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Climate Change Adaptation: Building on Experiences in Ethiopia

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Abstract

The Global climate is changing; and the change is coming in the forms of temperature change, precipitation change, sea level rise, and extreme events. Climate change affects ecosystems, water resources, food security, and human health. There are two options for combating the change: mitigation and adaptation. Since mitigation, the reduction of greenhouse gas emission is the responsibility mainly of the rich countries and they are hesitant about doing so; and since enough greenhouses gas has been released already to make reversal of climate change impossible in the near future, adaptation has become an indispensable option. Adaptation to climate is not new to humanity. It has been undergoing spontaneous adaptations, to various climatic conditions, throughout its existence. There have also been planned adaptation experiences in many countries that faced climate or related variability and disasters. Ethiopia is one of these countries which have experiences of policy making and institutional arrangements to respond to climate variability and drought hazards for nearly half a century, on which it can build on future climate change adaptations. This is a qualitative research paper, which is based mainly on document analysis and the author's observations and experiences. First, it elaborates on the merits of adaptation experiences, concept of climate change adaptation, and determinants of climate change adaptation; and second, it presents a critique on NAPA-Ethiopia, and discusses the adaptation experiences in Ethiopia based on the analytic framework formulated from the assemblage of the climate change impact categories, climate change manifestations, nature of impacts of each climate change manifestation on each climate change impact categories, possible adaptation actions, and adaptation determinants.

Keywords: adaptive capacity, National Adaptation Programs of Actions (NAPA), ecosystems, food security, water resources

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Introduction

The Global climate is changing. The change is expected to continue into the coming century at rates projected to be unprecedented in recent human history (Adger *et al.*, 2003). Climate change comes in the forms of temperature change, precipitation change, sea level rise, and extreme events; and affects ecosystems, water resources, food security, settlements, and human health (IPCC, 2007). The two options for humankind are mitigation of the change by cutting emissions and sequestration of atmospheric greenhouse gases in sinks, and adaptation by modifying the harmful effects of the change. Professionals working on climate change issues have disagreed on the relative importance of the two options to combat climate change. Three schools of thought (preventionist, adaptationist, and realist) are identified (Klein and Maciver, 1999). The *preventionist* school argues that emphasis on adaptation weakens society's willingness to reduce emissions leading to a catastrophe. The *adaptationist* school sees no need of interference with active adaptation into the natural and human systems because they have a long history of naturally adapting to changing circumstances. The *realist* school considers adaptation as a crucial and realistic response option along with mitigation.

The realist school is obviously the most tenable stance; but not so much for the least developed world, especially for Africa that contributes negligible proportion of the total greenhouse emissions. For them, Apuuli *et al* (2000) argue, the reduction of such emissions is

admitting liability and the financial consequences of their admission (Schipper, 2006). Adaptation was also considered as an action tantamount to surrendering to climate change instead of trying to prevent it (Glantz, 2007). Convinced that adaptation is the main way forward the UNFCCC initiated the National Adaptation Programs of Action (NAPA) for the Least Developed Countries in 2001 to help them prioritize their urgent adaptation needs and enhance their capacity to adapt. Nearly a decade later, the UNEP announced that over 30 African ministers reached a landmark agreement to mainstream climate change adaptation measures into national and regional development plans, policies and strategies.

Ethiopia is one of the world countries being and to be most affected by climate change. There are some evidences that climate change has already started appearing in Ethiopia. Mean annual minimum temperature has been increasing by about 0.37^0C every decade between 1951-2006, and the mean annual temperature is projected to increase in the range of $0.9\text{-}1.1^0$C by 2030, $1.7\text{-}2.1^0$C by 2050 and $2.7\text{-}3.4^0$C by 2080 (MoWR/NMSA 2007). It is injudicious for policy makers and planners in Ethiopia to delay or postpone actions until legally-binding emission reduction agreements are reached globally. Of course, substantial effort is being undertaken in the form of projects; the NAPA has already been made a reality; and there is the vitally needed awareness among policy makers about the extent of the threat and what can be done to alleviate it. A National Climate Change Forum was established in January 2009 to promote and facilitate awareness, adaptation, and mitigation efforts in Ethiopia at all levels (Oxfam, 2009). However, much more must be done on adapting to climate change impacts on the short and long term.

For over half a century Ethiopia has experienced several episodes of devastating droughts and lingering rainfall variability. Individuals, communities, governmental and non-governmental bodies have been engaged in one or the other form of adaptation to the climatic variability-induced challenges to livelihoods. The aim of this paper is to analyze the past and current adaptation practices in light of their possible contribution to future adaptation actions. Issues and concepts associated with climate change adaptation are discussed in sections 2 to 4; followed by a critique of NAPA-Ethiopia in section 5; and a brief outline of the analytical framework

designed to analyze the major concern of the paper is given preceding the analysis of Climate change adaptation experiences in Ethiopia in section 6.

Merits of Adaptation Experiences

Adaptation to climate change is not something that must start from scratch (Burton, 2000). It is an incremental process that can be built upon previous adaptations. What is new is the need to adapt much more rapidly. Human history is the history of adaptations; and there are many situations in the past where adaptations were made to changes in climate and climate related risks (Adger *et al.*, 2003). It is possible to learn many lessons from such experiences; for instance, the response to El Nino Southern Oscillation (ENSO) events could help to improve capabilities, anticipate or respond to climate change impacts, and identify indicators for building early-warning systems (Klein and Maciver, 1999).

A climate change adaptation research on Ethiopian and South African agriculture, acknowledged the importance of a better understanding of ongoing adaptation measures and the decision-making processes to inform policies aimed at promoting successful adaptation strategies (Bryan *et al*, 2009). This includes not only the planned interventions into adaptation but also indigenous experiences of local communities. A study by Yohannes and Mebratu (2009) has found that pastoralists have accumulated and deep-rooted knowledge and experience in adapting to the ever-changing environment. The importance of past and current adaptation experiences as guides for future actions is recognized by the UNFCCC which has recommended that the NAPA give due considerations to strategies to cope with climate change that already exist at local levels, and use them as the starting points for the identification of priority activities.

In spite of the huge benefits learning from present and past experiences has, it is not free from drawbacks. Characteristics of future climate change are likely to be very different to past climate variability, particularly in terms of the rate and magnitude of change (Adger *et al.*, 2003). This is particularly true for innovative actions whose consequences may become unknown (Adger *et al.*, 2005).

