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SENIOR SEMINAR ;THE IMPACTS OF CLIMATE CHANGE AND
VARIABILITY IN ETHIOPIA.

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List of Abbreviations

CC	Climate Change
CDM	Clean Development Mechanism
CV	Climate Variability
EBA	Ecosystem based adaptation
GDP	Growth National Product
GHG	Green House Gases
IPCC	Intergovernmental Panel on Climate Change
MDGs	Millennium Development Goals
NGO	Non-Governmental Organization
UNEP	United Nation Environmental Program

Abstract

Climate change or global warming can affect human welfare negatively in Ethiopia. Climate change and variability is rapidly emerging as one of the most serious global problems affecting many sectors in Ethiopia and is considered to be one of the most serious threats to sustainable development with adverse impact on environment, human health, agriculture, economic activities, natural resources and physical infrastructure. . The economic costs of future adaptations are being derived by examining the differences between the economic losses associated with scenarios of technology uptake and diffusion. Among these approaches, a key issue is the identification of successful adaptations in the developing world where the greatest risk and physical vulnerability persists. goes beyond deforestation and forest degradation. EBA approach suggests that ecosystem-based solutions can contribute to address climate change through providing social benefits and ecosystem conservation. There is a need for the developing countries to prepare more detailed assessments of adaptation to climate change including policies and ensuring their compatibility with action plans under other multilateral, environmental agreements. The implementation of the various mechanisms, including the Clean Development Mechanism and associated adaptation funds do not offer the desired but elusive win-win

solutions to climate change and development they always result in winners and losers, and the losers are invariably the most marginalized in terms of resources, new technologies and access to decision-making. There is a need to develop, disseminate and implement the knowledge, tools and technologies required to effectively engage in an integrated adaptation approach.

1.Introduction

1.1. Background

Climate change or global warming can affect human welfare negatively In Ethiopia. Human beings are likely to face severe storms, floods, droughts, and desertification. Agricultural yields are expected to drop in most tropical and sub-tropical regions, and in temperate regions too if the temperature increase is more than a few degrees .In addition, the range of pests and diseases (such as malaria) may expand. Climate change will most probably endanger ecosystems, leading to a loss of biodiversity through the extinction of numerous plant and animal species (UNFCCC 2007).

Climate change and variability (CC & V) is rapidly emerging as one of the most serious global problems affecting many sectors in the world and is considered to be one of the most serious threats to sustainable development with adverse impact on environment, human health, food security, economic activities, natural resources and physical infrastructure (IPCC,2007) .

Climate change is one of the all-encompassing global environmental changes likely to have deleterious effects on natural resources and human systems, economies and infrastructure. The risks associated with it call for a broad spectrum of policy responses and strategies at the local, regional, national and global level. The United Nations Framework Convention on Climate Change (UNFCCC) highlights two fundamental response strategies: mitigation and adaptation. While mitigation seeks to limit climate change by reducing the emissions of greenhouse gases (GHG) and by enhancing sink' opportunities, adaptation aim to alleviate the adverse impacts through a wide-range of system-specific actions (Fussel and Klein, 2002).

Adaptation measures must be pursued to tackle the climate change problem and to create an effective and inclusive international climate change regime, more attention has been devoted to mitigation in the past, both in scientific research and policy debate. Sensitivity to the issue of adaptation has grown over the last couple of years, particularly after the IPCC. Adaptation has now emerged as an urgent policy priority, prompting action both within and outside the climate change negotiations (Parry *et al.*, 2005).

Evidences indicate that the CO₂ content of the atmosphere could double by 21 century and that climate change has already begun. Measurement records indicate an increase of $0.6 \pm 0.2^{\circ}\text{C}$ in global average temperature since the late 19th century. If nothing is done to reduce emissions, current climate models predict a global warming of about $1.4\text{--}5.8^{\circ}\text{C}$ between 1990 and 2100 (IPCC 2007). Therefore, the objective of this seminar paper is to review coping with the impacts of climate variability and climate change in Ethiopia.

