South Asian Perspective on Trade and Climate Change Adaptation and Mitigation

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Executive Summary

Trade exacerbates carbon emissions. On the other hand climate change is likely to affect the comparative advantages of South Asian countries and in turn impact trade. Hence policy responses which target climate change adaptation and mitigation will affect future trading opportunities of South Asia and could initially be expensive, as it will necessitate a shift to lower carbon-growth trajectory.

Impact of Climate Change on South Asia

South Asia encompasses several different climatic conditions as a consequence of climate change, including drought, floods, coastal erosion, submersion because of sea level rise and melting glaciers. Sea-level rise and coastal erosion would fully submerge Maldives and Bangladesh would lose 17 percent of its land surface. Food production could fall by 30% by 2050. By 2050, the decline in per capita income under the business as usual scenario is likely to be 6.7 percent in Bangladesh, 2.8 percent in India, and 7 percent in Sri Lanka. There is likely to be an increase in mortality of 4% for a rise in temperature of 1 degree Celsius. Hence Mitigation and Adaptation are the need of the hour. The main problem for the region is shortage of funds, technologies and other resources.

Mitigation challenges and their trade interface

Mitigations challenges are focused on India as it accounts for roughly 6% of global emissions. The main mitigation challenge for India is its dependence on thermal energy and the fact that fossil fuels account for roughly 25% of its total revenue. The main trade challenge is that there is a direct contradiction between raising tariffs and encouraging tariff jumping investment. As India is a large market with reverse engineering capacities it needs policy space in terms of TRIPs, TRIMs and tariffs to transition to at least 50% renewable energy as specified in its NDC. In the case of agriculture it needs flexibility to be able to export from its Public distribution system (PDS) stocks to meet food shortages in the region arising because of climate change. Trade in EGs account for a small proportion of trade from the region. Hence while trade liberalization would be beneficial in theory more policy space in the WTO and RTAs may be needed. EU and other countries Carbon Adjustment at the Border (CBAM) policies may hurt the region's trade interests unless adjustment is made for the excessive taxation of fossil fuels in India particularly.

Adaptation Challenges and their trade interface

Currently, South Asia houses 25% of the world's hungry and malnourished. With each 1% rise in temperature, wheat yields are likely to drop by 2 to 4%. As an adaptation measure it is proposed that tariffs on green goods be lowered whereas tariffs on so called dirty goods which are carbon intensive should be raised. However lower tariffs on the latter which include raw materials and intermediate goods are generally kept low as part of the industrialization policy in South Asia. There is also a fear that the region which is large in terms of population could become dependent on one country for its green goods needs if it is does not use TRIMs, revocation of patents, and tariffs to develop its own climate friendly industries. Technology dissemination especially in the case of agriculture would go a long way in helping South Asia adapt to climate change. Special conditions for the dissemination of publicly funded technologies such as waiver of patents, joint ownership of patents, compulsory licensing and other such mechanisms need to be explored. South Asia could also encourage the export of EPPs, provided mutual recognition, certification, traceability and other such barriers to trade are resolved.

Recommendations

- South Asia should accelerate movement of capital for climate friendly investment. For this global funds should also be available to the region.
- Compulsory licensing for climate-friendly patents and copyrights should be promoted globally so that South Asia can benefit from appropriate technologies.

- Flexibilities for border adjustment of carbon taxes, climate-friendly subsidies, climate-friendly procurement, increasing domestic capabilities, and other climate policies should be provided to South Asia in the WTO.
- To the extent that South Asia taxes fossil fuels border adjustment for carbon in the EU should adjust for these taxes.
- To the extent that the tariff regime does not conflict with the objective of developing indigenous climate friendly industries, South Asia should reduce tariffs on Climate friendly goods and services.
- Special emphasis for liberalisation of EPPs has to be given in the OECD countries for exports from South Asia.
- South Asia should be permitted some flexibility in the trade from PDS stocks especially in case of climate induced shortages. MC12 Declaration on Food Security laid the foundation for discussions on the use of PDS stocks.

Introduction

Trade exacerbates carbon emissions. On the other hand climate change is likely to affect the comparative advantages of South Asian countries and in turn impact trade. Hence policy responses which target climate change adaptation and mitigation will affect future trading opportunities of South Asia. Climate change mitigation and adaptation will necessitate a shift to a lower-carbon growth trajectory which will be expensive initially for South Asian economies. However recent studies have shown that low carbon growth can yield better poverty reduction and human development outcomes than a business as usual scenario.[1] In this context, trade can make new low-carbon technologies available to South Asian nations.

Climate change has resulted in extreme weather conditions such as cyclones in South Asia negatively impacting trade-related transportation and logistics infrastructure. Further export capacities may be affected by loss of life, injury of employees and damage to buildings and machinery. Cyclones, floods and droughts in South Asia have affected planting and harvesting of main crops. For example due to extremely hot spring in 2022, food production in India is likely to decrease, but has been ideal for a bumper crop of mangoes. In this situation imports of food grains may help alleviate immediate shortages. The only problem is South Asia accounts for 25% of the World's population and hence grain shortages would imply a rise in world prices when it goes to global markets. Hence while small shortages can be met through imports large shortages can have disastrous effects and hence the need for stockpiling food grains to meet domestic shortages. Imports alone will not meet the needs of the region.

A shift to sectors and products which are less carbon intensive, such as electronics and other light manufacturing is already under way in India. Since India introduced the production linked incentive[2] scheme in 2020, output of electronics has doubled. But South Asia as a whole lacks appropriate mechanisms to move from a carbon intensive growth strategy to a less carbon intensive one. The World Bank in a recent report has offered a template that "brings together information on the trade and climate interlinkages at the country level to identify (a) key vulnerabilities in trade to rising temperatures, changing precipitation, and more frequent extreme weather events; (b) areas where trade can support mitigation and adaptation to a changing climate as well as emerging constraints; (c) regulatory gaps in the climate and trade policy environment; and (d) recommendations of climate-relevant trade policy options".[3] While this template is a good starting point to discuss a South Asian perspective, its peculiarities and vulnerabilities require a more focused approach.

This paper focuses primarily on the South Asian region which encompasses Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal and Sri Lanka. While trade-based co-operation in South Asia has been growing it is still much lower than the one observed in South-East Asia. Climate change may force trade-based cooperation as most countries will be faced with similar problems of different dimensions. This paper thus identifies trade related policies that can support climate change mitigation and adaptation efforts in South Asia. In this context it sets up priorities for focus in the region as well as at the multilateral level.

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[1] https://www.sciencedirect.com/science/article/pii/S0048733321000949, Innovation, growth and the transition to net-zero emissions, NicholasStern, AnnaValero#.

[2] The Production linked incentive scheme is an initiative of Government of India to encourage FDI to move to India using Indian Labour and to encourage domestic and local producers to create micro jobs. It subsidizes 4-6% of the total costs subject to firms meeting incremental production and investment targets. https://www.india-briefing.com/news/what-are-production-linked-incentive-schemes-and-how-will-they-build-up-indias-manufacturing-capacity-23538.html/

[3] Paul Brenton and Vicky Chemutai, 2021, The Trade and Climate Change Nexus The Urgency and Opportunities for Developing Countries, © 2021 International Bank for Reconstruction and Development / The World Bank 1818 H Street NW, Washington, DC 20433 Telephone: 202-473-1000; Internet: www.worldbank.org

This paper is divided primarily into two parts The first deals with the trade interface of climate mitigation issues and the second with the trade interface for climate adaptation issues. Mitigation focuses on slowing climate change, primarily on reducing emissions, whereas adaptation deals with attenuating the effects of Climate Change.

Within this context there are several details which are interesting in the South Asian context. Section 1 analyses the possible impact of climate change in South Asia. Section 2 discussed climate mitigation issues in South Asia especially India. Section 3 deals with the trade interface of climate mitigation. Sector 4 deals with adaptation issues in South Asia and section 5 with their trade interface. Finally the paper offers some conclusions and recommendations.

1. Impact of Climate Change on South Asia

The impact of climate change in South Asia could be severe but will vary significantly across countries.[4] The region encompasses several different climatic conditions, including drought, floods, coastal erosion, submersion because of sea level rise and areas affected by melting glaciers. Overall, the South Asia region is among the world's most vulnerable to climate change.[5] A 2009 study 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".[6] Table 1 is a bird's eye view of some of their vulnerabilities

Table 1: South Asian 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. Table constructed by IMF.[7]

Notes: 1/ Columns one and two refer to the **Global Climate Risk Index 2020 which** ranks 181 countries for the 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/ Column 3 uses data from the **INFORM Global Risk Index 2019** which 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/ Column 4 uses the **World Risk Index 2019 which** ranks the disaster risk of 180 countries in the world. The

[4] Hijioka, Y., E. Lin, J.J. Pereira, R.T. Corlett, X. Cui, G.E. Insarov, R.D. Lasco, E. Lindgren, and A. Surjan, 2014, "Asia." In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1327-1370.

[5] Climate Central, 2019, Flooded Future: Global Vulnerability to Sea Level Rise Worse than Previously Understood, October 29.

[6] World Bank, 2009, South Asia: Shared Views on Development and Climate Change. (Washington: World Bank)

[7] IMF Working Papers, Volume 2021 (2021)_ Issue 217 (Aug 2021)_ Climate Change in South Asia_ Further Need for Mitigation and Adaptation, Pg 10

index takes into account disaster exposure, vulnerability, susceptibility, lack of coping capacities, and lack of adaptive capacities. The lower the rank, the higher the risk.

