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Bhutan's Glaciers Meltdown, Threats and the Need for Joint Response Mechanism

LHAM DORJI

Socio-Economic Research and Analysis Division
National Statistics Bureau
THIMPHU

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Introduction

Major glacier-fed rivers of Bhutan flows into Indian (Brahmaputra), runs through Bangladesh [as River Jamuna, Megna and Padma] and empty into Bay of Bengal. The risk of Glacial Lakes Outbursts Floods (GLOF) is lately identified as the main climate change challenge in Bhutan and Nepal (Himalayan-Hindu Kush regions) with 'rippling effects' in the lowlands of India, Bangladesh and the islands of Maldives and Sri-Lanka. GLOF aside, the impacts of melting glaciers are notable as periodic landslides and flashfloods in the mountains, soil siltation and floods in the plains, and other geotechnical hazards in the Eastern Himalayan Quadrangle (EHQ) countries of Bhutan, Bangladesh, India and Nepal (also known as GBM countries). The EHQ region is also referred to as 'water towers of Asia' or 'Third Pole' because of the largest glaciated area beside two poles.

Bangladesh and part of Northern India Region (NER) as riparian lands are more vulnerable to glaciers melting and associated disasters. Such vulnerability is expected to escalate with the rise in global temperature, melting of snows, and the frequent combination of peak flows of River Ganges, Brahmaputra and Megna (GBM). The alteration of hydrological cycle and ecosystems brought about by receding glaciers can increase erratic monsoon patterns thus making both floods and droughts more common in the EHQ region. Droughts can occur, because most of the rivers in GBM are stored for part of the year in snowpack, and reductions or unseasonable snowmelts are expected to increase the risk of drought. Out of 128 natural disasters recorded in South Asia between 2006 and 2008, 93% of these were of hydro-meteorological, and most of these disasters occurred in Bangladesh and India (South Asia Disaster Report, 2008).

In the long period, the retreat of glacier-fed rivers due to warming of cryosphere, shifting rainfall patterns and decline in ground water levels can lead to acute and unprecedented shortage of water and variation of water cycle in the EHQ. It is predicted that by 2025, most of the countries in the EHQ region will face either physical or economic scarcity of water (FAO, 2005 cited in Jaitly, 2009, p. 17).[1] The Intergovernmental Panel on Climate Change (IPCC) concluded more than 90% likelihood of most river basins turning drier leading to persistent water shortages[2] (Jaitly, 2009, p. 18, cited in Kundzewics et al, 2008). This is expected to aggravate water-related conflicts, mal-adaptations across the boundaries and add significant risks to already volatile disaster situation.

On top of the emerging water risks, the trans-boundary water issues have never been harmonized among the countries in the EHQ. The water diplomacies between them are usually overshadowed by the idea of 'water rights and allocations' rather than 'benefit-sharing, joint water management and building adaptive capacity to address the shared vulnerability to the climate change', and more so, by political apprehensions. For example, India had been fairly occupied by China's proposal to dam Yarlung Tsangpo or upper Brahmaputra, which consists of only 20% of water flowing through India with its sensitivity felt only during lean seasons, whereas the urgent need was to focus on managing about 80% of water emerging from the Himalayan region. This issue, which is more or less based on political perception of threat, took a great deal of India's advertence.

Some progress is made in terms of recognizing the trans-boundary water challenges as having the regional dimension such as the recent declaration in Thimphu by the ministers of EHQ countries on the need to work together to carry forward GBM regional cooperative action programmes. However, further coordinated actions by the EQH countries will be crucial to harmonize policies and efforts to minimize the emerging climate change challenges associated with trans-country Rivers, particularly in the context of

[1] Troubled Waters : Climate Change, Hydropolitics, and Transboundary Resources David Michel Amit Pandya *Editors* Copyright © 2009 The Henry L. Stimson Center, paper by Ashok Jaitly

[2] B. C. Bates, Z. W. Kundzewicz, S. Wu, and J. P. Palutikof, eds., *Climate Change and Water*, IPCC Technical Paper VI (Geneva: IPCC, 2008).

immediate and long term consequences of glaciers meltdown.

The Bhutanese government is giving the highest priority to mitigate GLOF and is preparing for its disasters. Rapid melting of glaciers is brimming up many moraine glacial lakes in Bhutan, causing the natural water reservoirs to recede and increasing the risk of glacial lakes outburst [anytime]. About 25 out of 2674 glacier lakes in the country are identified as potentially dangerous of bursting and flooding the valleys and plains down streams. The action taken so far by the Bhutanese government is to be seen as prudent preventive and adaptive short-term response to the perceived threats of GLOF. The country remains almost helpless when it comes to mitigating the risks of permanent retreat of glaciers that feed major rivers in the region. This call for three strategic policy responses: mitigative response to minimize GLOF threats, adaptive response if disasters occur, and long term mitigation effort to decelerate—if not halt— the permanent evanescence of mountain snows.

