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## Climate Change in South Asia: Further Need for Mitigation and Adaptation

by Ruchir Agarwal, Vybhavi Balasundharam, Patrick Blagrave, Eugenio Cerutti, Ragnar Gudmundsson, and Racha Moussa



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# Climate Change in South Asia: Further Need for Mitigation and Adaptation[1]

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## Abstract

The South Asia region is both a large contributor to climate change and also one of the regions most vulnerable to climate change. This paper provides an overview of the region's vulnerabilities, national committments to mitigate emissions, and national policies to adapt to a changing climate. The paper also discusses policy measures that may be needed to make further progress on both mitigation and adapatation. Our analysis suggests that while substantial progress is being made, there remains scope to adopt a more cohesive strategy to achieve the region's goals—including by improving the monitoring and tracking of adaptation spending, and by laying the groundwork to equitably increase the effective price of carbon while protecting low-income and vulnerable households in the region.

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## I. INTRODUCTION

As one of the world's regions most vulnerable to climate change, there is an urgent need to further pursue policies which mitigate the region's contribution to global warming, and adapt to the fallout from more frequent severe weather events, sea-level rise, and less predictable rainfall and agricultural output. These events matter, not only because of the physical risks they present, but also because of their potential deep impact on issues such as food security, migration, and the sustainability of livelihoods in affected areas.

This paper provides an overview of South Asia's circumstances vis-à-vis climate change—its contributions to carbon emissions, and its vulnerabilities—and presents policy commitments already made to both *mitigate* emissions and *adapt* to a changing climate, and highlights areas where more action is required.[2]

Decreasing the human contribution to climate change requires *mitigation* policies. These policies consist of actions taken to reduce greenhouse gas emissions, thereby directly limiting climate change. In South Asia, while India is a substantial carbon emitter, other countries in the region contribute relatively little to the global stock of greenhouse gas emissions, and Bhutan is the only country in the region which is carbon neutral. Hence, although each country in South Asia has a role to play in curbing emissions, the role of India is crucial at a global level. While India's per capita emissions remains significantly below that of advanced countries and India has made significant progress in terms of reaching its mitigation commitments under the Paris Agreement, there remains scope for India to adopt more ambitious targets going forward. This could allow India to play a role as a global leader in carbon-emission reduction, and also gain from a cleaner and healthier domestic environment.

In the face of a changing climate, countries must put in place *adaptation* policies. Even assuming full global coordination on mitigation polices, global warming will not be reversed,[3] and countries need to take steps to protect their citizens and ready their economies for a changing climate. There are numerous types of adaptation measures (e.g., educating the public, investing in climate resilient infrastructure, better preparing for natural disasters, protecting biodiversity, etc.) that would result in increased resilience to climate change. This paper presents a novel stock-taking analysis of the measures already taken by countries in the South Asia region—in terms of nonstructural interventions, institutional reforms, fiscal actions, financial actions, and risk management—as well as highlights the need for a comprehensive framework when analyzing investment plans. This framework needs to include the investment impact of regular or climate-change-resilient projects on future

[2] This paper covers Bangladesh, Bhutan, India, the Maldives, Nepal, and Sri Lanka. These are the 6 South Asian countries covered in the IMF Asian Pacific Department.

[3] As reviewed in the next section, the mitigation policies embedded in the Paris Agreement are seeking to decrease the speed of global temperature increases, which would significantly decrease some of the consequences of climate change.

economic prospects, as well as a strategy for funding sources (including donor support), especially in the presence of limited fiscal space in the region.

Our analysis reveals that South Asian countries are making substantial progress in adapting to the new reality of climate change, as well as in terms of mitigation. However, there is a lack of cohesive strategy to achieve all their goals, and insufficient monitoring and tracking of their adaptation spending. Additionally, learning and adopting "best practices" and experiences from other regions and countries on adaptation and mitigation will be essential. Finally, the analysis of both adaptation and mitigation plans and needs also highlight the large financing resources that would be required to tackle climate change in the region, and the essential role of the international community in supporting these efforts, which may prove fiscally challenging, especially for low-income countries.

The paper is organized as follows: section 2 presents the risks and vulnerabilities to climate change faced by South Asia, sections 3 and 4 present the mitigation and adaptation analysis, respectively, and section 5 concludes.

## II. Climate Change Risks and Vulnerabilities in South Asia

Climate change is a reality that we are all facing. The surface average global temperature—a summary statistic that is largely influenced by the stock of $CO_2$ (Hsiang and Kopp, 2018)—indicates that the planet is warming at a rate that has not been seen in the last 20,000 years (see Figure 1). The average global temperature during 2015–19 has been the warmest of any equivalent period on record since 1880 (NOAA Global Climate Report, 2019). Moreover, projections indicate that temperatures will increase even further by the end of the next century. Although considerable uncertainty surrounds temperature projections, the scientific consensus predicts that without further action to tackle climate change, average temperatures could rise by 3.7°C or more relative to 2005 by the end of the century (RCP 8.5 Prediction).[4] Very substantial cuts to current emissions will be needed to limit warming to less than 1.8°C (RCP 4.5 Prediction).[5]

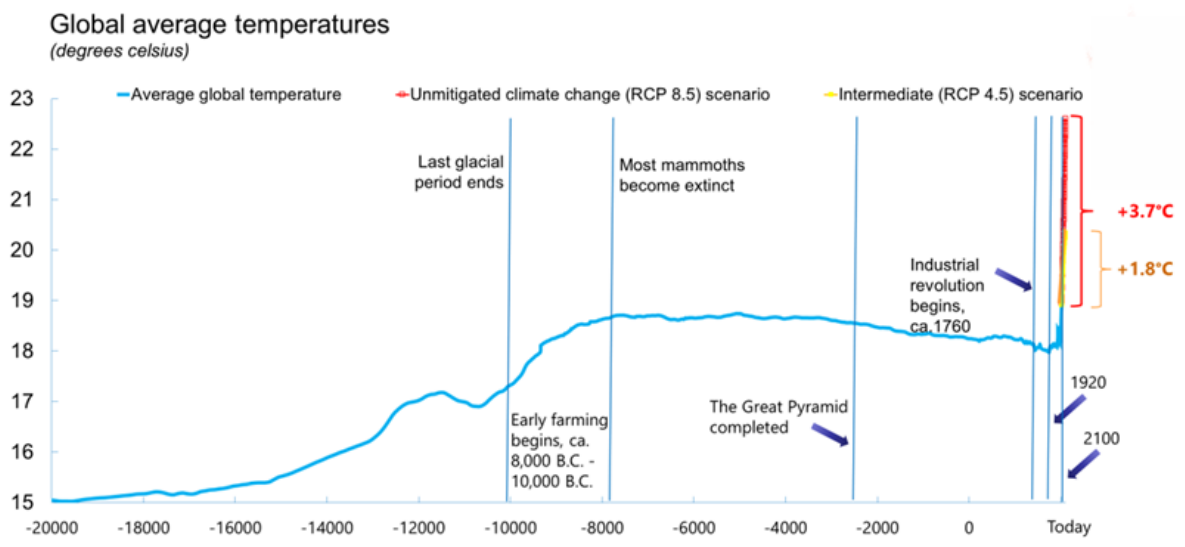
The impacts of climate change will manifest through different channels. For example, the increase in global temperatures will raise the sea level. As shown in Figure 2, the IPCC

[4] See Intergovernmental Panel in Climate Change (2013) for more details.

[5] The Intergovernmental Panel in Climate Change (IPCC) constructed four possible scenarios, called Representative Concentration Pathways (RCPs), using alternative greenhouse gas (GHG) concentration assumptions to project likely ranges of temperatures over the 21st century. Under the RCP 8.5 high emission scenario of unmitigated climate change, the average global temperature by 2081–2100 could rise by 3.7°C (with a projected range of 2.6°C–4.8°C). Warming would occur all over the globe, with larger increases over the northern hemisphere, where some regions could experience temperatures almost 12°C higher than in 2005. The RCP 4.5 scenario is an intermediate scenario, which assumes that there is increased attention to the environment. CO2 emissions peak around 2050 and decline thereafter. The Paris Agreement aims to contain the rise in temperature to less than 2°C (ideally to less than 1.5°C) relative to the preindustrial average, which would require policy efforts beyond those assumed in the RCP 4.5 scenario.

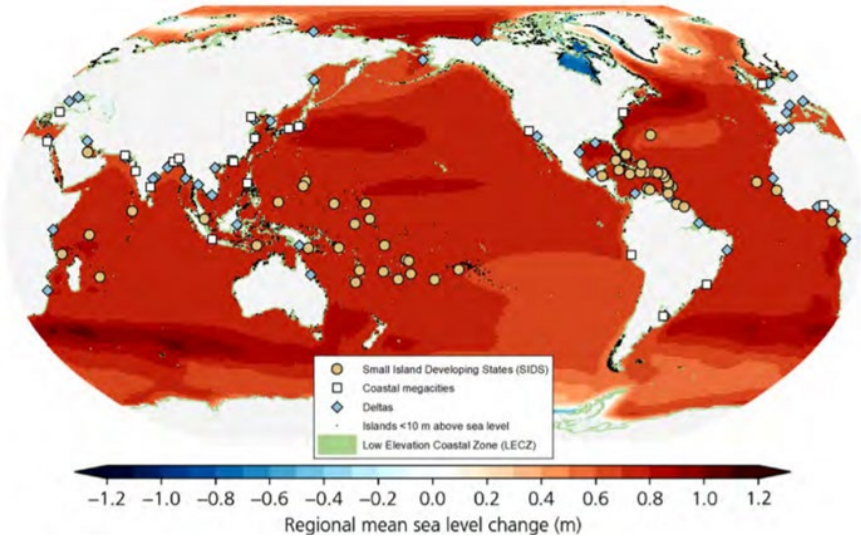
estimates that, depending on the effectiveness of 21st century mitigation and adaptation pathways under all emission scenarios, most low-lying regions around the world may face adaptation limits beyond 2100.[6]

**Figure 1. Past and Projected Increases in Global Temperatures**




Sources: IMF, *World Economic Outlook* October 2017 Chapter 3, Intergovernmental Panel on Climate Change (IPCC) Coupled Model Intercomparison Project Phase Five AR5 Atlas subset; Marcott and others (2013); Matsuura and Willmott (2007); NASA Goddard Institute for Space Studies; Royal Netherlands Meteorological Institute Climate Change Atlas; Shakun and others (2012); and IMF staff calculations.
Note: RCP = Representative Concentration Pathways.

**Figure 2. Sea Level Rise would Affect Multiple Low-Altitude Areas**

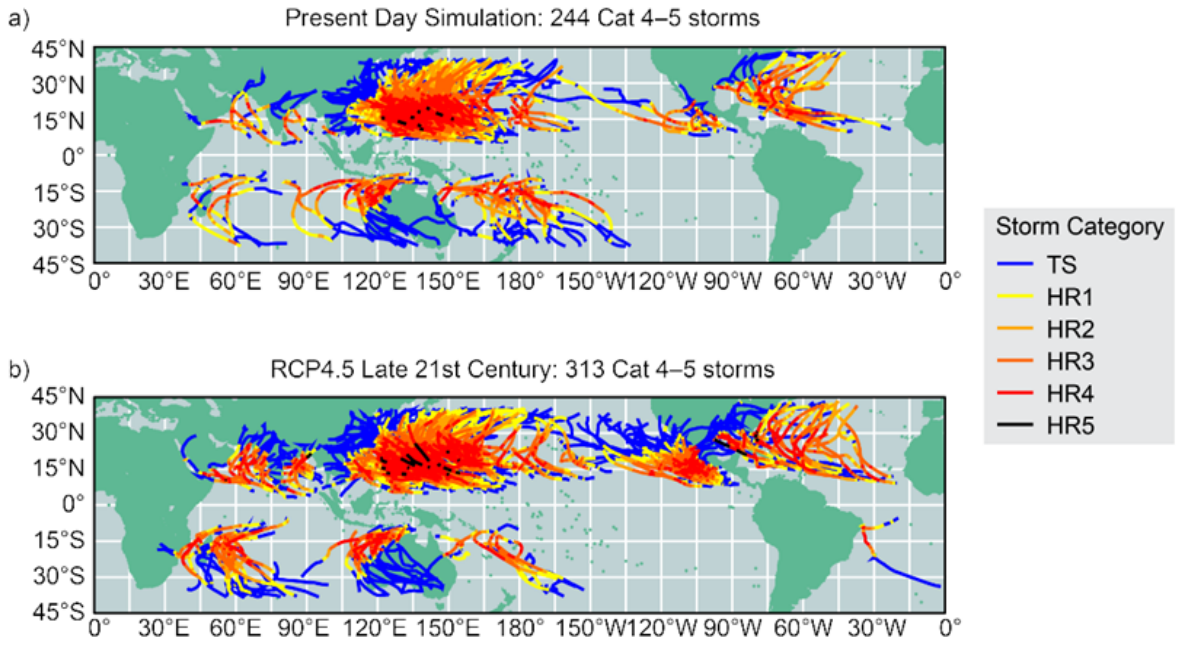



Note: The global distribution of low-lying islands and coasts particularly at risk from sea level rise. Regional sea level changes refer to projections under RCP8.5 (2081–2100).
Source: IPCC - The Ocean and Cryosphere in a Changing Climate

[6] According to the Klein et al. (2014) an adaptation limit is reached when the risk to a country's objectives or to the sustainability of a natural system cannot be avoided.