Concept of Climate Change Adaptation

Climate change, as defined by the IPCC (2007), is a change in the mean and/or the variability in the properties of climate, that persist for decades or longer, arising from natural or human causes. The UNFCCC definition, in contrast limits climate change only to those caused directly or indirectly by human activities (UN, 1992). The definition by the latter seems to favor mitigation as adaptation measures cannot be applied separately for human caused climate change impacts. It is not yet, and may never be, possible for atmospheric science to distinguish with certainty between normal climate variability and climate change (Burton, 2000).

Climate change adaptation is characterized metaphorically as a 'chameleon-like umbrella concept' the meaning of which takes on the complexion of its surroundings, and also as a climate change construct which is 'lost in translation' (Glantz, 2007). In spite of its ambiguity it has become possible to settle on some overarching conceptualization. Climate change adaptation is adjustment of ecological, social or economic systems in response to observed or expected climate change and variability through changes in the processes, practices, or structures to moderate detrimental consequences and enhance beneficial ones (Adger *et al.,* 2003; Adger *et al.,* 2005; Leary, 1999; Smit *et al,* 1999; IPCC, 2001). Adaptation must not be confused with coping. The former is more fundamental change of a system to allow for a new coping range to be established; whereas the latter is a short-term response to variability (Mertz *et al.,* 2009). This implies that the predominantly short-tem response experiences of the present and past can only serve as springboard for more enduring adaptation actions.

Adaptation is classified variously. One among the many classification schemes is that provided by Klein (2001): Adaptation becomes *reactive* when responses occur after the initial manifestations of change; but if actions come before impacts start to appear it is *proactive* or *anticipatory.* Adaptation can also be *planned*, a deliberate policy decision, and *autonomous* where such decisions are absent. Adaptation decisions motivated by individuals and companies are termed *private adaptation,* whereas those performed by government bodies are dubbed *public adaptation.* Adaptation by natural systems is essentially reactive; while those by human systems can be both reactive and anticipatory. Planned

adaptations can be both reactive and proactive; but autonomous adaptation is only reactive.

Determinant of Climate Change Adaptation

Adaptation depends on adaptive capacity. Adaptive capacity, which is the ability of a system to adapt to the impacts of climate change, in turn, is determined by economic resource (assets, finance); technology (warning systems, protective structures, crop breeding, irrigation, settlement relocation or redesign, flood control measures); information and skills (knowledge about available options, the capacity to assess them, and the ability to implement the most suitable ones); and the level of development of institutions that determine entitlements and access to resources for communities (IPCC, 2001). The study by Bryan *et al* (2009) in Ethiopia and South Africa has confirmed that problems associated with lack of access to credit, land, extension services and climate information undermined adaptation to climate change.

Adaptation is influenced by more other factors than economic and technological. Class, gender and culture play a large role as in the Burkina Faso study where culture acted as a major barrier to embracing four of the most successful livelihood strategies: labor migration, working for development projects, gardening, and the engagement of women in economic activities (Nielsen and Reenberg, 2010). Ethics and attitudes to risk are also important determinants of adaptation (Adger *et al.*, 2009).

Adaptation can be said to have become effective when adaptation actions achieve their expressed objectives. However, an action may be effective for one but produce negative externalities potentially increasing impacts on others (Adger *et al.*, 2005). Mendelsohn (2000) gives two examples of the externalities that could arise from one sided adaptation actions: One is the forester in a warmer climate switching tree species in order to take better timber benefits threatening the survival of wildlife species dependent on the old species, which are valued by others users. The second example pertains to the ecological cost of controlling mosquitoes intended to provide health benefits. Adaptation may in itself exacerbate vulnerability. Dependence on credit may cause indebtedness if crop failure occurs (Mertz *et al.*, 2009). In cases of joint adaptation, conflict is inevitable as individuals or powerful

groups will naturally press for the choice that maximizes their personal benefits rather than maximizing the value to society (Mendelsohn, 2000).

A Critique on NAPA-Ethiopia

The UNFCCC requires that the Least Developed Countries submit a list of priority adaptation projects for possible funding. NAPA-Ethiopia has finalized the identification of priority activities for adaptation to climate change, dubbed as: 'Priority Adaptation Projects' (PAP), and submitted them in June 2009. The huge effort that is put into this very important action plan is commendable. However, there are some technical and substantive flaws that have to be addressed to help improve the prioritization scheme.

Institutional Arrangement and the Consultative Process

The starting point of the critique of NAPA-Ethiopia should be the process of preparation of the PAP. The institutional arrangement of the NAPA process has a doubtful value for climate change adaptation, which must be more participatory, at least in the academic disciplinary sense. The National steering committee is composed mainly of experts drawn from the natural science disciplines skewed more towards meteorology, hydrology, geology, and agronomy. Scholars from such disciplines as anthropology, biology, demography, development studies, economics, education, geography, psychology, and sociology should have been beneficially involved in the process. There is already a consensus that the economic sector in Ethiopia that is to be most affected by climate change is agriculture. It is this sector which is expected to be most engaged in adaptation. Hence, it deserves to play a leadership role in the NAPA preparation process. There seems to be some conflict in the assignment of roles as the National Climate Change Forum is chaired by the State Minister of Agriculture.

It may also be argued that the use of consultants to prepare the technical reports that formed the raw material for the preparation of the NAPA was far from being a wise decision. The skepticism has its grounds in what was stated in the section for recommendations of the NAPA document. Unsure about the meticulousness of the selection and prioritization process it is recommended that the dropped projects may have to be re-evaluated through consultation with experts and "more importantly through consultation with the very beneficiaries on the ground" (MoWR/NMSA,

2007:54). The admission that the main stakeholders were not involved and the recommendation that they should be involved sometime in the future is incomprehensible. It is evident that the entire consultative process was done where the subsistence farmers and pastoralists had little role. There is no hint, either in the text or in the photos of the several consultative meetings of the participation of the key stakeholders. This is typically a top-down approach which is not only inconsistent with the County's development approach but also with the requirements for successful climate change adaptation.

The Selection of Projects and Prioritization

The criteria set for selection of projects were designed to be 'comprehensive and holistic' to pick out projects which are pertinent to address immediate adaptation needs to cope with various environmental hazards including climate change risks (MoWR/NMSA, 2007:54). There is no reason why the criteria for selection have to be comprehensive and holistic in a situation where the projects are needed for 'immediate adaptation' which obviously implies specificity in time and space. In view of its importance as a rationale for the selection of the projects what is meant by "urgent and immediate" had to be operationally defined in the context of climate change adaptation. It is also important to make a clear distinction between adapting to and coping with climate change. The former is a more fundamental change creating new coping ranges; but the latter is a short-term response. The two terms seem to have been used as synonyms rendering the target of the whole process blurred.

