



Energy Security and Climate Change in South Asia: A Threat Analysis for Bangladesh, Nepal, Pakistan and Sri Lanka

Funded by:
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Foreword

Today, one-fourth of world's total global population lives in South Asia, making it the most densely populated region on our planet. The region ranges from the Himalayan Mountains to the Gangetic plain and the coastal areas. Changing landscapes, industrialisation, urbanisation, migration and unplanned growth are major drivers of development. Megacities like Karachi, Mumbai, Dhaka, Kolkata, and Delhi are among the biggest and fastest-growing metropolitan areas in the world – and they are most vulnerable to the impact of climate change.

More than 1.4 billion people in South Asia depend on the freshwaters from the mountainous region of Nepal, Bhutan and India – with one-fourth of the population still living below the poverty line. Deforestation, excessive urban growth, air, soil and water pollution, and overall environment degradation have dramatic consequences downstream.

The consequences of global climate change are obvious: Glaciers have shrunk, ice on rivers and lakes is breaking up faster, plant and animal ranges have shifted. Water shortages in urban areas and energy shortages impose huge obstacles for further social and economic development in South Asia.

In 2015, the Regional Project Energy Security and Climate Change Asia-Pacific (RECAP) of the Konrad-Adenauer-Stiftung (KAS) initiated a study project to conduct a threat analysis for Bangladesh, Nepal, Pakistan and Sri Lanka under the aspects of energy security and the impact of climate change. Leading experts from the Consortium of South Asian Think Tanks (COSATT) shared our endeavour and contributed profound and comprehensive insights from the perspective of their respective country.

This publication hopefully provides a stimulating guide to the specific challenges climate change and energy security impose on the nations in South Asia. The results clearly show, that greater attention to these threats is needed from the governments, private sector and multi-national agencies. This can only be achieved by increased cooperation among SAARC member states.

We sincerely hope that this publication will provide useful information and recommendations to policy makers, experts, practitioners and researchers in the region and beyond. We also aim at initiating similar studies on the remaining SAARC countries Afghanistan, Bhutan, India and The Maldives in the near future.

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Energy Security and Climate Change in South Asia: A Threat Analysis for Bangladesh

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Abstract

Bangladesh is facing an existential threat due to climate change. The report tries to critically analyse the threats and challenges of climate change in Bangladesh as well as the adaptation strategies planned by the government. The report argues that climate change will have wide-ranging impacts on the country and as such the adaptation strategies should have to be robust as well as compatible to the changing global scenarios. Furthermore, the report suggests that the impacts will not be limited to the national boundaries of Bangladesh and hence, will require global and regional cooperation.

Introduction

Climate change is, at present, arguably the biggest challenge the world faces. Academic debates in the field of non-traditional security have now become dominated by this issue. Climate change first became a global problem in the early 1970s, through the 1972 Stockholm Conference, the first major inter-governmental conference on environment preservation. The extent and significance of climate change, as a global concern, have been growing ever since. Every country in the world has more or less realised (if not internalised) the threat of climate change and is trying to move towards effective mitigation policies.

In the first section, the report discusses the threat mapping of climate change. The report starts with shedding light on the effects of climate change on the world in general. Then it moves on to the threats faced by Bangladesh. A detailed analysis shows the *impacts of climate change in Bangladesh* ranging from water to food, health, energy, livelihood and other issues.

The next section talks about the wider *implications* of climate change in Bangladesh. Such implications may not be the direct resultants of climate change but have been heavily influenced by its effects. The section mainly discusses issues like social cohesion, internal and regional instability and possibilities of interstate conflicts.

The third section is about the *adaptation strategies* undertaken by the government of Bangladesh. The report analyses the strategies made by the *Bangladesh Climate Change Strategy and Action Plan 2009*. Lastly, based on the observations, the report tries to make a set of *recommendations* for the accomplishment of climate change goals for Bangladesh.

Methodology

This study was conducted following a qualitative research approach. Primarily, a secondary literature review was undertaken to generate data and a basis for the report. Although a significant amount of data exists on climate change in general, data with relevance to Bangladesh remains limited. The data initially generated was cross-checked with the study objectives as part of a selection of data that is more relevant than the rest. This selected data was then analysed to form the basis of this report. The draft report prepared on the basis of the selected literature was then internally reviewed by the in-house research scholars of BIPSS. This final report was then prepared to incorporate the comments of the in-house review. As mentioned earlier, there is quite a significant amount of literature on climate change. However, the material on climate change adaptation is still in its infancy. This report relies on the Government of Bangladesh's Adaptation Strategy but relates it to the available literature from other sources to ensure a significant relevance to the adaptation strategy.

The scope and resources of the study were limited to the existing literature. However, it may be noted that a more credible study is only possible when quantitative and spatial primary data is cross-checked against the available literature. This paucity was felt even more acutely due to the shortage of spatial data on the on-going implementation of the adaptation strategy.

Background

GLOBAL EFFECTS OF CLIMATE CHANGE

There is a rudimentary consensus among the experts about possible effects of climate change. These effects are spread among some key areas; the foremost of them is arguably the rise of sea level. Due to the increase in global temperature, the ice sheets in the Arctic and the Antarctica are melting fast. Besides, the mountain glaciers are also melting at an alarming rate. This condition will cause a significant rise in the sea level. According to an Intergovernmental Panel on Climate Change (IPCC) report in 2007, by 2100 the estimated sea level rise would measure around 0.18 meters to 0.59 meters.¹ However, the report did not include the ice calving, which, if taken into account, will push the estimation to about 0.8 to 2 meters for the same period.² Other experts have estimated it to be about 0.5 to 1.4 meters.³ Based on these estimations, it could be safely concluded that we may witness a sea level rise of at least 1 meter by the end of the 21st century.

The rise of sea level will result in additional effects. Some low-lying countries and small islands are at risk of complete or partial submersion into the sea. A large part of the coastal areas around the world may get inundated. This loss of huge landmass will cause unprecedented human displacements across the globe. The sea level rise will also cause saline intrusion into the rivers and ground waters, significantly affecting the agricultural sector and food security of the people. There will be a severe shortage of fresh water which is essential for different purposes.

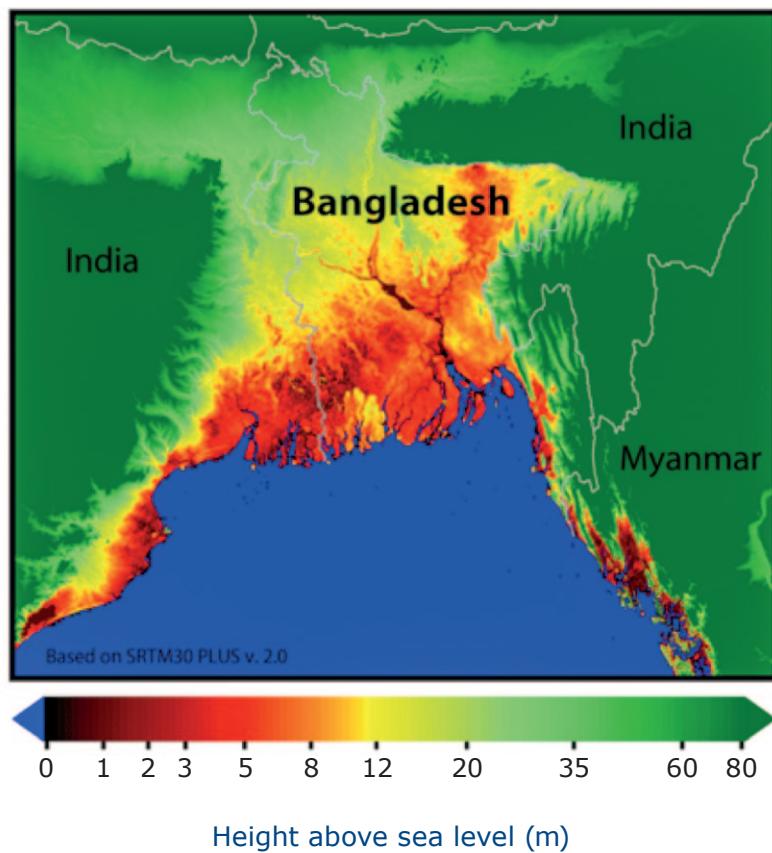
Climate Change will also cause extreme weather conditions like cyclones, floods, heat waves, droughts, river erosions and irregular water cycles. The world has already started witnessing such conditions in the form of several major natural disasters in recent years.

¹ Solomon, Susan Snell; Intergovernmental Panel on Climate Change (2007). "Climate Change 2007: The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change". Cambridge: Cambridge University Press for the Intergovernmental Panel on Climate Change.

² Pfeffer, W.T., Harper, J.T., O'Neel, S.; Harper, O'Neel (2008)."Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise". *Science* 321 (5894): 1340-3

³ Rahmstorf, S. (2007)."A Semi-Empirical Approach to Projecting Future Sea-Level Rise". *Science* 315(5810): 368-70.

Coastal Inundation Risk – Bangladesh



STATUS OF BANGLADESH

Bangladesh, situated between South and Southeast Asia traversing the Bay of Bengal, is the world's largest riverine delta with a gross area of 147,570 square kilometres. The country is also home to the 8th largest population in the world with about 160 million people. It is also one of the most densely populated countries with a density of about 1,222 people per sqm km. Bangladesh is considered a lower middle-income developing country with a per capita income of US\$ 1,080 (2014) and a poverty headcount rate of 31.5% as of 2010.⁴

The landmass of Bangladesh is mainly formed of soft alluvial plain. The country is situated on a low-lying land with most elevations at less than 10 meters above sea levels while the coastal area in the south is mostly at sea level. Bangladesh is

⁴ The World Bank.(2016). *Bangladesh | Data*. Retrieved July 4, 2016, from <http://data.worldbank.org/country/bangladesh>.

crisscrossed by at least 700 rivers, including 58 trans-boundary rivers originating in neighbouring India and Myanmar.⁵ The rivers of Bangladesh are like the veins of a human body which are essential for the existence of the country.

According to experts, Bangladesh is one of the most vulnerable countries to Climate Change. The IPCC predicts that Bangladesh may lose about 18% of its landmass by 2050 if the sea level continues to rise at the current rate.⁶

5 Rashid, HarounEr (1991). *Geography of Bangladesh*. Dhaka, Bangladesh: University Press. p. 38.

6 Ibid. 1

Threat Mapping

WATER SECURITY

In a high-density country like Bangladesh, the effects of climate change on the surface and ground water resources will be very severe and alarming. Changes to water resources and hydrology will have a significant impact on the country's economy, where people mostly depend on the surface water for irrigation, fishery, industrial production, navigation and similar other activities.

Climate change and climate variability are now real and a stable situation is not likely to be achieved soon. Climate change-induced sea level rise could submerge a significant amount of Bangladesh's land area by 2050, reducing cultivatable land and displacing 35 million people. Water requirement in Bangladesh has continued to increase in all sectors. Given that both the population and the economy are developing at a fast pace, increasing wealth and affluence will lead to a greater per capita demand for water and food. This includes an increasing need for irrigation water, depending on what kind of crops are being grown and the preferred diet of the Bangladeshi population.

Water sources remain constant, but water from the rivers originating from the Himalayas will continue to decrease as the ice glaciers get diminished. Climate change will perhaps also affect the flow of rivers by disrupting the storage of water in Himalayan glaciers due to temperature and drastic shift in precipitation habit. If the changes are already pushing the historical average deviation, the situation could be dire for Bangladesh.

According to World Health Organization (WHO), of the 147 billion cubic meters (bcm) water required in the country during the dry season, only 90 bcm are available. The 40% deficit leads to drought in some regions.⁷ It is expected that climate change will cause significant changes in river salinity, especially in coastal zone areas. This will directly result in a shortage of drinking water in the coastal urban areas.⁸ Interestingly, in 2016 most of the wells (accounting to 56 per cent) have

⁷ Pereira, L. S., Cordery, I., & Iacovides, I. (2009). *Coping with Water Scarcity: Addressing the Challenges*. Springer Science & Business Media. p.146.

⁸ Climate Change, Food and Water Security in Bangladesh - Future Directions International. (2016). Future Directions International. Retrieved 13 August 2016, from <http://www.futuredirections.org.au/publication/climate-change-food-water-security-bangladesh/>.

already started to show a decline in water level, with the remaining share of the wells showing stable levels. In the last decade, declining water level trend was exacerbated due to reduced precipitation during the wet seasons.⁹ Many of the wells go beyond its threshold level when it is no longer operable, leading to a lack of access to drinking water and irrigation as well. Once again, climate change is to blame for reduced rainfall and continual decline in the recharge rate.

The WHO described the arsenic contamination in Bangladesh as "the largest mass poisoning of a population in history". Half of Bangladeshis, up to 77 million people, have been exposed to the toxic arsenic.¹⁰

Bangladesh also suffers from the unilateral water withdrawal by India from the trans-boundary rivers. Being a lower riparian country, Bangladesh remains vulnerable to the number of dams built in the upper riparian areas in India to control the natural flow of the rivers. About 123 rivers in the western Bangladesh have died due to the effects of these dams, most notably the Farakka Barrage.¹¹

The rising sea level is causing excessive salinity to the rivers and ground waters of Bangladesh. According to the World Bank, "The coastal community in southern Bangladesh will be on the *front line* of climate change because of continued sea-level rise (SLR) beyond 2100, even if greenhouse gas emissions are stabilised today." The coastal districts in the divisions of Barisal, Chittagong, and Khulna are the worst affected areas where the salinity may increase by over 55% by 2050.¹²

FOOD SECURITY

Ever since 1971, the independence year of Bangladesh, providing food security to its population has been crucial socioeconomic and political priority of the government of Bangladesh. Food security in Bangladesh had consecutively fallen short,

⁹ Climate Change, Food and Water Security in Bangladesh - Future Directions International. (2016). Future Directions International. Retrieved 13 August 2016, from <http://www.futuredirections.org.au/publication/climate-change-food-water-security-bangladesh/>.

¹⁰ Tan, SweeNgin et al. (2010) "Arsenic exposure from drinking water and mortality in Bangladesh" *The Lancet*, Volume 376 , Issue 9753, 1641-1664.

¹¹ Uddin, J. (2011). *Conflict Management for the Farakka Barrage*. Lambert Academic Publishing, 35.

¹² The World Bank. (2015). *Salinity Intrusion in a Changing Climate Scenario will Hit Coastal Bangladesh Hard*. Retrieved July 4, 2016, from <http://www.worldbank.org/en/news/feature/2015/02/17/salinity-intrusion-in-changing-climate-scenario-will-hit-coastal-bangladesh-hard>.

especially during the 1988 and 1998 seasons when a dangerous flood hit the country and caused a major loss in rice grown in the *Aman* season.¹³

The performance of the agricultural sector heavily relies on the characteristics and frequency of floods. This brings us to the issue of global warming, which is one of the main factors that could threaten food security in Bangladesh. Due to climate change and the resulting sea level rise, the agricultural production can have a dire impact as large as floods. The major impacts of sea-level rise on crop yield are flooding and salt-water intrusion. Agriculture in Bangladesh is also heavily reliant on the weather. This is why climate change especially threatens the production of crops as one severe cyclone can destroy a large amount of harvest. If extreme weather increases, a significant danger is posed to the country's food security.

Being a developing country with a relatively high poverty rate, food security is a major issue for Bangladesh. About 60 million people in the country are considered food insecure with insufficient intake of daily food "required for a healthy life".¹⁴ Statistics show that 41% of the children under the age of 5 are stunted while 36% of them are underweight. About 53,000 children in Bangladesh succumb to death every year from malnutrition while the country is exposed to the highest rate of infant and maternal malnutrition.¹⁵

Climate change will result in a huge loss of arable land for Bangladesh. The Khulna and Barisal regions, which host some of the largest agricultural productions in the country, are the worst affected by climate change. As per the estimations of IPCC, by 2050, rice production is expected to drop 10% and wheat production by 30% in Bangladesh.¹⁶ Furthermore, the population of Bangladesh is unlikely to stop growing at the alarming rate it is now. In fact, at about 1.6% population growth per year, the population is predicted to rise to 200 million or more by 2050; effectively increasing food demand by 50%. These factors constitute a set of technological and physical limitations that are difficult to overcome.

13 Faisal, I. (2004). *Food Security in the Face of Climate Change, Population Growth and Resource Constraints; Implications for Bangladesh*. Springer, 34(4), 487–498.

14 World Food Programme. (2016). *Bangladesh*. Retrieved July 4, 2016, from <https://www.wfp.org/countries/bangladesh/overview>.

15 Dhaka Tribune. (2013, December 19). *53,000 die from malnutrition every year in Bangladesh*. Retrieved July 4, 2016, from <http://www.dhakatribune.com/health/2013/dec/19/53000-die-malnutrition-every-year-bangladesh#sthash.9qIs7sug.dpuf>.

16 Ibid. 1

Besides inundation, sea level rise will directly cause "inward migration of the critical salinity front", therefore it will become a challenge to grow paddy in areas with high salinity (higher than 2dS/m).¹⁷ Salinity intrusion will drastically hit the agricultural sector of the country. According to the World Bank, "increase in soil salinity may lead to decline yield by 15.6% of high-yielding-variety rice and reduce the income of farmers significantly in coastal area".¹⁸

Extreme weather conditions like cyclones, floods, and droughts will also have a significant effect on the food yield. Every year, Bangladesh loses a substantial amount of crops due to poor infrastructure and disaster response mechanisms. In 2007, the Cyclone Sidr resulted in the loss of at least 2 million metric tonnes of rice which could have fed about 10 million people.¹⁹

The shrinking freshwater resources and the dying rivers will significantly reduce the production of fisheries which is the main source of animal protein for Bangladeshis. Livestock and poultry farms will suffer from a shortage of animal food and will result in lower production. Low and inadequate food production could trigger massive price hikes which may transform into a deadly famine killing millions.

HEALTH SECURITY

Climate change and climate variability can have direct as well as indirect effects on human health, for example through the exposure to rapidly changing weather patterns and indirectly through changes in water quality, liveability, food quality as well as ecosystems changes, agriculture, human settlement, etc.²⁰ As a result, health problems decrease the capacity of individuals and groups to adapt to climate change.

In tropical developing countries, drainage congestion and standing water will increase the chances of an outbreak of water-borne diseases. According to WHO and UNICEF, at least 19% of the population of Bangladesh have no access to

¹⁷ Faisal, I. (2004). *Food Security in the Face of Climate Change, Population Growth and Resource Constraints; Implications for Bangladesh*. Springer, 34(4), 487–498.

¹⁸ Ibid. 10

¹⁹ Sunny, Sanwar (2011). *Green Buildings, Clean Transport and the Low Carbon Economy: Towards Bangladesh's Vision of a Greener Tomorrow*. Germany: LAP Publishers, 354.

²⁰ Rahman, A. (2008). Climate change and its impact on health in Bangladesh. ngof.org. Retrieved 13 August 2016, from http://ngof.org/wdb_new/sites/default/files/Climate%20change%20and%20its%20Impact%20on%20Health%20in%20Bangladesh.pdf.

improved drinking water while 44% lack access to improved sanitation.²¹ The shrinking source for clean water is making the Bangladeshi susceptible to water-borne diseases like anaemia, arsenicosis, cholera, diarrhoea, hepatitis, malaria, schistosomiasis, typhoid and so on.

The impact of drought on health cannot be ignored as it can cause malnutrition and micronutrient deficiency. Dietary diversity also diminishes due to drought; a study of Bangladesh found that there is a direct causal relationship between drought and lack of food that gave rise to an increase in mortality from diarrheal illness.

Water salinity and its distribution in the coastal area are increasing with the sea level rise. Due to the increased density and distribution of salinity, germs (such as cholera) are getting favourable habitat which is helping them survive longer and spread around the coastal area. This hypothesis is also supported by Colwell and Huq (2001), who argue that most of the major cholera epidemics that have occurred during the last 50 years in the world originated in coastal regions. It won't be different in the case of Bangladesh. As the sea level rise continues to take place in its important coastal areas, diseases are likely to affect the habitants, promoting panic and habitual displacement.²²

Air pollution is also a major threat to the health security of Bangladesh. Chronic respiratory diseases cause at least 11% of total deaths in Bangladesh due to extremely polluted air.²³ Major concerning pollutant being the particulate matter, which is a complex mixture of extremely small particles and liquid droplets when breathed in, can cause serious injury in the deepest regions of the lungs. Series of heat waves can trigger heat strokes, viral infections and gastroenteric disorders. In 2007, 22 people died in a severe heat wave across the country.²⁴

The hospitals and other health infrastructures are vulnerable to huge damages by natural disasters like cyclones, floods, etc. Increasing devastations by natural disasters could also cause severe mental trauma and depression to a large number of victims.²⁵

21 World Health Organization/UNICEF. (2010, March). *Estimates for the use of Improved Sanitation Facilities | Bangladesh*. Retrieved July 4, 2016, from Joint Monitoring Programme (JMP) for water supply and sanitation: http://www.wssinfo.org/fileadmin/user_upload/resources/1273062654-BGD_san.pdf.

22 Ministry of Environment and Forests., *CLIMATE CHANGE AND HEALTH IN BANGLADESH*. IUCN.

23 World Health Organization. (2014). *Noncommunicable Diseases (NCD) Country Profiles | Bangladesh*. Retrieved July 4, 2016, from http://www.who.int/nmh/countries/bgd_en.pdf.

24 Gulf News. (2007, June 1). *22 die as heatwave sweeps Bangladesh*. Retrieved July 4, 2016, from <http://gulfnews.com/news/asia/bangladesh/22-die-as-heatwave-sweeps-bangladesh-1.182538>.

25 Ibid. 26

ENERGY SECURITY

Extreme weather conditions like heat waves can affect the electricity grids and cause power failures. Such conditions could cause fatalities in the form of accidents.

Bangladesh has only one oil refinery situated at Chittagong in the south-east part of the country. This oil refinery meets about 30% of the total domestic demand for refined oil.²⁶ An expansion program of the refinery is ongoing while several other refineries are proposed to be constructed.²⁷ Recently, Bangladesh also secured a large maritime territory after the verdicts of the cases against India and Myanmar over maritime delimitation. These verdicts have paved the way for the country to explore hydrocarbon resources beneath the sea. According to experts, the Bay of Bengal area hosts one of the largest hydrocarbon reserves in the planet, a substantial part of which falls under the Bangladeshi part of the sea.²⁸ As such, Bangladesh is currently in the process of exploring its offshore oil and gas fields in the Bay of Bengal. Cyclones and storms can cause disruptions to the energy infrastructures like oil refineries, and offshore hydrocarbon platforms.

Bangladesh has been aspiring to adopt nuclear power since the 1960s. Finally, the country signed a deal with Russia in 2015 for the construction of a 2,400MW power plant and is now poised to commission its first nuclear power station in 2023 at Rooppur, in the northwestern part of the country.²⁹ Apart from this, a number of ultra-supercritical thermal power plants are under construction. The nuclear power plants require large quantities of water to cool down its reactors. On the other hand, the thermal power plants need significant amount of water to generate the steam where the heat energy will be converted into electricity. The supply of such large quantities of water for the operation of these power plants needs a permanent and massive source of water which in most cases has to be a nearby river. As discussed before, the rivers of Bangladesh have been drying out because of several causes, instigating water scarcity across the country. This water shortage will cause huge disruption or complete shut-down to these power plants.

26 Reuters. (2016, July 18). *Govt seeks 160,000t of fuel oil in first tender.* Retrieved August 12, 2016, from Prothom Alo: <http://en.prothom-alo.com/economy/news/112469/Govt-seeks-160-000t-of-fuel-oil-in-first-tender>.

27 Dhaka Tribune. (2016, August 14). *Govt planning to set up new oil refinery in Payra.* Retrieved August 16, 2016, from <http://www.dhakatribune.com/bangladesh/2016/08/14/govt-planning-set-new-oil-refinery-payra/>.

28 Detsch, J. (2014, November 14). *Bangladesh: Asia's New Energy Superpower?* Retrieved July 4, 2016, from The Diplomat: <http://thediplomat.com/2014/11/bangladesh-asias-new-energy-superpower/>.

29 The Financial Express. (2015, December 25). *Rooppur nuclear deal signed with Russia.* Retrieved July 4, 2016, from <http://www.thefinancialexpress-bd.com/2015/12/25/7510>.

ENVIRONMENT AND ECOSYSTEM

Climate change and biodiversity exhibit an inverse relationship. Loss of biodiversity causes climate change; on the other hand, climate change induced natural calamities contribute to biodiversity loss. Climate is an important environmental influence on ecosystems. Climate changes and the impacts of climate change affect ecosystems in a variety of ways. For instance, global warming could force species to migrate to higher latitudes or higher elevations where temperatures are more conducive to their survival. Similarly, as the sea level rises, salt water intrusion into a freshwater system may force some key species to relocate or die, thus removing predators or prey that were critical in the existing food chain.

Ecosystems and wildlife will face severe damage while several endangered species will potentially be extinct because of shrinking habitat. If the global temperature rises by 2° Centigrade, 30% of all land species will be threatened by an increased risk of extinction. According to IUCN report in 2016, 31 species have reportedly become extinct in Bangladesh while 390 were listed as threatened.³⁰ About 75% area of mangrove forest, Sundarban (60007 Sq. km) will submerge if the sea level will increase by 45 cm. A total of 425 species have been identified there; the most significant is the famous Royal Bengal Tiger. Therefore, climate change impacts will have adverse effects on the Ecosystem of the Forest resources in Bangladesh while the Sundarbans is likely to suffer the most. If the sea level rises by 1m, then the islands of Bay of Bengal and whole Sundarban will be destroyed including its fauna &flora. Being the most bio-diverse forest in Bangladesh, Sundarbans alone supports 53% of birds, 43% of animals, 42% of reptiles, 36% of amphibians, 29% of plants and 17% of fish species of the country's total biodiversity resources.³¹

³⁰ Dhaka Tribune. (2016, June 23). *31 species gone from Bangladesh*. Retrieved July 4, 2016, from <http://www.dhakatribune.com/bangladesh/2016/jun/23/31-species-gone-bangladesh>.

³¹ Ibid. 1



Figure: Destruction of Sundarbans by Cyclone Sidr in 2007

(Source: Arifur Rahman Manir)

Coastal erosion is also a major threat which could be a slow-onset process – with identifying rates of erosion on Bhola Island, for instance, as between 0.31 to 0.43cm a day – as well as a sudden-onset event, for instance when high spring tides or storm surges result in much faster rates of change.³²

LIVELIHOOD SECURITY

Climate change contributes to increasing frequency and severity of disasters with adverse impacts on humans, natural ecosystem and quality of human survival. Due to disasters, poor people suffer from malnutrition as they fail to procure food (crop loss/damage, high price of essentials, etc.). Deforestation, overfishing, overgrazing, salt built up, water-borne diseases from irrigation, endangered wildlife from loss of habitat, loss of genetic diversity, water pollution, air pollution and climate change are related to each other and have impacts on food production, lives and livelihoods of the people of Bangladesh, especially in coastal regions.

32 Krantz, M. (1999). *Coastal Erosion on the Island of Bhola, Bangladesh*.
Swedish Centre for Coastal Development and Management of Aquatic Resources. Göteborg: SWEDMAR.

People of coastal belt, char and haor areas in Bangladesh are continuously fighting with the impact of climate change. Climate change is forcing people to take diversified occupation to maintain their livelihood.³³

About 47% of the total labour force of Bangladesh is directly or indirectly employed in the agricultural sector.³⁴ Shrinking arable lands and damages of crops by natural disasters will have a severe effect on the livelihood of the people.

About 1.3 million people are directly employed into the forest resources of Bangladesh.³⁵ However, the number will be significantly higher if the forward linkage industries are taken into account. Damages to the forests will affect the livelihood and security of these people.

The fisheries sector has also experienced an adverse effect because of the impacts of Climate Change. The fisheries sector contributes about 3.5% of the GDP in Bangladesh and people depend on fish products to meet up the majority of their daily protein requirements. There are around 260 species of fish in the country, and almost all the varieties are sensitive to specific salt and freshwater conditions. Nearly 1.4 million people are directly, while another 11 million are indirectly employed by the fishing industry in Bangladesh. About 73% of the fisheries production is from the inland freshwater sources.³⁶ Dying rivers could force the people dependent on the freshwater fisheries to change their professions.

Most of the coastal people (96.4%) have experienced several disasters. Climate change has created more challenges for the coastal people in the last decade. Due to the change in climate, the coastal communities have faced several challenges including climate change-induced disasters as well as the potential loss of their livelihood.

³³ People of coastal belt, char and haor areas in Bangladesh are continuously fighting with impact of climate change. Climate change is forcing people to take diversified occupation to maintain their livelihood.

³⁴ Central Intelligence Agency. (2016). *The World Factbook | Bangladesh*. Retrieved July 4, 2016, from <https://www.cia.gov/library/publications/the-world-factbook/geos/bg.html>.

³⁵ Khair, A. (2012). Forest and Forestry. In S. Islam, *Banglapedia* (2nd ed.). Asiatic Society of Bangladesh.

³⁶ Shafi, M. (2012). Fisheries resource. In S. Islam, *Banglapedia* (2nd ed.). Asiatic Society of Bangladesh.

HUMAN DISPLACEMENT

Submerged lands, extreme weather conditions like droughts, threats to livelihood are causing millions of environmentally displaced persons in Bangladesh. In 2013, at least 1.1 million people were displaced by Cyclone Mahasen.³⁷ According to several authors, about 1 million Bangladeshis are rendered homeless every year due to riverbank erosion alone.³⁸

It is argued that climate refugees from Bangladesh alone might outnumber all current refugees worldwide. Norman Myers projected that 26 million refugees will come from Bangladesh.³⁹ Sea-level rise could displace up to 20–30 million people in the coastal Bangladesh by 2050.⁴⁰

Almost one-fourth of the total population of the country lives in the coastal areas of Bangladesh, where the majority of the population are somehow affected (directly or indirectly) by coastal floods/tidal surges, river-bank erosion, salinity, tropical cyclones, etc. With the rise of sea-level up to one meter only, Bangladesh could lose up to 15% of its land area and around 30 million people living in the coastal areas of Bangladesh could become refugees because of climate change impacts.

A significant part of these displaced persons will result from the livelihood insecurity. The displaced people often move to the urban centres forming congested slums with poor living conditions. The slum population is the biggest contributor to urban crimes and greatly augments the crime rates in the cities.

Cities and towns situated along the coastal belt in Bangladesh are at the front line of climate change related disaster impacts and could experience a severe damage directly because of the sea-level rise and storm surges at any time. Direct impacts may occur through the increased floods, drainage congestion and water logging as well as infrastructure damage during extreme events. The critical urban sectors that suffered severely from the previous floods in Bangladesh include urban infrastructure, industry, trade, commerce and utility services, etc. As a consequence, it hampered usual productivity during and after major floods and hence increased

³⁷ Internal Displacement Monitoring Centre. (2015). *Bangladesh IDP Figures Analysis*. Retrieved July 4, 2016, from <http://www.internal-displacement.org/south-and-south-east-asia/bangladesh/figures-analysis>.

³⁸ Sifatul, Q. C.(2012). Fisheries resource. In S. Islam, *Banglapedia* (2nd ed.). Asiatic Society of Bangladesh.

³⁹ Myers, N. (2002). Environmental refugees: A growing phenomenon in the 21st century. *Philosophical Transactions of the Royal society of London, Series B(357)*, 609--613.

⁴⁰ Ibid. 1

the vulnerability of the urban poor by many folds. It should be mentioned here that around 40 percent of the urban population in Bangladesh lives in the slum and squatter settlements of the major cities which are highly prone to disaster risk during flooding.

The urban poor are therefore directly at the risk of natural disasters being enhanced by the impacts of climate change - especially in the absence/shortage of the necessary infrastructure as well as employment opportunities for them in the major cities of the country. In Bangladesh, women are particularly vulnerable because of the gender inequalities in the socio-economic and political institutions. During the 1991 cyclone and storm surge in Bangladesh, the death rate in case of women was almost five times higher than the men. While men were able to communicate with each other in the public spaces, the information did not reach most of the women timely.⁴¹

Human displacement will result in increased illegal migration and human trafficking. Bangladesh is already one of the largest sources of trafficked migration. Environmental displacement was one of the reasons for the '*Boat people*' crisis in 2015.

DISASTER SECURITY

According to IPCC, the climatic anomalies in Bangladesh are going to increase significantly.⁴² There will be increased frequency and severity of natural disasters like floods, droughts, storms, heat waves with greater durations. This will result in bigger human and material losses. Cyclone Sidr, a category-5 tropical cyclone in 2007, caused a death toll of about 15,000 people⁴³ and damages worth US\$ 1.7 billion.⁴⁴ A study reveals that among such disasters cyclone (99.1%) is one of the key challenges. Like cyclones, floods (80.2%), water logging (65.1%) and salinity intrusion (55.7%) have become major problems in the coastal areas because these havocs damage agricultural production and create a state of unemployment among coastal people. The study shows that tidal surge, earthquake, tornado landslides, and drought and low fertility have become key challenges in the coastal zone of Bangladesh.

41 "Climate Change & Its Impacts On Bangladesh". NCDO. N.p., 2012. Web. 15 Aug. 2016.

42 Ibid. 1

43 Foster, P. (2007, November 18). *Bangladesh cyclone death toll hits 15,000*. Retrieved July 4, 2016, from The Telegraph: <http://www.telegraph.co.uk/news/worldnews/1569832/Bangladesh-cyclone-death-toll-hits-15000.html>.

44 Reuters. (2008, July 6). *Bangladesh gets \$95 mln W.Bank loan for post-cyclone aid*. Retrieved July 4, 2016, from <http://in.reuters.com/article/idINIndia-34394220080706>.

Poorer people are more susceptible to the destruction caused by hurricanes and flooding for a variety of reasons. The poor typically live in substandard housing that is more sensitive to damage from winds, heavy rain and floodwaters. Substandard or non-existent sewage facilities and lack of potable water in poor neighbourhoods can result in greater exposure to water-borne diseases after flooding. Areas that are historically prone to flooding or mudslides are often inhabited by the poor. Disasters caused by climate change such as floods, river bank erosion, cyclone, tornado, cold waves, arsenic contamination in ground water, water logging, salinity intrusion, etc. are observed in recent years. However, the nature, season, severity, and extent of hazards are not the same in all cases. There are different types of disaster management with the shift of paradigm from emergency response to proactive disaster risk reduction.⁴⁵

There will be significant pressure on the authorities to evacuate a large number of people before the occurrence of calamities. Officials will also face enormous burden in tackling crisis-time and post-disaster situations. Lack of resources to cope with the damages may exacerbate the situation.

⁴⁵ Nasreen, M., Hossain, K. M., & Azad, A. M. (2013). *Climate Change and Livelihood in Bangladesh: Experiences of people living in*. Retrieved July 4, 2016, from Build Resilience: <http://www.buildresilience.org/2013/proceedings/files/papers/454.pdf>.

Wider Implications

BREAKDOWN OF SOCIAL COHESION

Effects of climate change like the food, water and livelihood insecurity as well as extreme weather conditions will significantly affect the national economy and further degrade the living standard of the people. Income inequality will increase by manifolds which will result in more social discrimination within the country. This will make the people frustrated, restless and dissatisfied.

The lowering living conditions due to climate change can result in the loss of social cohesion. Bangladesh may witness increasing religious riots between followers of different faiths like Hinduism, Islam, Buddhism, Christianity, etc. We may see growing attacks on religious institutions and places of worships like temples, mosques, pagodas, churches, etc. Such situations can cause a high number of casualties, leading to wider security implications. It is worth noting that Bangladesh has had a history of some violent religious tensions. Before the partition of India in 1947, the geographical region which now comprises Bangladesh witnessed some of the deadliest religiously motivated violence in the history of South Asia. The most notable of them is the 'Noakhali riots', where at least 5,000 people were killed religiously motivated. Along with the killings, there were also abductions, rapes and forced religious conversions.⁴⁶ There were also a number of events related to religious violence after the independence of Bangladesh, most notably in 1989, 1990 and 1992 when hundreds were killed and raped.⁴⁷ Most recently, numerous attacks took place on the Hindu temples in 2014 as part of the poll violence during the general elections.⁴⁸ The history of this religious violence in Bangladesh points to the fact that such events could take place again in future if the circumstances lead the people to similar situations. Given the new and advanced prowess of the people in conducting mass propaganda, we can assume that if such events occur in future, it will most likely be in a more severe and bigger magnitude than the earlier events. As a result, there will be even greater casualties than the past events, leading to a further breakdown of law and order and dissatisfaction of the people.

46 Khan, Yasmin (2007). *The Great Partition: The Making of India and Pakistan*. Yale University Press, 68–69.

47 GhoshDastidar, Sachi (2008). *Empire's Last Casualty: Indian Subcontinent's vanishing Hindu and other Minorities*. Kolkata: Firma KLM, 201.

48 Hossain, Emran (7 January 2014). "Obhoynagar reminds of '71 horrors". *Dhaka Tribune*. Retrieved 11 January 2014.

There could also be possibilities of ethnic violence among people of different ethnicities. Despite being a largely homogenous nation with the Bengalis being the dominant ethnic group, there are dozens of ethnic groups primarily based in the Chittagong Hill Tracts area and the hilly areas of Greater Sylhet and Mymensingh. There is already a history of civil war in the Chittagong Hill Tracts where the militants representing the non-Bengali ethnic groups in the area participated in a deadly armed conflict against the government of Bangladesh spanning about two decades through the late 1970s, 1980s and 1990s, demanding greater recognition for their indigenous culture and language.⁴⁹ Newer ethnic violence could trigger similar militancy in the area with bigger threats because of the expansion of terrorism around the world. The situation could demand giving independence to those regions following bloody struggles.

