

Living with Climate Change

Understanding Human Insecurity for surviving in the Climate Change Vulnerable Bangladesh

S. Jahangir Hasan Masum

eed Evangelischer Entwicklungsdienst

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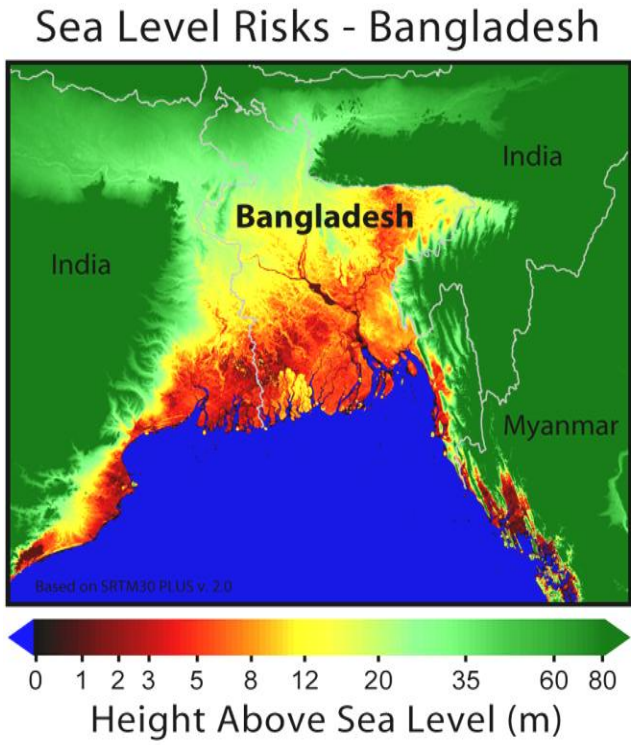
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Executive Summary

The term “Climate change” according to the Intergovernmental Panel on Climate Change (IPCC) refers to any change in climate over time, whether due to natural variability or as a result of human activity. However, United Nations Framework Convention on Climate Change (UNFCCC) has defined climate change as a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods. Primary sources of climate change are increased greenhouse gases (GHG) in the earth’s atmosphere.

The security of individuals, communities, nations, and the entire global community is decreasing due to climate change. It is anticipated that the consequences of climate change will increase livelihood insecurity, malnutrition, unemployment, lack of safe drinking water and water-borne diseases in Bangladesh and about one third of the population would be vulnerable to climate change and sea level rise. All the previous IPCC impact assessments recognized Bangladesh as one of the most susceptible to the negative impacts of climate change.

Community-driven adaptation is an action learning process to empower local communities to identify, analyse, and develop ways and means of increasing their local adaptive capacity to current and future challenges and opportunities related to climate change. In community-driven process, communities directly guide in the identification, analysis and development of community adaptation strategies to challenges and opportunities (risks) related to climate change.

Climate change assessments of Bangladesh suggest steadily increasing temperatures, particularly for the winter season, but also during the monsoon season. The knowledge about the type of climate change impacts and the community exposure to climate change risks is a fundamental requirement for enhancing community resilience. In community-driven adaptation, community document local impacts of climate change, historical coping strategies to climate extremes and devise appropriate adaptation measures that local communities can implement themselves. Local people have always coped with changing local environments.

Adaptation to climate change is crucial for reducing vulnerability. Building adaptive capacity to climate change and managing climate risks requires necessary measures to ensure the full and effective participation of Indigenous and local communities in formulating, implementing, and monitoring adaptation relating to impacts of climate change. Effective adaptation will manage and reduce the risk associated with changes in climate (similar to disaster risk reduction measures), and successful adaptation will reduce vulnerability by building on and strengthening existing coping mechanisms.

Climate change will disproportionately affect the world's poor, approximately two thirds of whom are women. Climate change will adversely affect women more than men in Bangladesh. Gender issues have rarely been addressed as part of the climate change discussions.

In the Climate Changing World, poor people might be considered as a burden of the system. The holistic understanding of whether the current coping strategies of poor households, and particularly of women, are significantly or sufficiently contributing to adaptation to climate change is very much needed. To overcome the missing human dimension of sustainable development framework, it is more appropriate to use the term “Sustainable People’s Development (SPD)”. SPD acknowledges that humans are inseparable from the

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ecosystems in which they live and also responsible for emissions and global warming. The Sustainable People's Development is focused on putting People at the center of sustainable development.

Sustainable People's Development (SPD) is conceptualized as process to engage people in an equitable way with fairness and respect for the value of diversity in people's lives and seeks a good quality of life for all people in equitable and sustainable society, at local, national and global levels. Each community should have their own definition as well as indicators of Sustainable People's Development.

The government of Bangladesh has yet to devise viable strategies and pro-poor policy approaches by integrating climate change, Food Sovereignty & Agriculture for reducing climate change vulnerability. The role Information & Communication Technology (ICT) for adaption to climate change need to be incorporated in the adaptation policies. The policy approach should follow the Principles of Sustainable People's Development (SPD) and Climate Resilient Development (CRD) to ensure for pro-poor climate governance. The integration of the scientific knowledge and the political realities is critically necessary for policy development to address the potential impact of climate change.

Three interrelated multilateral environmental conventions; UN Framework Convention on Climate Change (UNFCCC), b) United Nations Convention on Biological Diversity (CBD), and UN Convention to Combat Desertification (CCD) should be linked with climate policy.

Climate change makes new demands for adaptation and coping strategies by farmers and rural communities and presents new challenges for the management of their environment and agro-ecosystems. The survival of the Future generations will depend on how political leaders today acted on behalf of the people in the future following cross-generational social justice and equity. Our political leaders should act together because greenhouse gases do not respect political boundaries.

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Chapter 1

Climate Change Vulnerability & Human Insecurity

1. Introduction

During the High Level Event on Climate Change on 24 September 2007, Mr Ban Ki Moon, the Secretary General of the United Nations, stated *"I am convinced that climate change, and what we do about it, will define us, our era, and ultimately the global legacy we leave for future generations. Today, the time for doubt has passed. The United Nations Intergovernmental Panel on Climate Change has unequivocally affirmed the warming of our climate system, and linked it directly to human activity".* He also stated in the same address *"Today, the effects of climate change are being felt around the world. But they are being felt most by those who are the least able to cope. Indeed, the terrible irony for many developing countries is that, though they have contributed the least to the process of climate change, they are the ones most at risk from its consequences. For some island States and peoples this is a matter of survival. The moral imperative could not be clearer".*

1.1. The Big Picture of Climate Change

Over the past few centuries the climate of the earth has varied significantly from average weather conditions. Such significant departures in climatic conditions are referred to as 'climate change'. Climate change is an ongoing process in Earth's history under the influence of the Sun. For the last million years, the Earth has experienced many warm & ice ages, sea-level fall and rises. Global warming and climate change are already happening, and will continue at some level, even if fossil fuel use were to stop immediately, because a significant part of the CO2 remains in the atmosphere for centuries (Monastersky 2009[1]). In a simple sense, climate change is the difference between a climate scenario at a projected time and the current climate. A climate scenario consists of projections of possible climate futures, containing developments of driving forces, greenhouse gas emissions, temperature change and sea level rise and their key relationships[2]. The term "Climate change" according to the Intergovernmental Panel on Climate Change (IPCC) refers to any change in climate over time, whether due to natural variability or as a result of human activity. However, United Nations Framework Convention on Climate Change (UNFCCC) has defined climate change as a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

1 Monastersky, Richard. "Climate Crunch: A burden beyond bearing." Nature 458, 1091-1094 (2009)
2 http://www.lenntech.com/greenhouse-effect/climate-change-glossary.htm#Climate_change

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Climate Change is complex and caused by an intricate interplay amongst various factors most of which are not restricted to national boundaries. Primary sources of climate change are increased greenhouse gases (GHG) in the earth's atmosphere. GHGs build up in the atmosphere and act like a greenhouse. GHGs capture heat and cause a rise in the average temperature of the earth's surface and related climate impacts. The global temperature increases if the GHGs increase in the atmosphere. The principle GHG is carbon dioxide (CO_2). Carbon dioxide from the combustion of fossil fuels from cars, power plants, and factories accounts for about two thirds of the human induced warming effect. Methane, nitrous oxide and other gases emitted from industrial and agricultural activities account for the remaining third. Deforestation is another root cause of climate change. Trees filter the air of carbon by taking in carbon dioxide and releasing oxygen. It is estimated that since the industrial revolution in the 1850s, carbon dioxide in the atmosphere has increased by more than 30%, methane by more than 150%, nitrous oxides by 17% and ozone by 35%. The average surface temperatures have increased by 0.3 to 0.6^0C since the late nineteenth century. The temperatures of the last half century are unusual in comparison with those of at least the previous 1300 years. Over the last 100 years (1906–2005), global temperature has increased by 0.74°C.

Global picture of Emissions	**GDP per capita**			**Carbon intensity** CO_2 **emissions per unit of GDP**			**Carbon footprint** CO_2 **emissions per capita**		
Country name	**1990**	**2004**		**1990**	**2004**		**1990**	**2004**	
Bangladesh	**1,344**	**1,974**	**47%**	**0.12**	**0.15**	**24%**	**0.1**	**0.3**	**74%**
China	1,827	6,171	238%	1.30	0.70	-46%	2.1	3.8	84%
Germany	23,945	29,163	22%	0.58	0.38	-35%	12.3	9.8	-20%
India	1,861	3,204	72%	0.49	0.44	-10%	0.8	1.2	**55%**
Japan	26,629	30,477	14%	0.37	0.36	-1%	8.7	9.9	13%
Nepal	1,165	1,540	32%	0.03	0.08	159%	0.0	0.1	**197%**
Norway	28,292	40,782	44%	0.31	0.53	69%	7.8	19.1	144%
Pakistan	1,836	2,253	23%	0.39	0.41	7%	0.6	0.8	**35%**
Sri Lanka	2,647	4,400	66%	0.09	0.15	61%	0.2	0.6	166%
Thailand	5,164	8,377	62%	0.38	0.56	48%	1.7	4.2	**145%**
United States	31,768	40,971	29%	0.68	0.57	-17%	19.3	20.6	7%
Bangladesh has increased its carbon footprint per person by 74%									
Developing countries	2,907	4,958	71%	0.64	0.56	-13%	1.7	2.4	41%
Least developed countries	1,153	1,396	21%	0.14	0.17	21%	0.2	0.2	0%
Arab States	4,641	5,786	25%	0.75	0.86	15%	3.4	4.5	32%
East Asia and the Pacific	2,484	6,298	154%	0.9	0.63	-30%	2.1	3.5	67%
Latin America and the Caribbean	6,891	8,259	20%	0.4	0.36	-10%	2.5	2.6	4%
South Asia	**1,974**	**3,183**	**61%**	**0.49**	**0.46**	**-6%**	**0.8**	**1.3**	**63%**
Sub-Saharan Africa	1,905	1,945	2%	0.55	0.57	4%	1	1	0%
Central and Eastern Europe and the CIS	7,887	9,152	16%	1.49	0.97	-35%	10.3	7.9	-23%
OECD	22,518	28,642	27%	0.54	0.45	-17%	10.8	11.5	6%
High-income OECD	25,929	33,182	28%	0.52	0.45	-13%	12	13.2	10%
WORLD	**7,043**	**9,348**	**33%**	**0.68**	**0.55**	**-19%**	**4.3**	**4.5**	**5%**
GOALPOSTS	569	665		0.03	0.02		0.04	0.04	
	33,843	40,971		3.30	2.07		24.18	24.92	

The global average temperature is expected to increase by about 0.2°C per decade over the next two decades[3]. The best estimates indicate that the Earth could warm by 3° C by 2100. The atmospheric concentration of carbon dioxide is now far higher than in the last 650 000 years and has been growing faster in the last ten years than it has been since the beginning of continuous measurements around 1960[4].Global average sea level is expected to rise by 18 to 59 cm by the end of the 21st century.

3 IPCC, 2007: *"Fourth Assessment Report (AR4),* Intergovernmental Panel on Climate Change (IPCC), 2007
4 http://www.greenfacts.org/en/climate-change-ar4/index.htm

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Two combined land and sea surface temperature records from NASA's Goddard Institute for Space Studies (GISS) and the US National Climatic Data Centre (NCDC) both calculate that the first six months of 2010 were the hottest on record.

1.2. The root causes of climate change

In technical point of view, the man-made emissions of Greenhouse Gases or GHGs through energy consumption or the exploitation & combustion of fossil fuels are the root cause of climate change. The global temperature increases if the GHGs increase in the atmosphere. The principle GHG is carbon dioxide (CO2). Carbon dioxide from the combustion of fossil fuels from cars, power plants, and factories accounts for about two thirds of the human induced warming effect. Methane, nitrous oxide and other gases emitted from industrial and agricultural activities account for the remaining third. Deforestation is another root cause of climate change. Trees filter the air of carbon by taking in carbon dioxide and releasing oxygen.

In economic context, industrialization for the economic development is the root cause of climate change. Every country wants to improve the living standards of its population through increasing speeding up industrialization.

In social context, ignorance or insignificant knowledge of the people is the root cause of climate change. If the relationship between human activity and climate had been widely understood many decades ago, we simply would not be facing the same magnitude of challenge that we face today. Public support and the related political will for taking action would have been available earlier, and many of those who influence climate change would have made different decisions.

Vulnerability of key sectors to impacts of climate change for Tropical South Asia

Regions	Food & Fiber	Biodiversity	Water resources	Coastal Ecosystems	Human Health	Settlements
South Asia	*Highly Vulnerable*	*Highly Vulnerable*	*Highly Vulnerable*	*Highly Vulnerable*	*Moderately Vulnerable*	*Highly Vulnerable*

Source: W*orking group report II of the Intergovernmental Panel on Climate Change (IPCC), Climate Change 2001: Impacts, Adaptation and Vulnerability.*

1.3. Living with Insecurity in a Climate Changing World

Any broad environmental change like climate change can be a significant factor that undermines human well-being and marginalized people are likely to vulnerable for such environmental change (McCarthy et. al, 2001[5], Matthew, 2001[6] and Najam, 2003[7]). Climate change may undermine livelihood security of these marginalized people by reducing access to, and the quality of, natural resources that are important to sustain livelihoods. Climate change is anticipated to have far reaching effects on the sustainable development of developing countries including their ability to attain the United Nations Millennium Development Goals by 2015 (United Nations 2007[8]).

The United Nations Environment Program estimate that climate change related disasters could be costing the world US$300 billion within a few decades[9]. Climate change presents significant threats to achieving all of the Millennium Development Goals, particularly those related to eliminating poverty and hunger and

5 McCarthy, J., Canziani, O.,Leary, N., Dokken, D. and White, K. (Eds). 2001. Climate Change 2001: Impacts, Adaptation & Vulnerability. Cambridge University Press: Cambridge.
6 Matthew, R. 2001. 'Environmental Stress & Human Security in Northern Pakistan', Environmental Change and Security Project Report 7: 21-35
7 Najam, A. 2003. 'The Human Dimensions of Environmental Insecurity: Some Insights from South Asia, Environmental Change & Security Project Report 9: 59-74
8 UN. 2007. The Millennium Development Goals Report, United Nations. New York. http://www.un.org/millenniumgoals/pdf/mdg2007.pdf
9 http://www.unep.org/Documents.multilingual/Default.asp?DocumentID=192&ArticleID=2758

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promoting environmental sustainability[10]. The UNFCCC recognizes that the concerted efforts of nations are essential to slow climate change. While an estimated 1.6 billion people in developing countries do not have access to electricity, do not enjoy modern energy services[11] and do not emit large amounts of greenhouse gases (in stark contrast to communities in industrialized nations), their energy and development needs still need to be met. As a consequences of climate change, the losses due to more frequent tropical cyclones, loss of land as a result of rising sea levels and damage to fishing stocks, agriculture and water supplies, could annually cost the world around $US 304.2 billion[12]. It is estimated that in low-lying countries like the Deltas of Bangladesh and Small Island States the cost could be significantly higher. Projected sea level rise could flood the residence of millions of people living in the low lying areas of South, Southeast and East Asia such as in Viet Nam, Bangladesh, India and China (Wassmann *et al*. 2004[13], Stern 2006[14]).

In Asia, the principal impacts of climate change on health will be on epidemics of malaria, dengue, and other vector-borne diseases (Martens *et al*. 1999[15]). Throughout Asia one billion people could face water shortage leading to drought and land degradation by the 2050 (Christensen *et al*. 2007[16]). 30 percent of the Asian coral reefs could be lost in the next 10 years (Cruz *et al*. 2007[17]) and such loss could be as high as 88 per cent (59 per cent of global) in the next 30 years (Wilkinson 2004[18]). Climate change is anticipated to have far reaching effects on the sustainable development of developing countries including their ability to attain the United Nations Millennium Development Goals by 2015 (United Nations 2007[19]).

1.4. Climate Security, Intergenerational Equity and Human Insecurity

It is now well-known that human action can significantly influence intensity of the dynamic natural process of the climate change. Nevertheless, we often fail to perceive the time-bound implications of the climate change because the change process cannot clearly perceivable within our short human life span. We may understand the impact of climate change better if we view it together with the context of **intergenerational equity and sustainability of the humanity**. This envisage that climate change should be interpreted as a four dimensional (4D) environmental issue because changes in climate generate impact on the earth by geomorphic entity (length, width) and atmosphere (height) through time.

