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Climate Change Adaptation in Developing Countries: Beyond Rhetoric

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1. Introduction

Developing countries face unique vulnerability and adaptation challenges related to climate variability and change as a result of being, on the one hand, more exposed and sensitive, and on the other hand, having less adaptive capacity for dealing with it (Yohe *et al.*, 2006; UNFCCC, 2007; World Bank, 2010). Also widely accepted is the urgent need for adaptation to combat what the Inter Governmental Panel on Climate Change (IPCC) sees as the most likely climate change impacts in the developing world. These include;

“reduced crop yields in tropical areas leading to increased risk of hunger, spread of climate sensitive diseases such as malaria, and an increased risk of extinction of 20-30 percent of all plant and animal species.” The report continues, “by 2020, up to 250 million people in Africa could be exposed to greater risk of water stress. Over the course of this century, millions of people living in the catchment areas of the Himalayas and Andes face increased risk of floods as glaciers retreat followed by drought and water scarcity as the once extensive glaciers on these mountain ranges disappear. Sea level rise will lead to inundation of coasts worldwide ...people living with the constant threat of tropical cyclones now face increased severity and possibly increased frequency of these events with all associated risks to life and livelihoods” (UNFCCC, 2007, p. 5).

In the face of such dire consequences, developing countries especially and international organizations, led most prominently by the UNFCCC (United Nations Framework Convention on Climate Change; see <http://unfccc.int/2860.php>), have been hard at work in an attempt to design feasible climate change adaptation policies and actions. The nexus of these efforts between the developing countries and the UNFCCC is a mechanism called NAPA (National Adaptation Programmes of Actions), which were instituted by Decision 5 at the 7th Conference of Parties (CoP) held in Marrakesh, Morocco, in 2001.

These efforts have galvanized political action and provided much needed guidance to developing countries on how to plan for adaptation to predicted climate change impacts. Even more importantly, they have also provided funding mechanisms and commitments from developed countries to help the least developed countries (UNFCCC Article 4/3-5) implement adaptation strategies.

Despite such seemingly impressive progress, a number of critical issues related to adaptation remain to be resolved if we are to move beyond the rhetoric of broad scale policy

to implementation at the scale at which most ordinary people experience the impacts of climate change and climate variability. Using primarily case examples from Africa but also elsewhere in the developing world, this chapter addresses a number of such issues, including the role and place of adaptation in development policy, the question of what to adapt to, as well as the specifics of how to implement adaptation.

The chapter is laid out as follows. Section 1 provides a definition and discussion of relevant terms; Section 2 focuses on the above identified critical issues, and Section 3 lists further actions and steps needed to implement adaptation effectively in developing countries.

2. Definition and elaboration of terms

Climate change adaptation, defined as “initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects” (IPCC, 2007, p. 76), represents the right end of the spectrum of individual and societal responses to climate change. At the left end of that spectrum is mitigation, which includes policies and activities designed either to reduce the entry of additional Green House Gases (GHGs) into the atmosphere or reduce the concentration of existing atmospheric GHGs. Despite present ubiquity in the scholarly literature and policy domain, adaptation has not always been popular or even central in the climate change discourse. As noted by Ayers and Dodman (2010), when climate change was first addressed by the UN general assembly in 1988, the focus was on mitigation because climate change was perceived as a global problem requiring global collaboration. Adaptation, which at the time was understood to be local, was seen as inherently undesirable owing to concerns that some countries might choose as a matter of policy to invest in adaptation rather than mitigation due to its perceived lower costs, undermining the global coalition required to address climate change (see, Kjellen, 2006). Another concern, expressed most famously by Al Gore, was that adaptation represented a lazy and arrogant attitude to climate change; lazy because it avoids the hard work required to mitigate the problem and arrogant because it presumed that the problem could be solved on the back end i.e. after the fact (see, Pielke, 1999, p. 162). During the following decade however, climate change proponents came to accept what in hindsight should have been obvious from the beginning; that because GHGs are long-lived in the atmosphere and their effects cumulative, many projected impacts would proceed apace even in the improbable event that mitigation efforts completely halted emissions. Thus, it would appear that it was Mr. Gore who demonstrated at best unjustified optimism or worse, arrogance, in believing that the problem could be solved entirely or largely on the front end via curtailing emissions. In any event, following closely on this realization was another sobering revelation namely; that the impacts of climate change would be felt most strongly by the poor or developing nations of the world. Thus, in the emergence and acceptance of adaptation as a legitimate response to climate change, it was co-linked closely and strongly with developing countries.

2.1 Why are developing countries more vulnerable?

Climate change is expected to impact developing countries more severely because developing countries are more vulnerable. But what is vulnerability and why are developing countries more vulnerable than their developed counterparts? The IPCC (2007, p. 89) defines vulnerability as “the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes.

Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity." Thus, we can visualize this dependence graphically, using the analogy of the three legged stool (Fig. 1).

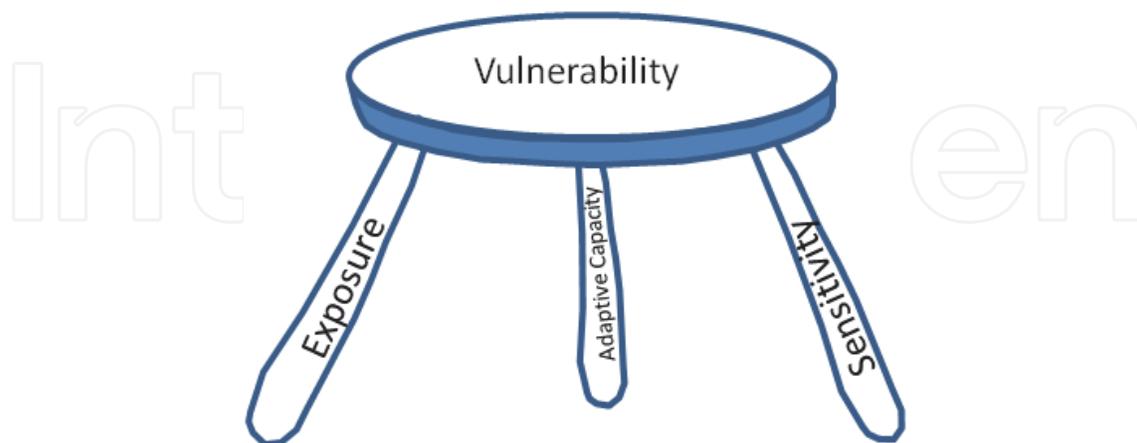


Fig. 1. Vulnerability as a function of exposure, sensitivity, and adaptive capacity.