Another channel will be the increase in severe storms. Knutson et al. (2015) project that although there could be fewer tropical cyclones in a warmer late-twenty-first-century climate, there will be an increase in average cyclone intensity, precipitation rates, and the number and occurrence days of very intensive category 4 and 5 storms. While their simulations (see Figure 3) suggest that the geographical basin with the largest fractional increase in severe storms will be the northeast Pacific (+338 percent), substantial increases are also projected in the Atlantic (+42 percent), north Indian (+200 percent), and south Indian (+64 percent) basins. Other channels of how climate change could manifest are humidity changes as well as changes in the patterns of droughts and floods.

**Figure 3. Increase in Severe Storms would Affect South Asia**




Source: Knutson et al. (2015). Notes: Storm categories or intensities are shown over the lifetime of each storm, according to the Saffir–Simpson scale. The categories are depicted by the track colors, varying from tropical storm (blue) to category 5 (black; see legend).

The impact of climate change in South Asia could be substantial and will impact countries differently.[7] The region encompasses several different climatic conditions spread over a wide and diverse geographic area. Landscapes in the region include arid areas subject to severe droughts, low-lying coastal areas subject to flooding and coastal erosion, islands whose continued existence is threatened by the projected rise in sea levels, tropical zones subject to increasingly frequent and devastating cyclones, and mountainous ranges affected by the melting of glaciers.

[7] See Hijioka et al. (2014) for further details.

Overall, the South Asia region is among the world's most vulnerable to fallout from climate change, as many of its countries have substantial portions of their population living in coastal areas (Climate Central, 2019)—making them more vulnerable to sea-level rise and severe weather events. With a high population density and high poverty levels, the region is generally considered highly vulnerable to natural disasters. In a 2009 study, the World Bank (2009) noted that over 50 percent of South Asians had suffered from at least one natural disaster in the preceding two decades, leading to the loss of more than 200,000 lives and damages amounting to about US$45 billion. Table 1 illustrates that Bangladesh, Nepal, India, and Sri Lanka have been particularly exposed to extreme weather-related events over the last twenty years. On the other hand, the impact of glacier melting on Bhutan and Nepal and of the rise in sea levels on the Maldives is likely to become more intense over the medium and long term.

**Table 1. South Asia Vulnerabilities**

| Climate Risk Rank 2018 1/ | Climate Risk Rank 1999–2018 1/ | Global Risk Rank 2/ | Natural Disaster Risk Rank 3/ |
|---|---|---|---|
| India (5) | Bangladesh (7) | Bangladesh (22) | Bangladesh (10) |
| Sri Lanka (6) | Nepal (9) | India (29) | Sri Lanka (73) |
| Nepal (20) | India (17) | Nepal (46) | India (85) |
| Bangladesh (98) | Sri Lanka (22) | Sri Lanka (97) | Nepal (116) |
| Maldives (118) | Bhutan (103) | Bhutan (115) | Bhutan (143) |
| Bhutan (135) | Maldives (175) | Maldives (136) | Maldives (169) |

Sources: INFORM Global Risk Index 2019, Global Climate Risk Index 2019; UN-World Risk Index.
Notes: 1/ The **Global Climate Risk Index 2020** ranks the climate risk indices of 181 countries for year 2018, and for the period 1999–2018. The index takes into account the number of deaths per 100000 inhabitants, the sum of losses in US$ in purchasing power parity, as well as losses per unit of GDP. The ranks are in parentheses. The lower the rank (smaller number in brackets next to country name), the higher the risk. 2/ The **INFORM Global Risk Index 2019** ranks 191 countries at risk from humanitarian crises and disasters that could overwhelm national response capacity. The index is made up of three dimensions: hazards and exposure, vulnerability, and lack of coping capacity. The lower the rank, the higher risk. 3/ The **World Risk Index 2019** ranks the disaster risk of 180 countries in the world. The index takes into account disaster exposure, vulnerability, susceptibility, lack of coping capacities, and lack of adaptive capacities. The lower rank, the higher the risk.

The retreat of glaciers in the Himalayas is set to affect more than 1.5 billion people who live in the floodplains of major rivers, not only because of flooding risks, but also because of the long-run depletion of water supplies which could severely undermine agricultural activity. Sea-level rise and coastal erosion would not only eventually submerge much of the Maldives; it is also projected to lead to a loss of 17 percent of land surface and 30 percent of food production by 2050 in Bangladesh.[8] The combination of extreme weather and unpredictable rainfall patterns in the context of rapid population growth and urbanization is also projected to lead to growing competition for scarce water resources, loss of ecosystems and

[8] See https://www.nytimes.com/2014/03/29/world/asia/facing-rising-seas-bangladesh-confronts-the-consequences-of-climate-change.html

biodiversity, and a significant reduction in food production. Knox et al. (2015) looking at the impact of climate change on projected crop yields notably shows that for South Asia, the reduction could be as high as 16 percent for maize by the 2050s, while Havlik et al. (2015) points to a 15 percent decline in meat and milk production by 2030. The IPCC (2014) notes that heat stress could lead to a fifty percent decline in the most favorable and high-yielding wheat area of the Indo-Gangetic Plains. In a context of demographic growth, such trends present clear risks in terms of income and food security, which in turn may prompt an acceleration in migration flows, both nationally and internationally.[9]

Another recent World Bank study (World Bank 2018a) looks at the impact on South Asian countries of temperature and precipitation changes at the 2050 horizon. It indicates that temperatures in the region are expected to increase by 1.6°C relative to 1981–2010 in a climate-sensitive scenario which assumes collective global action in line with commitments made under the 2015 Paris Agreement. In a carbon-intensive scenario which assumes no global action, they are expected to increase by 2.2°C. Average monsoon precipitation is projected to increase by 3.9 percent in the climate-sensitive scenario and 6.4 percent in the carbon-intensive scenario.

Because they will exacerbate the intensity and frequency of glacier melting, flooding, cyclones, and coastal erosion, these weather changes are expected to prompt a decrease in living standards in the region, and to have a marked negative effect on Bangladesh, India, and Sri Lanka. While a warmer climate might have a positive impact on productivity in cold mountainous areas in Bhutan or Nepal, it would notably reduce agricultural productivity elsewhere and increase the propagation of infectious diseases, leading to lower labor productivity. In the case of India, the increased risk of flash droughts could have significant negative impacts on food production, irrigation needs, and livelihoods in rural areas.[10] The decline in per capita income under the carbon-intensive scenario is by 2050 projected to reach 6.7 percent in Bangladesh, 2.8 percent in India, and 7 percent in Sri Lanka. In hotspots, areas where changes in weather are expected to have a disproportionately large impact, the reduction in per capita income is projected to reach 14.4 percent for Bangladesh, 9.8 percent for India, and 10.0 percent for Sri Lanka.[11]

## III. MITIGATION EFFORTS IN SOUTH ASIA

A key global coordination mechanism in reducing carbon emissions is the Paris Agreement, and countries' nationally determined contributions to lower emissions. However, even meeting these commitments is likely to be insufficient to achieve the needed reduction in carbon emissions and keep global temperature increases contained to well below 2°C above

[9] See Chen and Mueller (2018) for further details.

[10] See Mishra et al. (2021) for further details.

[11] See also World Bank (2018a).

pre-industrial levels. As the largest carbon emitter in South Asia and one of the largest emitters in the world, India has a key leadership role to play.

**The Global Coordination Mechanism for Mitigation**

The United Nations Framework Convention on Climate Change (UNFCCC) or "Convention" entered into force on 21 March 1994. Its aim is to prevent dangerous human interference with the climate system. As of 2019, it has near-universal membership, and 197 countries have ratified the Convention—known as 'Parties to the Convention'. Building on the Convention, the Paris Agreement charts a new course in the global effort to combat climate change and adapt to its effects. The Paris Agreement entered into force on 4 November 2016. As of 2019, 187 of the 197 parties to the convention have ratified the Paris Agreement, whose central aim is to strengthen the global response to the threat of climate change.

The Paris Agreement aims to keep global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to further limit warming to 1.5°C. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change and it includes enhanced support to assist developing countries. Under the agreement, all Parties are required to put forward their best efforts through nationally determined contributions (NDCs) and to strengthen these efforts in the years ahead. This includes requirements that all Parties report regularly on their emissions and on their implementation efforts.

As of 2019, 184 parties had submitted their first NDCs, and all six South Asian countries covered here (Bangladesh, Bhutan, India, the Maldives, Nepal, and Sri Lanka) had submitted their NDCs. Table 2 below summarizes the key pledges and targets for the six countries based on information gathered from the respective NDCs. Unconditional targets refer to targets that the countries have pledged to in their NDCs without any conditions attached. By contrast, conditional targets refer to targets that a given country has pledged to achieve only conditional on international support (typically in the form of grants, financing, or technology transfer).

There is considerable heterogeneity in the type of commitments made by the six South Asian countries in their respective NDCs. For instance, India has unconditionally committed to a 33–35 percent reduction in emissions intensity by 2030, compared to 2005 levels. By contrast, Bangladesh has committed to a 5 percent reduction in GHG emissions by 2030, compared to business-as-usual (BAU) levels, in the power, transport, and industry sectors; and the Maldives has committed to conditionally reduce 26 percent of its Greenhouse Gases (below BAU) for the year 2030. Moreover, the Maldives highlighted during its NDC 2020 resubmission that it believes it has a responsibility to take a transformational economic and environmental path to development and aims to reach net-zero emissions by 2030 on condition that it gets extensive support and assistance from the international community.

Meanwhile, Nepal has no 2030 targets, but a conditional 2050 target to reduce fossil fuel dependency by 50 percent, conditional on receiving bilateral/multilateral grant support.

