Climate Change and South Asia
A Briefing Note

উন্নয়ন অন্বেষণ
Unnayan Onneshan
The Innovators
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Climate Change and South Asia

Acknowledgement:

This note is a product of collaborative efforts of people interested in, and work on, climate change, coordinated by the Climate Change and Biodiversity Unit of the Unnayan Onneshan. We would like to thank Palash Kanti Das of Oxfam GB Matthew Stilwell and Alex Rafalowicz of the Institute for Governance & Sustainable Development, and Lindsay Bass, Anna Brittain, Michael Conrardy, Scott Eaton, Tetsuhuisa Kamiya and April Price of the Donald Bren School of Environmental Science and Management, UCSB, for their contributions. From Unnayan Onneshan, Rashed Al Mahmud Titumir, Abdul Baten, Jayanta Basak and Mahsoun N R Choudhury contributed to this note.

Printed by: Dot Net Ltd. 51-51A Purana Paltan, Dhaka

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Climate Change and South Asia

The Context:

The Bali Action Plan shines with lots of hopes for developing countries that in two years there would be a shared vision to combat global warming. In that plan, the shared vision was portrayed as a 'long term cooperative action" which would include a "long term global goal for emission reduction". This implies an action taken jointly with long term goals so that rising global temperature would be far below two degree centigrade. This 2^0C is based on the recommendations of Inter-governmental Panel on Climate Change (IPCC). However, according to IPCC, there is a strong likelihood that the temperature increase from pre-historic levels may overshoot 2^0C if drastic actions are not taken urgently.
The significance of the shared vision is of utmost importance for planning any action. The ultimate objectives and principles of the UN Framework Convention on Climate Change (UNFCCC) stipulate that any action taken must be in line with common but differentiated responsibilities (CBDR) and respective capabilities, and respective social and economic conditions.

From Bali to Copenhagen, numerous dialogues and discussions have taken place regarding the shared vision, but no satisfactory solution is achieved. For developing countries, in particular, least developed countries (LDCs), small island developing states (SIDS) and African countries, even the 2^0C increase would be catastrophic. The main concern arises on the issue "right to survival" and for some it is about "right to development".

South Asia is the most affected region: it includes four LDCs, one SIDS, and three developing countries. The idea of a shared vision has not come up sharply though some sporadic steps have been taken at the South Asian Association for regional Cooperation (SAARC) level. South Asian policy makers have yet to come together to define a shared vision for themselves. And, in the global context, parties are acting differently and separately, though all of them are part of big negotiating bloc called G77+ China.

It is imperative to articulate a South Asian shared vision related to specific regional issues internally and externally, and that would signal the regional cohesion on climate change issues.

The climate change theory is simple in its own way. The atmospheric concentration of green house gases (GHGs) in the air should be kept limited to 350 parts per million (ppm) so that temperature would not rise up to a certain degree celsius. There are various predictions done by IPCC but the most important parameter is setting temperature increase far below 2^0C and even to limit it to 1.5^0C.

The complexity arises when links are made with economic, social, ecological, lives and livelihoods options and development path with these changes. The most negative changes will be observed in LDCs, SIDs, African countries. The northern rich countries will also face the problem but they are far better equipped to tackle these problems. As it is related to emission reduction, any long term cooperative action depends on some criteria. If it is about time scale how long this would be, how cooperative process would lead to actions. Now for any action, whether it is for the long term or short term, it needs a goal to reach.

This briefing note covers three aspects of climate change impacts in South Asia. The Part - I deals with the issues related to projected risks, impacts and cost, Part - II attempts to define a science based position and finally Part - III addresses the need for a South Asia shared vision.

Part I: Projected Risks, Impacts and Costs

> "*With an estimated 600 million people subsisting on less than US$1.25 a day in South Asia, even small climate shocks can cause irreversible losses and tip a large number of people into destitution."*[1]

Overview

This paper is for citizens and Governments of the South Asian Association for Regional Cooperation (SAARC) namely: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka.

It summarizes projected risks, impacts and costs to the region based on information contained in the IPCC Fourth Assessment Report and related studies. It asks the following four key questions:

1. What does the IPCC say about climate change and South Asia?
2. What are the projected impacts in South Asia?
3. How much might impacts cost South Asia and globally?
4. What is required to enable South Asia to minimize the risks, impacts and costs of adapting to and mitigating climate change?

1. What did the IPCC say about climate change and South Asia?

According to the IPCC, South Asia is seeing:

> … a significant acceleration of warming over that observed in the 20th century. **Warming is … stronger over South Asia** and East Asia and greatest in the continental interior of Asia (Central, West and North Asia).[2]
>
> **Warming greater than the global mean is projected for South Asia (3.3°C)**[3]
>
> The IPCC observed that temperatures are increasing in every sub-region of Asia.[4]
>
> According to the IPCC, **South Asia is the only sub-region in Asia to record the status of 'highly vulnerable' for all of the following sectors**: food and fiber; biodiversity; water resources; coastal ecosystems; human health; and land degradation.[5]
>
> South Asia is therefore among **the most vulnerable sub-regions in Asia.**

According to the IPCC:

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[1]Richard Damania, Lead Environmental Economist for the South Asia Region, The World Bank, 'Why is South Asia Vulnerable to Climate Change?', November 2008, http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/0,,contentMDK:21991827~menuPK:2246552~pagePK:2865106~piPK:2865128~theSitePK:223547,00.html

[2]Contribution of Working Group II to the IPCC Fourth Assessment Report, Chapter 10, Climate, 10.3.1, http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch10s10-3.html#10-3-1

[3]Contribution of Working Group II to the IPCC Fourth Assessment Report, Chapter 11, Regional Climate Projections, 11.4.3, http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch11s11-4-3.html

[4]Contribution of Working Group II to the IPCC Fourth Assessment Report, Chapter 10, Observed climate trends, variability and extreme events, 10.2.2 http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch10s10-2-2.html : "Increasing trends have been observed across the seven sub-regions of Asia. The observed increases in some parts of Asia during recent decades ranged between less than 1°C to 3°C per century."