Bhutan's national-level mitigation effort against the GLOF threats is an important step, but it is not sufficient, unless there is strong trans-boundary conscience and regional cooperative framework for actions at the EQH level. Both Bhutan and Nepal understand the criticality of mitigating GLOFs, but it is the issue that is not to be left to them alone given the higher propensity of indirect, foreseeable and devastating trans-boundary impacts in the south, and also considering the labour and cost intensive nature of such efforts.

This paper, which mainly focuses on the Bhutan's context, looks into how the countries in the Eastern Himalayan Quadrangle (EHQ) can cooperate to mitigate and adapt to GLOFs, gradual recessions of glaciers, monsoon floods and other natural disasters caused by climate change. This paper also attempt to elucidate how the EHQ countries can use trade relations, agriculture cooperation, energy development, technology exchange and information sharing to mitigate and adapt to the impacts of climate change.

GLOF adaptation and mitigation efforts in Bhutan

The environmental conservation through sustainable management of natural resources and ecosystem services has been the cornerstone of the Bhutanese GNH policy. The government has long recognized environment as crucial to fulfill various development goals including poverty reduction, and is now in the process of streamlining the climate change issue into the main development framework.

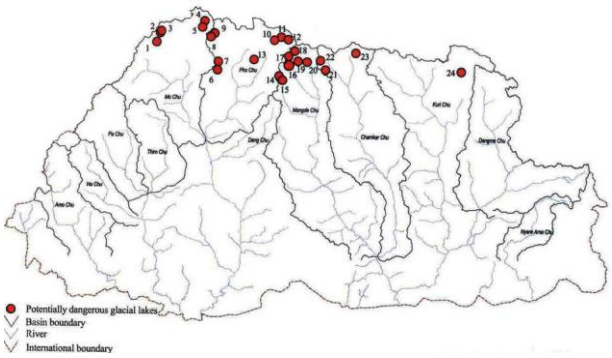
The most important contribution of Bhutan to regional and global efforts to reduce climate change impacts is its forest coverage of 70.46% (51.32% secured as protected areas and biological corridors), which serve as rich reservoir of biodiversity and carbon sink. Bhutan's carbon production is approximately 1.5 million tons, the volume far lower than its carbon absorption capacity of roughly 6.3 million tons. Bhutan is one of the few countries in the world with negative carbon emissions (NAP Biodiversity Persistence and Climate Change Report, Bhutan, 2011, p.4). Despite its effort, Bhutan's status as negative carbon emitter and its commitment to maintain the same status in perpetuity may not make Bhutan invulnerable to the impacts of global climate change. The rise in global temperature will render the country more susceptible to climate risk as warming is higher in the Himalaya regions due to extreme altitudinal variations (Sherstha & Eriksson, 2009,pp?)

The risks of GLOF present new threats to lives, livelihoods and development for Bhutan. There are now enough evidences of the glaciers in Bhutan, located in the northern fringes of the country (figure 1) [3] retreating fast. Karma et al (2003) observed higher rates of debris-free glaciers retreat in Bhutan than in eastern Nepal. They attribute this to the sensitivity of these glaciers to the intensity and variability of monsoon. The Department of Geology and Mines' (DGM) study using satellite images shows that Bhutan's snow caps are receding at the rate of 20-30 metres per annum,

[3] Securing the Natural Freshwater Systems of the Bhutan Himalayas Climate Change and Adaptation measures on Water Resources in Bhutan November, 2011, Country Paper, Climate Summit for Living Himalaya, Thimphu, 2011.

and that they are moving closer to reaching critical geostatic thresholds.

Figure 1: Bhutan's glaciers and glacial lakes



Source: Securing National Freshwater in Bhutan, Report for 2011 Climate Summit

The historical trend of glacial lakes outburst in Bhutan, though ascribed to climate change only very recently, shows recurrent occurrences of the GLOFs (in 1957, 1960, 1968 and 1994). A study by DGM with Institute of Geology, University of Vienna (2002) warns about the potential GLOF from Raphstreng and Thorthormi Glacier Lakes. The combined GLOF of these two lakes is expected to result in a flow of over 53 million cubic metres of water that can cause devastating damages in the lower valleys, and further down in plains and coastal zones.