**Table 2. Paris Agreement Pledges and Targets**

| | India | Bangladesh | Nepal | Sri Lanka | Bhutan | Maldives |
|---|---|---|---|---|---|---|
| **Ratified** | Yes | Yes | Yes | Yes | Yes | Yes |
| **Share of 2012 GHG** | 5.73% | 0.35% | 0.09% | 0.06% | 0.01% | 0.00% |
| **2017 Emissions per capita relative to U.S.** | 11% | 3% | 2% | 7% | 9% | 22% |
| **Unconditional Target** | 33-35% reduction in emissions intensity by 2030, compared to 2005 levels. | 5% reduction in greenhouse gas emissions by 2030, compared to business-as-usual levels, in the power, transport and industry sectors. | None | By 2030, an unconditional 4% emissions cut in the energy sector and 3% in other sectors, compared to business as usual projections | Remain carbon neutral, so that emissions of greenhouse gases do not exceed carbon sequestration by forests. | None |
| **Conditional Target** | 40% of cumulative electricity installed capacity from non-fossil fuel based resources by 2030 with the help of transfer of technology and low cost international finance including from Green Climate Fund (GCF) | Further 15% reduction, conditional upon international support in the form of finance, investment, technology development and transfer, and capacity building. | By 2050, to reduce fossil fuel dependency by 50%, but requires bilateral/multilateral grant support | Conditional on international support, a further 16% emissions cut in the energy sector and 7% in other sectors, compared to business as usual projections | None | 26% reduction of emissions by 2030 (under BAU), in the context of sustainable development, enabled by financial support, technology transfers, and capacity building. With extensive support, the goal would be net-zero emissions by 2030. |
| **LULUCF** | Increase tree cover, creating an additional carbon sink of 2.5 to 3 billion tonnes of CO2 equivalent by 2030. | None | Maintain 40% of the total area of the country under forest cover | Increase the forest cover of Sri Lanka from 29% to 32% by 2030 | Maintain current levels of forest cover | None |

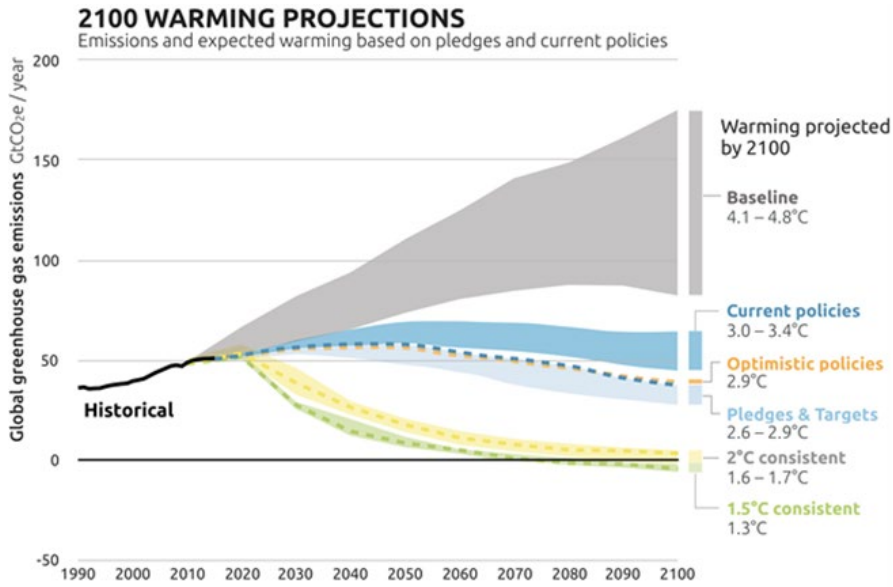
Source: Fund staff calculations based on each individual NDCs that can be accessed at the NDC public registry maintained by the UNFCCC secretariat; Global Carbon Project.

Bhutan is notable for being one of two countries in the world that is already carbon neutral (with Suriname being the other). Bhutan made the commitment to remain carbon neutral in 2009 despite their status as a small, mountainous developing country. Consistent with this, their NDC renewed this commitment to remain carbon neutral going forward, and it is expected to adhere to this commitment for the foreseeable future. According to Bhutan's second national GHG inventory, Bhutan is a net sink for greenhouse gases. The estimated sequestration capacity of Bhutan's forest is 6.3 million tons of CO2 while the emissions for year 2015 was less than 2.5 million tons of CO2 equivalent. This is largely due to huge areas of forest cover, low levels of industrial activity and almost 100 percent of its electricity generation through hydropower.

NDC pledges should be evaluated against the huge human and economic effort that is needed to meet the Paris Agreement goal to limit warming well below 2°C by 2100. According to the latest estimates in the UN Emissions Gap 2018 report, to prevent warming of 2°C by 2100, we will have to make sure that global emissions do not exceed 40 gigatons of CO2 equivalent by 2030. By comparison, to limit warming to 1.8°C by the end of the century, emissions would have to be cut even further, not exceeding 34 gigatons of CO2 equivalent by 2030. And to prevent 1.5°C of temperature rise by 2100, our total emissions will have to stay below 24 gigatons of CO2 equivalent.

Even if countries follow through on all of their unconditional climate pledges, the planet's average temperature is expected rise by about 3.2°C by 2100—well beyond the goal of Paris Agreement (Figure 4). Therefore, to avoid damaging levels of climate change, countries will need to be bolder in their climate commitments with material action to make those commitments a reality.

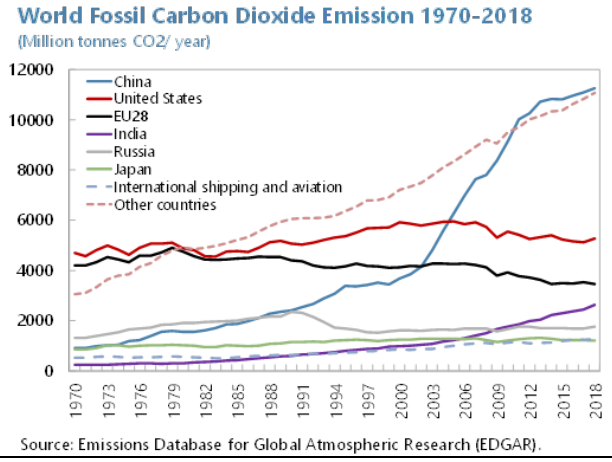
**Figure 4. Warming Projections**




Source: Climate Action Tracker.

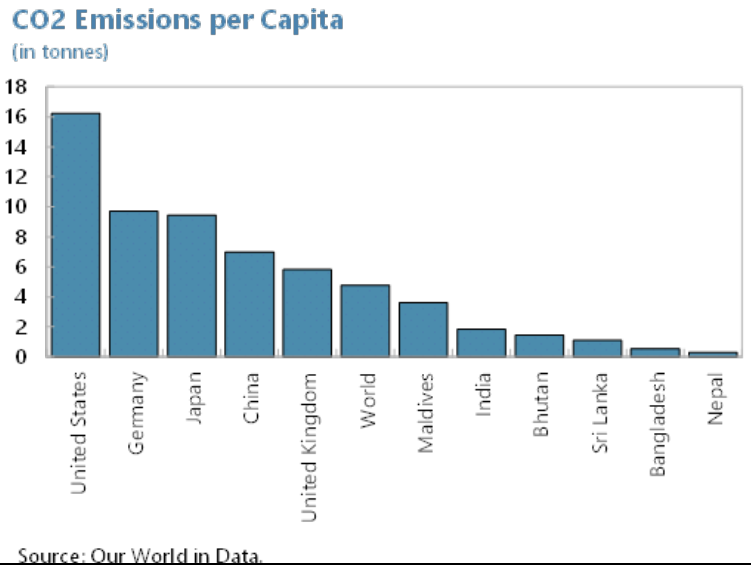
All countries need to reduce emissions, but the biggest global impact will come from the top four emitters—China, the United States, the European Union, and India. These four emitters account for more than 56 percent of all the greenhouse gases that were emitted over the last decade. As of 2018, China is currently the largest contributor, accounting for 27 percent of all emissions (and has committed to reach carbon neutrality by 2060); the U.S. and the European Union account for slightly more than 20 percent of the global GHG emissions; and India's emissions represent about 6 percent (Figure 5). However, it must be noted that India's emissions per capita remains significantly below that of advanced countries (Figure 6).

**Figure 5. World Fossil Carbon Dioxide Emission 1970 -2018**




Thus, among the South Asian countries, much of the focus is on India with respect to mitigation, given its relatively large share of greenhouse gas (GHG) emissions. As of 2012 (a date for which comparable data is available for all six countries), India accounted for almost 6 percent of global CO2 emissions, despite its low per capita emissions and large needs for better living standards for a sizable fraction of the population (Figure 6). By contrast Bangladesh accounted for ⅓ of a percent; and the others less than 0.1 percent of global GHG emissions (see Table 2). In this context, India's mitigation policy is of central interest to the global community focused on combatting climate change. This is the focus of the next sub-section.

**Figure 6. CO2 Emissions per Capita**

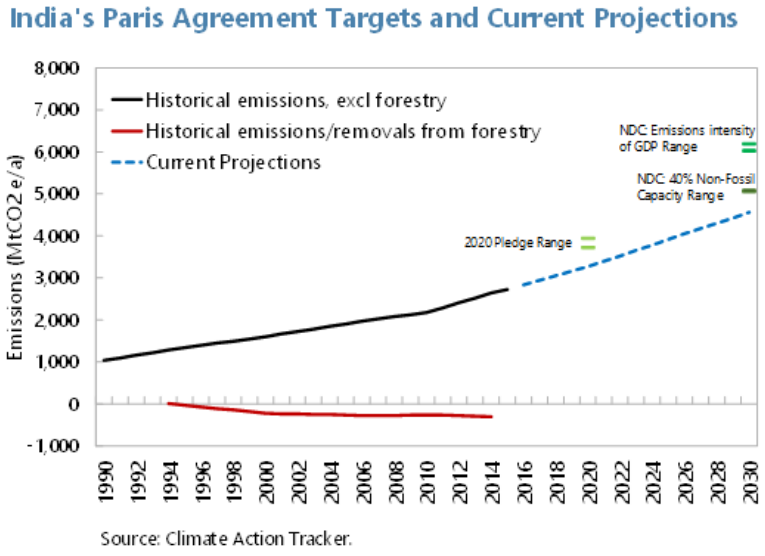


## India's Mitigation Path

While India's emissions are projected to grow as the country's economy develops, its commitments may be compatible with the 2ºC goal set in Paris. India is emerging as a leader in renewable energy, with significant investments in renewable energy (in addition to still-sizable investments in fossil fuel). According to the 2018 UN Emissions Gap Report, India is one of the few G20 members where the emissions under current policies are projected to be more than 10 percent below their unconditional NDC targets for 2030.

India is expected to achieve both its 40 percent non-fossil target and its emissions intensity target by 2030. India's NDC commits it to reducing its emissions intensity of GDP by 33-35 percent below 2005 levels by 2030 and increasing the share of non-fossil energy in total power generation capacity to 40 percent (with help of international support). Estimates by Climate Action Tracker (CAT)—an independent scientific analysis under a collaboration between Climate Analytics and New Climate Institute that tracks government climate action—suggest that India can achieve its NDC target with currently implemented policies (Figure 7). In particular, the CAT projects that its share of non-fossil power generation capacity will reach 60–65 percent in 2030. Thus, under current policies, India is projected to achieve both its 40 percent non-fossil target and its emissions intensity target. These reported estimates from CAT India are consistent with the findings of the 2018 UN Emission Gap Report and several other studies.[12]

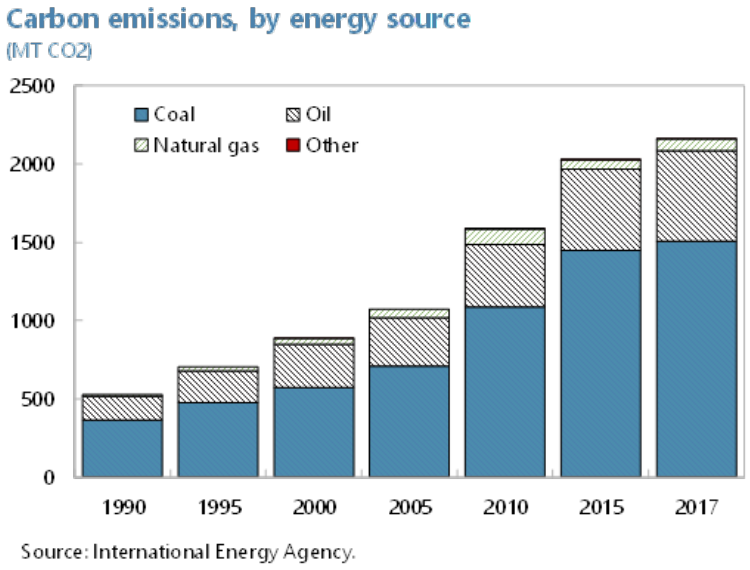
**Figure 7. India's Paris Agreement Targets and Current Projections**




[12] Other studies, including Dubash et al. (2018), analysis by The Energy and Resources Institute (TERI) (COMMIT, 2018), IEA World Energy Outlook (IEA, 2017), Mitra et al. (2017), Vishwanathan and Garg (2017), come to the same conclusion that India is likely to meet its NDC targets and even overachieve its emissions intensity reduction target.

India's progress offers it an opportunity to become a leader on the world stage by taking bolder steps towards the more ambitious 1.5ºC goal set in Paris. Going forward, India will have an opportunity to strengthen their mitigation goals in the 26th session of the Conference of the Parties (COP 26) to the UNFCCC, which is expected to be held in 2021. One priority for India could be to phase out its reliance on unabated coal-fired power plants.[13] By energy source, carbon dioxide emissions in India come primarily from coal (Figure 8).

