

# Climate Change and its Management in Coastal Areas: Bangladesh Perspective

Dr. M. Shahtab Hossain<sup>1\*</sup>, Dr. S. M. Abul Kalam Azad

Managing Director<sup>1</sup>, Former Joint Secretary<sup>2</sup>

Proshika Integrated Agricultural Farm Trust, Dhaka, Bangladesh<sup>1</sup>

Ministry of Defence, Government of the People's Republic of Bangladesh<sup>2</sup>

## Abstract

The coastal region of Bangladesh covers about 20% of total land area and over 30% of the cultivable lands of the country. It includes highly diverse ecosystems e.g. the world's largest single tract of mangroves (the Sundarbans), beaches, coral reefs, dunes and wetlands. With its dynamic natural environments, provides a range of goods and services to the peoples of Bangladesh. It is agreed and documented that being a deltaic coastal country, Bangladesh is one of the most vulnerable countries to climate change in the world. Climate related change in coastal zones embodies potential additional stress on systems that are already under intense and growing pressure. The country has already been facing several climate change effects such as increasing cyclones, flood frequency probabilities, erosion, inundation, rising water tables, salt water intrusion and biological effects. Coastal environments particularly at risk include mangroves, tidal deltas and low-lying coastal plains, sandy beaches, coastal wetlands, estuaries and coral reefs. These biogeophysical possessions will have consequent effects on ecosystems and eventually affect socio-economic systems in the coastal zone. The Sundarbans, most important ecosystem of the country will be totally lost with one meter rise in sea level. There are two options to minimize the impacts named mitigation and adaptation. It is needed to be considered both mitigation and adaptation options for Bangladesh, even though the country has very limited scope for mitigation. This is why mitigation involves global efforts to execute and adaptation is more local. As a result, effective adaptation policies and mitigation measures ought to be developed and implemented to minimize climate related impacts on Bangladesh.

**Keywords:** *Bangladesh, Climate Change, Management, Impacts, Coastal Areas*

## INTRODUCTION

Climate change is a problem that is continuously affecting people and the environment. Historically, Bangladesh is one of the most susceptible countries of the world to bear the burden of the negative impact of climate change. The coastal areas are worst affected and the coastal population are the sufferers. Climate change refers to any significant change in measures of climate (such as temperature, precipitation, wind, sea level, and natural phenomena), lasting for an extended period of time (decades or longer) that negatively affects the terrestrial and aquatic ecosystems (all living things: plants, animals and organisms, interacting with each other, and also with their non-living environments: weather, earth, sun, soil, climate, and atmosphere). Greater energy efficiency and new technologies hold promise for reducing greenhouse gases (such as Carbon dioxide- CO<sub>2</sub>, Methane- CH<sub>4</sub>, Nitrous oxide- N<sub>2</sub>O, water vapor, while others are synthetic. Those that are man-made include the chlorofluorocarbons-CFCs, Hydro-fluorocarbons-HFCs, Per-fluorocarbons-PFCs, Sulphur- hexafluoride- SF<sub>6</sub>) and solving this global challenge. Greenhouse gases and certain synthetic chemicals, trap some of the Earth's generated energy, thus retaining heat in the atmosphere. Efforts are being made for reducing, reusing and recycling solid waste to decrease the amount of heat-trapping greenhouse gases released.

Bangladesh is now widely recognised to be one of the countries which are most vulnerable to climate change. Natural hazards that come from increased rainfall, rising sea levels, and tropical cyclones are expected to increase as climate changes, each seriously affecting agriculture, water and food security, human health and shelter. It is believed that in the coming decades the rising sea level alone will create more than 20 million climate refugees. Bangladeshi water is contaminated with arsenic frequently because of the high arsenic contents in the soil. Up to 77 million people are exposed to toxic arsenic from drinking water.

Bangladesh is prone to floods, tornados and cyclones. Also, there is evidence that earthquakes pose a threat to the country. Evidence shows that tectonics have caused rivers to shift course suddenly and dramatically. It has been shown that rainy-season flooding in Bangladesh, on the world's largest river delta, can push the underlying crust down by as much as 6 centimetres, and possibly perturb faults.