For Bhutan, besides affecting the human lives the GLOFs are likely to impinge on the very backbone of the Bhutanese economy-the hydropower sector, which constitutes 22% of GDP and agriculture. Bhutan plan to invest US$ 3.3 billion for the additional capacity of 3.8 GWe by 2022. The local studies reveal that seasonal variation in water flows already affect optimum utilization of the power plants besides the probable destruction to the infrastructure in case of lake outbursts. Unless significant and sustained actions are undertaken at the regional level to maintain the amounts of ice stored in mountains, glaciers in Bhutan may disappear in a few decades that otherwise serve as natural water reservoirs and regulator of seasonal flows of rivers in Bhutan, Bangladesh and Northern India.

Bhutan's hydropower energy export also contribute towards reducing burning of fossil fuels—coal, oil and natural and heat trapping greenhouse gases (GHGs) and in maintaining healthier regional and global environment. The eco-friendly clean energy sharing mechanism between Bhutan and India is a good example, and many feels it deserve to be considered for carbon credit gains for its role in offsetting industrial pollution in the region. It is sadly ironical that such beneficial joint undertaking is under threats from GLOF and glaciers meltdown that is not of Bhutan's own-making, but the legacies of more industrialized nations, and that no credits are given to such green projects. It is obvious that the magnitude of future climate change and severity of its impacts in the EHQ region will grow if the option to rely on this alternative source of energy becomes inoperable due to glacial retreats.

The Bhutanese government has initiated the several adaptation activities such as artificial lowering of the level of risky lake (Thorthomi Glacier Lake), GLOF hazard zoning, landslide management and flood prevention and watershed management. The overall progress of these activities are, nonetheless, hindered by lack of resources and expertise, considering huge number of risky lakes that needs similar measures and a demanding nature of this task as access to glacial lakes are by foot only for six months and the tasks have to be executed without using machines.[4] The budgetary assistance of US$ 4.2 million from the Global Environment Facility (GEF) under LDCF seems insignificant in relation to the magnitude of the problem and huge logistic impediments. LDCF-funded project[5] cover only three GLOF out of nine NAPA priority projects. The co-financing is provided b the RGoB (USD 2.6 Million), by the Austrian Development Agency (USD 0.8 Million), WWF (USD 30,000) and UNDP (USD 526,000).

[4] Bhutan National Adaptation Programme of Action, National Environment Commission, Thimphu.

[5] This fund was set up with voluntary contributions from developed countries. The Adaptation Fund, currently the only active fund, was born very late at the United Nations' Climate Conference in Bali in 2007 and is funded through a mechanism of 2% levy on CDM projects, which is wholly inadequate and places no additional burden upon those who are primarily responsible for the impacts of Climate change.

Past deadlock in joint climate change mitigation and adaptation efforts

Bhutan has a major stake in the prevention and mitigation of GLOF related disasters [not only for its own sake] to prevent undesirable destruction in the plains of Bangladesh[6] and NER. There is a salient need for the EHQ countries to recognize the regional dimension of GLOFs and their shared vulnerability rather than consider GLOFs as phenomenon specific to those countries with glacial lakes. This is so in the context of trans-boundary river system (for example, India and Bangladesh share about 57 rivers) and regional nature of disasters.

Bhutan alone can neither deal with the apparent rise in the GLOF risks caused by the impacts of climate change nor are its impacts confined to it. The current disaster management policies, risk reduction and preparedness plans in Bhutan can address only the recurrent natural hazards in the country; they are apparently not prepared to deal with new GLOF and its impacts beyond borders[7] (Country Paper-water, RGoB, SAARC Climate Summit, 2011, p. 20). This situation call for a joint effort, but at present, there is not much combined actions or concerted efforts towards mitigating GLOF threats. The cooperation between the EHQ countries in the common use and management of these transnational rivers is more or less mired in political controversies.

The treaties over the Ganges and Mahakali (1996) between India, Bangladesh and Nepal, which many described as interim measure to settle differences within the limited context (Jaitly, pp. 27) is by no means an arrangement meant for the optimum management of trans-boundary rivers, and in no way take into account the integrated system of mitigating the threats of GLOFs and glaciers retreat. Transnational river basins have remained a contentious issue between Bangladesh, India and Nepal that may worsen with the increase in GLOF threats and growing scarcity of glacial fed rivers unless some common framework is developed and actions are taken together.