**Figure 8. Carbon Emissions in India by Energy Source**




The generation of electricity in India is still heavily coal-dependent for a variety of reasons, including its historical cost advantage and an abundance of domestic supply which supports domestic-energy-security objectives, as well as the perception that coal ensures reliable and affordable energy access (see Tongia and Gross, 2019 for a fuller discussion).[14] In addition to emitting substantial amounts of carbon, India's thermal power sector is much more dependent on water than are renewables, and a relative lack of water since 2013 has reduced the efficiency of coal-fired-plant operations (Luo, Krishnan, and Sen, 2018).

Over the past decade, there are signs of a gradual shift away from thermal power generation towards renewable sources. A decade ago, power generation came primarily from thermal sources (about 64 percent) with just under 10 percent from renewables (Figure 9). As of end-2019, the role of thermal had barely declined, but renewables (mainly solar and wind) accounted for nearly a quarter of India's power generation. Among renewables, solar and energy have come to play a dominant role, with a smaller share attributed to hydro power generation. Perhaps more encouraging has been the trend over the past two years, wherein

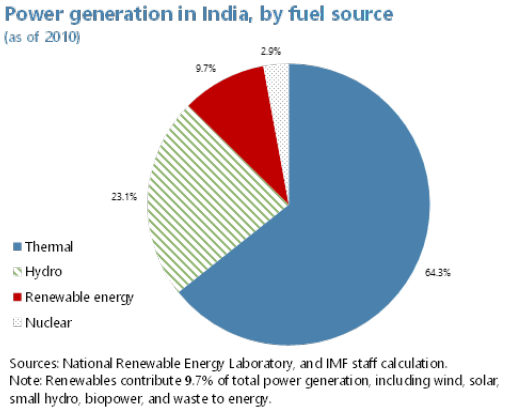
[13] Unabated here refers to plants without Carbon Capture and Storage (CCS) capacities.

[14] Worrall and others (2019) provide suggestive evidence on the lack of spatial correlation between coal thermal power plants and energy access in India.

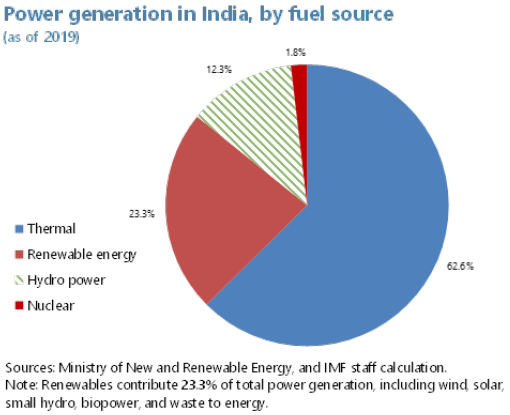
marginal additions to power generation capacity have been dominated by renewables (Figure 10). Indeed, this shift has come amidst a sharp reduction in the levelized cost of electricity (LCOE) generated using solar technology—according to the International Renewable Energy Agency, India now has the world's lowest LCOE in this area, with this metric having fallen by over 80 percent since 2010 (IRENA, 2020).

Going forward, with a large population and a rapidly growing economy, demand for energy in India will increase markedly. In order to limit carbon emissions associated with this increase in demand for energy, the transition away from fossil fuels towards renewables generation is vital. In addition, measures targeting greater energy efficiency of appliances and lighting, and green building construction can play a role in limiting any unnecessary growth of electricity usage.

**Figure 9. Power Generation in India**



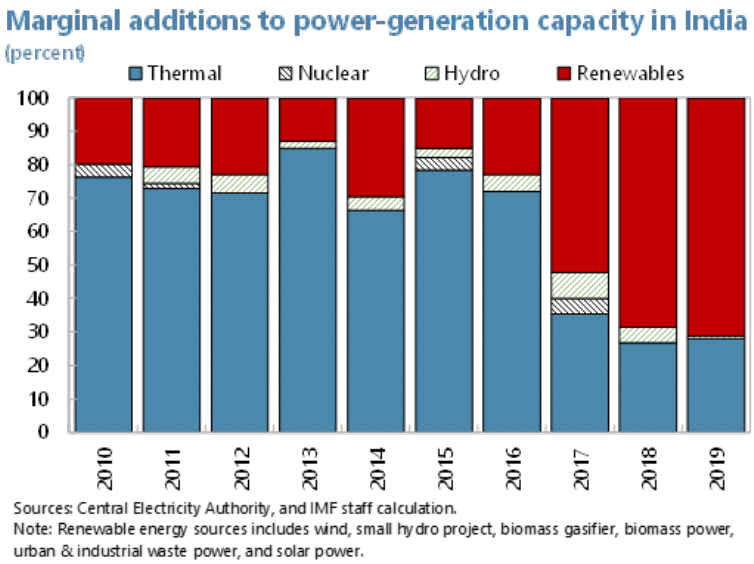

Sources: National Renewable Energy Laboratory, and IMF staff calculation.
Note: Renewables contribute 9.7% of total power generation, including wind, solar, small hydro, biopower, and waste to energy.




Sources: Ministry of New and Renewable Energy, and IMF staff calculation.
Note: Renewables contribute 23.3% of total power generation, including wind, solar, small hydro, biopower, and waste to energy.

India's latest Electricity Plan (Central Electricity Authority, 2018) still envisions several new coal-fired power plants. While several advanced countries are envisioning a similar phasing out (e.g., Canada by 2030), India also has an opportunity to embark on a similar goal and demonstrate leadership at the world stage. This will also benefit the local population by reducing local air pollution and incentivize a shift towards cleaner and potentially job-rich renewable technologies.

**Figure 10. Marginal Additions to Power-Generation Capacity in India**




Sources: Central Electricity Authority, and IMF staff calculation.
Note: Renewable energy sources includes wind, small hydro project, biomass gasifier, biomass power, urban & industrial waste power, and solar power.

## Some Mitigation Policy Considerations

The recent strong increase in addition to renewable power generation capacity is being facilitated by an increase in government subsidies to renewables (Abhinav et al., 2018), illustrating the important role for policy in durably reducing carbon emissions. Going forward, one approach to reduce emissions rapidly and substantially is to meaningfully change the relative cost of electricity generation via renewables, relative to non-abated coal-fired production. This can be achieved either by further lowering the cost of renewables through greater subsidization or technological innovation (e.g., rapid decline in price of solar or wind energy due to technological advancements), or by increasing the cost of thermal production.

Existing policies in India have elements of both approaches. Recognizing the need to partly internalize the externalities associated with the generation of electricity using thermal sources, especially coal production, a coal cess tax was enacted in 2010.[15] Nevertheless, the efficacy of this cess in discouraging coal production and usage in power generation is dampened by large subsidies which remain in place throughout the value chain benefitting coal mining and the operation of coal-fired power plants (Abhinav et al., 2018). The elimination of these subsidies would also help shore up India's fiscal position, in the context of the current COVID-19 pandemic.

[15] The 'clean energy cess' was first enacted at a rate of 50 rupees/ton in 2010, and has been increased three times since its enaction. With the enaction of the GST in 2017, the clean energy cess was replaced by the GST compensation cess (a tax on coal production), at an unchanged rate of 400 rupees/ton.

Levying a direct tax on fossil-fuel production, in proportion to their carbon content and ultimately their carbon emissions (a so-called carbon tax) would accelerate the shift away from thermal power generation while also providing a fiscal dividend. As discussed in IMF (2019b, 2020), the enaction of a carbon tax is an important mechanism in reducing emissions. As an example, a $50/ton carbon tax would reduce carbon dioxide emissions by about 35 percent below a 'no-policy-change' baseline scenario, by 2030.[16] Unlike subsidization which carries a fiscal cost, a carbon tax could provide a large fiscal boon to India. IMF (2019c) estimates that a $50/ton carbon tax would generate between 1.5 and 2 percent of GDP in additional fiscal revenues, by 2030. If this boost to revenues were put towards reducing the country's deficit, it would play a large role in counteracting the deterioration in India's fiscal position associated with the COVID-19 pandemic and necessary fiscal support measures. Alternatively, higher fiscal revenues could be partly used to increase fiscal transfers to lower income households, thereby offsetting any negative distributional impact that the carbon tax itself may imply (see Jain and others, 2018 for a discussion of household compensation using cash transfers). In addition, a well-designed carbon pricing reform can support distributional and poverty objectives. In this regard, analysis in IMF Fiscal Monitor (2019c) suggests that a carbon tax may in fact have a similar or smaller incidence on lower-income households than on those with higher incomes, due largely to the fact that electricity is either less available or less consumed by rural households in India. Additionally, using part of carbon pricing revenues to increase fiscal transfers to lower-income households would make the reform more progressive and could result in net benefits among poorer households. Doing so could make the reform both pro-equity and pro-poor (see also IMF, 2021). In addition, it could also help with improving air quality and mitigating pollution.

Overall, while raising the carbon tax further in the future can bring several benefits, several design issues and implementation timing need to be considered to mitigate the impact on the vulnerable. Further work is needed in each South Asian country to evaluate, assess, and design the practical aspects of the policy implementation to ensure vulnerable and low-income households are protected and adequately covered by the various fiscal transfers. Moreover, more thought will need to be given to the impact of carbon taxes on growth and inflation as policy makers are likely be worried about this. In particular, although carbon taxes could potentially be the most efficient method of lowering carbon emissions relative to other alternatives (regulating lower emissions, or enacting an emissions-trading system), the unilateral imposition of a carbon tax would almost surely carry a direct economic cost. In fact, for a $50/ton tax, one estimate suggests a reduction in the level of GDP by just over 0.5 percent in 2030 (IMF, 2019b), whereas other studies indicate that any impact on GDP could be reduced through recycling carbon-tax revenue into productive investment (Ojha,

[16] As empirical evidence on the elasticity of carbon emissions with respect to prices is relatively limited, these estimates are subject to considerable uncertainty. For one empirical study, see Rafaty, Dolphin, and Pretis (2020), which indicates a positive link between carbon prices and emissions reductions.

Pohit, and Ghosh, 2020). Moreover, the welfare cost of introduction of carbon tax combined with pro-poor fiscal transfers will depend on future improvements in the social safety net and enhancements in targeting of welfare programs. (In this context, note that administrative capacity need not be a constraint for designing socially fair climate policy.) Such costs and the distributional consequences would need to be weighed against indirect economic benefits associated with reduced carbon emissions (for instance in the form of better health outcomes, reduction in premature pollution-related deaths). Options to enhance protection of vulnerable households are discussed further in IMF (2020).

Finally, the COVID-19 shock has already led to sectoral re-allocation away from some dirty-energy-intensive sectors, which could help reduce transition costs on the path to a greener economy. Some sectors that rely intensively on carbon—such as airlines, transportation, etc.—have been particularly impacted by the COVID-19 shock, and the adverse impact is expected to last for several years. While in the short-term this has led to sizable pain for the workers and businesses operating in these sectors, over the medium-term this provides an opportunity for job creation in less pollution-prone sectors. In this context, over the medium term, a well-designed carbon tax package—that is combined with complementary product and labor market policies—could support the re-allocation of capital to and re-skilling of labor in more productive and cleaner sectors.