The objective for the selection of what should be specific projects has also become open-ended including 'various environmental hazards' rather than the more specific adaptation responses to climate change and variability. Of course, taken broadly, adaptation has to address other non-climate change induced vulnerabilities as well. However, specific projects are expected to be narrowly targeted. The haste induced by strict deadlines may be understandable; but simplistic dependence on "picking out" from existing projects is not.

The process of selection was set to address the list of climate related hazards and main human vulnerabilities and livelihood impacts (ALM, 2009). Drought, floods, heavy rains, strong winds, frost, heat waves, and

lightning are identified by NAPA-Ethiopia as climate related hazards in Ethiopia. However, some of these hazards like lightning, frost and strong winds do not qualify as significant climate related hazards in Ethiopia deserving adaptation priorities. It is not heavy rain per se that becomes a hazard but by triggering floods and landslides. Heavy rainfall may destroy poorly constructed houses and other structures; but that is attributable more to the building standards than to the force of rain droplets. Though it may happen in the future, heat waves have not been hazards of any significance in Ethiopia. It is hard to guess why these phenomena are selected as hazards for adaptation priority projects meant for immediate or urgent responses. For short-term adaptation it should have been more appropriate to give more emphasis to drought as a hazard rather than swamping it in a list of less pertinent meteorological events.

The main human vulnerabilities and livelihood impacts identified for Ethiopia are: land degradation, soil erosion, deforestation, loss of biodiversity, desertification, recurring drought, flood, and water and air pollution. Soil erosion can be subsumed in land degradation and there is no need of including climate related hazards, like drought and floods, in this list of 'vulnerabilities and livelihood impacts'. Land degradation, deforestation, loss of biodiversity, and water and air pollution are rightly identified as livelihood impacts; but desertification should not be portrayed as a straight forward result of human actions. It is a gradual process which is the result of an intricate combination of natural causes and human impacts. Human vulnerability to climate change impacts means that people lack the means (knowledge and resources) to protect themselves from the impacts. Land degradation, soil erosion, deforestation, loss of biodiversity, desertification, recurring drought, flood, and water and air pollution are a list of phenomena which have little to do directly with how vulnerability is conceptualized. Of course, they can cause human vulnerability through a chain of cause and effect relationships. For example, land degradation can cause decline in agricultural production, which in turn results in decline in income. Then, low income becomes an indicator of vulnerability. Another list of the main sources of risk and vulnerability in most parts of Ethiopia (MoWR/NMSA, 2007:16) includes earthquakes. Given the insignificance of earthquakes for the concern at hand, its inclusion evades logic.

The Priority Adaptation Projects by NAPA-Ethiopia fits into the classification of adaptation as planned adaptation. It is a deliberate action to

boost the adaptive capacity of natural and human systems to climate change. A closer examination of the list of 37 identified adaptation options or needs or projects in the adaptation plan (ALM, 2009; MoWR/NMSA, 2007:8-9) reveals a lack of clear structure. The listing is haphazard in the sense that related actions are found scattered in the list rather than grouped theme-wise. The way the projects are described and the manner by which the list is compiled is so diffuse that trying to sort-out the action plan-items is analogous to selective timber harvesting in a rainforest. Re-assortment of the items in the list shows, for instance, five items related to forestry, five items related to ecosystems, four items related to rangelands, and four items related to research and public education.

There are some proposed adaptive actions like, rehabilitation of degraded ecosystems and biodiversity conservation; promotion of public education and research; improvement of rangelands; environmental health and malaria containment; income generating schemes like non-timber forest products, wild oil plants, agro-forestry and traditional herbal medicine; organizing communities which can facilitate joint adaptation; early warning systems; and large-scale and small-scale water development for food production and developing aquaculture and wild edible fruits as alternative sources of food, which certainly enhance the adaptive capacities of vulnerable people. However, there are also other proposed adaptive actions, which are of doubtful application in the Ethiopian context, like drought/crop insurance. In spite of this, drought/crop insurance is ranked at the top of the list of 11 adaptation actions (MoWR/NMSA, 2007:60).

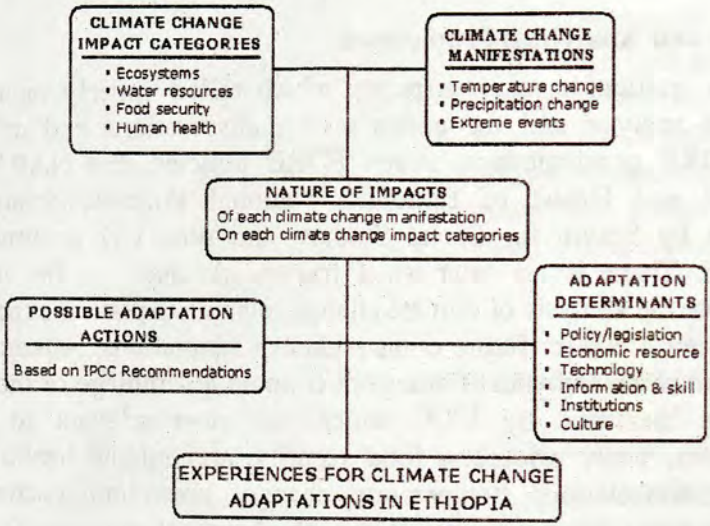
Furthermore, the value for adaptation of the proposed action to engage communities in carbon sequestration projects is far from obvious. This is a mitigation action which does not have a direct link with adaptation. There is a need to prepare vulnerability maps for all of the climate change impact categories, showing where specifically the NAPA projects for adaptive capacity enhancement are to be implemented, rather than broadly mentioning the names of regional states or moisture or geomorphic zones. The list of actions also appears to have no guiding framework. It is difficult to make out which project addresses which vulnerability. The guiding principle should be to identify vulnerabilities in their spatial, economic, technological, and cultural contexts and assess the existing strength of adaptive capacities in view of building on them.