1.2. Statement of problem

Although the basic causal relationship between global climate change and human emissions of greenhouse gases is pretty much a scientific consensus, climate change still deals with the uncertainty of various sources: scenarios of greenhouse gas emissions, global and regional climate responses to atmospheric greenhouse gases, impacts of climate change on human societies, prospects of agreements and implementation on climate policy, to name a few. These ambiguities and the associated difficulties of decision-making in an uncertain world are a likely cause of political gridlock of climate policy in many countries and in international negotiations of climate change. Yet, since climate change is caused by the gradual accumulation of greenhouse gases in the atmosphere, the control of greenhouse gas emissions needs to be started long before damages become significant. Global warming has many detrimental effects such as more frequent and severe natural disasters, droughts and floods, a rising sea level, and a reduction in biodiversity that particularly affects species upon which the world's poor rely for their livelihoods.

1.3.Objectives

1.3.1 General objective

The overall objective of this seminar work is to identify the coping mechanisms for climate change in Ethiopia.

1.3.2 Specific objectives

- ✓ To assess adaptation mechanisms in climate variability in Ethiopia
- ✓ To see impact of climate variability on agriculture
- ✓ To assess the impact of climate on human health, water resources
- ✓ To assess the international institutional policy responses on adaptation to climatechange

2. LITRATURE REVIEW

2.1. Definition and concept of climate change and variability

Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the UNFCCC, in Article 1, defines climate change as: a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes. Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal

processes within the climate system (internal variability), or to variations in natural or anthropogenic externalforcing (external variability). Therefore, climate variability is the Departure from normal or the difference in magnitude between climatic occurrences. The climate of

Africa is warmer than it was 100 years ago and model-based predictions of future GHG-induced climate change for the continent clearly suggest that this warming will continue and, in most scenarios, accelerate (Hulme *et al.*, 2001).

2.2. Impact of climate change

2.2.1. Element of variability

Nearly all human societies and activities are sensitive to climate in some way or other. This is because in large measure where people live and how they generate a livelihood and wealth is influenced by the ambient climate. Since climate is inherently variable for quite natural reasons, human societies have always and everywhere had to develop coping strategies in the face of unwelcome variations in climate or weather extremes for example migration and transhumance in semi-arid pastoralist societies or financial insurance mechanisms in the case of industrial societies. The vulnerability or security of individuals and of societies is determined, not only by the likely responses of the resources on which individuals depend, but by the availability of resources and, crucially, by the entitlement of

32 individuals and groups to call on these resources. This is well documented across a wide range of political and economic circumstances and development processes (Sen., 1999). Emerging conceptualizations of vulnerability and adaptation clearly draw on insights from risk and natural hazards, vulnerability to hunger and famine, and ideas of entitlement and autarky in development (Ribot *et al.*, 1996). But vulnerability to climate change, as with vulnerability to hazards, is not strictly synonymous with poverty. Although poverty and marginalization are keys driving forces of vulnerability and constrain individuals in their coping and long-term adaptation (Cannon, 1994).

Vulnerability to future climate change is likely to have distinct characteristics and create new vulnerabilities. This is not to say that

those most marginalized are not most at risk. Indeed it has been argued that both vulnerability and adaptation processes to climate change are likely to reinforce unequal economic structures. Global climate is already warming at a rate unprecedented in the past 1000 years and is therefore inevitably altering the character of local and regional weather around the world (IPCC, 2001a). A different global climate must by definition induce different experiences of local weather. Although we cannot lay out a simple cause-and effect chain from a severe weather episode back to human-induced climate change, we can begin to identify those parts of the world where we are already observing rather different weather characteristics from those that have been experienced in earlier decades. Thus the frequency of intense precipitation events is increasing over many Northern mid-latitude regions (Easterling *et al.*, 2000). That the global climate is changing is undisputed. The trend in climate over the past century a globally averaged change of nearly 1°C has occurred concurrently with changes in some extreme event regimes (IPCC, 2001a).

2.2.2. Human health

The causes of adverse health effects are notoriously multi-factorial and there are so far few observed changes that can be confidently attributed to climate change (McMichael and Githeko, 2001).

