypothesis because of the limited sample size. The study focused only on the financing of MDBs and the GCF. Many other organizations are also providing

climate finance regionally and globally. Future studies should consider an empirical study of climate finance considering country-level and macro-level variables. Future studies may consider all countries' or all regions' climate finance and climate risk data. Further, it is necessary to find out the COVID-19-related impacts on climate finance and climate risk globally and regionally.

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**Data Availability Statement:** The study used publicly available data and the sources are given in Table A1.

**Conflicts of Interest:** There is no conflict of interest.

## Appendix A

**Table A1.** Variable Sources.

| Variables | Meaning | Source |
|---|---|---|
| CFin | Annual MDBs' climate finance | Joint Report on Multilateral Development Banks' Climate Finance. www.ebrd.com (accessed on 21 May 2023) |
| LTCRS | Long-term climate risk score of Germanwatch | https://www.germanwatch.org (accessed on 21 May 2023) |
| YCRS | Yearly climate risk score of Germanwatch | https://www.germanwatch.org (accessed on 21 May 2023) |
| LTGDPL | Long-term GDP losses according to climate risk index of Germanwatch | https://www.germanwatch.org (accessed on 21 May 2023) |
| YGDPL | Yearly GDP losses according to climate risk index of Germanwatch | https://www.germanwatch.org (accessed on 21 May 2023) |
| GDPG | Yearly GDP growth rate | https://data.worldbank.org/indicator (accessed on 21 May 2023) |
| $CO_2$ | Annual $CO_2$ emission of each country | http://www.globalcarbonatlas.org/en/CO2-emissions (accessed on 21 May 2023) |

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