Climate is the global public elixir since we all share the world's atmosphere. The climate change directly and indirectly reduce securities for food, water, life, property, settlement, livelihood assets, livelihoods and others. Climate security is the integrated aspects of individual human security (e.g. livelihood security, food security, health security, water security and environmental security).

10 http://www.undp.org/climatechange/adap01.htm
11 International Energy Agency (2002) World Energy Outlook 2002: Chapter 13, Energy and Poverty, Paris.
12 http://www.unep.org/Documents.Multilingual/Default.Print.asp?DocumentID=192&ArticleID=2758
13 Wassmann R, Nguyen Xuan Hien, Chu Thai Hoanh and To Phuc Tuong. 2004. Sea Level Rise Affecting the Viet Namese Mekong Delta: Water Elevation in the Flood Season and Implications for Rice Production, *Climatic Change*. 66(1-2): pp. 89 –107.
14 Stern N. 2006. The Stern Review on the Economics of Climate Change. HM Treasury, UK. Cambridge University Press. http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm
15 Martens P, Kovats R S, Nijhof S, de Vries P, Livermore M T J, Bradley D J, Cox J and McMichael A J. 1999. Climate change and future populations at risk of malaria. *Global Environmental Change*. 9: pp. S89 –S107.
16 Christensen J H, Hewitson B, Busuioc A, Chen A, Gao X, Held I, Jones R, Kolli R K, Kwon W-T, Laprise R, Magaña Rueda V, Mearns L, Menéndez C G, Räisänen J, Rinke A, Sarr A and Whetton P. 2007. Regional Climate Projections. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change *[Solomon S, Qin D, Manning M, Chen Z, Marquis M, Averyt K B, Tignor M and Miller H L (eds)]*. Cambridge University Press. Cambridge, United Kingdom and New York, NY, USA
17 Cruz R V, Harasawa H, Lal M, Wu S, Anokhin Y, Punsalmaa B, Honda Y, Jafari M, Li C and Huu Ninh N. 2007. Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry M L, Canziani O F, Palutikof J P, van der Linden P J and Hanson C E (eds). Cambridge University Press. Cambridge, UK. pp. 469 – 506.
18 Wilkinson C. 2004. Status of Coral Reefs of the World: 2004, V. 1. Australian Institute of Marine 5 Science. Townsville, Australia. 302pp.
19 UN. 2007. The Millennium Development Goals Report, United Nations. New York. http://www.un.org/millenniumgoals/pdf/mdg2007.pdf

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Climate security may also be the capacity to survive against the climate change vulnerability or any adverse changes that may evolve due to climate change shocks. IPCC suggests that climate change vulnerability reflects the sum of the risks (hazards) to which a society or community is exposed, mitigated by its adaptive or coping capacity (its ability to respond effectively to risk) and compensated by the available alternative livelihood opportunities. In this form, the variability of vulnerability is seen to be driven locally mainly by socio-economic factors.

The security of individuals, communities, nations, and the entire global community is decreasing due to climate change. The human insecurity owing to climate change is perhaps the most wide spread non-military environmental threat the global community has ever faced. Climate change is a security concern because it has the potential to destabilize global socio-economic system, displace populations, and lead to the collapse of global development. Despite the omnipresent nature, climate security issues are still not high on the national security & policy agenda. Increased cyclone, storm surges, floods, riverbank erosion destroys and damage peoples properties including land, house, crop, cattle, and other livelihood assets and living essentials. Drought will generate scarcity of drinking water. Sea-level rise will contaminate fresh water resources with saline water.

Climate change will disproportionately affect the world's poor, approximately two thirds of whom are women.[20] Women and children are most vulnerable to hunger related deaths and illness, which would be indirectly exacerbated by climate change through increasing food and water shortages.

1.4.1. Climate Forced Migrant: A New Outlook of Human Insecurity

According to the International Federation of Red Cross and Red Crescent Societies in their World Disasters Report 2001, the year 2000 more people were forced to leave their homes because of environmental disasters than war. Approximately 25 million people could currently be classified as environmental refugees, amounting to 58% of the world's total refugee population. These estimates clearly indicate that significant numbers of people are already being displaced by climate change, and that the number will continue to grow in coming decades.

According to Norman Myers of Oxford University, at a conservative estimate, climate change will increase the number of environmental refugees six-fold over the next fifty years to 150 million[21]. This equates to 1.5 percent of the predicted global population in 2050 of 10 billion. Importantly, Norman Myers studied more than 2,000 sources of information to come to this estimate, and has since increased his figure to 250 million. Myers projections assume no action is taken to slow global warming. Richard Nicholls of Flood Hazard Research Centre, Middlesex University, suggested in 2004 that between 50 and climate change could be displace 200 million people by 2080; The International Organization for Migration (IOM) estimated that eventually one billion people could be 'environmentally displaced from their original habitat[22]. The Intergovernmental Panel on Climate Change (IPCC), the international science body that regularly produces assessment reports on climate change, suggested 150 million environmental refugees would exist by 2050.

20 Friends of the Earth Australia, 2003, "Changing the future of the world's poor?" http://www.foe.org.au/download/future_poor.pdf
21 Myers Norman, "Environmental Refugees in a Globally Warmed World", BioScience, v. 43 (11), Dec. 1993.
22 Lonergan, S and A. Swain, Environmental Degradation and Population Displacement. Global Environmental Change and Human Security Project, Research Report No. 2, Victoria, BC, Canada, May 1999.

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In this projection, the impacts of climate change, including coastal flooding, shoreline erosion and agricultural degradation were the major causes of displacement.

Top 20 countries with the highest number of people affected by climate related events 1990-2008

	Grand Total (Millions)	Drought	Earth Quake	Epidemic	Extreme temperature	Flood	Mass movement (Wet & Dry)	Strom	Other
China	2207.46	311.41	62.24	0.01	7.9	1481.63	0.02	344.22	0.03
India	904.45	351.18	5.56	0.35	0	512.15	0.22	31.95	0.04
Bangladesh	**147.95**	**0**	**0**	**2.21**	**0.19**	**114.76**	**0**	**30.77**	**0.03**
Philippines	70.2	2.85	1.97	0.01	0	7.55	0.29	56.16	1.36
Thailand	49.07	23.5	0.06	0	0	22.57	0.01	2.93	0.01
Kenya	44.61	35.7	0	6.87	0	2.04	0	0	0
Iran	40.84	37	1.37	0	0	2.3	0	0.17	0
Viet Nam	32.24	6.11	0	0.02	0	16.84	0	9.27	0
Ethiopia	31.04	29.09	0	0.05	0	1.89	0	0	0.01
Pakistan	29.41	2.2	1.25	0.02	0	23.98	0	1.97	0
United States	22.81	0	0.03	0.41	0	0.92	0	20.67	0.78
Malawi	19.86	18.25	0	0.05	0	1.56	0	0	0
Korea,Dem.Rep	18.72	0	0	0	0	10.22	0	0.49	8
Cambodia	0	6.55	0	0.42	0	9.26	0	0	0.9
Sudan	6.55	11.36	0.01	0.08	0	2.49	0	0	2.6
Australia	11.36	7	0.01	0	4.6	0.07	0	3.94	0.05
South Africa	15.64	15.3	0	0.1	0	0.12	0	0.11	0
Mozambique	15.51	6.04	0	0.31	0	6.79	0	2.4	0
Zimbabwe	13.94	13.16	0	0.52	0	0.27	0	0	0
Brazil	13.88	12	0	0.85	0	0.85	0.01	0.15	0.01

Source: Kirsten Halsnaes and Nethe Veje Laursen (2009), "Climate Change Vulnerability: A New Threat to Poverty Alleviation in Developing Countries", In Simin Davoudi et al, *Planning for Climate Change: Strategies for Mitigation and Adaptation for Spatial Planners*, London: Earthscan

1.4.2. Food Insecurity and Health Insecurity reducing Human Security

Food Insecurity: Climate change will have a great impact on food systems and jeopardize food security in many regions. The Food and Agriculture Organization (FAO) has estimated that climate change could cost 65 developing countries about 280 million tons in lost cereal production, equivalent to about 16 percent of agricultural output[23]. Across the developing world, climate change could potentially reduce the amount of rain-fed land by 11 percent by 2080. A United States Department of Agriculture study indicates that initially staple crop yields may rise but, as temperature increases beyond 1.2 degrees, yields will begin to decrease.

Table 1.2: Potential land loss and population exposed in for selected magnitude of Sea-level rise, assuming no adaptation

Country	***Sea-level Rise***	***Potential Land Loss***		***Population exposed***	
	(cm)	*Km^2*	*(%)*	*million*	*(%)*
Bangladesh	45	15668	10.9	5.5	5.0
	100	29846	20.7	14.8	13.5
India	100	5763	0.4	7.1	0.8
Pakistan	20	1700	0.2	n.a	n.a
Indonesia	60	34000	1.9	2.0	1.1
Malaysia	100	7000	2.1	>0.05	>0.3

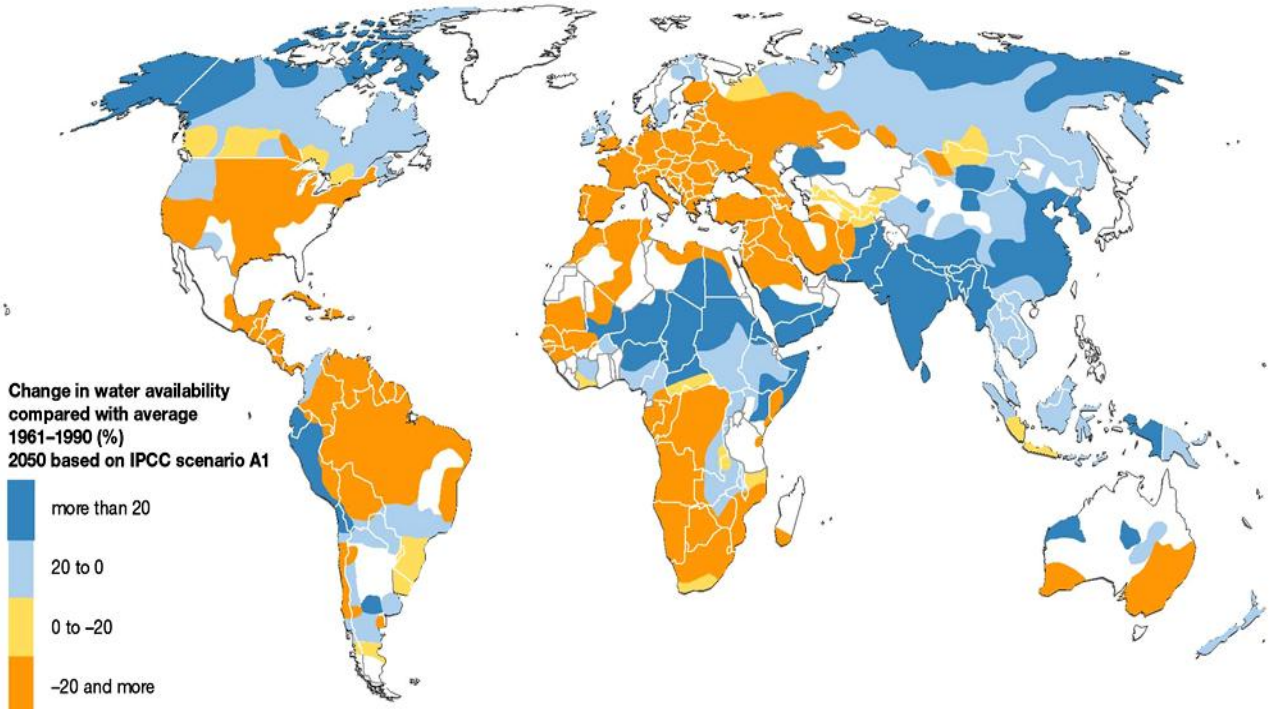
Source: *IPCC 2001, Climate Change 2001: Impacts, Adaptation and Vulnerability, Technical summary. A report of working group II of the Intergovernmental Panel on Climate Change (IPCC)*

Health Insecurity: The effects of climate change on health are generally manifested in medium to long-term risks stemming from drought and sea- level rise which could affect livelihoods and human well-being through worsening poverty and inequality; the spread of infectious diseases; food insecurity; displacement of populations and humanitarian needs; and increased competition for natural resources. the emergence and re-emergence of a number of diseases in recent time can be attributed in varying degrees to climate change-induced environmental and ecological factors derived mainly from human interactions with its eco-systems and consequent changes in bio-diversity and habitat through greenhouse gas emission, deforestation, use of

23 http://www.planetark.com/dailynewsstory.cfm/newsid/31554/story.htm

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pesticides, over-fishing and over-grazing, etc. Not much attention has so far been paid in the context of the UNFCCC to the direct and immediate impact of climate change on human health and development. Researchers found a robust relationship between progressively stronger El Nino events and cholera prevalence, spanning a 70-year period from 1893-1940 and 1980-2001[24]. One study findings [25] indicates that warming trends over the last century are affecting human disease. The majority of the humanitarian disasters globally between 1900 and 2000 were climate-related, and virtually all of these in the context of the developing world entailed health risks and emergencies. (Stern, 2007[26]). There is sufficient evidence of a link between climate change and health through the impacts of droughts, floods, coastal storms, etc. on human well-being and security (WHO, 2008).



Climate security = Health Security (Habitat Security + Food Security + Water Security) + Energy Security

The effects of temperature and rainfall changes on basic human needs is already causing shortages in the supply of fresh water in many parts of the world, leading to increasing competition for this most important basic human resource need (Bates et al, 2008[27]). Increased competition for diminishing water and food resources will be catastrophic for the poorest that are most vulnerable, and could even entail enormous financial costs for countries that are already very poor. Temperature and rainfall variations drive new patterns of disease over time (WHO, 2008[28]). According to the World Meteorological Organization (WMO), global warming is linked to unprecedented rainfall and flooding in many parts of Africa in recent time, resulting in losses in human well-being of unprecedented magnitude (WMO, 2007[29]).

24 Patz, J.A, 2002. A human disease indicator for the effects of recent global climate change. Proc. Nat. Acad. of Sciences, 99, 20: 12506-12508.
25 Rodo, X., M. Pascual, G. Fuchs, and A.S.G. Faruque, 2002. ENSO and cholera: A nonstationary link related to climate change? Proceedings of the National Academy of Sciences, 99, 20: 12901-12906.
26 Stern, Nicholas (2007). The Economics of Climate Change: The Stern Review. (Cambridge: Cambridge University Press).
27 Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof eds. Climate Change and Water. IPCC Technical Paper VI (June 2008)
28 World Health Organisation (2008). Climate change and Health. Report by the Secretariat.Executive Board, 124th Session, Provisional Agenda Item 4.8 (Geneva: WHO, EB124/11, 20 November 2008).
29 World Meteorological Organisation (2007). Report on Extreme Weather and Climate Events (Geneva: WMO).

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The majority of the world's poor people rely on local ecosystems (e.g. rain-fed agriculture and plants and animals from the forest) as the dominant source of staple food production and to support their livelihoods. Current decline in global food security and higher food prices –also partly attributable to climate change – is causing disproportionate nutritional harm to the poor and to children, migrants and other groups vulnerable to the transmission of infectious diseases. Movements of population triggered by climate change-induced factors, such as droughts and floods, increase the risk on health and vulnerability to the transmission of infectious diseases.

1.5. Indigenous knowledge & Climate Change Vulnerability Assessment

Vulnerability has an *internal* side-exposure to risk (location) and an *external* side, which consists of the inability to cope without a damaging loss and the limited potential for recovery (Watts et al., 1993[30]). Sensitivity relates to the intensity by which the shocks are experienced, whereas resilience refers to the capacity to bounce back to a 'normal' state after a disaster. ISDR defines vulnerability as the conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards (UN-ISDR, 2006). Vulnerability is therefore a function of character, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and it's adaptive capacity.

Vulnerability assessment offers a framework for policy measures that focus on social aspects, including poverty reduction, diversification of livelihoods, protection of common property resources and strengthening of collective action. Such measures enhance the ability to respond to stressors and secure livelihoods under present conditions, which can also reduce vulnerability to future climate change. All concepts and approaches to environmental assessment seek to link societal pressures with the status of the environment, and explore response options that might improve envir**o**nmental conditions and manage problems while enhancing (or at least not sacrificing) human well-being. Community-based interactive approaches for identifying coping potentials provide insights into the underlying causes and structures that shape vulnerability.

When addressing vulnerability it is important to distinguish between *individual* and *collective* vulnerability. Individual vulnerability can be determined by 'access to resources and the diversity of income sources, as well as by social status of individuals or households within a community.' Collective vulnerability of a nation, region or community can be determined by 'institutional and market structures, such as the prevalence of informal and formal social security and insurance, and by infrastructure and income (Adger, 1999'[31]). Resilience refers to the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures (ISDR, 2006[32]). Coping can be defined as 'a short term response to an immediate and inhabitable decline in access to food' (Davies, 1993[33]). Coping strategies generally follow a time sequence and often include three different behavioral elements in a situation of high climate risk: insurance function type activities (prepare for bad times), coping (actually deal with the disaster when it occurs) and recovery (trying to rebuild after a disaster).