Infectious diseases may become more prevalent as their reach increases and seasonality expands; the frequency and intensity of heat waves and natural hazards such as droughts, floods, and cyclones may increase, causing adverse health effects; and levels of air pollution may increase. Small changes in climate can result in substantial changes in risk. The increased health risks are likely to be most acute in developing countries. This is because many climate-related infectious and vector-borne diseases are associated with warm or hot weather conditions and, most importantly, because public health systems, which can substantially reduce health risks, tend to be relatively weak in many developing countries. A key factor in reducing future risks in developing countries is

the strengthening of public health systems, including monitoring and surveillance, public health infrastructure, and the development of effective adaptation measures. (Tol and Dowlatabadi, 2002

Table 1: Major Health effects of climate change

Phenomenon	Human health impact	Additional child-specific risks
Fewer cold days and nights	Fewer cold related deaths	Children will benefit
Increased frequency of warm spells and heat waves	Increased heat related deaths and illness	Very young at higher risk of death: older children will have more heat stress due to time spent outside during exercise
Increased heavy precipitation	Increased risk of injury, death as well as respiratory and skin diseases	Very young vulnerable to hospitalization and complication from infection
Increased temperature and rainfall	Reduction in vectors reproductive and incubation rates as well as parasite infection rates, resulting an	Young children more vulnerable

	increase in vector borne diseases	
Increased areas Of drought and wildfire	Increased risk of food and water shortage, malnutrition and infection, concentration of toxic water pollutant, injury and death	Growth retardation, development delays
Increased tropical storm and cyclones	Increased risk of injuries, death, water, food and vector borne illness	Children may be more susceptible to injuries, post traumatic and certain infections
Increased air pollution	Exacerbation of respiratory illness, premature mortality	Children's more airways susceptible to asthma and infection
Change in distribution and potency allergens and myco-toxins	More severe and more prevalent allergies	Allergies, cancer and birth defects
Increased sea level, saltwater intrusion into freshwater	Abrupt coastline, force migration, injury, drowning	Disruption of families and school infrastructure and other social disruption

Source: IPCC, 2001

2.2.3. Agriculture

The production of food crops is the most climate-dependent economic activity. Changes in climate can be expected to have significant impacts upon crop yields through changes in both temperature and moisture. As climate patterns shift, changes in the distribution of plant diseases and pests may also have adverse effects on agriculture. At the same time, agriculture has proven to be one of the most adaptable human activities to varied climate conditions. Many investments are relatively short-term and crops and cultivars can be quickly changed to suit new conditions.

There is flexibility also in farming practices, the application of irrigation water and other inputs. For these reasons, agriculture at the global level can probably adapt to a moderate amount of global warming (perhaps up to 2.5 degrees Celsius above current levels, assuming no dramatic change in climate variability). There are likely to be considerable regional variations, however. Crops in low latitudes are more often close to their limits of heat tolerance, while growing conditions are likely to improve in higher latitudes, where agriculture might gain in competitive Advantage. As in other sectors, adaptive capacity is likely to be a major factor in determining the relative distribution of adverse impacts (Gitayet *al.*, 2001). In some African countries, yields from rain-fed agriculture, which is important for the poorest farmers, could be reduced by up to 50 percent by 2020 (IPCC, 2007b). The consequences of climate change are potentially more significant for the poor in developing countries than for those living in more prosperous nations. Vulnerability to the impacts of climate change is a function of exposure to climate variables, sensitivity to those variables, and the adaptive capacity of the affected community. Often, the poor are dependent on economic activities that are sensitive to the climate. For example, agriculture and forestry activities depend on local weather and climate conditions; a change in those conditions could directly affect productivity levels and diminish livelihoods (USAID, 2007).

Table 2. Estimated Impact of Climate Change on Agricultural Production Across Southern

Region

Temperature	Temperature to increase by 3-7°C by 2080-2099.	Temperature to increase by 1-7.5°C by 2070-2099.	Temperature to increase by 2.3-4.5°C by 2070-2099.	Temperature to increase 2-3.8°C by 2070-2099.
Precipitation	Precipitation to decrease 30-40% in most part of southern Africa but increase 7% in tropical and eastern region by 2080-2099	Precipitation to change up to -40% to +12% 2080.	Precipitation to increase 10-17% by 2070-2099.	Precipitation to increase by 3-8 by 2070-2099.
Agriculture	Rain-fed cereal(wheat, maize and rice) production to decrease 12% (net loss) by 2080, with great general variation.	The overall yield to change by between -30% to +5% by 2080. For example rain-fed wheat production is to decrease 12-27% in 2080.	Net cereal production to decrease 4-10%. Rain-fed wheat production is decrease 20-75% in 2080.	The overall cereal production increase by up to 30%. But rain-fed wheat production decrease by 10-95% by 2080.