Analysis of Climate Change Adaptation Experiences in Ethiopia

Methods and Analytical Framework

This is a qualitative research paper, which relied entirely on qualitative document analysis and the author's own observations and experiences. Eight FDRE proclamations, seven FDRE policies, the NAPA-Ethiopia document and Digest of Ethiopia's National Policies, Strategies and Programs by Forum for Social Studies, and nine UN documents were examined. There is no established framework that can be adopted or adapted for the analysis of climate change related adaptation experiences in light of their merit for future climate change adaptations. Attempt is made here to sketch an analytical framework from an assemblage of those impact categories identified by IPCC which are most relevant to Ethiopia; (ecosystems, water resources, food security, and human health); climate change manifestations (temperature change, precipitation change, and extreme events); nature of impacts of each climate change manifestation on each climate change impact categories; possible adaptation actions based on IPCC recommendations and other sources; and adaptation determinants (policy/legislation, economic resource, technology, information and skill, institutions, and culture).

Figure 1. Analytical Framework for Climate Change Adaptation Experiences



The analysis takes climate change impact categories as the main thematic compartments. The remaining components of the analytical framework are analyzed in the context of each climate change impact category. Hence, the analysis is organized in four sub-sections corresponding to the climate change impact categories: ecosystems, water resources, food security, and human health.

Ecosystems

Ecosystem is a community of interdependent organisms together with the environment which they inhabit and with which they interact (Raj, 1987). Forest, wetland, grassland, and freshwater ecosystems are some of the well known examples. There is a particular climatic regime within which ecosystems evolve, adapt and persist. When the climate changes the resilience of the ecosystems is likely to be exceeded resulting in major changes in ecosystem structure and function; species' ecological interactions; shifts in species' geographical ranges; and increased risk of extinction (IPCC, 2007).

Climate change induced disturbances could come as a result of rainfall variability, floods or drought, and rising temperature beyond the coping range of individual species or communities in a particular habitat. Without human intervention ecosystems undergo reactive adaptation to climate change. Such adaptations are normal processes in nature; but may turn out to be unfavorable for humans and their livelihoods. Ecosystem services may be adversely affected posing difficulties for the availability of water, food, medicines and raw materials, and reducing or eliminating their values for recreation and tourism. Hence, human intervention in ecosystem adaptation in the form of planned adaptation becomes essential. Measures such as protecting threatened or endangered species that play key roles in ecosystems could be taken.

Ethiopia has a great diversity of climate and topography making the existence of varied ecosystems possible. There is an official conviction for the protection of ecosystems which could serve as a spring-board for much broader intervention to ecosystem adaptation to climate change. One of the main objectives of the 1993 National Population Policy of Ethiopia is 'maintaining/improving the carrying capacity of the environment by taking appropriate environmental protection/conservation measures' (TGE, 1993_c). The 1997 Environmental Policy of Ethiopia has addressed ecosystem protection under policy subheading 3.3 on 'Genetic, Species and Ecosystem Biodiversity' as follows: The policy promotes *in situ* systems (nature reserve, farmer's fields) and *ex situ* systems (gene banks, farms, botanical gardens, ranches, zoos) for conserving wild and domesticated biological diversity; and ensures that park, forest and wildlife conservation and management programs allow a major part of the economic benefits derived to be channeled to local communities (FDRE-EPA, 1997). The latter policy item is stated as one of the main objectives of the Ethiopian Tourism policy: 'guarantee benefits to all the communities around the tourist destinations by creating broad employment opportunities and distributing the income from tourism widely and equitably (FDRE-MoCT, 2008). This is pertinent to ecosystem conservation because the major tourist attractions in Ethiopia are wildlife and their habitats. Such policies help enhance the much needed grassroots participation in ecosystem conservation.

The Forest Proclamation of Ethiopia (FDRE, 2007_b) recognizes the decisive role forest conservation plays in reversing trends of disturbance of

ecological balance and depletion of biodiversity. Participation of and benefit sharing by the concerned communities is also acknowledged in the forest legislation. Proclamation for wildlife conservation (FDRE, 2007_a) is still another legal tool that facilitates interventions in enhancing adaptive capacities of ecosystems. Ethiopia has also entered into international commitments to ecosystems conservation by, for instance, signing the biodiversity convention and ratifying the agreement for conservation of African-Eurasian migratory water birds (FDRE, 2009).

Ethiopia's commitment to biodiversity has taken institutional form in the Institute of Biodiversity Conservation, having a gene bank and ten technical departments: forest and aquatic plants, medicinal plants, horticultural plants, field crops, pasture and forage plants, animal genetic resources, microbial genetic resources, ecosystem conservation, biotechnology and bio-safety, and ethno-biology (ibc-et.org). The Ethiopian Wildlife Conservation Authority is an additional institutional strength for ecosystem adaptation (FDRE, 2008_a).

The Rural Land Administration and Use Proclamation (FDRE, 2005_b) is arguably the strongest of proclamations in terms of legislating for ecosystem protection. Article 13 on land use planning and proper use of sloppy, gully and wetlands provided for the conservation of biodiversity in rural wetlands; cultivation and/or grazing to be practiced based on the nature of the slope of the land: ranging from use in conjunction with soil conservation and water harvesting and construction of terraces to temporary or permanent prohibition of cultivation and grazing from areas that need recovery or rehabilitation temporarily to those that have to be left for the development of trees, perennial plants and forage production permanently.

The Proclamation to Amend the Institute of Biodiversity Conservation and Research (IBCR) establishment proclamation (FDRE, 2005_a) is a climate change specific proclamation in the sense that it helps to mitigate the expected ecosystems' climate change induced biodiversity loss though species extinction. The proclamation entrusts the IBCR to 'Identify and study localities where man-made and natural calamites are causing genetic erosion and from such assessments recommend, to the concerned bodies, the restoration of the lost materials in the locality from the ex-situ

conserved germoplasm and, upon its endorsement, facilitate and support its implementation'.

There are also several other NGOs, which are engaged, inter alia, in ecosystem conservation, such as, the Ethiopian Wildlife and Natural History Society(EWNHS), Ethiopian Environmental NGO (EENGO), and LEM Ethiopia. Some quasi-governmental agencies, like Relief Society of Tigray (REST) and Organizing through Rehabilitation and Development of in Amhara (ORDA), have been engaged in environmental rehabilitation through area enclosures.

Research and human resource capacity development for ecosystem conservation at Bachelor, Masters, and Doctoral level is being carried out in several university departments such as Biology, Environment and Development, Environmental Science, Geography and Environmental studies/education departments. Research outputs on wetlands have been coming by and large from non-governmental bodies most notably the Ethiopian Wetlands Research Program financed by the European Union.