30 Watts, M.J. & H.G. Bohle (1993). The space of vulnerability: the causal structure of hunger and famine. Progress in Human Geography 17.
31Adger,N. (1999). Social Vulnerability to Climate Change Extremes in Coastal Vietnam. World development 27.
32ISDR. Drought Risk Reduction Framework and Practices; Contributing to the Implementation of the Hyogo Framework for Action. 2007.
33 Davies, S (1993). Are Coping Strategies a Cop out? IDS Bulletin 24

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"Indigenous knowledge is the basis for local-level decision-making in many rural communities. It has value not only for the culture in which it evolves, but also for scientists and planners striving to improve conditions in rural localities. Incorporating indigenous knowledge into climate change policies can lead to the development of effective adaptation strategies that are cost-effective, participatory and sustainable" (IPCC 4AR, WG II, Cross-chapter case studies, p865, citing Robinson and Herbert, 2001).

In the Budapest meeting (April 2008), the IPCC recognised that there is an increasing need for coordinated treatment of adaptation and mitigation within an integrated sustainable development strategy and the development of regional approaches to complement the global approach, particularly in assessing the impacts of and vulnerability to climate change. The IPCC will decide on how this and other 'new' issues will be incorporated into the mandate and functioning of the Working Groups for the preparation of the fifth assessment due in 2014. A well-designed framework for either assessment or action provides a logical structure for evaluating the system, ensures that the essential components of the system are addressed as well as the relationships among those components, gives appropriate weight to the different components of the system, and highlights important assumptions and gaps in understanding[34].

Indigenous/Local observations of climate change: A common assessment undertaken with or by indigenous and local communities involves documenting observations of climate change and its impacts. This type of assessment can be extremely powerful as local verification of global models or assessments, including through historical information, and as the basis for developing local adaptation strategies.

Traditional knowledge in forecasting and predicting weather and climate: The communities have mastered the traditional indicators, which include plants, animals, insects, birds, stars, the moon, the wind the temperature, clouds and lightning patterns[35]. Before the advent of modern scientific methods of forecasting, the traditional rural communities were able to observe the behaviour of some animals, birds, insects and plants and use these to forecast the weather for the coming season. The traditional forecasters are still the major source of weather and climate information for farm management in the rural areas. This type of assessment seeks to document traditional knowledge of climate, weather and environment, as well as traditional methods and indicators for forecasting weather. This type of assessment provides a historical record of climate observation that can be used together with western science to develop improved understanding of climate, changes in climate, forecasting and climate models. Traditional indicators are generally most accurate locally, and can contribute to developing local climate change coping strategies. These types of assessments can contribute to the "environmental condition" and "resilience/response" components of the vulnerability framework, and the "state", "impact" and "response" components of the DPSIR framework. It should also be possible to use this information in scenario development. Assessments of traditional climate forecasting have been undertaken in several locations around the world, including in the Pacific, Australia, New Zealand and Africa.

34 Millennium Ecosystem Assessment (http://www.millenniumassessment.org/en/Framework.aspx)
35 http://maindb.unfccc.int/public/adaptation/adaptation_casestudy.pl?id_project=113

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Chapter 2

Climate Change Canvas of Bangladesh

2. Bangladesh at a Glance

Bangladesh is an agro-economy based developing country in South Asia. Bangladesh is located between $20^0 34'$ and $26^0 38'$ latitude and between $88^0 01'$ and $92^0 41$ east longitude. It is bordered on the west, north and east by India, on the southeast by Myanmar, and on the south by the Bay of Bengal. Most of the country is low-lying land comprising mainly the delta of the Ganges and Brahmaputra rivers. Administratively, it is divided into 7 Divisions[36], 64 Districts[37], 482 Upazillas[38] and 4,498 Unions[39].

BANGLADESH: COUNTRY PROFILE	
Official Name	The People's Republic of Bangladesh
Capital City	Dhaka
Geographical Location	In South Asia between 20°.34¢ and 26°.38¢latitude and between 88°.01¢& 92°.41¢east longitude
Area	1,47,570 Sq.Km
Population	157.8 Million (in 2007) **185.6 Million (projected in 2020)**
Density	881 Per Square Km. (Census-2001)
Population by Area	Rural-76.57% Urban-23.43%
Language	National Language : Bengali-98% English is also widely spoken and understood.
Religion based Population	Muslim (89.7%), Hindu (9.2%), Buddhist (0.7%), Christian (0.3%), Animist and tribal faiths (0.1%)
Administrative Units (BBS-2001)	Division -6, District-64, Upazila/Thana-520 Municipal Corporation: 4 Municipalities- 223,Union Parishad-4533, Village-87928
Time	GMT +6.00 Hours
Main Seasons	Winter (November-February) Summer (March-June) Monsoon (July-October)
Principal Rivers	Padma, Meghna, Jamuna, Brahmaputra, Tista and Karnophuli,
	Source: http://www.banbeis.gov.bd/bd_pro.htm

Bangladesh (FAO Statistical Yearbook 2009)	1990-92	1994-96	1995-97	1999-2001	2003-05	2005	2006	2007
Number of People Undernourished (Millions)	41.6		51.4		40.1			
Proportion of Undernourished In Total Population (%)	36		40		27			
Agricultural GDP (Million $ Constant 2000 Prices)		9,244		11,450		13,114	13,762	14,389
Share In Total GDP (%)		25.3		24.3		21.4	21.0	20.7
GDP Per Capita ($ constant 2000 prices)		285		334		401	421	441

36 The second tier of administrative unit just below the national level. The whole country is administratively divided into seven divisions.
37 District is a third tier of administrative unit headed by Deputy Commissioner having co-ordination role among different departments of the Government. However, it is different from district council (Zilla Parishad), which is a first tier of Rural Local Government in Bangladesh.
38 Upazilla is a fourth tier of administrative unit and second tier of Rural Local Government in Bangladesh.
39 Union comprising on an average 8 to 10 villages having population of about approximately 30,000 serves as the lowest Local Government structure and administrative unit in Bangladesh.

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Topography of Bangladesh: The total Geographical area of Bangladesh is about 56,000 square miles. Out of which about 9 million hectares are cultivable land. Between thirty to seventy per cent of the country is normally flooded each year. The elevations in most of the country do not exceed 10m. The land elevation of 50% of the country is within 5 m of Mean Sea level (MSL). About 68% of the country is vulnerable to flood and 20-25% of the area is inundated during normal flood. The coastal zone is low-lying with 62% of the land have an elevation of up to 3 meters and 86% up to 5 meters. The coastal zone has several ecosystems that have important conservation value: mangrove, marine, estuary, islands, coral, sandy beaches which provides habitat for an abundance of plant species as well as an array of fish and wildlife. The water ecosystem of Bangladesh comprises tributaries and distributaries of three major river systems: Ganges, Brahamaputra, and Meghna; and numerous perennial and seasonal wetlands like haors, baors, andbeels.

Current climate: A humid, warm, tropical climate prevails over Bangladesh which is primarily influenced by monsoon and partly by pre-monsoon and post-monsoon circulations. The monsoon has its onset during the first week of June and ends in the first week of October, with some inter-annual variability in dates. Besides monsoon, the easterly trade winds are also active, providing warm and relatively drier circulation. In Bangladesh there are four prominent seasons, namely *Winter* (December to February), *Summer or Pre-monsoon* (March to May), *Rainy season or Monsoon* (June to early-October), and a very short *Autumn or Post-monsoon* (late-October to November). The mean annual rainfall is about 2300mm, but there exists a wide spatial and temporal distribution. Annual rainfall ranges from 1200mm in the extreme west to over 5000mm in the east and north-east (MPO, 1991). More than 80% of the 2,300 mm of annual precipitation that falls on Bangladesh comes during the monsoon period (Smith et al., 1998). In winter, the average minimum and maximum daily temperatures are about 9.7 and 26.6°C respectively. In the summer, the average maximum temperature is about 32.2°C.

Population: Bangladesh is one of the most densely populated countries in the world having more than 144 million people in an area of 147,570 square kilometer and a population density of more than 1,300 persons per km^2, and 75% of the population lives in rural areas[40].

Demographic status of Bangladesh			2006	2007
Total population (Thousands)			139215	141822
Population (Thousands)	Under 18		58970	59402
	Under 5		17284	17399
Population annual growth rate (%)			2.1	2.1
Crude death rate (per 1,000 population)			8	8
Crude birth rate (per 1,000 population)			27	26
Life expectancy at birth (years,)			63	64
Total fertility rate			3.2	3.2
% of population urbanized			25	25
Average annual growth rate of urban population (%)			3.6	3.6
Estimated number of people living with HIV/AIDS (in 000)	Low estimate		2.5	6.4
	High estimate		15	18
Adult literacy rate		Male	50	x
		Female	31	x
	Total adult literacy rate		41	X
Number of phones per 100 population			2	3

Source: UNICEF REPORT: THE STATE OF THE WORLD'S CHILDREN 2006 & 2007

Economy: Bangladesh ranks low on just about all measures of economic development. The per capita income in Bangladesh is US$370. This ranks below average South Asian per capita income and per capita

40 World Bank, 2002. World Development Indicators. On CD Rom. The World Bank, Washington, DC.

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income for low income countries[41]. With a Gini Index of 0.332, income distribution is somewhat unequal, although less so than in many other countries[42]. More than one-third (36%) of the people in Bangladesh live in poverty; in rural areas, it is 40%.

Employed Persons 15 Years and Over by Broad Economic Sector and Sex, 2002-2003

Broad economic sector	Both Sexes		Male		Female	
	No million	*%*	*No. million*	*%*	*No*	*%*
Total	44.3	100.0	34.5	77.9	9.8	22.1
Agriculture	22.9	100.0	17.2	75.0	5.8	25.0
Non-agriculture:	21.4	100.0	17.3	80.8	4.1	19.2
Industry	15.3	100.0	13.1	85.6	2.3	14.4
Services	6.1	100.0	4.2	68.9	1.8	31.1

Source: BBS, LFS 2002-2003

Infrastructure, social and human capital: In 2000, the World Bank estimated that only 9.5% of Bangladesh's 207,500 km network of roads was paved, putting it well below the average for low income countries of 16.5%, suggesting that its physical infrastructure in general might be less developed than that of low income countries. In the same year, the World Bank reported Bangladesh had only 51 scientists and engineers per million people, a number comparable to that for low income countries in general. Similarly, gross secondary and tertiary school enrollment stood at 47.5% and 4.8%, respectively, in 2000. Of that 4.8% in tertiary schools, however, nearly 50% were science and engineering students, a figure that compares favorably with much of the world.

The Rate of Landless People in Bangladesh

Year	Landless People(in percent)
1947	14.30
1970	19.80
1975	32.00
1984	46.00
2001	68.8

Source: Islam. Mujahidul ,2005, *The Daily Ittefaq*, 2 February,2005 Dhaka.

Although UNESCO has recognized long age about the importance of assimilation of scientific and technological information as well as communicable form of knowledge is prerequisite for socio-economic development in developing countries (UNESCO. 1982[43]), the rate of progress on such context is yet very slow in Bangladesh.

IUCN Bangladesh 2004, *"Strategy for Adaptation: Coping With Climate Change and Climate Variability".* Dhaka, Bangladesh.

Surveys conducted (as per of the Dialogue process) in villages and rural areas clearly show that Bangladeshis are aware that the climate is indeed changing, they may not understand why, but they are interested in learning how to adapt. Apart from natural disasters, other indicators of climate change are manifested themselves in the form of erratic weather patterns such as prolonged fogginess, changing temporal and spatial pattern of precipitation are among a few that are observed. Also, floods are occurring in unusual places and during unexpected times of the year, putting greater strains upon traditional coping and adaptation strategies.

[41] World Bank, 2002. World Development Indicators. On CD Rom. The World Bank, Washington, DC
[42] The Gini coefficient is a number between zero and one that measures the degree of inequality in the distribution of income in a given society. The coefficient would register zero inequality for a society in which each member received exactly the same income and it would register a coefficient of one (maximum inequality) if one member got all the income and the rest got nothing.
[43] UNESCO. 1982. Draft medium-term plan (1984-1989). Second part, VII. Information systems and access to knowledge. General Conference Fourth Extraordinary Session, Paris.

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2.1. Understanding the agro-ecological zones in Bangladesh

Floodplains occupy about 80 percent of the country, hills covers 12 percent and rest 8 percent is uplifted blocks ('terraces'). For the most part of floodplain land is flooded for several weeks or months during the monsoon season; (so also are valleys within hill and terrace areas). Flooding characteristics vary both regionally and locally; the extent, depth and duration of flooding also vary from year to year. The seasonal flooding characteristics have an important influence on physical and biological environmental conditions, as well as on land use and agricultural potential, settlement patterns and population distribution. The floodplain landscapes are not entirely flat. Typically, they comprise slightly higher parts (ridges) separated by depressions (basins, old channels). The difference in elevation between the tops of ridges and the centres of adjoining depressions varies between agro-ecological regions.

In 1987, FAO study recognized 30 agro-ecological regions and 88 sub-regions separated on the basis of important differences between them in physiography, soils and flooding characteristics (FAO, 1988).

1 Old Himalayan Piedmont Plain	16 Middle Meghna River Floodplain
2 Active Tista Floodplain	17 Lower Mcghna River Floodplain
3 Tista Meander Floodplain	18 Young Mcghna Estuarine Floodplain
4 Karatoya-Bangali Floodplain	19 Old Meghna Estuarine Floodplain
5 Lower Atrai Basin	20 Eastern Surma-Kusiyara Floodplain
6 Lower Pumabhaba Floodplain	21 Sylhet Basin
7 Active Brahmaputra-Jamuna Floodplain	22 Northern and Eastern Piedmont Plains
8 Young Brahamaputra and Jamuna Floodplain	23 Chittagong Coastal Plains
9 Old Brahmaputra Floodplain	24 St Martin's Coral Island
10 Active Ganges Floodplain	25 Level Barind Tract
11 High Ganges River Floodplain	26 High Barind Tract
12 Low Ganges River Floodplain	27 North-eastern Barind Tract
13 Ganges Tidal Floodplain	28 Madhupur Tract
14 Gopalganj-Khulna Bils	29 Northern and Eastern Hills
15 Arial Bit	30 Akhaura Terrace

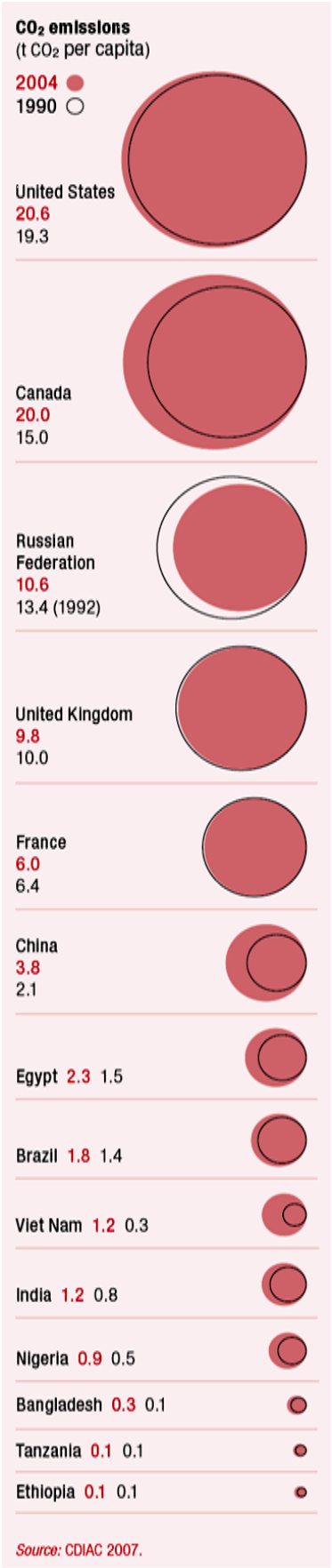
Villages generally are sited on ridges, and village boundaries generally include both ridge and depression land. Typically, too, the fragmented holding of an individual farmer comprises several small fields (average number about 10) which are scattered over both ridge and depression land types. It is useful to distinguish between normal' flooding', to which farmers' cropping practices are well adapted, and abnormal 'floods' which can damage crops.

ECOSYSTEMS OF BANGLADESH		
Terrestrial ecosystem	***Aquatic ecosystem***	***Transitional ecosystem***
Upland and Mainland Forests • Evergreen forests • Semi-evergreen forests and • Deciduous forests *Uplands of Barind tract* *Undulating terrains with acid soil* *Floodplains*	*The Bay of Bengal* *The rivers and their tributaries* *small river and canals* *lakes or oxbow lakes* *Ponds* *perennial and seasonal wetlands like* *haors, baors, and beels*	*Mangrove forests* *Coastal islands* (Bhola, Maheskhali, Kutubdia etc) *Coral resources* (St. Martin's Island) *Estuarine Ecosystems* *Recently accreted poldered land in the south* *Sand dunes/beach ecosystems* *Chars or small islands in the major river beds*

2.2. People's experience about climate change

From a historical perspective, Bengal communities have shown enormous resilience in combating and managing floods and river erosion related disasters. The inherent coping mechanisms within the communities and their traditional knowledge enabled them to organize at the community level and manage disasters.