[5]Contribution of Working Group II to the IPCC Fourth Assessment Report, Chapter 10, Confidence Levels and unknowns, 10.8.2, http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch10s10-8-2.html

Extreme weather events in Asia were reported to provide evidence of increases in the intensity or frequency on regional scales throughout the 20th century.[6]

The change in climate will induce more dangerous weather events:

Even under the most conservative scenario, sea level will be about 40 cm higher than today by the end of 21st century and **this is projected to increase the annual number of people flooded in coastal populations from 13 million to 94 million. Almost 60% of this increase will occur in South Asia** (along coasts from Pakistan, through India, Sri Lanka and Bangladesh to Burma)[7]

Similarly, within individual countries warming will not be uniform. For example in India:

Studies show that the heating up of India will not be uniform across the country. While the average annual increase will be about 1°C, the winters of north and northwest India may be more than 2°C.[8]

Region	Country	Change in temperature	Change in precipitation	References
South Asia	India	0.68^{0}C increase per century, increasing trends in anual mean temperature, warming more pronounced during post monsoon and winter	Increase in extreme rains in north-west during summer monsoon in recent decades, lower number of rainy days along east coast	Kripalani et al., 1996; Lal et al., 1996; Lal et al., 2001b; Singh and Sontakke, 2002; Lal, 2003
	Nepal	0.09^{0}C per year in Himalayas and 0.04^{0}C in Terai region, more in winter	No distinct long-term trends in precipitation records for 1948 to 1994	Shrestha et al., 2000; Bhadra, 2002; Shrestha, 2004
	Pakistan	0.6 to 1.0^{0}C rise in mean temperature in coastal areas since early 1900s	10 to 15% decrease in coastal belt and hyper arid plains, incase in summer and winter precipitation over the last 40 years in northern Pakistan	Farooq and Khan, 2004
	Bangladesh	An increasing trend of about 1^{0}C in May and 0.5^{0}C in November during the 14 year period from 1985 to 1998	Decadal rain anomalies above long term averages since 1960s	Mirza and Dixit, 1997; Khan et al., 2000; Mirza, 2002
	Sri Lanka	0.016^{0}C increase per year between 1961 to 90 over entire country, 2^{0}C increase per year in central highlands	Increase trend in February and decrease trend in June	Chandrapala and Fernando, 1995; Chandrapala, 1996

IPCC AR4, Table 10.2, Summary of key observed past and present climate trends and variability

2. What are the projected impacts of climate change in South Asia?

South Asia is already suffering from climate-change. The scale of future impacts depends on the scale of future warming. Areas of vulnerability include food and agriculture, fisheries, human health, coastal areas and other sectors. Some recent studies are summarized below:

[6]Contribution of Working Group II to the IPCC Fourth Assessment Report, Chapter 10, Summary of knowledge assessed in the Third Assessment Report, 10.1.1, http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch10s10-1.html#10-1-1
[7]Contribution of Working Group II to the IPCC Fourth Assessment Report, Chapter 10, Costal and low lying areas, 10.4.3, http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch10s10-4-3.html
[8]Dr. Tarun Das, Socio-Economic Impact of the Climatic Change in India, 30 October 2008, http://www.scribd.com/doc/17454338/Impact-of-Climate-Change-on-the-Indian-Economy

Food and agriculture

Crop yields are already declining across Asia, and particularly in South Asia[9], threatening food security. They are projected to continue declining:

> Climate change will have varying effects on irrigated yields across regions, but **irrigated yields for all crops in South Asia will experience large declines**. [10]

The International Food Policy Research Institute records that for South Asia, and relative to 2000 levels, the following yield declines are projected:

- -23% in rice;
- -57 % in wheat;
- -36% in maize. [11]

According to the Peterson Institute for International Economics study into agriculture impacts:

> **The results for India are sobering, with reductions in output potential ranging from about 30 to 35 percent in the southern regions to about 60 percent in the northern regions**. As discussed later, this model does not include the favorable effect of carbon fertilization. Even after inclusion of carbon fertilization effects, however, the losses would be severe.[12]

The most recent science indicates that a reduction wheat production in South Asia is almost inevitable:

> **The study finds that production losses in South Asia wheat**, Southeast Asia rice, and Southern Africa maize **are most certain and therefore are considered the most important crops in need of adaptation investments**. However, slim chances of **extreme losses are projected for a subset of the crops (South Asian millet, groundnut, rapeseed).** Given their importance to local sustenance, immediate attention is warranted.[13]

Fisheries

The disruption of fisheries by climate change is likely to affect large numbers of poor people in South Asia, and reduce options for future economic growth in those countries for which fisheries are important sources of food, employment and export revenues.[14]

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[9]See, Zhai, F., and J. Zhuang, 'Agricultural Impact of Climate Change: A General Equilibrium Analysis with Special Reference to Southeast Asia', Asian Development Bank Institute Working Paper 131, (February 2009), http://www.adbi.org/working-paper/2009/02/23/2887.agricultural.impact.climate.change/

[10]International Food Policy Research Institute, Climate Change: Impact on Agriculture and Costs of Adaptation, 6 November 2009, p. vii, http://www.ifpri.org/sites/default/files/publications/pr21.pdf

[11]International Food Policy Research Institute, Climate Change: Impact on Agriculture and Costs of Adaptation, 'Appendix 2', 6 November 2009, http://www.ifpri.org/sites/default/files/publications/pr21app2.pdf

[12]William R. Cline, Global Warming and Agriculture: Impact Estimates by Country (July 2007) Chapter 5, p. 49, - http://www.piie.com/publications/chapters_preview/4037/05iie4037.pdf

[13]Lobell, D.B., Burke, M.B., Tebaldi, I.C., Mastrandrea, M.D., Falcon, W.P and R.L. Naylor, 'Prioritizing Climate Change Adaptation: Needs for Food Security in 2030', Science v.319, (1 February 2008), p. 610.

[14]Allison, E.H., Perry, A.L., Badjeck, M., Adger, W.N., Brown, K., Conway, D., Halls, A.S., Pilling, G.M., Reynolds, J.D., Andrew, N.L. and N.K. Dulvy. "Vulnerability of national economies to the impacts of climate change on fisheries." Journal compilation, Fish and Fisheries, (2009), http://www.imcsnet.org/imcs/docs/vulnerability_of_fisheries.pdf

> Vulnerable Asian countries face combinations of three issues: high fisheries dependence, heavily exploited marine ecosystems, and high exposure of major riverine and coastal fisheries to climate change. **Fish constitute a high proportion of export income in parts of South and Southeast Asia**, **and are a major source of dietary protein** – typically 40% of all animal protein consumed

per year… **Fisheries production of some of the more vulnerable countries in Asia relies on rivers that arise in the Himalayan Mountains - the Indus, Brahmaputra, Ganga and Mekong. Climate change is likely to cause earlier season peak flows and possible reductions in flow, attributable to reduced snowfall and melting glaciers.**[15]

Human health

The health of citizens will be severely affected by climate change. The World Health Organization (WHO) has stated that global warming has resulted in a change in the profile of various diseases and this change will lead to an increase of diseases in tropical countries.[16]

> Models based on distribution and vectorial capacity of malaria vectors have projected two to **five times change in epidemic potential for P. falciparum malaria with 2–4°C increase in temperature;** highest changes are projected for high altitudes. Based on monthly incidence of malaria in different states of India, **the study found that northern states, such as Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana, Uttarakhand and northeastern states etc. are more vulnerable** to climate change.[17]

Natural disasters

According to the World Bank:

> South Asia suffers an exceptionally high number of natural disasters. Between 1990 and 2008, more than 750 million people—50% of the region's population— were affected by at least one weather-related disaster, leaving almost 60,000 dead and resulting in about $45 billion in damages.[18]

According to the IPCC, "extreme rainfall and winds associated with tropical cyclones are likely to increase in East Asia, Southeast Asia and South Asia."[19]

Coastal areas and flooding

The latest World Bank study shows that in South Asia:

- Approximately **23% to 33% of the countries' coastal zones will be subjected to inundation risk**;
- **Bangladesh will be worst affected (33.4%)**.[20]