### **OBJECTIVES OF THE STUDY**

The overall objective of the research is to suggest to the vulnerable population of the coastal districts - successful strategies for coping with different climate induced disasters through lesson learnt documentation and analyzing national and International actions for achieving sustainable development. However the specific objectives of the study are as follows:

1. To identify adaptation and mitigation strategies used by the coastal population of Bangladesh.
2. To understand climatic hazards faced by the coastal population of Bangladesh.
3. To analyze vulnerability of the areas.

### **METHODOLOGY OF THE STUDY**

The following methodology was used for the study:

**Study Design:** The study was survey type.

**Study Area:** The study has been conducted at Samnagar Upazila of Satkhira District, Pathorghata Upazila of Barguna District and Cox's Bazar Sadar Upazila and Moheshkhali Upazila of Cox's Bazar District.

**Sampling Method:** Random sampling method has been used for the study.

**Tools for Data Collection:** Questionnaire has been used for data collection.

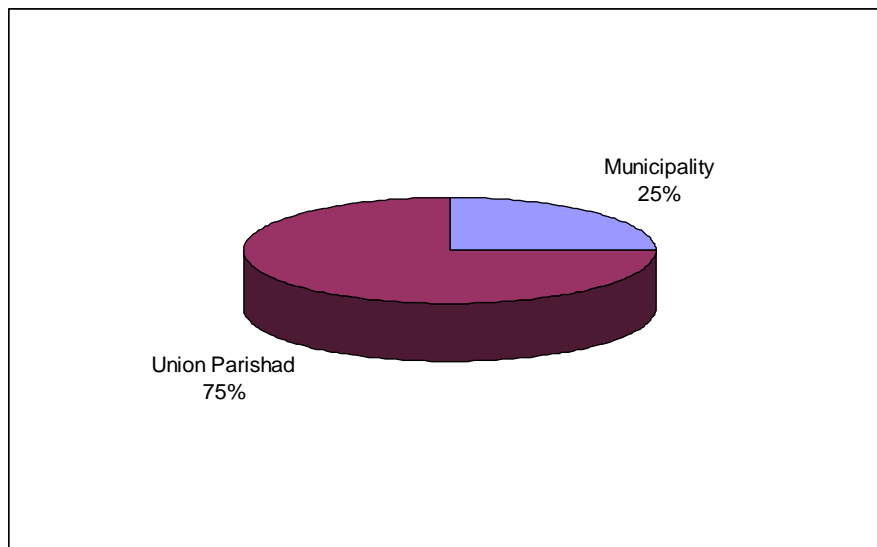
**Sources of Data:** Data have been collected from the field by face to face interview with the respondents.

**Sample Size:** 100 respondents have been interviewed for the study. The respondents were elected representatives of the local areas. 7 Chairmen, 23 Councilor, 66 Members, 2 Mayors, and 2 Secretary were interviewed for the study.

**Data Analysis:** The collected data were tabulated and analyzed by using Computer Program Microsoft Excel.

**RESULTS AND DISCUSSION****Table 1: Type of Organization**

Sl. No.	Type of Organization	Percentage
1	Union Parishad	75%
2	Municipality	25%
Total		100%