Though there is no history of extreme regionalism or provincialism in Bangladesh, the income and development disparity due to climate change could trigger such sentiments. Bangladesh is a country with a heavily centralised unitary government. The economic activities in the country are mainly based in the capital Dhaka, where people from different parts of the country have to come and settle for a better standard of living. Apart from the economy, the health and education sectors of the country are also dependent on the capital which again prompts people from other parts of the country to migrate to the city. Besides, people from the disaster-affected areas also have to migrate and settle in the large cities of the country. As mentioned before, Bangladesh is poised to lose about 18% of its landmass by 2050; people living in the affected areas will have to settle in other parts of the country which could lead to deadly clashes between the hosts and the migrants. This could result in more severe regionalism among the people. In such situations, different regions of the country could demand to form separate and sovereign states to overcome their issues.

People will gradually become devoid of any belongingness towards the society or the country at large. It will lead to the collapse of national unity and could trigger a civil war, thus threatening the existence of the country.

⁴⁹ Rashiduzzaman, M. (July 1998). "Bangladesh's Chittagong Hill Tracts Peace Accord: Institutional Features and Strategic Concerns". *Asian Survey*. University of California Press. 38 (7): 653–70.

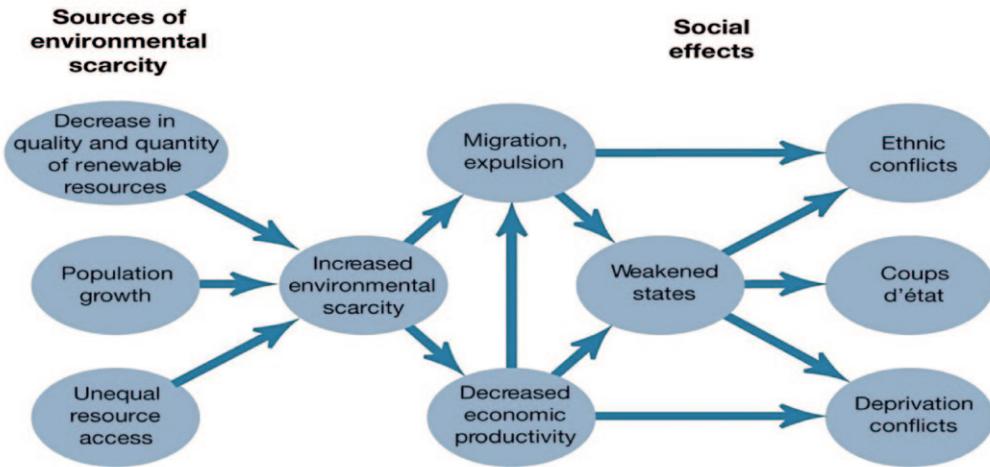


Figure: Some Sources and Consequences of Environmental Scarcity

(Source: *Essentials of International Relations*. 4th ed. Copyright © 2008 W.W. Norton & Company)

INTERNAL INSTABILITY

Poverty and poor living conditions as well as rising inequality and social discrimination will result in increasing criminal activities. Unemployment and dissatisfaction will push the youth into militancy and radicalization. Terrorist activities will swell substantially and will further affect the national security. In recent years, Bangladesh has been witnessing a new wave of terrorism, significantly catching global attention. The emergence of new militant groups like Jamaatul Mujahideen Bangladesh (JMB) and Ansarul Islam has made the terror scene in the country even more vicious. There have also been extensive radicalization drives by the militants in the country to recruit new fighters. The radicalization, especially among the youth, is going on in full swing in the country, further jeopardising the security status of the country. According to several media reports, young men and women are now increasingly becoming attracted towards militancy.⁵⁰ Because of massive radicalizations, the new recruits are much more motivated and inspired to contribute to the spread of terrorism. In this situation, future terror attacks could result in more severe and higher number of casualties. Some recent developments also suggest that the local militant groups are now affiliated with global terror groups like the Islamic State and Al Qaeda. Through these affiliations with these global terror organisations, the militants are now becoming much more economically solvent,

⁵⁰ Muhammed, A. (2016, August 27). *I was (almost) a terrorist*. Retrieved September 12, 2016, from Dhaka Tribune: <http://www.dhakatribune.com/magazine/weekend-tribune/2016/08/27/i-was-almost-a-terrorist/>.

for example because of the financial transactions from abroad.⁵¹ They are also receiving extensive and modern training on militancy to become more capable of conducting bigger and more violent attacks. Such situations can lead to extremely deplorable security conditions in the country, causing mass chaos.

The law and order situation in the country could get much worse which will result in increasing criminal activities. The law enforcement agencies will have a huge task to deal with the growing nefarious movements. There will be a swelling number of cases of theft, robbery, kidnappings, rapes, and murders. The illegal possession of arms and ammunitions could also rise significantly as the pressure on the law enforcement agencies increases. This will result in more severe crimes in the country.

Use of illicit drugs in the country, especially among the youth, will receive a huge growth. Due to the porous international borders with India and Myanmar, it is quite easy for the smugglers to arrange the entry of narcotics into Bangladesh. As a result, the narcotic products in India and Myanmar like Phensedyl, Yaba, etc. get an easy pass to the country, providing cheap access to these narcotics to the youth. These narcotics have substances that greatly enhance the mood and stimulate the emotions of the individuals. Such drugs can make the youth more inclined towards criminal activities and eventually lead the drastic growth of crime rates in the country.

The extent of corruption within all levels and sectors of the government will go up. Bangladesh is already regarded as one of the most corrupt countries in the world, ranking 13th in the Global Corruption Perception Index 2015 prepared by Transparency International in 2015.⁵² The government services will have a dramatic fall in their quality and efficiency. People will be further deprived of the government services as well as social welfare programs. This will lead the poverty rate to rise and as a result, the standard of living in the country will decline further. People will be even more frustrated and will eventually be attracted to terrorism and insurrections. In addition, the widespread corruption could also prompt the industries to violate the environmental code of conducts, which will lead to further degradation of the environment and enhance the effects of climate change.

51 Mohammad , J. K. (2016, August 8). *Five financiers behind terror attacks identified*. Retrieved September 12, 2016, from Dhaka Tribune:
<http://www.dhakatribune.com/bangladesh/2016/08/08/five-financiers-behind-terror-attacks-identified/>.

52 The Daily Star. (2016, January 28). *Bangladesh 13th most corrupt country: TI*. Retrieved September 12, 2016, from <http://www.thedailystar.net/country/bangladesh-ranked-13th-most-corrupted-country-208054>.

There will be increasing political violence and uncertainty within the country which will further undermine the living conditions of the people. A rise of anti-government protests will make the political climate in the country more unstable and violent. Business and economy will be hugely affected which will make the lives of the people even more unpleasant. Bangladesh is already a politically unstable country with regular country-wide strikes and road and rail blockades by rival political parties. Besides, clashes in towns and villages as well as educational institutions among rival groups within the political parties are common phenomena. Such instances of political clashes will become more frequent and violent, with the easy access to lethal weapons. On the other hand, extreme Leftist movements could reemerge in the country, riding on the poor living conditions of the people and increasing poverty and income disparity. There is already a history of widespread Leftist insurgencies in Bangladesh as well as in the greater South Asian region. The Leftist insurgency in the country was at its peak in the 1970s with significant territorial control. To this day, some militant leftist organisations like Purba Banglar Sarbahara Party continue to operate underground with little resources. With the wider implications of climate change, these organisations could rejuvenate and intensify their operations. Instances of military coups could also accelerate as the political situation deteriorates.⁵³

In addition crimes such as piracy at sea, forests and other areas will also escalate, jeopardising the lives of the people depending on marine and forest resources. There has been a recent surge in the kidnappings and abductions of Bangladeshi marine fishermen in the Bay of Bengal due to the growing piracy in the sea. The pirates demand hefty amounts of money from the poor families of the fishermen, making their economic conditions more appalling. The forest areas of Bangladesh have also been affected by piracy. In Sundarbans, the largest mangrove forest in the world, several groups of pirates called *Bondoshhu*, have occupied different ranges of the forest. As a result, the honey collectors and the tourists in the area have to suffer to a great extent. Instances of abductions and kidnappings of the honey collectors and tourists have been a recurring event. Because of the lowering living conditions and loss of employment due to the effects of climate change, the occurrence of piracy will witness a huge rise.

53 Tharoor, Ishaan (19 January 2012). "Behind Bangladesh's Failed Coup Plot: A History of Violence". Retrieved September 12, 2016, From Time: <http://world.time.com/2012/01/19/behind-bangladesh-failed-coup-plot-a-history-of-violence/?xid=rss-topstories>

POSSIBILITY OF CONFLICTS

South Asia is already a politically unstable region and vulnerable to further escalation. There have been at least five large-scale conflicts in the region involving Bangladesh, China, India, and Pakistan in the 20th century. It should be noted that China, India, and Pakistan are nuclear weapon states with a massive stockpile of highly enriched uranium. Furthermore, small-scale border conflicts and skirmishes are common phenomena in the region.

States in South Asia, or Asia at large, have been witnessing rapid and extensive modernization of their militaries in recent years. According to IHS Jane's, military expenditure in the Asia-Pacific will hit US\$533 billion in 2020 from US\$435 billion in 2015.⁵⁴ Defence spending in Bangladesh grew by 12.7% to US\$2.05 billion in 2014.⁵⁵ Regional instability caused by climate change could instigate violent conflicts among these states and could severely threaten the global peace.

The political tensions and changing geopolitical realities in the region resulting from the wider implications of climate change could trigger renewed possibilities of major conflicts in the region. Regional conflicts involving the small neighbouring states will become a usual occurrence. Such regional conflicts could escalate into major conflicts with the involvement of outside powers. The territorial disintegration of the states will result in a scramble for territorial acquisition and influence by outside powers. The geostrategic value of the region may induce the great powers like USA, China, Russia, and Japan to reshape their foreign policies and strategic visions with regard to South and Southeast Asia. The condition will instigate a 'Cold War' like situation in the world where different global powers will be trying their best to ensure greater influence. The great powers will begin to support their proxies in the regional conflicts. Later, it could result in direct confrontations among the great powers. It should be noted that in recent years, the relations between China and Japan have cooled due to the dispute over the control of Senkaku Islands, which the Chinese refer to as Diaoyu Islands. Besides, both countries have been pitted against each other in the South China Sea dispute. Japan has been quite vocal in supporting the Southeast Asian countries in dispute with China in their scramble for control over the Spratly Islands and the adjacent territorial waters.

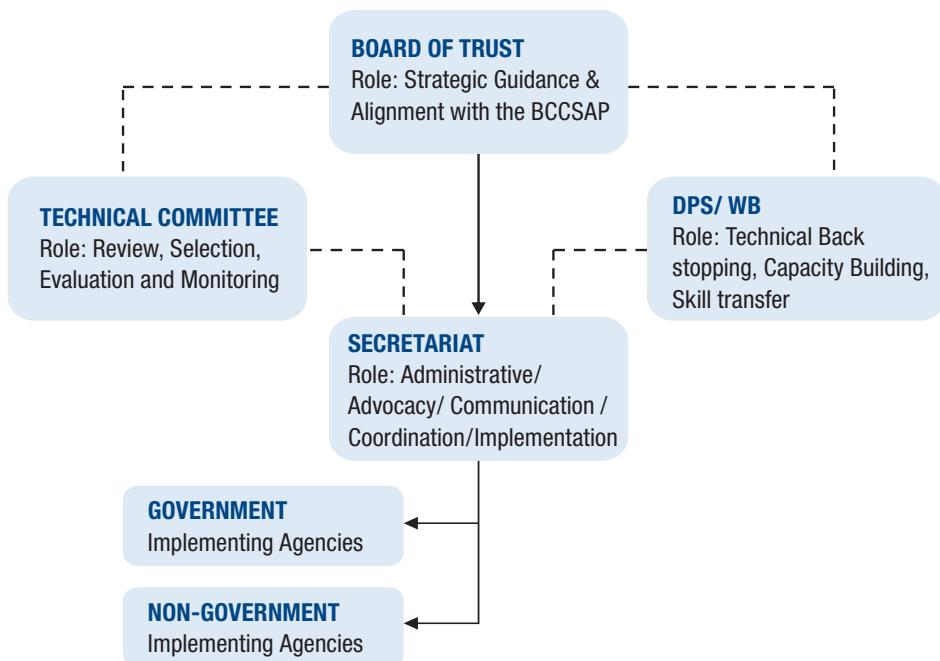
54 Kit, T. S. (2016, February 23). *Military spending in Asia-Pacific to hit US\$ 533b in 2020: Report*. Retrieved July 4, 2016, from Channel NewsAsia:
<http://www.channelnewsasia.com/news/asiapacific/military-spending-in-asia/2538358.html>.

55 Choudhury, I. I. (2014, June 3). *Defence budget 2014-15: Rising trend continues*. Retrieved July 4, 2016, from The Daily Star: <http://www.thedailystar.net/defence-budget-2014-15-rising-trend-continues-26743>.

These developments could also lead the world to a possible Third World War. If that happens, the world will witness the worst catastrophe in its history, with the introduction of numerous new generation weapons. A possible nuclear war will have drastic effects on the global ecosystem – millions or even billions of people will be killed, such that human race could face a threat of extinction. The ozone layers of the Earth will be destroyed, and the harmful rays of the sun will directly fall on the surface of Earth. This will make the planet uninhabitable and would result in the extinction of life.

Adaptation Strategy

This section will discuss the adaptation strategies proposed by the *Bangladesh Climate Change Strategy and Action Plan 2009*, prepared by the Ministry of Environment and Forests, Government of the People's Republic of Bangladesh.⁵⁶



NECESSITY FOR ADAPTATION

Global warming will continue for many decades, resulting in dangerous consequences for countries like Bangladesh unique in its vulnerability contexts. Impacts of climate variability, change and extreme events will lead to severe stress on overall development, environment and human society for generations ahead. Understanding the challenges over time is a primary and urgent need. In addition the challenges need to be explored from an inter-generational perspective. Ultimately, the better we understand them, the better is our chance to plan and respond to the challenge effectively. For Bangladesh, climate change is a serious long-term threat to development and achieving the UN Millennium Development Goals. Bangladesh must be a part of any future solution to climate change. Bangladesh needs support to adapt and manage impacts as the cost will be enormous.

⁵⁶ MoEF. (2009). *Bangladesh Climate Change Strategy and Action Plan 2009*. Dhaka, Bangladesh: Ministry of Environment and Forests, Government of the People's Republic of Bangladesh.

Effects of climate change are going to be more frequent and severe in the coming years. Climate change will severely challenge the country's economic ability to achieve high economic growth needed to sustain poverty reduction.

Proper adaptation strategies can save up damages worth billions of dollars as well as human losses. It will strengthen the social resilience and boost up the trust and of confidence of the people.

BCCSAP includes six thematic areas which are:

1. Food Security, Social Protection and Health
2. Comprehensive Disaster Management
3. Infrastructure
4. Research and Knowledge Management
5. Mitigation and Low Carbon Development
6. Capacity Building and Institutional Strengthening

FOOD SECURITY, SOCIAL PROTECTION AND HEALTH

The plan suggested increasing "resilience of vulnerable groups through the development of community level adaptations, livelihood diversification, better access to basic services and social protection".

It also called for developing "climate resilient cropping systems, (e.g. agricultural research to develop crop varieties, which are tolerant of flooding, drought and salinity, and based on indigenous and other varieties suited to the needs of resource-poor farmers), fisheries and livestock systems to ensure food security". Implementation of "surveillance systems for existing and new disease risks" and gearing up the health systems "to meet future demands" were also suggested. The report also recommended implementing "drinking water and sanitation programs in areas at risk from Climate Change".

Under this theme an "institutional capacity for research towards climate resilient cultivars and their dissemination" will be implemented. "Development of climate resilient cropping systems" would also be applied. "Adaptation against drought" will also be executed. Adaptation will be implemented in fisheries, livestock and health sector. A "water and sanitation program in climate vulnerable areas" will be conducted. "Livelihood protection in ecologically fragile areas" will be ensured.

"Livelihood protection of vulnerable socio-economic groups" will also be ensured with a particular priority towards women.⁵⁷

COMPREHENSIVE DISASTER MANAGEMENT

The plan recommended strengthening "the government's capacity and that of civil society partners and communities to manage natural disasters and ensuring appropriate policies, laws and regulations are in place".

It was suggested to "strengthen community-based adaptation programs and establish them in each of the disaster-prone parts of the country". Strengthening "the cyclone, storm surge and flood early warning systems to enable more accurate short, medium and long-term forecasts" was also recommended.

Under this theme "improvement[s] of flood forecasting and early warning systems" will be implemented. Improvement will also be made on storm and cyclone surge warning. Awareness will be raised as well as public education will be ensured towards climate resilience. "Risk management against loss on income and property" will be executed.⁵⁸

INFRASTRUCTURE

Infrastructure and facilities including road networks for transport, bridge and culverts, sea and airports, coastal and flood embankment for protection, industrial parks, public offices, public facilities including utilities, education, health centres, markets are all essential for a country to rapidly advance its people towards improved well-being. Safe infrastructure ensures the development services and benefits it should provide and Bangladesh has been investing substantially to improve its physical infrastructure. Recurring severe to catastrophic floods have damaged and destroyed the physical infrastructure in many parts of the country making the protection weak and failing.

Recommendations have been made to "repair and rehabilitate existing infrastructure (e.g. coastal embankments, river embankments and drainage systems, urban drainage systems)", along with ensuring "effective operation and maintenance systems".

⁵⁷ Ibid. 35, 27

⁵⁸ Ibid. 36

The plan also propounded to “plan, design and construct urgently needed new infrastructure (e.g. cyclone shelters, coastal and river embankments and water management systems; urban drainage systems, river erosion control works, flood shelters) to meet the changing conditions expected with climate change.”

It was also urged to “undertake strategic planning of future infrastructural needs, taking into account the likely future patterns of urbanisation, and socio-economic development and the changing hydrology of the country because of climate change”. Under this theme, “repair and maintenance of existing flood embankments, cyclone shelters, and coastal polders” will be implemented. “Improvement of urban drainage” will also be conducted. “Adaptation against floods” will be ensured. Further adaptation will be ensured against tropical cyclones and storm surges. “Planning and designing” will be conducted for “river training works”. The “resuscitation of river and khals” will be planned, designed and implemented “through dredging and de-siltation work”.⁵⁹

RESEARCH AND KNOWLEDGE MANAGEMENT

The report called for modeling “climate change scenarios for Bangladesh by applying global climate change models and methodologies at regional and national levels”. It was also recommended to “model the likely hydrological impacts of climate change on the Ganges-Brahmaputra-Meghna system to assess likely future system discharges and river levels in order to derive design criteria for flood protection embankments”.

It was suggested to “monitor and research the impacts of climate change on ecosystems and biodiversity” as well as “the likely impacts of climate change on the macroeconomy of Bangladesh and key sectors (e.g. livelihoods and food security) and contribute to developing a climate proof national development plan.”

A recommendation was made to “establish a Center for Research and Knowledge Management on Climate Change (or a network of centres) to ensure Bangladesh has access to the latest ideas and technologies from around the world, and ensure that data is widely and freely available to researchers.”

⁵⁹ Ibid. 35, 28

Under this theme, a “centre for knowledge management and training on climate change” will be established. “Climate change modelling” will be done at national and sub-national levels. “Preparatory studies for adaptation against sea level rise” will be conducted. “Monitoring of ecosystem and biodiversity changes and their impacts” will also be conducted. “Macroeconomic and sectoral economic impacts of climate change” will also be monitored. In addition, “monitoring of internal and external migration of adversely impacted population and providing support to them through capacity building for their rehabilitation in new environment” will be implemented. “Monitoring of impact on various issues related to management of tourism in Bangladesh and implementation in priority action plan” will also be executed.⁶⁰

MITIGATION AND LOW CARBON DEVELOPMENT

Bangladesh has one of the lowest per capita CO₂ emissions in the world, and is not required by any international treaty or negotiation process to commit to any reduction targets or timelines. It is important to note that mitigation potential is substantial for Bangladesh, with a huge energy supply deficit which is expected to grow over the next decades. “Hence the prospect of CDM looks bright with the country’s commercial energy consumption increasing at 6% per year.”

The report propounded to “develop a strategic energy plan and investment portfolio to ensure energy security and lower greenhouse gas emissions” and to “expand the social forestry program on government and community lands throughout the country”. Accordingly, it was advised to “expand ‘Green Belt’ coastal afforestation program with mangrove planting along the shoreline.”

It was also urged to seek “transfer of state-of-the-art technologies from developed countries to ensure that we follow a low-carbon growth path (e.g. ‘clean coal’ and other technologies).” Suggestions were also made on reviewing “energy and technology policies and incentives and revising these, where necessary, to promote efficient production, consumption, distribution and use of energy”.⁶¹

Under the theme, “Improved energy efficiency in production and consumption of energy” will be ensured. “Gas exploration and reservoir management” will also be

⁶⁰ Ibid. 38

⁶¹ Climate Change Cell. (2007, December). *Supporting the people of Bangladesh*. Retrieved from www.infokosh.gov.bd/download-attachment/1420/801.

implemented. "Development of coal mines and coal-fired power stations" will be executed. "Renewable energy development" will be implemented. "Lower emission from agricultural land" will be ensured. "Management of urban waste" will also be ensured. "Afforestation and reforestation programme" will be conducted. "Rapid expansion of energy saving devices e.g., Compact Florescent Lamps (CFL)" will be executed. "Energy and water efficiency in built environment" will be ensured. "Improvement in energy consumption pattern in the transport sector and options for mitigation" will also be implemented.⁶²

CAPACITY BUILDING AND INSTITUTIONAL STRENGTHENING

The report called for reviewing and revising, "where appropriate, all government policies to ensure that they take full account of climate change and its impacts". Since an overwhelming majority of the poorest and most vulnerable are women, children, and old people, the government needs to give specific attention to build women's capacity by taking the necessary steps locally, nationally and internationally. It was, hence, urged to "mainstream climate change in national, sectoral and spatial development planning (in government ministries and agencies, local government, the private sector, civil society and communities) and ensure that impacts on vulnerable groups and women are prioritised in plans".

It was recommended to "build the capacity of key ministries and agencies to take forward climate change adaptation (e.g. Ministry of Food and Disaster Management, Bangladesh Water Development Board, Local Government Engineering Department; National Agricultural Research System, the Health System, the Ministry of Women and Children's Affairs)."

The report also suggested to "build the capacity of the government to undertake international and regional negotiations on climate change" as well as of the "civil society and the private sector on carbon financing to access various global climate funds." Suggestions were also made on building "the capacity for education and training of environmental refugees to ease and facilitate their migration to other countries and integration in new societies."

62 Ibid. 35, 29

Under the theme, "revision of sectoral policies for climate resilience" will be conducted. "Mainstreaming climate change in national, sectoral and spatial development programmes" will be ensured. "Strengthening human resource capacity" will be implemented. "Strengthening gender consideration in climate change management" will also be executed. "Mainstreaming climate change in the media" will also be ensured.⁶³

IMPLEMENTATION

The government of Bangladesh has formed a National Steering Committee on Climate Change for the proper implementation of the Action Plan. The committee is headed by the Ministry of Environment and Forests and includes representatives from the business fraternity as well as different ministries and divisions concerned with climate change. The committee will be responsible for proving proper guidance on international negotiations, collaborations, research and development. The objective of this country framework is to facilitate addressing climate risk management and adaptation holistically, practically and systematically in a country setting, thereby enabling development to take into account climate-related risks and their management. It will chart a way for Bangladesh to integrate climate risk and adaptation practically.⁶⁴

The Ministry of Environment and Forests will also set up a 'Climate Change Unit' to support the National Steering Committee. The Action Plan will be periodically reviewed and revised and include recommendations of the government and private stakeholders as well as development partners.⁶⁵

FINANCING

Proper implementation of the adaptation strategies will depend on effective financing. It has been argued that since the Western and other industrialised countries are the most responsible for the historical greenhouse gas emissions, the funding has to come from these countries. Because of its poverty – over 80% of its population live on less than US \$2 a day – Bangladesh cannot afford the

⁶³ Ibid. 40

⁶⁴ Ibid. 52

⁶⁵ Ibid. 35, 30

kind of defences planned in Europe or the US. As a matter of fairness, adaptation measures in developing countries should be financed by rich countries. It is poor countries that are suffering the brunt of climate change, but it is the rich countries' greenhouse gas emissions that caused this problem in the first place. Some development partners already are investing in Bangladesh to address climate risks and impacts. The government of Bangladesh wants a new finance structure where the Least Developed Countries (LDC), Group of 77 and the developed countries will have an equal say on the generation, allocation and disbursements of the funds.

The report recommended that the funds have to be on a grant basis since the need of adaptation arises because of climate change. For example, the cost of adopting the energy-efficient technologies is quite high for developing countries like Bangladesh. It is recommended that the additional cost for such adoption should be provided on a grant basis.

The total cost of the adaptation program for the first two years is estimated to be US\$500 million and US\$5 billion for the first five years. A National Climate Change Fund has been established by the Government of Bangladesh, where it wants all the development partners of Bangladesh to contribute. The fund will be exclusively used to implement the Action Plan.⁶⁶

Innovative, practical, diversified, transparent, accountable and most of all legally binding mechanisms need to be established and governed equitably enforcing climate justice. Market mechanisms to curb emissions should include substantial incentives in the second commitment period if realistic funds are to be generated to invest adaptation needs and demands that are likely to surface in the coming decades.⁶⁷ As an example, luxury tax can be introduced on limitless or environmentally harmful lifestyle. This way, the consumption pattern can be reshaped. Financial size matters but a strong governance will matter more. A competent authority can allocate the fund according to the right priority. "Emitters should own up and finance the cost of adaptation, victims and vulnerable should have the right to decide how this fund should be managed and utilised."⁶⁸

66 Ibid. 35, 31

67 Ibid. 52

68 Ibid. 52

TECHNOLOGY TRANSFER

"Access to proper cost effective and efficient technology for adaptation and mitigation" is quite essential for proper and efficient execution of the strategies. In this regard, it has been recommended that every project to be initiated under the Action Plan must have special provision for transfer of relevant advanced technology. There should also be an assessment of technology needs in the investment activities where necessary.

Reducing vulnerability to climate change impacts on the ground can be realistically achieved once appropriate mechanisms, instruments and arrangements evolve, enabling those who are vulnerable to match their resource requirement with their felt needs and response strategies.

In some cases, the technology is restricted through Intellectual Property Rights (IPRs) by the inventors and patent holders. Here, it is suggested that "the acquisition of the technology has to be facilitated by appropriate financing mechanisms".⁶⁹

⁶⁹ Ibid. 43

Recommendations

Based on the above considerations, the report makes the following recommendations:

Innovative research and development: The impacts of climate change will cause changing patterns in the lifestyle of the people, technology, and the global situation. There is no alternative to innovative research and development to face the upcoming challenges. This research and development should mainly focus on the needs and requirements of Bangladesh. For that, funding for scientific research from both the government and private sources should increase substantially. It is imperative to "explore new adaptation options for the community to adapt to the impact of climate change; sharing experiences with relevant stakeholders on good practices for adaptation to climate change and variability."⁷⁰ Through these research activities between researchers, stakeholders and policy makers/planners, a strong connection has to be established to share research results and needs and to formulate viable adaptation policies/strategies at the national level to act upon. This sort of research would also provide good practices or technologies that have shown better potential for adaptation to climate change and variability as well as improved livelihood options in the backdrop of climate change impact.

Strengthening and implementation of national environmental legislations: National legislations on environmental issues should be strengthened and properly implemented. Loopholes in the existing laws should be eliminated so that individuals from every level of national and international sphere abide by them.

Effective mass awareness programs: Effective mass awareness programs should be conducted to enhance the realisation of Climate Change. People should be made aware the effects of climate change and the necessity to save the environment. Citizens should also learn about their individual roles as part of the society to fight climate change and a sense of social resilience should be built up. Real adaptation will take root with the poor and most vulnerable securing their access to necessary information, knowledge, services and resources timely, adequately, and in accordance to their needs. The measures must secure access to the right information to make decisions and build necessary resilience, in the most cost effective way.

⁷⁰ Ibid. 52

Transparency and accountability: The implementation of the adaptation strategies will include large projects involving billions of dollars and a huge workforce. As a result, the chances of corruption and irregularity will increase. Transparency and accountability must ensure the successful implementation of adaptation strategies. Good governance of the climate regime and its negotiated outcomes will hold all parties fully accountable to their role and commitment, to the needs of the real world, its people and the atmosphere that supports life on it. This will further ensure transparency in decision making, equal participation and responsive disclosures. Meaningful and effective participation by all parties in climate change mitigation will prevail by recognising we have no alternative to that of taking action immediately, adequately. Ultimately, the consequences of inaction will challenge the integrity of the global community in securing the right to be able to cope with climate impacts and maintain the well-being of life on this planet.⁷¹ Bangladesh needs to access low carbon energy to unlock its potential. The mitigation potential is substantial for Bangladesh, considering its energy supply deficit which is expected to grow over the next decades. Reliable and affordable energy, including electricity, is essential for economic growth and human development. Access to cleaner, non-fossil fuel energy can ease the balance of payment of an oil-importing country like Bangladesh. With the country's commercial energy consumption increasing at 6% per year, prospects for CDM look promising.

Regional and international cooperation: Effects of climate change will not be restricted by the international borders of the states. Every country in the world is susceptible to the impacts of climate change. For the proper mitigation of the impacts, a sense of common interest must be promoted to ensure regional and international cooperation. Bangladesh and its people can become less vulnerable if sustainable development and other goals address and integrate climate risks. Adaptation to climate change and climate risk management should, therefore, be part of Bangladesh's development planning. Climate impacts will affect the entire population in South Asia in the coming decades, in one way or another. Hence there lies the need for a systematic recognition across sectors and countries. The stakeholder groups should further ensure identifying and assessing risks, and scope risk management and adaptation options. Adaptation to climate change requires taking steps to prepare and rationalise costs.

⁷¹ Ibid. 52

Conclusion

Climate change is real, the effects of which the world has already started to witness. There is simply no option other than preparing ourselves to face the challenges. The threats posed by climate change will be particularly high for the economically deprived countries. Thus, Bangladesh has already been listed as one of the most vulnerable countries to climate change.

Challenges faced by Bangladesh due to climate change are multidimensional and will require a similar approach to fight them. The formulation of a comprehensive national climate change adaption strategy plan by the government of Bangladesh is something quite commendable. However, the strategy plan could become obsolete as time passes by, which is why it needs to be regularly reviewed while taking the recommendations of various stakeholders into account. In any case, the effective implementation of the strategy plan will depend on the willingness of the policy makers and the authorities in concern.

Bangladesh has a major stake in what future commitments the world agrees to. The fate of this country and people are directly linked to both mitigation and adaptation to climate change. Anthropogenic emissions already released in the atmosphere have placed our country at high risk to unavoidable global warming and resulting impacts on the climate. The future aspirations of this country and its people are threatened. Bangladesh's future is very much in the hands of those responsible for ensuring a meaningful outcome from negotiations. International and regional consensus and action have a key role in supporting global and regional public goods for adaptation, such as forecasting climate and weather, disaster response, more resilient crop varieties, technologies for water conservation and irrigation, new methods to combat land degradation, prevention and treatment of malaria and other water and vector-borne diseases.

Above all, mainstreaming of climate change is essential in every sphere of life. This issue must be taken into consideration by every individual in both their personal and public lives. The effects of climate change can never be mitigated without proper realisation of the matter.

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Energy Security and Climate Change in South Asia: A Threat Analysis for Nepal

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Mahesh Raj Bhatta

Introduction

The Centre for South Asian Studies (CSAS) is pleased to contribute to a better understanding of the crucial issues of climate change and energy security in Nepal through this well-founded research paper. It was commissioned by the Regional Project Energy Security and Climate Change Asia-Pacific (RECAP) of the Konrad-Adenauer-Stiftung (KAS) based in Hong Kong. This research has been carried out under the auspices of the CSAS by Mr Ujjwal Upadhyaya, Dr Smriti Dahal and Mr Mahesh Raj Bhatta and is being published in conjunction with similar country reports from Bangladesh, Pakistan and Sri Lanka.

The first paper by Mr Ujjwal Upadhyaya underlines the grim reality that increased drought spell and intense rainfall (high volume, low duration) led to more occurrences of flash flood and landslides in Nepal over the past decade. Prolonged drought periods have caused occurrences of forest fires. Like many other mountain regions in the world, such rich and resourceful topography now is being threatened due to various effects and consequences of global warming which leads to climate change. A number of visible climatic impacts have already been noticed and documented; the most widely reported indicator being the shrinking size and area of high altitude glaciers and glacial lakes which has short and long-term implications on water storage in the river basins, affecting the livelihoods of the up-stream, mid-hill and downstream population. Moreover, the country having sharp and steep slopes is also believed to suffer a negative impact on water-induced hazards, such as the increased frequency and magnitude of high-speed flash floods, landslides and debris flows affecting living conditions and livelihoods of the people in general. Glaciers have been declining both in area and in number in all major river basins in Nepal, leading to trans-boundary implications. Eastern and Central Nepal seem to be affected most in terms of declining glaciers as Koshi and Gandaki basins are soon running out of it. Nepal's major natural resources, biodiversity and water are at the forefront of climate vulnerability.

In the second paper, Dr Smriti Dahal writes that the average temperature in Nepal has increased at an annual rate with the increase being stronger in the higher altitudes of the country and more pronounced during the winter months as opposed to the summer. Warming has also been greater in the Western half of the country as compared to the Eastern. Approximately 64% of the country's cultivated areas

are heavily dependent on monsoon rains. Changes in the time and duration of such rainfall will affect the agriculture production significantly, especially the production of rice. Higher temperatures will increase water demand, combined with a decrease in precipitation. Many agriculture systems will turn towards irrigation to ensure food security and maintain livelihoods. The unsustainable consumption of ground water for irrigation along with other uses is considered to be the main cause of groundwater depletion. Heavy reliance on rain-fed farming, limited irrigation facilities and significant water conservation and harvesting mechanisms will, in turn, prove disastrous for agriculture in case of extreme events. The impact on food security of Nepal as a result of climate change further underscores that heat stress along with varying precipitation in Nepal will shorten the growing period of the crops and reduce crop yields. Although an increase in temperature is expected to result in immediate increase in yields due to the "fertiliser effect" of rising atmospheric carbon, the net result for food production is predicted to be negative for developing countries. Nepal and other countries in South Asia are likely to suffer prolonged droughts and overall crop yields in the region are expected to decrease up to 30% by the mid-21st century.

In the third paper, Mr Mahesh Raj Bhatta writes Nepal's electricity generation is dominated by hydropower, though in the entire scenario of energy use of the country, the electricity is a tiny fraction – only 1% of energy need is fulfilled by electricity. The bulk of the energy demand is dominated by fuelwood (68%), agricultural waste (15%), animal dung (8%) and imported fossil fuel (8%). In regard to this scenario and the country's immense potential of hydropower development, it is important for Nepal to increase its energy dependency on electricity with hydropower development. This contributes to deforestation, soil erosion and depletion, and increased flooding downstream in the southern plain of Nepal and the neighbouring state of India every year but there is little option for a country currently reeling under 16 hours of power cut during winter. Between 2005 and 2014 peak demand has more than doubled from 557 to 1,200 MW. In the same period annual electricity production increased from 2,642 GWh to 4,631 GWh. Out of these, 3,558 GWh have been produced domestically, while 1,072 GWh have been imported from India. Nepal which possesses 83,000 MW of hydro potential has now become a power importing country due to the gross politicisation of the issue of hydro-resources, political instability in the country, policy inconsistency and lack of transmission lines. Nepal is also vulnerable on energy as was seen last year (2015) of a total scarcity of fuel and cooking gas in the country due to a border blockade.

NEPAL

Despite facing such acute shortage of daily essentials, Nepal has done little to make sure that people do not have to suffer again in the future. What the country needs is for all the political parties to be hand in hand as regards to the issue of developing hydro-resources. Similarly, there need to be concrete plans and swift implementation by the government on the issue of developing solar, biogas and wind energies in Nepal. Although many such plans and programmes are on paper, there hasn't been concrete action on those fronts.

I hope this in-depth study will prove useful to academics, policy makers, students and the general public. I would like to thank Dr Peter Hefele and the entire team of the KAS RECAP for their support to CSAS in this endeavour.

Dr. Nishchal N. Pandey

Director, CSAS

Kathmandu

Sep. 2016

Climate Change and its Threat Analysis in Nepal

HYDROLOGY, METEOROLOGY, GLACIOLOGY, CRYOSPHERE AND WATER INDUCED HAZARDS

Ujjwal Upadhyay¹

BACKGROUND

Climate Change is defined as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UNFCCC, 1997 cited in Bhatta, 2011). It has become a global issue for the inhabitants of the earth. From pictures of polar bears clinging to melting ice floes in Alaska, to dried and cracked farmland stretching into the horizon in South Asia and Africa – images of the ecological impacts of climate change have become part of our combined consciousness and inspire concern and discussion about what climate change ultimately will mean to our planet (IWGCCH, 2009). Thus the global climate change has become one of the most visible environmental concerns of the 21st century (*ibid*). Climate is an environmental component in the form of an aggregate that consists of temperature, precipitation, humidity and air (Upadhyay 2009, ICIMOD 2010). Change in climate is a natural phenomena as it is changing since the origin of the earth (Smith, 2007). The natural rate of climate change is very slow where the species would have enough time to adapt to the change (Darwin, 1859). However, if the change is accelerated by *anthropogenic* activities then it would take place at a high rate, not allowing species to adapt to that change. This finally creates adverse impacts on lives, people's livelihood and development of society (Lamichhane 2010, Upadhyay 2015).