India as a major regional player and with more capacity to assist the neighbours in climate change adaptation and mitigation is not doing enough, especially for Bangladesh and Nepal. Lack of political commitment and continued disputes between Bangladesh and India has put Farraka Barrage issue at stalemate. This barrage causes water scarcity in Bangladesh during lean seasons and massive floods during heavy seasons. India is alleged to have installed Farraka barrage to ensure all season navigability of its own Kolkotta port least bothered about the problems caused to Bangladesh.

Historically, in 1978, India and Bangladesh came up with different proposal to manage the flow of River Ganga at Farraka. India proposed inter-basin transfer of water from Brahmaputra basin to Ganga basin through a canal link justifying that Brahmaputra has plenty of untapped water, and that flood hazards can be minimized through inter-link transfer of water as Brahmaputra basin usually experience floods prior to Ganga basins. Bangladesh proposed building dams and reservoirs in Nepal to control floods. Both these proposals did not materialize.[8] In the light of mounting threats from climate change, it is crucial that India and Bangladesh resolve the issue of Farraka Barrage. One viable option is Bangladesh to allow India to use Chittagong Port and India let Bangladesh benefit from and minimize the risk of flood caused by Farraka Barrage (Quader, 2009).[9]

Bangladesh has Comprehensive Disaster Management Programme (CDMP, 2009-2013), which is a joint initiative of the government of Bangladesh and UNDP (US $ 50.75 million support by the UK Department for International Development, the EU and

[6] The country is low-lying riverine land traversed by many branches and tributaries of the Ganges and Brahmaputra Rivers. Most parts of Bangladesh are less than 12 m (39.4 ft) above the sea level and it is predicted that 45 cm rise of sea level may inundate 10-15% of the land by the year 2050 resulting over 35 million climate refuges from the coastal districts.

[7] Securing the Natural Freshwater Systems of the Bhutan Himalayas Climate Change and Adaptation measures on Water Resources in Bhutan November, 2011

[8] *P.K. Parua. Flood Management in Ganga-Brahmaputra-Meghna Basin: Some Aspects of Regional Cooperation.*

[9] Dr. A.K.M.A Quader. *Bangladesh and India*, Banglanews, Tuesday, 04.21.2009, 06:20pm (GMT).

Sweden). But CDMP is largely a post-disaster management strategies with little initiatives on prevention and reducing risks and vulnerabilities associated with GLOF and gradual snow melting. The preventive measures taken alone by Bangladesh cannot result in fuller benefits unless done jointly with Bhutan, Nepal and India where the major floods originate.[10] The scientists have already observed that frequent flooding in Bangladesh has a strong link with melting of glacial ice and climate change. Strengthened regional-level post-disaster response and management capacity (through initiative like CDMP) is crucial. The region has more to gain by cooperating on these issues rather than handling individually as being done at present.

Bangladesh as the most vulnerable country to natural disaster vis-à-vis GLOF and snow melting is in a better position to attract the international community's support to the region's effort to minimize GLOF threats and implications of glaciers meltdown. Conversely, except for a nearly failed multi-donor trust fund floated 2007, Bangladesh remained rather hesitant to launch such international campaigns. Instead, it has kept aside domestic fund of TK 700 million (in 2009) on top of the previous TK 300 million to climate change fund. This policy to dedicate domestic resources rather than campaigning for international assistance has reduced the scope for greater international support. Even if it manages to receive some support from the international community, the emphasis is on domestic climate mitigation projects (such as Denmark's support), not to promote regional efforts for preventive or adaptation measures.[11] Doha, 2009 rightly pointed out that 'Bangladesh government should have exerted pressure on international agencies and support assistance before mobilizing its domestic resources for the purpose'.[12]

The water relations between India and Nepal also have never been amicable. An effort to resolve the troubled water relations between Nepal and India was made by signing Mahakali Treaty in 1996 for integrated development of the river including hydropower generation, but this has not been satisfactorily realized due to some mistrust between the two countries and subsequent Nepali misgivings about the unequal dependence on India's energy demand (Jaitly, pp. 28)

Bhutan and India are doing well in the management of water resources, but India's focus on Bhutan is tilted more towards hydropower generation rather than supporting the latter to adapt to, and mitigate the impacts GLOF and climate change, which in the longer run is likely to affect Bhutan's hydropower sector. There is a need to strengthen policy framework by which these two countries can collaborate on resolving climate change impacts on Bhutan's hydropower industry.