The three-legged stool is a particularly useful analogy because inherent in the representation is the solution to managing vulnerability. The following paragraphs briefly review various dimensions of each leg of the stool.

2.2 Climate change exposure

Susceptibility to risks and hazards begins with exposure. That is, an entity (society or person) cannot be vulnerable to a risk to which they are not exposed. As an example, in order to be at risk of contracting tuberculosis, you must be exposed to the bacteria (*Mycobacterium tuberculosis*, MTB) or have been in close contact with a carrier of the bacteria. It is for this reason that public health officials recommend testing if you have travelled to TB endemic countries. But exposure to climate is a poorly defined term when it is defined at all. The IPCC glossary of climate change terms includes this rather unhelpful cyclical definition; "the degree to which a system is exposed to significant climatic variations" (IPCC, 2007, p. 373), which says exactly nothing. Public health officials are well aware that there is more to contracting a disease than mere exposure to it. A healthy, well nourished individual has a much higher likelihood of resisting a disease that would easily infect a weak individual with compromised immune system. There are in fact, three elements to exposure. The first is, of course, the climatic and environmental characteristics confronting the system. With respect to climate change this might include the expected degree of temperature rise. A region or country expected to experience a 4°C temperature rise has greater exposure than one where temperature is expected to rise by only 1°C. Coastal communities living in locations where sea level is expected to rise are exposed to the degree of expected sea level rise. The second element of exposure is the degree to which the system depends on the resource(s) in question. Egypt, for example, is nearly entirely dependent on the River Nile for its water resources. On the other hand, the Republic of Congo has abundant water resources and is relatively unconcerned about changes in the flow regimes of the Congo River. Third and finally, risks due to exposure are a function of system resilience or susceptibility. Resilience has a similar meaning to resistance; it refers to the amount of change a system can undergo

without changing state. In climate change context, resilience also has been used to describe the ability of an individual, community or system to ‘bounce back’ and overcome adversity (Magistro, 2009).

SubSaharan Africa (SSA) agriculture offers textbook examples of exposure to climate change. As noted by Tarhule *et al.*, (2009), SSA depends more strongly and directly on rainfall than any other region on Earth. Approximately 65% of the labor force (FAO, 2006) and 95% of the land use (Rockström *et al.*, 2004) in the region are devoted to agriculture, and overwhelmingly to rain fed agriculture. In economic terms, agriculture contributes, on average, about 30% the Gross Domestic Product (GDP) for SSA countries (compared to 14% for developing nations elsewhere) and represents up to 55% of the total value of African exports (Sokona & Denton, 2001; UNFCCC, 2006). Seventy percent of the regions’ labor is employed in agriculture but for the poor, that percentage is as high as 90%. Thus, Sub-Saharan Africa scores high on each of the elements that characterize exposure. Similar kinds of dynamics can be explicated for the region with respect to other climate change impacts including health, water, biodiversity, and coastal flooding. It is the culmination of all such domain exposures that make the region so highly vulnerable.

2.3 Climate change sensitivity

Now, suppose a system is exposed to a risk, then the degree to which the system is impacted or vulnerable depends on its sensitivity. Sensitivity is the degree to which a system is affected, either adversely or beneficially, directly or indirectly by, climate related stimuli (IPCC, 2007). If a system is highly sensitive or susceptible to a given risk, then it suffers the associated risk impacts commensurate with its degree of exposure. On the other hand, systems that are completely insensitive may experience zero impacts even though they may be completely exposed to the risk. Public health officials are often flummoxed by isolated cases of sex workers who never contract HIV (Human Immunodeficiency Virus) even after multiple exposures to the disease. These workers are immune or insensitive to the effects of the virus. To a degree, therefore, a system’s sensitivity may completely counterbalance the effects of exposure.

Continuing with the illustration of African agriculture, we note that it is also highly sensitive to climate change, stemming from the fact that the vast majority of SSA agricultural production is near subsistence level and unable to produce substantial surplus even during years of good rainfall. Consequently, the region historically has experienced cycles of feast or famine that mimic the pattern of rainfall surplus and drought. In short, as the annual rainfall cycle goes so goes African agriculture and, along with it, the welfare and livelihoods of the populations that depend on agriculture for a living. Yet, climate change is expected to exacerbate existing patterns of climate. For Africa this change is expected to manifest primarily as increased temperatures, more variable rainfall characterized by more frequent occurrences of extreme events, such as droughts and floods, possible shortening of the growing season, and spatial shift in the growing zones of staple and economic crops, among other things.

2.4 Adaptive capacity

Adaptive capacity is the “ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences” (IPCC, 2007, p. 365). A rich and growing

literature on adaptive capacity (for an excellent and succinct review, refer to Smit & Wandel, 2006) has identified many of the determinants or drivers of the process (Figure 2). Some determinants are local while others reflect more general social political and economic systems. Local adaptive capacity “reflects such factors as managerial ability, access to financial, technological and information resources, infrastructure, the institutional environment in which adaptation occurs, political influence, kinship network, etc” (Smit & Wandel, 2006, p. 287). Determinants related to the general social political and economic systems include factors such as the availability of crop and flood insurance whether private or subsidized by the state, as well as the ability of impacted groups to influence regional or national policies related to their domain or sector.