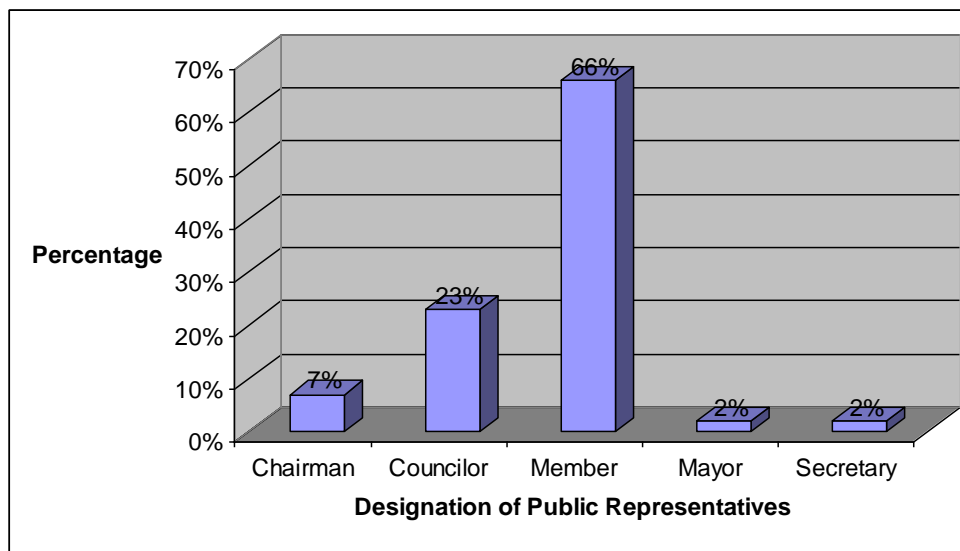
**Figure 1: Type of Organization**

Category of the Organization is described above. From the graph it was found that out of 100 respondents, 75% respondents engaged in Union Parishad and 25% respondents are engaged in Municipality.

**Table 2: Designation of Public Representatives**

Designation	Percentage
Chairman	7.0%
Councilor	23%
Member	66%
Mayor	2.0%
Secretary	2.0%
Total	100%

**Figure 2: Designation of Public Representatives**

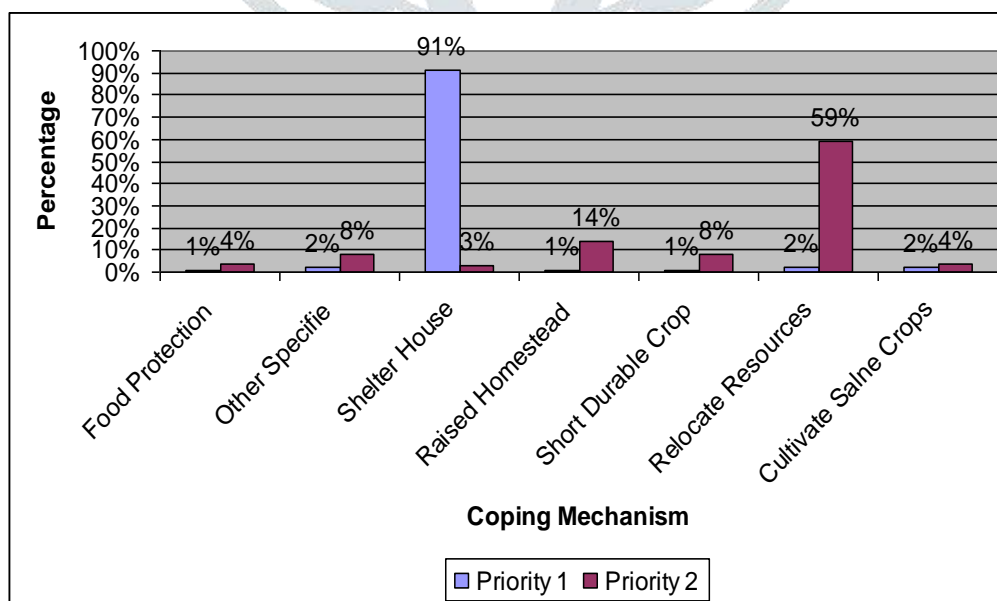


Designation of the Public Representatives is described above. From the graph it was found that out of 100 respondents, 66% was Member of Union Parishad which is the maximum and 2.0% are Mayor of Municipality and Secretary of Union Parishad. Other representatives are Chairman of Union Parishad, Councilor of Municipality are 7.0% and 23% respectively.