There is now some growing sense of optimism that SAARC has recently adopted climate change agreements and roadmaps. But, history tells that such initiatives tend to remain rhetoric or conference talks and commitments. For example, in 2002 SAARC Summit, the proposal to establish a regional biodiversity database was made, but this proposal was thrown into an empty rhetoric. There was no effort from the countries in the region to initiate joint R&D on biodiversity management, climate change adaptation and mitigation and to increase agriculture productivity. In response to the need for a common disaster preparedness program, the SAARC Meteorological Research Centre in Dhaka (1995) and the SAARC Disaster Management Centre in New Delhi (2006) were established. However, their functions have remained restrictive because the actual burden of operating those agencies remained entirely on the corresponding governments. This is evident from the 2008's meeting of SAARC environment Ministers in Dhaka calling for greater actions in exchange of meteorological data and disaster preparedness (Jaitly, 2009, p. 26).

The SAARC Environment Ministers' Action Plan Declaration on Climate Change of July 2008 include cooperation on six thematic issues: adaptation to climate change, policies and actions for climate change mitigation, policy and actions for technology transfer,

[10] Bangladesh takes Global Lead to Deal with Disaster Risk Reduction, Banglanews (Thursday, 12.10.2009).

[11] Uddin, K.M. *Climate Change Mitigation: Dhaka hesitant to campaign for global fund*, Tuesday, 07.07.2009, 12:35pm (GMT),

[12] *Ibid*.

financing and investment, climate change education and awareness and management of climate change impacts and risks. This has provided some optimism for the more vulnerable countries in the face of climate change. But again, the overall progress in these agreed areas remained sluggish.

Building on new promises for regional cooperation

The 16th SAARC Summit held in Thimphu (2010) with 'Climate Change' as the central theme adopted the "Thimphu Statement on Climate Change" to promote regional cooperation and action on climate change in the four key sectors: water, biodiversity, food security and energy. This was the egression of the idea of shared vision and recognition of the common but differentiated responsibilities (CBDR) towards various threats posed by climate change. The recent Summit for High Himalayas, 2011 held in Thimphu led to charting the national road maps for next ten years by four EHQ countries for adaptation to climate change to ensure food security, water and energy security.

The recent advances on climate change issues provide some sense of optimism in the EHQ region. But, their success will depend on the ability of the EHQ countries to adopt CBDR approach more seriously than ever. At present, the people in the coastal plains generally perceive the Himalayan glaciers as distantly related to their immediate problems, even so when scientific evidences shows that the sea level rise could have devastating impacts on coastal ecosystems such as coral reefs, mangroves and sea grass beds, as well as in inundating the coastal communities. The variation in the runoff rivers will directly affect the mountain communities and ecosystems, but long-term melting of glaciers can lead to sea level rise. Glacier mass balance or the difference between accumulation of snow and ice on glaciers and melting give a theoretical maximum value for sea level rise of 2 m in the current century (Pfeffer *et al*. 2008, cited in Gupta *et al*, 2011, p. 225).[13]

[13] Chapter 15 Sea Level Change and Asia; Ramesha Chandrappa l Sushil Gupta, Umesh Chandra Kulshrestha- Coping with Climate Change Principles and Asian Context, Springer-Verlag Berlin Heidelberg 2011.

In the recent climate change summit, Bangladesh was chosen to steer climate change related water initiatives. The Roadmap to Energy Security prepared by Bangladesh for the 'Bhutan Climate Summit, 2011' accentuate the need to recognize achieving agreements or treaties on development and sharing of waters in trans-boundary river systems based on transparency, fairness and equity to attain water security through regional cooperation. Ironically though, not much mention on mitigating and adapting to the common threats from GLOFs and glaciers melting is made—and therefore— it is possible that GLOF threats will not receive adequate regional credence in the foreseeable future. As raised by many presenters from the EHQ countries in the recent precursor meet to discuss the 17th SAARC Summit in Maldives, there is still the need to sort out the issue of 'trust deficit and egocentrism in the region' that impede the actual implementations of declarations, agreements and programs.

Several adaptation initiatives are being undertaken at the national level together with the implementations of NAPAs that contains the provisions for joint water management. These initiatives are important but not adequate in the regional context. Considerable amount of common actions are required: firstly, to foster the joint adaptive capacity against GLOF threats, and secondly; for the long-term mitigation of glaciers meltdown. This is the issue Maldives government as the organizer of the 17th SAARC Summit cannot ignore, considering both immediate and long term impacts of GLOF and glacial meltdown to the region and coastal zones as well. A critical question now is, "how to speed up the process of the cooperative actions".