In theory, even if a system or society is exposed to a risk to which it is sensitive such risk would have minimal adverse effect given perfect or complete adaptive capacity. The system simply adjusts itself to compensate for or accommodate the new circumstances in much the same way as a chameleon might change its colors to blend in with its environment. In reality, of course, there is no such thing as perfect adaptive capacity, just as completely insensitive systems are rare. But there are degrees of adaptive capacity not just in every society but also in relation to specific risks. A society or system might score very high on adaptive capacity in response to a specific risk but the same system may exhibit extremely low adaptive capacity when faced with a different kind of risk.

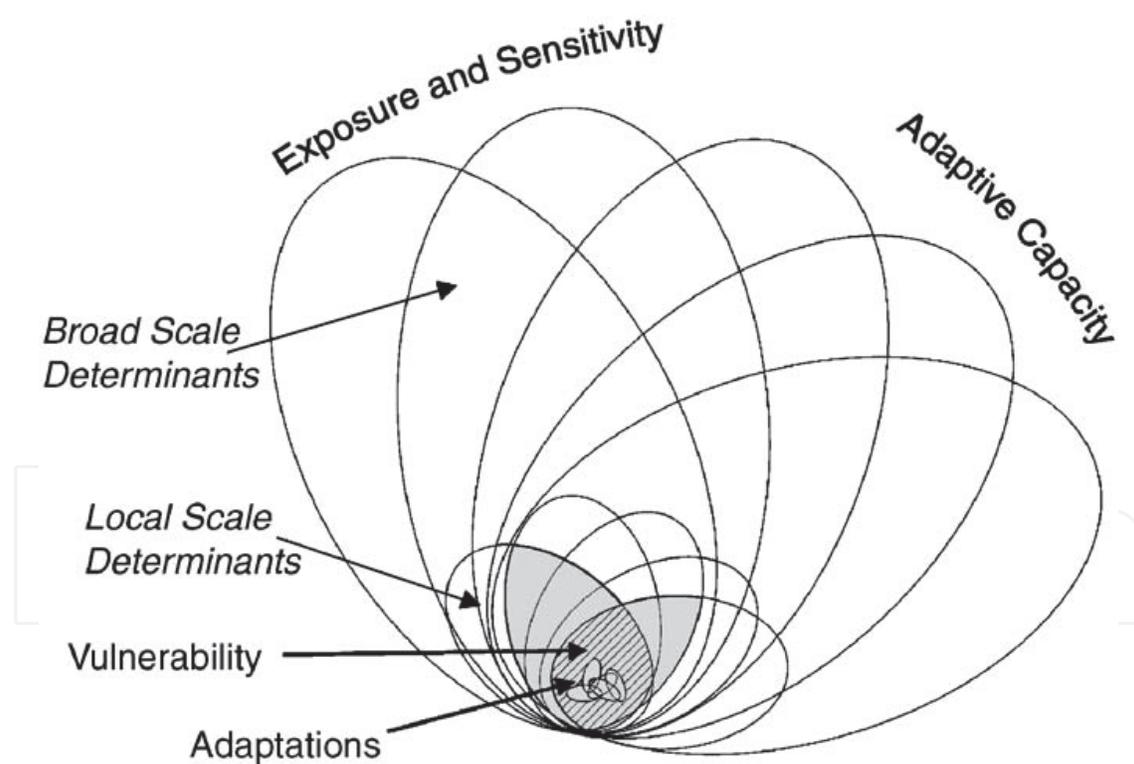


Fig. 2. A nested hierarchy and model of vulnerability (after Smit and Wandel, 2006). Reproduced with permission of the publisher.

Like any other region, Africa has attempted to adapt to its historical pattern of climate variability with some notable success stories. For example, Adger *et al.*, (2003) noted that agricultural communities in northern Nigeria continued to increase per capita agricultural production and stability during the period from 1970-2003 characterized by the longest and

most intense drought in the history of the region as well as the confounding effects of population growth (see also, Nyong *et al.*, 2007). Elsewhere in Bangladesh, local government investments in shelters have helped reduce the mortality from cyclones (Adger *et al.*, 2003, p.186). Despite such successes, frequent and widespread droughts accompanied by massive famines, such as the Sahel droughts of 1970-73 and the East African drought of 1983-85, the Mozambican floods of 2000, the Sahel floods of 2007 (Paeth *et al.*, 2008) underscore the fact that adaptation to high intensity or high magnitude climate anomalies has generally been unsuccessful or inadequate. Similar examples of adaptation limitations or outright failure can be found in the areas of health, environmental and biodiversity resources, fish, livestock and coastal systems, among several others.

Although discussed separately for purposes of clarity, exposure, sensitivity and adaptive capacity are all strongly interconnected through the environmental, political, and socio-economic processes driving them (Smit & Wandel, 2006, p. 286). In other words, many of the same reasons for a system's high exposure underlie its sensitivity and low adaptive capacity. Furthermore, all three concepts are dynamic, context-specific, and scale-dependent (Smit & Wandel, 2006).

2.5 Conceptualizing the role and place of adaptation in development

Development experts have long argued that the elements of climate change vulnerability are essentially the same as the attributes that cause underdevelopment. Indeed, both developed and developing countries have various degrees of exposure and sensitivity to climate change in different domains. In fact, from a strictly environmental and climatic point of view, there are several areas in which climate change impacts are expected to be more severe in industrialized countries than in the developing countries. For example, many General Circulation Models (GCMs) predict higher proportionate temperature, precipitation, and ecosystem range changes in high latitudes (where most developed countries are) than in the low latitudes (where most developing countries are). But the greater focus and concern of both development and climate change scholars is on developing countries which will be least able to deal with the impacts of climate change. The logic that emerges from this consideration is the following: if development equals an enhanced ability to deal effectively with climate change, is accelerated development the solution to climate change adaptation in developing countries?