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[15]Allison, E.H., Perry, A.L., Badjeck, M., Adger, W.N., Brown, K., Conway, D., Halls, A.S., Pilling, G.M., Reynolds, J.D., Andrew, N.L. and N.K. Dulvy, 'Vulnerability of national economies to the impacts of climate change on fisheries', Journal compilation, Fish and Fisheries, (2009), p. 16, http://www.imcsnet.org/imcs/docs/vulnerability_of_fisheries.pdf

[16]The Statesman (India), 'Mosquito Menace Global Warming To Blame?' 9 November, 2008, http://www.lexisnexis.com.proxy.library.ucsb.edu:2048/us/lnacademic/results/docview/docview.do?docLinkInd=true&risb=21_T8910674902&format=GNBFI&sort=RELEVANCE&startDocNo=26&resultsUrlKey=29_T8910674905&cisb=22_T8910674904&treeMax=true&treeWidth=0&csi=227171&docNo=31

[17]Dhiman, R.C., Pahwa, S., Dhillon G. P. S. and A.P. Dash. 'Climate change and threat of vector-borne diseases in India: are we prepared?', Parisitology Research v.106, (2010), p. 766.

[18]The World Bank, 'Why is South Asia Vulnerable to Climate Change', 2009, http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/0,,contentMDK:22404173~pagePK:2865106~piPK:2865128~theSitePK:223547,00.html

[19]Contribution of Working Group II to the IPCC Fourth Assessment Report, Chapter 11, Regional Climate Projections, 11.ES, http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch11s11-es.html

[20]Dasgupta, S., Laplante, B., Murray, S. and D. Wheeler, 'Climate Change and the Future Impacts of Storm-Surge Disasters in Developing Countries', World Bank Policy Research Working Paper 4901, (April 2009), p. 27, http://www.eenews.net/public/25/10905/features/documents/2009/05/13/document_cw_02.pdf

The Top Ten High Impact Coastal Areas identified by the World Bank for South Asia are: Cox's Bazar, Bangladesh; Khulna, Bangladesh; Bakerganj, Bangladesh; Karachi, Pakistan; Jamnagar, India; Vadodara (Baroda), India; Moratuwa, Sri Lanka; Thane, India; Chandpur, Bangladesh; and Bhavnagar, India. Kolkata and Chittagong are identified in the top 25 cities in the world with the most severe human impacts of storm-surges.[21]

The World Bank concludes:

> [Some countries] **will be so heavily impacted** [by sea level rises] **that their national integrity may be threatened**.[22]

3. How much will impacts cost in South Asia and globally?

South Asian countries will require considerable levels of new and additional technology and finance to enable adaptation to the impacts of climate change.

The level of finance required for South Asia will depend on the level of mitigation undertaken globally. Low levels of mitigation imply higher (and potentially exponentially higher) costs.

Based on various estimates of warming, the following costs have been projected for South Asia and for developing countries more generally. Cost estimates are often conservative, and should be updated based on the most recent science and local observation.

Adaptation Estimates for South Asia

Many South Asian countries are already spending a great deal to adapt to climate change. The World Bank has predicted a 2 degree C temperature increase could result in **permanent GDP reductions of 5% for South Asia**.[23]

The World Bank projects that storm surges, just one impact caused by increase sea-level rise, could have an incremental negative impact of 38.4% on coastal area GDP in South Asia.[24]

To give context to these projections it should be recalled that severe droughts in India (just one possible climate impact) cost approximately $7 billion and that these droughts could increase their frequency three-fold (from once every 25 years to once every eight).[25]

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[21]Dasgupta, S., Laplante, B., Murray, S. and D. Wheeler, 'Climate Change and the Future Impacts of Storm-Surge Disasters in Developing Countries', Center for Global Development Working Paper 182, (September 2009), p. 22-24, http://www.ftsnet.it/documenti/534/Climate_change_and_the_future_impacts_of_storm-surge_disasters_in_developing_countries.pdf
[22]Dasgupta, S., Laplante, B., Meisner, C., Wheeler, D. and J. Yan, 'Sea-Level Rise and Storm Surges: A Comparative Analysis of Impacts in Developing Countries', World Bank Policy Research Working Paper 4136, (February 2007), p. 44, http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2007/02/09/000016406_20070209161430/Rendered/PDF/wps4136.pdf
[23]World Bank, 'Climate Smart World Within Reach', 15 September 2009, http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/0,,contentMDK:22316141~pagePK:146736~piPK:226340~theSitePK:223547,00.html?cid=3001_8
[24]Dasgupta, S., Laplante, B., Murray, S. and D. Wheeler, 'Climate Change and the Future Impacts of Storm-Surge Disasters in Developing Countries', Center for Global Development Working Paper 182, (September 2009), p. 25, http://www.ftsnet.it/documenti/534/Climate_change_and_the_future_impacts_of_storm-surge_disasters_in_developing_countries.pdf
[25]Economics of Climate Adaptation Working Group, Shaping Climate Resistant Development, (2009), p. 42, http://www.swissre.com/resources/387fd3804f928069929e92b3151d9332-ECA_Shaping_Climate_Resilent_Development.pdf

According to estimates, "**India is now spending over 2.6 percent of its gross domestic product to adapt to climate change."[26]** This amounts to approximately $32 billion *in India alone in 2010.*

Global Estimates

Research shows damage in developing countries from climate change could cost more than 13.5% of their GDPs by 2100 if no adaptation actions are taken.[27] Costs are predicted to escalate rapidly from 2030. This must be considered in proposing a total adaptation cost.

Existing studies by the UNFCCC Secretariat and other international organizations understate the costs of adaptation to developing countries. An IIED review of the UNFCCC finance study states:

The UNFCCC estimate of investment needs ($66 billion per year) is probably an under-estimate by a factor of between 2 and 3 for the included sectors. The amount would be considerably higher if other sectors are considered.[28]

Important sectors not included in the UNFCCC study are: insurance for climate-change related disaster damage; mining and manufacturing; energy; retail; financial sector; and tourism.[29]

The following table[30] adjusts the UNFCCC figures by a factor of three (3), the inclusion of costs for ecosystem adaptation, and disaster insurance are based on the UNFCCC's studies but not included in its final report.[31]

Sector	UNFCCC Est. for developing countries	World Bank EACC Estimate	IIED Revision
Agricultural, forestry and fisheries	7	7.6	21
Water Supply	9	13.7	27
Human Health	5	2	15
Coastal Zones	4	30.1	12
Infrastructure	41	29.5	123
Ecosystems	0	0	270
Extreme Weather Events/Insurance	0	6.7	200
TOTAL ($US billion)	66	89.6	668

[26]Thaindian News, 'Climate change costs India over 2.6 percent of GDP: Economic Survey', 02 July 2009, http://www.thaindian.com/newsportal/enviornment/climate-change-costs-india-over-26-percent-of-gdpeconomic-survey_100212459.html#ixzz0jnbw50Uk

[27]Frank Ackerman, Elizabeth A. Stanton, Chris Hope, and Stephane Alberth, Did the Stern Review underestimate U.S. and global climate damages?, (Stockholm Environment Institute, Working Paper WP-US-0802), October 2008, p. 10.