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People's disaster management history indeed has been fundamental to the development of Bengali society and culture. People along the coastal belt perceive that due to climate change unusual type of flood would happen in future.

Community knowledge about the climate change in Bangladesh

(Compiled from the IUCN report[44])

Trend of Rainfall Peak of the rainy season: Ashar and Sraban (late June and July)	• Reduced rainfall during the peak of the rainy season: Satkhira and Kushtia district • Excessive irregular rainfall: Sunamganj district • Excessive and untimely heavy rainfall: Bhola • Rainfall decreased by 50 percent over the last 8-10 years: Khagrachari district
Temperature Variation	• Changes in temperature range (both in summer and winter): Shatkhira, Kushtia, Sunamganj and Manikganj. • Maximum temperature range has increased to 38°C - 42°C from 32°C –35°C: Kushtia • Length of the cold season has increased (It endures up to the month of Falgoon and Chaitra (February and March)): Kushtia, Shatkhira
Water Logging	• Siltation on the estuaries of the river: Sunamganj, Manikganj • Excessive rain or tidal bore: Bhola
Seasonal Cycle	• Trend of seasonal cycle has been changed: Satkhira, Thakurgaon, Kushtia, Manikganj • Nor'westers or Aswins (storm in October) have not occurred at the time as occurred in the past: Satkhira, Kushtia, Manikganj
Cyclone and Tidal Flow	• Cyclone and tidal bores have increased: Bhola
Drought	• Drought is identified as a serious threat in the near future and drought occur several times in a year: Kushtia, Manikganj and Thakurgaon
Water Salinity and Sea Level Rise	• salinity has increased: Satkhira • anticipated rise in sea level in future due to temperature increase: Kushtia
River bank erosion	• River bank erosion increased: Kushtia
Cloudy, Foggy and Cold Winter	• Prolonged and frequent cold cloudy weather: Sunamganj and Manikganj • incidence of cloudy weather with light rain frequently both in the dry but mainly in winter and rainy seasons: Bhola • thick foggy days in the winter: Thakurgoan & Khagrachari.
Flood	• unusual high flood: Satkhira • number of flash flood in every year: Sunamganj • early flood: Manikganj and Bhola

People of the NW part of the country have experienced number of flash flood in every year, which have destroyed Rabi crops and Boro paddy and cause serious damage to their livelihood. The people of Manikganj and Bhola have long experience about early flood. Short rainy season with excessive rainfall and prolonged heavy rain in the post monsoon-period have been causing early floods in the area. The stakeholders reported that the intensity of floods has increased about 33 percent compared with the past.

[44] IUCN Bangladesh, 2003: Bangladesh National Dialogue on Water and Climate: Local Consultative Report.

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2.3. Climate Change Vulnerability of Bangladesh

Climate change is a global problem that affects us all. But communities in developing countries are likely to suffer most from the negative impacts of climate change[45]. Climate change presents significant threats to achieving all of the Millennium Development Goals, particularly those related to eliminating poverty and hunger and promoting environmental sustainability[46]. According to UNFPA's report "State of the World Population-2005", Bangladesh's population is about 141.8 million and projected to grow to 242.9 million by the year 2050. The per capita availability of land, particularly for agricultural production is .07 hectares (2001 estimate). It is anticipated that the consequences of climate change will increase livelihood insecurity, malnutrition, unemployment, lack of safe drinking water and water-borne diseases in Bangladesh and about one third of the population would be vulnerable to climate change and sea level rise.

Most of the climate models consider sea level rise, higher temperatures, evapotranspiration losses; enhanced monsoon precipitation and run-off, potentially reduced dry season precipitation, and increase in cyclone intensity are as baseline markers of climate change which causes various impacts from local to global scale based on the stress level of these markers. In case of Bangladesh, many of these climate change markers so stressed that they already demonstrates a serious barrier to the continual economic development of Bangladesh[47]. In Global context, Bangladesh holds the longest natural beach of the world (the southeast coast of Bangladesh) and the Sundarbans; the largest single block mangrove ecosystem in the world (shared with India), 798th UNESCO world heritage site, Ramsar Wetlands (the southwestern coast of Bangladesh). The Sundarbans Mangrove Forest is the most diverse mangrove ecological alcove in the world and the largest remaining habitat in the world for the Royal-Bengal Tiger. The Sundarbans Mangrove Forest is also one of the most organic productive areas in the world.

Vulnerability Indicators (Source: UNDP Human Development Report 2008)		**All developing countries**	**South Asia**	**World**	**Bangladesh**
Electricity consumption per capita (kilowatt-hours)	2004	1,221	628	2,701	154
Electricity consumption per capita (% change)	1990-2004	..	..	..	1.1
Electrification rate (%)		68	..	76	32
Forest area (% total land)	2005	27.9	14.2	30.3	6.7
Forest area (thousand sq km)	2005	21,147.80	911.8	39,520.30	8.7
Coal (% of total primary energy supply)	1990	30.3	23.9	25.3	2.2
	2005	32.5	26.1	25.3	1.4
Biomass and waste (% of total primary energy supply)	1990	26.3	37.1	10.3	53.5
	2005	18	25.3	10	34.3
CO2 emissions, total (Mt CO2)	1990	6,831.1 T	990.7 T	22,702.5 T	15.4
	2004	12,303.3 T	1,954.6 T	28,982.7 T	37.1
CO2 emissions, average annual change in (%)	1990-2004	5.7	7	2	10.1
CO2 emissions (% of world total)	1990	30.1	4.4	100	0.1
	2004	42.5	6.7	100	0.1
CO2 emissions per capita (tonnes)	1990	1.7	0.8	4.3	0.1
	2004	2.4	1.3	4.5	0.3
Carbon intensity of energy	1990	2.34	1.94	2.64	1.2
(kt CO2 per kt of oil equivalent)	2004	2.58	2.34	2.63	1.63
Carbon intensity of growth	1990	0.64	0.49	0.68	0.12
(kt CO2 per million 2000 PPP US$)	2004	0.55	0.46	0.55	0.15
CO2 emissions/sequestration from forests (Mt CO2 per year)	1990-2005	5,091.50	-49.3	4,038.10	1.2
Carbon stocks in forests (living biomass) (Mt C)	2005	190,359.70	3,843.50	282,650.10	31

45 Jarraud, M (2003) Climate change and global energy needs: A 21st century perspective, World Meteorological Organization in Renewable Energy 2003, World Renewable Energy Network (affiliated to UNESCO), Sovereign Publications Ltd., London.
46 http://www.undp.org/climatechange/adap01.htm
47 Shardul Agrawala, Tomoko Ota, Ahsan Uddin Ahmed, Joel Smith and Maarten van Aalst, 2003: Development and climate change in Bangladesh: focus on coastal flooding and the sundarbans, Organisation for Economic Co-operation and Development (OECD), COM/ENV/EPOC/DCD/DAC(2003)3/FINAL

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All IPCC impact assessments carried out so far have identified Bangladesh as one of the most susceptible cases as regards the negative impacts of climate change. According to the IUCN report, the case of Bangladesh is unique in the climate change context as this country will eventually face the multidimensional appearance of climate change such as flood, cyclone, sea level rise, drainage congestions, salinity, drought etc[48].

Trend of climate change: The climate models all estimate a steady increase in temperatures for Bangladesh, with little inter-model variance. The Bangladesh Country Study for the U.S. Country Studies Program projected that temperature would rise 1.3°C by 2030 (over mid-20th century levels) and 2.6°C by 2070[49]. In the case of Bangladesh, IPCC projections warn of increasing temperatures, greater rainfall variability, stronger and more frequent cyclones and sea storms, enhanced sea-level rise, and coastal erosion for Bangladesh.

Summary of climate parameter trends[50]	
Rainfall	Trends of Maximum Rainfall for 1-day, 5-day,and 10-day durations show a slight increasing trend (0.2mm/yr, 0.79 mm/yr, and 0.87mm/yr) respectively.
Temperature	The overall temperature regime in Bangladesh is showing a rising tendency following the global trend.
Cyclones	For the period of 1891-2000, the annual frequencies of severe cyclonic storms show a slight increasing trend.
Wind	The trend of maximum series for the period 1980 to 1998 for both annual and monsoon show an increase. For pre-monsoon, post-monsoon, and winter however, there is a decreasing trend.

Within the last decade, Bangladesh has experienced local level fluctuations in rainfall pattern. In the last 4-5 years, people have been experiencing change in rainfall pattern, such as excessive, irregular and prolonged heavy rainfall in the beginning of monsoon and reduced rainfall during the peak season. It has been observed that the range of temperature has changed both in summer and winter and the length of the cold season has also increased.

Rainfall (in mm) by Hydrological Region

Hydrological Region	*Rainfall*	*Dependable Rainfall (DR)*	*Evapotranspiration (ETo)*
South East SE	2271	1746	1275
North West NW	1739	1332	1332
North Central NC	1956	1529	1316
Rivers & Estuary RE	2318	1810	1325
South West SW	1665	1259	1381
North East NE	3194	2595	1233
South Central SC	2307	1793	1287
Eastern Hills EH	2445	1733	1360
Bangladesh	2360	1725	1320
MPO 1991			1553

P = Rainfall; DR= Dependable Rainfall; ETo= Evavotranspiration Source: WARPO, 2000

The trend of seasonal cycle (Traditional cycle of six seasons) has changed. At present mainly three seasons (the rainy season, winter and summer) are perceptible. Furthermore, these three seasons are also not appearing at the same time every year as they did in the past. Nor'westers or Aswins (storm in October) have not occurred at the time as occurred in the past. Similarly, intensity of cold and fog increased and duration of winter extended. Cyclone and tidal bores have increased in the last 15 years.

48 IUCN Bangladesh, 2003: Bangladesh National Dialogue on Water and Climate: Local Consultative Report.
49 Manabe, S., R.J. Stouffer, M.J. Spelman, and K. Bryan. 1991. Transient responses of a coupled oceanatmosphere model to gradual changes of atmospheric CO2. Part I: Annual mean response. Journal of Climate 4:785-818.
50 IUCN Bangladesh 2004, "Strategy for Adaptation: Coping With Climate Change and Climate Variability". Dhaka, Bangladesh. 35-36pp.

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2.3.1. Climate change risks on the coasts of Bangladesh

The coastal region of the country where mean elevations are within 1 to 3 meter are identified as the most vulnerable part due to climate change. Coastal area encompasses majority of the heavy industries, sea ports, and major tourist spots in Bangladesh. The coastal zone is home to over a quarter of the national population. Current estimates project the coastal population to reach 50 million by 2050.

Administrative districts in the coastal zone along with their key characteristics.

No.	Name of District	Area	Population	Eligibility Criteria for Coastal Zone		
		Km2	('000)	Effect of Salinity	Tidal Fluctuation	Cyclone risk
1	Bagerhat	3,959	1,515,815	√	√	
2	Barguna	1,832	837,955	√	√	√
3	Barisal	2,791	2,330,960	√	√	
4	Bhola	3,403	1,676,600	√	√	√
5	Chandpur	1,704	2,210,162		√	
6	Chittagong	5,283	6,545,078	√	√	√
7	Cox's Bazar	2,492	1,757,321	√	√	√
8	Feni	928	1,196,219	√	√	√
9	Gopalganj	1,490	1,132,046	√	√	
10	Jessore	2,567	2,440,693	√	√	
11	Jhalokathi	758	696,055	√	√	
12	Khulna	4,395	2,334,285	√	√	
13	Laksmipur	1,458	1,479,371	√	√	√
14	Narail	990	689,021	√	√	
15	Noakhali	3,601	2,533,394	√	√	√
16	Patuakhali	3,205	1,444,340	√	√	√
17	Pirojpur	1,308	1,126,525	√	√	
18	Satkhira	3,858	1,843,194	√	√	
19	Shariatpur	1,181	1,057,181		√	
	Total	47,203	34,846,215			

The geographic location and geo-morphological conditions of Bangladesh have made the country one of the most vulnerable ones to climate change, particularly to Sea Level Rise. Bangladesh is situated at the interface of two different environments, with the Bay of Bengal to the south and the Himalayas to the north. The environmental characteristics of the country are immensely controlled by the river system. Bangladesh has many rivers, canals, haors, baors, beels, and ponds, which are resources for culturing fish. Wetland-dependent fishers and farmers are most vulnerable to environmental change and disaster.[51]

UNDP's Comprehensive Disaster Management Program (CDMP) lists climate change as a serious component of Bangladesh's vulnerability to natural hazards. Approximately 20 percent of the country and millions of people experiences normal annual flooding. A 67 cm sea level rise could inundate all of the Sundarbans. Even a 25 cm sea level rise would result in a 40% mangrove loss (Smith, Rahman, & Mirza. 1998[52]). A 1 m rise in sea level would inundate 20% of Bangladesh's total land, directly threatening 14% of the country's population with inundation (IPCC 2001[53]). A study has shown that Bangladeshis are aware that the climate is indeed changing, they may not understand why, but they are interested in learning how to adapt (IUCN Bangladesh 2004[54]).

51 Technical session II: Overview paper: Wetlands, Water and Livelihoods, CONVENTION ON WETLANDS (Ramsar, Iran, 1971), Asia Regional Meeting in preparation for Ramsar COP9, Beijing, China, 13-16 May 2005
52 Smith, J.B., A. Rahman, and M.Q. Mirza. 1998. Considering Adaptation to Climate Change in the Sustainable Development of Bangladesh. Report to The World Bank by Stratus Consulting Inc. Boulder, CO.
53 IPCC 2001, Climate Change 2001: Impacts, Adaptation and Vulnerability, Technical summary. A report of working group II of the Intergovernmental Panel on Climate Change (IPCC)
54 IUCN Bangladesh 2004: Strategy for Adaptation: Coping With Climate Change and Climate Variability. Dhaka, Bangladesh.

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2.4. Critical Triggers that Controls Climate Vulnerability in Bangladesh

Climate change poses significant risks for Bangladesh; however the core elements of its vulnerability are linked with two factors, natural vulnerability due to the physiographic nature of the country and the extent of societal exposure of climate change risks. Bangladesh currently has extreme vulnerability to cyclones, both on account of its somewhat unique location and topography, and because of the low capacity of its society and institutions to cope with such extreme events.

Natural Vulnerability: Bangladesh is naturally vulnerable to climate change because of physiographic characters of the country. Most of the country is low-lying land comprising mainly the delta of the Ganges and Brahmaputra rivers. Floodplains occupy 80% of the country. Mean elevations range from less than 1 meter on tidal floodplains, 1 to 3 meters on the main river and estuarine floodplains, and up to 6 meters in the Sylhet basin in the northeast[55]. Only in the extreme northwest, elevations are greater than 30 meters above the mean sea level. The northeast and southeast portions of the country are hilly, with some tertiary hills over 1000 meters above mean sea level[56]. With the exception of the hilly Chittagong area and the northwestern part of the country, most of the country is less than 10 m above sea level. One-fifth of the country is flooded every year, and in extreme years, two-thirds of the country can be inundated. The huge sediment loads brought by three Himalayan rivers, coupled with a negligible flow gradient add to drainage congestion problems and exacerbate the extent of flooding.

Societal exposure of climate change risks on population: All the previous Intergovernmental Panel on Climate Change (IPCC) impact assessments recognized Bangladesh as one of the most susceptible to the negative impacts of climate change. According to IUCN, the case of Bangladesh is unique in the climate change context as this country will eventually face the multidimensional appearance of climate change such as flood, cyclone, sea level rise, drainage congestions, salinity, drought etc. The entire coastal belt including Khulna, Barisal, and Patuakhali regions are most vulnerable to the projected sea level rise and changes in hydrological conditions brought about by climate change. Increased depth of flooding will be pronounced in the lowlands and depressions in the Faridpur, southwest Dhaka, Rajshahi, Pabna, Comilla, Sylhet and Mymensingh districts. Climate change might hamper irrigation in Barind Tract, upper Teesta belt, Chittagong hill tracts and the southwest region in Bangladesh. The utilization of surface water in the southwest region will be decreased due to high salinity limits. Coastal islands, the southeast region, the Brahmaputra-Jamuna river banks might face sever river erosion and displace people.

Very high population and population density of the country enhance the societal exposure to climate change risks. Approximately 20 percent of the country and millions of people experiences normal annual flooding and all the previous major flooding events have inundated more than fifty percent of the country's total area. Conversely, low rainfall years, such as 1997 and 2001, also have demonstrated very serious implications for agricultural productivity, fish availability, and other aspects of rural livelihoods. With over 35% of population in Bangladesh is suffering from malnourishment[57] and 61% of children are malnourished.[58]
A relatively uneducated and illiterate public can be considered as less capable of adapting to climate change, and thus has higher vulnerability.

55 Rashid, H.E., 1991, "Geography of Bangladesh" (Second Revised Edition), The University Press Ltd., Dhaka, Bangladesh.
56 Huq, S. and Asaduzzaman, M.. 1999. Overview. In *Vulnerability and Adaptation to Climate Change for Bangladesh,* S. Huq, Z. Karim, M. Asaduzzaman, and F. Mahtab (eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands, pp.1-11.
57 Lal, M., H. Harasawa, and D. Murdiyarso. 2001. Asia. In Climate Change 2001: Impacts, Adaptation, and Vulnerability, J. McCarthy, O. Canziani, N. Leary, D. Dokken, and K. White (eds.). Cambridge University Press, New York, pp. 533-590.
58 World Bank, 2002. World Development Indicators. On CD Rom. The World Bank, Washington, DC.