In fact, from the beginning of its recognition as a major global challenge, climate change has been linked to development. The 1987 Brundtland report *Our Common Future* noted explicitly that climate change constituted a major challenge facing development in poor countries (World Commission on Environment and Development, 1987). However, for the next decade and half following this declaration, the dominance of the mitigation agenda among the climate change research community prevented further exposition of the linkages and dynamics. Ayers & Dodman (2010) have posited that the absence of explicit mention of climate change adaptation in the Millennium Development Goals is because the document was drafted during this lull. In 2002, adaptation received a major boost when 10 leading development funding agencies released a report titled *Poverty and climate change: Reducing the vulnerability of the poor through adaptation* in which they argued that pro-poor development was key to the achievement of the Millennium Development Goals (MDGs) and successful adaptation.

Beginning with that opening, there are now three identifiable ways in which adaptation is perceived in the development context. These are stand alone adaptation, mainstreaming

adaptation or adaptation plus development, and adaptation as development (Ayers & Dodman, 2010, p. 165).

Stand alone measures view adaptation strictly in terms of responses to climate change due to anthropogenic activities (UN, 1992). This approach stems from early definitions of climate change by the IPCC as due solely to human activities (i.e. anthropogenic global warming) rather than climate variability which includes also fluctuations due to natural earth system processes. In this sense, climate change is perceived to be what is additional to the baseline patterns of natural climatic variability. Consequently, the intervention strategies proposed also tend to be additional to baseline developments needs; those needs that would have existed within the community or society regardless of climate change are underemphasized or ignored completely. Thus, we see in this approach vestiges of early perceptions of adaptation as something local while climate change was considered a global phenomenon. Another characteristic of the stand alone approach is that it prioritizes technical and scientific intervention strategies such as dams, early warnings systems and irrigation projects among others. It seeks to address vulnerability but not the underlying drivers of vulnerability, including questions of equity, access, and affordability.

This approach has been criticized for addressing the symptoms rather than the causes of climate change vulnerability. Critics point out for example, that an intervention strategy, such as a dam or reservoir while technically and conceptually sound may be of limited success against climate change vulnerability if vulnerable groups lack access to the dam for political, social or other reasons or if they cannot afford to pay for irrigation water for economic reasons. Another limitation of the approach is that it could actually act as a constraint to effective adaptation. Ayers & Dodman (2010) cite the example of Tuvalu, a poor island nation, where sea level rise and erosion are expected to exacerbate existing erosion problems. Clearly, both the current erosion problems and the anticipated future erosion need to be addressed. But by UNFCCC convention, the bottom part of the erosion control infrastructure needs to be built by the Tuvalun government as part of its normal development obligations. Tuvalu could then apply for funds through the National Adaptation Programs of Action (NAPA) designed to assist the least developed countries deal with climate change impacts to build the top part section i.e. that which would curtail erosion due to climate change. The problem is that Tuvalu is unable to build the bottom section because it does not have the money to do so with the consequence that the nation is unable to access funds for which it is eminently eligible.

The second approach attempts to mainstream adaptation into development strategies and policies or to 'climate-proof' development by ensuring that development interventions will be able to withstand the effects of climate change. This approach is favored by major funding agencies, including the World Bank, which in 2010 released its strategic framework on development and climate change (World Bank, 2010). The approach integrates climate change adaptation into social, institutional, and infrastructural development but has been criticized for depicting adaptation as something tacked on to development i.e. adaptation plus development (Ayers & Dodman, 2010). To a degree, this sweeping criticism is unfair because in some cases, these agencies deal with projects conceived or even partially implemented prior to the policy decisions to factor climate change effects. In such instances the agencies are simply retroactively climate proofing their development interventions.

The third and final approach views adaptation as synonymous with development (adaptation as development). Here, the goal is to address the general indicators of underdevelopment, including poverty, access to education, health services, finances,

information, technology, improved living conditions etc, with a view to ensuring that the victims would be better able to deal with the effects of climate change. In a sense this approach implicitly attempts to reduce vulnerability in developing countries through fortifying them with the same attributes that make developed countries less vulnerable at least on the fundamental indicators. Diligent adherents of this position recognize that in some cases short-term or exigent development priorities might conflict with long term adaptation needs, leading potentially to maladaptation or conflict with local stakeholders. For example, confronted with an environmental or climatic hazard, many local and especially poorly educated stakeholders think in terms of immediate survival and coping rather than long-term adaptation. It is difficult to argue with this logic because the question of adaptation or long term impacts is moot if one is not around to deal with it. The problem arises if donor agencies, which have the resources and luxury of focusing on long-term adaptation insist on prioritizing adaptation over coping.

The view of adaptation as been synonymous with development begs further exploration. Literature search indicates that few studies have bothered to critically examine the question of why adaptation needs to be conjoined to development, as well as the follow up question of whether this linkage is real or contrived. There are good reasons for such exercise. For decades development scholars have promoted various strategies as panacea to underdevelopment, from technology transfer, to trade liberalization, to democracy, to debt forgiveness, and now... adaptation. To date, while there has been some progress, many developing countries particularly in SSA remain firmly in the grips of crushing poverty. What reason is there then, for believing that casting adaptation as development would be a more effective strategy; that it will have a better chance of bringing about sustained development where the previous policies have failed? Or might the approach, like its predecessors, fail to live up to its lofty expectations? In an attempt to address these questions, a good starting point is to contrast global efforts toward, and characterization - some might say the marketing- of climate change adaptation with the MDGs.

The MDGs are time-bound targets designed to provide concrete, numerical benchmarks for tackling extreme poverty in its many dimensions, through unified global efforts in education, health, environment, and economics (www.beta.undp.org/undp/en/home/mdgoverview.html). The United Nations Development Program (UNDP) which developed and oversees the project proclaims that the MDGs provide a framework for the entire international community to work together towards a common end, making sure that human development reaches everyone, everywhere (www.undp.org/mdg/basics.shtml). Thus the declared motive of the MDGs initiative is to ensure that *development* reaches everyone everywhere. Yet, today, it appears that it is adaptation to climate change, not the MDGs, that is being promoted as synonymous with development. In fact, to read the literature, the future survival of developing countries does not seem to be as dependent on achieving the MDGs as it is on adapting effectively to climate change. Certainly, enhancing the development profile of the world's poorest countries is needed for its own sake so why does development need the imprimatur of adaptation?