There are numerous cases in Ethiopia where nature and societies live in harmony. A few examples can be cited, such as, the belief in the "Adbar' among the Gedeos and the Sidamas (respect for the tree); protected forests in church yards in northern Ethiopia; watershed protection in the Semien Mountains; the 'Guassa' system in north-central Ethiopia; and the Konso system of traditional soil and water conservation in southern Ethiopia. While such indigenous practices struggle to survive, a culture of non-stewardship for the ecosystems is spreading in many parts of Ethiopia driven by economic, social and political factors of local and global origin. Social-cultural sanctions against forest, wetland and wildlife destruction are almost disappearing. The unbridled population growth and the sharply rising demand for food, shelter, and biomass fuel seems to have given little room for conservation ethic to take root. This can be a huge setback for planned adaptation to climate change for ecosystems in Ethiopia.

Water Resources

Water is one of the few key reasons for the existence of life on our Planet. Kofi Anan, the former UN Secretary General said, water "...pervades our lives and is deeply embedded in our cultural backgrounds" (UNESCO-WWAP 2006, p. v). The amount of water that is available to us is very

limited. Freshwater is 3 percent of the total amount of water on Earth, and only 0.3 percent is contained in rivers and lakes, which are not only the water we are most familiar with, but also where most of the water we use in our everyday lives exists (USGS).

Climate change can induce changes in the water resources. The warming of the Earth can be linked to changes in the large-scale hydrological cycle such as: increasing atmospheric water vapor content; changing precipitation patterns, intensity and extremes; reduced snow cover and widespread melting of ice; and changes in soil moisture and runoff (Bates et al, 2008). Decrease in the amount of rainfall causes decline in groundwater recharge reducing the discharge in springs, wells, streams, and lakes. The stress on the water resources will be aggravated by the increased rate of evaporation from surface water bodies as a result of increased temperature. Water resource adaptation to climate change can take the forms of extensive use of rainwater harvesting, storage, increased water-use efficiency in households and irrigation, formulation of water policies and adoption of integrated water resources management (IWRM).

Although Ethiopia has a huge water resource estimated to be about 122 billion cubic meters of surface water; which nevertheless, is mal-distributed in space and time (FDRE-MoWR 2001). Recurring drought and rainfall variability have been causing water shortages throughout the last half a century in many parts of northern, northeastern, southern, and eastern Ethiopia. Climate change is expected to cause further instability in the availability of water for ecosystem, household, and economic uses. There are strong policy, legislative, and institutional grounds, as well as experiences of adaptive actions to manage water shortages. There are already water legislation (FDRE, 2000), a water policy (FDRE-MoWR, 2001_a, and a water sector strategy document (FDRE-MoWR, 2001_b). The water sector policy and legislation provide for the follow up and supervision of the conservation of the water resources of Ethiopia; and one of the objectives of the National water strategy promotes the principles of integrated water resources management (IWRM).

There are some experiences of planned adaptations to such climatic variability and their adverse effects on the water resources, which could help future climate change adaptations. The 'fraternal-twin' actions of soil

and water conservation spanned the 60s, 70s and beyond as extension programs under the Ministry of Agriculture. The major components of the programs were bunding and terracing of slopes with high erosion potential. Besides reducing soil erosion, such measures to some extent helped increase recharge of ground water. The 1984-85 droughts brought with it the creation of ponds for runoff storage in many parts of northern Ethiopia under the auspices of the Department of Irrigation in the Ministry of Agriculture. The Sustainable Agriculture and Environmental Rehabilitation commissions in Tigray (SAERT) and Amhara (SAERAR) established soon after the EPRDF takeover were intensively working on the construction of several micro-dams for flood water storage. Rainwater harvesting, as a solution to water scarcity in areas of higher rainfall variability, was continued until a few years back in the forms of farm ponds. They were meant to ensure water security at the household level.

Water resources governance is centered around the Ministry of Water Resources (MOWR). There has been some devolution of powers to Regional water beauros. However, water supply is a government monopoly in Ethiopia. There is little private involvement in the water sector. There are a few NGOs, like Water Aid and the Ethiopian Rainwater Harvesting Association (ERHA), which have water conservation as one of their areas of focus.

A key vulnerability in adaptation to climate change impact on water resources is the prevailing attitude to possible threats of water shortage. The often reported sum totals of water resources in Ethiopia, which conceal significant geographic variations, have created wrong impressions among the people that water shortage is not for Ethiopia. Hence, water conservation is far from being a norm.

Food Security

Food security is said to exist when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996). Climate change will affect all four dimensions of food security: food availability (production, distribution and exchange), food accessibility (affordability, allocation and preference), food utilization (nutritional and societal values and safety) and food systems stability. The effect comes through climate change impact on human health, livelihood assets, food

production and distribution channels, as well as changing purchasing power and market flows (FAO, 2008).

Gregory and colleagues (2005) identified four core areas that should be targeted to help reduce the vulnerability the food systems: food price mechanisms designed to serve the interest of producers and consumers; regional specialization in food production lowering production costs and food prices; economic growth leading to income and employment generation; and stability and governance supported by an effective pool of human and institutional resources facilitating the establishment and maintenance of food systems.

Planned adaptation to climate change impacts on food security must be guided by appropriate polices. There should also be pertinent institutional arrangements, capacity building in the forms of training and access to appropriate technology, financial incentives in the forms of subsidies and tax breaks, access to low-interest credit, and research and development. Agronomical measures such as changes in the planting dates of crops, selecting crop varieties or acquiring new varieties that are adaptive to new temperature and moisture regimes are needed. The latter involves relocating crops to localities which would be more suitable for some crop varieties than they currently are as a result of changes in agro-climatic conditions. Other measures include improved land management such as erosion control through tree planting, biological and engineering methods of soil conservation.

The history of Ethiopia in the last five or more decades has been punctuated by mainly drought induced food insecurity which several times reached famine proportions affecting hundreds of thousands to millions of people. Food insecurity problems, which are triggered by climate variability, have more often than not been causing political instabilities in the country. In fact, it was one of the major reasons that ended the Monarchy in Ethiopia; and shook the Military Government from its foundations. It has also become a recurring nightmare for the current EPRDF Government. The climate-induced food insecurity has been tarnishing the international image of the Country to say the least. The reason why rainfall variability or recurring drought hazards cause widespread food insecurity in Ethiopia is quite obvious. According to the 2007 National Census of Ethiopia 83.8% of the population live in rural areas leading agrarian and pastoralist livelihoods.