## IV. Adaptation Strategy in South Asia

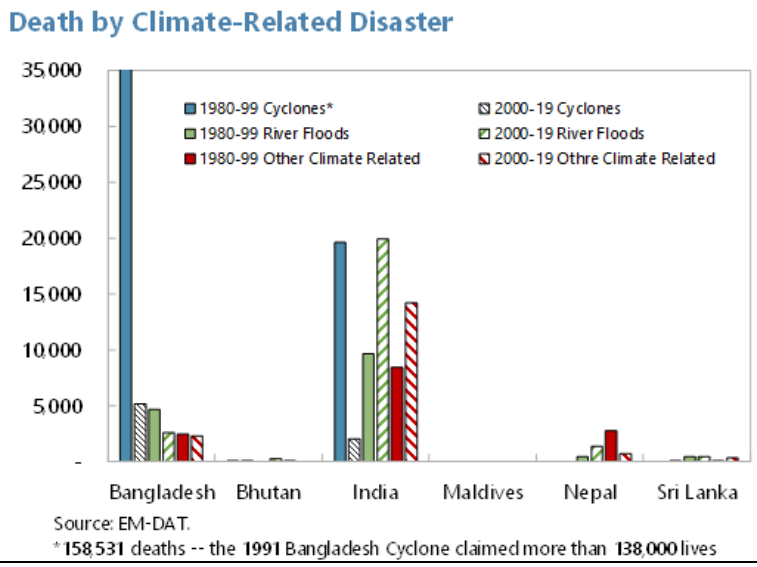
Adaptation is the other main policy response to climate change and consists of improving the resilience of people's behavior and the country's infrastructure to the consequences of climate change. Adapting to climate change takes many forms. In addition to making physical infrastructure more resilient to climate shocks, adaptation involves improving policy-making processes to be more agile in the face of climate shocks, internalizing climate risk in areas such as land use laws and procurement, educating households and firms on their role in adapting to climate change and providing support in the effort (Global Commission on Adaptation, 2019 and Hallegatte et al. 2020). South Asia has made strides in adapting to climate change and there is scope for more action.

### Different Types of Adaptation Policies

Early warning systems for cyclones in the North Indian Ocean are a good example of adaptation through policy. These cyclones routinely devastate the coastline and are often deadly and destructive. Improvements in early warning systems and evacuation exercises have helped save the lives of thousands of people as demonstrated in comparing two category 5 cyclones from 1991 and 2020 in the North Indian Ocean (Figure 11). The 1991 Bangladesh cyclone was a category 5 tropical cyclone and among the strongest and deadliest cyclones in the North Indian Ocean with more than 138,000 deaths and an estimated US$1.78 billion in damages (EM-DAT). Most recently, on 20 May 2020 another category 5 cyclone, Amphan, made first landfall and impacted the coasts in Bangladesh and

West Bengal, having also an impact on Sri Lanka and Bhutan.[17] Amphan is the costliest cyclone ever recorded in the North Indian Ocean with estimated damages above US$13 billion and it claimed the lives of 128 people. Thanks to improvements in early warning systems and evacuation efforts, 2.4 million Bangladeshis were evacuated before the storm made landfall, saving thousands of lives (IFRC, 2020).

**Figure 11. Death by Climate-Related Disaster**




In addition to adaptation policies that trigger benefits by educating the public and changing people's attitudes, the need to improve physical infrastructure is also a key element in effective adaptation. Physical infrastructure needs in South Asia are well documented, even before considering the need for infrastructure to be resilient to climate change. A recent study by Rozenberg and Fay (2019) estimates that in order to achieve their development goals, low- and middle-income countries will need to spend between 2 and 8 percent of GDP annually until 2030. The estimates vary based on spending efficiency and development goals. In the scenario where the Sustainable Development Goals (SDGs) are attained and full decarbonization is achieved around 2050, the average annual capital cost and maintenance cost for South Asia would be 4.8 and 2.7 percent of regional GDP up to 2030.

To maximize the benefits of the needed infrastructure, new infrastructure should be resilient to climate shocks to the extent possible. Satisfying infrastructure needs requires a comprehensive analysis of investment plans, their impact on future economic prospects, as well as a strategy for funding sources, especially in the presence of limited fiscal space in the region. Using the example of the Maldives, Box 1 illustrates through a general equilibrium framework how the choice between standard- and adaptation-capital is intertwined with

[17] https://www.theguardian.com/world/2020/may/20/super-cyclone-amphan-evacuations-in-india-and-bangladesh-slowed-by-virus

decisions on how to finance the additional investment, whether with debt or through other sources. More generally, as shown in Box 2, other studies have also highlighted that South Asian economies can still stand to gain from improving their adaptability to climate change, including in terms of infrastructure.

The incidence and impact of COVID-19 in the region also highlights the importance of strengthening preparedness to respond to future pandemics and increases the need to design adaptation policies with a view to addressing the risk of future pandemics. Evidence suggests that climate change along with changes in land use driven by urbanization, deforestation, and increased demand for food, reduces biodiversity and exacerbates the risk of the emergence of new diseases and their transmittal to humans (Keesing et al., 2010; Romanelli et al., 2015). Deforestation and urbanization have encroached on the ecosystems of species that carry pathogens, putting human beings in closer contact with pathogen-carrying animals. Domesticated mammals, such as cattle and pigs, can also transmit pathogens if they are exposed to the originating species (Johnson et al., 2020; Romanelli et al., 2015). It is important to maintain surveillance of at-risk areas to protect the habitat of pathogen-carrying species and ensure that interaction with humans and other animals is limited; additionally, environmental impact assessments can take health risks into account (Keesing et al., 2010; Romanelli et al., 2015). Vector-borne diseases, such as those transmitted by mosquitos, are also impacted by climate change. Changes in rainfall and temperatures will alter the regions where vectors spread the disease and can lead to an intensification of transmission (UNEP, 2018). Reducing the population of vectors is important in limiting the spread of vector-borne diseases. On this front, it is important to monitor vector-population growth in order to limit interaction with humans.

**Box 1. Enhancing Infrastructure Resilience to Climate Change in the Maldives[18]**

The increased likelihood of adverse climate-related shocks calls for building adaptation (resilient) infrastructure. Satisfying these infrastructure needs requires a comprehensive analysis of investment plans, their impact on future economic prospects, as well as a strategy for funding sources, especially in the presence of limited fiscal space. This box presents the results of an analysis illustrating precisely these challenges, through calibrating the model of Marto, et al. (2017) to Maldivian data, and using it as a general equilibrium framework to analyze the effects of climate-change-related shocks, public investment and its financing sources.

Climate change-related shocks can affect the economy by damaging both public and private capital and by temporarily hampering productivity, but the investment in adaptation capital could make the economy more resilient to these shocks. To consider those dynamics, the general equilibrium growth model is tailored to small-open economies prone to natural disasters, with firms that use different types of capital and labor to produce traded and non-traded goods and services. The modeling of natural-disaster shocks allows us to analyze the implications of alternative public investment decisions, such as the choice between standard and adaptation infrastructure. The choice between standard and adaptation capital is intertwined with decisions on how to finance the additional investment, whether with debt or through other sources. The model allows us to underscore critical margins that influence both types of decisions.

The financing strategy is crucial in the case of the Maldives, given its limited fiscal space. To this aim, illustrative experiments are set up along two main dimensions: investment options and financing. For the sake of simplicity, the assumption is that authorities use the same budget envelope of 1 percent of GDP for 5 consecutive years for building standard or adaptation infrastructure, and a natural disaster occurs as soon as this investment plan is completed. The experiments help

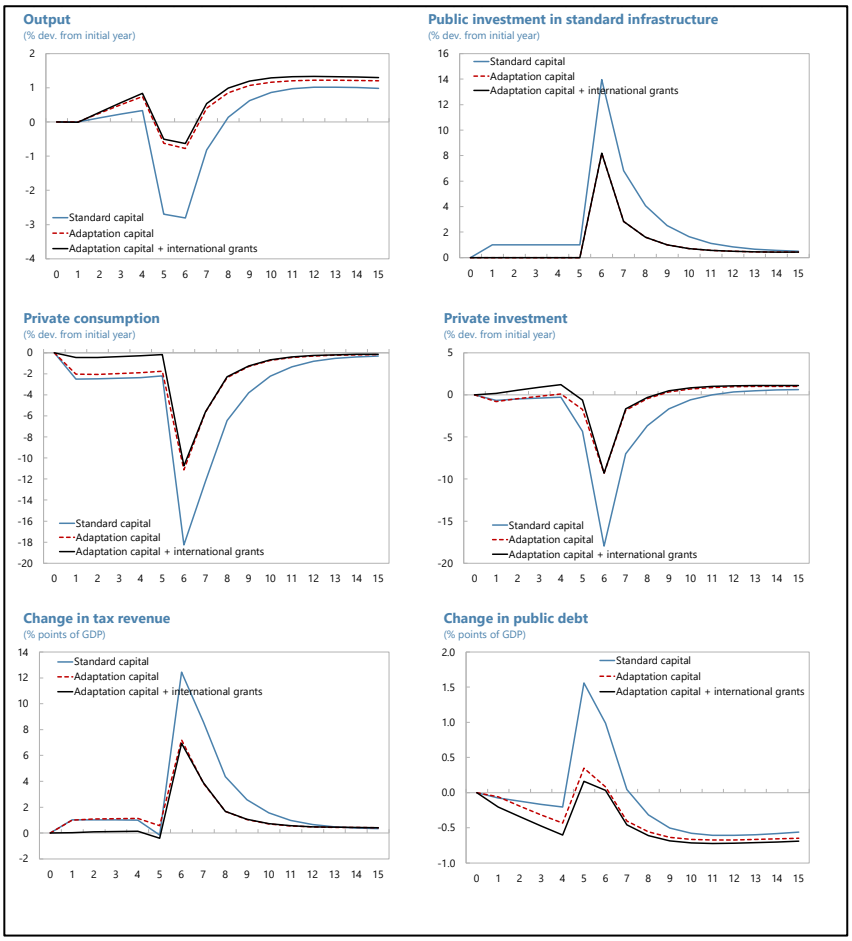
[18] This box was prepared by Giovanni Melina and Marika Santoro (both RES), based on Melina and Santoro (2021).

address three main questions: (i) What are the gains associated with adaptation infrastructure in the face of a natural disaster? (ii) How does the outcome change when the government finances the initial investment with international grants, rather than by raising taxes? (iii) What are the financing needs for reconstruction in the aftermath of a disaster, depending on whether the government has invested in standard or adaptation capital? And what does this mean for international donors?

Three scenarios are considered: (1) investment in standard infrastructure; (2) investment in adaptation infrastructure financed by higher taxation; and (3) investment in adaptation infrastructure financed by international grants. These simulations, for simplicity, assume that the post-disaster reconstruction is financed by increased taxation, under the assumption that the Maldives has no fiscal space for deficit-financed spending. It is, however, possible that donors would intervene also with post-disaster grants.

The natural-disaster shock is assumed to destroy 10 percent of capital and to trigger a symmetric productivity drop in both the tradable and non-tradable sectors. While the magnitude of this shock is illustrative, it is in the range of shocks similar to highly disruptive floods observed in island countries. The results highlight the following.

- *Impact of the shock on GDP.* Building resilient infrastructure in the Maldives can halve the losses in terms of GDP at the trough triggered by the natural disaster. Note that, investing in resilient infrastructure yields a dividend even before the disaster occurs, as its greater gross rate of return and durability imply that its net return is higher (the greater durability is captured by a smaller depreciation rate of resilient infrastructure relative to that of standard infrastructure). The additional tax pressure required for the reconstruction in the case of standard infrastructure would be (politically) infeasible. The supplementary increase in tax revenues should be of the tune of 6-7 percentage points of GDP, in the aftermath of the shock (difference between blue and black/red lines in the tax revenue chart).




- *Financing.* Financing public investment (in standard or adaptation infrastructure) with higher taxation would lead to a sacrifice in terms of GDP, and private consumption and investment in the ramp up of the investment effort. Grant-financing can reduce this cost (or eliminate it if it covers the investment plan in full, as in the example provided).

*Donors' considerations.* The large increase in tax revenue required to support the reconstruction underscores the large financing gaps that authorities could face with worsening climate conditions. Very likely, donors might have to financially support the country during the reconstruction phase. The experiment underscores the tradeoff faced by the international community: financing the initial investment in adaptation infrastructure with prospects of much smaller post-disaster disbursements, or wait for the disaster to occur and sustain the reconstruction in case of standard infrastructure, with potentially twice-as-large disbursements (difference between black and blue line in the tax revenue chart, in the aftermath of the shock).

## Current State of Adaptation in South Asia

South Asian countries have advanced to different degrees in their adaptation to climate change in relation to non-structural interventions, structural resilience building, fiscal actions, financial actions and risk management.

*Non-structural interventions and structural resilience building*

First, all South Asian countries have developed a national climate change action plan and disaster management plan (see Table 3 as well as the annex for more detailed information). These non-structural interventions involve developing guidelines, operating frameworks and action plans to help guide both ex-ante resilience building and post-disaster resilience. These plans are quite granular in nature, invariably containing sectoral action plans for each vulnerable sector.[19] Sri Lanka is the only South Asian country to have officially released its National Adaptation Plan (NAP) while the rest have made progress towards parts of the process (UNFCCC, 2019). Some countries like India have also encouraged their states to prepare their own action plans and are requiring them to be revised on regular intervals.