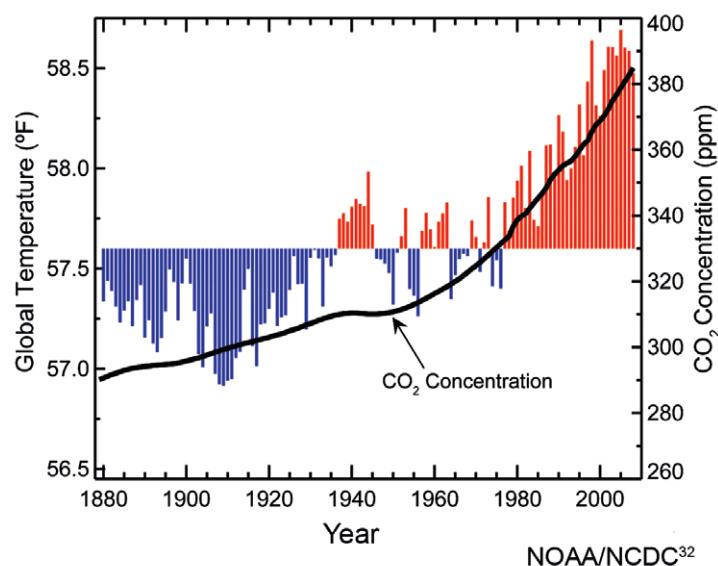
Global average temperature is one of the most-cited indicators of global climate change and shows an increase of approximately 0.77°C since the early 20th

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Century (IPCC 2007). The global surface temperature is based on air temperature data over land and sea-surface temperatures observed from ships, buoys and satellites. There is a clear long-term global warming trend, while each individual year does not always show a temperature increase relative to the previous year, and some years show greater changes than others. These year-to-year fluctuations in temperature are due to natural processes, such as the effects of El Niños, La Niñas, and the eruption of large volcanoes. Notably, the 20 warmest years have all occurred since 1981, and the ten warmest have all occurred in the past 12 years (<https://www.ncdc.noaa.gov/sotc/global/201513>).

Figure 1.1 below shows global annual average temperature measured over land and oceans. Red bars indicate temperatures above and blue bars indicate temperatures below the 1901–2000 mean temperature. The black line shows atmospheric carbon dioxide concentration in parts per million.

Figure 1.1



(Source: <http://www.ncdc.noaa.gov/indicators/>)

Global mean sea level has been rising at an average rate of approximately 1.7 mm/year over the past 100 years (measured from tide gauge observations), which is significantly larger than the rate averaged over the last several thousand years. Since 1993, global sea level has risen at an accelerating rate of around 3.5 mm/year. Much of the sea level rise to date is a result of increasing heat of the ocean causing it to expand. It is expected that melting land ice (e.g. from Greenland) and

mountain glaciers (mainly Hindu-Kush-Himalaya in Central Asia) will play a more significant role in contributing to future sea level rise. By 2100 the average rise of sea level would reach 16.8 cm affecting more than 78 million people in the world (NOAA and Climate Centered Population Numbers, based on 2010 US Census Data for the Contiguous US). This will have much detrimental impacts on countries like Maldives, Sri Lanka and Bangladesh in South Asia. Northern Hemisphere average annual snow cover has declined, also in Hindu-Kush Himalaya (HKH), in recent decades particularly affecting high and snowy mountains. This pattern is consistent with warmer global temperatures. Some of the largest declines have been observed in the spring and summer months.

CLIMATE CHANGE AND THE THREATS ASSOCIATED WITH NEPAL

Nepal is located between $80^{\circ}4'$ and $88^{\circ}12'$ east longitude and it ranges from $26^{\circ}22'$ to $30^{\circ}27'$ north latitude. Comprising five geographic and climatic zones – Plain Terai, Siwalik Hills, Middle Mahabharat Mountains, High Mountains and High Himalayas – the country has all kinds of climatic features ranging from Tropical to Arctic (Castillo et. al. 2015). The high mountain region has much lower temperatures than the southern Terai plain and middle mountains region year-round (UNDP 2012). The elevation ranges and annual temperatures for each of Nepal's five geographic regions are shown below in table 1.

Table 1: Elevation ranges, Climate and Average Temperature in Nepal's five geographic regions

Region	Elevation (m)	Climate	Average Temp. ($^{\circ}\text{C}$)
Terai	200	Humid tropical	>25
Siwalik Hills	200–1500	Moist sub-tropical	25
Middle Mountains	1000–2500	Temperate	20
High Mountains	2200–4000	Cool to subalpine	10-15
High Himalayas	>4000	Alpine to arctic	<0-5

Agrawala et al. 2003

Whilst being a global issue, climate change is a major environmental and social challenge for a country like Nepal (LFP, 2010). Although the country is responsible for less than 0.025 percent of total annual greenhouse gas emissions of the world (Karki, 2007), it is experiencing increasing trends and the associated effects of climate change in every ecological zone and stratum of socioeconomic. Apart from many hydrometeorological risks and hazards, Nepal's rural inhabitants, notably the ones highly dependent on natural and land-based resources for their livelihoods, are likely to be the most negatively affected by changes in ecosystems and impeded environmental services caused by the climate change (ICIMOD- Technical 6 Report, 2010).

In this context, Nepal, the country lying in the lap of eastern Himalayas – a part of the largest and tallest mountain range of the world – is facing such threats. The country with an area of 147,181 square kilometres has such highly varied landscape from 70 to 8,848 meters above sea level within 153 kilometres North-South span which makes it unique in terms of altitude, climate, environment. Nepal is thereby determinate for social, ethnical and cultural diversity (Upadhyay 2016). Although about 22 percent of the total land area being located in the southern plain, remaining lands lie at mountainous regions with high differences in altitude. The country, bestowed with varied climatic and ecological zones, tropic to arctic, has been a unique repository of many biologically and physically valuable species in various habitats such as forests, waters and mines. The forests provides resources like timber, herbs, and medicinal plants, including wild fruits and fibres along with a faunal biodiversity carrying high ecological as well as economic value. More than 6,000 rivers and rivulets flowing through four major (Koshi, Gandaki, Karnali and Mahakali) and six small sub-basins provide tremendous opportunities to harness electricity as much as 83 GW through hydroelectric projects of which 48 GW is economically and socially viable. Furthermore, these resources can be systematically stored (in monsoon when 80 percent of total annual precipitation takes place) and tapped to supply water for drinking, irrigation and energy generation through multipurpose programmes and projects. In a well regulated manner it could better cater the demand of more than 500 million people living downstream, both in Nepal and in India in Ganges Basin where land becomes extremely dry for at least four months in a year, particularly from March to June (SMEC 1998).

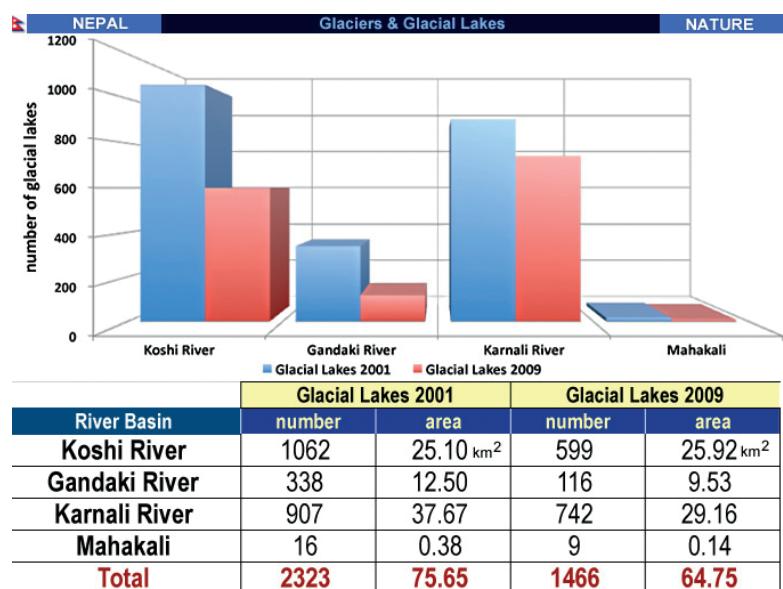
Nepal has already observed increased drought spell and intense rainfall (high volume, low duration) leading to more occurrences of flash flood and landslides,

prolonged drought periods causing more occurrences of forest fires, glacial retreats and Glacier Lake Outburst Flood (GLOF) threats (Shrestha, 2007). In Nepal Climate change has implications for the reduction of snowpack on the mountains, water supply shortages, increase in forest fires, increase in extreme weather, increased demand for irrigation and decreases in power generation. Wells dry up due to lower water table (Regmi, 2009). According to NAPA (2010), Nepal is ranked 6th among the 200 countries who will suffer most from the climate change impacts (Bhandari 2014). Over two million Nepalese people depend on climate-sensitive sectors like agriculture and forestry for their livelihood (Garg et al., 2007). Forests provide a carbon reservoir as they contain about 60% of all carbon stored in terrestrial ecosystems (CIFOR 2007), and they serve as critical adaptation buffers (Chaudhary and Aryal, 2009). Water upsurge and debris flows triggered by glacial lake outburst flood (GLOF) have damaged forests, agricultural lands, walking trails, bridges, and rivers as far as hundred of meters downstream (ICIMOD 2013). Floods wash away forests and living creatures along with it, thus reshuffling composition of plant and animal species both up and downstream (ibid). The possibility of wider gaps in protected area management is one of the projected impacts of climate change. Approximately 10 percent of known species of the Himalayas were listed as threatened (Lal & Murdiyars, 2001) and, annually, 2.45 percent of species are on the verge of extinction because of climate change (Alan & Regmi, 2004). Warmer and drier conditions from global warming have also caused a significant increase in the number of major wildfires (National Wildlife Federation, 2006 as cited in Bhandari, 2014). IPCC reported that forest fires caused by unusually high temperatures in Nepal may threaten the extinction of red pandas, leopards, monkeys, deer, bears and other endangered animals (Lal, 2001 as cited in Bhandari, 2014). In response to climate change, many birds are changing their nesting and migratory patterns in Nepal (Butler, 2003).

GLACIERS AND GLACIAL LAKES

As like many other mountain regions in the world, such rich and resourceful topography now is being threatened due to various effects and consequences of global warming which leads to climate change. A number of visible climatic impacts have already been noticed and documented; the most widely reported indicator being the shrinking size and area of high altitude glaciers and glacial lakes which has short and long-term implications on water storage in the river basins, affecting the

livelihoods of the upstream, mid-hill and downstream population. Moreover, the country having sharp and steep slopes is also believed to suffer negative impacts on water-induced hazards, such as the increased frequency and magnitude of high-speed flash floods, landslides and debris flows affecting living conditions and livelihoods of the people in general. Glaciers have been declining both in area and in number in all major river basins of Nepal, leading to trans-boundary implications (ICIMOD 2014). Eastern and Central Nepal seem to be affected most in terms of declining glaciers as Koshi and Gandaki basins are soon running out of it. However, the other parts of the country too are losing glaciers at a slower pace (*ibid*).



Source: ICIMOD 2010

Glaciers are believed as the most important source of water playing a crucial role to manage and control both hydro-meteorological and ecological activities at the regional level by ensuring a continuous supply of pristine water over a vast region. Disruption in glacier and glacial lake systems and its cycle further reinforces the physical climate which is already deteriorated by the climate change effect. That will have an impact on the hydrological cycle in its entirety again, starting with a reduction in snow cover and glaciers and, gradually, availability of water downstream (Eriksson et al. 2009).

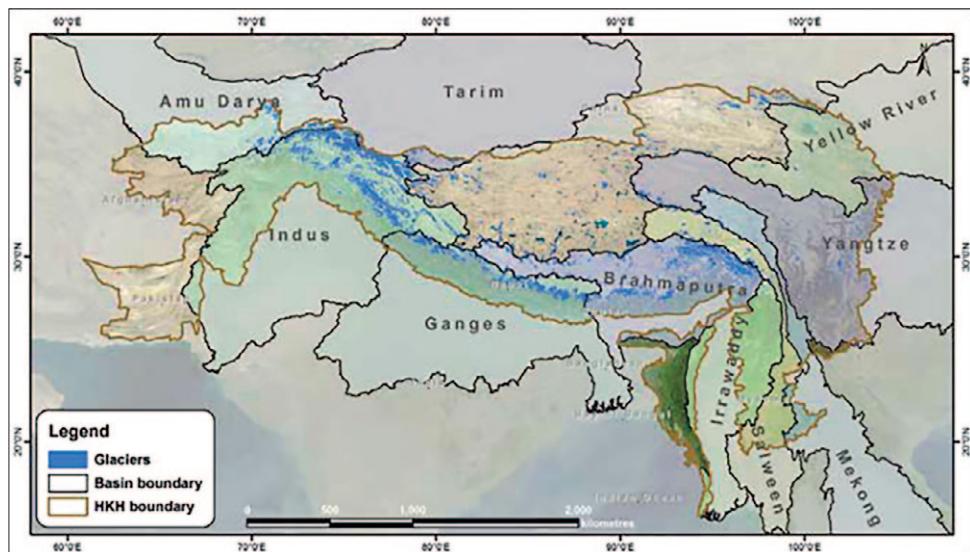
In Nepal alone, more than 100 major glacial lakes located in Himalaya region are rapidly melting, especially Imja and Tso Rolpa (Mool et. al 2009). The Himalaya region abounds in glaciers. Nepal Himalayas contain 3,808 glaciers and 2,315

glacial lakes of various sizes above 3,500 meter above sea level, covering an area of 5,323 km² with an estimated ice reserve of 481 km³ (Thomas and Rai, 2005, cited in ICIMOD 2014). The recent Gorkha Earthquake (7.9 Richter in Magnitude) and thereby occurred aftershocks have put these geological structures in peril. In this wake, rapid glacial retreat and high chances of GLOF at high altitude have put the entire Himalayan region into a disaster prone zone (Upadhyay 2015).

Moreover, a comprehensive inventory done quite recently on Nepal's glaciers depicts that Nepal has lost more than a quarter of its glacial mass in the last three decades, and the accelerated melting is posing a potential threat to neighbouring ice sheets (ICIMOD 2014). The data derived from the satellites Land-Sat ETM+2010 and SRTM DEM (Slope Aspect) followed by some data processing techniques like remote sensing corrections and multi-resolution segmentation of both clean-ice (CI) and debris-covered (DC) type glaciers depicted the decreased trend of new glacial lake formation as well as the shrinking area and number of existing lakes. The total glacier area and ice reserves in the landlocked Himalayan country came down by 24 per cent and 29 per cent respectively between 1977 and 2010. (*Ibid*) The glaciers receded on an average by 38 square kilometre (sq km) every year, and such a massive retreat could destabilise adjoining ice sheets, trigger frequent avalanches and increase the risk of glacial lake outbursts, affecting communities downstream. Nepal has a total of 3,808 glaciers covering 3,902 sq km. The report in May 2014 came a week after studies by the US National Aeronautics and Space Administration (NASA), and the University of Washington revealed that a large section of the Antarctica ice sheet was rapidly melting. The accelerated melting of glaciers in the last three decades is a key indicator of global warming, which threatens water flow in rivers fed by glaciers. The increased melting of ice also puts the local communities at risk of glacial lake outbursts. Reduced precipitation and warmer temperatures will cause a short-term danger of too much water coming out of the Himalayas, and long-term risk of insufficient water (Bajracharya *et al* 2009). Nearly 1 billion people downstream in China, India, Pakistan and Southeast Asia depend on the Himalayas and the Tibetan plateau for water (Upadhyay 2009, ICIMOD, 2010).

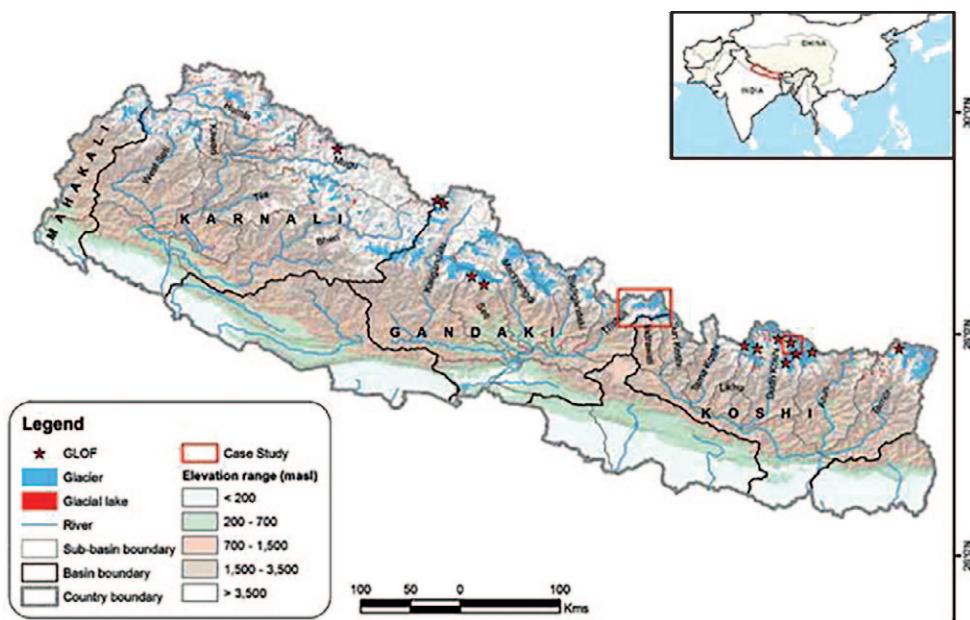
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Figure 1.3: Glaciers in Hindu Kush Himalayan Range



Source: ICIMOD 2014

Figure 1.4: Glaciers and Glacial Lakes in Nepal



Source: ICIMOD 2014

TEMPERATURE AND ITS EFFECTS

Like everywhere, Nepal's temperature, too, is in increasing trend. Warming seems to be consistent and continuous after the mid-1970s. Nepal's temperature is rising by about 0.41°C per decade (Dahal, 2005, Kansakar et al. 2004, Shrestha et al., 2000 cited in Care Nepal, 2009). Studies also indicate that the observed warming trend is not uniform across the country and is more pronounced in autumn and winter. In addition, the warming trend is higher in the higher altitude region compared to lower plain of Terai (UNDP 2012; Practical Action Nepal 2010, cited in Castillo *et al.*). In the middle mountains and Himalayan regions, the annual rate of mean maximum temperature ranged from 0.068°C to 0.128°C per year. In Terai, the annual rate of mean maximum temperature ranged below 0.038°C per year. Although the trends vary from study to study, Nepal is undeniably warming at a much higher rate than average global warming of 0.01°C per year (Practical Action Nepal, IPC 2007). Climate change scenarios for Nepal showed considerable convergence on continued warming, with countrywide averaged mean temperature increases of 1.2°C and 3°C projected by 2050 and 2100 respectively (Shrestha et al., 1999 cited in Bhusal, 2009, Niraula 2012, Upadhyay 2015). Indeed, other studies conducted by using Global Climate Services GCS models project the increase of 1.3°C to 3.8°C and 1.8°C to 5.8°C by the 2060s and 2090s respectively. The same models project an increase in frequency of hot days and hot nights of 11 to 28% and 18 to 28% respectively. Likewise, the frequencies of cold days and cold nights are expected to decrease (Practical Action Nepal 2010). The temperature of high-lying areas has been soaring as the rate rises with increased altitude. As more than 20 percent of the land of Nepal is located above 3,500 meters above sea level, these areas are more threatened by increased warming effects, negatively influencing the wind and rainfall pattern and thereby vegetation, forests, biodiversity and agriculture. The shifting of tree-line is another clear example of increased temperature being seen in every area of the country having a steep topography. To adapt with the environment, vegetation tends to climb up to 500 meters upwards (in Humla in Western Nepal). Shifting up of tree species also shifts the faunal species (both terrestrial and avian) that are dependent on respective trees for fruits and shelter. As such wild plant species do have very long term direct relation with crop species grown by the local community, alteration in wild vegetation may badly disrupt the traditional cropping pattern. Alteration of wild tree species may change various features including the effect on pollination, soil nutrient level, soil moisture, pH level, and chemical composition of the soil. Moreover, wild fauna shifted along with

trees may affect the community regarding crop damage and livestock depredations leading to more human-wildlife conflicts (Upadhyay 2015). As there are 284 meteorological stations in Nepal and none of them have been installed above the altitude of 3,500 meters from sea level, it has been difficult to trace out the exact change in temperature in the past few decades, particularly in highlands. But studies done in many ecological and climatic hotspots clearly depict about the increased temperature. The analysis of temperature data collected both at an hourly and a daily basis for the past 30 years in different sub-basins (higher and lower altitude) of Gandaki basin shows the continuous rise in temperature. As seen at the global level, temperature in the high altitude area is increasing at a higher rate. The average annual temperature growth rate at an elevation of 164 MASL (metres above sea level) and 1723 MASL in southern plain and northern valley of the basin have been 0.063 and 0.121 respectively (Bhusal 2010, Sharma 2011, Niraula 2012, Upadhyay 2015).

Data (ranging from 20 to 42 years) from six meteorological stations (Lumle (0814), Pokhara Airport (0804), Bandipur (0808), Bharatpur Airport, Rampur (0902), and Jhuwani (0903)) and five hydrological stations (Kali Gandaki (410), Narayani (450) Rapti (460), Marsyangdi (449) and Trishuli (447)) have been acquired and assessed to analyze the meteorological performance and trend. The result showed that there was a rise (by 1.68 °C) in average annual minimum temperature in the last 32 years (1983–2014). Monsoon and winter mean minimum temperatures depict the rising trend of 1°C in both lower and higher sub-basins. Local people's perception (derived from the primary questionnaire surveys taken by over 300 respondents) too showed the same result as locals complained about the increasing warm afternoons and relatively less cold winters. The mean annual maximum temperature has gone up by 0.58 (30.6 to 31.18)°C in the lower basin, too. Both monsoon mean maximum temperature and winter mean maximum temperature are increasing by 0.5 and 0.1 °C respectively in both upper and lower basin (Upadhyay 2015, "Seeking Adaptation Measures in the Changing Climate Condition in Eastern Himalayan Foothills, Case of Mid and Lower Gandaki Basin").

RAINFALL AND PRECIPITATION

The annual average rainfall is in increasing trend by 20mm in last 32 years. Similarly monsoon and winter mean rainfall too are in an upward trend with increased precipitation by 118 mm and 21.2 mm respectively. The fact is: mean average rainfall is rising in monsoon season along with increased temperature mainly because of its erraticism. In past twenty-six years, the afternoon (14:30–17:30 PM) rainfall has declined by 0.6 mm that has caused more “duration of sunshine” during this time to increase the temperature. Moreover, less rainy days and increased duration of sunshine in monsoon season have also been increasing the mean maximum and minimum temperatures. The farmers’ perception of climate change and real time hydro-met data were found highly correlated according to Pearson’s Correlation Coefficient test conducted.

Alteration in rainfall and its erraticism has amplified the chances of “too much, too little water hazard” leading to more occurrences of frequent floods and thereby induced disasters like erosion, landslide, debris flow, and prolonged drought spell. Increased intensity and a decreased duration of rainfall lead to more surface runoff with less underground infiltration and percolation affecting proper ground water recharge. This leads to decreased water table affecting the livelihood of the community in terms of water availability in dry season in particular (Eriksson *et al* 2009; Upadhyay 2015).

RIVERS AND HYDROLOGY

Hydrological study of major rivers and its discharge reveals the fact that the snow-fed rivers are drying up more rapidly than the rivers originating from springs from middle mountains and draining through urbanised areas like East Rapti. The flow of water at four major rivers draining through the foothills of Annapurna mountain range of eastern Himalayan basin is found to be declining. The Station No-410 (data about Kali Gandaki River) shows that the discharge decreased significantly in past 32 years (1964–1995) from average annual discharge of 491 to 283 m³/s. There is a significant decline in the mean monsoon and winter discharge of the river – from 1074 to 743 and from 132.2 to 68.6 m³/s respectively. The analysis of available data from 1996 to 2006 shows that the annual average flow is decreasing at the rate of 19.82 m³/s per year. With the analysis of the available data

(1975-2006) on the annual average flow of Trishuli River at Betrawati (447), it was found to be increasing in monsoon season by $2.7366 \text{ m}^3/\text{s}$ per year. However, during the dry season (Nov–April) it has been found to be decreasing by $2.2206 \text{ m}^3/\text{year}$. The Station No-450 (data about Narayani River) also has the similar case with a moderately declined average annual discharge from $1.509 \text{ m}^3/\text{sec}$ to $1.486 \text{ m}^3/\text{sec}$ in past 31 years (1980-2010). Adding to this, the average monsoon as well as winter season discharge is decreasing in Narayani River from $3.587 \text{ m}^3/\text{sec}$ to $3.389 \text{ m}^3/\text{sec}$. But quite surprisingly, the national station No-460 data showed that the discharge rate of Rapti (non-snowfed, originating from Mahabharat hills) River has been increasing in the recent past by 18 and 23 percent ($43.2 \text{ to } 51.2 \text{ m}^3/\text{s}$ in monsoon and $9.32 \text{ to } 11.43 \text{ m}^3/\text{s}$ in winter) respectively. Marsyangdi (at Bimal Nagar) and Trishuli (at Betrawati) too have been consistently declining in its discharge, particularly in dry season. With the analysis of the available data on the annual average flow of Trishuli river, it has been found to be increasing by $2.7366 \text{ m}^3/\text{s}$. However, during the dry season (Nov–April) it has been found to be decreasing by $0.2806 \text{ m}^3/\text{s}$. River waters are mainly declining due to decreasing snow caps and drying tributaries that confluence with it. However, monsoon-induced flash floods have been causing much high level flow that makes average annual discharge greater than actual. Discharge rate has been losing its uniformity. Adding to this, people have been using upriver and tributaries water for irrigation and many other purposes. Driven by the rapid population growth along with drying spring and ground water sources, people are more bound to use river and stream to fulfill their water needs that too are reducing the amount of water in the rivers flowing downstream. Water from Trishuli river is being lifted up to 300 meters to irrigate lands in Nuwakot, Gorkha and Dhading districts. Although people have been making waterholes to conserve water for irrigation along with rainwater harvesting techniques to store water for daily household use, the demand-supply deficit is rising consistently. Drip irrigation techniques were seen in some of the farms in the middle basin where water was very scarce.

Each day, on an average 54 trillion litre of water is drained through Nepal to the bordering nation India (Dhungel, Pun 2008) and the discharge of water is declining every day due to reasons above. Adding to this, population growth in the upstream and thereby increased usage of water from small tributaries too has declined the discharge rate of water in big rivers (Upadhyay 2015). Burgeoning deforestation and increased agriculture area have been consuming more water in the upstream, thus leaving even less water to major river systems. Another alarming effect is an

altered monsoon system comprising delayed and less rainfall, particularly influenced by El Niño effect, resulting in less precipitation in watersheds that are crucial to continuously feed waters to the tributaries and other sources coming out of it. This will have many detrimental effects in years to come.

CONCLUSION

The monsoon tends to begin later; the rainfall is more irregular, and flash floods are more frequent. The winter rains are reduced and some years fail altogether. People are noticing that summers are hotter and winters less cold. Mountain communities are receiving less snowfall, sometimes being converted to rain, and seeing glaciers retreat. In the mid-hills, water sources are drying up, and in the plains people report greater flooding and sudden cold waves being frequent. Some unexpected microclimatic changes have also started being seen at different pocket areas like small and moderate valleys. Nepal's climate is influenced by the Himalayan mountain range and the South Asian Monsoon (NCVST, 2009). The climate, predominantly influenced by the monsoons and westerly disturbance, is characterised by four distinct seasons: pre-monsoon (Mar–May), monsoon (Jun–Sep), post-monsoon (Oct–Nov) and winter (Dec–Feb).

As temperature varies with altitude and season, it has been increasing at a much higher rate in the northern high altitude than in the southern plain posing more risk to glaciers and glacial lakes.

Although Nepal has a negligible share in global emissions of greenhouse gases, it is particularly vulnerable to climate change due to its fragile mountain ecosystem. Nepal's major natural resources, biodiversity and water are at the forefront of climate vulnerability.

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Climate Change in Nepal

The Impacts on Livelihoods and Food Security

Dr. Smriti Dahal²

CLIMATE CHANGE AND NEPAL

Research has no doubt shown that the atmosphere has warmed, the amounts of snow and ice have diminished, and sea level has risen (IPCC 2014). Each of the last three decades has been successfully warmer than the preceding decade, with the year 2015 being the hottest year in data stretching back to 1850s. Scientists have very little doubt that 2016 will not follow the trend with each month of the first quarter of 2016, beating the average temperature for the month within the last century. For example, February has smashed a century of global temperature records by being 1.35°C warmer than the mean temperature for the month (The Guardian 2016). This trend in temperature increase seems alarming for our future, especially with the UN Climate Change Summit held in Paris in December 2015 confirming that we should not pass the 2°C rise in temperature, which is the danger limit for global warming (COP 21 2015).

According to the IPCC (2014), impacts of climate change, especially increased floods combined with droughts and irregular precipitation patterns, are expected to have severe effects on South Asian countries in the future, with Nepal being one of them. All Least Developed Countries (LDCs) (like Nepal) are responsible for just 0.025% of global greenhouse gas emissions in total, i.e. Nepal ranks among the 4th most vulnerable to climate change (Maplecroft 2011). Although relatively small in areal size, especially compared to its two major giant neighbours China and India, Nepal has very diverse climatic conditions, ranging from tropical in the southern-most part of the country to alpine in the north. The country is divided into three physiographic regions, with each region resulting in very diverse climatic conditions. A combination of factors increases Nepal's vulnerability to climate change

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- physiographical variations, the region being prone to natural disasters and the country's challenges of addressing high levels of poverty, population density and rapid urbanisation.

The average temperature in Nepal has increased at an annual rate with the increase being more in the higher altitudes of the country and more pronounced during the winter months as opposed to the summer. Warming has also been greater in the Western half of the country as compared to the Eastern. While we have witnessed more intense precipitation events in the country, due to lack of data from a few functioning meteorological and hydrological stations scattered across the country we do not have definitive trends in precipitation. We can definitely say through observation that the western half is drier than the eastern half and timing of monsoons has become increasingly unpredictable.

The physiographical diversity within Nepal leads to eco- and socio-cultural diversity as well. Different groups of people depend differently on these diverse climatic conditions and are impacted at different levels. According to the UNDP, millions of the world's poorest people are already being forced to cope with the consequences of climate change. The increased exposure to drought, to more intense storms, to floods and environmental stress is holding back the efforts of the world's poor to build a better life for themselves and their children. In Nepal alone, more than 1.9 million people are estimated to be highly vulnerable, another 10 million exposed to increasing risks of climate change.

Home to a population of more than 30 million, Nepal is one of the poorest countries in the region, with about one-third of its population living under \$1.25 per day. Eighty-three percent of the total population in Nepal lives in rural areas; the poverty rates are higher in the rural setting (World Bank 2013, FAO 2013). Although Nepal is experiencing an increased high level of growth in food consumption, it is one of the most undernourished, malnourished and food insecure countries in the world. Approximately 29% of Nepalese are undernourished (FAO, WFP, IFAD 2012). In Nepal, more than 75% of the population depends on agriculture for daily subsistence and livelihood. In addition, agriculture employs more than 65% of the country's population and contributes almost 40% of the country's GDP (FAO 2013). Hence agriculture in the region is closely related to food security and poverty alleviation. Agriculture also has close linkages with other economic sectors and hence agriculture growth has a multiplier effect on the entire economy. All these

various socioeconomic conditions coupled with non-traditional insecurities like climate change are likely to increase the vulnerability of Nepal and its people in the coming future.

CLIMATE CHANGE, AGRICULTURE AND FOOD SECURITY

Food security is defined as the condition where all the people have access to sufficient, safe and nutritious food that meets their dietary needs for an active and healthy life (FAO, WFP, and IFAD 2012). For example, the world demand for cereal is projected to increase to 2.50 billion tonnes in 2050 from 1.2 billion tonnes in 1974. Similarly, the demand for meat is expected to increase to 327 million tonnes from merely 109 million tonnes in 1974 (Lal 2013). This will also lead to future rises in food prices. These increases in food demand coupled with future rises in food prices will be more severely felt in developing countries like Nepal where malnutrition is already a serious problem. The increase in the frequency of climate-related events is further likely to aggravate the problem of food security worldwide (Lal 2013). Agriculture, especially rain-fed agriculture, is extremely sensitive to climate change (Ramay et al. 2011). Climate change will impact resources like land, seeds, water, forests, as well as people who work on these resources used for food production. The main direct effect of climate change on agriculture will be through changes in temperature and precipitation which will affect growing seasons and timing of critical events related to crop development. According to Agarwal et al. (2000), the production of rice, corn and wheat has declined due to increasing water stress arising from a combination of increasing temperature and reduction in number of rainy days. Another study conducted in Gulmi, Nepal showed that farmers have noticed a trend of erratic rainfall patterns and decrease in winter rain, although changes in monsoons have not been that strong. Proper timing and amount of rainfall in agriculture have a strong impact on yields. These erratic rainfalls also increase incidents of droughts and floods.

Climate change affects water resources in a magnitude of way; the depth and variability of climatic changes are likely to affect water resources which in turn will affect food security in different intensities throughout the country in the future. The impacts of climate change through changes in rainfall patterns and its intensity, glacier retreats and evapotranspiration, will impact agriculture production,

mainly by a reduction in crop productivity and loss of arable land. Water quality and quantity in Nepal is increasingly being compromised due to climate impacts and regional conflicts. Water is a key driver for agriculture production in Nepal, with the majority of agriculture dependent on the monsoons. Water scarcity and rainfall variability can lead to a decrease in the agricultural production which in turn can have an adverse impact on food security in Nepal. For example, a major impact of climate change on water availability will be in the production of rice in the country. Rice is a prime staple crop for Nepalese whose production will decrease from the decrease in steam flows, delayed monsoons, and erratic rainfall which will cause droughts and floods (NAPA 2010). Approximately 64% of the country's cultivated areas are heavily dependent on monsoon rains. Changes in the time and duration of such rainfall will affect the agriculture production significantly, especially the production of rice (Lohani 2007). Higher temperatures will increase water demand, combined with a decrease in precipitation. Many agriculture systems will turn towards irrigation to ensure food security and maintain livelihoods (Turrall, Burke, and Faures 2011). The unsustainable consumption of ground water for irrigation along with other uses is considered to be the main cause of groundwater depletion. Heavy reliance on rain-fed farming, limited irrigation facilities and a significant water conservation and harvesting mechanisms will, in turn, prove very disastrous for agriculture in case of extreme events.

A decline in rainfall combined with an increase in temperature will increase the water requirements of different crops due to high evapotranspiration while less rainfall will increase the net irrigation requirements for crops (Hanjra and Qureshi 2010). Hence this will exacerbate the existing water scarcity problems in many regions and countries and further affect food security. Mismanagement of water resources will heighten the issue of water scarcity in many areas, especially those with transboundary linkages. A combination of other factors will lead to increasing agriculture demands which will further stress the water resources in the area. Climate change is also likely to increase malnutrition through its effects on infectious diseases like diarrhoea, dysentery and other diseases (Tirado et al. 2010). Hence, this will have additional negative impacts on the food insecurity in the region, in particular for the poor and vulnerable population who are already living on the margins and prone to malnutrition and episodes of food scarcity.

The heat stress along with varying precipitation in Nepal will shorten the growing period of the crops and reduce crop yields. Although an increase in temperature

is expected to result in immediate increase in yields due to the "fertiliser effect" of rising atmospheric carbon, the net result for food production is predicted to be negative for developing countries (Hanjra and Qureshi 2010). Nepal and other countries in South Asia are likely to suffer prolonged droughts and overall crop yields in the region are expected to decrease up to 30% by mid-21st century (IFAD 2008). It is predicted that South Asia will experience a 50% decline in wheat production by 2050, which equals to 7% of global food production (Hanjra and Qureshi 2010). Similarly, cereal production in the region is expected to decline by 4–10% by the end of the 21st century.

Agriculture is extremely sensitive to even a slight increase in temperature; hence, even a small increase in local temperature is likely to have a severe impact on agriculture production in the country, especially for high yielding crops like rice and wheat. Since rice and wheat are among the top earning crops and the most preferred for consumption, their low yields can significantly hurt the food production and increase the cases of famine and food scarcity in different parts of Nepal. These rises in temperatures are raising irrigation requirements for crops, and variable rainfall patterns will place rain-fed agriculture at severe risk.

The impacts of climate change on agriculture and food security have already been observed at various scales throughout the country. The population living in higher altitudes mostly practice subsistence farming, and such changes in climatic conditions will put these areas under economic stress as well as food insecurity due to a decrease in agriculture production. Most food secure regions of the country, the far and mid-west, are also witnessing crop failures and a decrease in yield, further pushing them down in the food insecurity index. To cope with the impacts of poverty, communities are practising unsustainable methods of agriculture production and ecosystem management which are also exacerbating the impacts of climate change. To field greater yield in shorter time, many farming communities are using techniques that are decreasing the capacity of the bio-physical systems to cope with the impacts of climate change. For example, reduction of biodiversity, pollution, soil erosion and degradation, and high energy inputs from fossil fuels are contributing to the emission of greenhouse gases.

Along with different locations, climate change will affect people of different gender and class differently. Studies show that women, children and elderly will suffer from relatively more severe impacts than other groups of the society due to their

dependence on resources and their level of vulnerability. For example, the dependence of women on subsistence farming is relatively higher in Nepal as male are more occupied with the markets and off-farm employments. The out-migration of men to middle eastern countries is also creating highly feminised agriculture systems where the labour inputs of women in agricultural practices are very high along with their responsibility for generating livelihood and food security for the family.

ADDRESSING CLIMATE CHANGE AT THE NATIONAL CONTEXT

Nepal has at certain levels developed various mechanisms to deal with climate change, the impacts of which are currently being felt by farmers throughout the country. This section talks about these mechanisms at both the community and the government levels.