Data sharing in the EQH Region for response to GLOF disasters

The region is in a dire need for a comprehensive understanding of climate change that can inform and expand more effective climate change response choices. The EHQ region—until now—is least understood in terms of climate change variability and vulnerability, and a large part of it can be attributed to lack of integrated and collaborative climate observing systems. The

observational capacity for critical physical, social and ecological variables is insufficient. Forget about regional scale, there is dearth of basic projections and analysis of climate change and glacier impacts even at the national level to support adaptive risk management and iterative decision-making.

Bhutan for example has several flood warning network stations along the main north-south rivers established in collaboration with the Central Water Commission (CWC) of India since 1973. These stations provide hydro-meteorological information to stations in India for flood forecasting. The information is relayed on an hourly basis. Nonetheless, the growth and development of shared hydro-meteorological information system between Bhutan and India had been extremely slow, which experts largely attribute to lack of technical expertise, poor organizational set-up, and inadequate network facilities and equipments that results in poor flood warning services and immense destructions to human and human lives in the lower lands (GNHC, 2008, p. 146) though not a political discrepancy.[14]

Bhutan has limited capability to analyze climate data to assess threats and viable solutions. The issue of glaciers in Bhutan is less studied. Save for glacial lake risks zoning within the country, Bhutan do not have a well-developed system of long-term monitoring and analysis of indicators of glaciers, glacial lakes, river discharges, snow cover and contribution of snow melt to water flow of rivers.

The situation is not better in Nepal and Bangladesh. Information sharing and early warning system between Bangladesh and India are affected by the existing difference over Farraka Dam and disputed water sharing system—and more so—due to some political controversies.

Mitigating long-term impacts of Climate Change in the EHQ region

The GLOF can be seen as near or mid-range threats that require immediate actions including building of joint adaptive capacity and disaster management. The more direful consequence that may lead to irremediable cataclysm is the gradual increase in the temperature of the region. The increase even by 2 degree Celsius (as noted earlier as well), is expected to lead to gradual collapse of ice sheets in the Himalayas that could drain volumes into sea.

The notion that the rise in sea surface temperature cause expansion of waters (thermal expansion) leading to sea level rise need to be further corroborated by a broad acceptance that coastal plains and island countries (Sri Lanka and Maldives) too are equally vulnerable to the gradual meltdown of glaciers in the Himalayas. For example, if the Himalayan ice sheets were to shrink substantially over several decades, a large amount of fresh waters will flow to Bay of Bengal and alter the ocean circulation patterns with dire consequences to the island countries.

Mitigation response is determined by the extent to which the reduction of Greenhouse Gas emissions (GHGs) is made, and thus, the need for sustainable growth policy at the regional level to prepare the EHQ countries for a low-carbon future grows. Having an effective national policy to control GHGs alone is not enough as the impacts of the GHGs transcend the boundaries.

The economies of India, Bangladesh, Bhutan and Nepal are growing rapidly. India's contribution to GHG emissions is expected to rise significantly. Bhutan's metric tons per capita Co2 emission has been all the time low, but this achievement has been offset by the increase in the CO2 emissions by other countries (Table 1). Maldives (2.42 metric tons per capita) was a major contributor of Co2 in the region (2005) despites its extreme vulnerability to rising sea level and its adaptation to climate change being a matter of survival. Bangladesh contributed just 0.26 metric tons per capita co2 emissions (in 2005), and yet this country was always worst affected by climate change related disasters.

[14] Tenth Five Year Plan: Programme Profiles, Volume II, 2008. Gross National Happiness Commission, pp. 146.

Tables 1: Key Indicators- Agriculture, Energy Use and Co2 Emissions for South Asian Countries, 2000-2005

Country/ Year	Energy Use (Kg of oil equivalent per capita)		CO_2 Emission	
	2000	**2005**	**2000**	**2005**
Bangladesh	134.19	157.80	0.20	0.26
Bhutan	-	-	0.71	0.65
India	452.57	491.61	1.14	1.28
Maldives	-	-	1.83	2.42
Nepal	334.33	339.34	0.13	0.12
Pakistan	463.15	489.36	0.77	0.86
Sri-Lanka	431.72	462.07	0.54	0.56
Total	**1815.96**	**1940**	**5.32**	**6.15**

Source: World Development Indicators, World Bank 2008

The fact that there was increase in the total Co2 emissions in the region does not mean the region lack opportunities to minimize the GHG emissions. Unlike in the Northern developed countries, South Asian countries have been leading through a low-carbon development path, which are inherent in their social and cultural norms, and simple means of livelihoods. The EQH countries have the opportunity to rethink their development paradigms and improve consumption patterns, or go the way other developed countries did.