In line with the proposals in many of the action plans, nearly all South Asian countries have started to build adaptive capacity. Adaptive capacity refers to physical, economic, natural and human capital that is resilient to climate change risks (Carbon Disclosure Project, 2014). Examples include improving crop and livestock production practices for higher food security and farmer income; safeguarding communities in coastal areas; enhancing early-warning systems, climate-resilient building measures and water management. However, South Asian countries have only recently started to transition from planning to implementation, and they would require more investment in adaptation capital and climate resilient green growth initiatives in the coming years, given their high exposure to climate risks.[20] The countries should also promote inclusive growth strategies given that poverty and the lack of access to basic services are strong predictors of vulnerability to climate change (World Bank, 2020). This would be instrumental in making adaptive capacity accessible to the high-vulnerability populations.

Apart from taking early steps for climate change adaptation, as highlighted in Table 3, no South Asian country has enacted any laws or regulations to directly address climate change adaptation. Examples of such policies in other countries include National Building Codes that stipulate natural-disaster-proof physical infrastructure and land regulations to prevent land degradation. Starting in 2019, both Sri Lanka and the Maldives have taken initiatives to strengthen the safety and resilience of their built environment through participation in the

[19] The national adaptation plans of Bangladesh, Bhutan, India, the Maldives, Nepal, and Sri Lanka incorporate plans to address the increase in diseases because of climate change. Most plans focus on vector-borne diseases, but plans also include pathogenic diseases, diarrheal diseases, and heatstroke. Details of the plans vary but tend to cover research, monitoring, prevention, and education.

[20] IMF (2021) shows that many South Asian countries currently have low adaptive capacity, even after controlling for income levels.

Building Regulation for Resilience (BRR) Program. As part of the program, the current level of building regulatory capacity of both countries will be assessed and tailored recommendations will be provided and incorporated into the existing regulatory framework. Utilizing such programs and updating the laws and regulations could play a critical role in building adaption capital. In addition, none of the South Asian countries have a cohesive and holistic climate risk financing strategy. Resilience-building would require consistent spending over the next decades that would be facilitated by formulating a financing roadmap.[21]

**Table 3: Survey of Non-Structural Interventions and Structural Resilience Building in South Asia**

| | Bangladesh | Bhutan | India | Maldives | Nepal | Sri Lanka |
|---|---|---|---|---|---|---|
| National Climate Change Action Plan | ■ | ■ | ■ | ■ | ■ | ■ |
| National Disaster Management Plan | ■ | ■ | ■ | ■ | ■ | ■ |
| Enact laws and regulations to address adaption to Climate Change | | | | | | |
| Adaptation Capital and Climate Resiliant Green Growth initiatives | ■ | ■ | ■ | ■ | ■ | ■ |
| Climate Risk Financing Strategy | | | | | | ■ |

Source: Authors based on the status of these respective adaptation categories as of July 2020. See the Annex for the details on each category by country.

*Fiscal Actions*

Fiscal policies could play a vital role in financing resilience building. Most South Asian countries have limited fiscal space to deal with natural disasters and other climate change shocks to the economy (Table 4). With potentially increasing frequency and severity of natural disasters due to climate change, coping with shocks such as the COVID-19 pandemic and other crisis situations will become more challenging. Some South Asian countries have established contingent budgets or reserve funds to cover disaster expenses, usually financed by annual appropriations and drawn down in the event of a disaster. An example is Bhutan's Druk Gyalpo Relief Fund of about US$ 1.5 million funded through annual budget appropriations by the Ministry of Finance. These funds are generally limited in scope and size to cover small and recurring losses from natural disasters such as local floods and landslides (World Bank, 2017). Given the vulnerability to severe natural disasters, such funds might not offer sufficient buffers against climate change. Relying on new loans and donations from the international community following a disaster is risky as it is often inadequate in providing timely assistance and recovery. For example, two years after the 2001 earthquake in Gujarat, India, assistance from a government reserve fund and international sources had reached only 20 percent of original commitments (World Bank, 2003). Therefore, South Asian countries could have high returns from investing in risk-reduction and adopting other risk-coping strategies such as self-insurance, risk-transfer instruments and ex-ante financing arrangements.

[21] See IMF (2021) for estimates of public adaption costs as share of GDP annually in South Asia.

For risk-reduction purposes, a majority of the South Asian countries have started to allocate budget or create a resilience fund for adaptation building. An example is Bangladesh's Climate Fiscal Framework (CFF) where about 2 percent of the national budget was allocated to resilient infrastructure building in 2017.Alternatively, the Maldives levied a green tax of six US dollars per person per day from resorts, vessels, and hotels and three US dollars per person per day from guest houses from 2016 and this revenue could be used for resilience building. However, besides Bangladesh and Nepal, monitoring and tracking climate-related expenditures in the national budget system can be improved across South Asia. This public financial management (PFM) tool would help the governments identify financing gaps, effectively mobilize investment to attain the national action plans, evaluate the climate financing activities and improve accountability (CPI, 2018; GFLAC and UNDP, 2018). Finally, given the capacity constraints in South Asian countries, adaptation strategies are likely to be cost-effective and efficient when built into, funded from, and made an integral part of the existing schemes and programs, rather than trying to create new ones and find additional resources for the same.

**Table 4: Survey of Fiscal Actions in South Asia**

| | Bangladesh | Bhutan | India | Maldives | Nepal | Sri Lanka |
|---|---|---|---|---|---|---|
| Setting fiscal policies and targets | ■ | | ■ | ■ | | |
| Climate Change Expenditure Tagging System | ■ | | | | ■ | |
| Climate/Green Fund for adaptation | ■ | ■ | ■ | ■ | | |
| Natural Disaster Related Reserves (Contingency Funds) | | ■ | ■ | | | |
| *Fiscal Space* | *Moderate* | *Moderate* | *Limited* | *Limited* | *Moderate* | *Limited* |

Source: Authors based on the status of these respective adaptation categories as of July 2020. See the Annex for the details on each category by country.
Note: Fiscal space assessments are estimated based on the last published IMF Article IV debt sustainability assessment. These assessments were performed pre-COVID and do not reflect the developments since the outset of the pandemic.

*Financial actions and risk management*

South Asian countries generally have an underinsurance problem whereby few people have adequate protection in the event of natural disasters. Sri Lanka has the only public national insurance program in South Asia, the National Natural Disaster Insurance Scheme (NNDIS) launched in 2016 (Table 5). The NNDIS covers properties of all uninsured households and small businesses for up to SLRs 2.5 million for damages caused by natural disasters, excluding drought, and lives for SLRs 100,000 per person. Besides the Sri Lankan case, microinsurance for households and farmers is the most common instrument across the region, and these schemes tend to be run by private or non-governmental organizations with financial sustainability, transparency and solvency issues (Linnerooth-Bayer and Mechler, 2009). In addition, no South Asian country currently has a sovereign parametric insurance scheme or has issued catastrophe bonds (Cat bonds) to tackle the increasing costs from climate change. A Cat bond is a security that pays the issuer when a predefined disaster risk is realized. This lack of take-up in insurance can primarily be attributed to the high costs and high barriers to access. Pooling insurance or issuance of Cat bond by multiple countries in a region like that of Pacific Alliance Countries Cat Bonds (Chile, Colombia, Mexico and Peru)

can overcome these challenges through economies of scale for insurers, better costs and diversification for investors (World Bank, 2018b).

While South Asian countries have limited self-insurance and risk-transfer instruments, there has been some take-up in ex-ante financing arrangements such as the IDA Catastrophic Risk Deferred Drawdown Option (Cat DDO) that boosts post-disaster resilience. These instruments ensure immediate liquidity in the aftermath of disasters, including health-related events, and are usually cheaper than the cost of maintaining reserve funds.[22] As of July 2020, the Maldives, Bhutan, Nepal and Sri Lanka have an approved Cat DDO with the World Bank. On April 2020, World Bank approved a USD 10 million contingency financing for the Maldives under the Cat DDO signed in 2019 to deal with the COVID-19 crisis. This experience highlights the important role that risk sharing instruments can play. Larger countries in the region like India and Bangladesh can generally absorb the impact of adverse natural events since the affected region can be subsidized by revenues from unaffected regions. However, for smaller states like Bhutan and the Maldives, pooling arrangements stretching beyond their borders would be critical to sustaining the increasing costs of natural disasters (Linnerooth-Bayer and Mechler, 2009).

**Table 5: Survey of Risk Sharing Instruments and Financing in South Asian Countries**

| | Bangladesh | Bhutan | India | Maldives | Nepal | Sri Lanka |
|---|---|---|---|---|---|---|
| Green Finance | ■ | | ■ | | | ■ |
| Catostrophe Bonds | | | | | | |
| Contingency Credit Lines (eg. Cat DDO) | | ■ | | ■ | ■ | ■ |
| Green Bonds (Resilience bonds) - US$ millions | | | ■ | | | |
| Macro- level National Disaster Risk Insurance | | | | | | ■ |
| Micro-level Index Insurance | ■ | | ■ | | ■ | ■ |
| Meso-level Index Insurance | ■ | | ■ | | | |
| Concessional funding for adaptation (GCF, GEF etc.) | ■ | ■ | ■ | ■ | ■ | ■ |

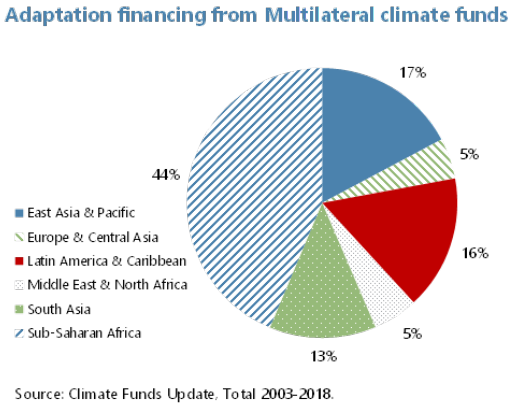
Source: Authors based on the status of these respective adaptation categories as of July 2020. See the Annex for the details on each category by country.

Besides mobilizing domestic revenue for adaptation, South Asian countries are not leveraging funding from external sources as effectively as countries in other regions. Various sources and channels of climate financing are available. While there has been some action in terms of accessing multilateral concessional financing such as the Green Climate Fund for adaptation, it has been limited. In fact, East Asia & Pacific remains the primary destination region for climate finance, accounting for US$ 238 billion per year (53 percent of all flows) on average during 2017/2018 whereas South Asia only received US$ 31 billion per year (7 percent of all flows) (Figure 12; based on Global Landscape of Climate Finance, 2019). The conditions to access climate finance vary but generally require a robust PFM system. This highlights the need for South Asian countries to continue strengthening PFM and public

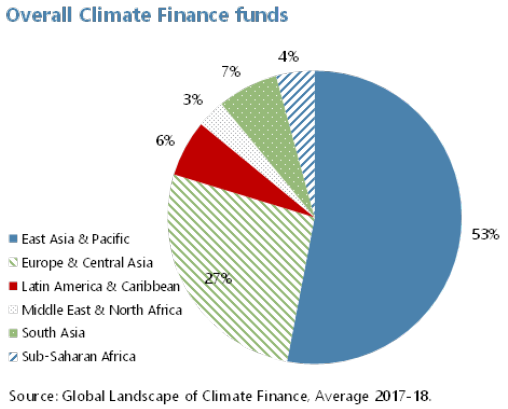
[22] Cat bonds provide a hedge against natural disaster liabilities by transferring risks to capital markets. They are ideal for covering low frequency, high severity events like tropical storms and hurricanes. Cat DDO is a risk retention instrument ideal for medium frequency, medium severity events like floods (World Bank, 2017). See IMF (2019a) for a discussion on the options for financing different types of disaster risk.

investment management efficiency; and to improve project planning and prioritization to access the available climate financing. The international donor community can foster resilience building by continuing to mobilize more funds, defining conditions more clearly and improving accessibility.

**Figure 12. Climate Financing by Region**




Source: Climate Funds Update, Total 2003-2018.




Source: Global Landscape of Climate Finance, Average 2017-18.