[28]Parry, Martin, N. Arnell, P. Berry, D. Dodman, S. Fankhauser, C. Hope, S. Kovats, R. Nicholls, D. Satterthwaite, R. Tiffin, T. Wheeler (2009). Assessing the Costs of Adaptation to Climate Change: A Review of the UNFCCC and Other Recent Estimates, International Institute for Environment and Development and Grantham Institute for Climate Change, London, p. 15.

[29]Listed in, ibid.

[30]Amounts in $US billions

[31]For ecosystem adaptation costs see, ibid, p. 17; For the cost of damages from extreme weather see, Andrew Dlugolecki, The Cost of Extreme Events in 2030, (A report for the UNFCCC, 16 July 2007): Dlugolecki sees a global gap in insurance capital of at least $450 billion, p. 28.

[32]The report only provides a breakdown per-sector using its mid-range figure of $89.6 billion which is based on creating a net sum of all countries, including those who may have positive net effects from climate change – the $102 billion figure excludes the potential for positive impacts.

In addition, the conservative estimate of the macroeconomic cost of extreme weather in World Bank modeling is that a climatic disaster affecting at least half a percent of a country's population, reduces real GDP per capita by 1 percent. With the average incidence post-1990 of one climatic disaster of this size every three years these disasters would reduce GDP per-capita by 3 percent over a decade.[33]

This shows that the finance necessary to prepare for, compensate and survive the impacts of climate change in South Asia alone are well in excess of the $100 billion a year proposed for *all* developing countries in the Copenhagen Accord.

A fuller estimate of the financing and compensation required by South Asian countries should cover: 1) avoidance costs; 2) actual costs; and 3) opportunity costs. Further work is required to evaluate the full extent of these costs.

4. What is required to enable South Asia to minimize the risks, impacts and costs of adapting to and mitigating climate change?

Minimizing the risks, impacts and costs to South Asian countries of adapting to and mitigating climate change requires a position on climate change that is based on the best available scientific and economic analysis and ensures the full and effective implementation of the UN Climate Convention and its Kyoto Protocol.

Such a position must ensure an approach that "adds up" in terms of the main components of a fair and effective deal to address climate change.[34] The main elements are set out in the attached diagram:

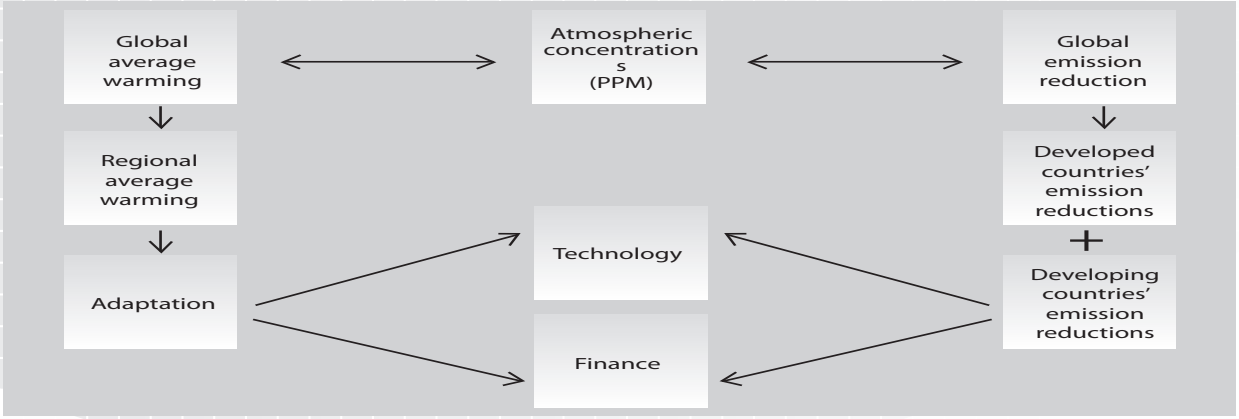
These include:

1. An effort to minimize the risks, impacts and costs of adapting to climate change;
2. An appropriate limit on warming (regional and global);
3. An appropriate limit on global GHG concentrations;
4. An appropriate limit on global GHG emissions (i.e. the remaining carbon budget);
5. An appropriate allocation and sharing of the carbon budget by developed and developing countries;
    a. Appropriate mitigation commitments for Annex I countries;
    b. Appropriate mitigation actions for non-Annex I countries; and
6. Equitable transfers of technology and finance for mitigation and adaptation actions by developing countries.

Effective and accountable institutions must support enhanced action on these elements.

[33]Claudio Raddatz, The Wrath of God: Macroeconomic Costs of Natural Disasters, World Bank Policy Working Paper WPS5039, 1 September 2009, http://econ.worldbank.org/external/default/main?pagePK=64165259&piPK=64165421&theSitePK=469372&menuPK=64216926&entityID=000158349_2009090816455

[34]Stilwell, M, "Solving the climate calculus: Sealing a deal that adds up to keep the world safe" (forthcoming)



This simple set of relations describes the relationship between the main topics being discussed in the climate negotiations under the Kyoto Protocol (AWG-KP) and the Bali Action Plan (AWG-LCA):

- *Shared vision*: A global goal measured in terms of:
  - Temperature limits (e.g. 1, 1.5 or 2 degrees C);
  - Atmospheric concentrations (e.g. 300ppm, 350ppm or 450ppm); or
  - Global emission reductions (e.g. more than 100%, 85% or 50% by 2050 from 1990 levels); as well as
  - Global goals quantifying the other relevant elements below.
- *Annex I mitigation commitments*: Mitigation commitments (under the AWG-KP, and under the AWG-LCA for the United States as a non-Party to the KP) to be fulfilled by developed countries, whether framed as medium term (e.g. 50%, 45% or 30% by 2020) or longer-term (e.g. over 200%, 95% or 80% by 2050) commitments;
- *Non-Annex I mitigation actions*: The mitigation actions to be undertaken by developing countries,enabled and supported by finance, technology and capacity building;
- *Adaptation*. The requirements for adaptation including an appropriate architecture, institutions and funding;
- *Technology*: The associated requirements of developing countries for technology for adaptation and mitigation, in all relevant sectors; and
- *Finance*: The associated requirements of developing countries for technology for adaptation and mitigation, whether framed in financial terms (e.g. $X billion by 2020) or other terms (e.g. 5% Annex I GNP).

For any climate deal to be fair and adequate for the South Asian region this "climate calculus" must add up. Based on the above elements, a fair and adequate approach must – at a minimum – address the following questions:

1. What level of impacts and warming are countries in South Asia willing to risk?
2. What limit on warming does this require globally?
3. What emissions reductions does this require for 2050 (i.e. what is the future global carbon budget)?
4. How should the budget be shared or *allocated* fairly?
5. How should the budget, once allocated, be *used* by Annex I and non-Annex I countries?
   - What mid- and long-term targets for Annex I (i.e. what is Annex I use of the budget)?
   - What mid- and long-term actions for non-Annex I (i.e. what is the non-Annex I "residual" use of the budget)?
6. What technology/finance is required to enable non-Annex I mitigation actions?
7. What technology/finance is required to compensate/adapt to temperature increases?
8. What institutions are needed to deliver this response?