**Table 3: Coping Mechanism of Climate Induced Hazard**

Category	Priority 1	Priority 2
Food Protection	1.0%	4.0%
Other Specifie	2.0%	8.0%
Shelter House	91%	3.0%
Raised Homestead	1.0%	14%
Short Durable Crop	1.0%	8.0%
Relocate Resources	2.0%	59%
Cultivate Salne Crops	2,0%	4.0%

**Figure 3: Coping Mechanism of Climate Induced Hazard**



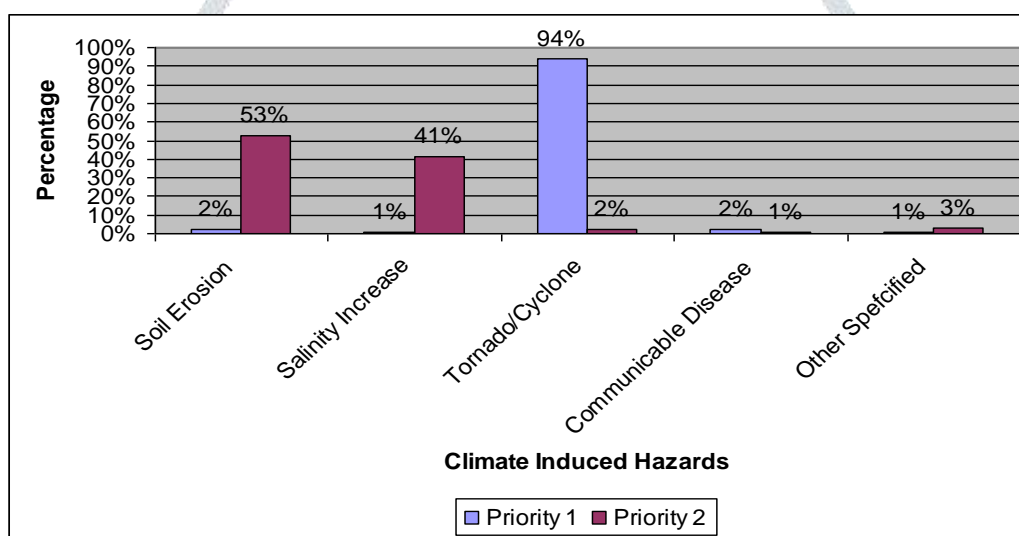
Coping mechanism of the disaster prone areas are described above. Here opinions of the respondents are categorized into Priority 1 and Priority 2. From the graph it was found that in case of priority 1, out of 100 respondents, 91% respondents were agreed that Shelter House is the most effective coping mechanism against natural disaster and other coping mechanisms are Food Protection, Other Specific adaptation

measure like take shelter in embankment/dam during disaster period, Raised Homestead, Short Durable Crop, Relocate Resources and Cultivable Saline Crops are 1.0%, 2.0%, 1.0%, 1.0%, 2.0% and 2.0% respectively. In case of Priority 2, out of 100 respondents, maximum 52% respondents agreed that Relocate Resources is the most effective coping mechanism against natural disaster and other coping mechanisms are Food Protection, Other Specific, Raised Homestead, Short Durable Crop, Relocate Resources and Cultivable Saline Crops are 4.0%, 7.0%, 8.0%, 17%, 8.0%, and 4.0% respectively.

**Table 4:** Climate Induced Hazards

Hazards	Priority 1	Priority 2
Soil Erosion	2.0%	53%
Salinity Increase	1.0%	41%
Tornado/Cyclone	94%	2.0%
Communicable Disease	2.0%	1.0%
Other Specified	1.0%	3.0%