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Temperature variations: Temperature largely controls the rates of growth (e.g. photosynthesis) and development (e.g. leaf appearance, flowering) in crops. Episodes of high temperature, particularly during critical plant development stages drastically reduce yields of field crops. Most agricultural crops offer varieties, which vary in their general and specific climatic requirements and in their length of total growing period from sowing to harvest. This variation allows a crop to be adapted to a wide range of climatic conditions and to the period required and available for crop production. When crops are grown under lower than optimal temperatures, yields can be reduced by various mechanisms including: limited light interception (e.g. due to slow leaf area expansion), inefficient conversion of intercepted light into biomass (i.e. reduced photosynthesis rates), or direct damage to plant tissues caused by early or late frosts.

Poverty: The World Bank defines poverty as "the inability to attain a minimal standard of living" (World Bank, 1990:26). Poverty is generally defined in the following two ways: 1. lack of "means" in relation to "needs" and 2. lack of "means" in relation to "means" (Sen, 1999:12[59]). Although the poverty rate in Bangladesh has gone down by 10% since 1990, nearly half of the population still lives below the poverty line with food security being of vital importance to the poor. Landlessness combined with lack of employment opportunities restricts access to adequate nutrition, leading to poor health status and reduced ability to work, with women headed households being especially vulnerable.

Poverty Head Count Ratio by DCI Method 1981- 82 to 2000.	% of population below poverty line		
	National	Rural	Urban
2004	40.9	40.1	43.6
2000	44.3	42.3	52.5
1995-96	47.5	47.1	49.7
1991-92	47.5	47.6	46.7
1988-89	47.8	47.8	47.6
*1985-86	55.6	54.7	62.6
*1983-84	62.6	61.9	67.7
*1981-82	71.0	73.0	68.0

Sources : BBS, HIES various years, PMS 2004; Poverty estimates were based on 2200 k.cal and for other years 2122 k.cal

Incidence of Poverty by Sex of Head of Households by DCI Method	Percentage of Population			
	Absolute Poverty (< 2122 K. cal)		Hard Core Poverty (< 1805 K. cal)	
	Men-headed	Women-headed	Men-headed	Women-headed
1988-89				
National	47.8	44.5	27.7	32.0
Rural	47.9	42.3	28.5	33.0
Urban	47.6	49.0	26.2	35.7
2000				
National	44.0	49.1	19.6	26.4
Rural	41.0	47.7	18.4	54.6
Urban	52.4	53.3	24.4	27.7

Gender of Household Head	% of population below poverty line (using upper poverty line)		
	Total	Rural	Urban
Male	49.9	53.1	36.6
Female	48.0	51.6	37.0
	% of population below poverty line(using lower poverty line)		
Male	37.7	37.4	18.7
Female	34.2	37.7	23.2

According to the *Direct Calorie Intake (DCI)* method, head-count poverty declined from 46.2 percent in 1999 to 40.9 percent in 2004. The corresponding estimates under the *Food Energy Intake (FEI)* method have

59 Sen, Amartya, 1999, *Poverty and Famine*, Oxford University press, London.

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been 44.7 and 42.1 percent for 1999 and 2004 respectively. According to both these measurements, *the rate of poverty reduction has been found to be higher for urban areas compared to rural areas.*[60]

2.5. Climate Change Impact on Bangladesh

UNDP's Comprehensive Disaster Management Program (CDMP) lists climate change as a serious component of Bangladesh's vulnerability to natural hazards. The most vulnerable part of Bangladesh lies along the southeast and southwestern coasts of the country where mean elevations are within 1 to 3 meter. These two coastal zones encompass majority of the heavy industries, both of the country's sea ports, major tourist spots, the longest beach of the world (the southeast coastal zone) and the Sundarbans- the largest mangrove ecosystem in the world (the southwestern coastal zone). Between these two coasts, there lies the most productive region of the country in terms of agriculture production. Any impact on these coasts could have dramatic consequences for the Bangladesh economy.

Climate change assessments of Bangladesh suggest steadily increasing temperatures, particularly for the winter season, but also during the monsoon season[61]. There is some uncertainty in projections on a clear direction of change in the case of long-term precipitation averages[62], though rainfall events are expected to become more intense, with increasing variability during the monsoon season. In addition, the IPCC Fourth Assessment Report (SPM)[63] suggests sea-level rise of several tens of centimeters by the end of the century, barring rapid glacial disintegration which could increase sea level much faster than anticipated with gradual change. This will change coastal morphology – leading to progressive inundation of low-lying lands – but will change river flow patterns and reduce river speeds, increasing sedimentation, raising river beds and worsening the threat of floods.

According to IPCC in their recently published Fourth Assessment, the following changes have been observed in climate trends, variability and extreme events

a) In Bangladesh, average temperature has registered an increasing trend of about 1°C in May and 0.5°C in November during the 14 year period from 1985 to 1998.
b) The annual mean rainfall exhibits increasing trends in Bangladesh.
c) Serious and recurring floods have taken place during 2002, 2003, and 2004. Cyclones originating from the Bay of Bengal have been noted to decrease since 1970 but the intensity has increased.
d) Frequency of monsoon depressions and cyclones formation in Bay of Bengal has increased.
e) Salt water from the Bay of Bengal is reported to have penetrated 100 km or more inland along tributary channels during the dry season.
f) The precipitation decline and droughts has resulted in the drying up of wetlands and severe degradation of ecosystems.

One study has estimated that due to the predicted rise in sea levels, the 65 per cent of the populations who are currently vulnerable to floods, may increase to more than 90 per cent with the possibilities of about 5 million people being severely affected by inundation[64]. During the period 1973–1987, about 2.18 million tons of rice was damaged due to drought and 2.38 million tons due to flood. It is very alarming that three very severe droughts had occurred within 4 years. An analysis of the relative effects of flood and drought on rice

60 GOB, 2005: Bangladesh, Unlocking the potential, National Strategy for Accelerated Poverty Reduction, General Economics Division, Planning Commission, Government of People's Republic of Bangladesh (GOB).
61 Ahmed, A.U. et. Al., (1999), 'Vulnerability of Forest Ecosystems of Bangladesh to Climate Change,' in S. Haque *et al*. (eds), 1999, Vulnerability and Adaptation to Climate Change for Bangladesh (Kluwer Academic Publishers), Dordrecht, The Netherlands.
62 Mitchell, T.D., Carter, T.R., Jones, P.D., Hulme,M., New, M., 2003: A comprehensive set of high-resolution grids of monthly climate for Europe and the globe: the observed record (1901-2000) and 16 scenarios (2001-2100). Journal of Climate: submitted.
63 IPCC 2007. "Climate Change 2007: The Physical Science Basis: Summary for Policymakers." IPCC: Geneva, Switzerland.
64 Nasreen, Mahbuba, 2004. Disaster Research: Exploring Sociological Approach to Disaster in Bangladesh, published in the e-journal of Sociology, www.bangladeshsociology.org. Volume 2, number 2, October, 2004

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production between 1969-70 and 1983-84 shows that drought is more devastating than floods to aggregate production. Drought affects annually about 2.32 million hectares and 1.2 million hectares of cropped land during the Kharif (summer) (November to June) and Rabi (winter) (July to October) seasons respectively, while soil salinity, water logging and acidification affect 3.05 million hectares, 0.7 million hectares and 0.6 million hectare of crop land, respectively in the country.

Sectors	Sectoral Impacts of Climate Change in Bangladesh
Population at risk	Poverty will increase; low agricultural outputs due to drought, salinity and flooding will limit livelihood options; even without climate change, 55% of the populations are affected by inundations; about 8.5 million people live in drought-prone areas.
Infrastructure	A one meter SLR will cost over $5 billion, equivalent to 10% of the GDP; such infrastructure includes water systems, housing & settlements, transport networks, utilities & industry.
Agriculture & Food Security	About 17% decline in rice production & a 61% decline in wheat production; agriculture employs about 30% of the population & contributes % of GDP.
Coastal Zone	Vulnerability would be acute due to combined effects of saltwater intrusion, drainage congestion, extreme weather events, subsidence, and changes in upstream river discharge.
Fisheries	Contributes 5.5% of GDP & about 80% of animal protein intake of diet comes from fish; Contributes 3.5% of GDP & about 80% of animal protein intake of diet comes from fish; SLR & intrusion of saline water into rivers & other inland water bodies in the coastal region would cause fish habitats to decline.
Forestry & Biodiversity	Sundarbans, the world's largest mangrove forest, would be the worst victims due to a combination of high evapotranspiration & low flow in winter resulting in increasing soil salinity; with a one meter SLR, it would be lost for ever; increasing floods will affect forestry.

Huq, Saleemul et al., Mainstreaming Adaptation to Climate Change in Least Developed Countries (LDCs), IIED, ENDA & Shell, 2003.

2.5.1. Status of Cyclones, Floods & Droughts in the Climate Chang Near Future

The possible impact of climate change in the near future for the most part are related to coastal and riverine flooding, but also enhanced possibility of winter (dry season) drought in certain areas.

- ***Flooding will be increased:*** Bangladesh is already vulnerable to coastal flooding, and this vulnerability will increase under climate change due to a combination of factors. The effects of increased flooding resulting from climate change will be the greatest problem faced by Bangladesh. Both *coastal* flooding (from sea and river water), and *inland* flooding (river/rain water) are expected to increase. Alam et al (1998) reported that, by the year 2030, an additional 14.3% of the country will become extremely vulnerable to floods, while the already flood vulnerable areas will face higher levels of flooding[65]. It is also reported that, even if the banks of the major rivers are embanked, more non-flooded areas will undergo flooding by the year 2075.

- **Salinity Intrusion:** As sea level continues to rise the associated effects of permanent inundation is likely to increase the salinity near coastal areas. The study also shows that 5 ppt saline front will penetrate about 40 km inland for SLR of 88 cm, which is going to affect the only fresh-water pocket of the Tentulia River in Meghna Estuary. Increased salinity intrusion due to sea level rise poses great threat to the Sundarbans. The Sundarbans has already been affected due to reduced freshwater flows through Ganges river system over the last few decades particularly during the dry season. This has led to a definite inward intrusion of the salinity front causing the different species of plants and animals to be adversely affected. Increased salt water intrusion is considered as one of the causes of top dying of Sundari trees. The impact of sea level rise will further intrude the saline water to landward. Sea level rise of 32 cm will intrude 10 to 20 ppt salinity level more in the Sundrabans. The rate of salt-water intrusion will also affect the ability of the ecosystem to adapt.
- **Drainage Congestion will be common:** Drainage congestion for a long time makes land unproductive and reduces the opportunities for intensive cultivation or other uses. Drainage provision is vital to the

65 Quoted in Shardul Agrawala, Tomoko Ota, Ahsan Uddin Ahmed, Joel Smith and Maarten van Aalst, 2003: Development and climate change in Bangladesh: focus on coastal flooding and the sundarbans, Organisation for Economic Co-operation and Development (OECD),

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cultivation of upland crops, i.e. vegetables, fruits, flowers, plant nurseries and so on. The drainage of coastal polders mainly depends on the tidal characteristics of the surrounding rivers and degree of siltation of these rivers. Present study mainly focused on the change in the tidal characteristics of the surrounding rivers due to sea level rise and its impact on inundation area of the polder.

- **Frequency and intensity of cyclones will be increased:** Higher mean sea levels are likely to compound the enhanced storm surges expected to result from cyclones with higher intensity. The IPCC Third Assessment illustrated the evidence of a 5-10% increase in peak intensity (wind-speed) of tropical cyclones that likely to enhanced storm surges and coastal flooding. IPCC also projects a 20-20% increase in intensity of associated precipitation that would contribute to (rain-water) flooding both in the coast and inland as the cyclone makes landfall[66,67]. Although these estimates are not location specific but for tropical cyclones in general, hence could be considered appropriate for Bangladesh. In addition, IPCC also concluded that *frequencies of tropical cyclones may change but none that their locations will change*. Considering the fact that over two-thirds of the country is less than 5 m above sea-level and densely populated, in future storm surges might be even higher than those observed currently and can cause more disastrous phenomena. It is notable that Bangladesh is already prone to inland flooding because of its topography and geographic position at the mouth of three major river systems. One study depicted that the effect of any repeat of the 1991 cyclone with a 2°C increase (which causes a 10% increase in wind speed) and a 0.3 m sea level rise would result in a 1.5 m higher storm surge and would inundate 20% more land than the storm surge from the 1991 cyclone[68].

- ***A fifth of Bangladesh will be drowned entirely and the rest regularly experience floods on the scale of 1998:*** Digital terrain modeling techniques reveals, at present expected rates, the sea level will be 1.5 meters higher in about 150 years from now[69]. On current predictions, a fifth of Bangladesh will be drowned entirely and the rest regularly experience floods on the scale of 1998 by 2100[70].

- ***Increased rate of Himalayan glacier melt may cause more frequent inland flooding:*** Higher temperatures will result in more glacial melt, increasing runoff from the neighboring Himalayas into the Ganges and Brahmaputra rivers. It is already observed that temperatures in the Himalayas are rising at higher rates, which ultimately enhance the snow melt rate of the Himalayan glaciers. In very near future, intensified flooding is likely to happen over the country due to this upstream climate change impact.

- ***Increased precipitation will raise the water level of the major rivers and may intensify flooding:*** Mirza and Dixit (1997) found that a 2°C warming with a 10% increase in precipitation would increase runoff in the Ganges, Brahmaputra, and Meghna rivers by 19%, 13%, and 11%, respectively[71]. This will contribute to increased runoff and likely to intensify flooding. The projected water level hydrographs show that maximum water level will cross the danger level in all stations. The highest water level will remain above the danger level for 35 days in Hardinge Bridge, 30 days in Bahadurabad and 22 days in Bhairab Bazar respectively by the year 2030. Increased water level above the danger level indicates possibility of flooding.

66 IPCC, 2001a, “Climate Change 2001, Scientific Basis; Summary for the Policy Makers”, IPCC, WMO-UNEP, Geneva, Switzerland, pp. 20.
67 IPCC, 2001b, “Climate Change 2001: Impacts, Adaptation and Vulnerability, Summary for Policymakers”,Working Group II, Inter-governmental Panel on Climate Change (IPCC), Geneva.
68 Ali, A. 1996. “Vulnerability of Bangladesh to climate change and sea level rise through tropical cyclones and storm surges.” *Water, Air, and Soil Pollution* 92:171-179.
69 Mirza, M.M.Q., 2002, “Global Warming and Changes in the Probability of Occurrence of Floods in Bangladesh and Implications”, Global Environmental Change.
70 http://peopleandplanet.org/resources/climatechangebriefing/theimpact/
71 Mirza, M.M.Q.and Dixit, A.,1997, “Climate Change and Water Resources in the GBM Basins”Water Nepal, 5(1), pp.71-100.

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- ***In non-cyclone situations, problems of coastal inundation and salinization will be increased if sea-level rise on:*** Even in non cyclone situations, higher mean sea levels are going to increase problems of coastal inundation and salinization in the low lying deltaic coast of Bangladesh.

- ***Urban Flooding and water logging might increase:*** The combined effects of increased precipitation and increased discharge and water level in the major rivers will directly affect Dhaka city. The increased discharge and water level, particularly for the River Brahmaputra, will affect the discharge and water level in the rivers surrounding Dhaka city. The expected increase of precipitation will cause water logging in the city.

- ***Small prolongation of winter season may cause drought:*** The climate models show small decreases in the winter months of December through February. The increase is not statistically significant, and winter precipitation is just over 1% of annual precipitation. However, with higher temperatures increasing evapotranspiration combined with a small decrease in precipitation, dry winter conditions, even drought, are likely to be made worse.

- **Very severe droughts might hit more frequently than the anticipated rate:** During the last three decades (between 1960 and 1991), droughts occurred in Bangladesh 19 times which have affected about 47 percent area of the country and 53 percent of the population[72]. Bangladesh have experienced only 4 (1951, 1961, 1975, 1979) very severe droughts in between 1950 to 1980 whereas within a decade (1981 to 1990), 4 very severe droughts (1981, 1982, 1984, and 1989) had occurred in the country. It is very alarming that three very severe droughts had occurred within 4 years. An analysis of the relative effects of flood and drought on rice production between 1969-70 and 1983-84 shows that drought is more devastating than floods to aggregate production.

- **Land degradation will be increased:** Bangladesh experiences long spell of dry months (7 months) and moderate to severe droughts are spread over a region of 5.46 M ha. 6.0 million hectares of land in Bangladesh falls below the minimum threshold for sustainable cultivation. Drought reduces total cultivable area available for production. The total economic cost of land degradation exceeded US $ 2000 million per year.

Length of time (decade/10 years)	Number of severe droughts	Average Drought Lag Time (interval between two severe droughts)
1951-1960	1	10 years
1961-1970	1	10 years
1971-1980	2	5 years
1981-1990	4	2.5 years

Source: Government of Bangladesh (GOB), 2001: National Report on Implementation of United Nations Convention to Combat Desertification Bangladesh, Ministry of Environment and Forests, Government of the Peoples Republic of Bangladesh, July 2001.