Adaptation

Farmers at the community level, based on their traditional knowledge and experience, have developed their own practices to adapt to climate change. Studies show that farmers throughout the country have perceived the impacts of climate change on agriculture. However, the number of programmes provided by various government and non-government entities to tackle the impacts of climate change is very few (Chaudhary et al. 2011; Jodha et al. 2011). The main impacts of climate change that farmers have encountered are floods and droughts. Farmers have noticed changes in crop cycles, encroachment by invasive species and new pests, and changes in soil moisture among others. To tackle these impacts, farmers have used their own knowledge and initiated various adaptation practices with technical and financial support from research and donor organisations. Farmers are adapting through:

- Technological innovations;
- Changing cropping patterns;
- Prioritising the use of organic manure over chemical fertilisers;
- Replacing the planting of cereal crops with other crops;

- Introducing new crop varieties like vegetable farming in the higher altitudes to adapt to increase in temperature;
- Using traditional methods to store food and avoid loss through floods;
- Building water harvesting and storage systems;
- Building stronger community bonds by relying more on community user groups for various coping mechanisms.

A detailed study on climate change and agriculture done by OXFAM in 2009 sheds light on some of the impacts of climate change and coping mechanisms adopted by farmers in the mid and far western region of Nepal.

Impacts of climate change	Means of Adaptation
<ul style="list-style-type: none"> ■ Warmer drier winter and lack of winter rains and snow; ■ Unpredictable monsoon, season changing, rainfall more intense; ■ Destruction of crops from intense cold waves resulting in decline in crops and food security; ■ Rivers drying and their impact on washing, irrigation and livestock feeding; ■ Floods and inundations in the Terai. 	<ul style="list-style-type: none"> ■ Improving water management by building small ponds or installing rainwater tanks to collect rainwater for consumption and to irrigate kitchen gardens; ■ Construction of check dams and reforesting catchment areas for recharging water systems; ■ Income diversification by shifting to non-agriculture incomes through small business enterprises and caste based skills like tailoring, pot making, weaving, etc.; ■ Developing savings and credit schemes to regenerate livelihood assets such as rearing of goats; ■ Changing crops from grains to vegetables, and those that require less water, both for consumption and for selling; ■ Preference for small animals like goats due to shortage of feed and fodder; ■ Extreme coping mechanisms like skipping meals, consuming less food, sale of assets and migration (done mostly by the most vulnerable).

Policy

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted in May 1992 as an international legal instrument to address the global problem of climate change. Nepal signed this Convention on 12 June 1992 and became Party to it in 1994. The Ministry of Population and Environment serves as the focal point for the Convention and carries out all the provisions of the Convention. Since then Nepal has taken various steps at the policy level to address the issues/impacts of climate change. At the national level, the Government of Nepal has established the Climate Change Management Division in the Ministry of Population and Environment in the first quarter of 2010.

A key piece of climate change legislation prepared and promulgated by the Government of Nepal is the Climate Change Policy in March 2011. The main goal of this policy is to improve livelihoods by mitigating and adapting to the adverse impacts of climate change, adopting a low-carbon emissions socio-economic development path and supporting and collaborating in the spirits of the country's commitments to national and international agreements related to climate change. A number of developments completes the implementation of the policy. Most notably, the National Adaptation Programme of Action (NAPA) which was endorsed by the Government on September 28, 2010, and National Framework on Local Adaptation Plans for Action (LAPAs) of November 2011 accompany the Climate Change Policy. Specific objectives of the policy are:

- Incorporating impacts of climate change into Nepal's planning documents;
- Strengthening NAPA, LAPA and implementing on the ground projects;
- Strengthening the capacity of people and institutions to cope with climate change with appropriate financial support and inter-sectoral linkages;
- Prioritising regional areas;
- Intensifying the cooperation between government, NGOs, and private sector.

NAPA

The main objective of NAPA is to access and prioritise climate change vulnerabilities and identify adaptation measures. NAPA's implementation framework envisages that the operating costs will be kept to a minimum and at least 80% of the available financial resources will reach the local level to fund activities on the ground. It aims to provide proposals for priority activities and assist a multi-stakeholder framework of action on climate change. The nine priorities that include urgent and immediate adaptation needs for addressing extreme climatic events and their consequences are:

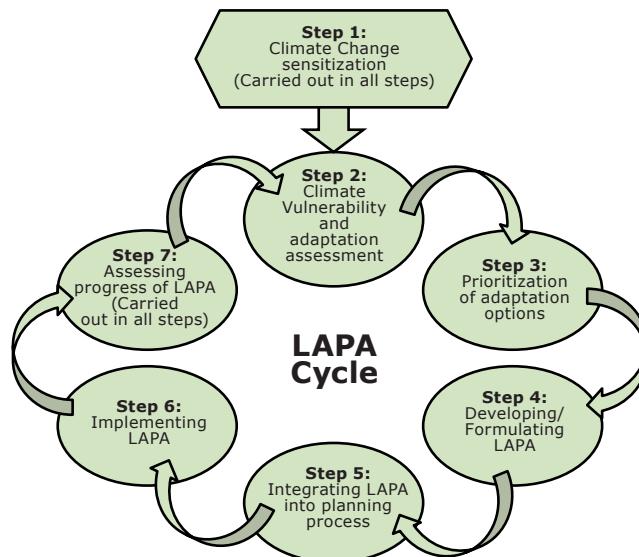
- 1.** Promoting community-based adaptation through integrated management of agriculture, water, forest and biodiversity;
- 2.** Building and enhancing adaptive capacity of vulnerable communities through improved system and access to service related to agricultural development;
- 3.** Community-based disaster management for facilitating climate adaption;
- 4.** GLOF monitoring and disaster risk reduction;
- 5.** Forest and ecosystem management for supporting climate-led adaptation innovations;
- 6.** Adaptation to climate challenges in public health;
- 7.** Ecosystem management for climate adaptation;
- 8.** Empowering vulnerable communities through sustainable management of water resources and clean energy supply;
- 9.** Promoting climate-smart urban settlement.

LAPA

Nepal is a pioneer in the development of the Local Adaptation Plan for Action (LAPA), which aims to provide climate change actions at a more localised level. The main purpose of LAPA is:

- Enabling communities to understand the changing and uncertain future of climatic conditions and engaging them effectively in the process of developing adaptation priorities;
- Implementing climate-resilient plans that are flexible enough for responding to changing and uncertain climatic conditions;
- Informing sectoral programmes and catalysing integrated approaches between various sectors and sub-sectors.

LAPA identifies local adaptation needs that focus on, among others, reducing local climate risks and vulnerabilities, and increasing resilience using seven steps as presented in the figure below (Government of Nepal 2012).



The LAPA framework ensures that the process of integrating climate change adaptation and resilience into local and national planning is bottom-up and considers the needs and resources of the climate vulnerable people in adaptation planning. It also identifies and integrates the needs of the households and communities at most

risk to climate change (for example, economically poor, those deprived of public services and socially disadvantaged households and communities) into development planning. It is responsive by providing immediate, efficient and effective delivery of adaptation services to climate vulnerable communities and households. The Nepal Climate Change Support Programme (NCCSP) assisted by the United Nations Development Programme commenced in 2013. It is the first significant Government led initiative to implement Nepal's NAPA, with a specific focus on providing assistance to climate change adaptation for the poorest and most vulnerable communities. Its key targets included the development of 100 LAPAs. By 2015, the vulnerability of 80,000 people had been reduced. The programme aims to mainstream climate change into Nepal's development agenda, contribute to poverty reduction, livelihood diversification and community resilience.

CONCLUSION

Although the impacts of climate change are felt and observed at various levels in the country, there are still very few studies/research about the effects and likely impacts of climate change in Nepal. Scientific evaluations are yet to be carried out to understand the types and degrees of impacts on specific geographical regions and development sectors. This is due to inadequate human and financial resources and lack of appropriate instruments. On a scientific level, specific impacts of climate change on agriculture, water resources, forests, biodiversity and other related sectors are yet to be assessed. Currently the research is more based on perceptions.

Insufficient integration between institutions, including intergovernmental cooperation and public and private partnership, makes adapting to these adverse conditions difficult in Nepal. Existing gaps in capacity, knowledge and experience across the country along with inadequate tools, knowledge and financial resources make the country weak in tackling the impacts of the existing inequalities. Hence the integration of private sector into adaptation strategies is a must for the region to address the consequences of climate change. These partnerships also enhance the capacities of policy makers and experts to gain stronger access to climate change funds and technologies.

Mostly in the case of climate change, there is a lack of information on monitoring and evaluation of climate change adaptation practices. Documenting good practices across the region while understanding and sharing lessons learned across South Asia is an important action that needs to be adopted by Nepal. There is a need for monitoring and statistical analysis of major river basins in Nepal, and for studying river flows and floods. There is a need to manage natural resources more effectively mainly through efficient water and land use measures.

On the other hand, many initiatives are currently present to tackle the impacts of climate change, water scarcity and food security in Nepal. However, these policies and plans, although good on paper, have not been effective in developing significant practical options. In addition, nothing concrete has been established at the national level to manage these issues of food security, water scarcity and climate fluctuations in Nepal. In most cases, climate change and food security policies have been fragmented and isolated; lacking links between different sectors. As mentioned above, Nepal currently lacks general research on these three issues and their nexus. Nepal has also failed to integrate these three topics with existing development strategies. There is also need to factor in the cost of climate change into economic planning. There is a strong need to follow up these action plans and statements with formulation and implementation of specific time-bound actions.

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Energy Crisis in Nepal: Hydro Power Potential and Challenges

Mahesh Raj Bhatta³

Nepal has a huge hydropower potential, but much of the 83,000 MW of hydro-energy is still untapped. Being rich in natural resources, Nepal possesses a great potential of development of energy generation. The nature of Nepali rivers and the steep gradient of the country's topography provide ideal conditions for the development of some of the world's largest hydroelectric projects in Nepal. Current estimates are that the commercially viable hydropower generation potential of Nepal is 42,000 MW. However, the present situation is that Nepal has developed only approximately 600 MW of hydropower. Therefore, the bulk of the economically feasible generation has not been realised yet. Besides that, secondary and tertiary benefits have not been realised from the development of its rivers. Nepal is at lowest in the list of per capita electrical energy consumption among the other SAARC countries which accounts just for 68 KWh in 2003, a number which slightly inclined from 35 KWh in 1990.

The first hydropower generation was commissioned in 1911 in Phurping near Kathmandu. To date, although bestowed with tremendous hydropower resources, only about 40% of Nepal's population has access to electricity. Most of the power plants in Nepal are the run-of-river type with energy available in excess of the domestic demand during the monsoon season and deficit during the dry season. Nepal has no known major oil, gas, or coal reserves, and its position in the Himalayas makes it hard to reach remote and extremely remote communities.

Nepal's electricity generation is dominated by hydropower, though in the entire scenario of energy use of the country, the electricity is a tiny fraction – only 1% of the energy need is fulfilled by electricity. Main energy sources are fuelwood (68%), agricultural waste (15%), animal dung (8%) and imported fossil fuel (8%). With this scenario and having immense potential of hydropower development, it is important for Nepal to increase its energy dependency on electricity by developing hydropower. This contributes to deforestation, soil erosion and depletion, and increased

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flooding downstream in the southern plain of Nepal and neighbouring states of India every year. On the other hand, the development of hydropower will help to achieve the millennium development goals (MDGs) by protecting the environment, increasing literacy, and improving the health of children and women with better energy.

The state-owned Nepal Electricity Authority (NEA) is responsible for the electricity supply through the national grid. Power supply is limited to about 40% of the population (2009) living mainly in urban areas. Only 8% of people in rural areas have access to electricity. The low level of electrification hampers both economic development and access to information and education in the countryside. Beside the national grid, thousands of small installations (diesel generator sets, solar home systems, small island mini-grids, etc.) are installed in Nepal. Therefore, the NEA serves only 15% of the total population of Nepal. For this small number of customers, average electricity supply is less than eight hours per day, with load shedding accounting for up to 16 hours during winter. In December 2008 the Nepal Government declared a “national energy crisis” and approved an Energy Crisis Management Action Plan. Another major constraint is the lack of transmission lines. Although many hydro projects are in the offing, lack of transmission lines hinder smooth supply and become a major hurdle in exporting energy to India and possibly also to Bangladesh. Political instability in the country, raising of pointless demands such as asking for shares by the local populace, not permitting transmission lines above one’s private land, and backing of political parties to nefarious groups hindering hydropower plant construction, are some of the major issues currently being debated inside Nepal. This has discouraged foreign investors and also shunned off those already inside Nepal trying to invest in this sector.

ELECTRICITY DEMAND IN NEPAL

The electricity consumption and the number of consumers increase at a rate of approximately 9.3 % per year, according to the Nepal Electricity Authority (NEA). Because of growing population and household consumption, the demand for electricity has risen dramatically particularly in cities like Kathmandu. Due to the continuously increasing demand and stagnation in creating additional power generation capacities, a noticeable shortage of power supply since 2007 has been the consequence, which forced the NEA in early 2009 to cut power for up to 16 hours per day in some regions including urban centres.

The NEA as the major electricity utility faces an immense increase in electricity demand, whereas at the same time production and transmission capacities are limited. Although ambitious development targets are announced by politics, the development of plants and transmission lines cannot keep up with economic development and its induced demand increase. Between 2005 and 2014 peak demand has more than doubled from 557 to 1,200 MW. In the same period annual electricity supply rose from 2,642 GWh to 4,631 GWh. Out of these, 3,558 GWh have been produced domestically, while 1,072 GWh have been imported from India.

CAUSES OF ELECTRICITY CRISIS IN NEPAL

Supply lag over demand

Supply shortfall over the demand of consumers is the immediate cause of present load shedding in Nepal. Demand has inclined steeply especially in the few past years where urbanisation is rapid. Annual energy demand has crossed an average of 9.3% growth. Present demand exceeds over 808 MW where NEA toils to manage 326 at its best. The shortage of 482 MW pulled the country to severe energy crises, and power cuts to become normal in Nepalese daily life. The future needs are clearly marked, yet the prospective plants to support the escalating demand failed to develop. The cumulated shortage remained and the option to install larger plants remains the only way to tackle the present trend.

Monopoly of Nepal Electricity Authority (NEA)

The single entity dealing with the power sector is Nepal Electricity Authority (NEA) with the monopoly power to exercise in the energy market. Production, transmission and even distribution through national grid are the sole responsibility of NEA. Butwal Power Company (BPC) is a private enterprise which is involved in the distribution within few districts with a small section of coverage. The responsibility of NEA is observed to be beyond its capacity as opined by many stakeholders whose claims are supported by its inefficiency to grow as expected. The higher technical and non-technical losses of power generated and the weakening financial status threat even its future existence.

Resource deficit

Power production is heavily constrained by the availability of financial and human resources. A huge investment is required to carry out a project. Financial resources are set forth as the leading constraints in the power production given the high per capita energy production. However, the degree depends on the scale of production. The sector is envisaged as a lucrative area by private sectors. Resource analysts think that financial resource is a manageable constraint. But a visionary leadership to get the right thing done is very much needed. The average cost of per KW hydro-power lays at US \$ 2.481 which is a comparatively high figure in power production.

Inadequate private investment

Partnership with the private sector is the best possible way to fill up the resource constraint in a liberalised economy. Resource in the private sector needs to channelise in the productive sector of national interest. Although the private sector accepts that power production is a lucrative sector to invest, yet only about 24% of the total installed capacity is carried by the national and international private sector. There is a huge trend of holding licenses intended to carry out projects after the Electricity Act, but very few investors get their work done. The 10th national development plan period ended up with the installation of just 39.5 MW electricity out of targeted 214 MW from private investment, showing totally inadequate investment from the major players in the sector.

Failure to meet development targets

Policy versus implementation debate is not a new discourse in development debate while reviewing any shortcoming. The same fate evokes out even in the power development sector in Nepal. The vision to develop a set target of power production in different planning periods has the syndrome of being far away from achievement in return. The 10th National development Plan had aspired to gear up the sector and push up the installed capacity up to 315 MW, but 40 MW still lack to be installed – with zero addition from the government sector. The ninth plan resulted out with a better figure of 216 MW out of a set target of 268 MW.

Seasonal variation supply

All except one power plant are run-off-river type. The acclaimed capacity of 619 MW at present corresponds to the installed maximum strength. The plants are heavily dependent on nature and its production is directly proportional to precipitation level. During the winter the volume of river water declines drastically, and so does the generation of power. The run-off-river type just supports 230 MW whereas the reservoir type Kulekhani manages an output of 46 MW. This reduction of power generation in the dry season puts heavy pressure to manage demand where power demand is at its apex.

Lack of timely maintenance

Most of installed plants run far below their installed potential. Frequent breakdown of sub-systems, low generation due to inefficient appliances and alternative use of generators due to long maintenance duration are single or collective cause of the state. There is a tendency to point towards inadequate rainfall as the cause of load shedding. However, most of the plants have never attempted to generate power at its claimed installed capacity. The national capacity of installed power is 619 MW, but there is no evidence of production above 530 MW even in the flooding season. Thermal plant of 56 MW capacity ran a maximum output of 19 MW, Trishuli of 24 MW ends with record output of 18 MW, and BhoteKoshi struggles at 14 MW out of 36 MW. These are few examples on the list. This inefficiency is a result of neglecting a timely maintenance of turbine and generators.

RENEWABLE ENERGY DEVELOPMENT SCENARIO IN NEPAL

There is a dire need to substitute as well as supplement the traditional energy supply system by modern forms of sustainable energy in terms of resources and technology. Because of the county's dependence on imported fossil fuel, high costs of grid connection and low and scattered population density, a decentralised energy supply system becomes the natural and feasible choice. Decentralised new and renewable energy systems such as micro hydro, solar photovoltaic, biogas, etc. provide feasible and environment-friendly energy supply options in rural areas.

The positive role of renewable energy technology for the fulfilment of energy needs of the rural area was recognised by the National Planning Commission/Nepal during the Seventh Five Year Plan. The Eighth Five Year Plan (1992–1997) envisaged the need for a coordinating body for large scale promotion of alternative energy technologies in Nepal. Alternative Energy Promotion Centre (APEC) was thus established to promote the use of Renewable Energy Technology and act as the government coordinating body. Though renewable energy programmes have positive implications for poverty reduction, this has not been the explicit goal of renewable energy programmes in Nepal until the commencement of the Tenth Five Year Plan (2002–2007).

ALTERNATIVE SOURCES TO FILL THE GAP AND RESOURCE POTENTIAL

Nepal needs to tackle the energy scarcity through rationalised utilisation of its abundant renewable energy resources such as solar, biogas, wind, biomass, mini and micro hydro, etc. There are abundantly available sources for big, small and mini/micro hydropower, enough solar radiation, good potential of wind in selected areas and other biomass-based resources to meet the energy need of the country. Larger projects of altogether 40,000 MW can be generated in Nepal technically and economically. Mini-, micro- and pico-hydro installations up to 100 KW can be developed in a short period of time to electrify the villages. The currently installed total capacity of micro hydro projects is about 20 MW. However, altogether mini/micro-hydro could generate about 1.000 MW of power.

Nepal receives ample solar radiation as it is located in favourable latitude. With National average sunshine hours of 6.8/day and solar insulation intensity of about 4.7 kWh/m²/day, there is a huge potential for large-scale development of solar energy technologies in the country. About 1.5 million households can install domestic biogas plants based on animal dung. Another possible application of biogas technology in Nepal is to manage household solid waste in urban and peri-urban areas.

The exact potential of wind energy is still to be estimated for Nepal. The data analysis shows the terrain with high elevations has higher wind resources. If developed in potential sites which are in comparative advantages to other available

technological options, then at least a significant size of few wind farms can be built in Nepal in the near future. Annapurna Conservation Area covers 143 sq km where Wind Potential Density is above 300 watt/m² and with 5 MW installed per sq km yields 716 MW. A study has also indicated that about 3,000 MW power can be generated from the sites which are within 10 km from National grid lines.

CONCLUSION

Alternative energy sources have to be explored to solve the present energy crisis in Nepal. No doubt, hydropower is and will be the backbone to supply Nepal's overall energy demand but relying only on hydropower may not be a wise decision in the long run. There are issues such as political instability, lack of coherent government policy related to hydropower plants, insufficient foreign direct investment into this sector and a lack of transmission lines. In the light of climate change, snow melting due to black carbon, and technological advancement in other complementary or competing technologies, there is a serious environmental aspect to the whole debate about building big hydro-dams as well. To enhance energy security, it is most urgent to have an energy mix with multiple resources. Time has come to plan an energy mix by promoting biomass, biofuel, biogas, wind and solar-based electricity. Electrical energy and fuel supplied from multiple sources should be Nepal's strategy.



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Energy Security and Climate Change in South Asia: A Threat Analysis for Pakistan

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Energy Security and Climate Change: A Threat Analysis¹

Geographically, Pakistan is located in the Hindu Kush-Himalayan (HKH) region, extremely vulnerable to the adverse impacts of climatic change. The country is a small Greenhouse Gases (GHG) emitter; contributing only about 0.8% of the total global GHG emissions, ranking 135th in the world by per capita GHG emissions. However, it is going to be at the receiving end of climate change. In 2007, it was among the top twenty global warming hotspots in the world, and now it is ranked eighth most vulnerable country to climate change. The country's water security, food security, and energy security are interconnected and are increasingly threatened by the vagaries of climate change.

The Himalayan glaciers are melting which will gradually reduce water inflows into the Indus river system. This will negatively impact the water and agriculture sectors of Pakistan that sustain its economy and provide livelihood to millions of its people. Climate change would also increase the variability of monsoon rains and enhance the frequency and severity of extreme events such as floods and droughts leading to frequent disasters. In the last few years, Pakistan has experienced an increase in incidents of flooding. The years 2008, 2010, 2011 and 2012 had been extremely disastrous for the country due to excessive flooding. Damages from the single flood event in 2010 were estimated at US \$10 billion. There is also increase in heat waves and drought spells claiming many lives and severely affecting livelihood conditions. The growing population, rapid urbanisation and industrialisation would result in higher water demands for domestic and industrial purposes, for food production and energy. The severe water-stressed and heat-stressed conditions in arid and semi-arid regions would also lead to reduced agriculture productivity and power generation. The sea level rise and increased cyclonic activity due to higher sea surface temperature would pose a threat to coastal areas. Increased upstream intrusion of saline water in the Indus delta is also going to affect coastal areas adversely. Floods, droughts, melting glaciers and rising sea level are likely to force people to migrate to other areas causing social and political instability.

¹ *Research Study, *Energy Security and Climate Change in South Asia – a Threat Analysis for Pakistan*, for Konrad-Adenauer-Stiftung (KAS)'s Regional Project "Energy Security and Climate Change in Asia-Pacific," (RECAP).

Although climate change mitigation and adaptation are recognised as a priority area, not much has been done practically in that regard. Despite elaborate mechanisms for implementation, the actual execution of the strategies outlined in National Climate Change Policy and Framework for Implementation of Climate Change Policy (FICCP) have been ineffective especially in the field of institutionalisation of climate change at the federal and provincial levels. Pakistan needs to develop national mitigation and adaptation plans. Multiple action plans are required in the area of technology, financing and capacity-building. For this to happen, the country needs to build institutional mechanisms. Pakistan needs to change the narrative by bringing energy into the framework of climate change. Pakistan is engaged in a number of energy-related activities like construction of hydropower plants, development of renewable sources of energy and promotion of energy efficiency and conservation that can be brought under the rubric of climate change as they are helping mitigate climate change.

Pakistan is also facing a severe energy crisis resulting in frequent and prolonged power breakdowns, shutting down of industrial units; badly affecting economic growth, creating social unrest and political instability. The energy crisis is generated by a variety of factors, like increased reliance on oil-based expensive energy mix since the 1990s, widening demand-supply gap, lack of an integrated energy strategy and poor energy governance. Hydro power dominated Pakistan's energy mix from the 1960s to 1980s, but due to shifting to oil based power in the 1990s, it fell from 60 per cent in 1962, to 30 per cent in 2009-10. It is estimated that the national demand for electricity would keep on growing rapidly, at about 10 percent annually, due to rising population and economic development requirements. The demand is expected to touch around 30,000MW by 2020. The estimated cost of power crises to the economy is approximately Rs. 380 billion per year, around 2 percent of GDP.

Pakistan is endowed with immense hydro, wind and solar energy potential that could be harnessed to meet its current and future energy requirements. However, the country faces problems similar to what other developing countries are undergoing when it comes to successful implementation of renewable energy systems: Such as, lack of technological resources, poor financial support, government's lack of support and incentives. Amongst the various alternated and renewable energy sources, the cheapest and foremost is the hydropower. However, a well-planned and strategized investment into harvesting solar as well as wind power can be the basis of clean, pollution free, climate friendly and relatively cheaper (long term) source of energy generation and bring about sufficient economic dividends. A shift towards renewables would reduce carbon emissions and making economic development process in the country more sustainable.

These two-part study attempts to map Pakistan's vulnerability to the impacts of climate change and challenges pertaining to the energy security, both constraining socio-economic development and stability of the country. It offers recommendations in both areas that are interconnected. These range from revisiting climate change adaptation and mitigation policy and practices by involving the local community and business sector in formulating adaptation strategies and bridging policy-practice gaps to the restructuring of energy policy and systems by shifting energy mix in favour of renewables and improving energy governance.

Methodology

The study follows qualitative approach and case study method. It is a qualitative risk analysis which explores the extent of Pakistan's vulnerability to the impacts of climate change and challenge of energy security. It suggests various steps that can contribute to building Pakistan's resilience through adaptation and mitigation measures to climate change and ensure affordable and sustainable supply of energy which is critical to the country's development and stability.

The study utilises primary as well secondary data on climate change and energy security of Pakistan. Since the study is more qualitative in nature than quantitative, so there is no sampling involved. However, it has utilised statistical data for qualitative analysis and used semi-structured interviews with the officials/practitioners and think tanks analysts dealing with the issues of climate change and energy. These include Ministry for Climate Change, Pakistan Meteorological Department (PMD), Planning Commission of Pakistan, and Leadership for Environment and Development (LEAD) Pakistan, International Union for Conservation of Nature and Natural Resources (IUCN), Pakistan Water Partnership (PWP), National Disaster Management Authority (NDMA), UN Framework Convention on Climate Change (UNFCCC), International Centre for Integrated Mountain Development (ICIMOD), etc. On energy sector, it relied on data provided by Water and Power Development Authority (WAPDA), Alternate Energy Development Board (AEDB), Energy Conservation Centre (ENERCON) and Pakistan Council of Renewable Technology (PCRET), etc.

Climate Change – a Threat Analysis for Pakistan

Dr. Shaheen Akhtar^{2*}

Climate change is a global phenomenon and is going to have multidimensional impacts on Pakistan. The country is extremely vulnerable to the adverse impacts of climate change, even though it contributes only about 0.8 percent of the total global GHG emissions. Globally, it is ranked as 8th most vulnerable country in terms of long-term risks stemming from climate change. It was the fifth worst affected country in Global Climate Risk Index in 2016.³ The Himalayan glaciers are receding which will gradually reduce water inflows into the Indus river system. Further, it is projected that climate change will increase the variability of monsoon rains and enhance the frequency and severity of extreme weather events such as floods and droughts. Monsoon season presents threat of riverine floods, flash floods, urban flooding and glacier lake floods. There were super floods in 2010 and 2011 and recurrent floods in 2012, 2013, 2014, 2015 and 2016 which incurred huge human and material cost. The 2010 floods alone cost the economy \$10 billion, affecting 20 million people. In 2011, floods again devastated a million houses, affecting over 6 million people and destroying 4.5 million acres (over 18,000 square kilometers) of land respectively. Further, the annual cost of environmental degradation in the country is estimated to be 6 percent of the GDP. A large part of country's economy is based on agriculture which provides livelihood to millions of its people but is climate sensitive. Climate change is also adversely affecting Indus Delta; mangroves cover is decreasing, causing loss of biodiversity, incurring financial damages and affecting the livelihood of coastal communities.

Climate change is one of the most complex issues facing businesses, governments and societies across the globe and Pakistan is likely to experience similar effects. Pakistan views climate change as a 'threat multiplier'. Rapid urbanisation, population growth, economic development, and increasing demand for water from agriculture and industry are likely to aggravate the situation further. There has always been a competition for water allocation for irrigation and energy sector which is going to intensify under the conditions of climate change. The severe water stressed and heat stressed conditions in arid and semi-arid regions would further increase

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3 Global Climate Risk Index 2016 – Germanwatch. <https://germanwatch.org/fr/download/13503.pdf>

water demand for agriculture and power generation. Thus, climate change is going to pose a serious direct threat to water, food and energy security of Pakistan that are interconnected.

Although climate change mitigation and adaptation are recognised as a priority area, not much has been done in that regard. Despite elaborate mechanisms for implementation, the actual execution of the strategies outlined in National Climate Change Policy (NCCP) and Framework for Implementation of Climate Change Policy (FICCP) have been ineffective especially in the field of institutionalisation of climate change at the federal and provincial levels. Pakistan needs to develop national mitigation and adaptation plans in the area of technology, finance and capacity-building. The country has a low technological and scientific base and limited access to knowledge. It has low capacity to adapt to changes resulting from climate change. It also lacks financial and institutional capacity. Pakistan also needs to change the narrative by bringing energy into the framework of climate change and use development of renewable energy, energy efficiency and conservation as steps helping mitigate climate change.

The study attempts to map multiple threats posed by climate change to Pakistan. It analyses climate change trends and projections for Pakistan. How is it going to impact its water resources, food and energy security? What is the likely impact of extreme weather events on its population and economy? What is Pakistan's response to climate change in terms of adaptation and mitigation policies and strategies? What are the main challenges to Pakistan's climate change policy implementation and how can they be addressed? The study suggests that Pakistan needs to revisit climate change adaptation and mitigation policy and practices by involving the local community and business sector in formulating adaptation and mitigation strategies and bridging policy-practice gaps.

CLIMATE CHANGE: GLOBAL CONTEXT

The earth is warming, and its climate is changing. According to the United Nations Framework Convention on Climate Change (UNFCCC), climate change is "attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods".⁴ The IPCC, a leading body for the assessment of climate

⁴ *United Nations Framework Convention on Climate Change*, United Nations, 1992. 3

change, was established by the WMO and UN Environment Programme in 1988. Its main activity is to prepare comprehensive assessment reports about climate change at regular intervals of about five to seven years; 1990, 1995, 2001, 2007 & 2013/14. The IPCC in its *Fourth Assessment Report* in 2007, defines to climate change as "any change in climate over time, whether due to natural variability or as a result of human activity".⁵

The IPCC's *Fifth Assessment Report (AR5)* 2014 concluded that the average global temperature of the earth has increased by 0.6 C in the last century. It is expected to rise by 2.6–4.8 by the end of this century resulting in climatic changes in the world. The AR5 observes that "warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased."⁶ Atmospheric and surface temperature has increased and each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90 percent of the energy accumulated between 1971 and 2010. Between 1870 and 2000 the sea level rose 18 cm globally – 6 cm of that rise was in the last 20 years alone. By 2100 the sea level could rise from 0.26 to 0.98 m, about 95 percent of it in the Ocean area. About 70 percent of the coastlines worldwide are projected to experience sea level change within 20 percent of the global mean sea level change. There is growing ocean acidification.

Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. Globally, the mass loss from glaciers has increased since the 1960s, and this is evident in regional-scale estimates. Over the last two decades, the Greenland and Antarctic ice sheets have been losing mass. Glaciers have continued to shrink almost worldwide, and Arctic sea ice and Northern Hemisphere spring snow cover have continued to decrease in extent. Between 2003 and 2009, most of the ice loss was from glaciers in Alaska, the Canadian Arctic, the periphery of the Greenland

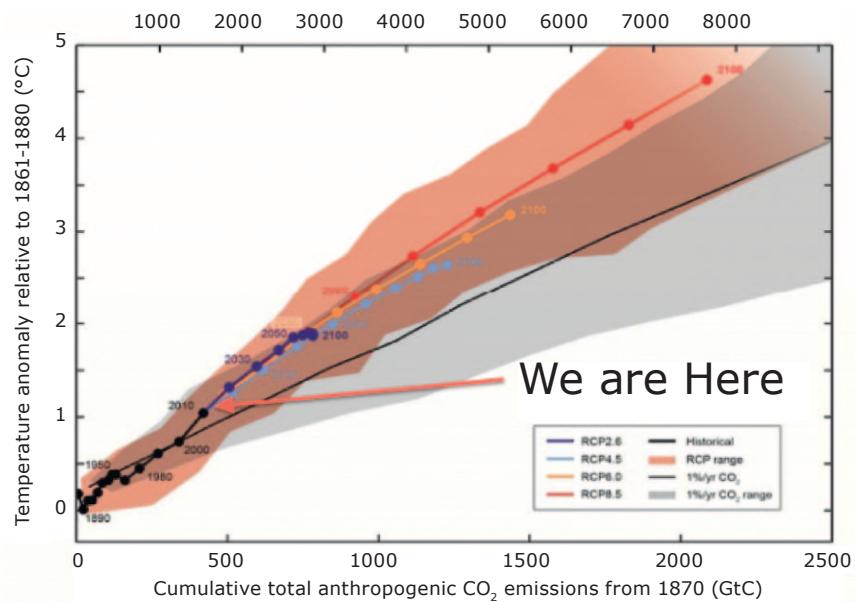
⁵ IPCC Fourth Assessment Report: Climate Change 2007 ; Climate Change 2007: Synthesis Report, http://www.ipcc.ch/publications_and_data/ar4/syr/en/mains1.html

⁶ IPCC, 2013: Summary for Policymakers. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 4. http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf

ice sheet, the Southern Andes and the Asian Mountains. Together these regions account for more than 80 percent of the total ice loss. Greenland's volume of ice is being reduced at the rate of 375 cubic km a year. In Antarctica, the picture is more complex as the West Antarctic ice sheet is losing ice rapidly, but is growing in volume in East Antarctica.

The scientific understanding of climate change is growing over time. The debate, however, continues to be on the causes of global warming, the extent of climate change, human activity contribution to it and its consequences for development. The discourse is divided between those who strongly believe that climate change is due to human activity and others who argue that it is the result of both human activity and natural variability over time and space. The IPCC AR5 concluded that "human influence has been the dominant cause of the observed warming since the mid-20th century,"⁷ which has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes. This was confirmation of its earlier assessment in AR4 (2007) that anthropogenic activity is largely causing global warming.

Cumulative total anthropogenic CO₂ emissions from 1870 (GtCO₂)



⁷ IPCC, 2013: Summary for Policymakers. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 17.

MAPPING PAKISTAN'S VULNERABILITY TO CLIMATE CHANGE

Geographically, Pakistan is located in the Hindu Kush-Himalayan (HKH) region which is extremely vulnerable to the adverse impacts of climatic change. Over the past decade, IPCC is expanding the definition of vulnerability to climate change. In its Fifth Assessment Report AR 5, it defines vulnerability as "propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and a lack of capacity to cope and adapt".⁸ Vulnerability to climate change is the degree to which geophysical, biological and socio-economic systems are susceptible to and unable to cope with adverse impacts of climate change.⁹ Pakistan's vulnerability stems from its diverse geography, rising population, growing irrigation and energy demands, industrial demand, poverty and low financial and technological capacity to cope with the climatic threats.

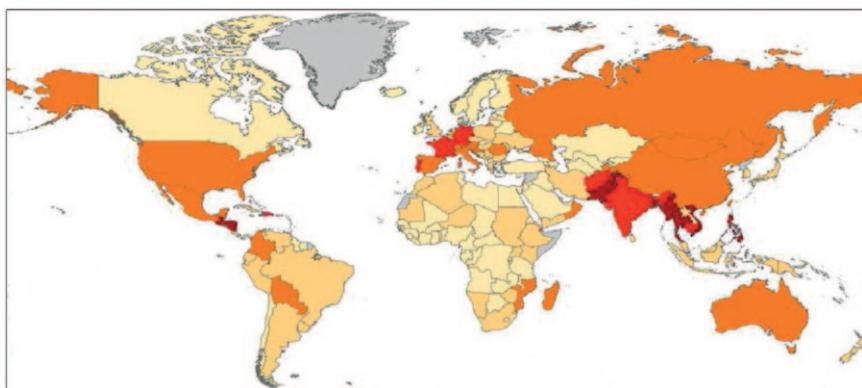
Pakistan has a very diverse geography. From the long range of mountains, glaciers, deserts, to the plain areas and hundreds of miles of coastal line, Pakistan has a highly diverse topography which makes it vulnerable to all types of impacts resulting from climate change. Moreover, Pakistan is situated in a semi-arid to hyper-arid region which further increases its vulnerability. It is one of the world's driest countries with an average annual rainfall of about 240 mm. It is a 'single basin' country and its dependence on external water resources is 76 percent. The population and economy are heavily dependent on an annual influx into the Indus river system. The basin accounts for 21 percent of GDP, 45 percent employment, and more than 60 percent of its exports.¹⁰ Pakistan is now facing the most severe challenge created by climate change. It is ranked very high on the global climate risk index.