These are rain-dependent subsistence economies in which the role of irrigation is negligible.

The climate variability-induced food insecurity has been getting the policy attention it deserves. Hence, there is a relatively strong policy and institutional foundation that can help to boost the adaptive capacity for climate change caused food insecurity in the future. A National Food Security Strategy was prepared in 1996, which was followed by regional level strategy documents. The strategy was revised to focus more on chronically food insecure moisture deficit and pastoral areas with greater emphasis on environmental rehabilitation, rainwater harvesting, high value crops and livestock, and agro-forestry.

The Agriculture Development Led Industrialization (ADLI) strategy of the EPRDF Government and the Sustainable Development and Poverty Reduction Program, SDPRP, (FDRE-MoFED, 2002), all have food security as one of those at the top of the priority list. The major strength of the food security strategy is the vulnerability mapping that is often updated. The early warning system also makes up another vital component of adaptation capacity. Although the most enduring cause of food insecurity in Ethiopia is widespread poverty, it is rainfall variability or drought hazard that has been making it seem dramatic. Hence, government actions thus far have put institutional arrangements for food security in the context of disaster management. The National Policy for Disaster Prevention and Management (TGE, 1993_b) has set food and seed reserves as top preparedness priorities.

Concurrently, there are efforts to move from relief to development where adaptive capacity to food insecurity will be more enduring or sustainable. To this effect, agricultural research organizations and agriculture faculties in several Ethiopian universities are conducting research inline with these principles. Technology transfer through extension programs to introduce better water management and crop husbandry is still another important component of the strategies. The formation of new and the rehabilitation of old cooperative unions levels the ground for joint adaptations by making land use planning possible and access to credit easier.

Whenever successful adaptation to climate induced food insecurity cannot be realized in-situ there is an accumulated experience of relocation of affected populations to low risk areas. Of course, such programs were not

all success stories. Resettlement programs were and still are beset by complex political, attitudinal and logistical problems. In spite of this, huge lessons have been learned, which can make future implementation of planned adaptation to climate change induced food insecurity much easier. Probably based on the rationale that the agricultural sector is the most affected by climate related disasters and food insecurity the Disaster Prevention and Preparedness Agency (DPPA) ceased to be an autonomous commission and was brought under the Ministry of Agriculture and Rural Development (FDRE, 2008). Whether or not the institutional rearrangement will improve adaptive capacity is a matter of conjecture.

Workneh (2008) has evaluated the strengths and the weaknesses of the Food Security Strategy and Productive Safety Net Program. The strengths are that they focus on the most vulnerable (rural population), integrate with other sectors, and combine short-term relief and long-term adaptation capacity building through public works and asset formation. The key weakness which must be removed in order for them to be strong springboards for future adaptation to climate change is the institutional arrangement which is manifested in the lack of coordination, clearly spelt out modalities for the participation of stakeholders, and systems of monitoring and evaluation.

The PASDEP (Plan for Accelerated and Sustained Development to End Poverty 2006-2010) experience is a program of action that could make up reinforcement for adaptive capacity. PASDEP, through its National Food Security Program known as Productive Safety Net (PSN), is focused on improved access to seeds and extension, small-scale irrigation and rainwater harvesting, voluntary resettlement, employment in public works, free distribution to the most vulnerable social groups, and the establishment environmental agencies at lower administrative levels, to millions of people who are chronically food insecure and badly affected by food shortages in drought years.

Human Health

WHO (1946) has defined health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. McMichael and Haines (1997) and Ebi and Nyong (2009) provided details of health impacts of climate change under three categories: 1. exposure to

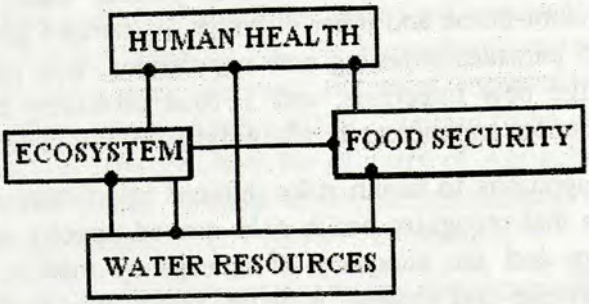
extreme weather events and thermal extremes causing deaths, injuries, psychological disorders, damage to public health, water supply and sanitation infrastructure, contamination of potable water, and increased exposure to vector-borne and other diseases; 2. changed geographic range of vectors and parasites exposing new populations, who have little or no immunity to the new infections; and 3. food insecurity causing serious health consequences and increased risk of dying from infectious diseases.

Successful adaptations to health risks induced by climate change require health policies that recognize health risks caused directly or indirectly by climate change and the adequacy of emergency medical services and disease surveillance and control. A health policy was formulated by the transitional government of Ethiopia (TGE, 1993_a), which gives special attention to the health needs of victims of man-made and natural disasters, development of the preventive components of health care, and encourages National capacity building by producing drugs, vaccines, supplies and equipment locally. The health policy is being implemented through periodic Health Sector Development Programs (HSDP) by promoting intersectoral activities. The latter approach is appropriate to climate change adaptation in the health sector because climate change related health problems arise from other sectors like water and food security. Ethiopia has been implementing the Health Sector Development Programme (HSDP) since 1997/8. The first phase was completed in 2002, the second phase in 2005 and the third in 2010.

Integrative Adaptive Capacities

Although each climate change impact category has its peculiarities, with regard to climate change manifestations and the nature of adaptation actions required, as discussed in the preceding sections, the more realistic picture is an integrated one. Adaptive capacity and actions in one category will directly or indirectly affect other categories positively or negatively. Ecosystem disturbance could have direct health impacts from floods, heat waves, water shortage, landslides, altered infectious disease risks, mental health, depletion of natural medicine, health consequences of livelihood loss, displacement (slum dwelling, conflict, etc.) and stress on the food systems (WHO, 2005).

Fig.2. Schema of Interacting Impact Categories



Bates *et al* (2008) have described the nexus of impact categories that puts water at the center: Changes in water quantity and quality impacts on health, food security, ecosystem conservation and human health. Water is the key integrative climate change impact category, the adaptive capacities and actions of which influence other categories. This particular role of water impacts as key to all other sectors is also recognized by the IPCC, (2007).