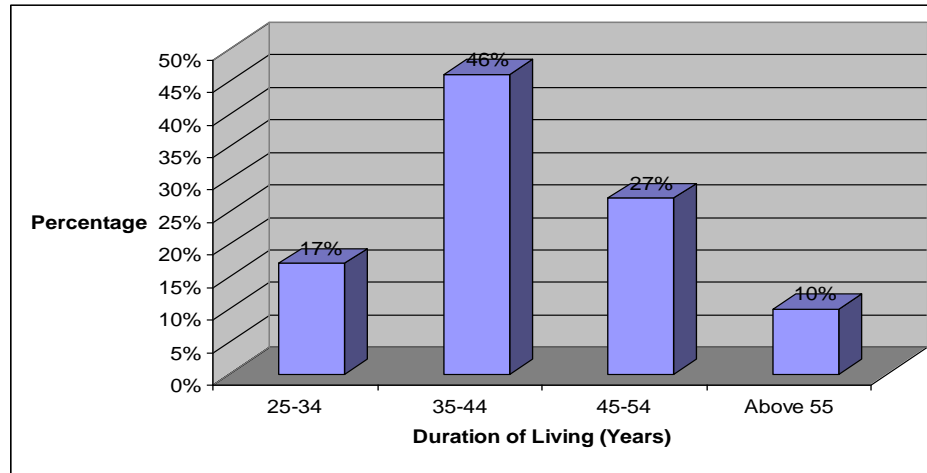
**Figure 4:** Climate Induced Hazards



Climate Induced Hazards are described above. Here opinions of the respondents are categorized into Priority 1 and Priority 2. From the graph it was that in case of priority 1, it was found that out of 100 respondents, maximum 94 % respondents agreed that Tornado/Cyclone is the main climate induced hazards, and other climate induced hazards are Soil Erosion, Salinity Increase, Communicable Disease and Other Specified hazards are 2%, 1%, 2%, and 1% respectively. In case of Priority 2, it was found that out of 100 respondents, maximum 53% respondents agreed that Soil Erosion is the main climate induced natural hazards and other climate induced natural hazards are Salinity Increase, Tornado/ Cyclone, Communicable Disease and other Specified hazards are 41%, 2%, 1% and 3% respectively.

**Table 5: Duration of Living**

Duration	Percentage
25-35	17%
35-44	46%
45-54	27%
Above 55	10%
Total	100%

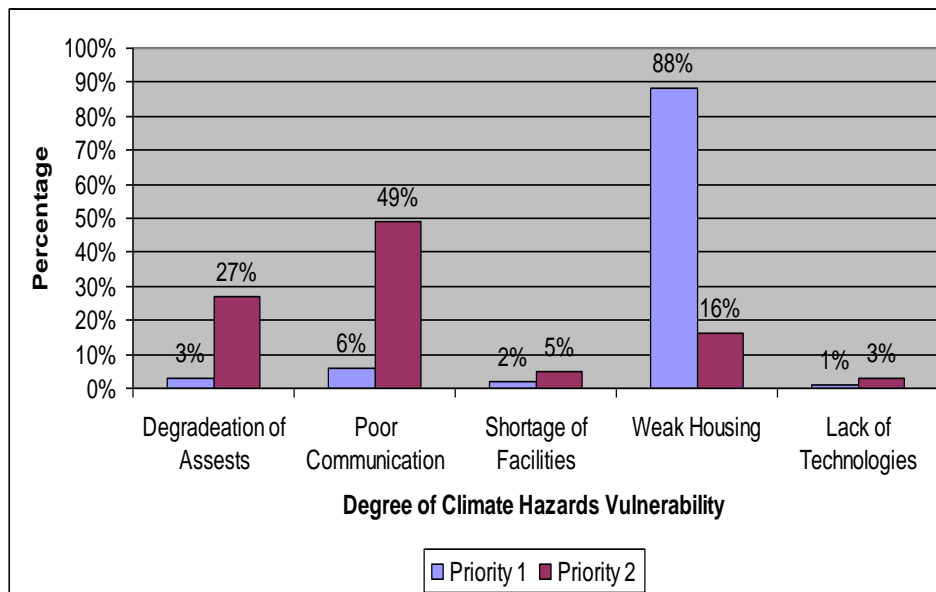
**Figure 5: Duration of Living**

Duration of living of the respondents is described in the above graph. From the graph it was found that duration of living 35-44 years is 46 % which is the maximum and duration of living above 55 years is 10 % which is the minimum. Duration of living 25-34, 45-54 years is 17% and 27 % respectively. The selection of the participants was done randomly.