The companion paper entitled *Climate Change and South Asia: Defining a Science-based Position on Climate Change* offers some preliminary responses to these questions, as the basis for further discussions among civil society and policy-makers in the South Asian region.

Part II: Defining a Science-based Position on Climate Change

Overview

This paper is for citizens and Governments of the South Asian Association for Regional Cooperation (SAARC) namely: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka.[35]

It explores the elements of a science-based position on climate change designed to reduce the projected risks, impacts and costs to the region. It asks the following eight questions:

1. What level of warming is South Asia willing to risk?
2. What limit on warming does this require globally?
3. What emissions reductions does this require for 2050 (i.e. what is the future global carbon budget)?
4. How should the budget be shared or *allocated* fairly?
5. How should the budget, once allocated, be *used* by Annex I and non-Annex I countries?
    a. What mid- and long-term targets for Annex I (i.e. what is Annex I use of the budget)?
    b. What mitigation actions for non-Annex I (i.e. what is the non-Annex I "residual" use of the budget)?
6. What technology/finance is required to enable non-Annex I mitigation actions?
7. What technology/finance is required to compensate/adapt to temperature increases?
8. What institutions are needed to deliver this response?

What level of warming is South Asia willing to risk?

According to analysis in the IPCC 4th Assessment Report, South Asia is the only sub-region in Asia to record the status of 'highly vulnerable' for all of the following sectors: food and fiber; biodiversity; water resources; costal ecosystems; human health; and land degradation.[36]

Keeping temperatures down is required to avoid a range of threats. These include:

- Increase in the frequency of intense precipitation events in parts of South Asia;[37]
- Increase in extreme rainfall and winds associated with tropical cyclones;[38]
- 23% to 33% of coastal zones could be subjected to inundation risk;[39]
- Crop yields could decrease up to 30% in South Asia by the mid-century;[40]

[33]Claudio Raddatz, The Wrath of God: Macroeconomic Costs of Natural Disasters, World Bank Policy Working Paper WPS5039, 1 September 2009, http://econ.worldbank.org/external/default/main?pagePK=64165259&piPK=64165421&theSitePK=469372&menuPK=64216926&entityID=000158349_2009090816455

[34]Stilwell, M, "Solving the climate calculus: Sealing a deal that adds up to keep the world safe" (forthcoming)

- Storm surges caused by sea-level rise could reduce the GDP of coastal areas by 38.4%;
- A 2°C increase could result in permanent GDP reductions of 5% for South Asia;[41] and
- Displacement of people as sea level rise along with the disproportionate impacts could threaten the national integrity of some states.[42]

2. What limit on warming does this require globally?

South Asian and other developing countries are losing billions of dollars due to climate change.[43] Further warming in South Asia will cause further – and escalating – levels of damage and suffering.

According to the IPCC, "warming greater than the global mean is projected for South Asia (3.3°C)"[44]. This is around 1.4 times the global average projected warming (2.3°C).[45]

Keeping temperature increase in South Asia to well below 1.5°C could thus require a global goal of "below 1°C". Keeping it well below 2°C could thus require a global goal of "below 1.5°C".

3. What emissions reductions does this require for 2050 (i.e. what is the future global budget)?

Limiting temperature increase requires limiting GHG concentrations and emissions. Limiting concentrations to 350ppm CO2[46] yields:

- 14% chance of exceeding 2°C globally; and
- Considerable chance of exceeding 1.5°C globally.[47]

Even temperatures/risks of these levels are arguably unacceptable to South Asia. To limit concentrations to 350ppm CO2, emissions must be limited to 750GtCO2 between 2000 and 2050. Of this amount, 33oGtCO2 has been used between 200o to 2009, leaving 420GtCO2.[48]

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[40] World Bank, at: http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/0,,contentMDK:21469804~menuPK:2246552~pagePK:2865106~piPK:2865128~theSitePK:223547,00.html

[41] **Study: "The World Development Report 2010: Development and Climate Change"** More at : Climate change may reduce South Asia GDP 4-5 percent: World Bank http://www.thaindian.com/newsportal/business/climate-change-may-reduce-south-asia-gdp-4-5-percentworld-bank_100248000.html#ixzz0jnghLOpn

[42] Dasgupta, S., Laplante, B., Meisner, C., Wheeler, D. and J. Yan. (2009). **"Sea-Level Rise and Storm Surges: A Comparative Analysis of Impacts in Developing Countries.**" World Bank Policy Research Working Paper 4136. February 2007. Available: 3_Dasgupta et al.pdf

[43] See, e.g., Global Humanitarian Forum, Human Impacts Report: Climate Change – The Anatomy of a Silent Crisis (2009). See also, Mirza M, Climate change and extreme weather events: can developing countries adapt? in CLIMATE POLICY, 3 (2003) at 233-248

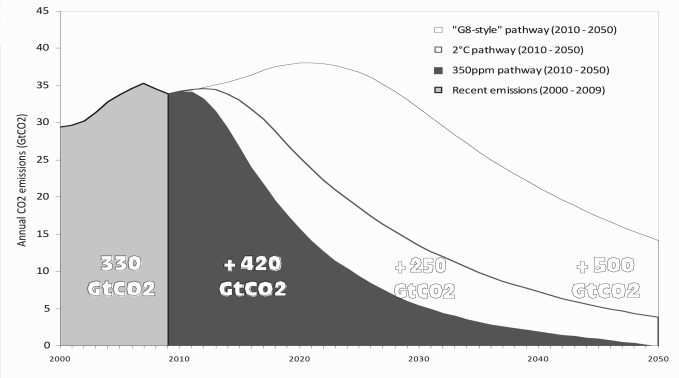
[44] http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch11s11-4-3.html

[45] Contribution of Working Group I to the IPCC Fourth Assessment Report, Chapter 11, Regional Climate Projections, at page 866-867

[46] This is consistent with the position in the UNFCCC negotiations of the Group of Least Developed Countries and the Alliance of Small Island States.

[47] A 350ppm Emergency Pathway, P. Baer T. Athanasiou and S. Kartha (2009). This budget and associated calculations build on the influential work of Meinshausen, M., N. Meinshausen, W. Hare, S. C. B. Raper, K. Frieler, R. Knutti, D. J. Frame and M. R. Allen (2009). "Greenhouse-gas emission targets for limiting global warming to 2°C." Nature 458: 1158-1163. (http://www.nature.com/nature/journal/v458/n7242/full/nature08017.html). They also build on the work of NASA scientist Dr. James Hansen and colleagues. See, e.g., Hansen, J., M. Sato, P. Kharecha, D. Beerling, R. Berner, V. Masson-Delmotte, M. Pagani, M. Raymo, D. L. Royerm and J. C. Zachos (2008). "Target Atmospheric CO2: Where Should Humanity Aim?" The Open Atmospheric Science Journal 2: 217-231. www.columbia.edu/~jeh1/2008/TargetCO2_20080407.pdf (See Annex C for further information on probabilities)

to 2009, leaving 420GtCO2.[48]



Lesser levels of ambition have been misleadingly presented elsewhere as consistent with keeping warming below 2°C. In particular, developed countries have called for a 50% global emission reduction by 2050 from 1990 levels. This, however, entails a risk of more than 50% of exceeding 2°C (and considerably higher levels of warming in South Asia). It would not be reasonable, therefore, to characterize this as a "two degree" pathway.