8 IPCC, AR5 , 2014. 5.

9 Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability
Contents1919.119.1.2 https://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch19s19-1-2.html

10 Economic losses from disasters", Pakistan National Briefing, Lead, March 2015.
<http://www.lead.org.pk/lead/attachments/briefings/LPNB3.pdf>

World Map of the Global Climate Risk Index 1995–2014



Climate Risk Index: Ranking 1995 – 2014

1-10	11-20	21-50	51-100	<100	no data
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Source: Germanwatch and Munich Re NatCatSERVICE

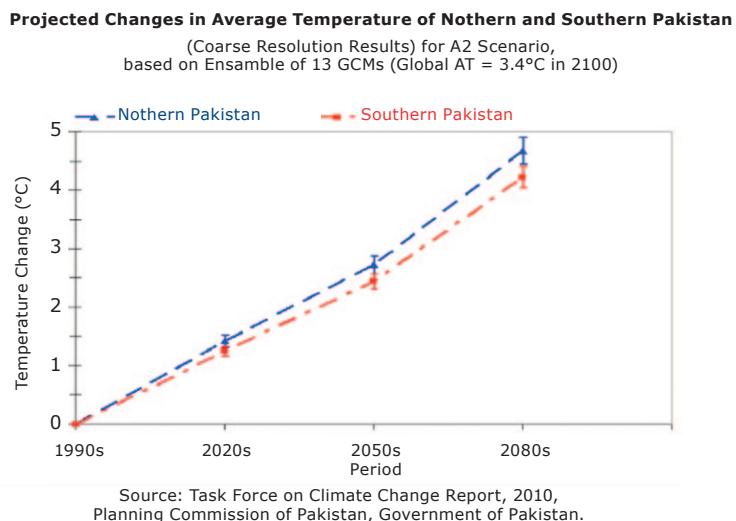
CLIMATE CHANGE TRENDS & PROJECTIONS FOR PAKISTAN

Climate Change is manifested in the rising temperature, erratic monsoons and glaciers melt. During the last century, average annual temperature over Pakistan increased by 0.6 °C, in agreement with the global trend, with the temperature increase over northern Pakistan being higher than over southern Pakistan (0.8 °C against 0.5 °C). Studies based on several Global Circulation Models (GCMs) project that average temperature over Pakistan will increase in the range 1.3–1.5 °C by 2020s, 2.5–2.8 °C by 2050s, and 3.9–4.4 °C by 2080s, corresponding to an increase in average global surface temperature by 2.8–3.4 °C by the turn of the 21st century.¹¹ Precipitation is projected to increase slightly in summer and decrease in winter with no significant change in annual precipitation. It is projected that climate change will increase the variability of monsoon rains and enhance the frequency and severity of extreme weather events such as floods and droughts. There is a clear and visible shift in summer monsoon trends from north-east to the north-west by a range of 80–100 km, threatening the agriculture of Pakistan.¹²

¹¹ Task Force on Climate Change Report, 2010, Planning Commission, Government of Pakistan, February 2010. <http://www.pc.gov.pk/usefull%20links/Taskforces/TFCC%20Final%20Report.pdf> Xii.

¹² Climate Change: The Reality of Our Times, *Development Advocate Pakistan*: Volume 2, Issue 4. UNDP Pakistan, December 2015. http://www.pk.undp.org/content/pakistan/en/home/library/hiv_aids/_-development-advocate-pakistan--volume-2--issue-4.html

Fig 1. GCM Ensemble based projected temperature changes in 2020, 2050 and 2080 over Northern and Southern Pakistan for A2 and A1B scenarios



MELTING GLACIERS IN UPPER INDUS BASIN

Pakistan heavily relies on the Indus basin that it shares with India along with China and Afghanistan. The basin is highly dependent on water derived from the melting of snow and glacier in the upper part of the basin. According to the inventory of glacier prepared by International Centre for Integrated Mountain Development (ICIMOD) in 2011, there are 18,495 glaciers in the basin covering 21,192 km² area that support the Indus basin system. Of these, 13,215 glaciers are in the Upper Indus Basin (UIB), 5218 are in Indus Pakistan, mostly in Gilgit Baltistan and Azad Jammu and Kashmir¹³ and 7,997 in Indus India, mainly in Indian-administered Jammu & Kashmir and Himachal Pradesh.¹⁴ It is estimated that the volume of ice contained in those glaciers is 2,696 km³.¹⁵ Almost 70–80 percent of the water in the UIB comes from glaciers in the Western Himalaya and the remaining share comes from the monsoon rains, mainly during the monsoon season from July to September. Snow melt accounts for more than 65 percent of the Indus river, 50 percent of Jhelum¹⁶

13 "Glacial Melt and Downstream Impacts on Indus Basin-Dependent Water Resources and Energy", International Centre for Integrated Mountain Development (ICIMOD) Kathmandu July 2010. 10.

14 Himanshu Thakkar, "There is little hope here: India's National Action Plan on Climate Change: A Civil Society View", February 2009. South Asia Network on Das, Rivers and People (SANDRP) New Delhi, www.sandrp.in 20.

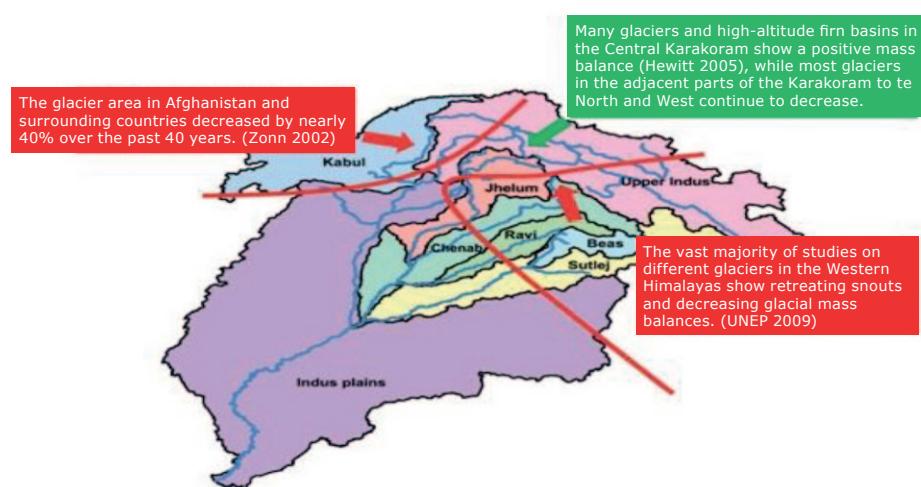
15 The Status of Glaciers in the Hindu Kush-Himalayan region, ICIMOD, 2011. www.icimod.org
 also see. 'Glaciers of Indus Basin',
<http://geoportal.icimod.org/indusbasin/GeneralContent/GeneralContentDetailPage.aspx?ContentID=214>

16 For Indus and Jhelum see, IJAZ -UL-HASSAN KASHIF, Water Resource Management of Pakistan", www.ipeislamabad.org/.../Water%20Resource%20management%20Mar

and 49 percent of Chenab river.¹⁷ The quantum of water flowing in the Indus and its tributaries varies widely from year to year, depending on snowfall in the Himalayan and Karakoram ranges and rainfall in the catchment areas. Super floods occur approximately once every five years, which has raised the average flow to 140 maximum annual flows (MAF) over the past 30 years. In the remaining four years, average water availability has been 135.60 MAF. This variability is likely to intensify under the conditions of climate change and is becoming a great source of anxiety for Pakistan as a lower riparian.

There is high uncertainty regarding the behaviour of glaciers in the UIB, especially the cryosphere. Various studies including those conducted by ICIMOD indicate that glaciers in Western Himalaya are retreating while glaciers in central part of the UIB in the Karakorum range are either stable or advancing described as Karakoram anomaly. The anomaly may produce "surges" with rapidly advancing glacier snouts.¹⁸ Space Application Centre (SAC), India observed that 359 glaciers in Chenab basin that stretched over 1,414 sq. kms (km^2) in 1962 were reduced to 1,110 km^2 by 2004 – a reduction of 21 percent in the snow cover area.¹⁹

Spatial Behaviour of Glacial Dynamics in the IB



Source: 'Glaciers of Indus Basin', ICIMOD, 4 December 2011.

17 For Chenab see, R. D Singh, water resources in the Himalayas: Assessment and Sustainability", <http://www.imd.gov.in/ims/pdf/plenary/RDS.pdf>

18 Kohler, T., Wehrli, A. & Jurek, M., eds. 2014. *Mountains and Climate Change: A Global Concern*, Sustainable Mountain Development Series. Bern, Switzerland, Centre for Development and Environment (CDE), Swiss Agency for Development and Cooperation (SDC) and Geographica Bernensia. 37. <http://lib.icimod.org/record/32102/files/Mountain%20and%20Climate%20Change.pdf>

19 R. D. Singh, water resources in the Himalayas: Assessment and Sustainability", <http://www.imd.gov.in/ims/pdf/plenary/RDS.pdf>
mr Singh is Director NIH, Roorkee; Based on data produced by SAC, Ahmedabad.

The Kolahoi, biggest glacier in IAJ&K, the main source of Jhelum river is melting faster than other Himalayan glaciers, from 11 km² to 8.4 km² over the past three decades.²⁰ The 78-km long Siachen glacier – the site of an Indian-Pakistani military standoff – has shrunk to half of its size.²¹ The glacier is the source of the Nubra River that falls into the Shyok River in Ladakh which then joins Indus. A faster melting of Siachen Glacier means greater chances of flooding in the Indus basin and more frequent avalanches. Walter Immerzeel along with other experts in a study using various remote sensing products identified spatial-temporal trends in snow cover in the UIB from 1999 to 2008. It identified a significant negative winter snow cover trend for the upper Indus basin. The anticipated effects of climate changes in UIB are:

- Accelerated melt of glacier resulting in an increase in glacial runoff.
- Less precipitation will fall in the form of snow causing an increase in rain runoff on the expense of snow runoff.
- Snow will melt faster causing a shift in the hydrograph towards spring.²²

According to the Pakistan Meteorological Department (PMD), the rate of glacial melt, which has risen by about 23 percent in the previous decade, is among the fastest in the world.²³ The glacier melt whether it is slower or faster is going to impact water security, food security and energy security of Pakistan in particular.

ASSESSING CLIMATE CHANGE IMPACTS

Climate change is posing a grave threat to water security, food security and energy security of Pakistan. A *Task Force on Climate Change* (TFCC) set up in 2008 by the government of Pakistan, in its report in 2010 identified major climatic threats that have consequences for water, food and energy security of the country besides impacting its coastal areas, ecosystem and biodiversity. These included:

20 Michael Renner, "Water Challenges in Central-South Asia", Peacebuilding Centre, Noref Policy Brief, No. 4. December 2009.

21 Indus equation: Overview of Pakistan's Water Resources, *Strategic Foresight Group Report*, Mumbai, 2011, P.17. http://www.strategicforesight.com/publication_pdf/10345110617.pdf

22 W.W. Immerzeel, P. Droogers, S.M. de Jong and M.F.P. Bierkens, Satellite Derived Snow and Runoff Dynamics in the Upper Indus River Basin, 10th International Symposium on High Mountain Remote Sensing Cartography, 2010. 309. http://www.futurewater.nl/wp-content/uploads/2011/05/34_HMRSC-X_Immerzeel_et_al.pdf

23 Saleem Shaikh and Sughra Tunio, "Pakistan Expands Glacier Monitoring in Effort to Cut Disaster Risk", 24 August, 2016. <http://floodlist.com/asia/pakistan-expands-glacier-monitoring-effort-cut-disaster-risk>

- Increased variability of monsoons;
- Rapid recession of Hindu Kush-Karakoram-Himalayan (HKH) glaciers threatening water inflows into the Indus River System (IRS); reduction in capacity of natural reservoirs due to glacier melt and rise in snow line;
- Increased risks of floods and droughts;
- Increased siltation of major dams resulting in greater loss of reservoir capacity;
- Severe water-stressed and heat-stressed conditions in arid and semi-arid regions, leading to reduced agriculture productivity and power generation;
- Increased upstream intrusion of saline water in the Indus delta, adversely affecting coastal agriculture, mangroves and breeding grounds of fish;
- Threat to coastal areas including the city of Karachi due to sea level rise and increased cyclonic activity due to higher sea surface temperatures;
- Increase in deforestation; loss of biodiversity; increased health risks and risks to other vulnerable ecosystems (e.g. rangelands, degraded lands, mountainous areas, etc.)²⁴

In the last few years, the growing frequency of extreme events shows that the country has already started suffering from multiple impacts of climate change. In November 2015, the government, in a report submitted to the parliament, stated that coastal and marine environment, dry land ecosystems, agriculture and livestock sector, forests, biodiversity and health were among the sectors that had been seriously affected by climate change.²⁵

IMPACT ON WATER SECURITY

The water resources of the country will be affected enormously by climate change. Currently, Pakistan's water requirement in the Indus water system is 139.54 MAF while availability is 135.60 MAF, a gap of 3.94 MAF which is likely growing manifold in future. Country's storage capacity is very low, about 11.5 MAF, for 30 days of water in the Indus basin, while India can store for 120-220 days. Receding and eventually disappearing high altitude reservoirs of snow and ice will over time reduce downstream runoff, and

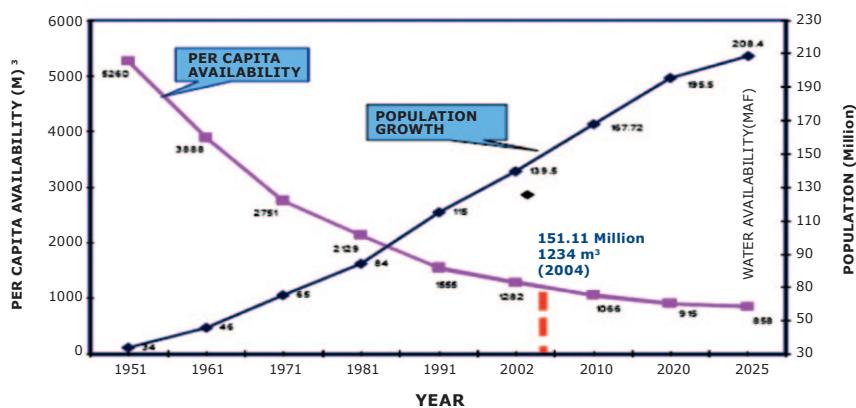
²⁴ (TFCC p. xiii)

²⁵ "Climate change has cost the country \$20bn: report", *Dawn*, 9 November 2015.
<http://www.dawn.com/news/1218423>

increase its variability, observed ICIMOD in 2009.²⁶ Best estimates are that there will be 50 years of glacial retreat, during which time river flows will increase. In the beginning, there will be 20 to 40 percent increase in Indus flows and after 50 years, there will be glacial retreat and flows will drop down to 30 to 40 percent, in 100 years time. In June 2010 Immerzeel in a report, *Climate Change will Affect Asian Water Towers* observed that by 2050 Indus Basin would lose 8.4 percent of its upstream flow due to climate change.²⁷ Molle observed that Indus is becoming a closed basin as during certain periods of the year, water even does not reach the sea anymore.²⁸

The depletion of glaciers along with growing population, urbanisation and industrialisation will adversely affect the availability of freshwater resources of the country. Pakistan is fast moving from water stressed to water scarce country. The per capita water availability has declined from 5,600 cubic meters per person in the 1950s to 1066 cubic meters in 2010. It is projected to fall to a critically low level of 800 cubic meters annually by 2025 when Pakistan's population will rise to 208 million.²⁹ Water is in high demand for urban and rural populations, and at the same time crucial for agriculture/food, energy and industrial production. Agriculture sector consumes over 90 percent of the water while the share of domestic is 4–5 percent and industrial sector 5 percent. Thus climate change would gradually reduce the availability of water for agriculture, industrial and domestic sectors.

Water Availability vs Population Groth



26 *The Changing Himalayas: Impact of Climate Change on Water Resources and Livelihoods in the Greater Himalayas*, International Centre for Integrated Mountain Development (ICIMOD) Kathmandu, January 2009. 6. available at <http://books.icimod.org/index.php/search/publications/593>

27 Walter W. Immerzeel, et al. "Climate Change Will Affect the Asian Water Towers", *Science* 328, 1382 (2010); http://futurewater.nl/wp-content/uploads/2011/05/Immerzeel_Science_11June2010.pdf

28 Molle, F., Wester, P., and Hirsch, P.: River basin closure: Processes, implications and responses, *Agriculture Water Management*, 97, 569–577, doi:10.1016/j.agwat.2009.01.004, 2010.

29 WAPDA.

IMPACT ON AGRICULTURE/ FOOD SECURITY

Agriculture is one of the major sectors likely to be adversely affected by climate change in Pakistan. It is likely to have a significant impact on the food production, food accessibility and food system stability of Pakistan. Pakistan's economy heavily depends on agriculture which is facing a grave threat from climate change. With a total area of 79.61 million hectares, the country has 22.3 million hectares under cultivation of which 19.12 million hectares are irrigated and 3.67 million hectares are rain-fed. The irrigated area consumes about 80 percent of the country's fresh-water resources, covers 84 percent of cultivated area and contributes hugely to the national food production. The rainfed, hilly and dryland agriculture cover 16 percent of the total cultivated area of the country and has little contribution in the national food basket but serves as a basic source of meeting the subsistence needs of farming families living in the areas.³⁰

The flows in all the rivers in Indus basin are quite variable in different cropping seasons and years. About 84 percent of flows occur in the Kharif³¹ (April–June) crop season, and only 16 percent occur in the Rabi³² (October–December) season. This creates water shortages for the Rabi crops. There is also an overall decline in the inflow in the Indus rivers system with its variability ranging between -4.9 to -15.0 over last eight years.³³ Further, agriculture productivity is likely to suffer severe losses due to high temperature, droughts, flood conditions and soil degradation. Adverse consequences of the rainfall have already been observed in Pakistan in the form of droughts and super floods which have badly affected agriculture sector as well.

³⁰ Arjumand Nizami, Carmenza Robledo, *Natural Resource Management and Climate Change Mitigation, Adaptation and REDD+ Part IV: Adaptation to Climate Change*, Intercooperation Pakistan, 2010. 9.

³¹ Rice, sugarcane, cotton, maize, moong, mash, bajra and jowar are "Kharif" crops.

³² Wheat, gram, lentil (masoor), tobacco, rapeseed, barley and mustard are "Rabi" crops.

³³ Pakistan Economic Survey 2015-16, 25. http://www.finance.gov.pk/survey/chapters_16/02_Agriculture.pdf

Actual Surface Water Availability (Million Acre-Feet)

1 acre-foot = 1233.84 cubic meters

Period	Kharif	Rabi	Total	% age increase/decrease over the Avg.
Average system usage	67.1	36.4	103.5	-
2007–08	70.8	27.9	98.7	-4.6
2008–09	66.9	24.9	91.8	-11.3
2009–10	67.3	25.0	92.3	-10.8
2010–11	53.4	34.6	88.0	-15.0
2011–12	60.4	29.4	89.8	-13.2
2012–13	57.7	31.9	89.6	-13.4
2013–14	65.5	32.5	98.0	-5.3
2014–15	69.3	33.1	102.4	-1.1
2015–16	65.5	32.9	98.4	-4.9

Source: Indus River System Authority

A recent WWF study titled *Climate Change Adaptation in the Indus Ecoregion: A Micro-Econometric Study of the Determinants, Impact and Cost-Effectiveness of Adaptation Strategies* observed that climate change would badly affect the agricultural productivity in Pakistan. In particular, by 2040 assuming a 0.5 Degrees Celsius increase in average nationwide temperatures, an 8–10 percent loss is expected across all crops corresponding to PKR 30,000 per acre.³⁴ Crop simulation models based studies shows that wheat yields will be reduced by 3.4 to 12.5 percent in the semi-arid irrigated areas (Faisalabad and Sheikhupura), 3.8–14 percent in arid areas (Multan & Bahawalpur, Badin and Hayderabad) and up to 16 percent in rainfed (Chakwal) areas under both A2 and B2 scenarios towards the end of 21st century. Similarly, in the Basmati rice tract, the yield is expected to be reduced by 10.4 percent, 16.5 percent and 17.8 percent under B2 scenario by 2020, 2050 and 2080, respectively. Under the A2 scenario, the yield is expected to decline by 11.4 percent, 15.8 percent and 21.5 percent, respectively by 2020, 2050 and 2080. This accounts for 14 percent in arid areas (Multan & Bahawalpur, Badin and Hayderabad) and up to 16 percent in rainfed (Chakwal) areas under both A2 and B2 scenarios towards the end of 21st century. Similarly, in the Basmati rice tract, the yield is expected to be reduced by 10.4 percent, 16.5 percent and

³⁴ Ali Dehlavi, Ashley Gorst, Ben Groom, and Farrukh Zaman, *Climate Change Adaptation in the Indus Ecoregion: A Micro-Econometric Study of the Determinants, Impact and Cost Effectiveness of Adaptation Strategies*, WWF, February 2015
<http://www.mocc.gov.pk/>

17.8 percent under the B2 scenario by 2020, 2050 and 2080, respectively. Under the A2 scenario, the yield is expected to decline by 11.4 percent, 15.8 percent and 21.5 percent, respectively by 2020, 2050s and 2080s.³⁵

IMPACT ON INDUS DELTA

The fan-shaped Indus Delta, the fifth largest in the world, is located at the mouth of the Indus River shaping 563 km of the entire coast of Sindh. The Indus Delta occupies almost 600,000 ha area located mainly in Badin and Thatta districts of Sindh Province. There are 17 major creeks making up the Delta. Historically, the Indus delta was very productive and has a distinct and vibrant eco-system sustaining flora and fauna. The Indus Delta is located in a climatically arid zone of intense heat and highly variable rainfall. In this region, temperature is likely to increase by 4°C till 2100 and rainfall is going to be highly variable on temporal and spatial scale.³⁶ Keti Bunder, a part of the Thatta District located 200 km south-east of Karachi is most vulnerable to the impacts of climate change. The deltaic region would not only be affected by the local weather conditions but also weather activities upstream Indus and over the neighboring sea in the south due to climate change. The increased intrusion of saline water in the Indus delta is already adversely affecting coastal agriculture, mangroves and the breeding grounds of fish. The area of mangrove forests in the Indus delta fell from 263 000 ha in 1977 to 160 000 ha in 1990, 106 000 ha in 2003³⁷ and to around 73 000 ha in 2006.³⁸ The estimated loss of economic value for this 72% decline in total mangrove cover in the Indus Delta is approximately US\$ 616 million in 2010.³⁹ The loss of mangroves cover has also affected over 135,000 people respectively. In addition, the projected sea level rise and increased cyclonic activity due to higher sea surface temperatures also threaten coastal areas including the city of Karachi.

35 Pakistan Economic Survey 2015-16, 271-272.

http://www.finance.gov.pk/survey/chapters_16/16_Environment.pdf

36 Rasul, G. A. Mahmood, A. Sadiq, S. I. Khan, "Vulnerability of the Indus Delta to Climate Change in Pakistan", Pakistan Journal of Meteorology, Vol. 8, Issue 16: Jan 2012.

http://www.pmd.gov.pk/rnd/rnd_files/vol8_Issue16/8_Vulnerability%20of%20the%20Indus%20Delta%20to%20Climate%20Change%20in%20Pakistan.pdf

37 (World Bank, 2005)

38 (WWF – Pakistan, 2006).

39 Muhammad Zafar Khan, and Ghulam Akbar, " In the Indus Delta it is No More the Mighty Indus", River Conservation and Management. Edited by Philip J. Boon and Paul J. Raven, 2012 John Wiley & Sons, Ltd. Published 2012 by John Wiley & Sons, Ltd.

http://projectseed.net/wp-content/uploads/Paper_Indus_Delta_ZafarAkbar_2012.pdf

INCREASED FREQUENCY AND IMPACT OF EXTREME WEATHER EVENTS

Extreme climatic events in the form of hydro-meteorological disasters (floods, cyclones and droughts, etc.) caused by climate change variability have increased all over the world. Pakistan has also witnessed increased frequency of hydro-meteorological disasters such as floods, GLOFS, droughts, extreme heat waves, cyclones – incurring human losses as well as huge direct and indirect economic losses. The melting glaciers in Gilgit Baltistan (GB) increase threat from Glacier Lake outburst floods. There are about 2.500 glacial lakes formed due to glacier melt waters, and 52 of them were declared potentially dangerous for Glacial Lake Outburst Flood (GLOF).⁴⁰ Gilgit-Baltistan has observed more than 35 GLOF events in the last 200 years, but their frequency has increased in the recent years with five GLOF events in the Gojal Valley (Upper Hunza) during the year 2008.⁴¹

Most of GLOF events occurred in GB have been linked with extreme weather conditions, i.e. either there was an abrupt rise in temperature, heat wave or rainfall a short time before or during the GLOF phenomenon. Booni Gole Glacier located near Chitral in Hindukush mountain range generated an outburst flood in July 2010 which was triggered by monsoon downpour and caused huge erosive damage to agricultural land and human settlements along the flow channel. On January 4, 2010, Attabad landslide blocked Hunza River and resulted in the formation of a huge lake. It submerged major parts of five villages – Ainabad, Sheskat, Gulmit, Gulkin and Hussaini, killing 20 people and displacing over 6000 from the upstream villages. It destroyed 27 km road of Karakorum Highway (KKH) from Attaabad to Gulmit and two main bridges from Ayeenabad to Shishkat and from Shishkat to Gulmit. It cut off land communication link with rest of the country and suspended trade between Pakistan and China. The glacier continues to pose a potential threat of outburst. The Pakistan Meteorological Department observed that the thawing of permafrost in the mountains above the Hunza River probably caused the massive landslide that blocked the river and formed the Attabad Lake.⁴²

⁴⁰ ICIMOD

⁴¹ Din, K. , S. Tariq, A. Mahmood, G. Rasul, "Temperature and Precipitation: GLOF Triggering Indicators in Gilgit-Baltistan, Pakistan", *Pakistan Journal of Meteorology*, Vol. 10, Issue 20: Jan, 2014. 39.
http://www.pmd.gov.pk/rnd/rndweb/rnd_new/journal/vol10_issue20_files/4.pdf

⁴² Rina Saeed Khan, "Permafrost and climate change", *Dawn*, 9 August 2013.
<http://www.dawn.com/news/1035110/permafrost-and-climate-change>

Glacial lake outburst, cloud outburst and flash floods hit different parts of district Chitral in July 2015, causing extensive damages to houses, mosques, bridges, roads, irrigation and water channels. The communication infrastructure was also severely affected. In April 2012, 140 people of the NLI infantry battalion of Pakistan Army were buried under an avalanche that had hit the military base in the sector. In 2001 urban flooding occurred in Rawalpindi–Islamabad due to cloud burst, followed by the 2009 urban flooding in Karachi, floods in Kohistan and Sindh in 2011. In 2015, summer, torrential downpours and flooding killed at least 81 people and affected almost 300,000 people across Pakistan. In 2016 pre-monsoon rains and landslides killed at least 127 people in Khyber Pakhtunkhwa, Gilgit–Baltistan region and AJK. The monsoon rains caused further havoc across the country, and recurrent floods caused huge economic losses. The 2010 floods resulted in the loss of 2000 lives and economic losses of \$10 bn amounting to 7 percent of the GDP. In 2011, floods again devastated a million houses, affecting over 6 million people and destroying 4.5 million acres of land respectively. In 2012 climate-related losses stood at \$ 6 bn. Deforestation, limited drainage capacity of rivers and steep gradients amplify destruction year after year. Changing patterns of monsoons combining with Mediterranean jet stream and high temperatures on both ends produce floods in Pakistan.

Besides floods, there have been spells of droughts in the areas like Thar desert (Sindh province) and Baluchistan in years of 1998–2002 and 2014–2015 which are continuing. The severe drought in 1999 and 2000 affected 3.3 million people and 30 million livestock.⁴³ Since 2013, Tharparkar district and surrounding areas have been hit by a drought-like due to low rainfall, impacting livelihoods, nutrition and health conditions of the people in the area. The government estimates that Pakistan has, collectively, suffered losses to the tune of \$20 billion due to the adverse and increasing effects of climate change.⁴⁴

The recurring heat waves are another emerging extreme event, the frequency of which has increased in the past few years. In June 2015 an intense heat wave in Karachi and interior Sindh claimed around 2000 lives. There is also increased cyclonic activity at the southern coastline of Pakistan since 2007. The coastal communities and industries have faced the risk of Cyclones Yemyin (2007), Phet (2010), Nelofer (2014) and Ashobba (2015).

⁴³ PEPA, 2005.

⁴⁴ Khawar Ghumman, "Climate change has cost the country \$20bn: report, 11 September, 2015.

CLIMATE INDUCED REFUGEES

Floods, droughts, melting glaciers and rising sea level are likely to force people to migrate to other regions. From 2008 to 2013 disasters displaced a total of 13.76 million people, placing Pakistan fourth worldwide in absolute terms.⁴⁵ Recurrent floods are resulting in repeated displacements. 2010 floods displaced 20 million people. In Thatta district alone, half a million hectares of fertile land have been affected due to sea water erosion. The lives of 400,000 fisherman families are threatened and they will be forced to migrate to other areas. In 2014, more than 100,000 people fled the coast in the wake of loss of agriculture and fish stock due to loss of water. These tens of thousands of jobless farmers and fishermen pack the streets of inland towns, seeking jobs and places to live.

INTERPLAY OF CLIMATE CHANGE AND ENERGY SECURITY

Water is essential for both agriculture and power generation and has been competing in Pakistan's context. Rising temperatures resulting in enhanced heat and water-stressed conditions are expected to reduce agricultural productivity and power generation. Pakistan is facing perennial energy shortages since a decade or so. The energy sector will face a dual impact, both from the supply side and the demand side. The supply shortages will be aggravated due to the low share of hydro in the energy mix and the increasing kerbs on thermal power due to its climate change impact. Further, in water shortages in the winter season and especially in drought scenarios hydropower generation is likely to get further reduced drastically. The increased frequency and severity of storms, flooding will disrupt energy supply system/infrastructure, i.e., decaying transmission lines, etc. The energy security will also come under stress from changes in the water availability and the timing of availability for hydropower generation as well as the cooling of thermal power plants. Further, the increased rate of sedimentation in water reservoirs will reduce their power generation capacity.

On the other hand, the demand for energy will not only increase due to the increase in population, urbanization and needs of economic development which is already

⁴⁵ Global Estimated 2014: People Displaced by Disasters, Internal displacement Monitoring Centre (IDMC), Norwegian Refugee Council (NRC) September 2014.
<http://www.internal-displacement.org/assets/publications/2014/201409-global-estimates2.pdf> 32.

taking place, but also due to the increased energy requirement for room heating and cooling due to the rise in Earth's temperature, the extreme heat and the cold events. The Planning Commission in its 'Energy Security Action Plan for 2005–2030' estimated that based on 7.5–8.0 percent per annum growth in GDP the demand for commercial energy would increase 6 folds by 2030. This implies an increase in power generation capacity from 19,500 MW in 2005 to 162,500 MW by 2030. Now, this projection is slightly altered because of the slow GDP growth during the last few years. However, the country would still require about 100,000 MW and it is presently producing just 22,000 MW. If one takes into account the climate change impact and the additional energy requirements that it will impose, the rise in demand will be much higher.

CLIMATE CHANGE ADAPTATION

Given the multiple climatic threats, Pakistan has to prioritise its adaptation strategy. UNFCCC defines adaptation as "adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change."⁴⁶ The adaptation is a dynamic process which includes three essential stages: 1) assessment of vulnerability; 2) building capacity; and 3) implementation of adaptation measures.⁴⁷ To what extent do Pakistan's adaptation strategies respond to climatic threats that it is facing?

Pakistan recognises climate change mitigation and adaptation as an important area of concern. It has evolved a comprehensive framework policy called National Climate Change Policy (NCCP) approved in 2012. It was based on the *Task Force report on Climate Change* (TFCC) of 2010. The NCCP called for policy interventions for mitigation, adaptation and capacity building regarding vulnerable sectors such as water, energy, agriculture, food, transport, coastal areas and public at large. It identified 120 policy interventions in the framework. It proposed a series of measures to create an institutional architecture at both federal and provincial levels. These included: a) the establishment of Climate Change Cells within relevant

⁴⁶ UNFCCC, 2013.

⁴⁷ Arjumand Nizami and Carmenza Robledo, Natural Resource Management and Climate Change Mitigation: Adaptation and REDD+; Part IV, 'Adaptation to Climate Change, InterCooperation (Govt of KP & Swiss Agency for Development and Cooperation), 2010. 6. https://assets.helvetas.ch/downloads/4_adaptation.pdf

federal and provincial ministries. *b)* Setting up of a National Climate Commission to coordinate domestic climate change activities as well as to prepare appropriate responses to international developments. It also proposed that the administrative structures of Federal and Provincial Environmental Protection Agencies (EPAs) should be redesigned so as to integrate climate change concerns into initial Environmental Impact Assessment (EIA) processes and that national and provincial implementing entities be instituted to manage adaptation and mitigation projects at the federal and provincial levels. It called on the federal government to develop an 'Action Plan' for implementation of its policy directives and asked the provincial government to come up with their own strategies. For oversight, the NCCP proposed the creation of federal and provincial climate change Policy Implementation Committees which would meet on a biannual basis with the PCs reporting to the National Committee. In November 2013, the government followed up NCCP with a Framework for Implementation of CCP (FICCP) to reinforce and streamline coordination at the Federal and Provincial levels to ensure greater integration of climate change concerns into national planning and development.

The government has also taken some initiatives to improve knowledge gaps and reduce deforestation contributing to climate change. In 2016, the government approved Rs. 892.5 million for a four-year project to expand the network of monitoring stations for more accurate data on temperature, humidity, changing rainfall patterns and wind speed while tracking the rate at which glaciers are melting.⁴⁸ The Prime Minister has also approved the launch of 'Green Pakistan Programme' to improve forestry and wildlife sectors. This programme targets to add 100 million plants over the next five years all over the country, but these steps are not sufficient to offset the impacts of climate change on the country. Pakistan is also one of few countries that has undertaken a Climate Public Expenditure and Institutional Review (CPIER) and has established public expenditure and institutional benchmarks.

48 Saleem Shaikh and Sughra Tunio, "Pakistan Expands Glacier Monitoring in Effort to Cut Disaster Risk", 24 August, 2016. <http://floodlist.com/asia/pakistan-expands-glacier-monitoring-effort-cut-disaster-risk>

CHALLENGES TO CLIMATE CHANGE POLICY

Despite elaborate mechanisms for implementation, the actual execution of the strategies outlined in NCCP and FICCP have been ineffective especially in the field of institutionalisation of climate change at the federal and provincial levels. The failure stems primarily from the inability of both federal and provincial governments to adapt more effectively to the major overhaul of governance structures brought about in 2010 by the 18th Constitutional Amendment which devolved 47 subjects, including environmental pollution and ecology. Consequently, the lines of authorities are blurred between Federal Ministry of CC and its provincial counterparts. The Amendment has made provinces responsible for environmental lawmaking and CC service delivery; it has retained the authority of the Federal Government to direct the implementation of relevant obligations as well as set the direction of the national policy of CC. To add confusion, the MCC which was set up in 2012 was downgraded in 2013 to the status of a division under the federal cabinet and its budget was slashed by 60 percent. However, in January 2015, it was upgraded to a dedicated ministry but without any accompanying increases in budgetary allocation or provision of new projects. The provinces do not have the capacity to shoulder the new responsibilities allocated to them effectively. The capacity of local communities is also weak.

WAY FORWARD

Pakistan needs to develop national mitigation and adaptation plans. Multiple action plans are required in the area of technology, financing and capacity-building. For this to happen, the country needs to build capacity of existing institutions, access appropriate technology, secure finances and foster capacity building initiatives for the vulnerable communities.

Effective policy planning & coordination: The cross-cutting effects of climate change require a “whole of government” approach including parliament, finance, planning and sectoral departments at all levels. There is a need to mainstream climate change in sectoral policy making, particularly in core areas such as energy, water management and agriculture.⁴⁹

⁴⁹ "Why Pakistan needs a Climate Change financing Framework", *Policy Brief*, UNDP Pakistan, June 20, 2016.

- Effective policy implementation requires the establishment of firm linkages between the Ministry of Climate Change as the lead federal agency dealing with environment and sectoral ministries such as agriculture, energy, finance, planning and development, transport, urban planning and water. Further, the Medium Term Budgetary Frameworks of ministries should take into account climate change effects. The finance and planning institutions at the federal and provincial level should track climate change related expenditure and progress. Provinces must integrate climate change issues into their growth strategies given its impact on poverty and social development.
- The Council of Common Interest (CCI) and the Ministry of Inter-Provincial Coordination which serves as the secretariat of CCI can play an important role in harmonising federal and provincial CC policies. There is a need to integrate local governments with provincial governments in planning and implementation of CC policies.
- **Strengthening mitigation and adaptation strategies:** Pakistan needs to develop a national vulnerability index for developing better mitigation and adaptation strategies in future. Building water reservoirs, reforestation and afforestation, mass transit system, solid waste management and building resilience of the local communities will help in mitigation and adaptation.
- **Mainstreaming climate change and climate financing:** Informed policy response is possible only if climate change is mainstreamed into the planning and budgetary system across sectors, and is an intrinsic part of development policies.⁵⁰ Developing a Climate Change Financing Framework (CCFF) is an effective way to mainstream climate change into the planning and budgeting cycle. Pakistan needs to invest 5.5 percent of GDP annually for mitigation and 1.5–3 percent for adaptation to address the effects of climate change. For a 15 percent reduction in GHG reduction, an annual investment of around \$8 bn is required which it has to manage by tapping internal or external resources. In 2009, the developed countries committed to mobilising US\$ 100 billion per year by 2020. If a climate change financing framework is placed, it can help in capturing different sources of funding for climate change.
- **Changing the narrative:** Pakistan needs to change the narrative by bringing energy into the framework of climate change. Pakistan is engaged in a number of energy-related activities like construction of hydropower plants, development of renewable sources of energy and promotion of

⁵⁰ Why Pakistan needs a Climate Change financing framework? Policy Brief, UNDP, Pakistan, June 20, 2016.

energy efficiency and conservation that can be brought under the rubric of climate change as they are helping mitigate climate change. The change in narrative will sensitise and convince the international community that Pakistan is serious about meeting the challenges of climate change and will help it in securing assistance from Green Climate Fund, Adaptation Fund and Technology Mechanism.

- **Bridging knowledge gaps:** There is a need to monitor the behavior of the glaciers and glacial lakes, and compile their inventories on a regular basis to ensure effective water resources management in future. Because of the complexities at high elevations, general circulation models (GCMs) are unlikely to have much value for forecasting purposes. Therefore, a major investment is needed in snow and ice hydrology monitoring stations, further scientific research, and forecasting to improve the hydrologic predictability of the UIB.⁵¹

⁵¹ Winston Yu, Yi-Chen Yang, Andre Savitsky, Donald Alford, Casey Brown, James Wescoat, Dario Debowicz, and Sherman Robinson, *The Indus Basin of Pakistan: The Impacts of Climate Risks on Water and Agriculture*, IBRD/World Bank, 2013. www.worldbank.org 6.