Note: The wide range of temperature and precipitation reflect the scenarios on which the estimates are based across regions.

Sources: Christensen *et al.*, 2007

2.2.4. Water resource

Climate change is expected to have significant impacts on water supplies creating or exacerbating chronic shortages and on water quality. There is already widespread acceleration of glacial retreat and in many areas stream flow is shifting from spring to winter peaks. If continued, these shifts could affect the availability of water for agriculture and other uses. Sealevel rise will result in saltwater intrusion into coastal fresh water aquifers, potentially reducing water resource availability. Changes in quantity and intensity of precipitation are likely to result in more floods and droughts and increased demand for irrigation water (Arnell and Liu, 2001).

Water management often requires costly investment in infrastructure. Given the long economic and physical life of reservoirs, water withdrawal, treatment, delivery, and disposal systems, adaptive responses are generally slower in water management than in agriculture (Burton and May, 2004).

2.2.5. Drought

Drought is one of the most common disasters. Drought can increase a location's vulnerability to other hazards such as salt water intrusion, wildfire, wind-induced soil erosion, and natural ecosystems' capacity to capture atmospheric carbon dioxide (Zhao and Running 2010).

2.2.6. Ecosystem and biodiversity

Natural ecosystems are highly adapted to specific climatic conditions in specific localities. While some of the more mobile species (birds and larger animals) may be able to migrate rapidly enough in response to

changing climate patterns, many ecosystem components, including many tree species, have much lower mobility. Even where migration is a theoretical possibility, human development has fragmented many ecosystems, weakened them through pollution and other forms of degradation, and in many places limited or cut off migration routes. The combined effects of human development and the slow rate of natural adaptation suggest that considerable

ecosystem disruption will take place as the climate changes, and that substantial loss in the diversity of species is likely to occur (Gitayet. *al.*, 2001)

2.3. Coping strategies of climate changes in Ethiopia

Some adaptation by individuals is undertaken in response to climate threats, often triggered by individual extreme events Other adaptation is undertaken by governments on behalf of society, sometimes in anticipation of change, but, again, often in response to individual events. But these levels of decision-making are not independent they are embedded in social processes that reflect the relationship between individuals, their networks, capabilities and social capital, and the state (Adger , 2001).

But this distinction obfuscates the role of the state in providing security, or in using security as a weapon of coercion when faced with an environmental risk. The nature of the relationship between individuals and agents of government in handling risk is a fraught but under-researched area (Adger, 2001).

Political ecology approaches demonstrate that, for example, when faced with a flood risk, residents of marginalized but risky areas have only a limited set of adaptation options and the state allows such risks to exist as part of the politized nature of urban planning and control (Pelling, 1999).

Realizing that action is required to enhance the adaptive capacity of the most vulnerable societies and groups, an emerging research agenda is focused on identifying generic determinants of resilience. This is being undertaken in part through learning the lessons from present and past adaptations. These determinants include the social capital of societies, the flexibility and innovation in the institutions of government and the private sector to grasp opportunities associated with climate change, and the underlying health status and wellbeing of individuals and groups faced with the impacts of climate change (Adger, 2001).

This review suggests that there are critical limits as to how far analogues of past and present adaptation experiences are relevant for adaptation to future climate change as a result of two inter-related phenomena. First, there may well be nonlinearities, or critical thresholds, in the climate change impact or response function of natural and social systems. And, secondly, the magnitude and rate of the change in climate in many parts of the world may turn out to be unprecedented in human history. Taking these factors together, human societies may experience what is already hypothesized in emerging ecosystem science that smooth change and adaptation can be interrupted by sudden and dramatic switches to another state, resulting in the inability to cope with new circumstances. These sudden shifts can be seen in forest, coral reef, grassland and other ecosystems as a result of apparently gradual climate change (Scheffer *et al.*, 2001).

There is also the reverse situation where climate change is not gradual i.e., a sudden discontinuity in climate or more than one extreme weather event coming in close sequence which may also undermine the inability to cope. Indeed, this characteristic of the sequencing and recovery time from weather-related hazards is well understood within the hazards research area. Blaikie *et al.* (2004) suggest that the timing of hazardous

discrete events in nature constitutes a building of pressure on the vulnerability of marginalized populations. The vulnerability of populations is both event based and a product of political and economic structural factors (Mustafa, 1998).