**Table 6: Degree of Climate Hazards Vulnerability**

Degree	Priority 1	Priority 2
Degradation of Assets	3.0%	27%
Poor Communication	6.0%	49%
Shortage of Facilities	2.0%	5.0%
Weak Housing	88%	16%
Lack of Technologies	1.0%	3.0%



**Figure 6: Degree of Climate Hazards Vulnerability**

Degree of Climate Hazards Vulnerability is described above. Here opinions of the respondents are categorized into Priority 1 and Priority 2. From the graph it was that in case of priority 1, out of 100 respondents, 88% respondents agreed that Weak Housing is the effect of natural disaster which is the maximum and lack of technologies is 1% which is the minimum effect of natural hazards. Other effects of natural hazards are Degradeation of Assests, Poor Communication, Shortage of Facilities, Weak Housing and Lack of Technologies is 3%, 6%, 2% respectively. In case of priority 2 out of 100 respondents, 49% respondents agreed that Poor Communication is the effect of natural disaster which is the maximum and Shortage of Facilities is 1% which is the minimum effect of natural hazards. Other effects of natural hazards are Degradeation of Assests, Weak Housing and lacks of Technologies are 30%, 6% and 4% respectively.

## SUMMARY AND RECOMMENDATION

A study was conducted to identify the adaptation and mitigation strategies of climate induced hazards in the coastal areas and understand the climate hazards and degree of vulnerability caused by these disasters in coastal zone in Bangladesh. Adaptation to climate change is a complex topic that presents a number of challenges. This involves a process of sustainable and permanent adjustment in response to new and changing environmental circumstances. So adaptation cannot be treated as a stand-alone issue and should be premised on the following factors.

1. Vulnerability and adaptation assessments should be developed for prioritizing adaptation policies and measures. Adaptation has to be mainstreamed in investment planning both in public and private sector. Governments therefore need to devise policies, incentives, and regulation to public and private initiative toward strengthening adaptation.
2. Capacity needs to be built for both short-term and long-term adaptation planning. Innovative risk sharing mechanisms (insurance) are needed to respond to emerging challenges including biodiversity loss and land degradation.
3. Adaptation, rather than being concentrated in one sector, should essentially be dispersed across all socio-economic sectors including water, health, agriculture, and infrastructure, each of which presents in own challenges, and will involve stakeholders in different if overlapping groups. Adaptation measures are likely to be less capital intensive and more amenable to small scale interventions.

4. More Shelter Centers should be built to give shelter during the natural hazards.
5. Living house should be built in such a way so that the houses can resist the tidal surge and cyclones.
6. Governmental institutions (ministries, governmental organizations and agencies), private entries and NGOs should consider integrating climate change in their planning and budgeting at all levels of decision making and coordinate their actions among themselves.
7. Vulnerability and adaptation assessments should be developed for prioritizing adaptation policies and measures. Adaptation has to be mainstreamed in investment planning both in public and private sector. Governments therefore need to devise policies, incentives, and regulation to public and private initiative toward strengthening adaptation.

Still many climate change impacts timing and exact magnitude are uncertain. Hence, the strategy and Action Plan will require periodical revision. The following enhancements should be considered by Government of Bangladesh to their policies and programs.

1. Adopt meaningful, achievable climate change targets.
2. Pursue strong, binding emissions targets in international negotiations.
3. Ensure commitment of developing countries fair share to climate change adaptation for Bangladesh.
4. Education, training and public awareness.
5. Seeking more support for climate change mitigation and adaptation research: The Government of Bangladesh should look for increased funding support to research into innovative technologies including renewable energy, understanding climate change dynamics, carbon capture and sequestration, energy efficiency, crop varieties, and other adaptation and mitigation innovations.
6. Encourage environmental solutions in other countries.
7. Collaborate with our neighbors who are victim of climate change.