Energy Security – a Threat Analysis for Pakistan

Salma Malik^{52*}

Security and provision of energy are the cornerstones of any country's sustainable development as well as the main drivers for economic and industrial growth. Countries, whether developed or developing, remain heavily reliant on energy resources, and it is often considered that in terms of strategic importance, energy security is becoming critical for individuals and state actors alike. However, with the need for "dependable and affordable energy" increasing, key factors pertaining to uninterrupted and smooth flow of fuel, financial affordability, demand side management as well as integrating and adapting to a range of traditional as well as alternate means of energy resources must be kept in mind.

Where on the one hand, rapid industrialization and increased economic interdependence have enhanced the demand and consumption of energy manifold, it has resulted in a corresponding depletion and exhaustion of natural and renewable sources of energy. Ill effects of human practices on environment and climate change are more drastically visible and severe than ever before. They have resulted in irremediable loss and depletion of fossil fuel, thus making it imperative to seek viable, climate-friendly, and clean sources of renewable energy generation that not only prevent further damage to our current and future environment but may also help contain or reverse the energy shortfall for good. According to a 2010 study,

If the current fossil fuels are utilized at the same rate, the current oil reserves are only going to last for another 40 years. As far as the gas is concerned, it is only going to last for another 65 years. Biomass fuel suggests that the current coal reserves are only going to last for another 155 years. If oil and gas reserves are continued to be utilized at the same pace, then more coal is going to be used to substitute energy resources.⁵³

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53 Joseph Iwaro and Abraham Mwasha, "A Review of Building Energy Regulation and Policy for Energy Conservation in Developing Countries," *Energy Policy*, Vol: 38, Issue No. 12, December (2010), pp. 7745-7746. Also see: Bilal Hamid and Attique ur Rehman, "The face of renewable energy in Pakistan," preliminary draft, <http://umconference.um.edu.my/upload/163-1/Paper%20110.pdf> p.02.

Despite a general realisation of the impending doom, countries have not been able to bring about efficient renewable energy conservation policies, and continue in their quest to exploit and consume critical natural resources (fossil fuels), as the demand for energy keeps mounting. The last Paris Climate Summit deliberated intensively on the negative imprint of mismanagement, excessive consumption as well as the indiscriminate exploitation of energy resources, without taking into effect the twining impact of climate degradation. This resulted in each member state promising a similar policy shift as well as policy adoptions to secure their future climate and energy security needs, yet there appears very little that has been put into practice.

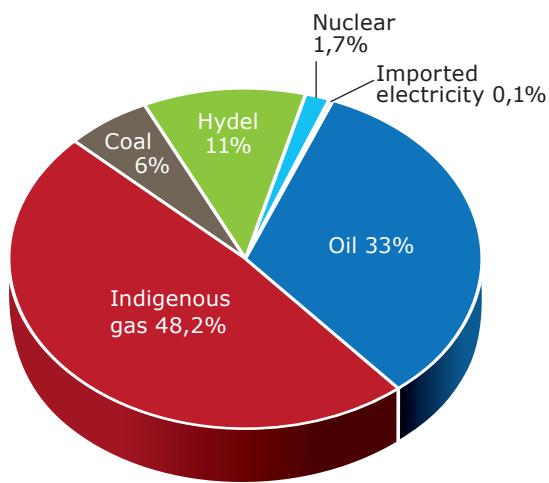
Similarly, Pakistan having abundant renewable energy sources, remains heavily reliant on external sources for energy generation, coming across as a severely (energy) resource deficient country. There are several reasons for this, first and foremost being the rapidly depleting indigenous gas and oil reserves; an ever-widening gap between the demand and supply; and an enhanced physical security threat, where many times energy pipelines have been attacked or damaged by insurgents and terrorists, thus halting the supply of oil or gas for domestic as well as commercial consumers. Moreover, last but not the least, the energy cost is rising, which is proportionally affected by all the previously stated factors.

Pakistan today stands as the eightieth most vulnerable country, in term of the consequences of climate change and its impact on available energy sources. Unfortunately there has been abysmal long-term planning, and instead there is witnessed a reactionary mindset towards energy and the environment within this broader issue making it highly problematic. Weak governance exacerbates Pakistan's other vulnerabilities such as floods, glacier melts, water stress. Especially the fact that its two neighbours, India and China both are high carbon emitters, further complicates the future climate and energy profile. Being blessed with a wide range of ecological zones such as glaciers, high mountains, tropical forests, riverine belts, deserts, and coastal ecosystems, it should not be difficult for the country to still develop policy parameters for securing both its energy needs as well as prevent drastic effects of climate change.

Relying on the available energy mix which is highly dependent on expensive fuels, Pakistan pursues a combination of non-renewable and renewable means of production. Currently, 87% of Pakistan's energy is sourced from non-renewable sources (33% oil, 48% natural gas and 6% coal) whereas 13% of energy is sourced from renewable sources (hydroelectric, solar, biomass, wind, ocean and geothermal

energy)⁵⁴ – more specifically, hydropower, yet there exists a huge deficit in energy production and consumption in Pakistan, amounting to 12000 MW: subsequently, with only 61% of the country's population having access to electricity, whereas only 21% have access to natural gas.

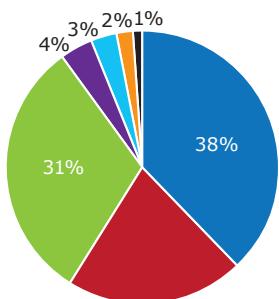
Table 01: Pakistan's Primary Energy Mix



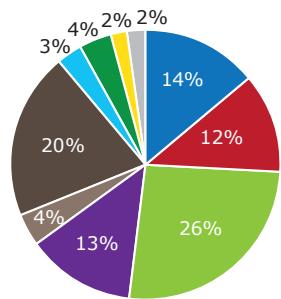
Source: Energy Year Book 2013.⁵⁵

Table 02: Pakistan Energy Mix (2015–16 to 2019–20)

Fuel Mix 2015-16



Fuel Mix 2019-20



Source: Energy Year Book 2013.⁵⁶

54 Government of Pakistan, Pakistan Energy Year Book 2013, Islamabad.

55 Ibid

56 Ibid

As a result, the country faces a severe energy crisis resulting in frequent and prolonged power breakdowns, shutting down of industrial units; badly affecting economic growth, creating social chaos and political instability. The energy crisis is generated by a variety of factors, such as the shift from hydro to oil-based expensive energy mix, widening demand-supply gap and lack of integrated energy strategy and bad energy governance. It is estimated that the national demand for electricity would keep on growing rapidly, at about 10 percent annually, due to rising population and economic development requirements. With an annual growth rate of 1.49%, the country's population stands at an approximate 193 million,⁵⁷ and the growing energy needs and consumption would enhance the energy demand to around 30,000 MW by 2020.⁵⁸ With an economy which remains heavily reliant on energy, the estimated cost of power crises is approximately Pak. Rs. 380 billion per year, which is around 2–3 % of the GDP.⁵⁹

According to official estimates, there is a potential of 1,250 MTOE of oil and natural gas in addition to 1,540 MTOE of coal and a potential of approximately 100,000 MW of renewable energy (56,721MW of hydro and 43,000 MW of wind).⁶⁰ However, disproportionate reliance on imported oil, which is 85 percent of the total supply has been a massive strain on the balance of payments besides making the current energy mix unfavourable. The energy crisis goes back at least two decades, when the state policies adopted an energy mix approach, tilting more for importing furnace oil, rather than relying on the domestic hydropower resources. As mentioned previously, this resulted in an increase in the overall cost of power generation, coupled with high proportion of line losses, correspondingly enhanced tariffs, in turn giving rise to:

The phenomenon of circular debt in the energy sector, whereby slippages in the payment of bills (particularly on the part of public institutions) trigger a chain of delayed payments for imported furnace oil, natural gas or other inputs to the thermal generation system, which in turn hamper the operation of the power plants and result in less than optimum capacity usage.⁶¹

57 Government of Pakistan, "Population, Labour Force and Employment," *Pakistan Economic Survey 2014-15*, Also see, "Pakistan population clock," United Nations Department of Economic and Social Affairs: Population Division, <http://countrymeters.info/en/Pakistan>

58 Maira Shakeel Syed, Dr. Ijaz Ahmad Chaudhry, Muhammad Farooq, Adnan Qamar, "Modeling and Forecasting of Energy Scenario in Pakistan with Application of Decentralized Energy Planning," *Journal of Faculty of Engineering & Technology (JFET)*, Vol 21, No 3 (2014), Pages 10

59 Ibid.

60 Ch. 19, "Energy." Pp. 203-4.

61 Safiya Aftab, "Pakistan's Energy Crisis: Causes, Consequences and Possible Remedies," *NOREF Expert Analysis*, Norwegian Peace Building Resource Centre, January 2014, http://www.peacebuilding.no/var/ezflow_site/storage/original/application/ade59fba5daf67a11a1c217434abf440.pdf

According to the governmental assessments, the total commercial primary energy mix supplied during fiscal year July 2014–March 2015 was 50.9 MTOE⁶² in comparison to previous fiscal year's 48.8 MTOE, thereby showing a growth of 4.4% whereas the consumption rate grew by 2 % from the previous year's 24.6 MTOE to 25.1 MTOE.⁶³ With increased economic and industrial consumption, the demand for energy in two decades is projected to surge up to 92 MTOE, for which the depleting resources certainly remain inadequate, as domestic gas reserves are predicted to last another seventeen years only.⁶⁴ For this purpose, the need is to plan and build upon renewable energy resources, which will neither add to the already stressed energy resources, such as gas nor prove a drain on the economy, as in the case of export of expensive crude oil. With vast coal reserves in the Thar region and immense potential for harvesting solar and wind power, along with hydroelectricity generation, the future energy mix needs to cater to the rapidly altering and increasingly expensive international energy sources, the drastic impact of climate change on the renewable energy resources, ever-increasing domestic as well as industrial consumer needs as well as future financial profile.

The planning commission of Pakistan through its *Medium Term Strategic Framework (MTDF)* provided an analysis of the country's sources of energy and how this mix would cater to energy security by the year 2030. Accordingly, the crude oil reserves stand at an estimated 27 billion barrels including 300 million barrels proven reserves. However, against a level of consumption of 100 million barrels, the available level of production stood at 22.6 million barrels, which is even less than one-fourth of the requirement. The indigenous natural gas reserves stood at 8 trillion cubic meters including the proven reserves of 0.8 trillion cubic meters. Of this 93 million cubic meters per day are produced against the daily level of consumption of 82 million cubic meters.⁶⁵ The coal reserves stand at 185 billion tonnes including the proven reserves of 3.3 billion tonnes. Used primarily by industrial consumers, the level of consumption is 6.1 million tonnes against a production level of 3.3 million tonnes.⁶⁶ Estimated at 185 billion tonnes, most of Pakistan's coal reserves are located in the

62 Acronym for million tonnes of oil equivalent. It is the unit to quantify the amount of energy which is released by the burning of a million tonnes of crude oil. Source: "What do we mean by MTOE," <http://www.electrotechnik.net/2012/05/what-do-we-mean-by-mtoe.html>

63 Govt. of Pakistan, "Highlights Pakistan Economic Survey 2014-15," *Economic Adviser's Wing*, http://www.finance.gov.pk/survey/chapters_15/Highlights.pdf pp. 12-14.

64 Ch. 19, "Energy," ibid.

65 "The Depletion of Global Oil Reserves Environmental Sciences," *UK Essays*, November 2013, Available from: <https://www.ukessays.com/essays/environmental-sciences/the-depletion-of-global-oil-reserves-environmental-sciences-essay.php?cref=1.h>

66 Govt. of Pakistan, "Pakistan Coal Power Generation Potential," NEPRA, 2004, <http://www.nepra.org.pk/Policies/Coal%20Potential%20in%20Pakistan.pdf>
Also See, Govt. of Pakistan, Ch. 28, "Energy Security," *Ministry of Planning, Development and Reforms*, <http://pc.gov.pk/mtdf/28-Energy%20Security/28-Energy%20Security.pdf>

province of Sindh. This includes the much talked about and promising 176 billion tonnes of Thar coal, which has yet to be mined and brought into usage. The overall mineable reserves of coal are estimated at 2 billion tonnes.

Additionally, the country has an estimated hydropotential of 46,000 MW, with only 6.459 MW as installed capacity. Catering to a sizeable bulk of power generation, the hydroelectricity provides about 29.853 GWH, out of the total power generation mix of 83.755 GWH. With the immense potential for hydroelectric generation, Pakistan's reliance on imported fuel and coal has proved extremely cost intensive, becoming even more expensive with the widening gap of payments. Furthermore, the rapid decline and depletion of oil and gas reserves would become critical unless new discoveries are made, or new markets explored. However, much depends on the complementing factor of financial resources and capacity to sign new deals. According to the planning above commission study, "the oil sector has all along been heavily dependent on imports of about 85 percent of the national requirement. Annually about 7.8 million tonnes of crude oil, 5.2 million tonnes of oil products and 2.8 million tonnes of coal are being imported at the cost of around \$ 3 billion."⁶⁷ The following table provides a short, medium to long-term profile of the country's energy mix and demand projections.

Table 03: Energy Mix & Demand Projection (2004–2030)⁶⁸

	Baseline of Projection		Short Term		Medium Term				Long Term		
	2004		2010		2015		2020		2025		2030
Total MTOE	50.8		79.39		120.18		177.35		255.37		361.31
Oil	15.20	30%	20.69	26%	32.51	27%	45.47	25.7%	57.93	22.7%	66.84
Natural Gas	25.45	50%	38.99	49%	52.98	44%	77.85	44%	114.84	45%	162.58
Coal	3.30	6.5%	7.16	9%	14.45	12%	24.77	14%	38.28	15%	68.65
Hydro	6.43	12.7%	11.03	13.9%	16.40	13.6%	21.44	12.1%	30.50	12%	38.93
Other Renewable	0.00	0.0%	0.84	1.1%	1.60	1.3%	3.00	1.7%	5.58	2.2%	9.20
Nuclear	0.42	0.8%	0.69	0.9%	2.23	1.9%	4.81	2.7%	8.24	3.3%	15.11
											4.2%

Source: Ministry of Planning, Development & Reforms, Govt. of Pakistan.⁶⁹

⁶⁷ Ibid.

⁶⁸ Govt. of Pakistan, Ch. 09, "Energy for Growth," *Ministry of Planning, Development and Reforms*, <http://www.pc.gov.pk/vision2030/Pak21stcentury/Chapter%20Wise/Ch%209,%20Energy%20for%20Growth,%2081-90.pdf>

⁶⁹ Ibid.

Given the energy profile and rising needs, the expected growth rate is projected to be 7.4 percent per annum. To meet future requirements with domestic resources, domestic exploration, if feasible, needs to be enhanced. This may not be entirely possible, given the depleting resource base. At the same time, there is a drastic need to diversify energy supply options, as well as explore the potential for an alternate energy provision. The governmental approach in this regard has been:

- Enhancing the exploitation of hydropower;
- Exploration and production activities of oil, gas and coal resources;
- Increasing the share of coal and alternate energy in the overall energy mix;
- Optimising the utilisation of country's indigenous resource base to reduce dependence on imported fuel through an institutionalised strategy;
- Creating an environment conducive to the participation of the private sector, as well as technically skilled human resource and expertise; and
- Lastly, to develop the energy scenario in the context of regional perspective.⁷⁰

STRUCTURE OF ENERGY SECTOR

The country's power sector has traditionally been run by two main public sector entities, namely the Water and Power Development Authority (WAPDA) established in 1958 and the Karachi Electric Supply Corporation (KESC), operating even prior to the formation of Pakistan, as early as 1882 under the British (colonial) Indian Companies Act, but nationalized in 1952. The KESC resurfaced in 2005 as a private entity "K-Electric," in an attempt to boost its work efficiency. In order to break the monopoly enjoyed by such public sector entities, which were now suffering from incompetence, malpractices, poor service delivery as well as poor service provision resulting in a massive power shortage, the private investment was encouraged in the energy sector, and an Independent Power Projects (IPP) policy was launched in 1994. To facilitate and encourage more such investment, the Private Power and Infrastructure Board (PPIB) was set up to provide a one- window support to investment into the private sector. Furthermore, the National Electric Power Regulatory Authority (NEPRA) was established in 1997. The NEPRA in its mission statement, laid out its aim to:

⁷⁰ Ch. 28, "Energy Security," p. 07.

"Develop and pursue regulatory framework, which ensures the provision of safe, reliable, efficient and affordable electric power to the electricity consumers of Pakistan; we shall facilitate the transition from the protected monopoly service structure to a competitive environment where several power sector entities function in an efficiency-oriented or market driven environment and shall maintain a balance between the interests of the consumers and service providers (as well as the government)."⁷¹

The government besides launching the IPPs, reorganised the WAPDA into nine distribution companies (DISCOs), four thermal generation companies (GENCOs) and a National Transmission and Dispatch Company (NTDC), that is responsible for transmission lines and grid stations of 220KV and above. However, the hydroelectric power development and operation functions remained with WAPDA. In 1998, Pakistan Electric Power Company (PEPCO) was established to facilitate the restructuring and re-organization of WAPDA and the companies. Furthermore, through an Act of Parliament, the federal government in May 2010 bestowed upon the Alternative Energy Development Board (AEDB) setup in 2008, to facilitate alternative/renewable energy projects, develop and implement off-grid electrification programme of rural areas and to introduce alternative and renewable energies (AREs) at an accelerated rate. These policies, programs and projects were sanctioned to the private sector in order to assist and facilitate fast paced development and generation of ARE to achieve sustainable economic growth. The government aims to generate 5% of total national power generation capacity through renewable energy technologies by the year 2030. In addition, under the remote village electrification program, AEDB has been directed to electrify 7,874 remote villages in Sindh and Balochistan provinces through the ARE technologies.⁷²

PROBLEMS AND IMPEDIMENTS

Until recently, Pakistan has faced a critical energy crisis due to a host of reasons, some being generic to a growing economy with a huge population and slow paced infrastructural growth, and few being unique to the country, such as, misallocation of resources and funds, the incompetence of exploration sector, a rapid increase in oil prices in the international market, fewer dams and power wastage. This

⁷¹ "Our Mission," Official Web site, *National Electric Power Regulatory Authority, (NEPRA)*, Government of Pakistan, <http://www.nepra.org.pk/mission.htm>

⁷² "About AEDB," Official Webpage *Alternative Energy Development Board*, Ministry of Water and Power, Govt. of Pakistan, <http://www.aedb.org/index.php/ae-technologies/biomass-waste-to-energy/53-about-aedb>

had in turn given rise to a host of problems, such as rapid inflation, widening trade deficit, depreciation of currency. Severe power outages attributed primarily to energy shortage, impacting the poverty index negatively, due to unemployment and decrease in industrial activity.

Despite the reorganization and a serious attempt to increase the efficiency and power production, there appeared many problems, such as slow development of indigenous resources as well as power generation and storing reservoirs such as water dams, coal reservoirs, etc.; gaps between implementation strategy and capabilities; financial constraints, slow progress and pace of the private sector. Furthermore, an ad hoc approach to the management and identification of important aspects such as load forecasting, project identification, tariff regime and future investment requirement, gave rise to poor coordination and rivalry amongst different stakeholders and institutions, thus negatively impacting the competitive development of power sector.”⁷³

The effects of transition of power generation sector from the cost effective, efficient and renewable hydroelectric power, to the more expensive, experimental and non-renewable energy mix options, has immediately been visible through increased import bills, and delay in development of domestic resources. For a country, which is already stressed financially, this proved a major strain and with external financial donors, seeking an end to subsidies provided to domestic and industrial consumers, the power sector has impacted the industrial growth in the most drastic fashion. Although there is already a reversion to hydropower, it will take considerable time to correct the situation as the gestation period for hydro-based generation is relatively long.

Enlisting the problems faced by the power generation and distribution structure, there are several which any power sector would face universally, such as:

- A lopsided and inefficient subsidised tariff structure, which provides relief to domestic and agriculture consumer, yet many in the industrial and commercial sector who are outside the subsidy bracket, consider it a smokescreen for theft and pilferage.
- There is incurred a huge loss in revenue annually due to high transmission, distribution, auxiliary losses and pilferage.

⁷³ Chapter 28, "Energy Security."

- Lack of and where available overloaded transmission and distribution network, which can be made better through digital information and adjustment of load capacity and positioning.
- Poor and old equipment and infrastructure leading to a lack of conservation and wastage of energy, which is approximately 20% of the total consumption.
- There is also an exclusion of local stakeholders in the shape of engineering industries, which is costing heavily in terms of importing electrical engineering and auxiliary power products required; which ends up adding to the overall financial cost.
- Overloaded preexisting infrastructure, transmission system as well as grid stations, leading to high distribution losses, transmission line constraints, poor quality of service and various other problems related to quality and stability of the setup.
- The slow pace of exploration, drilling activities and infrastructure development in the oil and gas sector.
- Neglect of the Coal sector, due to lack of capability and proper institutional setup.
- A very costly energy mix transformation, as most of the power generated is through imported furnace oil, which is much more expensive than hydropower. According to the governmental assessments, electricity produced through hydropower costs around Pak. Rs. 1 per unit in comparison to that produced through furnace oil which costs Pak Rs. 12–17 per unit, and through diesel-run power plants Rs. 23 per unit.⁷⁴
- The heavy dependence on imported energy generating resources has given rise to a somewhat unique notion of circular debt, implying a trigger off a chain of delayed payments, that have a direct impact on the running of power generating plants and adding to external dependency and delays. The circular debt for the year 2015 stood at Rs. 313,618 million. The government aims to bring this figure down to Rs. 211,649 million by the year 2018⁷⁵ – however, much depends on timely payments as well as an accurate assessment of electricity cost and timely payment of tariffs as well as power generation costs by all concerned.⁷⁶

⁷⁴ Aftab, NOREF, ibid. also see: Imtiaz Ali Qazilbash, "Pakistan has 100,000MW production potential," *The Express Tribune* (Pakistan), November 22, 2015, <http://tribune.com.pk/story/996382/hydroelectric-power-pakistan-has-100000mw-production-potential/>

⁷⁵ Govt. of Pakistan, "Managing Circular Debt," *Ministry of Water & Power*, September 2015, <http://www.mowp.gov.pk/gop/index.php?q=aHR0cDovLzE5Mi4xNjguNzAuMTMwOjkwODAvbW93cC91c2VyZmlsZXmxL2ZpbGUvQ2FwcGluZyUyMENpcmN1bGFrJTlwgRgVidCUyMFJlcG9ydCUyMFNlcHQIMjAyMDE1LnBkZg%3D%3D>, pp. 02-07

⁷⁶ Ibid.

- Political nature of hydroenergy in the country.
- Last but not the least has been the overall security situation, which has made energy pipelines, infrastructural development, foreign investment and resource input of any nature, whether financial, human or infrastructural extremely risky and difficult.

THE (RENEWABLE) ENERGY MIX

As mentioned previously, energy and economy run hand in glove. If we look at Pakistan's economic performance over the decades, it has never been a steady one. In the recent decades, a third 'E' added to the equation, makes this factor all the more complicated, and that is the menace posed to a steady and stable economy and undeterred energy provision by the threat of extremist violence and militancy. The three E's as termed by the current government are the fundamental basis of a stable, secure and progressive Pakistan. As the global political dynamics underwent a shift and the return to democracy brought technocrats, industrialists and traders into mainstream politics, there was witnessed a steady growth in the economy and gradually policies were made commerce friendly. Correspondingly, growth in the economy seeks a parallel demand for energy. With an environment conducive for investment, the period witnessed a fast-paced industrialisation, which was not matched equally with infrastructural development and the required energy needs. Pakistan being a country with limited indigenous energy resources, came under immense stress resulting in importing large quantities of oil and related products primarily from the oil-rich Middle Eastern Emirates and Saudi Arabia.

Of the total installed power generation capacity of almost 23 GW (22,797 MW), the average demand is 16–18,000 MW, with an ever increasing demand at the annual rate of eight percent per year, placing Pakistan's per capita electricity consumption at one-sixth of the World Average. According to the International Energy Agency, the world average per capita electricity consumption is 2,730 kWh compared to Pakistan's per capita electricity consumption of 451 kWh, and by the year 2025, the demand for electricity will reach 49,078 MW.⁷⁷

The country's existing energy mix is highly expensive due to its dependence on imported fuel despite the fact that Pakistan is an immensely resource-rich country

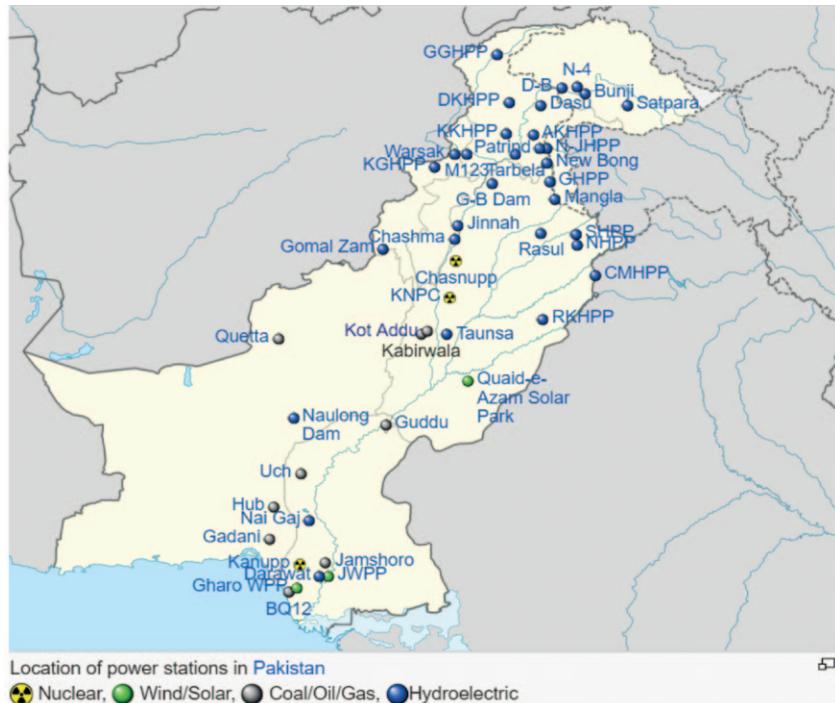
⁷⁷ Zahid Gishkori, "Dark days ahead: 'Electricity woes to worsen in future,'" *The Express Tribune*, July 13, 2011, <http://tribune.com.pk/story/208495/dark-days-ahead-electricity-woes-to-worsen-in-future/>

with enormous hydro, coal as well as oil reserves as well as alternate and renewable energy generating resources. However, hydro power has become a controversial political question, with different opinions raised and discussed endlessly concerning oversize, allocations, royalties, placement and location of water reservoir dams. Since the late 1980s, very less exploration in terms of discovering and drawing feasibility studies of new oil fields has been carried out. As mentioned above, in the overall energy mix, gas accounts for 48 percent, oil 33 percent, hydro 11 percent, coal six percent, nuclear two percent and a small fraction of imported electricity.

Stuck in the similar dilemma of over-reliance on imported petroleum and oil products for commercial, industrial and domestic consumption, the import percentage of these products has been sufficiently high making this issue all the more critical. The gap between demand and supply, as well as production and consumption of oil, are widening, with a corresponding increase in energy needs and consumption, putting immense pressure on the growing economy of the country.⁷⁸ To reduce reliance on costly imports, and reduce the widening gap between consumption and production, the country has to explore and exploit its abundant and naturally endowed renewable energy resources. Located in a geographical stretch, Pakistan has a huge potential for solar as well as wind energy. However, the country faces problems similar to what other developing countries are undergoing when it comes to successful implementation of renewable energy systems, such as lack of technological resources, poor financial support, government's lack of support and incentives. Amongst the various alternated and renewable energy sources, the cheapest and foremost is the hydropower. However, a well-planned and strategized investment into harvesting solar, as well as wind power, can be the basis of clean, pollution free, climate friendly and relatively cheaper (long term) source of energy generation and bring about sufficient economic dividends.

⁷⁸ E Adeel Ahmed and Mithilesh Kumar Jha, "Status of Petroleum Sector in Pakistan – A Review," Energy Field of Study, School of Environment, Resources and Development, Asian Institute of Technology, Bangkok, http://ogbus.ru/eng/authors/AdeelAhmad/AdeelAhmad_1.pdf

Table 04: Various Alternate & Renewable Energy Power Projects in Pakistan

Source: Pakistan Report⁷⁹

HYDRO POWER

Considered as one of the cheapest sources of power generation, hydropower has low running costs, although there is an initial requirement of huge capital investment.⁸⁰ There is a potential for generating 50,000 MW of power through this source. However, since the last 50 years, not more than 4,800MW have been extracted from mega-hydro plants and the rest is still to be extracted and utilised.⁸¹ The Tarbella and Mangla dams are the two biggest sources of electric power for the country and hold the capacity of 3,046 MW and 1,000 MW respectively. Besides these two mega projects, there also are the Chashma, Mirani, Ghazi Barotha, Warsak, Gomal Zam and many other smaller dams.

Unfortunately, construction of dams has also been a matter of political rift amongst the centre and the provinces, as well as the controversy as to what is better –

⁷⁹ "Pakistan's Power Production Capacity Map," *PakReport*, <http://www.pakreport.org/whoknows/#data>

⁸⁰ Hasan, 2002

⁸¹ Kazi, 1999

smaller and more reservoir dams or large scale projects. The construction of Kalabagh dam which has become a moot point for decades is one such glaring example, whose timely construction could have not only fulfilled major power generation needs and helped strengthening economy, but also saved precious rain and river water, which is now lost as a result of having no reservoirs, even smaller ones to help catch and harvest this down flow.

However, there are under construction projects such as Diamer Bhasha, Dasu, Taunsa, Neelum Jehlum hydropower plant and many others which can and will contribute to enhancing and improving the hydroelectric power generation. According to energy experts, if an honest effort is done to establish hydropower as a (primary) source of energy in our country, even the recoverable potential in micro hydropower (MHP) up to 100KW is roughly estimated to be 300MW on perennial waterfalls in northern Pakistan.⁸² One can thus safely make an estimate as to what bigger and mega projects can potentially generate. In the recent decades, both private, as well as public sector entities, are now actively investing in the hydroelectric sector, in various capacities, which will bring greater relief in future.

SOLAR POWER

Pakistan's geographic location blesses it with immense natural energy generation sources, amongst which solar power is one such asset, abundantly available. The last two and a half decades have seen substantial investment as well as developments in this field, and at present the solar energy, though not as mass scaled, as envisioned, is still being used for various purposes. According to a study, if only about 0.25% of the Balochistan province which is about 0.1% of the total landmass, is covered with solar panels with an efficiency of just 20%, the electricity generated would be sufficient for the entire country.⁸³

At the moment, there are small scale, stand-alone units being run by photovoltaic power such as rural telephone exchanges, repeater stations, highway emergency telephones, cathodic protection, refrigeration for vaccine and medicines in the hospitals, etc. However in order to encourage, promote and prove the credibility

⁸² M. U. Hassan, "Development of renewable energy technologies in Pakistan – an overview," *Pakistan Council of Renewable Energy Technologies*, Ministry of Science & Technology, pp. 1-3.

⁸³ "The Feasibility of Renewable Energy in Pakistan," *Triple Bottom Line*, Sustainability Advocacy: A Specialized CSR Platform, (Online Magazine)
<http://www.tbl.com.pk/the-feasibility-of-renewable-energy-in-pakistan/>

of this sector, the entire parliament building of Pakistan was converted entirely to running on solar power energy, thus becoming the first such parliament building in the world to be solar powered.⁸⁴ Other projects such as converting big scale public parks in the country to solar power are being worked upon.

The percentage of the rural population, which lives away from the national (power) grid is about 70%. Therefore the Alternate Energy Development Board (AEDB) has initiated pilot projects by setting up 100 solar homes to exploit solar energy. Both the private and public sectors are actively involved in the advancement and upgrading of photovoltaic activities, by not only trading but also producing photovoltaic products and appliances. At present there are around 12 solar power generation projects underway, with the Quaid-I-Azam solar park, due for completion by the end of the year 2016 being the biggest project with 1000 MW power generation capacity.⁸⁵

WIND POWER

With a 1,000 km wide coastline, like solar energy, Pakistan has a huge potential for wind power generation as well. One of the fastest growing technologies, wind energy has been very effectively used for decades in many developed countries. Pakistan fortunately has high wind speed zones near major city centres. Near the Islamabad capital territory it ranges between 6.2 to 7.4 metres per second, in Karachi, it is between 6.2 to 6.9 metres per second and various wind turbines which are available in the neighbouring countries require a speed of 3–4 metres per second to start turning. The provinces of Sindh and Balochistan have sufficient wind to power not only every coastal village but the Gharo-Keti- Bandar corridor in Sindh alone has the potential to produce 40–50,000 MW electricity, out of a total potential of 150,000 MW⁸⁶ which can even be exported to the Asian neighbours.

Additionally, the presence of rivers and lakes in the country ensures an uninterrupted flow of wind which is further helpful in the production of continuous electricity. The AEDB has already installed a number of micro turbines for small scale domestic units and at the moment around 33 wind power projects are under completion with

84 "Parliament shifts to solar energy," *Dawn*, (Newspaper) February 13, 2016,
<http://www.dawn.com/news/1239167>

85 "PM Nawaz inaugurates country's first solar park," *Dawn*, May 05, 2015,
<http://www.dawn.com/news/1180113/pm-nawaz-inaugurates-countrys-first-solar-park>

86 "Harnessing Wind Power Projects and Policies," *Pakistan & Gulf Economist*, March 15 2015 Issue

public-private interaction, of which the Jhimpir Wind Energy Project and the three Gorges Wind Farm, Foundation Wind Energy and Sapphire Wind Power Ltd are already operational. Wind power projects of 100 MW are being initiated on BOOT (build, own, operate and transfer) basis, at Keti Bandar and Gharo in Sindh.⁸⁷

Table 05: Potential Power Generation Plan 2005 – 2030
(Data energy mix/year in MW)

	Hydro	Coal	Oil	Gas	Renew- able	Nuclear	Total	Cumulative MW
2005	6460	160	6400	5940	180	400	19540	
2010	1260	900	160	4860	700	–	7880	27420
2015	7570	3000	300	7550	800	900	20120	47540
2020	4700 ⁸⁸	4200	300	12560	1470	1500	24730	72270
2025	5600	5400	300	22490	2700	2000	38490	110760
2030	7070	6250	300	30360	3850	4000	51830	162590
Total	32660	19910	7760	83760	9700	8800	162590	

Source: Energy Year Book 2013

Besides the resources above, Pakistan also relies on coal as well as nuclear. Other sources include liquid petroleum gas (LPG), as well as a very tiny portion comprising geothermal energy. As mentioned in the preceding paragraphs, Pakistan has estimated coal reserves of over 185 billion tonnes. However being low quality, it is not very feasible in terms of environmental protection as well as its impact on climate change. This problem reduces its overall share in the energy pool to less than two percent, of which nearly 90 % is used by brick kilns and 10% for power generation. Most of the coal used in the cement industry is imported from other countries. Pakistan also produces electricity through the three operational nuclear power plants, namely, the Karachi Nuclear Power Plant KANUPP commissioned in 1971, with a capacity of 137 MW; later to be followed by the two Chashma Nuclear Power Plants with capacity of 325 MW of each plant. At present the share of these three plants in the overall mix is a mere 2.3 %. However the Pakistan Atomic Energy Commission has planned to increase the Nuclear Power Capacity to 8,800 MW by the year 2030.

⁸⁷ Hamid and Attique, "The face of Renewable Energy," ibid.

⁸⁸ "KANNUP to retire by 2019," *Energy Outlook for Asia and the Pacific 2009*, Asian Development Bank, 2010.

Conclusion and Recommendations

Any country in the contemporary world is faced with the twin dilemma of pursuing its development needs and striking a balance to protect and secure its environment. Pakistan, with a rapidly growing population and economy which is gaining a fast pace, has similar issues and concerns. Despite the measures being undertaken, the country still faces an energy crisis. With 50 % of the energy needs being fulfilled by gas, there is a natural increase in demand and consumption of gas, with a similar demand and supply gap which appears to be widening in the electricity and oil sector. The government has undertaken several measures from the immediate, short term such as seeking to regulate and manage load sharing through load shedding to long-term measures of seeking viable, sustainable energy mix options. The best resource available to the country is harvesting and developing its renewable energy resources, amongst which, hydropower is the cheapest, safest and efficient source, which can help in managing and securing water needs as well. The need is for respective governments to realise the looming threat of energy deficiency, lack of renewable resources and environmental depletion if appropriate preemptive and preventive measures are not undertaken timely.

Not only measures such as seeking better renewable resources for energy generation need to be thought of but also supported by long-term environment-friendly policies and implementation strategies as well. There is a need to develop civic culture and responsibility when it comes to consumption of energy. Laws and regulations should be made for energy efficient practices and infrastructural development, appliances and future investment must cater to energy efficient policies. The existing infrastructure of transmission and grid stations is overloaded, which needs to be expanded and made more stable. The distribution network must be increased. In this regard, concrete measures need to be undertaken to prevent power theft and line losses. Any energy generation plan or strategy must be compliant with climate and environment protection policies, which will help build a future energy sector that secures environmental concerns, faced by the country.

For the foreseeable future, the country will remain reliant on the energy mix that it has heavily invested in. However, there should be a gradual shift towards renewable energy generation plans, and for this, the federal, as well as provincial governments, need to join hands. Villages and areas outside the national grid can easily

benefit from solar or wind power, which should be encouraged. The private sector should be encouraged to invest more in these areas, with a provision of jobs and vocations to local stakeholders. In case of non-availability of targeted and compatible human resource, educational institutions and technical training centres need to be roped in for developing the necessary human resource capital.