2.3.1. Adaptations

Given the potential risks associated with climate change, a serious effort on characterizing and understanding adaptation is therefore now underway. Analogues of adaptation in the past are complemented with policy and social science research on the present adaptive capacity of governments, civil society and markets to deal with climate perturbations. The economic costs of future adaptations are being derived by examining the differences between the economic losses associated with scenarios of technology uptake and diffusion. Among these approaches, a key issue is the identification of successful adaptations in the developing world where the greatest risk and physical vulnerability persists. But even where successful examples are identified, from indigenous strategies for resource management to large-scale infrastructure and irrigation, there will still be winners and losers. First of all it is necessary to distinguish adaptation by who is undertaking it and the interests of the diverse stakeholders involved. It is clear that individuals and societies will adapt and have been adapting to climate change over the course of human history. Climate is part of the wider environmental landscape of human habitation. Thus individuals and societies are vulnerable to climate risks and other factors and this vulnerability can act as a driver for adaptive resource management (Ribot *et al.*, 1996).

There are various geographic scales and social agents involved in adaptation according to (AfDB, 2002).

- A. **Local level:** municipal planning processes and community level strategies, covering areas such as risk assessment practices, community services, emergency preparedness programmes, seed banks.
- B. **Sectoral level:** impacts on agriculture, water resources, forestry, fisheries, coastal zones, urban planning, and human health, and disaster risk reduction, need to build into the sectoral planning process.
- C. **National Level:** government planning and budgetary processes.
- D. **Global level:** integrated unequivocally into the MDGs, country assistance strategies of international financial institutions, aid initiatives etc.

2.3.2. Redd+ and adaptation to climate change

Reducing Emissions from Deforestation and forest Degradation (REDD+) is an international mechanism to mitigate climate change by supporting policy implementation at the national level, with an aim to reduce greenhouse gas emissions related to deforestation and forest degradation. Furthermore, REDD+ goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management and enhancement of forest carbon stocks (UNFCCC, 2001).

Locally REDD+ implementation could be a source of income generating activities, ranging from tree growing to agro-related activities (bee-keeping, fruit growing and economic agroforestry practices). The regeneration of forests or reforestation/afforestation of areas will also have an indirect impact by increasing adaptive capacity in vulnerable areas like mountain slopes, Arid and Semi Arid Lands (ASALs) of Kenya, and fragile ecosystems like natural forests

2.3.3. Ecosystem-based on adaptation

Ecosystem-Based Adaptation (EBA) is an approach that builds resilience and reduces the vulnerability of local communities to climate change. Through considering the ecosystem services on which people depend to adapt to climate change, EBA integrates sustainable use of biodiversity

and ecosystem services in a comprehensive adaptation strategy (CBD, 2009).

Adaptation is seen as a key element in creating a resilient society. EBA puts special emphasis on ecosystem services that underpin human well-being in the face of climate change. This approach suggests that ecosystem-based solutions can contribute to address climate change through providing social benefits and ecosystem conservation. EBA approaches consider that both natural and managed ecosystems can reduce vulnerability to climate-related hazards and gradual climatic changes. The sustainable management of ecosystems can provide social, economic and environmental benefits, both directly through a more sustainable management of biological resources and indirectly through the protection of ecosystem services (World Bank, 2010).

2.4. International institutional policy responses on adaptation to climate change

Adaptation to climate change has increasingly become a focus of policy debates. A number of articles in the UNFCCC and the Kyoto Protocol refer to adaptation. The IPCC recognizes different forms of adaptation, but also states that there is little evidence that efficient or effective adaptations to climate change risks will be taken autonomously (Smit *et al.*, 2001).

However, there is a need for the developing countries to prepare more detailed assessments of adaptation to climate change including policies and ensuring their compatibility with action plans under other multilateral, environmental agreements (such as biodiversity and desertification) as well as with other national sustainable development plans or strategies (Huq, 2002).