2.5.2. Climate change impact on Agriculture and Biodiversity

Climate change imposes serious concern about agriculture in Bangladesh. Agriculture contributes about 25% of GDP (crops 14 percent, forestry 2 percent, livestock and poultry 3 percent and fisheries 6 percent) and the rural non-farm sector contributes another 36 percent[73]. In addition, agriculture generates two-thirds of total employment, contributes a quarter of total export earnings and provides food security to the increasing population.

72 Government of Bangladesh (GOB), 2001: National Report on Implementation of United Nations Convention to Combat Desertification Bangladesh, Ministry of Environment and Forests, Government of the Peoples Republic of Bangladesh, Bangladesh Secretariat, Dhaka –1000, July 2001.
73 Government of People's Republic of Bangladesh, 2005:Unlocking the Potential, National Strategy for Accelerated Poverty Reduction

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- **Climate change might redefine the agro-ecologically disadvantaged areas in Bangladesh**: Char lands, coastal areas, haors and other deeply flooded areas are recognized in PRSP report as the agro-ecologically disadvantaged areas in Bangladesh. Climate change might hamper irrigation in Barind Tract, upper Teesta belt, Chittagong hill tracts and the southwest region in Bangladesh. The utilization of surface water in the southwest region will be decreased due to high salinity limits. Coastal islands, the southeast region, the Brahmaputra-Jamuna river banks might face sever river erosion and displace people.

- **Climate change will severely damage Agriculture and Biodiversity:** According to one estimate (Nasreen and Hossain, 2004[74]), about 40 per cent of forestlands have reportedly been lost from 1960 to 1990 and the estimated rate of deforestation being 8,000 ha per year. Bangladesh has less than 0.02 ha of forest land per person, one of the lowest forest-man ratios in the world. Deforestation rate was 0.9 per cent in 1970, but rose to 2.7 per cent in 1984-90.If the current trend continues, forests are likely to disappear altogether in the next 35-40 years or even earlier. The implication of continued deforestation is that valuable species may disappear forever.

- ***Climate changes will reduce agriculture production:*** Sea level rise will threaten hundreds of thousands if not more than a million hectares of agricultural land[75]. In eastern Bangladesh alone 14,000 tons of grain production would be lost to sea level rise in 2030 and 252,000 tons would be lost by 2075. The current agricultural production for the country is 30 million tons[76]. The increasing temperatures and reducing precipitation both have a negative effect on yields. Of the three varieties of rice grown in Bangladesh, the Aus rice (grown during the summer, monsoon period under rain-fed conditions) seems to be the most vulnerable.

- ***Increased salinity level could destroy crops:*** It has been observed that salinity has increased along the coastal belt. If salinity level goes up, crops can't be cultivated at least for three years unless any measures are taken.

- ***Extinction of certain climate sensitive plant species of Bangladesh:*** The change in seasonal temperature and precipitation may negatively affect the propagation of several plant species, which fail to adapt to new temperature and rainfall patterns and timing. This may lead to the extinction of certain plant species of Bangladesh.

- ***Changes in rainfall may decrease on the production and breeding of local fishes:*** Differentiation of rainfall pattern in different locations might be due to consequence of climate variability and poses great threats for this agrarian and rural society. Besides agriculture production, changes in rainfall may impact on the production and breeding of local fishes (for example Koi, Shing and Magur).

2.5.3. Climate change impact on the Sundarbans Mangrove Forest

One of the likely adverse impacts of climate change is the loss of the Sundarbans, the coastal mangroves that straddle the coasts of western Bangladesh. If the Sundarbans are lost, the habitat for several valuable species would also be lost. A 45 cm sea level rise would inundate 75% of the Sundarbans, and 67 cm sea level rise could inundate all of the Sundarbans. Even a 25 cm sea level rise would result in a 40% mangrove

74 Nasreen, Mahbuba, and Khondokar Mokaddem Hossain, 2004. 'Transboundary Rivers: Socio-economic and environmental challenges in Bangladesh' published in Feroze M. Ahmed et al (eds.) *Regional Cooperation on Transboundary Rivers: Impact of the Indian River linking Project*, Dhaka: BAPA, BEN, DU, BUET and Others, December, 2004.
75 Huq, S., Ali, S.I. and Rahman, A.A, 1995. "Sea-level rise and Bangladesh: A preliminary analysis." Jour. of Coast Res. Special Issue 14:44-53.
76 WRI. 2001. World Resources: 2000-2001. World Resources Institute, Washington, DC.

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loss[77]. If both the fresh water zone and the moderate salt water zone of the Sunderban mangroves turn to saltwater zone then the whole mangrove is likely to hold only those types of species which now exist in the saltwater zone. The Sunderbans, haor basins, Khulna- Gopalganj beel areas are the critically affected areas.

Impact of Changes in Climatic elements and sea-level Rise on Bangladesh

Changes in Climatic elements and sea-level Rise	Vulnerable region of Bangladesh	Primary Change	Impacts	
			Primary	***Secondary***
0.5^0 C - 2^0 C (10 -to- 45cm sea-level rise)	Bangladesh Sundarbans	Inundation of about 15% (~750 km^2) Increase in salinity	Loss of Plant species Loss of wild life	Economic loss Exacerbated insecurity and loss of employment
~2^0C (5 to 10% rainfall; 45cm sea-level rise)	Bangladesh Lowlands	about 23-29% increase in extent of inundation	Change in flood depth category Change in monsoon rice cropping pattern	Risk of life and property Increased health problems Reduction in rice yield

Source: IPCC 2001, Climate Change 2001: Impacts, Adaptation and Vulnerability, Technical summary. A report of working group II of the IPCC

2.5.4. Climate change impact on the Scarcity and demand for Resources

Increasing Demand for water and Enormous scarcity of quality drinking water both will simultaneously be prominent: In a climate change scenario, surface water availability during monsoon will increase, whereas winter water availability will decrease and more water will be required for irrigation in winter. Because of climate change, quality drinking water for both drinking and irrigation will be adversely precious due to the reduced flow during dry season as well as frequent flooding. It is important to note that currently the water quality adversely affected by the presence of arsenic and other contaminants. In that context, the impact of climate change will impose enormous challenges to ensure quality drinking water for survival. Urbanization, industrialization and changing consumer habits will all produce significant increases in water demands, with many of these increases concentrated to a far higher extent than existing demand patterns. The groundwater table goes below 8.95 m to 18.56 m in dry season and most of the shallow tubewell goes below the suction lift capacity in the peak irrigation period. The ground water levels beneath Dhaka City have fallen steadily over the last twenty-five years in response to continuously increasing abstraction. Water levels have dropped and reached a maximum depth of 20 meters below ground surface in 1989 (from about 3 meters in 1965) [78].As a consequence of climate change the trend shows that drier regions would be drier in the winter season. Therefore, the possibility of growing rain-fed crops would be diminished. This will be particularly important in more arid areas such as the north-west where existing water availability is already a constraint upon agricultural production.

Population Growth & Annual Per Capita Water Availability

Year	Per capita water availability (m3/annum)
1991	12,162
2000	10,305
2010	9,000
2020	7,941
2025	7,670

Climate change will impose more demand for energy: Climate change will have its most complex and vexing effect on national economy in the realm of energy. As ambient air temperatures increase, energy demand for cooling will also increase, requiring more imported oil.

2.5.5. Climate change impact on Poverty and Livelihood Security

Climate change may undermine livelihood security of these marginalized people by reducing access to, and the quality of, natural resources that are important to sustain livelihoods. More than one-third (36%) of the people in Bangladesh live in poverty; in rural areas, it is 40%. Catastrophic events in the past have caused damage up to 100 km inland. Degradation of soil fertility due to indiscriminate and inefficient use of chemical

77 Smith, J.B., A. Rahman, and M.Q. Mirza. 1998. Considering Adaptation to Climate Change in the Sustainable Development of Bangladesh. Report to The World Bank by Stratus Consulting Inc.Boulder, CO.
78 Government of Bangladesh (GOB), 2001: National Report on Implementation of United Nations Convention to Combat Desertification Bangladesh, Ministry of Environment and Forests, Government of the Peoples Republic of Bangladesh, July 2001.

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fertilizer and pesticides and river erosion are already posing threats for both sustainability of agricultural and human habitation in Bangladesh. Given the contribution of agriculture to the livelihoods of general people of the country and its dependence on climate regime, any significant change in climate regime can have far reaching impacts on the overall socio-economic system. Nearly 76 percent of women fell under the category "poor" in terms of income and resource endowments[79]. One study has estimated that due to the predicted rise in sea levels, 65 per cent of the populations who are currently vulnerable to floods, may increase to more than 90 per cent with the possibilities of about 5 million people being severely affected by inundation (Nasreen, 2004[80]). The same study also envisaged that in Bangladesh, the damages to coastal infrastructure as the consequence of global warming and climatic change could be 12 per cent of GDP by the year 2010 and rice production could be dropped by as much as 10 per cent.

- ***Poverty will be more prevalent if threat of increased hunger arises from reduction in agricultural production:*** The threat of increased hunger from reduction in agricultural production would suggest the inclusion of agriculture as one of the major vulnerabilities facing the country. It is not just farmers whose livelihoods are at risk from climate change, but also those whose livelihoods depend on agricultural production such as suppliers of inputs, people who work in transporting and processing agricultural commodities, people who work as extension officers, and people who work in agricultural lending services.

- ***Massive displacement of populations may arise due to inundation:*** Sea level rise will result in coastal flooding; hence more people would be at risk from flooding from coastal storms. Inundation of such a large portion of the country could present major challenges in terms of loss of income and displaced populations. The entire coastal belt including Khulna, Barisal, and Patuakhali regions are most vulnerable to the projected sea level rise and changes in hydrological conditions brought about by climate change. Increased depth of flooding will be pronounced in the lowlands and depressions in the Faridpur, southwest Dhaka, Rajshahi, Pabna, Comilla, Sylhet and Mymensingh districts. A forced migration in a massive-scale likely to happen and that may imbalance social harmony and conflict for resources. A 1 m rise in sea level would inundate 20% of Bangladesh's total land, directly threatening 14% of the country's population with inundation[81]. In addition, the backwater and increased river flow from sea level rise could affect 60% of the country's population. [82,83] In addition, the major port of Mongla would be at risk, as would one-eighth of the country's agricultural land and 8,000 km of roads[84]. Although such a rise in sea level is reasonably probable over many centuries, [85] Bangladesh could face similar situation within the 100 years from today.

2.5.6. Climate change impact on human health

Climate change interacts with health in poor countries and communities are through the negative consequences for food security. Temperature and rainfall variation due to climate change affects agricultural production and productivity. The combination of higher temperatures and potential increases in summer precipitation could create the conditions for greater intensity or spread of many infectious diseases.

79 Government of Bangladesh, 2003: Consideration of reports submitted by States parties under article 18 of the Convention on the Elimination of All Forms of Discrimination against Women, Fifth periodic report of States parties: Bangladesh, CEDAW/C/BGD/5, 2003.
80 www.bangladeshsociology.org. Volume 2, number 2, October, 2004
81 Climate Change 2001: Impacts, Adaptation and Vulnerability, Technical summary. Intergovernmental Panel on Climate Change (IPCC)
82 Bijlsma, L. 1996. "Coastal zone and small island states." In Climate Change 1995: The IPCC Second Assessment Report, Volume 2: Impacts, Adaptations and Mitigation of Climate Change: Scientific Technical Analyses, R.T. Watson, M.C. Zinyowera, and R.H. Moss (eds.). Cambridge University Press, Cambridge, United Kingdom, pp. 289-324.
83 Karim, K. and Rahman, A., 1995. Bangladesh: Assessment of the vulnerability of coastal areas to climate change and sea-level rise: A pilot study of Bangladesh. In Proceedings of WORLD COAST 1993,
84 Huq, S., Ali, S.I. and Rahman, A.A, 1995. "Sea-level rise and Bangladesh: A preliminary analysis." *Jour. of Coast. Res.* Specl Issue 14:44-53.
85 Church et al. 2001. IPCC. In *Climate Change 2001: The Scientific Basis,* J.T. Houghton, Y. Ding, D.J.Griggs, M. Noguer, P.J. van der Linden, D. Xiaosu, and K. Maskell (eds.). Cambridge University Press, New York, pp. 639-693.

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Climate change is expected to present increased risks to human health in Bangladesh. Researchers found a robust relationship between progressively stronger El Nino events and cholera prevalence, spanning a 70-year period from 1893-1940 and 1980-2001[86]. One study findings [87] indicates that warming trends over the last century are affecting human disease. In general climate change is expected to present increased risks to human health in Bangladesh, especially in light of the poor state of the country's public health infrastructure. Bangladesh government expenditure on health (US$12 per person per year) is much below than the in general health expenditure (US$21 per person per year) in low income countries.

2.5.7. Climate change impact on Social Conflict, Development & Human Insecurity

Human insecurity, social conflict regarding resource ownership and use might be increase at the society due to climate change. Poverty and food insecurity may create more social conflict regarding resource ownership and use. The degree to which people are vulnerable to climate change depends on the extent to which they are dependent on natural resources and ecosystem services, and the extent to which the resources and services they rely on are sensitive to climate change.

The relationship between human insecurity, social conflict and climate change	
Factors of violent conflict	*Processes which climate change could affect society*
Vulnerable livelihoods	Climate change is likely to cause widespread impacts on water availability, coastal regions, agriculture, extreme events and diseases. These affect livelihoods by exposing people to risks, thereby increasing their vulnerability. The impacts will be more significant in sectors of the population with high resource-dependency, and located in more environmentally and socially marginalized areas. Some of these climate driven outcomes are long term and chronic (such as declining productivity of agricultural land), while others are episodic (such as floods).
Poverty (relative/chronic/transitory)	Poverty (and particularly relative deprivation) is affected by the spatial differentiation of climate impacts and the sensitivity of places to them. Climate change may directly increase absolute, relative, and transient poverty by undermining access to natural capital. It may indirectly increase poverty through its effects on resource sectors and the State. Stresses from climate change will differentially affect those made vulnerable by present political-economic processes.
Weak states	The impacts of climate change are likely to increase the costs of providing public infrastructure such as water resources, and services such as education, and may decrease State revenues. So climate change may decrease the State's ability to create opportunities and provide important freedoms for people, as well as decrease the State's capacity to adapt and respond to climate change itself.
Migration	Migration may be one response of people whose livelihoods are undermined by climate change. However climate is unlikely to be the sole, or even the most important 'push' factor in migration decisions. Yet large-scale movements of people may increase the risk of conflict in host communities.
Source: Jon Barnett, and Neil Adger, 2005: Security and Climate Change: Towards an Improved Understanding, Paper presented at an International Workshop " Human Security and Climate Change" Holmen Fjord Hotel, Asker, near Oslo, 20–21 June 2005	

Bangladesh might have to bear a huge Economic burden due to the climate change. At present, Bangladesh is too poor to be able to adapt to such a rise in sea level. The costs of protection would be substantial. One study estimated that 4,800 km of existing coastal defenses would be needed for upgrading and an additional 4,000 km of new defenses would be needed and that could cost up to 1 billion US$ [88]. In monetary terms, between about one-fifth and half of all development activities in Bangladesh could be affected by climate change. Bangladesh's extremely high exposure to natural hazards, particularly floods, is clearly reflected in the large share of emergency projects (about 7% of the amount and 9% of the number of development activities). Between 22-53% of development assistance (by aid amount) or 22-37% of donor projects (by number) are in sectors potentially affected by climatic risks[89].

86 Patz, 2002. A human disease indicator for the effects of recent global climate change. Proce. of the Na. Acad. of Sci., 99, 20: 12506-12508.
87 Rodo, X., M. Pascual, G. Fuchs, and A.S.G. Faruque, 2002. ENSO and cholera: A no stationary link related to climate change? Proceedings of the National Academy of Sciences, 99, 20: 12901-12906.
88 Huq, S., Ali, S.I.& Rahman, A.A, 1995. "Sea-level rise and Bangladesh: A preliminary analysis." *Jour. of Coas. Res.* Special Iss. 14:44-53.
89 Shardul Agrawala, Tomoko Ota, Ahsan Uddin Ahmed, Joel Smith and Maarten van Aalst, 2003: *Development and climate change in Bangladesh: focus on coastal flooding and the sundarbans*, Organisation for Economic Co-operation and Development (OECD),

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Chapter 3

Community-Driven Climate Change Adaptation

3. Introduction

Communities' are groups of people who live within or adjacent to the project area as well as any groups that regularly visit the area and derive income, livelihood or cultural values from the area. Community characteristics may include shared history, culture, livelihood systems, relationships with one or more natural resources, or the customary institutions and rules governing the use of resources. Community can be defined as *"A group of people with possibly diverse characteristics who are linked by social ties, share common perspectives, and are joined by collective engagements within a geographically confined area".*

Four indicators can be used to identify community:

- ✓ An organized society in small form (town, village, hamlet) that recognizes a single representative (leader, formal or informal)
- ✓ The people inside a confined geographical area; small enough to allow face-to-face interaction as the main form of contact between the individuals within the group
- ✓ Having a common good or a common interest and recognizing that, and been recognized as having that.
- ✓ A sense of common identity and characteristics ('we' versus 'them' feeling) on either/or social, cultural, economic, ethnic grounds.