Even an 85% global cut by 2050 entails a risk of exceeding 2°C of around 25%. Both this level of warming and the probability of exceeding it are unacceptable to South Asian countries. See Annex A for further information on probabilities.

4. How should the budget be shared or *allocated* fairly?

A sustainable approach to climate change requires the Earth's emissions budget to be set at levels that avoid dangerous climate change.

An equitable approach to climate change requires the Earth's emission budget – a resource worth trillions of dollars[49] – to be allocated fairly.

The graphic below describes allocation of the budget (historical to 2050, 1660 GtCO2 in total). On this scenario:

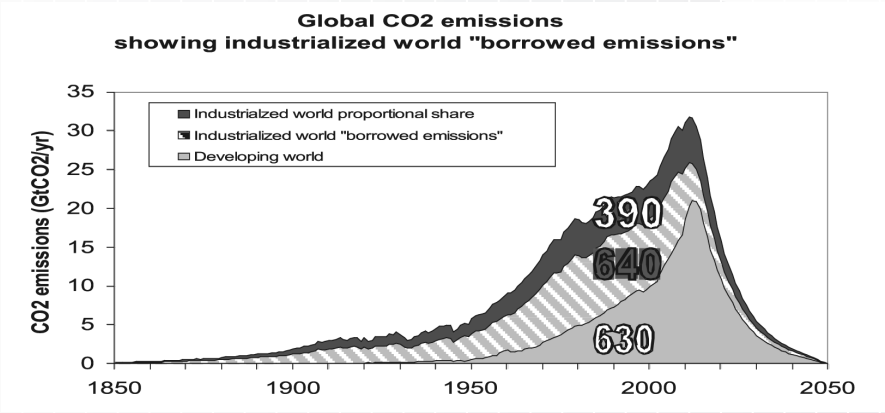
- Annex I would be allocated 390 GtCO2 based on their population ratio (around 20% of world population).
- Non-Annex I would be allocated 1270 GtCO2 (i.e. 640 plus 630 GtCO2, around 80% of world population).

On this scenario, Annex I would actually use 640GtCO2 more than a fair allocation of

[48]Id. Note that the "G8-style" pathway reflects the position of some developed countries that global emissions should peak and decline by 50% by 2050 from 1990 levels. The "2 degrees" pathway builds on the work of Meinshausen et al. See, e.g., M., N. Meinshausen, W. Hare, S. C. B. Raper, K. Frieler, R. Knutti, D. J. Frame and M. R. Allen (2009). "Greenhouse-gas emission targets for limiting global warming to 2°C." Nature 458: 1158-1163. (http://www.nature.com/nature/journal/v458/n7242/full/nature08017.html).

[49]Nicholas Stern (stating "If the allocations of rights to emit in any given year took greater account both of history and of equity in stocks rather than flows, then rich countries would have rights to emit which were lower than 2 tonnes per capita (possibly even negative). The negotiations of such rights involve substantial financial allocations: at $40 per tonne CO2e a total world allocation of rights of, say, 30Gt (roughly the required flows in 2030) would be worth $1.2 trillion per annum"), in The Global Deal (2009) at page 154.

industrial emissions[50], taking or "borrowing" it from non-Annex I countries.



5.How should the budget, once allocated, be *used* by Annex I and non-Annex I countries?

Once the budget has been allocated fairly, Parties can discuss how to use the budget, and the resource transfers required when use differs from allocation.

a. What mid- and long-term cuts for Annex I (i.e. what is Annex I use of the budget)?

The scenario above assumes that Annex I countries cut their emissions by at least half by 2017[51] and become carbon neutral before 2050.

On this scenario, the 20% of the world's population in Annex 1 countries would still have used 640GtCO2 more than their fair share of the global budget. This implies Annex 1 countries would be using:

- More than 60% of the total global budget (historically to 2050); and
- More than 40% of the remaining global budget (2000 to 2050).

They should compensate developing countries for their over-use of a trillion dollar resource, providing one basis for financial transfers/compensation to developing countries.

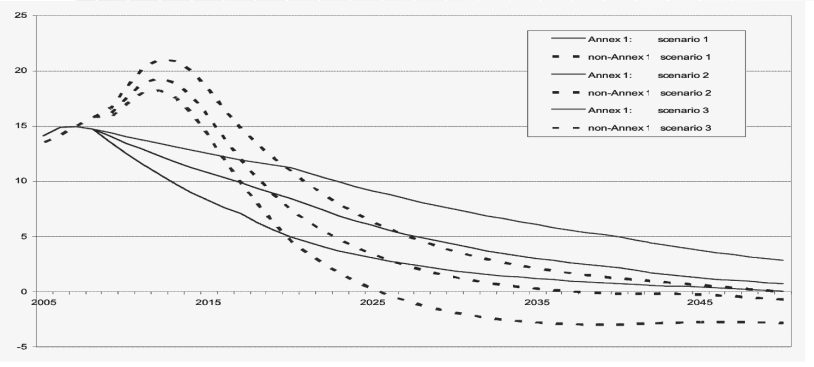
b. What mitigation actions for non-Annex I (i.e. what is the non-Annex I "residual" use of the budget)?

Assuming this scenario (shown as scenario 1, below), non-Annex I would still need to cut emissions drastically if global emissions are to remain within the budget set by the 350ppm pathway.

They would need more ambitious cuts if Annex I accept less of the burden of cutting their own emissions (scenarios 2 and 3).

[50] A range of approaches may be considered for allocating atmospheric space and the burdens of living within it fairly. Per-person allocation on a historical and future basis is one simple methodology. Others can also be considered.
[51] This is consistent with the approach put forward by Bolivia in negotiations under the AWG-KP, on behalf of countries including Bhutan, Ethiopia, Malaysia, Micronesia, Paraguay, Sri Lanka and Venezuela

They would, on the other hand, need less ambitious cuts if Annex I accept more of the burden – e.g. becoming "carbon negative" before 2050 by reducing and then removing GHG emissions.