1.1 Natural disasters and Climate Change

South Asia is extremely vulnerable to natural disasters, and a significant portion is exposed to more than one type of hazard. Between 1990 and 2008, more than 750 million people—50% of South Asia's population—were affected by at least one type of disaster, resulting in almost 230,000 deaths and about $45 billion in damages.[8] Aside from floods, natural disasters include landslides, windstorms, sea surges, and cyclones, droughts hit nearly 50% of the total disaster-affected population.[9] Some pressing issues for each country as experienced in 2022 are summarised below.[10]

- **India:** Temperature rises on the **Tibetan Plateau** are causing **Himalayan glaciers** to retreat, causing floods in the Ganges, Brahmaputra, Yamuna and other major rivers. **Heat waves' have become more frequent.** Landslides have become common in hilly areas.
- **Afghanistan:** Since 1950, **temperatures in Afghanistan have risen by 1.8°C leading to droughts, desertification and land degradation.**
- **Bangladesh:** Bangladesh's **flat, low-lying, and delta-exposed topography** have resulted in floods.
- **Bhutan:** Climate change has resulted in the melting of **Bhutan's glaciers**, increasing the frequency and severity of **glacial lake outburst floods (GLOFs).**
- **Maldives**: T**hreatened by sea level rise,** the nation may be completely submerged.
- **Nepal:** Climate Change related variations in weather patterns have resulted in **drought and an exceptional number of wildfires** in 2016**.**
- **Pakistan**: In addition to heat waves melting of glaciers in the Himalayas have flooded some of the **major rivers of Pakistan.** Between 1999 and 2018, **Pakistan was ranked the 5th most affected country in terms of extreme climate caused by climate change.**
- The ecological and climate continuities in South Asia make the case for **regional cooperation on climate-related matters compelling.**

1.2 Food Security and Climate Change

Four of the South Asian countries viz. Afghanistan, Bhutan, Maldives and Nepal are net food importers. Most of their food is imported from countries in the region. The major food producers in the region are Bangladesh, India, Pakistan and Sri Lanka. Climate induced disasters and sea level rise are likely to have a severe effect on food security and water availability of the region. Sea-level rise and coastal erosion would fully submerge Maldives and in Bangladesh a loss of 17 percent of land surface and 30 percent of food production by 2050 is expected.[11] By 2050, South Asia as a whole could see a reduction in maize output of 15%,[12] 50% in wheat output in the Indo-Gangetic belt, and by 2030[13] a decline in

[8] World Bank. 2009. Why is South Asia Vulnerable to Climate Change? http://go.worldbank.org/OJ4FWPUB10
[9] Ibid.
[10] https://www.drishtiias.com/daily-updates/daily-news-editorials/climate-and-cooperation-crisis-in-south-asia/print_manuallyf
[11] See https://www.nytimes.com/2014/03/29/world/asia/facing-rising-seas-bangladesh-confronts-theconsequences-of-climate-change.html
[12] Knox, Jerry, Tim Hess, Andre Daccache, and Tim Wheeler. 2012. "Climate Change Impacts on Crop Productivity in Africa and South Asia." Environmental Research Letters, Vol. 7 (3): 034032. Knutson
[13] Intergovernmental Panel in Climate Change, 2013, "Climate Change 2013: The Physical Science Basis." Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin,

meat and milk production of 15%.[14] With continued population growth and given that the region has 25% of the global population the impact on food security could reach critical proportions.

Simulations show that climate-caused changes in cereal production in South Asia could lead to an increase in food imports. At the same time, by the middle of this century, exports could be drastically reduced, with Bangladesh and Pakistan being the most affected countries. Furthermore, a decrease in cereal production would raise cereal prices and decrease household consumption. The price of cereal grains has increased by 13.7% in India and 31.5% in Sri Lanka between 1990 to 2015. In the mid-20th century, all four countries saw a decrease in cereal consumption. This could mean that these South Asian countries will face more food security issues because they are already lagging behind developed countries in average yields and have a large population that is undernourished.[15]

These findings are consistent with previous studies which predicted that average crop yields will decrease in 2050 as a result of climate change in South Asia.[16] Because of a decrease in cereal yields, the average calorie availability is expected to decline by around 15% in 2050, with cereal consumption projected to decline by as much as 24% in South Asia.[17] Bangladesh, India and Pakistan are most susceptible to declining crop yields because of decreasing water resources, glacial melting, flood, droughts and unpredictable precipitation.[18]

All four food producing countries would face decreasing yields by 2050, with Pakistan and India being affected most (suffering average yield decreases of respectively -9.6 percent and -3.9 percent when weighted by production). In the case of Pakistan there are particularly large decreases in average yields between -16 and -25%, especially that of rice by around -35.1% and groundnut by -49%. Other crops in Pakistan including maize and wheat are less affected, suffering average yield decreases of respectively -3.4 percent and -12.1 percent. Average groundnuts yields decrease significantly in Bangladesh (-12.8 percent). On the other hand, groundnut productivity in India would increase by 8.6 percent under some scenario assumptions. On an average across different climate change scenarios, rice yields in SAFTA suffer only moderately (except the case of Pakistan). Wheat yields decrease across all countries and scenarios, while average soybean yields in Sri Lanka increase (by 9.2 per cent).[19]

G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

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[16] Aryal, J.P., Rahut, D.B., Sapkota, T.B., Khurana, R. and Khatri-Chhetri, A. (2020), "*Climate change mitigation options among farmers in South Asia*", Environment, Development and Sustainability, Vol. 22 No. 4, pp. 3267-3289, doi: 10.1007/s10668-019-00345-0.

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[19]David Laborde, Csilla Lakatos, Gerald Nelson, Richard Robertson and Marcelle Thomas (IFPRI) in cooperation with Winston Yu and Hans G.P. Jansen (World Bank), Climate Change and Agriculture in South Asia: Alternative Trade Policy Options

1.3 Climate Change and Vulnerability of Ecosystem Services and Impact on Tourism

1.3.1 Ecosystem Services

Climate Change 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 biodiversity. The Himalayas provide a living to nearly 1.5 billion people. Around 10% of the volume of Himalayan rivers comes from melting glaciers.[20] With Climate Change Himalayas are retreating more rapidly than the global average for other mountains. This has led to a proliferation of dangerous glacial lakes, e.g. 20 in Nepal and 25 in Bhutan which may post a risk of floods downstream.[21] India is also witnessing the formation and spread of glacial lakes. Snow melt and snow cover patterns will also have effects on river as 80% of water in the upper Satluj River comes from snow melt and 20% from glacier melt affecting both India and Pakistan.[22]

Significant portions of Bangladesh, India, Nepal, and Sri Lanka are subject to flooding. Melting glaciers and rising seas raises the probability of flooding. Three large river systems converge in Bangladesh, merging the rainwater they collect from a catchment area 12 times the size of the country. Bangladesh floods could last up to 9 months a year. Recent trends of high intensity tropical cyclones and storm surges, partly attributable to rising sea surface temperatures, illustrate the effects of Climate Change.

The region's long and densely populated coastline is threatened by sea-level rise. The sea level is predicted to rise 45 cm by 2050, affecting 10%–15% of the land area and an estimated 35 million people.[23] More than 100 million hectares of arable land is likely to be affected. Sea level is also projected to rise by around 15–38 cms in India by 2050, placing major cities at risk, including Kochi, Kolkata, and Mumbai.[24] A high proportion of Sri Lankan coastal land is less than 1 meter above sea level, and could be submerged with the rising tides, along with critical transport infrastructure.[25] The survival of Maldives itself is in jeopardy, as the height of most of its islands is only 1.5m above sea level. All of the Maldives is affected by saline water intrusion due to rising sea levels.

Climate Change is also worsening erosion in the region. In India, 26% of the coastline is prone to erosion, while in Sri Lanka's apart from coastal erosion there are frequent landslides in the hills.[26] In mountain communities in Bhutan, India, and Nepal, landslides related loss of land is damaging economies, agriculture, and habitats, and constricting livelihood opportunities, particularly of the rural poor.

" South Asian vegetation provides essential ecosystem services to the 1.7 billion inhabitants living in the region." However, biodiversity and ecosystem services are threatened by climate and land-use change. Simulations under different Climate Change scenarios showed a decrease in tree dominance and biomass, whereas other simulations with CO_2 fertilization showed an increase in biomass, canopy cover, and tree height and a decrease in biome-specific evapotranspiration by the end of the 21st century.[27] The predicted changes in aboveground biomass and canopy cover triggered transition

[20] ADB. 2009. Building Climate Resilience in the Agriculture Sector in Asia and the Pacific. Manila: ADB / International Food Policy Research Institute.
[21] Pratap Singh and Lars Bengtsson. 2004. Hydrological sensitivity of a large Himalayan basin to climate change. Hydrological Processes.
[22] Jack D. Ives, Rajendra B. Shrestha, and Pradeep K. Mool. May 2010. Formation of glacial lakes in the Hindu Kush Himalayas and GLOF (glacial lake outburst flood) risk assessment. Kathmandu. ICIMOD.
[23]Government of Bangladesh, Department of Environment. 2007. Climate Change Cell. Dhaka.
[24] ADB, 2009, op.cit.
[25] Ibid.
[26] ADB, 2009, op.cit
[27] Palomo, Ignacio, Climate Change Impacts on Ecosystem Services in High Mountain Areas: A Literature Review, Mountain Research and Development, 37(2) : 179-187 Published By: International Mountain Society URL: https://doi.org/10.1659/MRD-JOURNAL-D-16-00110.1

towards tree-dominated biomes. Hence, vegetation in the region has the potential to remain a carbon sink. Projections showed that the bioclimatic envelopes of biomes need adjustments to account for shifts caused by climate change and elevated CO_2. [28]Provisioning ecosystem services are likely to face multiple and diverse impacts, both positive and negative. Climate change is likely to create water scarcity for local communities.

1.3.2 Tourism

Given the rising numbers of tourists in mountain regions of Bhutan, there is a competition for water between local residents and tourists.[29] Climate Change particularly because of melting glaciers could create water shortages in the long term and affect local subsistence agriculture. Other provisioning services such as medicinal plants that thrive only at very high elevations and also attracts tourists could be endangered by rising temperatures. Other complex processes act synergistically with climate change such as drought coupled with overgrazing. It is not clear, though, how climate change could impact the frequency and intensity of avalanches, but forest expansion under climate change scenarios could enhance avalanche protection at some sites in South Asia.[30]

Mountaineering and related tourism in the Himalayas will be negatively affected as the glaciers retreat.[31] Glaciers are also data sources, for example paleo climatic archives for the study of past climate patterns, and their loss will have negative consequences for scientists and society as a whole.[32] Human migration due to loss of livelihoods associated with changing water regimes could reach crisis dimensions and discourage tourism.[33] An increase in vector-borne illnesses such as malaria and dengue due to climate change in Nepal could discourage tourism. [34] Vector-borne transmitting species for dengue and chikunguya have already been found at 2100 m above sea level in Nepal.[35]

Low carbon mountain tourism is on a growth trajectory in South Asia, especially India and could benefit mountain communities and mountain tourists themselves. But tourism developments should be avoided in areas that are vulnerable to floods and debris flow hazards. Moreover, mountain tourism is characterized by high seasonality and spatial concentration, usually demanding elaborate infrastructure (such as roads, lifts, and cabins) and has multiple impacts on biodiversity and

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[28]Kumar, D., Pfeiffer, M., Gaillard, C., Langan, L., and Scheiter, S.: Climate change and elevated CO_2 favor forest over savanna under different future scenarios in South Asia, Biogeosciences, 18, 2957–2979, https://doi.org/10.5194/bg-18-2957-2021, 2021.

[29] Hoy A, Katel O, Thapa P, Dendup N, Matschullat J. 2016. Climatic changes and their impact on socio-economic sectors in the Bhutan Himalayas: An implementation strategy. Regional Environmental Change 16(5):1401–1415.