3.1. Community-Driven Adaptation Approach

The climate change literature is rapidly getting quite exhaustive with respect to conceptualizing, defining and measuring different aspects and levels of climate change vulnerabilities. However, examples and guidance on how to plan and implement adaptation actions in the community level is quite rare due to the lack of ground tested adaptation lessons.

Any community is sensitive to the impacts of climate change to varying degrees depending on specific local circumstances (nature and location of settlement; social and cultural systems; the ability of natural resources to meet human needs). The knowledge about the type of climate change impacts and the community exposure to climate change risks is a fundamental requirement for enhancing community resilience. Community resilience is also dependent on local observations of impacts (e.g. decrease in monsoon rainfall, increased droughts) and the frequency, magnitude and duration of the impact. It is widely recognized that the consequences of climate change will increase livelihood insecurity, malnutrition, unemployment, lack of safe drinking water and water-borne diseases in Bangladesh and about one third of the population would be vulnerable to climate change and sea level rise.

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Enhancement of adaptive capacity represents a practical means of coping with changes and uncertainties associated with climate change, and hence of reducing vulnerabilities. This can be achieved through improved access to resources, reduction of poverty, lowering of inequities, improved education and information, and improved infrastructure.

Community-driven adaptation is an action learning process to empower local communities to identify, analyse, and develop ways and means of increasing their local adaptive capacity to current and future challenges and opportunities related to climate change. In community-driven process, communities directly guide in the identification, analysis and development of community adaptation strategies to challenges and opportunities (risks) related to climate change. The direct community involvement also provides greater community awareness regarding their potentialities.

In community-driven adaptation, community document local impacts of climate change, historical coping strategies to climate extremes and devise appropriate adaptation measures that local communities can implement themselves. The local impacts documentation can be done using include, inter alia, resource mapping, seasonal calendar, time line, grandparents chart, animal and plant inventory, community values, root cause analysis and community action plan.

Local people have always coped with changing local environments. They have the knowledge and practices to cope with adverse environments. The enhancement of peoples' capacity is a key to the empowerment of local communities and their effective participation in development processes. The ability of human systems to adapt to and cope with climate change depends on factors such as wealth, technology, education, information, skills, infrastructure, access to resources and management capabilities.[90]

3.2. Adaptation to Climate Change

Adaptation is defined by the IPCC as the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Adaptation to climate change is a process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented. It is in general, an adjustment in ecological, social or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities. It involves both building adaptive capacity to increase the ability of individuals, groups, or organizations to adapt to changes, and implementing adaptation decisions, i.e. transforming that capacity into action. Both dimensions of adaptation can be implemented in preparation for or in response to impacts generated by a changing climate. Hence, adaptation is a continuous stream of activities, actions, decisions and attitudes that informs decisions about all aspects of life, and that reflects existing social norms and processes.

Building adaptive capacity to climate change and managing climate risks requires necessary measures to ensure the full and effective participation of Indigenous and local communities in formulating, implementing, and monitoring adaptation relating to impacts of climate change. Climate extremes such as droughts, floods, tropical cyclone and other climate hazards are frequently forcing poor households to live with chronic poverty.

[90] Chakravarthi Raghavan 'Global warming: Net losses for developing world" *South-North Development Monitor (SUNS),* 2001

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3.3. Challenges for the Community-Driven Climate Change Adaptation

Adaptation to climate change is crucial for reducing vulnerability. Effective adaptation will manage and reduce the risk associated with changes in climate (similar to disaster risk reduction measures), and successful adaptation will reduce vulnerability by building on and strengthening existing coping mechanisms. The number of population and population density of the country increases the societal exposure to climate change risks. A relatively uneducated and illiterate people are less capable of adapting to climate change, and thus have higher vulnerability. Although the poverty rate in Bangladesh has gone down by 10% since 1990, nearly half of the population still lives below the poverty line with food security being of vital importance to the poor.

The major challenge of the community-based climate change adaptation is sustainability and up-scaling of activities. The understanding of climate change adaptation as a community development process, through multi-stakeholder partnership is not yet well established among the local governance institutions and the local NGOs. In most cases, grassroots NGOs/CBOs are in disadvantaged positions on climate change issues as they emerge through addressing their own felt needs for their surrounding communities during disaster or resolving conflicts over natural resources such land, water or dealing with human rights violations.

The lack of media attention on climate change also acts as a barrier. Hardly any reports or article in the media relates to climate change focus on adaptation to current and future climate related calamities. Easily understood materials on climate change issues and making them accessible to non-technical audiences though websites, outreach materials, campaigns, etc., will help to overcome the knowledge and information barrier to work with key stakeholders to address climate change.

Community driven adaptation is location and context specific which needs new information and technologies to reduce risks and vulnerabilities from current and future climate variability and climate extreme events through building resilience and adaptive capacity of a community, ecosystems and vulnerable sectors. The lack of local information about the nature of climate change breeds' uncertainty and keep the rural poor people and their supportive stakeholders away from necessary adaptations. The environmental, economic, informational, social, attitudinal and political barriers to implementation of adaptation are not yet well documented. Many specific adaptation actions based on existing coping methods are ongoing at community or individual level. However, the sharing of coping strategies between communities is virtually absent due to lack communication.

Much of the populations in many of these vulnerable countries are non-literate, but they are rich sources of information, which comes from accumulated experiences based on traditional knowledge, values, practices and perceptions. The major challenges are to generate required information and make these appropriate and relevant to policy and planning in the context of mainstreaming climate change into development. For this information must be generated, managed and structured for best utilization in policy and development.

Being a new concept, it is important that climate change is communicated in a simple, easy to understand and relevant manner. A simple, climate change information sheet has to be developed so that many people can easily understand. Train environmental reporters/journalists in climate change and encourage the media to publish climate change information. To date, little has been done to connect local poor & indigenous perspectives and observations to potential response or adaptation strategies.

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3.4. Gender Sensitive Climate Change Adaptation

The gender aspects of climate change are a matter of justice, human rights, and human security. Deforestation, water scarcity, soil degradation, and exposure to agricultural and industrial chemicals and organic pollutants affect women and men in varying ways. Not only do women and men differ in the ways they use and manage environmental resources, the degradation of natural resources affects them differentially. Climate change will disproportionately affect the world's poor, approximately two thirds of whom are women.[91] Women and children are most vulnerable to hunger related deaths and illness which would be indirectly exacerbated by climate change through increasing food and water shortages. Among the people who die from climate-induced disasters, more than four-fifth (85%) of them are women[92].

Climate change will adversely affect women more than men in Bangladesh. Roughly half of Bangladesh's population is made up of women (48.9 percent in 2004, according to the World Bank gender profile), 80 percent of whom live in rural areas. Shortage of safe drinking water, especially in the coastal belt and in drought-prone areas in the north-west of the country will be very severe. This will impose hardship on women and children, who are responsible for collecting drinking water for their families. Increasingly saline drinking water may also result in health hazards, especially for pregnant women.

In most of the developing countries like Bangladesh, women are used to take food after all the family members had it. Consequently virtually all the time they are forced to eat less than men and they face the worst food insecurity during scarcity or natural disasters. Hence, it can be anticipated that if climate change negatively impacts on family food security, women will be malnourished. The World Health Organization estimates that the energy used to carry water may consume one-third of a woman's daily calorie intake. In areas where water is in particularly short supply, calorie use may be even greater, compounding the risk of malnutrition in resource-poor settings[93]. The Millennium Project Task Force on Environmental Sustainability has noted, "*when women lack the knowledge, means or authority to manage the natural resources on which they directly depend, degradation of these resources is more likely to occur*" (UNDP, 2004[94]). Gender issues have rarely been addressed as part of the climate change discussions.

Only in 2003, gender issues have been raised during the 9th Conference of the State Parties of the United Nations Framework Convention on Climate Change (UNFCCC). After that UNFCC Conference, gender issues are on the rise at the international level of climate change negotiations. However, women is yet virtually absent in the Climate leadership at all levels; whether it is local, national or international. The lack of appropriate framework for addressing climate change and for policy coherence at the national or country level is also partly responsible for lack of women's participation in climate leadership.

The holistic understanding of whether the current coping strategies of poor households, and particularly of women, are significantly or sufficiently contributing to adaptation to climate change is very much needed. A gender-sensitive response requires more than a set of disaggregated data showing that climate change has differential impacts on women and men. It requires an understanding of existing inequalities between women and men, and of the ways in which climate change can exacerbate these inequalities.

91Friends of the Earth Australia, 2003, "Changing the future of the world's poor?" http://www.foe.org.au/download/future_poor.pdf
92 Mirza, MMQ (2003), Climate Change and Extreme Weather Events: can developing countries adapt? Climate Policy, vol 3, Issue 3
93 Mayling Simpson-Hébert, "Water, Sanitation and Women's Health: the Health Burden of Carrying Water," World Health Organization, *Environmental Health Newsletter* 25 (1995).
94 UNDP, 2004. "Millennium Project Task Force on Environmental Sustainability". New York: United Nations Development Programme.

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Chapter 4

Sustainable People's Development & Climate Resilient Development

4. Introduction

Climate change is probably the greatest development challenge facing the resource-poor countries that do not have the means to adapt and respond effectively. Climate change presents significant threats to eliminating poverty and hunger and promoting environmental sustainability. According to the Environmental Sustainable Index 2001 Report, Bangladesh has been ranked in 99th position. Bangladesh scored 14 out of 100 countries in reducing vulnerability[95].

The most popular definition for sustainable development is coined by Brundtland Report (1983-1987) the final document of the U.N. World Commission on Environment and Development. According to the Brundtland report "*Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs*". Unfortunately globalization, free market mechanisms took the opportunity of ambiguity and vagueness of the definition and incorporation of human society and the economy as similar subsystems to redefine *sustainable development "as changing the present distribution patterns of the global wealth (commodity distribution in the global free market) for the satisfaction of people's (consumers) needs (choices)"*.

In the Climate Changing World, poor people might be considered as a burden of the system. One of the classic victims of the "sustainable development" is the indigenous community, whose knowledge transfer mechanisms for sustainability has always been oppressed.

4.1. Reviewing Sustainable Development in the Climate Changing World

The irony is that Sustainable Development was introduced to address the historical failure of the development policies in the previous decades. International Financial Institutions often misguided national policies of the developing countries in the name steady development in the quality of life for the current generation and future generations using Sustainable development framework. The decade-long monitoring (1997 to 2007) of the Asian Development Bank (ADB) projects in Bangladesh points out that Sustainable Development must integrate people centered approach.

Perhaps the appropriate definition would be as such "Sustainable Development is the development that free market economy meets the satisfaction of both present & future consumer's choices with the support of

[95] 2001 Environmental Sustainability Index, Annex: 5, World Economic Forum, Annual Meeting 2001, Davos, Switzerland.

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genetic engineering, WTO and International Financial Institutions (IFIs)". It is not an exaggerated statement if we look in the food security which is more or less used as a national security. In the global context, only ten big multinational corporations control about 40% of world seed market, who are increasingly monopolizing food production, and food value chain. This indicates that food security of the planet is more-and-more controlled by only few multinational corporations.

The culture of seed preservation totally lost in Bangladesh. Now all the seeds have to buy from the market or government and NGO run agriculture sales office. The high-breed seed trading culture of compels farmers to buy seed every year as well as also compels to shift agricultural crops in the same land and buy seeds of another crop after every three years. This vicious seed trading cycle created a compulsive demand for hard cash during the cultivation period. At present special loan arrangement for seed purpose is quite prominent which have encrusted poor people with additional loan burden.

4.2. Sustainable People's Development: Putting People at the Center

We can use any name for any approach and framework but if that name do not hold all the vital key words, policy makers and development actors might miss the crucial indicators during planning or policy formulation. Although "Ecologically Sustainable Development" highlights social justice and indigenous knowledge to restore the ecological development path and promotes using, conserving and enhancing the community's resources so that ecological processes are maintained to support the quality of life, for now and in the future. Nevertheless, the "Ecologically Sustainable Development" also missing the human dimension of development.

To overcome the missing human dimension of sustainable development framework, it is more appropriate to use the term "Sustainable People's Development (SPD)". After all it is people whose action is changing the climate. SPD acknowledges that humans are inseparable from the ecosystems in which they live and also responsible for emissions and global warming. The Sustainable People's Development is focused on putting People at the center of sustainable development.

In the UNFCCC negotiation premise, sustainable development received an extension which is low carbon approach. All the parties to UNFCCC have noted that adaptation measures should be designed in such a way that it can effectively contribute to poverty reduction and sustainable development with low carbon approach. The low carbon approach has already developed a market-based false solution "Clean Development mechanism (CDM)" For UNFCCC, the term "Climate Resilient Development (CRD)" approach is more appropriate than low carbon approach.

Sustainable People's Development (SPD) is conceptualized as process to engage people in an equitable way with fairness and respect for the value of diversity in people's lives and seeks a good quality of life for all people in equitable and sustainable society, at local, national and global levels. Each community should have their own definition as well as indicators of Sustainable People's Development.

4.3. Understanding the Climate Resilient Development (CRD)

The recent attention at the international level to develop governance structures to address the on climate change vulnerability, risks and stresses on our global environment provided scope to reflect critically on the sustainable development to redesign it with more emphasis on people. Perhaps this is the high time to address the need of the people through the sustainable (people's) development principles in climate resilient development policy making. In the current climate changed world, more specifically in Bangladesh case,

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Sustainable People's Development (SPD) and Climate Resilient Development (CRD) is synonymous. Policy is a fundamental aspect for addressing climate change shocks. However, policy makers and development actors need practical indicators to capture climate change trends and use immediately. For example, policy makers and development actors are using GDP, GNP & unemployment rates in economic planning and life expectancy, fertility, mortality and literacy for social planning.

On the other hand, climate policy-making has still depend on many proxy indicators like nutrition, natural disaster frequency, or the global indicators which may not always be accurate in national or local context. The exact indicators on sea-level change, CO_2 concentration in local context is yet to develop.

Potential Indicator for monitoring Climate Resilient Development (CRD)
✓ Human Development Index [HDI]
✓ GNP Growth Rate (%)
✓ Annual Rate of Deforestation (hectares)
✓ Protected Areas (% of country)
✓ Energy Consumption (giga joules per capita)
✓ Community Conflicts over land and natural resources are decreasing
✓ Use of Renewable energy is increased

Climate Resilient Development (CRD) is an approach to support climate vulnerable people's increased access to resources, institution, transfer and adoption of new technology, and diversification of livelihood options and pave the way for Climate Good Governance.

Selected potential proxies for national-level vulnerability to climate change

Category	*Variable*	*Proxy*
Economy	National wealth	GDP per capita (US$ PPP)
	Inequality	GINI coefficient
Health and nutrition	State support for health	Health expenditure per capita (US$ PPP) and/or Public health expenditure (% of GDP)
	General food availability	Food production index (annual change averaged over 10 years)
Infrastructure	Isolation of rural communities	Roads (km, scaled by land area with 99% of population)
Governance	Willingness to invest in adaptation	Political stability; Rule of law
	Effectiveness of policies	Control of corruption
	Conflict	Internal refugees (1000s) scale by population
Geography and demography	Coastal risk	km of coastline (scale by land area) Coastal risk Population within 100km of coastline (%)
Ecology	Environmental stress	Protected land area (%) Forest change rate (% per year)
	Sustainability of water resources	Groundwater recharge per capita Water resources per capita
Technology	Commitment to and resources for research	R&D investment (% GNP)

Source: Brooks‘ N. Adger, W.N. and Kelly‘ P. (2005) The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. Global Environmental Change Part A Volume 15, Issue 2, Pages 151-163 doi:10.1016/j.gloenvcha.2004.12.006

Since the consequences of climate change will increase livelihood insecurity, malnutrition, land degradation, lack of safe drinking water and water-borne diseases, Climate Resilient Development (CRD) approach can easily use these indicators. The diversification of agriculture production, food processing & storage infrastructure, and adequate disaster protection facilities for household & community are also good proxy indicators for Climate Resilient Development.

Climate change alters the state of biodiversity (e.g., changes in ecosystem boundaries, changes in genetic make-up).

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4.4. Global Frameworks for Climate Change Governance

4.4.1. The United Nations Framework Convention on Climate Change (UNFCCC)

In 1988, Climate Change agenda was for the first taken by the UN General Assembly and adopted resolution 43/53 of 6 December 1988 on the "Protection of the Global Climate for Present and Future Generation of Mankind". The United Nations Framework Convention on Climate Change (UNFCCC) was finalized and adopted on 09 May 1992 in New York, USA to reducing the adverse effects of climate change. On 4 June 1992, the UNFCCC was opened for signature at the UN Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil, and came into force on 21 March 1994. Today 189 governments are Parties to the Convention. Bangladesh signed the Convention on 9 June 1992 and ratified it on 16 April 1994.