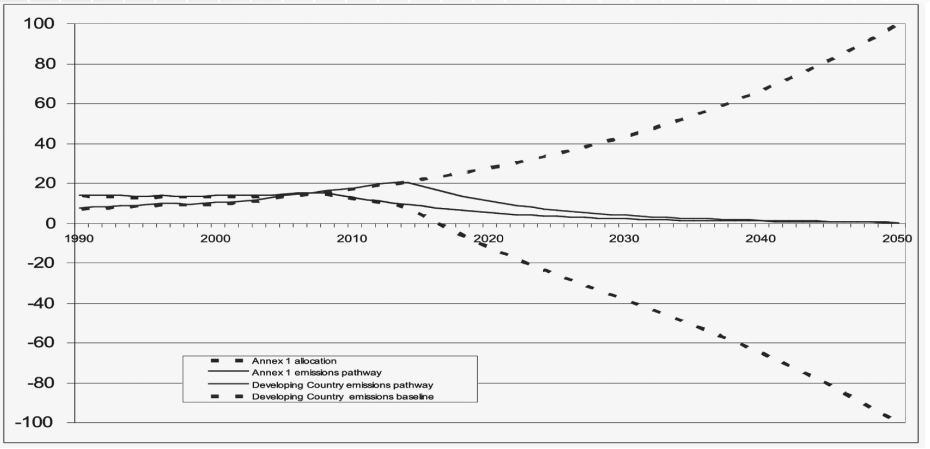
6. How much finance is required for mitigation action in South Asia?

The level of technology/financing required by non-Annex I depends on:

- The number of tons of GHG to be reduced; and
- The cost per-ton of reducing emissions.

Number of tons: The number of tons to be reduced depends on the difference between:

- The expected level of emissions in any year needed to meet non-Annex 1 needs (a "baseline"); and
- The available level of emissions in any year (an "emissions pathway").



Cost per ton: Assuming this scenario, if non-Annex I is to reduce by 8 GtCO2 in 2017 then financing of:

- 489 billion Euro will be required if the average cost per ton is 60 Euro; and
- 814 billion Euro will be required if the average cost per ton is 100 Euro[52].

		Finance and Technology expressed in billions of Euros	
	GtCO2	60 Euro/tCO2	100 Euro/tCO2
Finance and Technology (2017)	8	489	814
Finance and Technology (2020)	15	918	1,530
Finance and Technology (2010-2020)	44	2,648	4,413
Finance and Technology (2010-2050)	1,606	96,347	160,579

7. What technology/finance is required to compensate/adapt to temperature increases (i.e. point (4))?

Climate financing and compensation should cover: 1) avoidance costs; 2) actual costs; and 3) opportunity costs.

Adaptation costs can be reduced by:

- Deep emission reductions by Annex I countries;
- Major financing/technology for emission reductions by non-Annex I countries; and
- Major financing/technology to avoid costs (1), thereby reducing actual and opportunity costs (2 & 3).

India estimates it is already spending over 2.6% of GDP to adapt to climate change.[53] The World Bank has estimated that a global temperature increase of 2°C (consistent with the goal proposed by G8 countries) could see a 5% permanent reduction of GDP for South Asia.[54]

Recent estimates put potential global costs and damages from climate change into the trillions. One recent study, by Allianz insurance company, suggests that the value of assets at risk from sea level rise in global port facilities alone by 2050 could exceed $22 trillion dollars.[55]

[52]This analysis excludes offsets, which would require additional financing (as the burden of mitigation would shift even further to the developing countries)
[53]More at : Climate change costs India over 2.6 percent of GDP: Economic Survey
http://www.thaindian.com/newsportal/enviornment/climate-change-costs-india-over-26-percent-of-gdpeconomic-survey_100212459.html#ixzz0jnbw50Uk
[54]Study: "The World Development Report 2010: Development and Climate Change"
More at : Climate change may reduce South Asia GDP 4-5 percent: World Bank
http://www.thaindian.com/newsportal/business/climate-change-may-reduce-south-asia-gdp-4-5-percentworld-bank_100248000.html#ixzz0jnghLOpn
[55]See: https://www.allianz.com/en/press/news/commitment_news/environment/news_2009-11-23.html

As noted by the World Bank in relation to South Asia, the "magnitude of displacement of people as sea level rises along with the disproportionate impacts that could threaten the national integrity of some states."[56]

8. What institutions are required to deliver all this?

Achieving this requires new institutions for mitigation, adaptation, technology transfer and finance. It will require a major mobilization to help people address the inevitable damage associated with current and committed warming. And it will require a major effort to deploy technologies in all countries within the next five to ten years. Achieving this will require a "Marshall Plan" scale effort.

[56]Dasgupta, S., Laplante, B., Meisner, C., Wheeler, D. and J. Yan. (2009). **"Sea-Level Rise and Storm Surges: A Comparative Analysis of Impacts in Developing Countries**." World Bank Policy Research Working Paper 4136. February 2007. Available: 3_Dasgupta et al.pdf

Part III: Defining a Common Shared Vision for South Asia

Overview

This section deals with common elements mentioned as shared vision in various conference of parties (COP) decisions and how this may guide to develop a common position for South Asia. The following questions will be addressed in this section:

1. What does the current shared vision framework mean for South Asia?
2. How the context of vulnerability is used to define shared vision?
3. What are the real implications of Climate Change for South Asia?
4. What do we have on the table at SAARC?
5. What would be the final outline for South Asia Shared Vision?

1. What does the current shared vision framework mean for South Asia?

The current form of shared vision has mainly the following four components:

- Level of stabilization of GHG concentration – **350ppm** CO2 eq
- A limit of the global average temperature increase – **[1.5]** degree Celsius above the pre-industrial level and **[2]** degree Celsius above the pre-industrial level
- 2050 is appropriate time frame for long term goal. GHG emission reduction – **50** percent of 1990 level, **85-95%** for developed counties percent of 1990 level (there are figures with base year 1990, 2000, without base year)
- Global average GHG emission per capita reduced to about **2tCO2**

The most important issue is temperature increase. According to IPCC, South Asia would face more warming than global average projected warming. In this case, if South Asia strives for below 2^0C increase, globally it requires the temperature increase to be below 1.5^0C; and if it is 1.5^0C for South Asia, globally it should keep below 1^0C. Hence, the current status of temperature increase in the context of shared vision does not have a significant meaning for South Asia. With a 2^0C increase, it is inevitable that this region will face the higher warming than global average.

The other issues of GHG emissions are interlinked with GHG concentration, emission reduction target and per capita emission goal. The figures that we have on table are associated with the temperature increase of 2^0C. Even this figure runs a risk of exceeding the temperature limit of 2^0C.

If it is about defining the temperature increase for South Asia, that would be globally either 1^0C so that the increase in this region would be 1.5^0C. Accordingly, the goals for emission reduction targets and GHG concentration should be determined.

From the political negotiation context, it is evident that countries in this region have different positions as their national interests are linked with global interest and have political alignment with various blocs.

2. How the context of vulnerability is linked with shared vision?

The issue of vulnerability has been mentioned in various forms in several research works and dialogues. However, it could not have left a remarkable dent in the context of defining shared vision from political perspectives. The situation is far worse in the South Asian region. If 2.33^0C global average increases means shooting over more than 3^0C for South Asia, the vulnerability of South Asian people would increase to a scale of no return point. It should be noted that more than 40% of world's poorest population live in this region.

Vulnerability,[57] in simple terms, means a state that is function of exposure and can be measured in terms of severity of changes through climate change, sensitivity of the given systems; and inversely related to the strengths of current situation to tackle. The higher the strengths of any system, the lower would be the level of vulnerability. In the context of climate change, if temperature increases so high that the whole vulnerability leads to infinity, the scale and amount of strengths of the system do not have any implication.