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[34] Dhimal M, Ahrens B, Kuch U. 2015. Climate change and spatiotemporal distributions of vector-borne diseases in Nepal: A systematic synthesis of literature. PloS One 10(6):e0129869

[35] Dhimal M, Gautam I, Joshi HD, O'Hara RB, Ahrens B, Kuch U. 2015. Risk factors for the presence of chikungunya and dengue vectors (Aedes aegypti and Aedes albopictus), their altitudinal distribution and climatic determinants of their abundance in central Nepal. PLoS Neglected Tropical Diseases 9(3):e0003545.

ecosystems.[36] Hiking can cause soil erosion and impacts on vegetation and fauna close to hiking trails.[37] Waste generation, such as in high-mountain base camps, has long been recognized as a major impact of tourism on high mountain regions.[38] Climate change and tourism can also act synergistically, facilitating the spread of alien species.[39]

In addition to environmental impacts, economic impacts of tourism are of concern. There is a risk that tourism revenues will benefit only state organizations, big tour operators, and not reach the poorest of the poor.[40] Successful examples of equitable access to tourism revenues include model of homestays created in Ladakh, India that integrates community development needs with conservation goals. However these are few and far between.[41]

To sum up, climate change affects ecosystem services through impacts on food and feed, water availability, natural hazards regulation, spirituality and cultural identity especially in South Asia, aesthetics, and recreation. Climate change impacts on infrastructure and accessibility also affect ecosystem services. The diversity and magnitude of climate change impacts highlights the need to monitor ecosystem services in high mountain areas and to increase the adaptation options for local communities and tourists.

1.3.3 Uniqueness of Maldives and SIDs in South Asia

SIDs in South Asia include the Maldives, Sri Lanka and the Indian islands of Lakshadweep and Andamans. The Maldives archipelago, which is made up of over 1,100 coral islands in the middle of the Indian Ocean, is the lowest lying nation in the world.[42] Therefore, sea level rise caused by global climate change is an existential threat to the island nation. At the current rate of global warming, almost 80% of the Maldives could become uninhabitable by 2050, according to multiple reports from NASA and the U.S. Geological Survey. 90% of islands in the Maldives have severe erosion, and 97% of the country no longer has fresh groundwater.

In 2016, a bleaching event affected about 60% of the coral reefs. Without coral reefs, the islands are wide open to the rising waters. They need to build back and protect the reefs, "because IPCC (Intergovernmental Panel on Climate Change) is predicting that by 2050 if the temperature rises 1.5 degrees Celsius we can lose 70 to 90% of corals in the whole world." Research has previously shown that a healthy coral reef can absorb 97% of wave energy, dramatically reducing erosion. It's

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[41] Anand A, Chandan P, Singh RB. 2012. Homestays at Korzok: Supplementing rural livelihoods and supporting green tourism in the Indian Himalayas. Mountain Research and Development 32(2):126–136

[42] **Facing dire sea level rise threat, Maldives turns to climate change solutions to survive,** The islands could be 80% uninhabitable by 2050 at current global warming rates, By **Daniel Manzo**, **Ginger Zee**, **Sohel Uddin**, and **Dragana Jovanovic**, November 3, 2021, 6:07 PM, le:///C:/Users/User/Documents/TESS/Facing%20dire%20sea%20level%20rise%20threat,%20Maldives%20turns%20to%20climate%20change%20solutions%20to%20survive%20-%20ABC%20News.html

much cheaper than building a seawall. For example it costs $3,000 to grow a meter of sea wall whereas the cost of building a coral wall of a meter of it is about $300.[43]

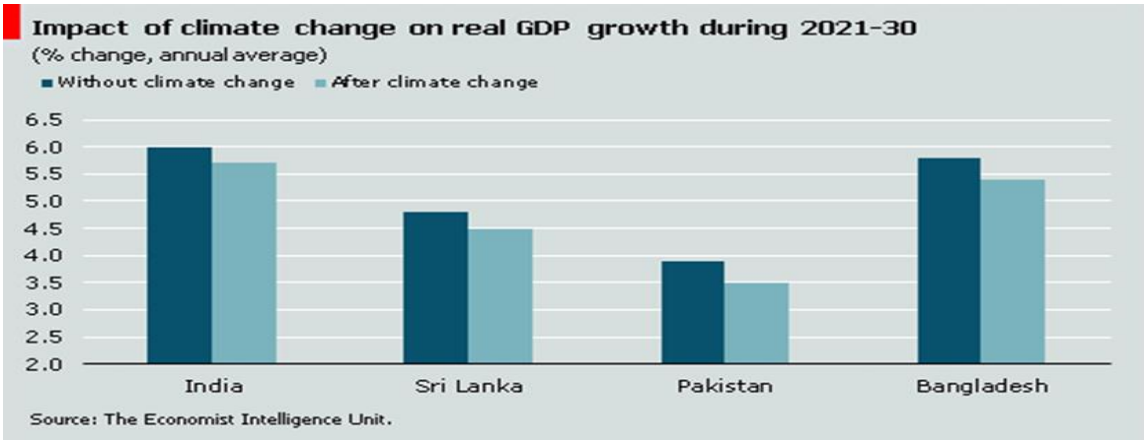
Tsunami, tropical cyclones are the most destructive severe weather and climate extreme events, which would affect SIDs in South Asia. A classic example of extreme events in South Asia is the tsunami of 26 December 2004. On that day, a massive earthquake of magnitude 9.0 struck the coastal area of northern Sumatra in Indonesia. These earthquakes triggered tsunamis that affected Indonesia and neighbouring countries (India, Malaysia, the Maldives, Sri Lanka and Thailand) in Asia and the east coasts of Africa (Somalia and Yemen), causing serious damage to the coastal areas and small islands, loss of life to an extent of 250,000 persons. It also caused large damage to natural ecological systems, such as coral reefs, mangroves and wetlands.[44] The rise in sea level also plays a major role in coastal erosion in islands, e.g. in Sri Lanka, coastal erosion aggravated in recent years due to Tsunami.

Over 80% of the land area in the Maldives is less than 1 m above mean sea level, and hence the islands of the Maldives are very vulnerable to inundation and beach erosion. If the sea level rises by 1 m, the Maldives will be submerged under water.[45] Presently, 50% of all inhabited islands and 45% of tourist resorts face varying degrees of beach erosion.[46] Most SIDs in South Asia have shortage of water at current levels of rainfall input, and extraction of groundwater is often outstripping supply.

1.4 Other effects of Climate Change on South Asia

Figure 1 shows the likely economic impact of climate change on some South Asian countries.[47] Climate change has also resulted in a loss of welfare worth US$41.8bn in India, US$27.5bn in Pakistan, US$24.7bn in Bangladesh and US$4bn in Sri Lanka. GDP in India, Pakistan, Bangladesh and Sri Lanka could fall by up to 2.6%, 7.2%, 8.9% and 7.8% in the mid-century compared to the base year of 2015[48]. As a result of climate change, prices will rise, with the highest increases expected in Bangladesh and Pakistan, at 50.7% and 43.2%, respectively.

Fig 1: Likely Impact of Climate Change on Real GDP growth in South Asia



[43] ibid

[44] **Ecological impact of tsunami on Nicobar Islands (Camorta, Katchal, Nancowry and Trinkat),** S. Ramachandran, S. Anitha, V. Balamurugan, K. Dharanirajan, K. Ezhil Vendhan, Marie Irene Preeti Divien, A. Senthil Vel, I. Sujjahad Hussain and A. Udayaraj, Current Science, Vol. 89, No. 1 (10 July 2005), pp. 195-200 (6 pages), Published By: Current Science Association

[45] Turner, R.K., Bateman, I.J., Adger, W.N., 2001. Ecological economics and coastal zone ecosystems' values: an overview. In: Turner, R.K., Bateman, I.J., Adger, W.N. (Eds.), Economics of Coastal and Water Resources: Valuing Environmental Functions. Kluwer Academic Publishers, Dordrecht/Boston/London.

[46] ibid

[47] http://country.eiu.com/article.aspx?articleid=1217958905&Country

[48] https://www.emerald.com/insight/content/doi/10.1108/IJCCSM-10-2021-0113/full/html

Weather changes notably higher temperatures are expected to decrease productivity in Bangladesh, India, and Sri Lanka, while it may increase it in Bhutan and Nepal. Apart from changes in agricultural productivity, the incidence of infectious diseases may increase, leading to lower labour productivity. By 2050, the decline in per capita income under the business as usual scenario is likely to be 6.7 percent in Bangladesh, 2.8 percent in India, and 7 percent in Sri Lanka. In some areas with a disproportionately large climate impact, per capita income could fall by 14.4 percent for Bangladesh, 9.8 percent for India, and 10.0 percent for Sri Lanka.[49]

Health and mortality related risks are likely to increase due to climate change induced rising and high temperatures[50]. Rising temperatures in densely populated South Asia increases the incidence of heat stroke, malaria, dysentery, and other diseases.[51]"Vector-borne diseases, including malaria, dengue fever, chikungunya, Japanese encephalitis, kala-azar, and filariasis, could become more common in India."[52] A Study estimated a 4% increase in mortality for each 1°C increase in temperature above 29°C.[53] In India, 73% of the population lacks access to safe drinking water and therefore Climate change will increase the prevalence of water borne diseases. In Bangladesh, "drinking-water supplies degraded by saltwater intrusion may increase the likelihood of involuntary fetus abortion due to hypertension, and projected higher temperatures and summer precipitation may encourage the spread of waterborne and vector-borne diseases".[54] Bhutan could also face similar health problems because of mounting shortages of water, flooding, landslides, and lowered water quality.[55]

Human health impact from poorer nutrition is foreseen for the Maldives as coral reef degradation and changes in species distribution reduce the productivity of fisheries, a significant source of dietary protein for the population. Sri Lanka and Nepal are likely to see an increase of malaria, dengue fever, and Japanese encephalitis.[56]

2. Climate Mitigation Issues

Dangerous Climate Change effects can be avoided by limiting global warming to 2°C relative to preindustrial levels. The IPCC states that "under this ambitious scenario, emissions would peak in South Asia by 2030 then decline; under such a scenario, Asian emissions in 2030 would be 1% higher than they are today".[57] Warming of just 2 degrees would pose a significant threat to economic growth and human development in South Asia.