Harvesting rainwater in storage systems, as an adaptation strategy helps enhance adaptation capacities in the health sector as water for sanitation becomes better available. Moreover, small-scale irrigation using stored rainwater could enhance food security. In situ rainwater harvesting, which allows water to seep into the soil will enable maintaining the integrity of existing ecosystems and restore the degraded ones. A good example for this is the widespread re-greening of the denuded landscape in central Tigray. One of the major thrust of Ethiopia's Sustainable Development and Poverty Reduction Program is focus on increased water resource utilization to ensure food security (FDRE-MoFED, 2002). Intersectorality has also become one of the key approaches in the health policy of Ethiopia.

Integration is crucial not only in the sectoral institutions but also in the academic disciplines. The threat of climate change is forcing a convergence of disciplines towards what might be called integrated risk assessment for climate (Burton, 2000). Since recently there is an academic movement in Ethiopia, notably in Addis Ababa University, where research is conducted and graduate programs are opened with a greater degree of multidisciplinary

and some nascent interdisciplinary. This should be only the beginning, though. Multi-disciplinarily is a simple juxtaposition of mono-disciplinary approaches; inter-disciplinarily, which may involve assembling of different viewpoints, is still rooted in fragmented disciplines; but in transdisciplinarity a higher level of harmony or a 'sym-phony' of the dissonant 'poly-phony' of knowledge is attained (UNESCO, 1998). It is in transdisciplinarity that issues like climate change and adaptation can be put in the right perspective; and this is the level universities in Ethiopia must aspire to reach.

Conclusions

Ethiopia is one of the world countries, which are expected to be most affected by climate change. The impacts will be manifested as temperature rise, rainfall decrease, and extreme events like drought and floods. These manifestations of climate change will affect ecosystems, water resources, food security, and human health. Successful adaptation to the changing state of the environment requires pertinent and adequate adaptive capacities. Adaptive capacities for climate change adaptation in Ethiopia do not need to start from a clean slate As a result of the widespread rainfall variability and drought hazard throughout four to five decades Ethiopia has accumulated policy and institution building experiences, which can serve as springboard for effective planning and implementation of climate change adaptation in the future. The problem is the general propensity on the part of planners to disregard such vital experiences and spend huge quantities of resources on 'reinventing the adaptation wheel'., A case in point is NAPA-Ethiopia, in which there are unmet expectations of using local know-how. Another setback to the success of climate change adaptation is the strong narrow disciplinary approach, which does not fit into the essence of adaptation; even though there is an emerging shift to multidisciplinary, interdisciplinary, and ultimately, to transdisciplinarity. People's insensitiveness to impeding risks is yet another challenge which must be improved through extensive public education.

References

Adger, W. N., Arnella, N. W. and Tompkinsa, E.L. 2005. Successful adaptation to climate change across scales. *Global Environmental Change* 15, pp.77–86.

Adger, W. N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni I., Nelson, D. R., Naess, L.O., Johanna, W., and Wreford, A. 2009. Are there social limits to adaptation to climate change? *Climatic Change*, 93 (3-4): 335-354.

Adger, W. N., Huq, S., Brown, K., Conway, D. and Hulme, M. 2003. Adaptation to climate change in the developing world. *Progress in Development Studies* 3, 3, pp. 179–195.

ALM.2009. Ethiopia- National Adaptation Programme of Action (NAPA). Adaptation Learning Mechanism (ALM), Submitted by Andréa on Mon, 2009-06-22 11:54. http://www.adaptationlearning.net/ethiopia-napa.(05/07/10)

Apuuli, B., Wright, J., Elias, C. and Burton, I. 2000. Reconciling National and Global Priorities in Adaptation to Climate Change: with an Illustration from Uganda. *Environmental Monitoring and Assessment*, Vol. 61, No. 1, pp.145-159.

Bates, B.C.; Kundzewicz, Z.W.; Wu, S.; and Palutikof, J.P. (Eds). 2008. Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 210p.

Bryan, E., Deressa, T., Gbetibouo, G., and Ringler, C. 2009. Adaptation to climate change in Ethiopia and South Africa: options and constraints. *Environmental Science & Policy*, Vol.12, Issue 4, pp. 413-426.

Burton, I. 2000. Adaptation to climate change and variability in the context of sustainable development. http://www.coastman.net.co/publicaciones/cc/%280042%29.pdf (19/11/09)

Ebi, K. L. and Nyong, A. 2009. the Health Risks of Climate Change Commonwealth Health Ministers' Update http://www.thecommonwealth.org/files/190382/FileName/2-EbiandNyong_2009.pdf (12/01/10)

Glantz, M. H. 2007. Lost in Translation: Society's "Adaptation" to Climate Change. http://www.fragilecologies.com/feb01_07.html (08/07/10)

Gregory, P. J.; Ingram, J. S. I. and Brklacich, M. 2005. Climate Change and Food Security. *Philosophical Transactions: Biological Sciences*, Vol. 360, No. 1463, pp. 2139-2148.

Klein, R. J.T. and Maciver, D. C. 1999. Adaptation to climate variability and change: methodological issues. *Mitigation and Adaptation Strategies for Global Change* 4, pp.189–198.

Klein, R.J.T. 2001. Adaptation to climate variability and change: what is optimal and appropriate? In Giupponi, C. and Schechter, M. (eds.) *Climate Change in the Mediterranean: Socio-Economic Perspectives of Impacts, Vulnerability and Adaptation*, pp.32–50, Edward Elgar: Cheltenham.

Leary, N. A. 1999. A Framework for benefit-cost analysis of adaptation to climate change and climate variability. *Mitigation and Adaptation Strategies for Global Change,* 4, pp.307–318.

McMichael, A. J. and Haines, A. 1997. Global climate change: the potential effects on health. *British Medical Journal*, Vol. 315, pp. 805-809.

Mendelsohn, R. 2000. Efficient adaptation to climate change. *Climatic Change*, 45: pp.583–600.

Mertz, O., Halsnaes, K. Olesen, J. E. and Rasmussen, K. 2009. adaptation to climate change in developing countries. *Environmental Management*, 43, pp.743–752.

Nielsen, J. O. and Reenberg, A. 2010. Cultural barriers to climate change adaptation: A case study from Northern Burkina Faso. *Global Environmental Change*, Volume 20, Issue 1, pp. 142-152.

Oxfam.2009. Ethiopia: National Forum to coordinate action on climate change. Press release 15 January 2009. http://www.oxfam.org/en/pressroom/pressrelease/2009-01-15/ethiopia-national-forum-coordinate-action-climate-change. (06/07/10)

Raj. G. 1987. Dictionary of the Environment. New Delhi: Anmol Pub.