One possible explanation is that climate change has broader impacts and threatens "all life on the planet" making it "the cause of anticipatory grief and felt loss" (Reser & Swim, 2011). In contrast, the MDGs have the most significance for developing countries even though a legitimate argument could be made that what ails the developing countries ultimately affects the developed nations. Nevertheless, what is true for social media and international discourse is also true for scholarly research, namely, issues that affect the developing

countries exclusively or primarily tend to receive much less coverage. This fact may account for the seemingly greater attention to climate change than the MDGs with the latter forced to align itself with the former to share in the glow as it were.

Another way to interpret the seemingly low key international perception of the MDGs is because they address a set of concrete uncontroversial issues. Controversy breeds attention. Every 20 seconds, a child dies from water related disease; 2.5 billion people lack access to improved sanitation, including about 1.2 billion who have no facilities at all; worldwide, over 3 million people die each year due to malaria, and in 2009, over 2.6 million new HIV infections were reported, claiming 6,000 lives each day. These are real numbers, not projections, and relatively unpoliticized. The point is that the causes of poverty and underdevelopment as well as their effects are obvious for anyone to see. That poor people suffer disproportionately from HIV/AIDS, malaria, and child mortality or lack access to safe drinking water or access to education and health amenities or credit is not a subject for debate. There is no question that young girls especially in the developing world are being discriminated against in terms of access to education. Additionally, the funding mechanisms for MDGs though structurally complex are very specific and require little justification. Funding is provided for example to combat Tuberculosis, HIV/AIDS, maternal health and so on.

In contrast, climate change adaptation attempts to address something that for the most part has not yet happened. This is a considerably harder sell especially when viewed against the backdrop of other very real and immediate needs. Adaptation as development both legitimizes and elevates the urgency associated with climate change, earning it a place at the crowded table of international development needs. This view in no way contests the very real development challenges that climate change poses nor does it doubt that effective adaptation will greatly accelerate development of the affected regions. It simply acknowledges that whether serendipitous or by design, portraying climate change adaptation as development serves the agenda of funding agencies. But this is not a case of funding agencies manipulating the development agenda. The UNFCCC has been an active and willing partner in this construction. At the Seventh Conference of the Parties (CoP), in Kuala Lumpur, Malaysia, the IPCC through the UNFCCC established the Least Developed Countries Fund (LDCF) to assist developing countries to adapt to climate change. This mechanism was reinforced a year later at the 8th COP of Delhi, India. The LDCF has been a major factor in shaping the research agenda related to climate change adaptation.

One question which the development scholars promoting the adaptation as development mantra have yet to address in any great detail is whether there is a risk that by conjoining the two adaptation is likely to suffer the same maladies that have stunted development in general. For example, throughout the 1970s and 80s, the developed countries poured billions of dollars in overseas development assistance to third world countries. In some countries notably in SSA, the money failed woefully in achieving its stated goals because it was diverted, mismanaged, there was a lack of local or internal technical and personnel capacity, and lack of political will and commitment among numerous others. The lessons learned from such past experience should inform the design and structure of the current efforts but thus far, development scholars appear to be more focused on winning the intellectual and policy debate and have yet to turn their attention to fine detail and logistical issues.

3. Climate variability or climate change: the question of what to adopt to

Due to considerable uncertainty concerning climate change projections, no one quite knows exactly how climate change will manifest and therefore the best way for dealing with it. One approach for planning for climate change adaptation is to use the past (observed) climate variability as analogue, i.e. temporal analogue. Analogues may also be spatial, i.e. when one looks at societal responses to climate change and climate variability in another region with comparable climatic conditions as the area of interest (Adger *et al.*, 2003). Such analogues require consideration of patterns and episodes of observed extreme climate variability as well as the corresponding responses of social, agro-ecological and environmental systems. Not everyone agrees that the analogues approach is ideal or the most effective approach. The key objection is that the future climate may differ markedly from the past in critical respects, including patterns of seasonal distribution and statistical characteristics such as mean, variance, frequency, and distribution of extremes. Moreover, when researchers talk of past climate as analogue, they typically consider primarily the periods of extremes, such as droughts, floods, and heat waves, and attempt to map the societal response to them. While such information is useful, these events are intermittent and it is not always clear how the dynamics of the coping strategies would evolve on a sustained or protracted basis. Consider the Sahelian drought of 1970-73 or the East African drought of 1983-85; in what ways would the affected regions have adapted if those levels of climate variability had become permanent? Additionally, the onset of extreme events tends to occur over a short period of time, even for creeping type phenomena like drought, relative to climate change.

Despite such concerns, there are also strong reasons why analogues provide acceptable templates for adaptation and response to change. In some parts of the world, such as the African Sahel region, the range of observed climate variability exceeds the expected range of future variation due to climate change.