2.1 Nationally determined Commitments of South Asia

The United Nations Framework Convention on Climate Change (UNFCCC) or "Convention" was ratified by 21 March 1994. However it was the Paris Agreement which put numbers on the lofty aims of climate

[49] World Bank, 2018, South Asia's Hotspots, The Impact of Temperature and Precipitation Changes on Living Standards. (Washington: World Bank).
[50] IPCC (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Technical Summary (p48).
[51] Sterrett, C. 2011. Review of Climate Change Adaptation Practices in South Asia. Melbourne, Australia: Climate Concern. http://www.oxfam.org/en/grow/policy/review -climate-change-adaptation-practices-south-asia
[52]Bush, K. F., G. Luber, S. R. Kotha, R. S. Dhaliwal, V. Kapil, M. Pascual, D. G. Brown, H. Frumkin, R. C. Dhiman, J. Hess, M. L. Wilson, K. Balakrishnan, J. Eisenberg, T. Kaur, R. Rood, S. Batterman, A. Joseph, C. J. Gronlund, A. Agrawal, and H. Hu. 2011. Impacts of Climate Change on Public Health in India: Future Research Directions. Environmental Health Perspectives. 119 (6) pp. 765–770.
[53] Bush et al, 2011, op.cit
[54] ADB, 2018, Technologies to support climate change adaption in developing Asia, Technologies to support climate change adaptation, 2018, https://www.adb.org/sites/default/files/publication/149400/technologies-climate-change-adaptation.pdf
[55] Ibid
[56] Ibid
[57] IPCC (2013). Climate Change 2013: The Physical Science Basis. Summary for Policymakers.

change and instituted mechanisms 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. The Paris Agreement, which entered into force on November 4 2016 required all parties to put forward nationally determined contributions (NDCs). As of 2019, six South Asian countries (Bangladesh, Bhutan, India, the Maldives, Nepal, and Sri Lanka) had submitted their NDCs.

Two kinds of NDCs were envisaged. Unconditional targets and conditional targets which countries pledged to achieve only on receiving international support (typically in the form of grants, financing, or technology transfer). India 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 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. Bhutan renewed its NDC commitment to remain carbon neutral going forward, and it is expected to adhere to this commitment for the foreseeable future.

Among the South Asian countries, much of the focus is on India with respect to mitigation, given its relatively large (6% of global emissions) share of greenhouse gas (GHG) emissions. However its low per capita emissions and large needs for better living standards for a sizable fraction of the population makes mitigation a challenge. By contrast Bangladesh accounted for ⅓ of a percent; and the others less than 0.1 percent of global GHG emissions.[58] In this context, India's mitigation policy is of central interest to the global community focused on combatting climate change.

Table 2 shows the NDC for six South Asian countries. As stated above the NDCs vary between countries.

[58] https://www.adb.org/sites/default/files/publication/27475/climate-change-sa.pdf

	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

Table 2 : Paris Agreement Pledges and Targets

Source: Fund staff Calculations based on each individual NDCs that could be accessed at the Indices Public Registry maintained by the UNFCCC secretariat Global Carbon Project, IMF Working Papers] Volume 2021 (2021)_ Issue 217 (Aug 2021)_ Climate Change in South Asia_ Further Need for Mitigation and Adaptation, Pg 10

2.2 Mitigation Challenges especially for India

To be cost-effective on a global scale, most mitigation needs to take place in countries projected to have the highest emissions in the future especially India. However although deep cuts in greenhouse gas emissions are technically and theoretically possible, making such cuts will entail substantial technological, economic, institutional and behavioural changes. India is also rapidly urbanising, has patches of energy scarcity and periods of low agricultural output on account of failed monsoons. Adopting sustainable agricultural practices, planning innovative low carbon towns and cities, and developing land-use schemes that intensify agricultural practices and sustainably managing livestock is an expensive process. International cooperation especially in agriculture and renewable energy is essential to limit greenhouse gas emissions effectively and to address other climate change issues such as building resilience and capacity in India.[59]

2.2.1 Mitigation challenges in decarbonising Energy

Around 70% of India's energy is met by fossil fuels especially thermal energy or coal based power. While coal is subsidised, its taxation both direct and indirect is very high. In fact some calculations suggest that indirect taxes alone account for 60% of the price of coal.[60] Hence coal is an important revenue earner for the Indian economy and the revenue from coal far exceeds the subsidies given to it.[61]During C*ovid-19 it was estimated that the Central government got 25% of its revenue from taxing fossil fuels while the states got around 13% from fossil fuels. Hence switching to alternatives especially when it is major drain on government revenue may prove difficult.*[62]

Transitioning to Renewable energy (RE) which has already started will be major drain on government revenue, especially as it is not expected to become as efficient as fossil fuels in the near future because of its intermittency and poor storage capacity. [63] Hence the simple formula of shifting subsidies from fossil fuels to RE will not work in India as the government cannot easily forgo a quarter of its revenue. In addition national and international funding to the tune of 25% of its revenue cannot be envisaged.

While decarbonising electricity production in India will decrease mortality and morbidity due to reduced particulate pollution, the loss of revenue to the public exchequer and the outgo of funds for subsidisation has to be met. In addition it has not been possible to honour commitments made by the Indian government to subsidise renewable energy. This is because distribution companies (discoms) find buying solar power at government guaranteed rates impossible. In general, there is a gestation period between investment in solar projects and production of solar energy.[64] At the time of investment the government needs to guarantee that it will purchase power at a particular rate. However solar power generation costs have fallen meanwhile, while the producers still want the government guaranteed rates. While the government may be forced to purchase at the guaranteed rate the discoms which transmit power to end users are unwilling to buy power from the government at the guaranteed rate. This is specially the case for schemes which involve integration of PV module

[59] IPCC (2014) Climate Change 2014: Mitigation of Climate Change. Technical Summary (p5).
[60] IKDHVAJ Advisers LLP, 2020, RODTEP Report for the electronics sector in India, Can be retrieved from Ikdhvaj.com
[61] Using fossil fuel as a cash cow: A big obstacle in India's energy transition, by Kundan Pandey on 31 March 2021, https://india.mongabay.com/2021/03/using-fossil-fuel-as-a-cash-cow-a-big-obstacle-in-indias-energy-transition/
[62] Ibid
[63] Mapping India's Energy Subsidies 2021: Time for renewed support to clean energy, 2021 The International Institute for Sustainable Development and the Council on Energy, Environment and Water
[64] DR. Harsha.V.Singh and team, 2022, EXIM Bank report on Integrating Trade and Investment Policies, 2022, Can be retrieved from Ikdhvaj.com.

production and solar power generation as the government guaranteed rate is higher in these cases. Hence transitioning to RE has been difficult especially because of CoVID induced shortages, and lack of cutting edge technologies.

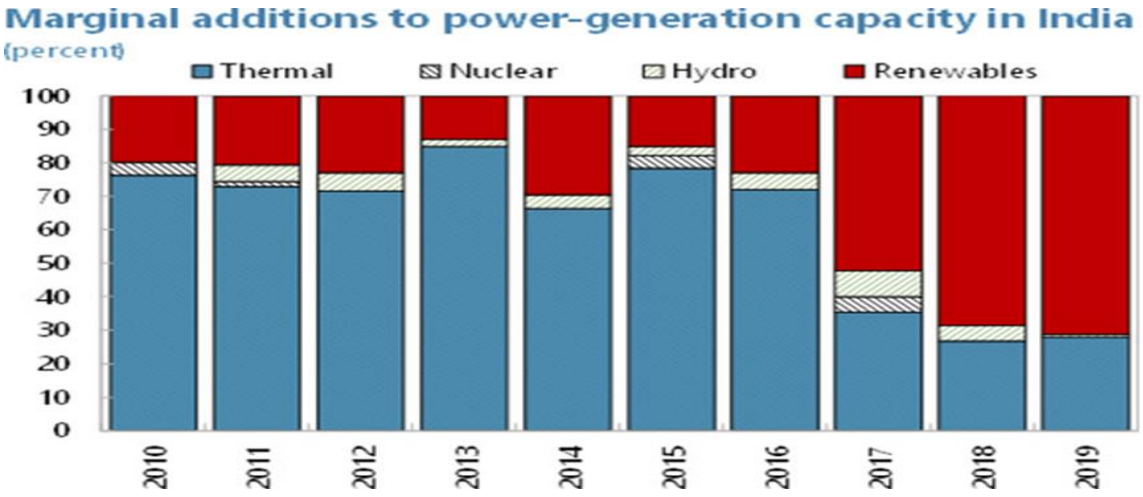
By way of example, generating solar energy in India is less expensive with Chinese PV rather than Indian PV modules as the latter is 20% more expensive. However during the Pandemic India had to rely on its own modules as there were a number of supply side problems in China. To build the entire supply chain India had to procure all inputs and its costs went up as a consequence by nearly 33%. However if India were to leapfrog to the next stage of technological development i.e. the hydrogen fuel cell technology currently being developed in Germany it would reduce costs by 30% thus becoming competitive with Chinese PV modules.[65] For accessing this technology, German technical collaboration and even finance would be needed by India.

To achieve its NDCs, including the new pledges of carbon neutrality by 2070, India will need to decarbonise its energy systems. Energy deficit states in India have been expanding coal-fired generation capacity in order to limit the risk of stranded fuel assets as well as meeting Paris Agreement goals. To enable this, India would need to phase out coal by 2050 and increase renewable energy take-up to reach at least 50% electricity generation share by 2030. At this point of time RE stands at 20% of total electricity generated.

2.3 Mitigation Policies in South Asia

India has invested heavily in RE (in addition to still-sizable investments in fossil fuel). India's current policies on RE implies that its emissions will be more than 10 percent below its unconditional NDC targets for 2030. (See Table 2). Non-fossil fuels are expected to contribute about 40% of its total energy by 2030, and it is expected to meet its emissions intensity target too. 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). (See Table 2). Fig 2 below shows the new additions to its energy mix of different kinds of sources.[66]

Fig 2: Evolution of different Kinds of Power Sources since 2010



[65] EXIM Bank Report on Integrating Trade and Investment Policies, 2021, Chapter on Solar Energy. See Bibliography for full reference.

[66] Ruchir Agarwal, Vybhavi Balasundharam[1], Patrick Blagrave, Ragnar Gudmundsson, and Racha Mousa, **2021,** Climate Change in South Asia: Further Need for Mitigation and Adaptation, https://www.elibrary.imf.org/view/journals/001/2021/217/article-A001-en.xml

Source: Central Electricity Authority, and IMF staff calculation, IMF IMF Working Papers 2021, pg 217; **Note**: Renewable energy sources includes wind, small hydro project biomass gasifier, biomass power, urban & industrial waste power, and solar power.

The objective of decarbonisation of energy is met through a two pronged approach. First subsidization or technological innovation (e.g., rapid decline in price of solar or wind energy due to technological advancements) reduces RE's levelised cost (LCOE). Secondly taxing fossil fuel increases the cost of thermal energy production.[67] However, there is a limit to the latter as reduction in the use of thermal energy which is an important revenue generator could be counterproductive for the government.

Carbon taxes on transport were patchily imposed by India. A Green Cess[68] was implemented in Goa and an Eco Tax on vehicles entering Mussoorie, a hill station in the Northern state of Uttarakhand. The GOI in 2010 implemented the Clean Energy Cess for increasing the use of clean fuels by augmenting the cost of consuming coal and using a portion of the revenue collected to fund research and clean energy projects. However, after the introduction of Goods and Services Tax (GST) in 2017, the Clean Energy Cess was abolished; in its place, a Compensation Cess on coal production at Rs.400 per tonne was introduced till 2022. This cess does not tax emissions and does not reward clean coal, hence was unsuccessful in reducing emissions.