Hence there is a fundamental dilemma at the heart of international action on this issue – the need for reductionist identification of the ‘climate’-related part of global social and economic trends, versus the desire to see climate change as another important dimension of global environmental threats to development. These same issues are played out throughout the mechanisms of the international agreements. Projects implemented as part of the Clean Development Mechanism (CDM) of the Kyoto Protocol, one of the so-called flexibility mechanisms, have the dual mandates of reducing greenhouse gas emissions and contributing to sustainable development. The Protocol suggests that a ‘share of the proceeds’ from the CDM shall be used to assist particularly vulnerable developing countries in meeting the costs of adaptation to the adverse effects of climate change. Ambitious claims have been made about the likely benefits of CDM projects in developing countries without basis in research or observation. Developing countries are unlikely to become fully engaged in implementing the UNFCCC unless they perceive development benefits. At present there are serious risks to developing countries engaging in CDM activities, not least of which is that it may distort development priorities, and may also lead to the situation where the only domestic mitigation measures remaining are higher cost activities (Parson and Fisher-Vanden, 1999).

3. Conclusion and recommendation

3.1. Conclusion

Adaptation to climate change is the adjustment of a system to moderate the impacts of climate change, to take advantages of new opportunities or to cope with the consequences. It creates a distortionary focus in these debates ‘planned adaptation’, either at the global scale through international institutions or at the scale of states through national governments. Of course, the role of international action is critical in this area, if only because of the interaction between planning for adaptation

with an emerging scientific understanding of the risks involved as expressed by the IPCC. Yet there are serious limits as to what international actions regarding adaptation can achieve. However, a re-alignment to focus on how policy can support the adaptive capacity and resilience of vulnerable communities would also potentially find synergies with more conventional development policy and analysis.

This review of issues has shown that much adaptation in the developing world will rely on past experience of dealing with climate-related risks. Thus much adaptation by farmers, fishers, coastal dwellers and residents of large cities will be autonomous and facilitated by their own social capital and resources. This will not easily be identifiable among a myriad of social, demographic and economic factors impinging on development trajectories and experiences

But there is a key role for planning for adaptation in these ongoing processes. International institutions need to appropriate these latest research insights on adaptation from the developing world and build a global coalition, not only to take action to reduce damaging emissions, but to facilitate the inherent resilience of populations coping with an uncertain future.

Finally, particular attention needs to be paid to the issues of adaptation in any future international climate regime, as a cross-cutting theme that is fully integrated into UNFCCC actions related to future research, commitments, capacity building, and also into decision making and management practices at various scales.

3.2. Recommendations

From this seminar work the following suggestions will be forwarded:

- Awareness creation must be given to the society about the impacts of climate change
- Different adaptation mechanisms must be applied on farming activities
- Afforestation/reforestation activities must be taken
- Improving the using of renewable energy sources should be habituated

References

Adger, W.N.2001.*Social capital and climate change*. Working Paper **8**, Tyndall Centre for Climate Change Research, University of East Anglia, Norwich.

- Adger, W.N., Benjaminsen, T.A., Brown, K. and Svarstad, H.2001a.*Advancing a political ecology of global environmental discourses*.Development and Change **32**, 681-715.
- AfDB (African Development Bank).2002.*Poverty and Climate Change: reducing the Vulnerability of the Poor through Adaptation*, www.oecd.org/dataoecd/60/27/2502872.pdf
- Arnell, N.,C. Liu, R.Compagnucci,L. Da Cunha, K. Hanaki, C. Howe, G. Mailu, I. Shiklomanov, and E. Stakhiv. 2001. Hydrology and Water Resources, in J. McCarthy, O. Canziani, N. Leary, D. Dokken, and K. White, eds,2001: *Climate Change Impacts, Adaptation, and Vulnerability*. New York: Cambridge University Press, pp. 191-233.
- Blaikie, P., Cannon, T., Davis, I. and Wisner, B.1994.*At risk: natural hazards, people's vulnerabilityand disasters*. London. Routledge.
- Burton, I. and E. May. July 2004. *The Adaptation Deficit in Water Resources Management*.IDS Bulletin, vol**35**, no. **3**, pp. 31-37.
- Cannon, T.1994.*Vulnerability analysis and the explanation of natural disasters*. In Varley, A., editor,:Disasters development and environment. Chichester: John Wiley, 13-30.
- CBD (Convention on Biological Diversity). 2009.*Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change*. Technical Series No. 41.Secretariat of the Convention on Biological Diversity (CBD).Montreal, Canada. 126 pp.
- Christensen, JH, Hewitson, B, Busuioc, Chen, A, 2007.*Regional climate projections*.**In:** The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel