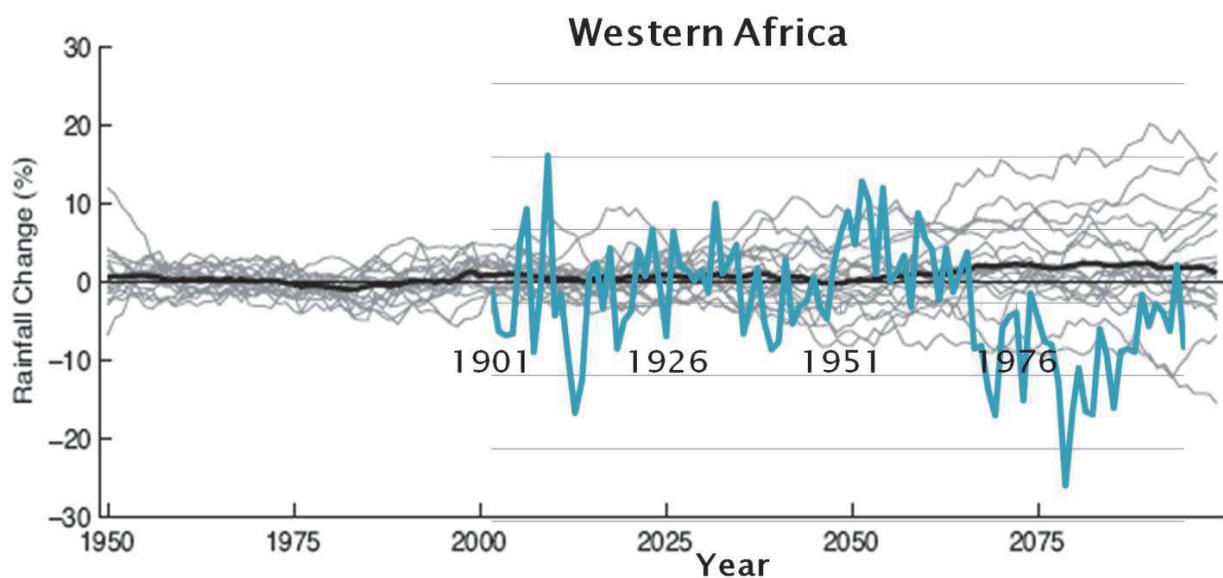


Fig. 3. Plot of observed climate variability (turquoise blue) during the 20th Century superimposed on GCM projections for the 21st Century showing percent rainfall changes in West Africa. (Courtesy, Casey Brown, University of Massachusetts).

In Fig. 3, the researchers superimposed the observed pattern of rainfall changes in West Africa during the last century over an ensemble plot of GCM projections of rainfall changes for the present century. It is immediately obvious that the range of observed historical variability far exceeds the total range of the ensemble projections. In numeric terms, the Sahel region of West Africa experienced repeated and sustained periods of variability that ranged from about 25 to 40% depending on location (Hulme, 2001; Lebel et al., 2003). In contrast, projected rainfall changes over West Africa as a result of climate change are expected to be in the range of $\pm 10\%$. By 2050, projected decline in runoff will be on the order of 5% compared to up to 60% during some periods of the last century. Also, the inability of GCMs to produce variability is well known. Even so, the significance of the example illustrated here goes well beyond either of those two caveats.

It is important to note the above situation for the Sahel is by no means unique. Observed rainfall variability has been shown to be greater than changes suggested by climate models for the next 50-100 years elsewhere in Africa, including eastern Africa and the Blue Nile Basin (Hulme, 1998; Adger *et al.*, 2003). Rainfall variability in northeast Brazil also is of the order suggested by future climate change (see, Marengo, 2004).

The key point is that for some parts of the world, the magnitude of historical climate, specifically rainfall variability that vulnerable groups have had to cope with and adapt to exceed the expected magnitude of climate change. Therefore, if vulnerable groups learn to cope with climate variability, they will be climate change ready.

The above suggests a fundamental flaw in the UNFCCC approach and funding mechanism, which seeks to focus adaptation efforts on climate changes above baseline conditions. Clearly, helping vulnerable groups to deal effectively with current climate variability, which means addressing the determinants of vulnerability would appear to be the superior approach. These examples emphasize the point that adaptation is very context specific, a fact that is frequently acknowledged but just as frequently glossed over.

4. Part 3: Implementing adaptation to climate change and climate variability

Researchers recognize several forms or levels of adaptation (Smit & Wandel, 2006). In terms of timing or when it is implemented, adaptation may be characterized as anticipatory i.e. carried out in advance of expected stimulus, or reactive i.e. in response to stimuli that has already occurred. It may be planned (formal) or spontaneous (informal), and it may be carried out at the level of the individual (private or autonomous) or an institution (public). This type of nomenclature has helped to impose a level of intellectual clarity regarding the different classes and types of adaptation responses. It also allows researchers to make informed guesses about the kinds of adaptation that vulnerable groups are most likely to implement under various contexts and scenarios. A review of the literature and consideration of relevant dynamics suggest the following.

4.1 Most adaptation in developing countries is likely to be autonomous and informal

In general, it can be expected that adaptation carried out by large entities such as governments and international development agencies are more likely to be planned and anticipatory. The reason is simple; these entities have access to the information, knowledge base, resources, institutional culture and even requirement for long term planning that is the hallmark of anticipatory adaptation. For example, the World Bank's strategy document on climate change adaptation (World Bank, 2010) requires all major World Bank funded

projects to undertake climate risk assessments covering the life term of the project. UNFCCC requires NAPAs to factor in the risk of climate change in all of their planning documents. Yet, a major characteristic of developing countries is that the formal organized or planned sectors are weak and cover only relatively small portions of the overall population and activities. And there is unlikely to be sufficient development aid or investment to implement planned adaptation in developing countries. The UNFCCC acknowledged as much when it stated, "it is clear that current funding is not enough to support adaptation needs. Recent studies...showed that an incremental level of annual investment and financial flows of about \$50 billion is needed for adaptation in 2030. In the context of any discussion on future international cooperation on climate change, future financial resources need to be sufficient, predictable and sustainable in order to facilitate adaptation to adverse impacts of climate change by developing countries" (UNFCCC, 2007, p. 52). Therefore, it can be expected that public, formal, and planned climate change adaptation interventions will represent only a small proportion of the overall climate change adaptation activities needed in these countries. The balance of the interventions necessarily will have to be made up through individual efforts. But a poor African farmer, for example, typically does not think about climate in 2030; he/she is much more likely to be concerned with the next year or two and 5 years would be considered a long planning horizon (see also, Salick & Byg, 2007).

The above consideration suggests that climate change adaptation planning in developing countries must recognize the reality that significant amount of adaptation will be reactive, informal, and private. It bears to note that there is nothing wrong with these modes of adaptation. We have already made the point that adaptation needs to be context specific and dependent on the resources available to the impacted domain. Therefore, for poor, small scale farmers, the actions that they take in response to climate variability and change are the actions that they can afford or which are most relevant to their needs. Moreover, the lines between anticipatory adaptation and reactive adaptation are not always rigid or even clear. For example, Reser and Swim (2011, p.284), cite the case of an individual who rebuilds his home after a storm. This individual may decide to build the home stronger and away from likely storm or flood damage. In this example, the act of rebuilding the home is clearly reactionary. Yet the decisions about how to make the home less exposed or susceptible to future storm damage is clearly anticipatory.