Schipper, E. L. F. 2006. Conceptual History of Adaptation in the UNFCCC Process. Review of European Community & International Environmental Law, Vol. 15 Issue 1, pp. 82 – 92.

Smit, B. and Wandel J. 2006. Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16, pp.282–292.

Smit, B.; Burton I.; Klein, R.J.T.; and Street, R. 1999. The science of adaptation: a framework for assessment. *Mitigation and Adaptation Strategies for Global Change* 4: 199–213.

Tol, R. S.J., Frankhauser, S. and Smith, J. B. 1998. The scope for adaptation to climate change: what can we learn from the impact literature. *Global Environmental Change*, Vol. 8, No. 2, pp. 109-123.

USGS Where is Earth's water located? US Geological Survey. http://ga.water.usgs.gov/edu/earthwherewater.html (05/07/10)

Workneh Negatu. 2008. Food Security Strategy and Productive Safety Net Program in Ethiopia. *In* Taye Assefa (ed.) p.1-14, *Digest of Ethiopia's National Policies, Strategies and Programs*. Addis Ababa: Forum for Social Studies.

Yohannes Gebre Michael and Mebratu Kifle 2009. Local innovation in climate-change adaptation by Ethiopian pastoralists. PROLINNOVA– Ethiopia and Pastoralist Forum Ethiopia (PFE) Final report. Addis Ababa University, Addis Ababa, Ethiopia.

Policies

FDRE-EPA 1997. Environmental Policy. Federal Democratic Republic of Ethiopia. Environmental Protection Authority, Addis Ababa, Ethiopia.

FDRE-MoCT 2008. Ethiopia's Tourism Policy Final Draft Ministry of Culture and Tourism

FDRE-MoWR 2001. Ethiopian Water Sector Policy. Federal Democratic Republic of Ethiopia, Ministry of Water Resources, Addis Ababa, Ethiopia.

TGE 1993. Health Policy of the Transitional Government of Ethiopia. Addis Ababa, Ethiopia.

TGE 1993. National Policy on Disaster Prevention and Management. Transitional Government of Ethiopia. Addis Ababa, Ethiopia.

TGE. 1993. National Population Policy of Ethiopia. Transitional Government of Ethiopia. Addis Ababa, Ethiopia.

Proclamations

FDRE. 2000. Ethiopian Water Resource Management Proclamation, No. 197/2000. Federal Negarit Gazeta, 6th Year No.25; 9th March, 2000; Federal Democratic Republic of Ethiopia, Addis Ababa.

FDRE. 2005_a. Proclamation to amend the institute of biodiversity conservation and research establishment proclamation, No. 381/2004. Federal Negarit Gazeta, 10th Year No. 16; 13th January, 2004; Federal Democratic Republic of Ethiopia, Addis Ababa.

FDRE. 2005_b. Rural Land Administration and Use Proclamation, No. 456/2005. Federal Negarit Gazeta, 11th Year No. 44; 15th July, 2005; Federal Democratic Republic of Ethiopia, Addis Ababa.

FDRE. 2007_a. Proclamation to provide for the development conservation and utilization of wildlife, No.541/2007. Federal Negarit Gazeta, 13th Year No. 51; 20 August, 2007; Federal Democratic Republic of Ethiopia, Addis Ababa.

FDRE. 2007_b. Proclamation to provide for the development, conservation and utilization of forests, No. 542/2007.Federal Negarit Gazeta, 13th Year No. 56; 4th September, 2007; Federal Democratic Republic of Ethiopia, Addis Ababa.

FDRE. 2008_a. Proclamation to provide for the establishment of the Ethiopian Wildlife Development and Conservation Authority, No.575/2008. Federal Negarit Gazeta, 14th Year No. 31; 22nd May, 2009; Federal Democratic Republic of Ethiopia, Addis Ababa.

FDRE. 2008_b. Proclamation to transfer rights and obligations of the Disaster Prevention and Preparedness Agency to the Ministry of Agriculture and Rural Development, No. 593/2008. Federal Negarit Gazeta, 14th Year No 51; 11th August, 2008; Federal Democratic Republic of Ethiopia, Addis Ababa.

FDRE. 2009. Proclamation to ratify the agreement for conservation of African Eurasian migratory water birds, No. 635/2009. Federal Negarit Gazeta, 15th Year No. 42; 30th June, 2009; Federal Democratic Republic of Ethiopia, Addis Ababa.

National Documents

FDRE-MoWR. 2001_a. Ethiopian Water Sector Strategy. Federal Democratic Republic of Ethiopia, Ministry of Water Resources, Addis Ababa, Ethiopia.

FDRE-MoFED 2002. Ethiopia: Sustainable Development and Poverty Reduction Program Federal Democratic Republic of Ethiopia (FDRE), Ministry of Finance and Economic Development (MOFED), Addis Ababa, Ethiopia.

MoWR/NMSA. 2007. Climate Change National Adaptation Programme of Action (NAPA) of Ethiopia. Federal Democratic Republic of Ethiopia, Ministry of Water Resources and National Meteorological Services Agency, Addis Ababa, Ethiopia.

International Documents

FAO. 1996. Rome declaration of world food security. World Food Summit, 13-17 Nov. 1996, Rome.http://www.fao.org/docrep/003/w3613e/w3613e00.HTM (08/07/10)

FAO. 2008. Climate change and food security: a framework document. United Nations Food and Agriculture Organization, Rome. http://environmentportal.in/files/climate-foodsecurity.pdf (05/07/10)

IPCC. 2001. Third Assessment Report. Intergovernmental Panel for Climate Change.

IPCC. 2007. Fourth Assessment Report. Intergovernmental Panel for Climate Change.

UN. 1992. United Nations Framework Convention On Climate Change.

UNESCO 1998 Transdisciplinarity: Stimulating synergies, integrating knowledge http://unesdoc.unesco.org/images/0011/001146/114694eo.pdf (06/07/10)

UNESCO-WWAP. 2006. WATER: A shared responsibility. The UN World Water Development Report 2. New York: UNESCO-WWAP and Berghahn Books.

WHO. 1946. Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June, 1946; Official Records of the WHO, no. 2, p. 100. http://www.who.int/about/definition/en/print.html (08/07/10)

WHO. 2005. Ecosystems and Human Well-Being Ecosystems. Health Synthesis Millennium Ecosystem Assessment, World health Organization. http://www.who.int/entity/globalchange/ecosystems/ecosys.pdf (06/07/10)