- on Climate Change. Cambridge: Cambridge University Press, pp. 847–940.
- Easterling, D.R., Karl, T.R., Gallo, K.P., Robinson, D.A., Trenberth, K.E. and Dai, A.G. 2000. *Observed climate variability and change of relevance to the biosphere*. *Journal of Geophysical Research* **105(20)**: 101–14.
- Fussler, H.M., and Klein, R.J.T., 2002. *Assessing the Vulnerability and Adaptation to Climate Change: An Evolution of Conceptual Thinking*, Paper presented at the UNDP Expert Group Meeting on Integrating Disaster Reduction and Adaptation to Climate Change, Havana, Cuba, 17–19th June 2002.
- Gitay, H., S. Brown, W. Easterling, and B. Jallow. 2001. *Ecosystems and their Goods and Services*. In McCarthy., pp. 235–342.
- Hulme, M., Doherty, R.M., Ngara, T., New, M.G. and Lister, D. 2001. African climate change: 1900–2100. *Climate Research* **17(2)**: 145–168.
- Huq, S. 2002. The Bonn–Marrakech. *Agreements on funding*. *Climate Policy* **2**, 243–46.
- IPCC 2001a. Climate change the scientific basis. Contribution of Working Group I to The Third Assessment Report of the IPCC. Cambridge: Cambridge University Press.
- IPCC .2007. Africa. *Climate Change Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge UK, 433–467.

- IPCC (Intergovernmental Panel on Climate Change).2007a.*The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge.*
- IPCC.2007b.*Summary for policymakers.in Parry, ML, Canziani, OF, Palutikof, JP, van der Linden, PJ and Hanson, CE (eds), Climate Change 2007. Impacts, Adaptation and Vulnerability.Contribution of Working Group II to the Fourth Assessment Reportof the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK, 7-22.*
- McMichael, A, and Githeko, A. 2001.*Human health. Climate change 2001. Impacts, adaptation and vulnerability in* McCarthy pp 451-485.
- Mustafa, D. 1998. *Structural causes of vulnerability to flood hazard in Pakistan.EconomicGeography* **74**, 289-305.
- Parry, J.E., Hammill, A., and Drexhage, J. 2005. *Climate Change and Adaptation, IISD*
- Parson, E.A. and Fisher-Vanden, K. 1999.*Joint implementation of greenhouse gas abatement under the Kyoto Protocol's Clean Development Mechanism: its scope and limits. Policy Sciences***32**, 207-24.
- Pelling, M.1999. *The political ecology of flood hazard in urban Guyana.Geoforum***30**, 240-61.
- Ribot, J.C., Magalhães, A.R. and Panagides, S.S.,editors, 1996. *Climate variability, climate changeand social vulnerability in the semi-arid Tropics.Cambridge: Cambridge University Press.*

- Scheffer, M., Carpenter, S., Foley, J.A., Folke, C. and Walker, B. 2001. *Catastrophic shifts in ecosystems*. Nature **413**, 591–96.
- Schneider, S.H. 2001. *What is dangerous climate change?* Nature **411**: 17–19.
- Sen., A.K. 1999. *Development as freedom*. Oxford: Oxford University Press.
- Smit, B. 2001. *Adaptation to climate change in the context of sustainable development and equity*. In McCarthy, J.J., Canziani, O., Leary, N.A., Dokken, D.J. and White, K.S., editors, Climate change 2001: impacts, adaptation and vulnerability. IPCC Working Group II. Cambridge: Cambridge University Press, 877–912.
- Tol, R.S.J. and H. Dowlatabadi. 2002. *Vector-Borne Diseases, Development, and Climate Change*. Integrated Environmental Assessment, 2, pp. 173-181.
- UNFCCC (United Nations Framework Convention on Climate Change). 2001., Rio de Janeiro, Brazil, www.unfccc.int/text/resource
- USAID (United States Agency for International Development). 2007. *Adapting to climate variability and change*. A guidance manual for development planning. USAID, Washington, DC.
- World Bank. 2010. *Convenient Solutions to an Inconvenient Truth: Ecosystem Based Approaches to Climate Change*. World Bank. Washington DC, USA.
- Zhao, M., and S. W. Running. 2010. *Drought-induced reduction in global terrestrial net primary production from 2000 through 2009*. Science.