3. Trade Policies which can support Mitigation in South Asia

3.1 Supportive agricultural trade Policies

It's also important to examine the effects of different agricultural support policies on emissions that are permitted under WTO rules. WTO allows Members to provide decoupled subsidies without any limitations but puts a maximum ceiling on certain coupled subsidies (i.e. those linked to production). Existing rules also allows Members to apply border protection (e.g. in the form of tariffs) up to the limit provided in their individual schedules of commitments. South Asia, especially India generally uses a higher level of uncoupled subsidies in comparison to coupled subsidies.

Without coupled subsidies, generally given by OECD and increasingly by large emerging economies countries global farm output would decrease by around one percent. [69] In developed countries, agricultural output would decrease by 1.7 percent and, in developing countries by around 0.5%.[70] The smaller impact on agricultural output can be attributed to their lower level of subsidies. As a result of the fall in output, global emissions would fall by around -0.6% which is huge in the context of a -2% fall in global emissions in this century.[71] The largest impacts would be felt in China, the EU, Mexico, and other countries that provide substantial coupled subsidies to agriculture.

For price support measures such as tariff barriers, export restrictions or government purchases at administered prices such as PDS, while more trade distortive, the impact on emissions may actually be positive. Simulations show that if these were to be removed, agricultural output globally would decline by about 0.1% and in some countries especially India actually increase.[72] This would also lead to an

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[67] Abhinav,R., Naran M.Pindoriya, 2018, Opportunities and key challenges for wind energy trading with high penetration in Indian power market, Energy for Sustainable Development, Volume 47, December 2018, Pages 53-61, https://www.sciencedirect.com/science/article/pii/S0973082618305404.

[68] On 24th May 2013 the government of Goa imposed an additional tax on products and substances causing pollution. Coal, coke, and petroleum were eligible for the green cess among other products. Feb 24, 2014, Times of India

[69] OECD, Agricultural Policy Monitoring and Evaluation, https://www.oecd.org/agriculture/topics/agricultural-policy-monitoring-and-evaluation/

[70] David Laborde, Abdullah Mamun, Will Martin, Valeria Piñeiro Rob Vos, August 2020, Modeling the Impacts of Agricultural Support Policies on Emissions from Agriculture, Study led by IFPRI.

[71] Ibid.

[72] Ibid.

increase in emissions especially because the production of emission intensive commodities such as beef, milk and rice would increase.

Hence while coupled subsidies should be removed for better mitigation outcomes, retaining border support measures and market price support, may actually keep emissions lower. "Analysis indicates that, without subsidies paid directly to farmers, output of some emission-intensive activities and agricultural emissions would be smaller. Without agricultural trade protection, however, emissions would be higher. This is partly because protection reduces global demand more than it increases global agricultural supply, and partly because some countries that currently tax agriculture have high emission intensities. Policies that directly reduce emission intensities yield much larger reductions in emissions than those that reduce emission intensities by increasing overall productivity because overall productivity growth creates a rebound effect by reducing product prices and expanding output. A key challenge is designing policy reforms that effectively reduce emissions without jeopardizing other key goals such as improving nutrition and reducing poverty". [73]

3.2 Supportive trade policies for the non-agricultural sector

3.2.1 Trade issues in the deployment of Renewable Energy: Tariffs and LCRs

There are other policies of the climate change policy-tool kit of South Asia that are likely to be inconsistent with WTO.[74] India chose to decrease the price of solar and wind power through subsidies, feed-in tariffs, and other measures. It put in place policies to develop domestic renewable energy industries including solar modules. However, cases have been brought against India, because the local content requirement violates the WTO. Local content policies and tariffs as well as safeguard duties on solar modules were imposed to develop these during CoVID times as the supply of Chinese modules dried up. Given that China controls 80% of the solar module market, it was hoped that localisation and tariffs would help make markets more competitive and increase domestic value-added in the longer run. Additionally, local content policies can correct for market failures by generating positive spillovers and linking domestic producers to local markets.[75] Local content policies can also be politically important in creating coalitions for climate change policy through job creation and production opportunities.[76] Similarly tariffs on solar modules were meant to encourage tariff jumping investment to create the necessary economies of scale. These requirements were imposed in government procurement schemes, which while compatible with the WTO, has not resulted in improved competitiveness. Hence while for climate mitigation purposes waivers to TRIMs can be sought under the WTO, it is important to balance localisation with building a competitive industry.

While in theory decreasing tariffs on solar modules may be attractive from a climate mitigation point of view, for large economies such as India in South Asia this may deter the development of a local industry and make it excessively dependent on China. Further leapfrogging to hydrogen cell solar modules may encounter obstacles under TRIPs. Hence for all mitigation technologies it may be essential to place them under compulsory license for achieving the objective of climate change mitigation.

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[73] ibid

[74] TRADE IN THE BALANCE Reconciling Trade and Climate Policy, bu.edu/gegibu.edu/pardee , November 2016

[75] Silvana Tordo, Michael Warner, Osmel Manzano, Yahya Anouti, 2013, **Local Content Policies in the Oil and Gas Sector,** World Bank Publications, 22 Jul 2013 - Business & Economics - 194 pages,

[76] Meyer,T., 2015, How Local Discrimination Can Promote Global Public Goods, *95 Boston University Law Review 1939 (2015)*, *Vanderbilt Public Law Research Paper No. 15-27*, *Vanderbilt Law and Economics Research Paper No. 15-25* 89 Pages Posted: 16 Oct 2015 Last revised: 8 Feb 2016, Timothy Meyer, Duke University School of Law, Date Written: October 14, 2015, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2674261#

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3.2.2 Border Adjustments of Carbon Taxes

India would find it difficult to impose an EU type "Carbon Border Adjusted Mechanism" (CBAM) in the absence of a robust system of domestic carbon pricing. CBT may also increase - inequity because of a rise in prices of essential commodities. The proposed CBAM would initially apply to five sectors: electricity, iron and steel, fertilisers, aluminium and cement. A recent study by the Commonwealth Secretariat on the implications of the CBAM finds that South Asia, particularly India would be adversely affected to the tune of nearly USD 6bn worth of exports. "In 2019, of the US$40 billion CBAM-related exports from six South Asian countries, around 14 per cent were sent to the EU. India alone accounted for just above 80 per cent of these exports".[77]Its possible that supply chains could shift out of South Asian countries thereby exacerbating inequality and reducing the incomes of the low skilled workers in the affected sectors. The CBAM could also decrease the flow of investment to South Asia. The Study also finds that the effectiveness in reducing emissions would be minimal compared with the negative economic effects of a global carbon tax on South Asia.[78] "The macroeconomic effects of the proposed CBAM and the prospects of similar policies by other developed countries point to the need for greater coherence between the multilateral trade and environmental regimes to tackle climate change".[79]

Implementation of this mechanism if it does not rely on voluntary disclosure would be unnecessarily expensive and administratively cumbersome. Further there is no mechanism to price carbon in different traded products. In the case of India it is also necessary to consider the fact that fossil fuels are heavily taxed. Depending on the intensity of power consumption in these industries India is already taxing the carbon context as its tax on fossil fuels actually ranges between 60 and 80%.[80] Hence EU's CBAM should also take this into account when levying taxes at the border. Hence flexibilities for border adjustment of carbon taxes should be provided by the EU for countries like India. climate-friendly subsidies, climate-friendly procurement, increasing domestic capabilities, and other climate policies should be provided to South Asia in the WTO.

3.2.3 Mitigating Climate Change through trade in Energy in South Asia

Energy use is increasing at unprecedented rates in South Asia to meet their ambitious poverty-reduction targets. With depleting energy resources especially coal and wood, South Asian countries are highly dependent on imported fuels, especially liquid hydrocarbon, for transport, particularly in India, Pakistan and Bangladesh. Maldives depends on oil products to meet its energy needs. Nepal and Bhutan have huge hydroelectric potential. The high potential of hydropower in South Asia can reduce the reliance of the region on imported fossil fuel. Hence improving the capacity of countries to intra-regionally trade in energy would help reduce emission levels. India and Bhutan already trade in energy. Building an integrated grid between contiguous countries could help reduce emissions. This would also need supportive policies which encourage renewable energy trade rather than fossil fuel trade. International support in building such an integrated grid as has been done in the EU would be of material importance.

3.2.4 Using trade in environmental goods and services (EGS) to mitigate climate change

Trade in EGS can reduce carbon emissions, enhance energy efficiency, and increase the use of renewable energy, thus mitigating climate change.[81] Since there is no single internationally accepted list of environmental goods (EGs), three lists are considered here as proxy. These are the OECD

[77] https://www.unescap.org/blog/implications-eus-carbon-border-adjustment-mechanism-commonwealth-members-asia-pacific-region
[78] Ibid.
[79] Ibid.
[80] IKDHVAJ Advisers LLP. RODTEP of Electronics, op.cit.
[81] Kshitiz Dahal, Posh Raj Pandey, May 2018, Green Growth and Trade in Environmental Goods and Services - A South Asian Perspective, Working Paper/18/01, SOUTH ASIA WATCH ON TRADE, ECONOMICS AND ENVIRONMENT (SAWTEE)

classification of EGs, the APEC list, and the Friends List. [82] As the last one is most comprehensive, trends of trade in products contained in that list can be considered.

Except for India, EG's exports of other South Asian nations cover few products. Bangladesh's exports mostly jute fibres and jute sacks. Nepal exports mostly jute sacks and pipes and tubes. Pakistan's EG exports consist of 'tubes/pipes' (40%) and for Sri Lanka top 10 products comprise 80% of EG exports.. For India the top ten exports comprise 41% of total EG exports. India, Pakistan and Sri Lanka export machinery such as static converters. Imports of South Asia are more diversified, though for Bhutan the top ten products comprise 85% of total EG imports.[83] Most EG imports consist of products related to renewable energy (RE). An assessment of RCA indicates that, except for India, South Asia countries have a comparative advantage in very few EGs, which implies that the environmental industries are not very developed in South Asia.

While trade in EGs has increased, tariffs are high in South Asia especially on RE products. A lot of EGS, especially in India are procured by the Government where non-tariff barriers, especially procedural ones may deter trade. Hence overall export has either stagnated or decreased, and rising imports have become a matter of concern. As India wants to develop its own RE industry, it is considering a phased manufacturing program (PMP) along the lines of electronics for solar photovoltaics too.[84]Under this program India would raise import duties to attract investment, provide subsidies, encourage production through government procurement, and then gradually phase out tariffs and subsides as the industry becomes competitive. This may require the use of local content requirement and other such measures which are currently not permitted by the WTO. Further Investment policy and trade policies may need to be reconciled to the extent that they contradict each other. Hence model rules for trade and investment treaties should be redesigned to reward climate friendly activity. Moreover, increasing tariffs especially for ITA products of which solar modules is one may be a part of India's domestic climate policy package. Hence the governance of disputes under trade and investment treaties will need to be reformed to ensure that nation-states have autonomy over climate policy-making.