The energy crisis which became critical since 2007, is now nearly a decade old and has proved a massive drain on the economy and the country's growth and development. By taking well strategized and articulated actions, which do not deplete the fragile environment, we can very well through well-paced measures not only overcome the crisis, improve and sustain the economy, but also secure the environment. The best solution is to invest heavily in renewable sources of energy and to adopt as well as adapt to practices and policy framework that are both climate-friendly and energy efficient. Such strategy may lead to energy conservation that can, in turn, bring about as well as reinforce sustainable development that will go a long way in benefitting industry, economy, as well as the environment.



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Energy Security and Climate Change in South Asia: A Threat Analysis for Sri Lanka

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I Introduction

Prof. Imtiaz Ahmed¹

Amitav Ghosh could not help reminding us of the number of displaced people likely to result from climate change, particularly in Asia. As Ghosh tried to explain the alarming statistics,

One study suggests that rising sea levels could result in the migration of up to 50 million people in India and 75 million in Bangladesh. Along with Bangladesh, Vietnam is at the top of the list of countries threatened by sea-level rise: in the event of a 1-metre rise in sea level, more than a tenth of Vietnam's population will be displaced [...] It is the matter of numbers again that makes Asia critical to the questions of mitigation, preparedness and resiliency. Aquifers are drying up in northern China as well as in America's Great Plains: but only 2 million people live in the 454,000 square kilometres that are watered by the United States' Ogallala Aquifer while the 324,000 square kilometres of North China are populated by 214 million people.¹

What precipitated climate change? Or, why talk of climate change when such change has always been a part of nature? Again, how is climate change related to energy security or inversely, did the craze for energy propel climate change? One quick response would be to say, yes! Indeed, human's uncritical engagement with fossil fuel civilisation since the dawn of the Industrial Revolution in the mid-18th century led to the excessive accumulation of greenhouse gases in the atmosphere. This process, particularly in the last two centuries, made the earth warmer in a much shorter span of time. Global warming fueled climate change to the detriment of life and living of all beings, including humans.

But then, in the wake of human-driven climate change, the post-Enlightenment positivist discourses and disciplinary boundaries got reformulated. Earlier 'natural history' remained separated from 'human history,' the latter did not bother to reflect on or encroach upon the disciplinary quest of the former.² Separated time-scale in the evolution of the two – nature and human – dictated that the history of nature and historiography were on different planes, and save minor cautionary

¹ Regional Centre for Strategic Studies -- Executive Director, Colombo/Sri Lanka

remarks by poets and philosophers, the disciplinary boundaries were taken for granted. This became untenable when more and more scientists in late 20th century agreed that something was wrong with the climate. Frequent cyclones around the world, drought in Australia, the melting of glaciers of the Himalayan and other mountain ranges, including that of polar ice caps, the continuous rise in the global sea level – which incidentally has been rising at a rate of at least 0.04 to 0.1 inches (1 to 2.5 millimeters) per year since 1900³ – all made life and living on earth hazardous and risky. Climate change could no longer be ignored.

Indeed, in the wake of climate change, the separation between natural science and human history became weak and somewhat unreal. This is not to discount the age-old relationship between the two but then such relationship was minimal and millennial, one hardly affecting the other. Change in geographical environment, for instance, required millions of years while change in the system of human society could come about in a few hundred or thousand years. However, that is no longer valid. The speed at which climate change started to reshape the earth has transformed humans into a geological force, imbued with the power of "changing the most basic physical processes of the earth."⁴ As Naomi Oreskes maintains:

For centuries, scientists thought that earth processes were so large and powerful that nothing we could do could change them. This was a basic tenet of geological science: that human chronologies were insignificant compared with the vastness of geological time; that human activities were insignificant compared with the force of geological processes. And once they were. But no more. There are now so many of us cutting down so many trees and burning so many billions of tonnes of fossil fuels that we have indeed become geological agents. We have changed the chemistry of our atmosphere, causing sea level to rise, ice to melt, and climate to change. There is no reason to think otherwise.⁵

This led some to contend that the earlier geological epoch of Holocene (whole or entirely Recent and dated 9,700 BCE) got replaced by the Anthropocene, with humans becoming a force of nature, tragically contributing to the extinction of species, indeed, as one critic remarked, "similar in intensity to the event around 65 million years ago which wiped out the dinosaurs."⁶ A rollback or halting the process of what is surely nothing less than 'self-destruction' is not that easy.

It is no accident that global warming and globalisation started to be discussed almost at the same time, both attracting public attention in the late 1980s and early 1990s.⁷ This was the time when capitalism entered a new phase, with the developed economies outsourcing their labour-intensive industries to low-wage countries of the Third World. China, India, Brazil, even relatively smaller countries like Bangladesh, Vietnam, Sri Lanka, all became global industrial houses, emitting carbon dioxide from activities like cement production, deforestation as well as the burning of fossil fuels like coal, oil and natural gas, and polluting the air more than ever. The developing countries wanted quick development, racing to catch the developed economies by blindly reproducing fossil fuel civilisation with little or no interest in the sustainability of the environment. The developed economies, on the other hand, wanted to boost up their shrinking profits by having marketable goods produced with cheap labour elsewhere in the world, hoping simultaneously to replace their labour-intensive industries with knowledge-economy.⁸ This, however, required massive investments in education, which, for reasons of special interests and quick profits, got limited to certain areas and in the process failed to address the issue of rapid *deindustrialisation* in the developed economies. Political fallouts from deindustrialisation and 'knowledge gap' were immense, the evidence of which is now found in the electoral mandate for Brexit and the shocking victory of Donald Trump in the UK and the USA respectively.

There are already some apprehensions that the world will witness a reversal of some of the international agreements reached for reducing global warming during Trump's presidency. This is mainly because during the election campaign, Trump called human-caused climate change a 'hoax.' At the same time, he vowed to dismantle the U.S. Environmental Protection Agency 'in almost every form.'⁹ Alarming though this may be, it is unlikely that Trump can unilaterally erase 2015's Paris climate agreement, which commits more than 190 countries to reducing their emissions of global warming carbon dioxide pollution. Nor can he fully dismantle Obama's domestic climate change regulations under the Clean Power Plan. However, he can certainly slow down the process and even ignore some of the commitments made. This will invite what can be referred to as the 'copycat syndrome,' with other big polluters, like India and China, becoming equally disinterested to the task of reducing global warming and limiting the impact of human-driven climate change. Any rollback on global climate commitment may not harm the big polluters blessed with large territories and developed economies, but is bound to impact upon the relatively small and environmentally fragile states like Sri Lanka.

Developing countries suffer from climate change from *without* as much as from *within*. A rollback on global climate commitment, particularly by the big polluters like the US, China and India, will certainly have a negative impact on the climate, making the developing countries suffer more as a result of distortions in their agricultural growth and food production. However, the problem is not entirely external. In fact, the current development discourse or 'developmentality' has been such that it has blinded the developing countries, including Sri Lanka, to develop their economies in the image of the developed economies. As the Pathfinder Foundation noted with reference to Sri Lanka,

The combination of rising oil prices and increasing domestic demand for energy in middle-income Sri Lanka places a higher premium on achieving energy security [...] As the economy becomes more complex and income rises, demand for fuel (both transport and power) will rise. On the transport front, higher levels of economic activity will result in more haulage and rising incomes will lead to more private vehicles. In the power sector, demand will increase from both industries, fueled by a more complex economy and households driven by rising incomes. At present, biomass accounts for about 40% of energy consumption. This figure will decline due both to higher incomes and increased urbanisation.¹⁰

Not surprisingly, there is popular excitement following the discovery of commercial quantities of natural gas in the Mannar basin, hoping that this would reduce the cost of power and ensure Sri Lanka's energy security. However, isn't such energy responsible for global warming and climate change? The contradiction here is striking: energy security required for development is largely conditional on having access to fossil fuels (coal, oil, natural gas) but then the latter can fuel climate change to the detriment of living beings! The critical question, therefore, is, how to ensure energy security without harming the environment?

A paradigm shift is certainly warranted. This study is a modest contribution towards such an effort. Indeed, it is with this objective in mind that Avanthi Kalansooriya, Minna Thaheer, and Rasika Sumudhu Jayasinghe have attempted to examine their respective areas of interests – renewable energy, disaster management, and gender – and contribute to the discourse on the ways and means of mitigating the threat faced by Sri Lanka on the issue of energy security and climate change.

Kalansooriya delves into an issue which is surely a challenge for Sri Lanka: How to keep its 'development goals' intact while adhering to the post-COP21 climate change regime? This is no easy task. Indeed, anyone familiar with the Kuhnian 'paradigm shift' will know that not only newer solutions come to solve hitherto unsolvable problems or 'crisis' but also the bulk of the concerned people must agree and adhere to the newer solutions.¹¹ Again, this is more easily done in 'pure science' than in 'social science,' for in the latter 'competing paradigms' inform the field and not one paradigm dominates and replaces another. Energy security and climate change inform both the fields – science and social science – and this is why the challenge is greater and the task simultaneously scientific and social. As Kalansooriya points out, "The civil society, think tanks, and the epistemic communities have a role to play in establishing a sound discourse on this matter through knowledge production, awareness programmes and inter-regional knowledge sharing exercises." People's participation at all levels, therefore, is required to face up to the contradiction and meet the challenge of securing energy without harming the environment.

Thaheer takes the discussion of climate change to real life issues where "variability of climate and natural hazards impact the daily rhythm of life," and this, according to her, "determines social cohesion, social order and social equilibrium." The complexity is even greater in multi-cultural, ethnoreligious, plural societies like Sri Lanka. A 'context sensitive lens' is required when climate change brings havoc to the country, particularly when managing disasters and rehabilitating plural communities. Moreover, such sensitivity would be required not only on the part of the state and non-state agencies but also on the part of the donor agencies whose effort must contribute to the social integration and sustainable development and not be the cause of alienation and future conflicts.

The comprehensive nature of the threat arising from energy insecurity and climate change cannot be minimised. As Jayasinghe emphasies, "women living in Sri Lanka, particularly in rural areas are still largely responsible for securing food, water, and energy for daily use. Climate change has induced greater threats to food security, raising large concerns in regards to health and nutritional disorders of women and children." In this context, 'context sensitivity,' one that Thaheer flagged, needs to be matched with 'gender-sensitivity.' Jayasinghe then comes up with a series of recommendations, which ranges from women-sensitive information campaign on the issue of environment to ensuring women's participation at all levels of environment and climate change-related decisions and policies.

A quick solution is certainly not in order, but a quick grasp of the threat is urgently required. This study would deem to have fulfilled its objectives if such realisation comes to impress upon the minds of the readers. I am personally grateful to Dr Peter Hefele and the entire team of the KAS Hong Kong for supporting this study. Let me also take this opportunity to thank Dr Nishchal Pandey, Director, CSAS, Kathmandu, whose constant reminder to complete the study was a source of inspiration, to say the least, and a kind of reminder which made all the difference to the study!

II Post-COP 21 Climate Change Regime and Prospects for Renewable Energy

Avanthi Kalansooriya²

The post-COP 21 climate change regime has been defined by a key milestone in which both Germany ran on almost 100% renewable energy on 16 May 2016 and Portugal ran on renewable energy for four consecutive days in mid-May 2016. This clearly signifies that there has been a change in the manner that nuclear and fossil fuels for the generation of energy are viewed unsustainable and how the energy policies at the domestic level are shaped. This also indicates that post-COP 21 has triggered the beginning of a new climate change regime where depending 100% on renewable energy for power supply has become a new norm. For quite a long time, the developing countries have relied on the rationale of "development first and renewable energy later" in order to emphasise that investing in renewable energy will not be a priority until they reach a firm footing in development. India's policy of coal rush and Sri Lanka's latest instalment of a coal power plant in Norochcholai are some examples of how South Asian countries started stressing the same rationale to shy away from investing in renewable energy.

Table 1 shows that Sri Lanka is gradually becoming highly dependent on coal for power generation which marks a shift from hydro-power to coal power. Due to fluctuations of rainfall and heavy droughts, the country's energy supply was hampered during numerous intervals in the past few years which resulted in infamous power cuts. Coal power was introduced to address this issue, although at the detriment of the environment. Thus, it is high time that Sri Lanka switches into renewable energy, not only in small scale but also in a massive scale in order to reduce the dependence on coal and long term heavy reliance on hydropower. Especially, given that Sri Lanka is a tropical country blessed with the potential for generation of solar power while also owning several areas suitable for generating wind power due its strategic location in the Indian Ocean and also considering the potential of using biomass, it is convenient to make this shift by using these natural resources. In

² Researcher, Regional Centre for Strategic Studies, Colombo/Sri Lanka

addition, the use of biomass and production of energy sources for biomass can be employed as a poverty reduction strategy, especially with a focus of meeting the UN sustainable development goals (SDGs). This paper will assess what prospects are ahead of Sri Lanka in strengthening its renewable energy policy by making large-scale national level investments keeping par within the post-COP21 climate change regime while keeping its development goals intact. It will also look at the challenges that Sri Lanka has to face in terms of making this shift while also providing a series of possible solutions to overcome these challenges.

ENERGY PROFILE OF SRI LANKA

Sri Lanka over the past few years has experienced considerable demand-side pressures for energy. It is believed that the demand for fuel for transport will grow two and a half times by 2020 (75% of the fuel is used for transport). In addition, the demand for power is expected to grow by 5.2% per annum (20% of imported oil is used for power generation).¹² In 2013, oil imports amounted to \$4.3 billion and accounted for 24% of all imports. In 2012, the corresponding figures were \$5 billion and 26% respectively.¹³ This proves that Sri Lanka spends a considerable amount of its GDI on oil and fuel imports. However, the country is not a producer of any sort of oil, gas or coal resources. Thus, this policy has taken a huge toll on its economy.

In contrast, the island receives rain from two monsoonal wind regimes; the Southwest and Northeast monsoons. The high rainfall, coupled with other bioclimatic conditions of the tropics, has yielded a high plant density in the island. Biomass, therefore, is available in plentiful amounts. Since Sri Lanka is located in the equatorial belt, it receives a year round supply of solar radiation. The tropical temperatures and the island's location in the ocean have resulted in distinct wind regimes.¹⁴ Hence, there is an enormous potential for renewable energy generation located within the country.

Since Sri Lanka is endowed with a profile conducive to generate renewable energy, it is crucial to harness renewable energy which can be cost-effective and which could offer one of the best solutions to address the energy crisis. In Sri Lanka, wind, solar power, biomass and hydroelectricity are considered the main renewable energy sources. The energy sector in Sri Lanka can be divided into two components; grid and off-grid power generation. Solar and biomass energy are mainly

used as sources for off-grid power generation. Meanwhile, coal, hydroelectricity, solar and wind powers are extensively used for grid power generation.

Year	Conventional hydrolytic (%)	Maximum from oil (%)	Coal (%)	Minimum from non-conventional renewable energy (%)
1995	94	6	–	–
2000	45	54	–	1
2005	36	61	–	3
2010	42	31	20	7
2015	28	8	54	10

Source: (M/P&E, 2008).

The above table extracted from the website of Sustainable Energy Authority illustrates that coal has not been used as a source for power generation until 2010 and later from 2010–2015, the usage of coal has seen a rapid increase. Meanwhile, the contribution of renewable non-conventional energy has grown very slowly. It contributed only by 10% to the overall energy supply. This shows the mismatch in the energy supply and especially how Sri Lanka's energy crisis has been addressed through a coal rush where the contribution of coal to the overall energy supply remains 20% by 2010 and has hiked up to 54% by 2015. In fact, this sudden rush shows that Sri Lanka has started becoming excessively dependent on coal while the usage of hydroelectricity – which was the backbone of Sri Lanka's power supply – has plummeted from 94% in 1995 to 28% by 2015. Within the span of 20 years, the contribution of hydroelectricity has seen a decrease whilst it has been overtaken by coal. This does not seem to be a cost-effective or a sustainable policy regarding the environmental impact.

WHY RENEWABLE ENERGY?

It is a very pertinent question to ask why we need renewable energy, especially why Sri Lanka needs renewable energy. It is common knowledge that the entire human civilisation has reached a stage of existential threat where global warming is real and that conventional energy sources are the main contributor to cumulative man-made carbon emissions. The Kyoto Protocol, an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC), commits its parties by setting internationally binding emission reduction targets. The protocol affirms that excessive carbon emission is correlated with the global

warming that we are experiencing today, and the major cause for carbon emission is no other than man-made development. The consumption of oil, gas, and other conventional energy sources has increased rapidly in order to meet the energy needs demanded by modern development. However, the Kyoto Protocol recognizes developed countries as key emitters and that they should be held accountable for the issue of global warming. Thus, the developing countries are seen mostly as receivers or the victims of current global warming related issues. Thus, there is a huge concern in developed countries to focus on inventing and supporting clean energy technologies. However, this paper argues that given that most of the resources for generating clean energy are located and concentrated in the so-called developing countries, it is highly relevant for the developing countries to work on developing clean energy sources. This is because in a few years' time, it will be tough to apply the current rationale to developing states since they also focus on extensive economic growth at the expense of the environment. Meanwhile, renewable energy sources will be the most durable and sustainable solution to the environmental crisis we are facing today. Clean energy is well known for its lesser carbon impact which is again common knowledge.

Moreover, for a country like Sri Lanka, it is highly important to harness its renewable energy capacities due to the persistent energy crisis that the country has been facing for a while. During the year 2016, there have been both scheduled and unscheduled power cuts that had negative impacts on the everyday life of the people and particularly on micro enterprises. Thus, it is important to have a sustainable energy policy to overcome these challenges. As highlighted above, Sri Lanka spends a large amount of its budget on importing coal for energy purposes. The table above also exposes that the reliance on coal has grown rapidly and quite unexpectedly over the years. This could be further detrimental to a developing country like Sri Lanka which is in the phase of reaching towards a middle-income country. It is also extremely important for the developing countries to take the energy crisis and the issue global warming more seriously while avoiding the naming and shaming game where the developed world is always placed on the centre stage as culprits. Thus, the paper calls for a more responsible role for all the states in mitigating the environmental impact and encourages in assuming a set of universal principles on developing a renewable energy regime.

WHAT IS A REGIME?

The regime literature defines *regimes* "as principles, norms, rules, and decision-making procedures around which the actor expectations converge in a given issue-area".¹⁵ Principles are beliefs of fact, causation and rectitude. Norms are standards of behaviour defined in terms of rights and obligations. Rules are specific prescriptions and proscriptions for actions. Decision-making procedures are prevailing practices for making and implementing collective choice. The regime theory was introduced to the study of international relations after considering the very anarchical nature of international systems. In a system where there is no central authority to govern and lay down universal laws, regimes have been quite helpful in agreeing on a common set of principles. Ozone regime is one such regime that has made progressive changes. The Montreal Protocol, which establishes principles to phase out CFC emissions in order to avoid further damages to the ozone layer, has been very successful in receiving the support of the states to cut down CFC emissions. This was achieved by a set of common principles, norms sans any international law that makes it mandatory for the countries to oblige by a common law. Thus, regimes seem to be more effective especially in circumstances where the states are highly reluctant to comply with laws. The strenuous negotiation processes on global warming continuously failed to establish any universal law that all countries can agree on. This proves that environmental regulation is becoming extremely difficult on the international level. In such a scenario, it becomes highly important to rely on norms, principles and decision-making procedures that combine into a regime. As a result, the paper argues that a regime-based approach could be used as an effective form of environmental governance. Hence a renewable energy regime for Sri Lanka is proposed.

Furthermore, the paper also intends to look at the global trajectories, especially how the terrain of renewable energy looks like post-COP 21. COP21 was a result of another long struggle to get states to an international negotiation table to discuss climate change. The Intended Nationally Determined Contributions (INDCs) were submitted to the UNFCCC. COP21 brought a renewed interest, discourse and a set of norms on global warming. As a result, there were attempts by several countries to switch to renewable energy. Germany is a classic example. Thus, COP21 has gradually led to a renewal of debate and interest towards mitigating global warming by introducing environmentally friendly policies.

RENEWABLE ENERGY IN SRI LANKAN CONTEXT

Biomass wood coming from home gardens is comprised of a mix, like cashew, mango, tamarind, bael tree, wood apple, Gliricidia, rubber wood, cinnamon wood, saw dust, paddy husk, coconut shells, and process waste to generate biomass energy frequently used in the rural contexts. However, most of these do not contribute to the grid power system. Rather, they are commonly utilised to address everyday small-scale energy issues, and the usage is limited to cooking or for mini industrial needs. Evidently, biomass is not used largely for power generation, transportation, etc. Thus it becomes very important for Sri Lanka to harness this resource in large scale if the country is thinking of a potential renewable energy. However, pinpointing towards the challenges, a report highlights that

"under these circumstances, a highly competitive market would prevail in future for biomass resources. High competition for biomass could be threatening due that the supplier (vendor) chain of biomass is highly informal. Thus illegal tree felling might also take place. Supply of biomass did not raise considerable issues some time ago, even with informal supply chains. Gradually, with the increase in demand by the industries, doubts have occurred whether the supply and demand is having a mismatch with each other now or in recent future."¹⁶

Biomass generation, even though it looks like there is much potential for it in an agrarian country like Sri Lanka, also poses considerable challenges in terms of mitigating the environmental cost. If the country wants to use it in large scale, it needs to explore ways of mitigating the environmental cost as well.

Looking at Sri Lanka's energy profile, it is obvious it has a lot of potential for the generation of renewable energy. However, at the same time, it is faced with certain challenges. In order to identify these challenges, a study on the institutional and policy landscape on renewable energy was conducted with a special focus on the role of Sustainable Energy Authority (SEA) which is the only government body established to look into the issue of sustainable energy production in Sri Lanka. The challenges that Sri Lanka faces at the moment in terms of switching to sustainable energy were identified and will be elaborated on below.

CHALLENGES BE POTENTIALS?

One of the major challenges that Sri Lanka grapples with is a lack of grid capacity to absorb the energy generated through renewable energy sources. The grid technology has not been upgraded for a long time to absorb higher and inflated capacities. Although there is potential to generate renewable energy, the grids are not in a capacity to accept them. According to the interview, more than the generation of renewable energy, grid capacity is a major issue in Sri Lanka. In particular if the grid does not accept energy generated through renewable energy, it could go to waste or count as an excess that would not make a difference regarding the goal of tackling the energy needs. Apparently, the government of Sri Lanka is negotiating with the Indian government to see whether the Sri Lankan grid could be connected to the Indian grid system so that there will be more capacity. Thus, upgrading the existing grid technology to absorb renewables remains a major concern and a priority for Sri Lanka.

Moreover, in terms of the organisational structure of the Sustainable Energy Authority, it has been authorised only to screen the proposals submitted by the private sector to implement renewable energy projects. The Authority itself does not proactively engage in implementing projects or exploring avenues for renewable energy development. It functions more as a screening agency with less authority. During the interview, it was revealed that SEA is quite under-funded in comparison to their counterpart Central Electricity Board (CEB). CEB is the main agency in Sri Lanka mandated with production and distribution of energy. As pointed out before, CEB heavily relied on hydropower for energy generation which was later overtaken by coal power as highlighted in the graph above. Thus, SEA has a weak mandate in comparison to its CEB counterpart. Especially, the engineers at SEA do not directly engage with developing models for renewable energy generation. It also remains understaffed to expand its mandate. However, it is crucial to make SEA a more powerful authority and develop a mechanism where both CEB and SEA could work together in solving the energy crisis in the country and using renewable energy for power generation.

It was also revealed that as the above-mentioned report rightly points out, the bids that were submitted for using biomass for energy production have failed to meet the environmental standards set by the SEA. Especially most of these projects focus on using the existing natural resources such as wood and other natural material used for biomass energy generation, but the projects fail to explain as

to how the regeneration of these natural resources would take place. This could have a detrimental impact on the natural resources such as trees. The sustainability of these projects is in question. Thus, SEA finds it difficult to approve many of these projects. SEA is, however, positive about harnessing the wind energy predominantly in the coastal areas of Sri Lanka, and wind is the largest contributor amongst all renewable energy options available for Sri Lanka. Solar still lags behind in contributing to the main grid system. The biggest challenge faced in terms of utilising solar power is the issue of storage. Although solar could be used during the daytime, storing it for night time usage is a big challenge.

It was also evident that there is a lot of potential for the private sector to invest in harnessing renewable energy opportunities in Sri Lanka. The involvement of foreign investors remains very low, but if tapped, it can make a lucrative investment opportunity. The SEA is also planning to work on public-private partnerships where SEA and private investors can collaborate on renewable energy development projects. It is notable that Sri Lanka established SEA very recently and its mandate is limited in multitude ways. As a result, the paper affirms that Sri Lanka has made some progressive strides in switching to renewable energy given it is a country challenged with lack of technological capacity and expertise to explore models of renewable energy. Lack of technological capacity to upgrade the grids is one of the biggest problems ahead.

Another major issue at hand is to find a source that could provide energy on a continuing basis to function the grids. Even though renewable energy could be generated on and off, there should be a key and continual source that helps the grids keeping functioning. To this end, they still have to rely either on hydro or coal power since they are more established energy sources. Developing renewable energy that is capable of providing energy consistently to be able to function grids is another huge challenge ahead of Sri Lanka.

Taking these challenges that Sri Lanka faces in terms of shifting towards renewable energy, the paper also takes note of the fact that it only looked at the role of renewable energy in power sector. Especially the need for energy for transportation was not taken into account. The paper mainly revolved around the energy crisis in the country with a focus on the global trends in shifting to renewable energy and how such trends could be replicated in the local context. Given we are at the threshold of a new phase, the Post-Kyoto phase shifting to renewable energy lies at the

heart of solving climate change issues. Renewable energy is highly instrumental in changing the current status quo of climate change related tragedies we are faced with. However, combined with several other factors such as biodiversity conservation, regeneration of vegetation and phasing down of other forms of detrimental elements that cause global warming, this could be achieved.

CAN WE REACH A RENEWABLE ENERGY REGIME?

The paper overall argues that given the rapid increase in the usage of coal power in energy generation, it is crucial for the developing countries as well to follow a renewable energy policy. The Kyoto protocol that prescribes developed countries to follow more environmentally sustainable energy policies, to a certain extent excludes the developing countries from the responsibility of working towards a common goal of reducing carbon emissions. Most of the developing countries have taken this as an opportunity for them to forward an agenda which basically assumes climate change goals could be achieved once the development goals are reached. This discourse is highly detrimental to the environment. Thus, the paper does not necessarily mean to forward a very polemic rhetoric, but it argues that this dichotomous developing-developed discourse about renewable energy needs to be revised and revisited.

Against this backdrop, the easiest pathway to achieve renewable energy goals would be focusing on norms, principles and decision-making procedures that could eventually lead to a solid regime. Given that laws are always received in a confrontational manner and difficult to implement, it is important to find soft forms such as norms and principles that could be more effective and efficient. Keeping the discourse on renewable energy alive, investing further in research and introducing key best practices could help in establishing renewable energy norms. This reiterates that soft forms of governance such as norms can have a penetrating impact amongst policy makers and citizens alike. For instance, the global landscape has seen progressive changes due to the norms that have been established over time through UN conferences, epistemic communities and scientific knowledge. Especially, the European Countries adopted renewable energy policies not through pressure mounted against them by the international community, but through softer forms such as the norms established by Kyoto protocol, UNFCCC and other inter-

national multilateral conferences. To address the key issue of renewable energy, regime building could be seen as a more effective strategy.

The paper establishes that for countries such as Sri Lanka thriving towards being a middle-income country, it is critical not to dump renewable energy priorities in its attempt to achieve greater heights of development. Development that can stand on par with environmental policies simultaneously helps in saving a great amount of income spent on fossil fuels and the alleged environmental cost accompanied with high consumption of fossil fuels. To enable these changes, there is an explicit need to build regimes consisting of norms and principles that lead to some soft form of governance and become part of a common discourse, policy and practice. The establishment of SEA is one example of achieving such a regime. It needs to be strengthened through penetrating renewable energy norms further into policy, practice and epistemic knowledge until it becomes a stable and solid set of norms and principles. The national level regimes should also replicate the global trends to reach a common regime. Hence it is not necessary for the developing countries to wait; they can also start building their own renewable energy regimes. Especially when there is enormous potential, the waiting will not help much.

RECOMMENDATIONS

The paper further posits that there is a plenty of potential for Sri Lanka to make a difference in renewable energy front. Nationally, it is important to invest in strengthening the Sustainable Energy Authority to a fully-fledged government institution that works on developing, innovating, and experimenting on renewable energy potentials for Sri Lanka by going beyond a limited mandate that authorises SEA only to fulfil the role of a screening agency. It is also important to invest on more projects such as Soorya Bala Sangramaya. A nationwide solar project that aims at building solar systems in household level should be implemented. Sri Lanka is currently engaged in harnessing renewable energy via public-private partnership which is commendable. There is an enormous potential for the private sector to invest in Sri Lanka since energy supply is a lucrative business and could be used as a corporate social responsibility initiative. Meanwhile, there is a lot of potential for the think tanks, epistemic community and the civil society in generating more knowledge on renewable energy issues. The issue has to be addressed both through social and natural sciences perspectives in order to capture the dynamics

of enhancing renewable energy. Particularly, it is crucial to contribute to a national and a regional discourse on why to implement renewable energy for developing countries and train them also to take a more responsible role. The victimisation debate that comes from the developing world would not be much helpful in establishing an emission-free developing world. The civil society, think tanks, and the epistemic communities have a role to play in establishing a sound discourse on this matter through knowledge production, awareness programmes and inter-regional knowledge sharing exercises. It is important to start on a small scale and focus on regime building where informal rules, regulations and discourses are built on renewable energy for the developing world which should further be reflected in the global climate change debate as well. Thus, this will lead to establishing a more meaningful Post-COP21 phase where both the developed and the developing countries commit to climate change obligations.

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III Disaster Management *sans* Conflict Sensitivity: A Recipe for Disaster

Minna Thaheer³

The absence of effective communication among the three pivotal parties involved – the scientists, policy makers and public – is the principal chokepoint in evolving conflict-sensitive policies in responding to natural disasters caused by climate change. Framing policies to alleviate climate change and disaster management at the level of policy-making is carried out in consultation with scientists who identify issues and remedies. The administrators frame the required policy/rules of implementation and the politicians determine priorities in implementation and persuading the public. Guidelines for climate communication are more or less universally known and agreed upon. However, the problems are mostly in implementation and in persuading the populace to recognise the imperatives of adopting sustainable behavioural patterns. Climate science progress has a correlation to the development of a climate communication science.

A situation of human misery, deprivation and threat to human security due to natural hazards that overwhelms the local capacity of governance agencies to respond effectively constitutes a natural disaster. Usually, it is the poor and the marginalised that bear the brunt of these disasters caused by climate effects, which can also be attributed to causes created by other human agency. Variability of climate and natural hazards impact the daily rhythm of life, which determines social cohesion, social order and social equilibrium. In multicultural, plural societies, existing ethnoreligious cleavages can be subject to sudden and furiously forceful pressures.

Plural communities learning to reconcile with new socio-political challenges in post-conflict contexts, can well retreat into doubt and discomfort when unable to cope with new situations precipitated by unanticipated disorder due to natural disas-

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ters such as floods and earth slips that affect the habitat. Equity, entitlement and economic security are primordial essentials that frame human conflict. This paper is an attempt to define and explain the experiences of Sri Lanka as a country that suffered geological and hydro-meteorological disasters in the context of a recently resolved civil war.

The intent of this paper is to advocate the adoption and reliance on context sensitive lenses in disaster management and rehabilitation of many communities which would be motivated to be guided by values of respect, acceptance and solidarity. Linking or delinking memories with future vision should be recognised as the primary task of humanitarian and development interventions following disasters natural or human-made, periodic or sudden. It is vital that state and non-state agencies ensure equitable non-discriminatory policies that are implemented in projects that focus on sharing of renewable and non-renewable resources.

HUMAN SECURITY DIMENSIONS IN DISASTER CONTEXTS

Human security in its contextual core identifies and defines the capacity of a person or a community to claim access to opportunity. The physical environment is a pivotal factor in determining who, how and why opportunity is accessed. Variability of the environment is caused even by development initiatives such as deforestation, river diversion, land reclamation and road construction. They have unintended consequences on human security by impacting living conditions. Altered ecosystems, too much or too little water and new roads can alter living conditions. They change economic conditions of different segments in different ways. While some benefit, others feel aggrieved. In pluralistic societies such as in Sri Lanka, these occurrences have had their share. As regards internal human security dimension in this paper, what is examined are the ability and the state of preparedness of the state to respond to natural disasters.

The website of the Ministry of Disaster Management informs about the varied mechanisms in place for this specific purpose of activating the first responders and the subsequent and sustained efforts to reach and restore normalcy.¹⁷ The landslide that occurred on 15th May 2016 in Aranayaka, in the Kegalle District of Sri Lanka had taken 144 lives, with 96 reported missing and several hundred rendered

destitute with their homes and belongings buried in the avalanche. The Ministry's website explains how its central agency – the Disaster Management Centre together with the International Water Management Institute (IWMI) – activated Sentinel Asia and International Charter on Space on the same day of the disaster, 15th May 2016 and obtained satellite images of affected areas. They had also accessed satellite data services from Japan, India, Germany, Canada, Thailand and the European Union to get additional information about the disaster. However, it provides insufficient information on the Ministry's expertise, ability and systems to anticipate, alert and prevent such calamitous events.

The Ministry has a dedicated arm – The Training, Education and Public Awareness Division – which "provides training and public awareness for relevant government agencies, departments and other stakeholders including community groups in Sri Lanka." According to the Ministry's website, the training is targeted at a variety of stakeholders and institutions to carry out the following purposes:

- "Strategic thinking and planning for implementing programmes for the Division keeping in line with corporate plan and the Road Map
- Promote and increase public awareness on Disaster Management (DM) and Disaster Risk Reduction (DRR) among school children, academic institutes, government officials, general public, Non-Government Organisations/ International Non-Government Organisation community
- Promote awareness and train university graduates through integration of DRR in university curriculum; Promote awareness on DM/DRR among professional group, key decision makers through training and short courses
- Increase capacity among key institutions through training of officials and training aids/tools; Integrate DM training curriculum in continuing education."¹⁸

One could reasonably raise the question why then does the state invariably appear almost always to have not adequately been prepared for immediate and successful interventions? There is a call for a constant state-centric focus on preparedness for averting disasters and to respond to disasters when they occur.

The State has the monopoly of resources to know when and where cyclical climatic adversarial effects take form. The state is also intimately familiar with location and dimensions of poverty-stricken and vulnerable communities. Why does the govern-

ment, which has an overarching access to both geography and economics of disasters appear to be unreliable in public mind for its preparedness? The staff are either not skilled enough for the task assigned or there is negligence, indifference or incompetence. The recent report of equipment needed to cope and counter natural disasters, has been rendered as unfit for use due to neglect and inadequate storage facilities. The equipment included tsunami warning towers, mobile emergency call centres and satellite communications systems. The report cites "in last month's [May 2016] worst-ever floods and landslides, the use of this equipment together with others would have been invaluable for early warning, prevention or rescue work."¹⁹

"As per the administrative level coordination is concerned, closer governmental inter-agencies' networking is a must in disaster management," says DIG of Police M H Marso, Special Branch Range, Sri Lanka²⁰. According to him, both identifying the local areas that are disaster-prone where each police station is located and disseminating information on contingency plans to the public are essential functions and services that are often overlooked. The armed forces, the Divisional Secretariat offices, the directly related authorities such as the railways, geological department, health sector authorities (especially the hospitals) must coordinate their activities in this regard. "The Central Environment Authority must also take a major share of the responsibility when issuing licenses for various activities that in the long run impact on environmental degradation because most natural disasters are man-made that can be prevented. They ought to do viable studies on the feasibility of any activity pertaining to the environment. The police can do little eventually by only taking action for public nuisance, but the damage is done by then. Some do harmful activities to the environment legally and some others illegally. Illicit mining, timber felling, sand mining, etc are examples for this,"²¹ says Marso. Agencies such as Forest, Geological, Wildlife Departments as well as Gem and Jewellery and National Environmental Authority are some of the governmental organisations that can be cautious to take first preventive actions before a disaster strikes, he emphasised.

In addition to persistent ill-preparedness, there are also sporadic complaints of state intervention in humanitarian relief work in areas of ethnic minorities. A complaint by a relief worker during the landslide disaster in the hill country last year is an example. The intervention by the Ministry of Disaster Management came at such a slow pace that the sense of abandonment of the affected people by the state was deeply etched in the mindset of the victims. It is generally said that they should

not only practice but also appear to practice them in some cases as perception is nine-tenths of belief for anguished minds recovering from the trauma of disaster. According to the relief worker, the clear and dominant apprehension was that the belated lukewarm response stated that a large number of the affected people were the upcountry Tamils. Their plight was therefore local in content and impact. The rest of the nation remained curious but not sufficiently concerned and the issue was not sufficiently political in the larger context of the Ministry of Disaster Management and the rest of the country. There was little effective media coverage as well. This suggests that the Ministry of Disaster Management in particular should upgrade its human resources and services in a manner that they react with greater sensitivity to disasters irrespective of scale, community and public awareness of the event. The greatest human tragedy in the age of electronic media is the tendency to classify human tragedy in terms of viewer ratings on mass media. This is precisely why there is a need for the Ministry of Disaster Management to adopt conflict-sensitive methods of interventions²² when dealing with an incident in which multi-ethnic communities are affected.