Even within climate finance, mitigation receives 93 percent of the available funds. Renewable energy sources such as solar and wind receive the biggest share of funding from climate finance and this is largely from the private sector. Private-sector entities dominated climate finance in the Americas, Oceania, Japan and South Korea while Western Europe, East Asia & Pacific, and South Asia had an almost equal split of public and private climate funds. Adaptation received minimal private funding, primarily from the multilateral climate funds (Global Landscape of Climate Finance, 2019). This reflects a continued dependency on public funds among developing countries for resilience building, as well as a need to further attract private investors to bring about a larger-scale shift in adaptation financing. The newest instruments for mobilizing private sector investments are green finance and green bonds. The larger South Asian countries, India, Bangladesh and Sri Lanka, are actively encouraging their commercial banks and financial institutions to lend to green projects and setting up targets. For example, Bangladesh Bank requires every commercial bank and financial institutions under its jurisdiction to disburse 5 percent of its total loaned amount to green projects (IMF, 2019b). Only India has an active green bonds market, owing to its relatively large and developed financial capital market.[23] While projects are funded with climate benefits, there is a lack of clarity on what constitutes green financing amongst the financial sector. The Central Bank of Sri Lanka developed a Roadmap for Sustainable Finance in 2019 to address this issue, and this could serve as a model for other South Asian countries that are looking to expand and standardize green financing. Even within green financing, encouraging projects

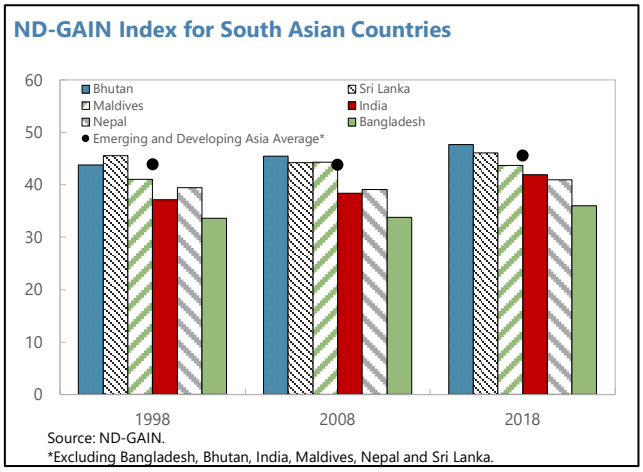
[23] The Reserve Bank of India (RBI) joined the Central Banks and Supervisors Network for Greening the Financial System (NGFS) in April 2021 as an avenue to benefit from the membership of NGFS by learning and contributing to global efforts on green finance. RBI is currently the only NGFS member from South Asia.

on climate-change adaptation can help to accelerate resilience building through the private-sector.

South Asian countries are making substantial piecemeal progress in adapting to the new reality of climate change. However, there is a lack of cohesive strategies to achieve all their goals, and insufficient monitoring and tracking of their adaptation spending. Additionally, learning and adopting "best practices" and experiences from other regions and countries on adaptation will be essential. The international community, particularly the IFIs, could be pivotal in guiding climate change adaptation in South Asia by continuing to develop diagnostic tools such as the joint IMF-World Banks's Climate Change Policy Assessment (CCPA), risk sharing instruments such as the Cat DDO and mobilizing funds through Global Climate Fund, Climate Investment Funds and other multilateral, regional and sovereign funds.[24]

**Box 2. The Costs and Benefits of Climate-Resilient Infrastructure**

South Asian economies stand to gain from improving their adaptability to climate change. The Notre Dame Global Adaptation Initiative (ND-GAIN) measures the vulnerability of a country to climate change and its readiness to take adaptive actions to tackle the vulnerability. A higher value for the index denotes a higher degree of readiness relative to the vulnerabilities present. The average index for South Asian countries is slightly below that of emerging and developing economies in Asia, though improvements have been made over time.




India and Bangladesh have identified adaptation costs under the Nationally Determined Contributions to adaptation and mitigation, made after a country ratifies the Paris Agreement. The identified adaptation costs for Bangladesh and India between 2020 and 2030 are USD40 billion and USD206 billion respectively.[25] [26] [27]

Studies have shown that investing in climate-resilient infrastructure is cost-effective, delivering benefits and averting losses (Global Commission on Adaptation, 2019 and Hallegatte et al.,2019). For example, Hallegatte et al. (2019) estimate the cost-benefit of climate-resilient infrastructure for 3000 scenarios by varying their parameters and find that in 96 percent of the scenarios the cost-benefit is above 1. In 55 percent of the scenarios it was above 4. They also find that in 93 percent of the scenarios, there is a cost to delaying strengthening

[24] IMF is developing a new climate assessment diagnostic the Climate Macroeconomic Assessment Program (CMAP) as a successor to the CCPA. The CMAP is similar to the CCPA in structure, following the NDC framework, covering climate risk and preparedness, national strategy, mitigation, risk management, adaptation, macroeconomic implications of climate policy, and national processes (PFM).

[25] Mitigation costs for the same period are estimated for Bangladesh and India at US$24 and US$834 million.

[26] World Bank Intended Nationally Determined Contributions (INDCs) database http://spappssecext.worldbank.org/sites/indc/Pages/CostFilterVisualization.aspx

[27] These costs are significant as the entire database, which includes 46 countries, have self-reported costs for adaptation between 2020 and 2030 amounting to US$783 million.

infrastructure.[28] The Global Commission on Adaptation (2019) also find that the benefit-cost ratio of investments in adaptation to range from 2:1 to 10:1.

The cost of infrastructure adaptation is hard to pin down. Global estimates had relied on a World Bank study (2010) which found that costs for developing countries ranged between US$70 and US$100 million per year and were calculated using a top-down approach. These estimates were found to be too low by the 2016 United Nations Environment Programme's Adaptation GAP report (UNEP, 2016). Using a bottom up approach informed by adaptation costs form various case studies, including those carried out as part of the European Union's ECON-ADAPT project (2015), the report found that costs for developing countries ranged between US$140 to US$300 billion per year by 2030 and between US$280 to US$500 billion by 2050. The 2018 UNEP Adaptation GAP report (UNEP, 2018) noted that while several studies on adaptation have been carried out, the 2016 estimates remain valid. The 2020 UNEP Adaptation GAP report also used 2016 estimates (UNEP, 2020). A recent IMF study estimates the public investment needs for making infrastructure climate resilient to be less than 1 percent of GDP annually for Bhutan, India, Nepal and Sri Lanka, and between 1-2 percent for Bangladesh (IMF, 2021). No other global synthesis of adaptation costs has been carried out.

Importantly, as emphasized in the UNEP 2016 report, estimates for the costs of adaptation are subject to uncertainties including the emissions pathway the world is on. The cost of adapting under a business as usual scenario is higher than the cost under a 2-degree-Celsius scenario. The development level of the economy impacts both the implementation costs, subject to the overall capacity of the economy to implement adaptation policies, and the positive externalities of adaptation. The status of education and governance also impacts the cost estimates. Generally, sectors covered in studies estimating the costs to adaptation are few (coastal areas, agriculture, and adaptation to hotter temperatures) and do not cover areas such as industry and services. Studies also tend to cover planned adaptation, and exclude adaptation which is taken up by individuals, households, and firms, irrespective of government policy, underestimating total incidence of adaptation costs in an economy (UNEP, 2016).

## V. CONCLUSIONS

South Asia is one of the world's most vulnerable regions to climate change. It features varied landscapes that include arid areas subject to severe droughts, low-lying coastal areas subject to flooding and coastal erosion, islands whose continued existence is threatened by the projected rise in sea levels, tropical zones subject to increasingly frequent and devastating cyclones, and mountainous ranges affected by the melting of glaciers. Mitigation policies have a vital role to play in reducing carbon emissions, and in turn the human impact on the climate, whereas adaptation policies can make the population and the economy more resilient in the face of a changing climate—action on both fronts is urgently needed.

Regarding mitigation, the region, and especially India, can play a leading global role by pursuing policies which seek to more aggressively limit carbon emissions. Over the medium term, the most promising policy option is to increase the cost of thermal power production, likely through the enaction of a carbon tax—such a policy would have the additional benefit of generating a fiscal windfall, which could help support the government budget, or could be used to offset the impact on lower-income households from higher electricity prices (see also IMF, 2019c and 2021). Further work is needed in each South Asian country to evaluate, assess, and design the practical aspects of the policy implementation to ensure vulnerable and low-income households are protected and adequately covered by the various fiscal transfers. Moreover, more thought will need to be given to the impact of carbon taxes on growth and

[28] Hallegatte et al. (2019) use the cost estimates from Rozenberg and Fay (2019) as a baseline and incorporate the incremental costs of more resilient infrastructure using estimates from Miyamoto International (2019).

inflation as policy makers are likely be worried about this. In addition, considerations of equity between nations will need to be considered, especially since South Asian countries currently have significantly lower emissions per capita compared to advanced countries. Finally, advanced nations will also need to find ways to facilitate technology and knowledge transfer to accelerate the tipping points at which renewables become cost-competitive with fossil fuels..

Adaptation policies are multifaceted and a comprehensive approach is needed. Countries in South Asia have shown progress in terms of planning as well as promoting climate resilient green growth. However, implementation is lacking as they have not enacted any regulations to directly address climate change nor do they have concrete financing plans. As in many countries in the larger Asia-Pacific Region, South Asia's ability to adapt to climate change may prove fiscally challenging, especially for low-income countries (IMF, 2020).

The transformation of South Asia to greener resilient economies would touch 1.5 billion people in a region with already many developing needs. The financing needs for achieving a successful mitigation plans in the region are large, and conditional on extensive support and assistance from the international community, as shown in South Asia NDCs' targets, which also incorporate the general pledge of assistance by developed countries. Similarly, as highlighted in the paper, although the costs for infrastructure adaptation are hard to pin down, the financing needs are not only large but also their use often cost-effective—both from the perspective of an individual country and for the international community, as shown in the example for enhancing infrastructure resilience to climate change in the Maldives. Hence, climate finance and technology transfers from developed countries to the region would be essential for both South Asia adaptation and mitigation plans and needs to be on track.[29]

The challenges stemming from climate change need to be addressed at all levels. At the national level, individual comprehensive country actions are particularly important to the extent that the nature of climate change challenges varies from country to country. Nonetheless, there is also much to be gained from a coordinated regional approach to building climate-resilient economies, in areas including river management, development of drought-resistant crops, harnessing hydropower potential, or pooled insurance mechanisms to better address the impact of more frequent natural disasters. Finally, international cooperation is essential for tackling a global issue like climate change.

[29] The UN report by the Independent Expert Group on Climate Finance (2020) highlights that meeting the pledge by developed countries to mobilize at least US$100 billion a year to support developing countries in mitigating and adapting to climate change—lagging even before the COVID-19 pandemic—requires urgent action.