3.2.5 Promoting Climate Mitigation through trade in Services

For Adaptation especially for the transition to a low-carbon economy, a wide range of environmental services such as those "related to the construction, operation, and maintenance of renewable energy generation and distribution; advisory services on reducing tailpipe emissions from vehicles; application of clean technologies in manufacturing; advisory services on land-use management and agricultural practices; and services related to the inspection, certification, and testing of products and services produced with low-carbon technologies" become relevant. Anecdotal evidence also suggests that trade in environmental services is often linked to trade in environmental goods.

In the environmental services sector, most trade takes place through commercial presence (mode 3), or cross border movement of natural persons (mode 4). Due to technological developments, cross-border supply (mode 1) is gaining importance. The limited commitments made by South Asians under GATS on environmental services is attributable to two main factors (a) the dominance of the government in South Asia in providing environmental services and (b) the propensity of environmental services to become natural monopolies (special distribution or collection networks, high capital investments).

[82] Compilation from JOB 09/132 in WTO (2010).
[83] Ibid
[84] https://psuwatch.com/budget-2021-announces-phased-manufacturing-plan-solar-gear-raises-import-duty/

Liberalisation of environmental services, especially Climate friendly ones has not proceeded smoothly because of the difficulties in classification. Another problem is the "lack of information and indicators on the restrictiveness of policies affecting trade in environmental services".

3.2.6 Mitigating Climate Change through diffusion of Climate friendly technologies

The objective of Article 2 of the UNFCCC is to stabilise GHG concentrations at a level that would prevent temperature rise beyond 2 degrees Celsius.[85] Meeting this objective requires technological innovations, including the development of knowhow for mitigation of greenhouse gas (GHG) emissions and adaptation to climate change that needs to be diffused rapidly and widely.[86]

One important point to note is the suitability of climate technologies in South Asia. The question is how can the climate technologies be identified and assessed. While there are methodologies and tools that exist,for example, Technology Needs Assessment (TNA), they may need to be adapted to the South Asian context. For India the TNA showed that the key areas of technology focus for mitigation are power generation and consumption, transport (especially freight), residential, and selected major industrial sectors.[87] This would require efficiency in generating power and efficiency in major power-using sectors (industry, residential and commercial buildings). It would also require the deployment of renewables to help decarbonise the power sector, and in rural areas the deployment of biomass-based or other decentralised renewable technologies.

Further the ability to adopt and scale up to more efficient and effective technologies that are suitable to South Asian and Indian conditions and development objectives needs to be assessed. For example while Chinese Solar modules would meet current needs, the more efficient technology the hydrogen cell technology currently being developed may be more competitively produced in South Asia. Hence a process needs to be put in place for constantly identifying new technologies both for mitigation and adaptation.

The mechanisms and institutions needed at a regional and national level need to be identified both for the use of proprietary technology at affordable prices or for the diffusion of publicly funded or developed technologies. In this context case studies from India on critical technologies (such as those related to food, medicine, internet, chlorofluorocarbons) suggest a need for providing credible incentives for innovation, including jointly developed technology and intellectual property rights (IPR) sharing, enhancement of enabling environments, and leveraging additional financial resources for climate technologies.[88]

3.2.7 IPRs and Climate Technologies

IPRs may constitute a barrier depending on several factors, such as whether or not the particular technology is patented, whether there are viable and cost-effective substitutes or alternatives, the degree of competition, the prices at which it is sold, and the degree of reasonableness of terms for licensing, etc.[89] In cases where learning occurs through reverse engineering (which applies to India), a strict IPR regime could hinder indigenous development of technology in the early stage of

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[85]UNFCCC- Article 2, Objective of the convention: https://unfccc.int/resource/docs/convkp/conveng.pdf accessed on March 08, 2018

[86] IPCC – Special Report- Methodological and Technological Issues in Technology Transfer https://www.ipcc.ch/pdf/special-reports/spm/srtt-en.pdf accessed on March 08, 2018

[87]Preeti Soni , Ambuj Sagar, Carlos Correa, Martin Khor, & K. M. Gopakumar, Martin Krause, 2011, Technological Cooperation and Climate Change ISSUES AND PERSPECTIVES, Working papers presented at the Ministry of Environment and Forests, Government of India - UNDP Consultation on Technology Cooperation for Addressing Climate Change 23-24 September, 2011; New Delhi, India

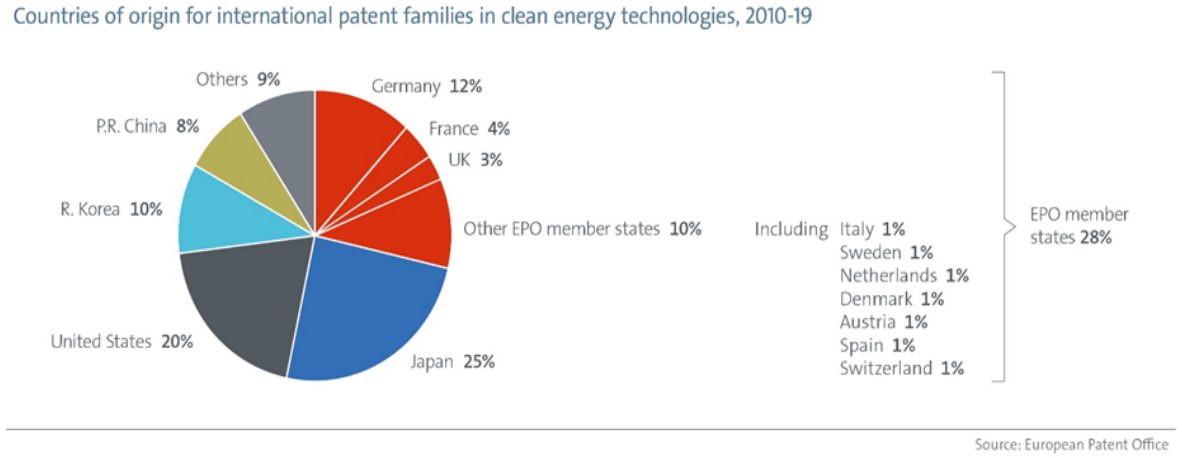
[88] Shashikant and Martin Khor, 2010, Intellectual Property Rights and Technology Transfer Issues in the Context of Climate Change, TWN.

[89] Preeti Soni , et.al, 2011, op.cit.

industrialisation.[90] The monopoly rights of patent holders could suppress local R&D as was the case with chlorofluorocarbons (CFCs) in India. Firms in India and Korea faced difficulties in obtaining rights to produce CFC substitutes, which hindered their ability to meet their commitments under the Montreal Protocol. In the case of HFC-134a, Indian companies were asked to pay a huge amount (USD25 million) by their US counterparts for the licence and, in some cases, patent owners were not ready to licence the technology to wholly owned Indian companies. Besides, Indian firms were more vulnerable because the acquisition of CFC technology was relatively recent and they had not recovered the costs before they were forced to buy substitutes.[91]

Most clean energy patents are privately owned and concentrated in developed countries like the US, Japan, Germany, etc. See Figure 3. Hence, the speed of diffusion of the most advanced energy technologies will largely be determined by companies and institutions in the Organisation for Economic Co-operation and Development (OECD) countries.[92]

Fig 3: IPRs and Clean Energy technologies



Besides trade, foreign direct investment is also an important conduit for cross-border flows of climate change mitigation technologies. Studies covering data from 62 countries (both developed and developing) including eight low-carbon technologies in the energy production, transportation, and building sectors, show that the impact of IPR protection varies between OECD and non-OECD countries and with the recipient country's absorptive capacities. Strengthening IPRs in OECD countries can increase the transfer of several low-carbon technologies, in particular, it can boost the imports of capital goods in hydro and cleaner vehicles, and foreign direct investments in solar PV, solar thermal, heating, lighting, and cleaner vehicles. For non-OECD countries while IPRs have a positive effect on FDI, it can reduce imports of solar PV and solar thermal equipment goods.[93] Thus there is a case for

[90] Kim, L., 2003, Technology Transfer & Intellectual Property Rights, The Korean Experience, Chairman and CEO, Humanities and Social Research Council, Korea Professor at Korea University Seoul, Korea, UNCTAD-ICTSD Project on IPRs and Sustainable Development, https://www.files.ethz.ch/isn/124127/2003_06_Technology_Transfer_.pdf

[91] Watal, J., 2003, Case study 3 India: The issue of technology transfer in the context of the Montreal protocol, - http://unctad.org/en/docs/itcdted6_en.pdf Page no.- 45

[92] Amrita Goldar, Shubham Sharma, Viraj Sawant, Sajal Jain, July 2019, Climate Change & Technology Transfer – Barriers, Technologies and Mechanisms, INDIAN COUNCIL FOR RESEARCH ON INTERNATIONAL ECONOMIC RELATIONS, New Delhi, India

[93] Dussaux, et.al, 2018, **Intellectual property rights protection and the international transfer of low-carbon technologies, Working paper** on 16 January, 2018, ,https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2018/01/Working-Paper-288-Dussaux-et-al.pdf

potential adjustment of IP rules aiming at fostering technology transfer towards the developing countries.

WTO Member States are already allowed "flexibilities" in TRIPS such as compulsory licenses and parallel imports to obtain technologies or products (that are patented) at more affordable prices. But the processes of negotiating with the patent holder and of issuing compulsory licenses should be eased. The possible exemption by developing countries of patents for at least the critical technologies required for climate adaptation and mitigation should be initiated. Innovating firms could recover their research costs through patenting in developed countries. Besides publicly funded technologies and research should be made available to South Asian countries for both adaptation and Mitigation. The UNFCCC process should therefore adopt the principle that developing countries can exempt climate friendly technologies from patents. This should be supplemented with global measures to enable the sharing of trade secrets. As second-best alternative, other measures can be considered, such as automatic granting of voluntary licenses and regulation of such licenses, and patent pools.

In the case of emerging technologies, it is desirable to promote collaborative research that could result in joint ownership of patents. For example, technologies in the case of electric vehicles are usually protected heavily by IPR regimes and can be expensive to buy for South Asia. Barriers could also arise due to the nature of the technology (stage of development), modes of transfer and sector-specific challenges. These need to be identified and addressed.

As far as technologies are concerned, most of the innovations are taking place in transport and energy sector. There has also been growth in the number of patents for other technologies such as waste water treatment, ICT for energy efficiency in buildings, carbon capture and storage, etc.