In comparison to agencies of the state, the NGO sector is better organised in the coordination of activities in responding to disasters. Their preparedness at all levels starting at the first phase as first responders is relatively superior to that of the state. They are equipped with sound coping strategies/policies both at state and non-state levels speaking of the humanitarian emergency-response-mechanisms and best practices that have been pooled together from a civil society point of view. Jeevan Thiagarajah, Executive Director, Consortium for Humanitarian Agencies says that there is no clear-cut answer to whether there is a coordinated effort towards humanitarian interventions in the aftermath of natural disasters. Sri Lanka has a long experience of disasters. "Although we are now free from the man-made disasters, the natural disasters are continuing to kick in. The third dimension of disaster is poverty, which is hardly addressed, but is perpetuated,"²³ says Thiagarajah.

He points out that there is a vast reservoir of resources, in the form of experienced people in the country to carry out disaster management work. These resources are not tapped and are not accessible. "Our governance structures of District Secretariats, Provincial Councils and the Ministry of Disaster Management are well-layered government structures to carry out the required interventions in the country. However, they cannot cope with the protracted displacements that remain to be the

most irking problem that those affected by natural disaster are facing," he said.²⁴ In any humanitarian crisis, keeping people in temporary shelters for periods longer than absolutely necessary, where shelter in a protected and managed environment is a life and death imperative, should be discouraged. Mr Thiagarajah says that in such instances, the need to keep up SPHERE²⁵ standards (one of the most widely known and internationally recognised sets of common principles and universal minimum standards in life-saving areas of humanitarian response) becomes imperative. It then becomes also important for those affected living in longer-term internment camps to be given basic requirements. Where health standards are concerned under SPHERE, it is relatively well ahead of performance in meeting standards and best practices, far above other sectors in Sri Lanka. According to SPHERE standards, the minimum living space for a house/family is a minimum of 500sq feet. "But such SPHERE standards are hardly met with. Most of the times, Principles of equity of aid and distribution are hardly met,' says Thiagarajah.

During the war and its aftermath, there was a semblance of the standards being met and a general awareness of these requirements among the aid/humanitarian community given the civil society's awareness-raising over such concerns. Things are different now. The post-tsunami coordination was the best period in mainstreaming consciousness that was later dissipated. Thiagarajah says that converting principles to standards is a need that needs to be worked on collectively. In situations like this, the poorest get hit the hardest as they already suffer another form of natural disaster – poverty. "No such standards apply in the slums where people experience poor SPHERE conditions. In the case of the worse ever floods in Colombo of May–June 2016, the poor who were already living in the suburban surroundings of the Kelaniya river were worse hit by the floods," he said. When the response to aid gets ethnicized, it leads to a varied set of other problems in a plural community such as in Sri Lanka. Civic response was at its height this time, but the process at times tended to be ethnicized.

According to him, the assistance and help from civil society funding sources were infinitely larger than from official funding sources. It was a mistake to streamline funding through NGO heads and the UN. After the tsunami, there was a tendency to channel and mainstream sources of financing. The dilemma one faces here is that, while there remains a need to allow the many funding sources to come in with aid, there was a lack of knowledge on equitable process, best practices and 'Do No Harm' principles. Thiagarajahh says, "in such instances, some level of coordination

and a supervisory role is required to be played by the state and this coordination must not lead to unnecessary conflicts.”²⁶

It is a heartening experience to learn about formal structures put in place by the corporate sector in the form of disaster preparedness mechanisms that could be activated in a systematic and accountable procedure when a natural disaster occurs. Sri Lanka got a sense of the corporate sector’s prompt responses during the period between the tsunami of 2004 to the flood of May 2016. The Maharaja Organisation that controls Sirasa and Shakthi TV channels emerged as a pioneering corporate entity that galvanised public response, support, involvement in disaster relief while ensuring the highest standards of delivery relief to the victims. Following their lead, many private companies have adopted best practices in distributing aid on an equitable basis. The assistance provided as part of their corporate social responsibility mechanisms is now institutionalised. It is a commendable development in terms of their outreach that reaches the most remote of areas on a non-discriminatory basis.

The next level of concern that irks post-disaster sustainable development based assistance is about ensuring social safeguards for communities resettling and rebuilding after a disaster. To ensure sustainable development, there is a need to ensure that aid and development assistance given at times of crisis especially from international donor agencies are streamlined and implemented after a feasibility study of the contexts that they are intervening. Aid agencies that come in with good intentions ought to ensure that they do not directly or indirectly aid and abet the local conflicts and negatively impact upon development making them further vulnerable to conflicts where they exist. This is a common ill that many communities worldwide have witnessed in the post-disaster sites where aid interventions make communities vulnerable to conflict or violent conflicts over unplanned resource allocations they make – in most cases unintentionally, favouring one group/community over another or making ill-informed interventions sans consultations, which will be discussed next.

UNINTENDED CONSEQUENCES OF INTERVENTIONS

This section of the paper is focused on the need for conflict-sensitive alertness in distribution of resource and prudence in interventions in multi-ethnic communities. It is important to ensure equality and non-discriminatory humanitarian assistance. Equitable disbursement of financial and material aid is a sine qua non in proper humanitarian assistance situations.

Many studies have been made on the socio-political dynamics that directly impacted on natural hazards and how interventions have deepened existing local inter- and intra- community cleavages. This nexus is particularly evident in multicultural communities. In Sri Lanka, the tsunami of December 2004 has much anecdotal evidence that points to consequences of the absence of disaster preparedness mechanisms. They also narrate how it spawned new conflicts, new challenges as never before. Conflict sensitive interventions, especially in the provision of relief and allocating resources are as important for non-government agencies as for state mechanisms.

In the aftermath of the 2004 tsunami, many alleged that several unregistered/ unknown groups entered the country with aid and did more harm than good in the long run. There are allegations of neo-Christian evangelical groups seeking to set up their proselytising missions and promoting unethical conversation with inducements of financial aid and housing assistance. Many Islamic sectarian groups are also known to have brought in aid and established new mosques, preaching a puritanical version of the religion and engaging in proselytising practices in the South of the country, especially in Galle. The latter groups, according to a Muslim schoolteacher, caused many sectarian rifts and intra-community violence among Muslims which had not experienced such religious based intra-communal social turmoil before the tsunami.

"The 'post-tsunami mosques' are the cause for a lot of the ills in our community where sectarian conflicts and avoidance of one another's mosques and funeral rites have become commonplace"²⁷. Each aid group brought in their own Islamic version/ school of practices from Saudi Arabia to South Africa, patronised by the loyal locals who later turned out to be a steadfast and ardent loyalist of the mosque that aided them during the tsunami. They decry the others as 'non-Islamic' and establish, protect and promote their puritanical versions over old practices and rituals of the

Muslim communities. "They even fight over the practice of giving alms (*roti*) on the holy night of Bharat before the commencement of the fast in the Muslims' holy month of Ramazan. This is an age-old practice that our Muslim communities carried out with full of passion and sacredness. The new 'tsunami mosques' denounce this practice saying it is nothing religious and that this must stop. However, we would love to keep these old practices alive as these are our much relished cultural practices,"²⁸ says another male Muslim schoolteacher who believes that those affected communities who received humanitarian aid have now become the custodians of the religion rendering new interpretations to it.

According to these women, the root cause for the social dislocation is the unequal distribution of aid that empowered some over the others. Such unchecked aid that came in shrouded in the name of tsunami relief succeeded in empowering one sectarian mosque over others. It has caused much damage to the social fabric of a peaceful community now facing intra-community rifts among Muslims.

A similar series of allegations were made against some Christian evangelical groups. They had distributed aid only among selected members of affected communities who were likely to convert and those already converted. The inequitable aid distribution by one Christian mission reached such high proportions that it created a massive upheaval in villages in the South. People marched against the new religious intruders. A former tsunami aid-worker recounted how a missionary working in his area discriminated against those who did not subscribe to his faith in distributing aid. "They gave a copy of the bible and the *bath* packet (rice packet) to a selected few who were willing to convert as against those who were resilient to such practices. These people even got houses and all facilities over their neighbours who lived in the IDP (internally displaced person) camps side by side with them."²⁹

Some aid workers given the task of distributing resources were also indifferent to the social structure and geographic imperatives of certain communities. Other communities had historically located their homes in places that were intrinsically linked to their livelihoods.

Sri Lanka offers an example of how indifferent planning that pays little attention to the inherent needs of people can create problems. We have witnessed cases where post-tsunami houses constructed for fishermen were built in the interior. The shift was dictated by a rule which stipulated a 100-meter tsunami-protection zone.

Fishermen who went out to sea at night found it impractical to stay far away from the ocean. Good intentions turned sour with fishermen abandoning the newly built houses. There were instances of insensitive interventions. One fisherman ended up owning more than one boat and more nets than needed. Poor assessment of requirements and clumsy interventions were rampant.

Insensitive distribution of aid and less than perfect protective measures led to another blatant oversight – the old IDPs who were displaced during the years of armed conflict and who continued to languish in their makeshift homes in locations far removed from their original homesteads were neglected while the focus was on the newly displaced tsunami victims. They lived side by side in the same camp sites. In many cases, in the North and the East, new IDPs displaced by the tsunami got preferential treatment and aid over those who suffered the tsunami of military conflict. The water displaced were in focus; the war displaced were not.

CONFLICT-SENSITIVE INTERVENTIONS

Conflict-sensitive approaches should include the following: Process of allocating land, house or any other assistance tangible or intangible must be devoid of any form of filtering on the basis of ethnicity, religion, caste, gender, language, disability perceived or real and reasons for displacement. Durable solutions and non-discrimination must be practised when rendering humanitarian assistance, and livelihood support. The principle of equity must be embedded in state action to ensure the right to work, acquisition of land, restoration of property and distribution of dividends of sustained growth. There should also be systemic protection in place to prevent illegal land grab by individuals and public agencies including the three armed forces. There is also need to be conscious of the needs of vulnerable groups and especially women (and female headed households), disabled persons and the elderly. Measures to intervene must always factor in their special needs in planning. Provision of sanitary pads in shelters, toilets, safe drinking water and other living needs must be made in a gender sensitive manner.

In a village in the east, toilets and wells for post-tsunami resettling communities were constructed away from their homes. The women of the community were not consulted. Given the topography of the cleared shrub jungle and the general lack of security, it was poor judgment. The women – especially the pregnant ones – found

it difficult to reach the toilets from dusk to dawn. When governments and NGOs disburse aid, the single overarching prerequisite must be equity that is demonstratively transparent. It can be achieved by simple initiatives such as sustained awareness-raising programmes in the media and at institutional level on 'Do No Harm Measures' by Mary Anderson.

This is especially important in communities where there are ethnoreligious tensions. Towards this end, lead Ministry and agencies working on relief should maintain a basic checklist of Do No Harm measures on hand with a checklist for quick reflection. Since the tsunami of 2004, Sri Lanka has experienced flash floods frequently plus landslides and cyclones. Reflections after these traumatic events show that the much-hyped codes of conduct and protocols of emergency responses have had no satisfactory impact. A former senior advisor to German GTZ (now part of GIZ), Dr Stephanie Schell Faucon, was quoted saying "No lesson has been learned ... codes of conduct are difficult to apply and what we have is not good enough," (Bauman, Ayalew, et al.:16). Many reports suggest that the design and implementation of aid, especially in conflict situations and pluralistic societies, need to improve. The report by Bauman, Ayalew maintains, "only a few actors in state institutions, INGOs and UN agencies have received sufficient training in DNH principles and similar approaches that can help to serve connectors instead of enhancing dividers." (Bauman, Ayalew et al.:16). This is a serious concern that the humanitarian and development community, especially the Sri Lankan government authorities dealing with humanitarian relief and development work, must take note of in their future interventions.

CONCLUSION

This paper is an effort to create awareness of the importance of disaster preparedness at state and non-state levels. It also advocates the use of context sensitive lenses in looking at disaster management, especially in aid distribution. It seeks to examine the best practices in rebuilding plural communities torn asunder by natural calamities. It explores effective paths towards sustainable solutions to problems caused by natural disasters while addressing human security dimensions of disaster management. It presupposes the demonstrated wisdom that disaster is a field ripe to receive the seeds of divisive destruction unless furrowed assiduously by caring hands to make it fertile for human dignity to flourish.

The paper emphasises the need for donor agencies to make informed interventions through consultations with national and local community-based organisations (CBOs) and civil-society organisations (CSOs) respectively especially on occasions that call for post-disaster aid interventions. It also stresses the need for conflict sensitivity through conflict analyses and conflict mapping exercises. Furthermore, the paper stresses aid interventions ensuring gender sensitivity in development planning and assistance. The paper recommends building on CSO-community relations to ensure social integration and sustainable development when aiding to rebuild post-disaster communities. Most of all, the paper advocates that Mary Anderson's Do No Harm- Principles should be followed when aid interventions are made in conflict-prone communities.

This paper has taken note of past errors. It has attempted to assess the negative impact of selective aid offered to plural societies that had unintended consequences of deepening wounds that would have otherwise healed with the benevolence of nature that is neutral. It is human intervention that is partial. The understanding and awareness among practitioners and institutions dealing with disaster management, humanitarian aid and relief work must, therefore, be examined not by declared good intentions but by the good that is delivered.

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IV When Mother Nature Marks Women: The Gendered Implications of Climate Change

Rasika Sumudhu Jayasinghe⁴

Over the past few years, climate change has, more significantly than ever, had tremendous and far-reaching implications around the world. More specifically, in Sri Lanka, which recently concluded a three decades long war, the populace now finds itself vulnerable to newer and more unpredictable forces, in particular dramatic environmental concerns. Climate change in Sri Lanka is expected to lead to a rise in sea level, higher temperatures, more frequent and prolonged droughts, high-intensity rainfalls and increased thunder activity. As a predominantly agrarian nation, this has massive implications on Sri Lanka's crop yields and economy, while natural disasters such as inundations, flooding, storm damage, and coastal erosion all will adversely affect human settlements, livelihoods and health. It is further undeniable that climate change has the greatest impact on people living in vulnerable areas, which often includes the poor and marginalised communities. The women and people of Asia are also currently at greatest risk with over 100 million people affected in this region annually (Nelleman et al. 2011). This paper thus aims to look at the gendered implications of climate change in Sri Lanka, recognising women as one of the most vulnerable communities in Sri Lanka.

Gender has been a key component of development policy, globally, since at least the 1970s, with the institutionalisation of 'women in development' (WID) theories. Thereafter, theories have continued to evolve. However there has been a significant lack of practice to match the rhetoric (Nelson et al., 2002). Therefore, a topic like climate change, which has continued to gain little attention until recently worldwide, has gained even less recognition in terms of the specific gender dimensions climate change holds. To an extent, this can be attributed to the lesser voice women have in policy and decision making, along with the strong correlation between poverty, vulnerability and disaster risks.

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Sri Lanka is unique in the fact that it has been hit by both geographical and hydro-meteorological disasters. Sri Lanka has traditionally been divided into two climatic zones: a wet zone in the southwestern region including the central hill country, and a dry zone covering predominantly northern and eastern parts of the country, being separated by an intermediate zone. Thus these two main zones are periodically affected by different concerns, including floods/landslides and droughts. The 2005 tsunami meanwhile affected both the Southern and North-Eastern coastlines. The geopolitical and socioeconomic conditions of these regions have vast differences, the North-East having been markedly affected by the war. Therefore, in addition to exploring the general implications climate change has had on women in Sri Lanka, this paper will work to provide a comparison that reflects the nuances of the various types of women in Sri Lanka: whether they are adversely impacted due to resource inequalities stemming from the war and/or due to general economic-impoverishment. Furthermore, it will analyse policies which have been in place towards mitigating and adapting the effects of climate change, with particular focus on gender-sensitivity, in order to highlight and provide policy recommendations which should be mainstreamed into addressing Sri Lanka's climate change threats and vulnerabilities in a gender sensitive manner.

BACKGROUND

The 2014 publication "The Sri Lankan Women", published by the Department of Census and Statistics, indicated that the population of women in Sri Lanka in 2012 was 10,463,000 and comprised 51.6% of Sri Lanka's total population. With over half of Sri Lanka's population being women, the ramifications climate change poses to this group of the populace can be immense.

Particularly, given Sri Lanka's geographic composition, which is made up of different climatic conditions, the phenomenon of climate change can be seen to impact women in a series of different ways. The wetter Southern region is likely to see an increase in the Southwest Monsoon rainfall, while the drier Northern part of the country is likely to experience a decrease in Northeast Monsoon precipitations. The dry zone of Sri Lanka includes Puttalam, Anuradhapura, Trincomalee and Hambantota, amongst smaller districts. Meanwhile, the wet zone includes Galle, Ratnapura, Nuwara Eliya and Kandy, along with other fringe districts. Based on the above district calculations, the dry zone comprises of approximately 1,329,610 women (sex ratio

of 95.1), while the wet zone comprises of approximately 2,191,860 women (sex ratio of 92.7) in 2012 (Department of Census and Statistics, 2014). These figures, of course, are based on a district basis, which are man-made delineations, and therefore do not completely portray the demarcations of this natural cycle which vacillate between the dry and wet zones. Overall over 90 percent of male household heads are reported to be married whereas the corresponding percentage for women household heads is over 50 percent. In contrast, 40.4 percent of the women are widowed, divorced or separated, while in the case of male heads only 2.5 percent are found in that case. This indicates that women headed households are more likely to lack a support system or partner to help mitigate the effects of climate change on the female. Proportionately, widowed, divorced and separated status are higher among rural women. Nonetheless, it is apparent that the sex ratios for both zones are particularly high, and with ratios well in the 1990s, almost 50% of both zones are occupied by women.

The dry zone further overlaps with many of the districts which were affected by the war. Extensions of the dry zone, including Mullaitivu, Vavuniya and Potuvil, which were heavily affected by the war, have in the past few years recorded a notable decreasing rainfall trend (Manawadu, 2008). The constituents of these areas, therefore, in addition to facing rapidly changing climatic conditions, have also faced losses in terms of family members; economic assets, including land; livelihood opportunities; other challenges such as disability and displacement. Moreover, the end of the war rendered scores of women as heads of household, throwing them into new roles within and outside the private domain. Women therefore when facing the new challenges extended by climate change are all the more likely to face a triple burden, by juggling the household, making a livelihood, and overcoming the multiple climate-induced concerns they may be faced with. Furthermore, many of these women, seven years after the war, are still dealing with realigning their lives, after having spent a large portion of time in internally displaced camps, and/or having been resettled in new homes and unfamiliar settings (Fonseka, 2010). Displacement often comes with the added issue of disrupted social networks, both in terms of household as well as emotional support, leaving many of these women further marginalised. In the face of extreme drought and other adverse climatic conditions, these already fragile networks, therefore, are even more vulnerable to disruption. Additionally, loss of limbs and other kinds of disabilities and trauma have considerably disrupted the ability of many women to maintain livelihoods. Many of these women suffer from multiple of these conflict-induced challenges, and when

faced with both disability and their role as heads of the household, performing basic functions and duties become all the more strenuous and challenging.

During the previous regime, growing militarisation of the region additionally compromised women's security and mobility (de Mel, 2007), adding to their socio-economic vulnerability. While today, military presence in the North and East is reduced, it is important to factor in the (in)security of women in these regions where a conflict mindset remains and sexual harassment is rampant, particularly in the light of impending natural disasters. Furthermore, widows find themselves more prone to suspicion, harassment and judgement by society, particularly when residing without the protection of their extended family. In conflict-ridden countries such as Sri Lanka, women traditionally live with their husbands and their respective families, and rendered heads of household have found themselves further stigmatised, unable to lay claim to land ownership, and made vulnerable in the face of land acquisition, in instances where their husbands have died or disappeared. This can be further compounded in the light of disasters, and often women may find themselves unwelcome in their in-laws home after the passing of their husband.

On the one hand, the Wet Zone, or the Southwestern region, is more prone to floods and inundations. The Southern Province, on the other hand, was relatively more stable regarding conflict-induced barriers and has in the recent past been the site of heavy investments in infrastructure, including the building of a new airport, a new port and several new highways. Rural communities in the South, however, do also remain resource-impoveryed and visibly impacted by climate-reliant vocations such as agrarian-heavy activity. Concerns have further arisen in Sri Lanka, regarding a lack of attention to gender and cultural sensitivity in design and implementation; increased aggression and domestic violence; lack of control over the finances women receive; and the exploitative practices adopted by microfinance lenders; including intimidation and sexual harassment when collecting payments (Dissanayake, 2012).

Women living in Sri Lanka, particularly in rural areas are still largely responsible for securing food, water and energy for daily use. Climate change has induced greater threats to food security, raising large concerns in regards to health and nutritional disorders of women and children. Similarly, caught between poverty and environmental destruction, these women need to travel long distances to access clean sources of water, particularly during the frequent droughts of the dry zones.

In addition to the daily responsibilities which women take on, including cooking and raising children, this adds a double burden on women in these areas. Strikingly, these women are often unable to earn incomes on their own; contributing a larger portion of their time to combatting both ingrained cultural barriers to work, but also overcoming these time-consuming environmental obstacles. Without financial autonomy of their own, and often further compounded by the lack of physical assets such as land of their own, women can find it difficult to recover from natural disasters, thereby becoming dependent on unsustainable emergency relief. Moreover, the multiplicities of barriers which women already face in these areas, when added to the specificities which climate change can cause, provide more than enough fodder in recognising that environmental challenges can impact women in negative ways.

CASE STUDY 1: TACKLING THE TSUNAMI, SRI LANKA, 2004

Women against the Waves

One of the key effects of the Tsunami was that women succumbed to death faster and at a greater rate, almost three times the number of men, because of physical and cultural constructs that made them less able to swim, climb trees and shed clothes, or flee from their homes in order to survive (Abeysekera 2005: 2). Men who were physically stronger, as well as used to climbing trees, either whilst picking fruit or playing, were able to scale the large trunks in order to escape the water. Women meanwhile were more constrained when it came to saving themselves through this manner, due to lack of being accustomed to scaling trees, lack of physical strength, constraining (and the more culturally approved) attire such as sarees or tight skirts, as well as given that most women were carrying their children and babies. Similarly, the attire also restricted the women's mobility in terms of being able to run quickly away from the waves.

Another reason for why women were worse affected by the calamity of 2004 was that many women were frequenting the informal markets or '*pola*'. Generally located on the main coastal roads, many villages hold them over the weekend. The tsunami hit on a Sunday (De Mel and Ruwanpura, 2006). Women were both buying and selling their goods and produce at these markets, indicating that the labour

or 'caregiving' responsibilities thrust on women were a key prompt towards their vulnerability. This includes doing marketing, cooking and cleaning at home, and caring for children, elderly family members and sick relatives. These traditional caregiving responsibilities are also often ignored when factoring in post-disaster recovery plans. Particularly, as these responsibilities are compounded with other constraints such as limited mobility, economic vulnerability and minimal public voice and representation, women also find it that much harder to access aid and disaster recovery benefits (De Mel 2007, Emmanuel 2009).

Aid, Labour and Livelihoods

Hyndman (2008) notes that in general widows were cast as more deserving of aid as female heads of households than their non-widow counterparts. However, the reason for being widowed, whether due to the conflict or in light of the disaster itself, also played a part in their access to aid. Given the fact that the East, in comparison to the South was majority Muslim/Tamil, in addition to gender, an exploration of ethnicity as a source that produced a difference in treatment among woman-headed households is also visible. In accessing aid and services, government services being overly dominated by the Sinhalese majority, also paved way for Sinhalese women to benefit from their ethnic group status. Meanwhile, a Post Tsunami Operational Management Structure (PTOMS) was established to allow for the LTTE to enter into partnership with the government in the area of economic reconstruction and development. The need for a ceasefire agreement between the government for the North and the East, in itself indicates a greater difficulty for citizens in the East (women even more) to have accessed assistance during the tsunami. The nexus between geographic situation, ethnic identity, conflict-induced vulnerability, and gender marginalisation, therefore, all play a role in the particular nuances of how women in Sri Lanka are impacted by climate change. While gender matters, to privilege gender as the sole cause of vulnerability "ignores the social realities that individuals in their own right and as members of families inhabit" (Ruwanpura, 2009).

In a country where cultural norms dictate that women are the principal caregivers, their domestic responsibilities make it difficult for them to work outside the home, procuring inputs and technologies, enforcing contracts in the informal economy, transporting inputs and raw materials, and marketing the output. Cultural norms

can themselves dictate what sort of business is suitable for women, and these may be exactly those activities that have the lowest returns. In fact, micro-enterprises owned and managed by women are often distress-driven survival strategies by women, who, due to various circumstances, have become the sole breadwinners of their families, and who have to juggle livelihood activities with their traditional, care-giving role in the household. In a study of the effect of 'treatment' grants on male and female-owned enterprises in three tsunami-affected districts in Sri Lanka, de Mel et al. (2007) found that returns to capital were zero among female-owned micro-enterprises but more than 9 percent per month for male-owned enterprises. They also found that significant returns for males showed that, on average, male-owned enterprises were more likely to generate the return on investment necessary to repay micro-loans. Differences in treatment effects by gender did not appear to be due to differences in the amount of the treatment invested, differences in access to capital, differences in ability, differences in risk aversion or due to females taking the grants out of their business and spending them on household investments. Differences in industry accounted for some of the difference but the rest remained unexplained. Meanwhile, even though profits were found to generally rise at a higher rate among men than women, de Mel, McKenzie and Woodruff (2009) found that more efficient outcomes were to be expected when the enterprise owner had more decision-making power in the household; or where the spouse is more cooperative with regard to the management of the company. Customarily, in Sri Lanka this decision-making power tends to lie in the hands of the male figure.

Moreover, while the success of women enterprises, in general, were comparatively worse off than those of male businesses, across the South and East affected districts, different patterns of employment among Muslim, Tamil and Sinhala women heads of household were also noted. Almost 60% of Sinhala women were participating in wage labour, compared to Tamil and Muslim women participation, whose ratio was still less than 50%, even when combined (Hyndman, 2008). McGilvray (1982; 1989) notes that Muslim women are hampered by restrictions on their mobility and related obstacles to income-earning opportunities. It was also found that Sinhala (Southern) women were less likely to be self-employed, than their Tamil and Muslim (Eastern) counterparts and therefore have more stable paid work. Women who were also self-employed were more likely to be affected by the tsunami, given that their houses may have also doubled as working places, leaving way for their raw materials and/or working environment to have been damaged and swept away by the waves.

Displacement, Social Networks, Assets and Land

The establishment of buffer zones, as a public safety mechanism, against a possible recurrence of the tsunami, was yet another gendered impediment for the survivors of the tsunami. The buffer zone, therefore, by extension rearranged the social composition and structure of villages. Houses which had been close to schools and sites of employment were suddenly displaced; causing women to wake up hours earlier to get their children ready for school, to send off their husbands, or to travel to work themselves. In the South, home of the Sinhala majority, the buffer zone was set at one hundred meters, whereas in the predominantly Tamil and Muslim dominated areas in the East, a two hundred meter zone was instituted. Both areas were densely populated, and impacted by land scarcity, adversely affected the residents in the area (Hyndman, 2008). On the part of the Eastern community, this was a second type of displacement to those already suffering from conflict-induced displacement.

Above all, new situations of vulnerability emerge when climate change and gender insecurity interact. In one displacement camp, women's mobility was restricted to the extent that draconian rules were used to control women, ensuring that women were not able to be seen outside of the camp, could not talk to police, or seek employment outside of the walls of the camp without gaining special consent and approval, as well as signing in and out of the camp. Seeking these kinds of benefits often keep women in precarious states of vulnerability. Women were also found in this unfamiliar setting to lack privacy, and above all find more utility in a house setting than men – particularly in terms of access to bathrooms and sanitation. Comparatively, the mobility, access and lack of need for bathroom facilities among men was much higher. Due to inadequate toilet facilities, women were forced to reduce the amount of times they went to the bathroom, rise early, and wait in long lines or forgo certain basic sanitary needs. Particularly this led to higher health complications among women, adding to their vulnerability and marginalisation. Furthermore, poor lighting and lack of privacy can and did also lead to unwarranted sexual advances by men at the camp, sexual abuse and rape.

Displacement also leads to the disruption of social networks. Social networks are seen to increase the sense of security – both physical and monetary – while their lack increased the sense of vulnerability, given that social networks are most frequently relied upon in times of emergency. These networks also facilitate efforts at a better

standard of living since access to small credit, loans for enterprise development, and employment opportunities come through these networks. Women in this case, who already had difficulty in coping with the effects of the disaster, may have even more difficulty in accessing the above post-disaster recovery mechanisms.

Additionally, the sudden evacuation of villages meant that many had to leave behind their livelihoods and other assets. For the conflict-affected East, this was a process that some had already undergone, being relatively newer for those affected in the South. Herein, not only were female lives lost but as were women's possessions, assets and wealth. Often in the form of jewellery, these items were swept away. Where they were not swept away, more than often, in order to obtain immediate liquid cash, the gold and ornate jewels of women; often passed down heirlooms; were sold, or mortgaged as another means of coping (Amirthalingam and Lakshman 2009).

Ownership of land amongst both the South and East is governed by laws on registration of deeds, prescriptive titles or ownership of state lands. However, specific personal laws, which impact inheritance and land rights also exist. For the most part, women in the Southern and Eastern districts are exposed to egalitarian and full legal rights. However, the Mukkuvar law, or customary law, which is found in the East, albeit not being formalised, gives women the right to own property transferred by a deed or sale. Inheritance of such land is however usually only half the share of males and, usually, is passed on as a part of a dowry. To this end, when dealing with inheriting the land of their male counterparts who had passed away, women found exercising their rights that much more challenging. Furthermore, regarding land, the Sinhalese legal code (including bilateral property inheritance laws) and relaxed social status due to their majority ethnic group status, enabled the women in the South to partake in a more streamlined process.

CASE STUDY 2: FENDING OFF THE FLOODS, SRI LANKA, 2016

The case study of the 2016 floods is much more anecdotal in nature. While minimal research exists on the specific gendered effects the floods had, and the damage caused was minimal in comparison to the tsunami, a small section on the effects of the floods is still important. This is particularly as it adds a supplementary analysis of the impacts natural disasters can have on women, and is also the most recent (and substantial) phenomenon that has occurred in relation to climate change in Sri Lanka's immediate past.

The rainfall Sri Lanka experienced in 2016 was the heaviest in twenty-five years, resulting in the worst natural disaster the country has faced since the 2004 Tsunami. Affecting 21 of the country's 25 districts, according to the Government of Sri Lanka Disaster Management Centre over 300,000 people were affected by the floods, an estimated 20,000 being displaced and over 5,000 houses being either destroyed or damaged. The majority of the effects of the landslide was in the Kegalle District (South), where three villages were destroyed. Several of the disaster-affected areas (particularly the South) were declared emergency zones due to the ongoing threat of further floods and landslides, displacing those housed in these areas. Moreover, people whose houses were not directly affected (in addition to those who were) but were reluctant to leave their houses for fear of looting and losing their valuables and assets. They were also forced to displace and set up shelter in safe locations, such as temporary camps, schools, religious buildings and with family and friends.

Overwhelmingly, despite the resilience of women and girls in the face of natural disasters, females were also disproportionately affected by the disaster. Similar outcomes to that of the tsunami occurred, including the inability for women to protect themselves primarily due to their attire, care responsibilities towards elderly, sick and young alike. Countless women lost their assets such as jewellery, not only due to the floods, but also in light of the looting that occurred after the disaster. Women were found less prepared as well as empowered to survive and/or recover (UNFPA, 2015), bearing the brunt of the environmental damages. In addition to losing jewellery, women also needed household equipment when they resettled to carry on with their daily activities. Some women lost equipment used

for self-employment such as sewing machines for making clothes, while also losing their basic household equipment, which is crucial in running a house.

Amongst the major items which were being collected as disaster relief measures apart from medicine, blankets and books for children, were sanitary napkins and underwear. Desperately in need of these items, women who no longer have access to the latter find themselves in a difficult and awkward situation, limiting their mobility (and thereby their access to other relief items) as well as causing serious hygiene concerns. Given the taboo nature of sanitary napkins within the Sri Lankan cultures, women also become uncomfortable in requesting for these items. Moreover, a directive was issued by the director general of health services to hospitalise all the pregnant mothers irrespective of their duration of pregnancy, given the fact that pregnant mothers can face a whole host of issues, including communicable diseases in camps and other complications as well as health issues during pregnancy. It, therefore, becomes imperative to address and uphold women and girls' Sexual Reproductive Human Rights (SRHR) during disaster response, ensuring that these are included both in disaster risk reduction and management plans. A notable outcome of the floods, however, was that, learning from the problems faced during the tsunami, Sri Lanka was better prepared to prevent gender-based violence and protect women in the camps (Tegal, 2016). It was yet another lesson in the acutely gendered experiences and differential impacts faced by women, in a time of an accelerated pace of climate change. Again, looking across the districts, these effects were exacerbated by existing inequities in socially constructed gender roles, responsibilities, perceptions and skewed power relations that tend to disadvantage women, whilst also being impacted by geographic distribution and ethnic relations.

CONCLUSION

By looking at the various dimensions that impact women, it is apparent that gender alone is inadequate in portraying all the overlapping intricacies and power dynamics which climate change and environmental disasters like the tsunami and the floods played respectively. It, however, remains that gender is an important lens that must be used when analysing the effects of natural disasters on people, for it exerts a distinct and disproportionate influence regarding aid, livelihoods, land recovery, loss of assets, and other disaster-related mechanisms, policies and areas.

The Sri Lanka United Nations Development Assistance Framework (UNDAF) Action Plan 2013–2017, an agreement between the United Nations and the Government of Sri Lanka that provides a framework for UN assistance in Sri Lanka, in line with Sri Lankan national priorities outlined various relevant policy documents. The UNDAF stands on four pillars: 1. Equitable Economic Growth and Sustainable Livelihoods; 2. Disparity Reduction, Equitable and Quality Social Services; 3. Governance, Human Rights, Gender Equality, Social Inclusion and Protection; 4. Environmental Sustainability, Climate Change and Disaster Risk Reduction. The third pillar (and fourth) therefore carries the main focus on mainstreaming gender into its assistance and during disaster risk reduction. Particular commitment is given to “promote alternative options to meet nutrition requirements”. The document states that given the predominant nature of nutritional disorders in Sri Lanka, which is likely to increase food insecurity along with climate change, alternative options need to be promoted to meet nutritional demands, especially for women and children. As stated previously, women in rural areas travel long distances to accrue food for their families, in particular during drought. The UNDAF calls for “women empowered to drive itself especially in the poor farming communities in the country.”

Meanwhile, the Disaster Management National Policy (2010) draws upon the pillars of “equality, diversity and inclusion”, when addressing the needs of integrating women into the National Policy. The document reads that “b. *All people affected* by disaster have equal rights to receive assistance and information regardless of ethnicity, gender, religious beliefs, ability or other personal attributes; c. Disaster management should give special consideration to marginalised groups and those with special needs or *otherwise vulnerable, including persons with disabilities, senior citizens, the sick, pregnant women, children and displaced persons*; d. Disaster management should ensure *gender equality* and in particular the *empowerment of girls and women*.” This therefore commands that Governments have a responsibility in ensuring gender considerations are taken into account as part of their strategies and response to climate change.

The Ministry of Environment also developed Sri Lanka’s first National Climate Change Adaptation Strategy (NCCAS) in 2010, after consultation with several other agencies. The NCCAS laid out a framework for Sri Lanka in moving a wide range of stakeholders towards building climate resilience. The 2011–2016 plan consists of five strategic goals: 1. Mainstream Climate Change Adaptation into National Planning and Development; 2. Enable Climate Resilient and Healthy Human Settlements; 3. Minimise Climate Change Impacts on Food Security; 4. Improve Climate

Resilience of Key Economic Drivers and 5. Safeguard Natural Resources and Biodiversity from Climate Change Impacts. Within this, gender is specifically addressed once again during food security, and in enabling healthy human settlements.

There is, however, a great deal more that the country can do in terms of ensuring that women, who are 50% of their populace, are guaranteed greater protection in the face of natural disasters. Given the increase in climate change related disasters in the recent past, it becomes all the more prevalent to strategise in a forward-looking manner the aim that gender is sufficiently mainstreamed in many areas of development policy and practice. Along with this is the need to ensure that the potential impacts of climate change on gender relations have been thoroughly studied, and do not remain invisible (Nelson et al., 2002). This also needs to ensure that this vulnerability towards environmental impacts is articulated in a cross-cutting manner, in addition to being gender-focused, ensuring that social, ethnic and poverty lines are also factored into disaster responses.

RECOMMENDATIONS

- Conducting an information campaign, including the distribution of pamphlets and the promotion of advertisements, which advice on protecting oneself during a natural disaster, particularly in relation to women and the specificities concerning them, including attire and SRHR.
- Improving women's livelihoods and enhance adaptation by ensuring women's access, control and ownership of resources and assets, including land and livestock.
- Improving access to immediate relief, particularly in terms of SRHR and aid, as well as development resources such as credit, information, training and outreach, and technology.
- Ensuring that women are involved in developing sustainable adaptation options due to their knowledge, multiple and simultaneous responsibilities and roles in productive areas.
- Ensuring women's participation in all decision making and policy levels, particularly in relation to environment and climate change issues. These should aim at enhancing participatory policies, capacity building and developing technical skills and leadership among women, in order to increase women's empowerment.

- Investing in technology, particularly green technology, which will be both labour saving and lifesaving, in addition to being gender sensitive and reflective of the needs and livelihood practices of women.
- Increasing women's rights, socioeconomic status and voice through gender-sensitive and climate-smart development assistance.
- Designing adaptation programmes in food security, agriculture and managing natural resources in ways that are sensitive and responsive to the different and multiple roles women and men play in various spheres of natural resource management, reflect their caregiving responsibilities and factor in customary and statutory structures and relations.
- More research and analysis of the specific impacts of climate change; particularly in terms of adaptation, impact, response and mitigation, through a gendered lens, which aims to fill gaps in research, knowledge and data.
- Ensured disaggregation of data by gender, marital state, ethnicity, etc. in order to enhance databases, research and literature which can be used to reflect power dynamics and gendered experiences in Sri Lanka.

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