Thus, shared vision requires a time line with a stringent target of emission reduction so that the temperature increase would be far below 2^0C. South Asia should consider a drastic emission reduction plan, within a short period of time, an agreed upon peaking in a shorter time frame, adaptation actions through enhancement of adaptive capacity and assistance by means of financing, technology transfer, skills.

3. What are the implications of Climate Change in South Asia?

The real implication for south Asia can be summarized in the following table:

Sea level rise Glacier melting Temp increase Frequent floods Frequent droughts Afghanistan Yes Yes Yes BD Yes Yes Yes Yes Yes Bhutan Yes Yes Yes India Yes Yes Yes Yes Yes Maldives Yes Yes Yes Nepal Yes Yes Yes Pakistan Yes Yes Yes Yes Yes Srilanka Yes Yes Source: WB (2009)

A sustainable approach to shared vision for South Asia requires two approaches: one is based on how this region is addressing jointly the current global shared vision and the other is about inward strategy. From the above table, it is evident that this region needs to address these two approaches together.

[57](Modified from Metzger et al., 2006)
Vulnerability is a state $\mathcal{V} \propto f\,\mathcal{E} * \mathcal{S} * 1/\mathcal{R}$; E is the measure of severity of the change, S is the sensitivity of the system (or the subject) to the exposure, R is the strength of the system to respond, defy and even take advantage of the imminent condition(s)

And this must be guided by the following approaches:

- **Water Security – regional equitable water management across basins**
- **Food Security – Ensuring food production and food availability regionally**
- **Energy Security – ensuring access to energy and energy cooperation**
- **Livelihoods Security – regional approach to address agriculture**

4. What do we have on the table at SAARC?

Though Climate Change has become one of most important national agenda for south Asian nations, SAARC has been playing a timid role. So far, we have one SAARC climate change action plan[58] but that can be considered only as an agreed written document and no guideline to implement that.

As far as declaration is concerned, Climate Change is mentioned only under Environment. In other areas, like in (Para 8, 9) of last Colombo declaration, it is only mentioned that more energy cooperation is requires and focus on renewable energy, efficiency and trading; technology sharing. It has also mentioned about regional hydro, grid and gas pipelines connectivity. Para 10 -14 mentions '…to intensify cooperation within expanded regional environmental protection framework.'[59]

However, there has been some progress at ministerial levels. The last ministerial meeting held in October 2009 at New Delhi decided that next summit theme would be on "Climate Change", there would be at least one sharing meeting every year and south Asia would work together for a common position on CC negotiations

5. What will be outline of South Asia Shared vision?

South Asia should adopt two approaches together to address the shared vision. In the context of global shared vision it is imperative to take an outward strategy which would address the four components of current form with a common political approach.

And most importantly, an inward strategy is required which regional issues would guide. In order to define that inward approach, we need SAARC cooperative actions towards long-term goals for greener equitable development paths based on common but differentiated responsibilities and respective capabilities within South Asia and social and economic conditions and other relevant factors.

[58]SAARC Action Plan on Climate Change, initiated the discussion at the Twenty-ninth session of the SAARC Council of Ministers (New Delhi, 7-8 December 2007) and adopted at 15th SAARC Summit

[59]Fifteenth SAARC Summit, Colombo, 2-3 August 2008, Declaration, Partnership for Growth for Our People

Annex A

Probabilities (Adapted from Baer et al., (footnote 4))

Meinshausen, M., N. Meinshausen, W. Hare, S. C. B. Raper, K. Frieler, R. Knutti, D. J. Frame and M. R. Allen (2009). "Greenhouse-gas emission targets for limiting global warming to 2°C." *Nature* 458: 1158-1163. (http://www.nature.com/nature/journal/v458/n7242/full/nature08017.html). Meinshausen et al do a sophisticated statistical analysis to ground the calibration of their model (version 6.0 of MAGICC, an intermediate-complexity climate model that has often been used in the IPCC's scenario analyses due to its capacity to mimic the response of various general circulation models). The key results are shown in their Table 1, reproduced below. Although they also show graphically the spread of CO_2 concentrations associated with their model runs, they don't report them in a way that allows easy analysis in cumulative emissions terms. For example, their figures only report out to 2100.

It is important to note that the estimates of the risk of exceeding 2°C reported above are based on the "Illustrative default parameters" of Meinshausen et al., who point out that less optimistic assumptions are also scientifically defensible, and would raise the estimated risk of exceeding 2°C along the two less ambitious pathways presented in figure 1 above ("2°C pathway" and "G8-style pathway") to more than 40 – 70%.

Table 1 | Probabilities of exceeding 2 °C

Indicator	Emissions	Probability of exceeding 2 °C*	
		Range	Illustrative default case‡
Cumulative total CO_2 emission 2000–49	886 Gt CO_2	8–37%	20%
	1,000 Gt CO_2	10–42%	25%
	1,158 Gt CO_2	16–51%	33%
	1,437 Gt CO_2	29–70%	50%
Cumulative Kyoto-gas emissions 2000–49	1,356 Gt CO_2 equiv.	8–37%	20%
	1,500 Gt CO_2 equiv.	10–43%	26%
	1,678 Gt CO_2 equiv.	15–51%	33%
	2,000 Gt CO_2 equiv.	29–70%	50%
2050 Kyoto-gas emissions	10 Gt CO_2 equiv. yr^{-1}	6–32%	16%
	(Halved 1990) 18 Gt CO_2 equiv. yr^{-1}	12–45%	29%
	(Halved 2000) 20 Gt CO_2 equiv. yr^{-1}	15–49%	32%
	36 Gt CO_2 equiv. yr^{-1}	39–82%	64%
2020 Kyoto-gas emissions	30 Gt CO_2 equiv. yr^{-1}	(8–38%)†	(21%)†
	35 Gt CO_2 equiv. yr^{-1}	(13–46%)†	(29%)†
	40 Gt CO_2 equiv. yr^{-1}	(19–56%)†	(37%)†
	50 Gt CO_2 equiv. yr^{-1}	(53–87%)†	(74%)†

* Range across all priors reflecting the various climate sensitivity distributions with the exception of line 12 in Fig. 3a.
† Note that 2020 Kyoto-gas emissions are, from a physical perspective, a less robust indicator for maximal twenty-first century warming with a wide scenario-to-scenario spread (Supplementary Fig. 1c).
‡ Prior chosen to match posterior of ref. 19 with uniform priors on the TCR.

Reproduced from Meinshausen et al. (2009)

While Meinshausen et al. do not report in their main paper on model runs that match the 750 GtCO2 cumulative emissions corresponding to Hansen et al.'s central scenario, these results are available from a downloadable calculator included in the "supplementary material" available from the online *Nature* journal. The result is that a pathway with a 750 GtCO2 cumulative budget (2000-2049) has a 14% chance of exceeding 2°C based on the "Illustrative default case" of Meinshausen *et al* (and the range is 5 – 30%.

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