India has been working towards achieving greater energy efficiency and renewable energy penetration. India has aggressively been working on increasing the share of solar, wind and hydropower in electricity generation and has focused, at the same time, on cleaning its thermal power plants. India has brought together countries across the globe possessing significant solar energy potential under the umbrella of the International Solar Alliance (ISA). ISA aims to promote collaboration on solar technologies and to test and establish best practices and business models and policies in the sector.

As far as TRIPS is concerned it was found to be a barrier to transfer of technologies under the Montreal Protocol. A technology transfer platform that strengthens national systems of innovation and initiatives such as an experts'/scientists' network to collaborate on climate related technology development will help developing countries to catch up with developed countries.

4. Climate Change Adaptation

South Asia has over a large historical span shown its capacity to adapt to Climate Change. It has a wealth of natural resources and strong social networks. The family network is also important in adaptation. Traditional practices for managing climate variability include diversifying crops, cropping patterns and livelihood sources, migration especially rural-urban, and most importantly the constant growth of the informal sector and small enterprises. The entrepreneurship at the grassroots locally called 'jugaad' based on a can-do attitude are some of its inherent strengths. However, will these be sufficient to deal with the effects of climate change remains an important question.[94]

[94] Kniveton, D. et al. (2013). "Climate change-related migration in Bangladesh," briefing note series. Institute for Development Studies, Sussex, United Kingdom

4.1 Adaptation Challenges in South Asia

Currently, South Asia houses 25% of the world's hungry and malnourished. This number is expected to reach 2.68 billion by 2050. Wheat, rice and maize are most likely to be affected by climate change in South Asia. A recent study from India shows that with each 1% rise in temperature, wheat yields are likely to drop by 2 to 4%. "Promotion of climate-resilient agriculture [among] smallholder farmers is challenging; farmers do not accept changes [in] farming methods easily. The availability of quality inputs and technology in remote areas is a challenge."

As was pointed out earlier the most severe effects of climate change will be felt on agriculture and food production in South Asia. India is the second largest producer of wheat and rice in the world, but is only a marginal exporter. In times of crisis India could turn an exporter as it has stockpiled stocks of grain. So far WTO does not permit exports of stockpiled grains. when they are procured at subsidised prices. The extent of subsidy is determined by the reference price which was fixed in 1986 by the then GATT. Even natural inflation would suggest that the reference price should be raised. Secondly all grains exported from India are presumed to be from the PDS, but only 30% of the grain is procured under PDS. If these two restrictions are lifted, then India could be a competitive exporter of food grains. South Asia as a whole should have the flexibility to export or restrict exports as the situation demands due to shortages resulting from climate change.

It is to be noted that South Asian agriculture is primarily rain fed and hence there is considerable variability in yearly outputs. To stabilise prices, production and availability of food grains India uses both stockpiling and the public distribution system. In addition during the pandemic it also distributed grains at subsidised prices to the below poverty line (BPL) groups as part of a major poverty alleviation scheme. Climate Change will further exacerbate the variability of yearly production and hence its two major policies will need to be brought into frequent use. WTO rules restrict exports of grain procured under PDS. However shortages may emerge due to climate change in many parts of the world and hence on humanitarian grounds these restrictions should be lifted. Flexibility should be provided to all countries in South Asia to export food grains when there is a climate induced shortage.

In South Asia, governments, businesses and communities will need to formulate both short term and long term approaches for adapting to climate risks. In the short term, integrating climate adaptation and disaster risk reduction will need to be integrated to growth and development strategies. This can be expensive as was shown above. "Support for effective disaster relief and recovery needs to continue, along with proactive efforts to reduce risk, such as integrating comprehensive risk assessments and risk reduction measures into national economic and development policy".[95] Sometimes Climate adaptation may include providing adequate housing, infrastructure or services, which are in any case a part of the planning toolkit of South Asian governments.

One of the major challenges in South Asia arise from the fact that poorly conceived sector-specific adaptation strategies could lower resilience in other sectors or ecosystems. For example rapid urbanisation of coastal zones can increase vulnerability of poor populations and increase the risk of future climate change.[96] Hence housing a growing population may lead to climate vulnerability.

In agriculture too, intensive agricultural practices and grain based production will need to be adapted to Climate change. In the agriculture sector, for example, South Asian countries are adopting climate adaptation strategies and practices for particular crops and geographic areas. However these options

[95] Paul Brenton and Vicky Chemutai, 2021, The Trade and Climate Change Nexus, The Urgency and Opportunities, for Developing Countries, 2021, World Bank, https://openknowledge.worldbank.org/handle/10986/36294
[96] IPCC (2014). Climate Change 2014: Impacts, Adaptation, and Vulnerability. Chapter 16 (p27).

are expensive and need help from advanced countries. Regional cooperation could be important in overcoming resource scarcities and conflicts related to climate change.[97]

4.1.1 Financing needs for Adaptation

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.[98]

The cost of infrastructure adaptation is difficult to estimate. A World Bank estimate showed that costs for developing countries could be as little as USD 75 to 100 mn per year.[99]However UNEP's Global adaptation report estimated these to range between US$140 to US$300 billion per year by 2030 and between US$280 to US$500 billion by 2050.[100]

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.[101] The cost of adapting under a business as usual scenario is higher than the cost under a 2-degree-Celsius scenario. Generally, sectors covered in Adaptation studies do not cover areas such as industry and services. Hence adaptation costs may actually be higher than estimates.

Hence financing needs for South Asia are huge and would need to be addressed within the context of international Cooperation.

4.2 South Asian policies for Adaptation

The National Climate Change Policy of Sri Lanka was drafted and adopted in 2011. However, inconsistent government policy has been a major challenge. In 2017 the government decided to phase out all fossil-fuel vehicles by 2040. All state-owned vehicles were to be electric or hybrid by 2025. For this purpose it proposed a reduction in import duties on electric and hybrid vehicles and increasing duties on vehicles powered by fossil fuels. However, in August 2018 due to a large trade deficit caused by increasing imports of hybrid cars the government increased the duty on a popular model of hybrid car.[102]

The Bangladesh Climate Change Strategy and Action Plan (BCCSAP) of 2009 was mainly for adaptation. Its size of USD 100mn was all too inadequate for its needs. Pakistan's Climate Change Act of 2017 spent 1.5-2.1% of its GDP from 2012-2015. However uncoordinated and limited projects did not yield good results. Maldives climate-change policy framework in 2015 had five thematic areas "(a) sustainable

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[97] Ibid.

[98] IMF. Mitigation costs for the same period are estimated for Bangladesh and India at US$24 and US$834 million. World Bank Intended Nationally Determined Contributions (INDCs) database http://spappssecext.worldbank.org/sites/indc/Pages/CostFilterVisualization.aspx. 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.

[99] World Bank, 2011, **Economics of Adaptation to Climate Change: Country Case Studies,** June 6, 2011, https://www.worldbank.org/en/news/feature/2011/06/06/economics-adaptation-climate-change-country-case-studies#:~:text=The%20World%20Bank's%20global%20study,the%20period%202010%20to%202050.

[100] UNEP 2016, UN Environment Annual Report 2016, Engaging people to protect the planet UN Environment Annual Report 2016 (unep.org).

[101] IMF, 2021, STRENGTHENING INFRASTRUCTURE GOVERNANCE FOR CLIMATE-RESPONSIVE PUBLIC INVESTMENT, file:///C:/Users/jhafa/Downloads/PPEA2021076%20(1).pdf

[102] Economist Intelligence Unit, 2021, Climate change: policies and challenges in South Asia, http://country.eiu.com/article.aspx?articleid=1217958905&Country=Sri

financing; (b) low-emission development; (c) adaptation and opportunities; (d) capacity-building and leading advocacy at climate negotiations; and (e) fostering sustainable development". [103]

In India too while adaptation implies reducing the carbon content of all sectors especially power, its reliance on coal revenues to the tune of 25% of its budget and growing industrial demands as well as its rural electrification program implies that fossil fuel will continue to be important. The Global Coal Plant Tracker, shows that the amount of coal-fired power capacity under construction in India, at 36.2 GW in 2018, was the second-highest in the world, after China. Bangladesh and Pakistan will also add 2.6 GW and 3.3 GW of coal fired power respectively.[104]

4.3 Technological Needs for Adaptation

4.3.1 Agriculture

Adaptation technologies in agriculture include those that can reduce water usage (e.g., drip irrigation) and reduce water waste (e.g water reuse). Further new and existing technologies should adapt to increased temperatures. For example, existing or new crop varieties with better tolerance to higher temperatures or those that are drought resistant can be used.[105] As part of a larger integrated adaptation approach technologies would need to focus on "(i) increased crop resilience, (ii) reduced water use and water waste in agriculture, (iii) strengthened adaptation to flooding, and (iv) protect livestock from the impact of climate change". [106] The only trade barrier that arises in this context is a ban on trade in germplasm which is the basis for the development of many of these technologies.[107]

4.3.2 Public Health

Technologies resulting in more accurate forecasting and longer warning times will allow public health authorities to prepare for cyclones, floods, heat waves, and other extreme events, and to provide facilities for vulnerable populations. Improved construction techniques can reduce flooding and storm damage associated with extreme events, and blunt their impact on public health. New electronic health technologies can also improve the detection, surveillance, and reporting of disease outbreaks, thus facilitating prevention and treatment.

Vulnerability to waterborne diseases can be reduced through better water treatment and wastewater management. Vector-borne diseases, on the other hand, can be prevented or made less severe through improved diagnosis, acute and prophylactic treatment, and measures to prevent transmission from vector to host and to reduce the population of disease-carrying organisms. Adaptation technologies that address food insecurity can decrease the likelihood of famine or malnutrition.

As far as health related technologies are concerned there is a public health exception under TRIPs which can also be used here.[108]

4.3.3 Transport

Adaptation within the transportation sector can begin with developing early warning systems for disasters and creating maps of high-risk vulnerable areas or roads.[109] In addition, alternative engineering designs and construction techniques need to be developed to attenuate effects of climate

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[103] Ibid
[104] Ibid
[105] Asian Development Bank, 2014, Technologies to Support Climate Change Adaptation in Developing Asia, Manila, Philippines, op.cit
[106]Ibid
[107]ibid
[108] TRIPS and Public Health, 2001, https://www.wto.org/english/tratop_e/trips_e/pharmpatent_e.htm
[109] **Mark J. Koetse** & Piet Rietveld, 2012, **Adaptation to Climate Change in the Transport Sector, https://www.tandfonline.com/doi/abs/10.1080/01441647.2012.657716?journalCode=ttrv20**

change. Improvements in drainage systems, the use of monitoring technologies and alternate materials, and slope fortification and other protective installations will also need to be installed.[110]

Road, rail, and airport infrastructure will need to use heat-resistant materials. According to the global Transport Knowledge Practice (gTKP 2013), Intelligent Transport Systems (ITS), such as automated traffic-control and travel-advisory systems can include data on water levels, wind speed, early warning systems and flood hazard mapping for storms as well as safety-related messages.