A number of actionable policy guidelines emanate logically from the foregoing discussion. First, recognizing that planned adaptation will not reach all groups and sectors that need it, there is a need to ensure that those groups which will be forced to act on their own have the right information on which to base their actions. Without such information, impacted groups will have no option but to rely on past experience, which may not be a good predictor of future outcomes. Indeed, a major risk to adaptation or cause of maladaptation, is when people act on the basis of faulty information and assumptions. Tarhule (2005), cites the example of responses to drought in the Republic of Niger. Following three decades of declining rainfall and diminishing water resources, many farmers relocated their homes and activities within or close to flood plains in order to be closer to water. On the face of it, such decision appears reasonable but once wetter conditions returned, these activities were confronted with greater flood risk directly as a result of their drought response strategies. It is reasonable to expect that climate change may entail many such incidences in the future because past experience will no longer be an adequate and sufficient predictor of the future. There is also the risk of disruptions to expected trends caused by possible non-linearities in climatic patterns. The key message here is that the governments and development agencies

working in developing countries need to provide information that guides vulnerable groups about sustainable and effective adaptation practices as well as maladaptation risks.

Moreover, it is important to ensure that vulnerable groups can in fact act upon that information. Generic information about what individuals and at-risk communities should do is useless if those communities cannot put such actions into practice. Buchanan-Smith *et al.* (1994) in their provocatively titled article, "let them eat information" provide an excellent discussion of the great gulf that exists between information and people's ability to put that information to beneficial use. Therefore, adaptation planning and policies need to be smart in identifying the kinds of interventions that are needed or likely to be most effective in specific context. Research in livelihoods analysis and consideration of the status of adaptive capacity within communities provides some guidance. For example, Fabricius *et al.*, (2007), utilized a livelihoods analysis framework to define three broad types of communities in terms of their adaptive capacity. These include (see Magistro, 2009):

- i. *Powerless spectator* communities with institutionalized histories of powerlessness and disadvantage have a low adaptive capacity and weak capacity to govern, do not have financial or technological options, and lack natural resources, skills, institutions, and networks.
- ii. *Coping actor* communities have the capacity to adapt, but are not managing social-ecological systems. They lack the capacity for governance because of lack of leadership, of vision, and of motivation, and their responses are typically short-term.
- iii. *Adaptive manager* communities have both adaptive capacity and governance capacity to sustain and internalize this adaptation. They invest in the long-term management of ecosystem services. Such communities are not only aware of the threats, but also take appropriate action for long-term sustainability.

Knowing the status or adaptive capacity of each community or domain can help in the development of the adaptation strategies most suitable to their situation and their abilities. For adaptive manager communities, all that might be necessary is a little bit of information or assistance and they will be on their way. For coping communities, greater emphasis may need to be placed on building their capacity to respond as a prerequisite to engaging in adaptation activities. Powerless spectator communities also need a healthy dose of capacity building but for many of these communities, there may be no alternative to direct intervention to help stave off expected suffering and economic loss.

Thus, vulnerability mapping needs to take into account not only expected climate change impacts but also community mapping and designation in terms of adaptive capacity. While conceptually sound, developing the metrics to capture sufficiently robust and dependable adaptation characteristics to permit such mapping would be challenging. But this is the kind of research that the hazard and, increasingly, development communities, have proved themselves most capable of.

4.2 Individuals and vulnerable communities and indeed many developing countries will have little motivation to act on climate change unless they perceive real benefits

That is, vulnerable groups are unlikely to implement some adaptation strategies regardless of the logic or soundness of such strategies unless those strategies address an immediate need or a recognizable future threat. The reason has to do with the razor thin margin of resources and efforts available to many vulnerable groups. Faced with deploying resources to address some immediate need and some alleged future threat, most people will, and rightly so, prioritize the more immediate threat. This point underscores the fact that

adaptation will be very context specific. Consequently, policy makers and development planners who seek to mainstream adaptation into current project must be prepared to show clear and direct linkages.

4.3 There may be no grand theory of adaptation. A cursory examination of the rather copious body of work on adaptation to climate change and climate variability shows that there is very little specificity in the recommendations that most studies offer

Even the UNFCCC adaptation (see, UNFCCC, 2007) strategies appear short on specificity despite being very detailed on problem description and analysis. On the other hand, the database on local coping strategies (<http://maindb.unfccc.int/public/adaptation/>) is potentially quite useful, not because it is more specific but because it simply documents coping strategies elsewhere, providing users insights into how other communities are learning to cope with climate change and climate variability.

The reason for the lack of specificity has to do with the previously discussed characteristics of the adaptation process; it is dynamic, context specific, and scale-dependent. Perhaps, in the end, one of the most effective adaptation strategies will be to teach vulnerable communities the *process* of doing adaptation. For example, at the most general scale we know that climate change and climate variability risks are caused by exposure, sensitivity, and adaptive capacity. Therefore, the solution is to reduce exposure, reduce sensitivity, and increase adaptive capacity. Beginning with this framework and working to progressing finer levels of detail and spatial resolution one might attempt to figure out for a given location who or what is exposed to climate variability and to what degree. Resolving those issues might prompt questions about why such exposure exists and finally how it might be mitigated. One could then follow the same *process* of reasoning with respect to how to reduce sensitivity or how to increase adaptive capacity. A focus on the process and on information dissemination puts the stakeholders in the drivers' seat rather than treating them as passive and helpless victims, but see below.