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## Annex

Below, we provide details collected from our research on the current state of climate change adaption in South Asia.

| Bangladesh | | |
|---|---|---|
| | | **Program Details** |
| *Non-Structural Interventions and Structural resilience* | | |
| National Climate Change Action Plan | | Bangladesh Climate Change Strategy and Action Plan (BCCSAP), released in 2009 |
| National Disaster Management Plan | | National Plan for Disaster Management (2016-2020) |
| Enact laws and regulations to address climate change impacts | | No Regulations have been implemented |
| Adaptation Capital and Climate Resiliant Green Growth Initiatives | | Projects in flood protection and Climate Resiliant Infrastructure mainstreaming (CRIM) |
| Climate Risk Financing Strategy | | |
| | | |
| *Fiscal Actions* | | |
| Setting fiscal policies and targets | | Climate Fiscal Framework (CFF) requires MOF to allocate approximately US$ 390 million equivalent in Bangladeshi taka from own budget during the last seven fiscal years, to fund actions identified in the BCCSAP. Ten percent of the money was allocated to civil society groups for community-based adaptation activities while the remaining 90 percent was given to a wide variety of government ministries and departments that had to submit projects identified in the BCCSAP. |
| Climate Change Expenditure Tagging System | | Tracking and monitoring of public spending to address climate change was initiated in 2014 thorugh Climate Fiscal Framework (CFF). |
| Natural Disaster Related Reserves (Contingency Funds) | | |
| Climate/Green Fund for adaptation | | Bangladesh Climate Change Trust Fund (BCCTF) and Bangladesh Climate Change Resilience Fund (BCCRF) - US$185 million multi-donor trust fund (MDTF) managed by World Bank |
| | | |
| *Financial Actions/Risk Management* | | |
| Green Finance | | Bangladesh Bank (BB) requires every commercial bank and financial institutions under its jurisdiction to disburse 5% of its total loaned amount to green projects. |
| Catastrophe Bonds | | |
| Contingency Credit Lines (eg. Cat DDO) | | |
| Green Bond (Resilience bonds) | | |
| Macro- level National Disaster Risk Insurance | | |
| Micro-level Index Insurance | | Proshika, a microfinance institution, offers an insurance which is bundled with savings. In case of damage due to flooding, clients receive indemnity payments twice the amount in their savings account. |
| Meso-level Index Insurance | | Sirajganj Meso-Level Flood Index Insurance Product |
| Concessional funding for adaptation (GCF, GEF etc) | | US$215 million from 2003 - Feb 2019 from Climate Funds Update |

| Bhutan | | |
|---|---|---|
| | | **Program Details** |
| *Non-Structural Interventions and Structural resilience* | | |
| National Climate Change Action Plan | | National Adaptation Programme of Action (NAPA) released in 2006 |
| National Disaster Management Plan | | National Disaster Risk Management Strategy (DRMS) (2019-2023) |
| Enact laws and regulations to address climate change impacts | | No Regulations have been implemented |
| Adaptation Capital and Climate Resiliant Green Growth Initiatives | | Building Climate Resilience in Agriculture and Climate change adaptation to protect human health |
| Climate Risk Financing Strategy | | |
| | | |
| *Fiscal Actions* | | |
| Setting fiscal policies and targets | | |
| Climate Change Expenditure Tagging System | | |
| Natural Disaster Related Reserves (Contingency Funds) | | Druk Gyalpo Relief Fund - The Ministry of Finance increases the fund annually by Nu.20 million until the balance reaches the ceiling of Nu.100 million. Private individuals and entities from within and outside the country can also donate towards the Druk Gyalpo's Relief Fund in addtion to Nu. 100 million. |
| Climate/Green Fund for adaptation | | Priority budget of US$10m for NAPA and Bhutan Trust Fund for Environmental Conservation - a multi-donor trust fund |
| | | |
| *Financial Actions/Risk Management* | | |
| Green Finance | | |
| Catastrophe Bonds | | |
| Contingency Credit Lines (eg. Cat DDO) | | Bhutan has a Cat DDO with World Bank for US$14.8 million |
| Green Bond (Resilience bonds) | | |
| Macro- level National Disaster Risk Insurance | | |
| Micro-level Index Insurance | | |
| Meso-level Index Insurance | | |
| Concessional funding for adaptation (GCF, GEF etc) | | US$42 million from 2003 - Feb 2019 from Climate Funds Update |

| India | | |
|---|---|---|
| | | **Program Details** |
| *Non-Structural Interventions and Structural resilience* | | |
| National Climate Change Action Plan | | National Action Plan on Climate Change (NAPCC), released in 2008 and State Action Plans on Climate change (SAPCC) |
| National Disaster Management Plan | | National Disaster Management Plan (NDMP) launced in 2016 |
| Enact laws and regulations to address climate change impacts | | Insurance products are often compulsory for farmers who seek institutional credit for crop cultivation and the purchase of livestock. This would help to deal with climate change related shocks. No regulations to directly impact climate change have been implemented. |
| Adaptation Capital and Climate Resiliant Green Growth Initiatives | | In May 2018, World Bank provided a $500 million as additional financing for the Pradhan Mantri Gram Sadak Yojana (PMGSY) Rural Roads Project to build 7,000 km of climate resilient roads. Other examples include enhancing climate resilience of India's coastal communitiesand programmes to promote sustainable agriculture, water conservation and conservation of the Himalayan ecosystem, and developing climate Resilient Green Growth Strategy for Punjab. |
| Climate Risk Financing Strategy | | |
| | | |
| *Fiscal Actions* | | |
| Setting fiscal policies and targets | | There is budget appropriation for climate change adaptation starting in 2016 with Rs. 100 crore (US$ 14 million) allocated in 2019 to NAFCC. |
| Climate Change Expenditure Tagging System | | |
| Natural Disaster Related Reserves (Contingency Funds) | | National Disaster Response Fund (NDRF) and State Disaster Response Fund (SDRF) provide liquidity to fund relief expenditures after natural disasters. The NDRF and SDRF are funded by both state governments and by the government of India in pre-defined proportions. |
| Climate/Green Fund for adaptation | | National Adaptation Fund on Climate change (NAFCC) launched in 2015 |
| | | |
| *Financial Actions/Risk Management* | | |
| Green Finance | | The RBI has allowed banks to count loans to social infrastructure and small renewable energy projects as part of the mandatory lending targets assigned to them to support some backward sectors.The National Bank for Agriculture and Rural Development, the apex bank for farm sector financing, supports projects many of which can be classified under climate finance. Over 28% of NABARD's cumulative disbursements have links with climate change adaptation and mitigation. |
| Catastrophe Bonds | | |
| Contingency Credit Lines (eg. Cat DDO) | | |
| Green Bond (Resilience bonds) | | The Indian green bond market had its first green issuance in 2015. By December 2018, the total green bond issuance reached US$ 7.15 billion making India the 12th biggest issuer in the world |
| Macro- level National Disaster Risk Insurance | | |
| Micro-level Index Insurance | | National Agricultural Insurance Scheme (NAIS) |
| Meso-level Index Insurance | | Examples include BASIX (Discontinued, one of the oldest meso-schemes), DHAN foundation, People Mutuals and Agriculture Insurance Company of India |
| Concessional funding for adaptation (GCF, GEF etc) | | US$54 million from 2003 - Feb 2019 from Climate Funds Update |

| Maldives | | |
|---|---|---|
| | | **Program Details** |
| *Non-Structural Interventions and Structural resilience* | | |
| National Climate Change Action Plan | | Maldives Climate Change Action Plan released in 2010 |
| National Disaster Management Plan | | National Disaster Management Plan is currently in draft process |
| Enact laws and regulations to address climate change impacts | | No Regulations have been implemented |
| Adaptation Capital and Climate Resiliant Green Growth Initiatives | | Supporting vulnerable communities in Maldives to manage climate change-induced water shortages and Climate Smart Resilient Islands Initiative |
| Climate Risk Financing Strategy | | |
| | | |
| *Fiscal Actions* | | |
| Setting fiscal policies and targets | | Implemented in 2016, the green tax is levied on tourists who stay at resorts, hotels, guesthouses and tourist vessels such as safari yachts.The government charges a Green Tax of six dollars per person per day from resorts, vessels, and hotels and three dollars per person per day from guest houses. Over $40m was collected in first 9 months of 2019 that can be used for resilience building |
| Climate Change Expenditure Tagging System | | |
| Natural Disaster Related Reserves (Contingency Funds) | | |
| Climate/Green Fund for adaptation | | Climate change trust fund administered by the World Bank and funded by the European Commission and AusAID as well as Green Fund to Facilitate, co-finance and enable investments in renewable energy, energy efficiency, waste management, water and sewage, and biodiversity and nature protection. |
| | | |
| *Financial Actions/Risk Management* | | |
| Green Finance | | |
| Catastrophe Bonds | | |
| Contingency Credit Lines (eg. Cat DDO) | | Cat DDO with World Bank |
| Green Bond (Resilience bonds) | | |
| Macro- level National Disaster Risk Insurance | | |
| Micro-level Index Insurance | | |
| Meso-level Index Insurance | | |
| Concessional funding for adaptation (GCF, GEF etc) | | US$39 million from 2003 - Feb 2019 from Climate Funds Update |

| Nepal | | |
|---|---|---|
| | | **Program Details** |
| *Non-Structural Interventions and Structural resilience* | | |
| National Climate Change Action Plan | | National Adaptation Plan of Action (NAPA) prepared in 2010. Climate Change (CC) Policy released in August 2019 by repealing the 2011 CC Policy. Local Adaptation Plan of Action (LAPA) published in 2011. |
| National Disaster Management Plan | | National Disaster Risk Reduction and Management Strategic Plan of Action (2018-2030) |
| Enact laws and regulations to address climate change impacts | | Nepal has not enacted any legal instruments to address climate change impacts |
| Adaptation Capital and Climate Resiliant Green Growth Initiatives | | Building Climate Resilience of Watersheds in Mountain Eco-Regions and adopting climate-resilient land-use practices in Churia Region |
| Climate Risk Financing Strategy | | |
| | | |
| *Fiscal Actions* | | |
| Setting fiscal policies and targets | | |
| Climate Change Expenditure Tagging System | | Nepal is one of the first countries to adopt a climate budget tagging. In 2012, Nepal incorporated the climate tag to the budget system. |
| Natural Disaster Related Reserves (Contingency Funds) | | |
| Climate/Green Fund for adaptation | | |
| | | |
| *Financial Actions/Risk Management* | | |
| Green Finance | | |
| Catastrophe Bonds | | |
| Contingency Credit Lines (eg. Cat DDO) | | Nepal has a Cat DDO with World Bank |
| Green Bond (Resilience bonds) | | |
| Macro- level National Disaster Risk Insurance | | |
| Micro-level Index Insurance | | Micro-level insurance for women - The product is offered through the Centre for Self Help Development at an annual cost of NPR (Nepalese rupees) 100. In return for the premium payment, the family of a female policyholder receives NPR 5,000-6,500 should the policyholder be killed by disaster, NPR 2,500-3,250 should her husband be killed in a disaster, and payments of up to NPR 6,500 for the repair or rebuilding of dwellings which collapsed during a natural disaster. |
| Meso-level Index Insurance | | |
| Concessional funding for adaptation (GCF, GEF etc) | | US$132 million from 2003 - Feb 2019 from Climate Funds Update |

| Sri Lanka | | |
|---|---|---|
| | | **Program Details** |
| *Non-Structural Interventions and Structural resilience* | | |
| National Climate Change Action Plan | | National Adaptation Plan (NAP) published in 2016 to last until 2025 |
| National Disaster Management Plan | | National Disaster Management Plan (NDMP) 2013-2017 |
| Enact laws and regulations to address climate change impacts | | Insurance products are often compulsory for farmers who seek institutional credit for crop cultivation and the purchase of livestock. No regulations to directly impact climate change have been implemented. |
| Adaptation Capital and Climate Resiliant Green Growth Initiatives | | Climate Resilience Improvement Project (CRIP) was approved together with the Cat DDO as a joint package designed to finance short term and long term interventions to reduce climate and disaster risk. Examples include projects to strengthen climate resilience of subsistence and smallholder farmers. |
| Climate Risk Financing Strategy | | |
| | | |
| *Fiscal Actions* | | |
| Setting fiscal policies and targets | | |
| Climate Change Expenditure Tagging System | | |
| Natural Disaster Related Reserves (Contingency Funds) | | |
| Climate/Green Fund for adaptation | | |
| | | |
| *Financial Actions/Risk Management* | | |
| Green Finance | | SLBA issued voluntary Sustainable Banking Principles, setting a general framework on how the Sri Lankan banking sector can conduct business to facilitate more sustainable economic growth locally. Eighteen banks have signed up, committing to mainstream environmental and social consideration into operation. |
| Catastrophe Bonds | | |
| Contingency Credit Lines (eg. Cat DDO) | | Catastrophe Deferred Draw-Down Option facility (CAT-DDO) with World Bank |
| Green Bond (Resilience bonds) | | |
| Macro- level National Disaster Risk Insurance | | The Sri Lankan Government has undertaken a National Natural Disaster Insurance Scheme (NNDIS) with the backing of National Insurance Trust Fund in 2016. The NNDIS covers lives and properties of all uninsured households and small businesses up to SLRs2.5 million in respect of damage caused by natural disasters, excluding drought, and lives for SLRs100,000 per person. Total capacity of the scheme has an annual limit of SLRs15 billion. |
| Micro-level Index Insurance | | Agriculture and Agrarian Board of Sri Lanka covers 700,000 farmers for crop insurance. |
| Meso-level Index Insurance | | |
| Concessional funding for adaptation (GCF, GEF etc) | | US$42 million from 2003 - Feb 2019 from Climate Funds Update |