A lot of technologies related to ITS are proprietary and involve privacy concerns.[111] Further infrastructure such as reliable energy supplies and internet access needs to be strengthened in South Asia. These technologies need to be adapted to South Asian conditions which can be expensive.

5. Supportive Trade Policies for Adaptation

5.1 Trade policies for Agriculture

As soil nutrients go down because of Climate change, fertiliser addition may be an effective adaptation technique. The lack of an effective system of standards is a major barrier to cross-border trade in regional fertilizer markets. Moreover, India may emerge as a major producer of foodgrains, hence regional and international trade including from stock piling should be permitted as a Climate adaptive policy under the WTO. In the region, frequent policy changes, poor trade-related infrastructure and transit agreements and slow customs processing all add to the complex process of trading agricultural products across South Asia. Two key issues need to be addressed: (a) establishing a consistent and stable policy environment for regional trade in fertilizers and grains and (b) investing in institutions that lower the transaction costs of trade.

Adaptation requires new techniques and technologies. For example, planting seeds earlier, new inputs that increase resilience to climate change (such as drought-resistant seeds and pesticides for weed control), and other higher yielding varieties could be effective adaptation responses. However trade barriers, especially SPS, plant quarantine, seed certification and variety release regulations are impediments to cross-border movement of seeds and techniques.

5.2 Tariffs and Non-tariff barriers

As an adaptation measure it is proposed that tariffs on green goods be lowered whereas tariffs on so called dirty goods which are carbon intensive should be raised.[112] However lower tariffs on the later which include raw materials and intermediate goods are generally kept lower as part of the industrialisation policy in South Asia. On the other hand in large economies such as India a safeguard duty and higher tariffs are charged on solar photovoltaics as the country wants to manufacture its own. Further excessive dependence on one country for several green goods can be a counterproductive strategy. Hence there appears to be a conflict between reducing tariffs and encouraging investment, as investors can jump tariff walls.

However, generally on green goods tariffs in South Asia are not very low. In addition there are nontariff barriers, including technical barriers to trade and sanitary and phytosanitary measures. Other nontariff barriers include local-content requirements, specifically requirements that incentivize the use of locally sourced materials, cumbersome certification and licensing procedures, and price controls. Procedures used in government procurement can also be a barrier to trade in these goods.

[110] ADB, 2014, op.cit.

[111] Shaheen, S., M. Camel, and K. Lee. 2012. Exploring the Future of Integrated Transportation Systems in the United States from 2030 to 2050: Application of a Scenario Planning Tool. Transportation Research Board Annual Meeting. 15 November, ADB.

[112] Paul Brenton and Vicky Chemutai, The Trade and Climate Change Nexus, The Urgency and Opportunities, for Developing Countries, 2021, World Bank, https://openknowledge.worldbank.org/handle/10986/36294.

Distinguishing the NTBs on Climate friendly goods and technologies would need better data for the design of appropriate policy reform.

5.3 Using trade in Environmentally Preferable products to promote Adaptation

Trade in environmentally preferable products could promote adaptation by fostering exports of goods that require less water or that resist extreme weather events. An important bottleneck in this context is the inability of South Asian countries to verify the environmental characteristics of their EPPs. In this context, given that EPPs have higher tariffs in the OECD countries[113]. It may be necessary to :

- Reduce the much higher tariffs on categories of goods in which South Asian countries have opportunities to supply EPPs. It must be noted that many of these may be agricultural goods and hence standard agricultural tariffs should not apply.
- Distinguishing EPPs in standard trade classifications by including characteristics such as traceability and definition of carbon competitiveness.
- Promoting Mutual recognition of carbon competitiveness standards and labels.
- Harmonising carbon abatement standards and regulations especially in the context of EPPs.
- Targetting government procurement and corporate buyers as they may be the most important market for EPPs.

5.4 Diffusion of technologies

Trade, especially regional trade will play a vital role in the global diffusion of adaptation technologies. This access will, in turn, create new business and job opportunities in areas that use, distribute, and maintain these new technologies. However, as stated in the Mitigation section, there are several barriers to the diffusion of these technologies.

The complexities in the nature of technology, channels of technology transfer and involvement of multiple stakeholders, particularly IPR holders has made it difficult to develop an appropriate framework for technology transfer both at the WTO and at the UNFCCC.

While there is technological advancement in the energy sector, adaptation technologies in agriculture and natural resource management have not matured. The negative impact on yields in South Asian countries due to floods and droughts, irregular monsoons, depleting water levels and poor soil management are already being felt. The issue of improved varieties of seeds and the development and transfer of agricultural technologies for water management, efficient irrigation and drought/flood resistant variety of seeds is critical for South Asian Agriculture. However trade in germplasm is prohibited and collaborative development of these technologies is yet to take off. Moreover most of the patents on 'Climate-ready' genes have been filed by Monsanto, Bayer, and Syngenta around the world.[114]There are concerns that these monopolistic rights may inhibit research in South Asia, increase prices, and restrict farmers' rights to save and exchange seeds.[115] Saving and exchange of seeds is the traditional way of seed innovation in South Asia, particularly in India. A regional approach on this issue will be of particular relevance.

In this context separate treatment under TRIPS for publicly funded or developed technologies is required. According to UNCTAD roughly 40% of total R and D spending in all developed countries was

[113]Brenton, P., and Chemutai, V., October 2021, Adaptation to Climate Change: Trade in Green Goods and Services and Access to Low-Carbon Technologies, https://elibrary.worldbank.org/doi/full/10.1596/978-1-4648-1770-0_ch4
[114] Shashikant and Martin Khor, 2010, Intellectual Property Rights and Technology Transfer Issues in the Context of Climate Change, TWN
[115] Ibid

done by the government.[116] This R and D spending largely underpins the development of several climate related technologies by the private sector. In these countries it is common practice to grant IPRs to the research institutes and the private sector can easily purchase these IPRs from the research institutes which have developed these technologies through public funding. It is imperative to explore mechanisms for the transfer of these technologies to South Asia which may have the capacity to reverse engineer and adapt them to their climatic conditions.

Conclusion

The impact of Climate Change will vary across South Asian countries. While Nepal and Bhutan may have an improvement in agricultural output, the other countries will see a decline. Countries like Maldives and Bangladesh as well as parts of Sri Lanka may be completely or partially submerged by Climate Change. However, additional work is needed in each South Asian country to evaluate, assess, and design the practical aspects of the Climate Change as its' likely to impact vulnerable and low income households.

The most important effects will be felt on the food security of the region. In the trade context, two specific aspects become relevant. The first is to remove the restriction on selling stock piled grains in the open market. MC12 reaffirmed the Bali Declaration on Stockpiling and agreed that member would not challenge the policy of stockpiling unless it distorted trade or affected other countries food security.[117] Building on these declarations a regional approach could be built using stockpiled grains in the region.

The second approach is to focus more on the removal of coupled support provided mostly by developed countries rather than uncoupled support, especially consumer price support provided mostly by South Asia. While such a tilt in policy may be more trade distorting it will definitely be more climate friendly. The development of climate resilient crops is taking place in a few countries whereas these genes are patented globally. It is imperative that access to this research and patent information be available globally, especially in South Asia to provide food security to the region.

While serious thought is being given to carbon taxes for mitigation of climate change, this policy may prove to be complex in its implementation in South Asia. The impact of carbon taxes on growth and inflation could be severe in South Asia. 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.[118] Other studies indicate that any impact on GDP could be reduced through recycling carbon-tax revenue into productive investment.[119]

The COVID-19 shock has already led to sectoral re-allocation in India and is indicative of what may happen with Climate Change. For example, resources have moved away from some emission intensive sectors such as airlines, transportation, etc. to electronics which has shown very high rates of growth since 2019. While in the short-term this has led to a decrease in employment, over the medium-term it may provide an opportunity for job creation in less pollution-prone sectors. In this context, over the

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[116] Ibid

[117] Agriculture meeting discusses MC12 outcomes, food security, Nairobi and Bali decisions, https://www.wto.org/english/news_e/news22_e/agri_27jun22_e.htm

[118] Aggarwal,.R., et.al, 2021, op.cit.

[119] *Ojha*,V.p., *Sanjib Pohit*, (spohit@ncaer.org) and *Joydeep Ghosh, 2020,* ***Recycling carbon tax for inclusive green growth: A CGE analysis of India, https://econpapers.repec.org/article/eeeenepol/v_3a144_3ay_3a2020_3ai_3ac_3as0301421520304353.htm***

medium term, a well-designed carbon tax package—that is combined with complementary product and labor market policies in terms of subsidies—could support the re-allocation of capital to and re-skilling of labor in more productive and cleaner sectors.

It is imperative to develop a workable framework for Technology and Financial transfers for Climate Change. South Asia has the capacity to innovate and adapt as well as reverse engineer technologies. A regional approach should be initiated in this context. For example using the TRIPs exceptions provided to LDCs, capacities could be built to develop and trade climate friendly technologies. Further technology assessments given similar topographies could also be conducted at the regional level. Furthermore a regional demand for a waiver of IPRs for climate friendly seeds should be made available at appropriate prices and publicly funded technologies should be available without the payment of royalties.

To conclude to promote climate friendly growth:

• While reducing tariffs on climate-friendly goods may promote diffusion, it may also hamper the development of an indigenous industry which is crucial as has been shown by the experience of India during COVID.

• While prohibiting fossil fuel subsidies may promote mitigation, it will be difficult in the short-run given the reliance of government on coal revenues in India.

• While carbon taxes may be a first best solution, its implementation especially measuring the carbon intensity of traded goods is cumbersome.

Recommendations on a regional approach:

- South Asia should accelerate movement of capital for climate friendly investment. For this global funds should also be available to the region.
- The role of using stockpiled grain in the case of Climate emergencies should be explored. In this context the MC12 Declaration on food security should be further worked upon and operationalised.
- Compulsory licensing for climate-friendly patents and copyrights should be promoted globally so that South Asia can benefit from appropriate technologies.
- Flexibilities for border adjustment of carbon taxes, climate-friendly subsidies, climate-friendly procurement, increasing domestic capabilities, and other climate policies should be provided to South Asia in the WTO. In this context, the role of high taxes on fossil fuels in South Asia should be recognised.
- To the extent that the tariff regime does not conflict with the objective of developing indigenous climate friendly regimes, South Asia should reduce tariffs on Climate friendly goods and services.
- Special emphasis for liberalisation of Climate Friendly services and EPPs has to be given in the OECD countries for exports from South Asia.

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