Taking into account the mounting threat from climate change and the region's extreme vulnerability, the important option is to question the dominant measures of GDP growth as the only indicator of human success. The more fossil fuels the EQH countries burn and the more greenhouse gases they emit, the more GDP will grow, and therefore – according to conventional economic dogma–the 'better off' these countries and people will be! The true costs of climate change, however, will remain invisible. It is ironic that natural or human-induced disasters actually make GDP grow, simply because money is spent on repair and clean up costs.

Bhutan defines growth in GNH measures that take factor in the environment conservation. Besides its comprehensive GNH index and indicators, which are now used as policy screening tools by Gross National Commission (GNHC), the country is taking steps to develop GNH accounts that will keep Bhutan out of the bandwagon that GDP growth is the solution to all problems.

More than anything, it is crucial for other countries in the region to pilot similar economic growth approach that emphasizes on environment, and the one that accounts the hidden costs of conventional economic growth on families, on society, on nature and ultimately on the health, happiness and quality of life. If the EQH countries fail to adapt and adopt such alternative development models, and continue with the present models that produce more GHGs, it is sure that the climate change will spell doom in the region. (Dissanaike, 2010, p.5)[15]

The energy sector is the other area that the region has immense potential for cooperation. SARI's energy pre-feasibility study reported that 'power trading within EHQ would increase economic and social benefits for all these four countries'. This is because the EHQ region has significantly but disparately located diverse energy reserves, which so have not been cross-traded satisfactorily. This represents one unique challenge for climate change responses in the region whereas it is also one of the best measures to mitigate climate change.

Having better access to clean energy through inter-border power trade will boost up the national economy, reduce poverty and reduce carbon emissions. Imagine if there is clean energy trade deal between Bangladesh and Bhutan-the former importing hydropower from Bhutan and the latter importing LPG gas and introducing in mass CNG automobiles. According to Bhutan's GHG inventory between 1994 and 2000, the emission grew at 21.4 % mostly due to the growth of transport sector.

At present, the export of gas from Bangladesh is a controversial issue. It does not have any concrete export policy despite widely known presence of gas reserve and its potential to increase the production through off-shore

[15] Tharuka Dissanaike, South Asia Disaster Report Special Copenhagen Issue, A South Asian perspective on Climate Change and increased Disaster Risk, Editors: Vishaka Hidellage, Buddika Hapuarachchi, Ramona Miranda, Jon Ensor and Daniel Vorbach, www.practicalaction.org

explorations. Bangladesh depends on natural gas for electricity generation (87 %), irrigation, fertilizer production and transportation. Bangladesh has a huge demand for electricity and its government is keen to import electricity from Bhutan and Nepal through Indian transmission grids.

Even as the idea of this cross-boundary regional power trade is welcomed both by Bhutan and Bangladesh, the question whether India would facilitate it looms at large. Until recently, Bangladesh has not been able to table the discussion on this issue with India at higher government level because of some strained relations such as alleged Indian's influence in Chittagong Hill Tract (CHT), maritime disputes, cross border militancy, Farraka Dam and use of 54 international rivers, border conflicts, and border fencing by India.

Nevertheless, both the countries had been making efforts to resolve the conflicts. They are already in the process of renewing their ties—an important advancement being the essential agreement to cooperate in the energy sector. India agreed to supply Bangladesh 250 MW electricity from its grid; they agreed to cooperate in developing inter-grid connectivity, and develop proper modality for the sale of electricity including generation of power from the renewable sources (Saurabh, 2010.p 3).[16] India and Bangladesh signed in 2010 the 'Memorandum of Understanding on Cooperation in Power Sector'.

In a tri-lateral meeting of Petroleum Ministers (Bangladesh, Myanmar and India) in 2005, the countries agreed to transport natural gas from Myanmar to India by pipeline through Bangladesh territory. It is expected that Bangladesh will make a bid to gain access to Indian grid for import of electricity from Bhutan in return for letting India use its territory for Myanmar-Bangladesh-India gas pipeline. If these two countries are able to remove political differences and come to better terms, including use of each one's territories as transits for various goods and services, Bhutan may be able to export electricity to Bangladesh and gain access to the latter's natural gas at a reasonable price. Getting this multilateral power trade regime works will not only promote sustainable growth in the region but also help in mitigating the impacts of climate change through reduced GHGs.