4.4 There is a need for more studies of the psychology of climate change adaptation and motivational behavior

Nearly all climate adaptation strategies implicitly assume that "the reduction of appraised threats motivates individuals to initiate coping responses" (Reser & Swim, 2011, p. 283). This assumption is not always rigorously tested or even investigated, especially in developing countries. Most people are aware of the health dangers that smoking poses but that does not stop them from indulging the habit. Other people also voluntarily engage in risky sexual behaviors and drug habits, fully knowing the risks involved. In Africa, efforts to combat issues like high population growths rates, land degradation, and female education often have run up against social-cultural norms and perceptions that are very difficult to overcome. What motivates people to decide to act or not act or choose the actions that they do in the face of clear and present danger? What are the emotional and cognitive heuristics involved and how might lessons learned from combating other threats like anti-smoking campaigns inform the climate change and climate adaptation efforts. These types of questions have not been sufficiently posed and investigated.

4.5 Adaptation has limits

Some sectors and activities are inherently structurally defective to the point where their adaptation options are limited. Other sectors and activities are doomed by timing and

circumstances and therefore unfit for adaptation. Pastoral nomadism is a good example of a system that is doomed by external circumstances beyond redemption. Each year, nomads find their traditional migratory routes blocked by land use changes as well as population and economic growth. There is no help for this sector other than total abandonment, even without the confounding effects of climate change. The best analogue for pastoral nomadism is the open range concept, which was prevalent in the United States during the 2nd half of the 19th Century. Open range referred to areas of public domain that were used as common pasturelands for cattle grazing. Fencing was prohibited on these lands, allowing free movement of cattle. The open range concept became unsustainable as the USA became more and more settled and economic growth necessitated changes to the land tenure system. Such is the case in parts of Africa today, where conflicts between nomadic livestock herders and sedentary farmers have intensified in recent years (Tarhule, 2002).

In a similar vein, Adger *et al.* (2003, p.189) noted, "the limits to many adaptation options are already apparent in areas such as population movement and migration, in the ability to bring new agricultural land under irrigation when rainfall is threatened, or to bring about large-scale infrastructural changes to minimize the impacts of sea-level rise on coastal areas." These examples make the point that recognition and even willingness to adapt may not be synonymous with the ability to do so. In some instances the most appropriate response to climate change and climate variability may be wholesale abandonment of lifestyles and sectors although some people may argue that such steps, too, represent merely an extreme form of adaptation.

5. Summary and conclusions

Climate variability and change will constitute, arguably, the defining phenomenon of this century. Societal response to climate change comprises two sets of activities that lie on the opposite ends of a continuum. The first is mitigation, which attempts to curtail the entry of additional GHGs into the atmosphere as a result of human activities. The second is adaptation, which attempts to increase the capacity of human and agro-ecological systems for dealing with the changes caused by climate change. Almost by tacit agreement, it is understood that developed countries will focus on climate change mitigation while developing nations will focus on climate change adaptation. This arrangement makes sense from a variety of perspectives. It is the developed nations which have contributed the most to the current GHG concentrations in the atmosphere and which also have the technological and economic resources for tackling the problem of emissions reduction. Developing nations, on the other hand, have generally contributed less to GHG emissions (although some of the larger emerging nations like China, India, and Brazil recently have become major GHG emitters). Most developing nations also contain significant populations and domains that are especially vulnerable to the impact of climate change, hence it makes sense that they should focus on ways of reducing that vulnerability.

Drawing from a variety of sources, including ecology hazards and development studies, a rich body of literature has emerged providing intellectual clarity on the philosophy and approach to climate change adaptation as well as the nuances and meanings of associated concepts. While much progress has been made on the academic front, the process of translating theoretical constructs into implementable ideas has lagged. This chapter undertook a critical review of the situation, mainly from an African perspective, and identified a number of salient factors necessary for bridging the gap between adaptation theory and practice, in other words, how to move beyond rhetorics.

The literature suggests that a considerable amount of research efforts has been devoted to explaining the role of adaptation in development. The key questions may be summarized as follows. Should adaptation focus on the climate change effects over and above baseline conditions or should it target the factors that make people vulnerable to climate change? When does adaptation equal development? What kinds of development qualify as adaptation? While stimulating intellectually and perhaps from the view point of how one funds adaptation, the ultimate value of these lines of analysis may be most pertinent with respect to planned or institutional adaptation activities. For most developing countries however, adaptation is likely to be piecemeal, autonomous, and reactive simply because there will not be sufficient money or technical capacity or personnel resources to reach a majority of the people who need help adapting to climate change. This realization suggests that adaptation efforts should focus on giving people the information they need to help themselves.

Development experts should be careful not to oversell the potential of climate change adaptation in bringing about development. Many such promises have been made in the past, including the Green Revolution, technology transfer, and debt forgiveness, and democracy but all ultimately fell short of the promised dividends. Instead, it may be more beneficial to focus on the lessons learned from those past experiences and failures, with a view to ensuring that adaptation lives up to its billing.

A number of assumptions regarding adaptation have not yet been sufficiently tested. The assumption that people are motivated to act once they have information may need to be tested. Similarly, not enough studies have investigated the psychology of climate change adaptation or even how social-cultural beliefs and practices may hinder (or promote) climate change adaptation. This is important considering the degree of inertia faced by other major social transformation initiatives, like anti-smoking campaigns or birth control in developing countries.

For many developing countries especially those in Africa, it would appear that climate variability and not climate change is the more serious threat. In some locations, the range of observed climate variability during the past century exceeds the expected magnitude of climate change. This suggests that if the impacted regions can cope with climate variability they will be climate change ready.

Finally, developing countries need to assume greater ownership over the climate change adaptation process to ensure both its sustainability and management according to national development priorities.

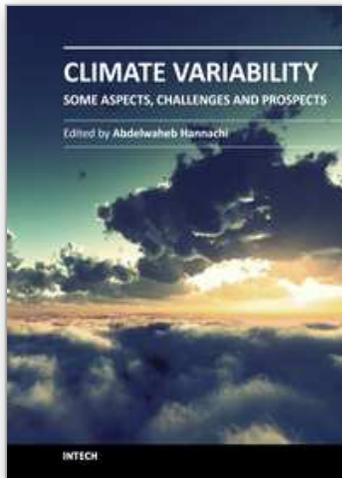
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