## REFERENCES

1. Adger, W.N. 2006, Vulnerability. Global environmental change. Vol, 16, pp 268-281
2. Agarwal, B. 1997, Gender, Environment and Poverty Interlinks: Regional Variations and Temporal shifts in Rural India, 1971-91", World Dev 25-1: 23-52.
3. Amin, M. S. 1989, The Disaster Flood- 1987-88: The Causes and Rehabilitation Agro-technologies. Edited. Bangladesh Agricultural Research Council Ministry of Agriculture. GOB.
4. Amin, M.S.; Anwar, I 1990, Hailstorms in Bangladesh and its Rehabilitation. Bangladesh Agricultural Research Council. Ministry of Agriculture. GOB.
5. Anon BIDS, 2003, An Input-Output table for Bangladesh economy-2000'. General Economics Division, Planning Commission Government of People's Republic of Bangladesh.
6. Bardhan P., and C. Udry 1999, Development Microeconomics, Oxford University Press, Somerset.
7. BBS, 2001, Statistical Yearbook of Bangladesh, 2000-2001'. General Economics Division, Planning Commission Government of People's Republic of Bangladesh.
8. Beata S K. and Shang-J W 2001, Pollution Havens and Foreign Direct Investment: Dirty Secret or Popular Myth?' NBER Working paper, 8465.
9. Besley, T. 1995, Property Rights and Investment Incentives: Theory and Evidence from Ghana", journal of Political Economy, 103: 903-937.
10. Carpenter, S.R., Brock, W.A., Ludwig, D. 2002, Collapse, learning and renewal. In Gunderson, L.H. and Holling, C.S. (eds.). Panarchy, understanding transformations in human and natural systems. Washington D.C.: Island press



11. Checkland, P. 1985, from optimizing to learning: a development of systems thinking for the 1990s. *J. Opl Res.Soc.* Vol 36(9). pp 757-767
12. China GOC Annon 1991, Govt. of China (1991): Sustainable Agriculture and Rural Development in China, Ministry of Agriculture, Beijing.
13. Cropper, M. C. Griffiths 1994, the Interaction of Population Growth and Environmental Quality”, *American Economics Review*, 84: 250-254.
14. Deaton, A. 1997, the Analysis of Household Surveys: A - Approach to Development Policy, John Hopkins University Press, Baltimore.
15. Eakin, H and Luers, A. L. 2006, assessing the vulnerability of socio-ecological systems. *Annual Review of Environmental resources.* Vol. 31. pp 365-394.
16. Eakin, H., Winkels, A. and Sendzimir, J. 2008. Nested vulnerability: exploring cross-scale linkages and vulnerability tele-connections in Mexican and Vietnamese coffee systems. *Environmental Science and Policy.*
17. FAO UNDP 1990, Human Development Report 1990, Oxford University Press, New York.
18. Feder, G., et al. 1988, Land Policies and Farm Productivity in Thailand, a World Bank Research Publication, the John Hopkins University Press, Baltimore and London.
19. Fussel, H.M. 2005. Vulnerability in climate change research: a comprehensive conceptual framework. UC Berkeley: University of California International and Area Studies, UC Berkeley.
20. Gallopin, G. C. 2006. Linkages between vulnerability, resilience and adaptive capacity. *Global Environmental Change.* Vol 16.293-303.
21. Khalequzzaman, M 1988, Environmental hazards in the coastal areas of Bangladesh: in Ferraras, S. F., and Pararas-Carayannis, G. (eds.), *Proc 3rd Intern Conf Natural and Man-made Coastal Hazards California, Mexico*, p. 37-42.)
22. McCarthy, J. J., Canziani, O. F., Leary, N. A., Dokken, D.J., and White, K. S. (eds.): 2001, *Climate Change 2001: Impacts, Adaptation, and Vulnerability, Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge.
23. Moss, S., Pahl-Wostl, C. and Downing, T. 2000. Agent-based integrated assessment modeling: the example of climate change. *Integrated Assessment*, Vol2. pp 17-30.
24. Nicholls, R.J. and Mimura, 1998, Regional issues raised by sea-level rise and their policy implications, *Climate Research*, 11(1), 5-18.
25. Petrosillo, I., Zaccarelli, N., Zurlini, G. 2010, Multi-scale vulnerability of natural capital in a panarchy of socio-ecological landscapes. *Ecological complexity.* Vol 7. pp 359-367
26. Smit, B. and Wandel, J. 2006, Adaptation, adaptive capacity and vulnerability. *Global Environmental Change.* Vol 16, pp 282-292.
27. Sterman, J.D., 2000, *Business Dynamics: Systems Thinking and Modeling for a Complex World.* McGraw-Hill/Irwin, Boston and London.