Among the major consequences of climate change is the adverse impact on food security as farmers in these countries possess low financial and technical capacity to adapt to climate change. The share of agriculture to GDP in all the EHQ countries has been declining (see table 2). The rising temperatures, severe seasonal droughts, flooding and soil erosions can further affect the agricultural productivity of these countries, causing food insecurity. India has committed to Bhutan to collaborate on transfer of technical expertise to develop new variety of heat resistant seeds; no such commitments exist for Bangladesh and Nepal.

Table 2: Value added % of agriculture to GDP

Country/Year	Agriculture (Value added % of GDP)	
	2000	**2005**
Bangladesh	25.51	20.14
Bhutan	28.38	23.62
India	23.35	19.06
Nepal	40.82	36.35

Source: World Development Indicators, World Bank 2008

Except for trade relations, a real collaboration between Bangladesh, Nepal, India and Bhutan in the field of watershed area management, flood adaptation, climate change related agriculture research, energy sharing, technology transfer etc have not come into a visible and fully viable operation. The share of regional trade in South Asia in 2008 to the global trade was just 4.8 % in 2008 (IMF DOTS, 2009). This is due to oversized sensitive lists (more than 20 % tariff rates on agricultural products and without any deadline for reducing them) and rampant use of non-tariff barriers (NTBs). The other problems are export ban on food items and growing bilateralism in the region.[17] These are a clear sign of lack of

[16] Issue Brief Indo-Bangladesh Relations: Opening New Vistas , Dr. Saurabh, Indian Council of World Affairs, New Delhi, pp.3, 12 February 2010

[17] Ratnakar Adhikari, South Asia Watch on Trade, Economics & Environment (SAWTEE), South Asian Civil Society Consultation on **Trade, Climate Change and Food Security Agenda for Copenhagen**,

'common will' to bear the shared risk of climate change; especially the long-term threats from glacier disappearances and subsequent shrinking of waters.

This long-term threat from gradual glacier meltdown on the both mountains and coastal areas demand a promising long-term combined strategies, investments and opportunities to respond to climate change. The EHQ region countries need to strengthen the present cooperation framework that take into account glaciers and make it workable, economic, ethical and intergenerational.

Conclusion

To mitigate and adapt to the adverse impacts of climate change, Bhutan, Bangladesh, India and Nepal must set a long-term shared vision and cooperative actions to manage GBM basins (which is now taking shape) develop more practical collaborative structural and non-structural projects of flood preventive measures resulting from GLOF and erratic monsoons rather than being overwhelmed by 'talk and do nothing syndrome'.

First, that the individual preventive measures by of each country to mitigate flood hazards cannot be as effective as the combined efforts because of a linked river system. For example, efforts made by Bhutan to lower GLOF risks may help India and Bangladesh, but time-bound support and actions by Bangladesh and India to Bhutan in its flood preventive initiatives can benefit all the parties even more.

Second, the EHQ countries might jointly construct storage dams and reservoirs in Nepal and Bhutan based on CBDR, which can serve as speed arresting or controlling meandering pathways of GLOF to delay the impacts on the downstream infrastructure. These can, apart from minimizing the flood hazards in all the four countries bring other benefits such as harnessing river flows upstream, particularly from strong monsoon flows, for redistribution over space and time, hydropower generation in Nepal and Bhutan, and transportation and irrigation in India and Bangladesh.

Third, the Joint Action Plan (JAP) for flood mitigation and adaptation between the EHQ countries must be strengthened and flood information sharing system between them reinforced through technological and infrastructure sharing in order to develop long-term monitoring and analysis of indicators on GLOF and glaciers melting and impacts on water resources as well as the exchange of flood forecasting and information.

Fourth, developing better observational capabilities to monitor and evaluate progress towards limiting climate change and its impacts also need enhanced sharing of knowledge and practices for improving the understanding of dynamics between climate, glaciology and hydrology through research and analysis. This will require the EHQ to promote public-private partnership for collaborative research and development, and investment projects and programmes, transfer of climate-friendly technologies through networking of national centers of learning and institutes.

Fifth, as stated earlier, climate change can severely affect agricultural productivity, and hence, the food security. The four countries facilitate easier transfer of agriculture goods, and power trade by reducing NTBs and transit arrangement. Short and long-term research collaboration on development and sharing of bio-engineering and introduction low-carbon fuels must be initiated.

Sixth, the EHQ countries should mobilize a regional climate change adaptation and mitigation fund and link it with national level to set up and manage a GBM regional river authority and high level policy and management committees to carry forward regional cooperative action programmes.

9-11 September 2009, Kathmandu, Nepal in which I was also one of the participants.

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