The UNFCCC sets an overall framework for intergovernmental efforts to tackle the challenges posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and emissions of carbon dioxide and other greenhouse gases. Under the Convention, governments:

- gather and share information on greenhouse gas emissions, national policies and best practices
- launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries
- cooperate in preparing for adaptation to the impacts of climate change[96]

The Conference of the Parties (COP) is the highest decision-making authority in the UNFCCC. The COP is the association of all the countries that are Parties to the Convention. COP is responsible for overseeing international efforts to address climate change. It reviews the implementation of the Convention and examines the commitments of Parties in light of the Convention's objective, new scientific findings and experience gained in implementing climate change policies.[97]

The Convention established two permanent subsidiary bodies: the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Subsidiary Body for Implementation (SBI). These bodies give advice to the COP and each has a specific mandate. SBSTA carries out methodological work in specific areas, such as the Land use, Land use Change and Forestry (LULUCF) sector, hydro fluorocarbons (HFCs) and per fluorocarbons (PFCs), and adaptation and vulnerability. The SBI gives advice to the COP on all matters concerning the implementation of the Convention. One of its major tasks is to examine the information in the national communications and emission inventories submitted by Parties in order to assess the Convention's overall effectiveness. The SBI advises the COP on budgetary and administrative matters and works together with SBSTA on cross-cutting issues such as capacity building, the vulnerability of developing countries to climate change and response measures, and the Kyoto Protocol mechanisms.

4.4.2. The Intergovernmental Panel on Climate Change (IPCC)

The United Nations Environmental Programme (UNEP) and World Meteorological Organization (WMO) jointly formed the Intergovernmental Panel on Climate Change (IPCC) in 1988 to provide objective information the latest scientific, technical and socio-economic information relevant for the understanding of human induced climate change, its potential impacts and options for mitigation and adaptation about climate change to the public and to policy-makers. IPCC is made up of scientists and experts from all over the world

96 http://unfccc.int/essential_background/convention/items/2627.php
97 http://unfccc.int/essential_background/convention/convention_bodies/items/2629.php

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and promotes the UN goals of human development. The IPCC does not conduct any research nor does it monitor climate related data or parameters but it produces reports that aim to reflect a range of views, expertise and wide geographical coverage. The IPCC has three Working Groups and a Task Force:

- Working Group I[98] assesses the scientific aspects of the climate system and climate change.
- Working Group II[99] assesses the vulnerability of socio-economic and natural systems to climate change, negative and positive consequences of climate change, and options for adapting to it.
- Working Group III[100] assesses options for limiting greenhouse gas emissions and otherwise mitigating climate change.

Each IPCC assessment report reviews a large number of methods and tools pertaining to specific sectors, scales of analysis, and environmental and socioeconomic contexts that are available for assessing impacts, vulnerability, and adaptation to climate change. Each of the IPCC reports presents an update on methodological advances. The work of the IPCC is important to the current policy for addressing climate change. Because of the first IPCC Assessment Report, the UN Framework Convention on Climate Change went into force in 1994. The Second Assessment Report of 1995 contributed to the outcome of the Kyoto Protocol in 1997. The Third Assessment Report (TAR) of 2001 was used to further develop policy in the UNFCC and the Kyoto Protocol. The Fourth Assessment Report was released in late 2007 and findings are incorporated in the learning activities.

4.4.3. The Kyoto Protocol

The Kyoto Protocol was established in 1997 in Kyoto, Japan, under the United Nations Framework Convention on Climate Change and entered into force on 16 February 2005. The industrial nations comprise 15 percent of world population yet, they account for almost half of emissions of CO2.[101] Under the protocol's terms, the industrialized countries have taken binding commitments to cut their emissions by a certain date (up to 2012) and by a certain percentage from their 1990 levels. The targets vary among the industrialized countries. It was agreed at Kyoto that the developing countries do not need to commit to cut their emissions because they have low per capita emission levels compared to developed countries, and therefore, they have the right to some "space" to increase their emissions as they develop their economies.[102]

Some developed countries are now pressing for developing countries (or at least some of them) to also commit to emission reduction in the near future. Developing countries argue that the industrialized nations have themselves not yet lived up to their Kyoto commitments, and thus the poorer countries should not yet be asked to make binding commitments. Further, many industrialized countries have not reduced their emissions in line with their commitments, and in fact, their emissions have actually increased above their 1990 levels.

4.5. Climate Governance: Call for Paradigm Shift in the Governance Culture

Climate change may undermine capacity of the government to support people to sustain livelihoods (Barnett, and Adger, 2005[103]). The heat trapping gases we send into the atmosphere in 2008 will stay there until 2108 and beyond. We are therefore making choices today that will affect our own lives, but even more so the lives

98 http://ipcc-wg1.ucar.edu/index.html
99 http://www.ipcc.ch/wg2.htm
100 http://www.rivm.nl/env/int/ipcc/
101 Human Development Report 2007/2008 Fighting Climate Change: Human Solidarity in a Divided World, UNDP, 2007, p7
102 Martin Khor 'Race on to tackle Climate Change' Third World Network, p2 http://twnside.org.sg/title2/climate/climate.change.doc
103 Barnett, J and Adger, N, 2005: Security and Climate Change: Towards an Improved Understanding, Paper presented at an International Workshop " Human Security and Climate Change" Holmen Fjord Hotel, Asker, near Oslo, 20–21 June 2005

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of our children and grandchildren. This makes climate change different and more difficult than other policy challenges. Time has come to shift the decision-making culture beyond traditional cost benefit analysis approaches into a comprehensive approach which includes both market and non-market (including environmental and intrinsic values) impacts of land use, policy decisions and options.

The agro-ecological regions of the country are very diverse and may experience impact in very different ways; the project encompassed almost all the fragile ecosystems in Bangladesh. However, in all the ecological regions the poor (including women, elderly, disable person and children) and indigenous communities are likely to be the most vulnerable by climate change. Therefore, people themselves are the focal point in any climate change adaptation framework. This leads to the shift of paradigm on policy and actions.

In current international development context, vulnerability and adaptation assessments (V&A) are essential guide to decision making on international aid and investment. For example, since 1976, food security has been a central area of intervention of the European Commission in Bangladesh. Whereas in the early 1990s food security interventions focused on food availability and agricultural production, the emphasis from the late 1990s was laid on access to food and nutrition. At the national level, vulnerability and adaptation assessments (V&A) are also an essential guide to resource allocation during natural disasters including climate related disasters.

Three interrelated multilateral environmental conventions; UN Framework Convention on Climate Change (UNFCCC), b) United Nations Convention on Biological Diversity (CBD), and UN Convention to Combat Desertification (CCD) should be linked with climate policy. The policy needs are clearly delineated in the various parts of the Climate Convention, and the Kyoto Protocol. Both the UNFCCC and the Kyoto Protocol have addressed the policy needs for vulnerability assessment, which would be instrumental, and the basis for, the allocation of resources for adaptation to climate change.

The integration of the scientific knowledge and the political realities is critically necessary for policy development to address the potential impact of climate change. Planning for vulnerability assessment due to future climatic requires long-term vision. There may be many unknown factors that yet masking the real situation. Although much progress has been made, there are large uncertainties in predicting regional climate changes, future conditions in the absence of climate change, or to what degree climate will become more variable. Current ability is also limited in predicting regional-scale climate changes, future conditions in the absence of climate change, or to what degree climate will become more variable. All these factors are important in predicting the potential impacts of climate change.

4.5.1. Pro-poor Climate Adaptation Policy Approach

Climate Risk reduction cannot be viewed as a technical problem with technical solutions. It is also a matter of enacting policies and enforcing laws, building and maintaining accountable institutions, and producing an environment of mutual trust between government and the population. It is difficult to sustain community initiatives, if they do not become part of the government policies. The policy paradigm is consistently stressing on finding climate change adaptation strategies, though the importance of mapping the baseline status and situation analysis based on community knowledge base have not yet received the deserved attention. It is essential to have climate adaptation policies & planning in such a way that conserves and sustains the ecosystems and support the poor and ensures livelihood security for the growing population.
The policy approach should follow the Principles of Sustainable People's Development (SPD) and Climate Resilient Development (CRD) to ensure for pro-poor climate governance. While development will provide for

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better livelihoods for the present generation, it should do so in a manner that does not compromise nature's ability to sustain such development in order to provide for future generations.

To ensure for pro-poor climate governance, Climate Resilient Development (CRD) should include learning from the Rural People and Farmers. For example, The Bangladeshi farmers with their unique and innovative coping mechanisms have proven many times their resistance to recurrent natural hazards like floods and droughts, cyclones and tidal surges. For example, in the event of flood of greater magnitude, seeds of transplanted aman cannot be sown due to lack of nursery land or seedlings are damaged. In such situation, they raise the seedlings on floating rafts made out of water hyacinth. The farmers of the country are also capable of switching to local varieties in places of high yield varieties in case of drought or flood as local varieties are low water consuming and taller.

4.5.2. Adaptation Policy Frameworks (APF)

The United Nations Development Programme – Global Environment Facility (UNDP-GEF), with support from the Swiss, Canadian and Dutch governments, developed the Adaptation Policy Frameworks (APF) as an innovative set of guidance for the development and implementation of adaptation strategies. The APF aims to help countries as they integrate adaptation concerns into the broader goals of national development. Ultimately, the purpose of the APF is to support adaptation processes to protect and, when possible, enhance human well-being in the face of climate change, including variability.

The APF has been designed as a methodological tool to guide adaptation studies, planning and policy exercises. The framework provides a structured approach to formulating and implementing adaptation at different scales. It suggests a suite of methods and tools for adaptation, in accordance with local context and coverage. The APF provides guidelines on the "Vulnerability-based approach" including improving access to new markets and supporting livelihood diversification under future climate, and the "Adaptive-capacity approach" focusing on awareness in and the resilience of communities to climate change and variability.

4.5.3. Status of Climate Change Governance in Bangladesh

Bangladesh has signed, ratified, and accessed 27 international conventions and protocols related to environment and development. However, the country's capacities at individual, institutional and systemic levels to implement these conventions are limited[104]. As a signatory to these environmental conventions and protocols, the GOB needs to implement them at a national and local level. Similarly citizens have also rights to monitor the implementation progress. However, lack of access to information on international conventions and protocols acts as a drawback for social mobilization and advocacy for ensuring government obligations into actions.

The government of Bangladesh has yet to have a written policy on climate change issues. In fact, Bangladesh government initiatives on climate change policy are very recent, just after the Bali COP in 2007. In 2008, Bangladesh has developed a country framework for Climate Resilient Development to ensure national development is resilient to climate change and its impacts in such a way that the lives, livelihood and well being of its people is sustained over time. The country framework is to facilitate the National Climate Change Policy development. Many sectoral policies have highlighted the importance of integration of environment and resource management for achieving sustainable development of the nation. The issue of

104 IUCN, GEF & UNDP, 2006: Draft Inception Report on Bangladesh, National Capacity Self-Assessment for Global Environmental Management.

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climate change has been recognized in the National Water Management Plan and National Strategy for Economic Growth, Poverty Reduction and Social Development.

Without addressing the need of the rural poor and the reduction of agro-biodiversity vulnerability, the policy focus for coping climate change as well as MDG goals might be ineffective. Because, 75% of the country's total population and 85% of the total poor live in the rural areas and the rural economy as a whole contributes more than 60 percent of total GDP.

The SAARC Meteorological Research Council (SMRC) carried out a study on recent relative sea level rise in the Bangladesh coast. The study has used 22 years historical tidal data of the three coastal stations. The study revealed that **the rate of sea level rise during the last 22 years is many fold higher than the mean rate of global sea level rise over 100 years**, which shown the important effect of the regional tectonic subsidence.

Bangladesh government has to undertake widespread educational and public awareness programs and also devise mechanisms to ensure public access to climate change information following the Article 6 of the UNFCCC. Although Bangladesh National Adaptation Programme of Action (NAPA) incorporated this need, the progress is inadequate in terms of total population of the country. Ministry of Environment and Forest and Department of Environment is dealing climate change issue as a broader environmental issue and the Official Focal Point of the United Nations Framework Convention on Climate Change (UNFCCC). They are actively participating in the climate change negotiations and pursuing for integrating climate change and variability particularly natural disaster in the development plan. No policy measures or strategic action plan have been undertaken either by the Ministry of Agriculture or by the Ministry of Fisheries and Livestock. The representative departments or directorate working under these ministries have not adapted any innovative approaches to combat the likely threats to Bangladesh agriculture of climate change in either the short or the long term.

There are also some examples of development policies and priorities in Bangladesh that might potentially conflict with climate change responses. In particular, policies to encourage tourism and build tourism infrastructure in vulnerable areas of the coastal zone, particularly the Khulna region, might need to take into account the projected impacts of climate change to reduce the risk of mal-adaptation. Meanwhile, plans to encourage ecotourism in the fragile Sundarbans might risk adding one more stress to a fragile ecosystem that will likely be critically impacted by sea level rise and salinity concerns.

The Bangladesh Meteorological Department (BMD), under the Ministry of Defense, provides relevant weather forecasts on a regular basis. BMD operates 35 meteorological stations throughout the country, of which ten provide agro-meteorological data, reporting daily to the central office in Dhaka. The BMD Storm Warning Centre (SWC) issues daily forecasts based on analysis of meteorological charts and satellite and radar images. In addition to routine daily forecasts, BMD issues special weather bulletins for heavy rainfall, droughts, tropical cyclones and associated storm surges. BMD also issues one-month forecasts for the general public. The BMD operates 10 agro-meteorological stations. Ten Pilot Balloon Observatories record upper wind direction and speed four times a day. The Agro-meteorological Division of BMD issues a bulletin every ten days with meteorological data from 32 meteorological stations, highlights the rainfall situation and offers 10-day forecasts. The Department of Agricultural Extension (DAE) operates 64 rainfall stations, one at each district agricultural office. Daily rainfall data is compiled by the BMD Deputy Director's office and communicated to the DAE in Dhaka.

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4.6. Conclusion

The lack of scientific information and its critical understanding as well as social perception regarding climate change imposes a major challenge for people at all levels from making the critical decisions that are necessary to adapt. It is important to devise viable strategies and pro-poor policy approaches by integrating climate change, Food Sovereignty & Agriculture for reducing climate change vulnerability. However, without social and technical data about the nature of climate change, a decision for choosing the viable strategies to mitigate climate change impact is often difficult. For climate sensitive regions, the policy should take into account the unique natural characteristics of the region. It is essential to have climate adaptation planning in such a way that conserves and sustains the ecosystems and support the poor and ensures food sovereignty for the growing population. Most development projects will need to take the effects of climate change into account and incorporate components of adaptation as appropriate.

The role Information & Communication Technology (ICT) for adaption to climate change need to be incorporated in the adaptation policies. ICTs play a key role in producing, storing, retrieving and comparing information related to climate change issues. The nature of adaptation interventions varies depending on a wide range of elements, such as the set of stakeholders, the sector and the scale of application. As a result, ICT support the implementation and management of adaptation strategies with a wide variety of tools: among the others, forecasting tools, early warning system and resource management systems. ICT tools also provide an effective way to communicate the impact of an adaptation strategy. A process of democratization of climate change information through dissemination mechanism is required to educate people and strengthen nation environmental governance goals.

Climate change makes new demands for adaptation and coping strategies by farmers and rural communities and presents new challenges for the management of their environment and agro-ecosystems. The global perspective, dealing as it does in worldwide production scenarios and global averages, tends to obscure the central role of small-scale farming, (farming less than 3ha of land) of pastoralists and of traditional rural communities in food production and environmental management It also does not adequately reflect the importance of indigenous peoples and rural communities and the role they play in the maintenance of key agro-ecosystems and centers of cultural and biological diversity and in the continuing provision of vital ecosystem services.

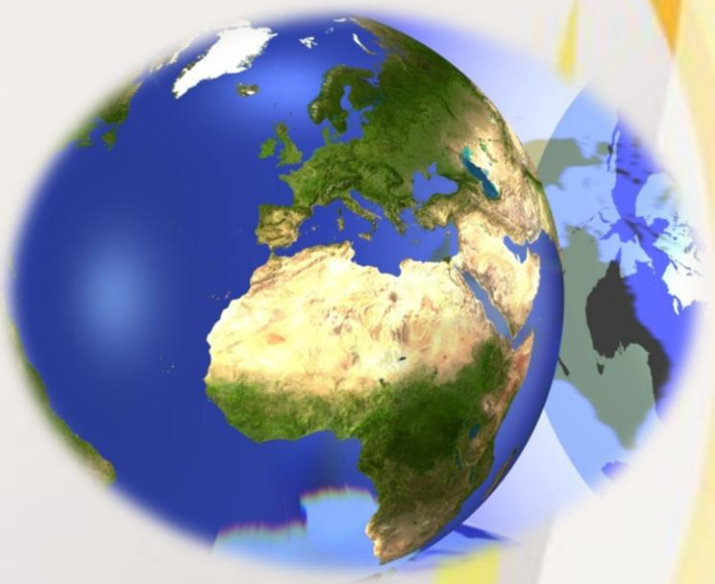
The survival of the Future generations will depend on how political leaders today acted on behalf of the people in the future following cross-generational social justice and equity. Our political leaders should act together because greenhouse gases do not respect political boundaries.

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Promoting Peace & Progress

Coastal Development Partnership (CDP)

Central Coordination Office:

MUSAFIR Villa, House No # 53/1&53/2, Flat # B-3, West Agargaon,
Sher-E-Bangla Nagar, Dhaka-1207, Bangladesh

Registered & Foundation Office:

55/2 Islampur Road, Khulna-9100,
Bangladesh