

# Climate Change and AIDS: A Joint Working Paper



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## EXECUTIVE SUMMARY

AIDS and climate change (CC) are two of the most important “long wave” global issues of the recent past, the present and the future. They share similarities, interactions, and present possibilities for a more united response. Yet these links have received little analysis. This paper seeks to address that gap. It first focuses on scientific issues, identifying major, minor, and speculative pathways by which AIDS and CC are likely to interact. These interactions are, here, called the HIV and Climate Change Complex (HACC).

The maximum impact of CC is in the future, likely to occur decades after the peak incidence of HIV. The severity of the HACC will largely be determined by the temporal overlap of these ranges. The HACC will also have an uneven spatial distribution, modified by the regional impact of CC and the regional epidemiology of AIDS, each of which varies by physical and social elements. Populations with currently high rates of HIV are the most vulnerable to a worsening or prolongation of the epidemic due to CC. This places the people of SSA at the greatest risk of the HACC, though outside Africa populations in north east India and New Guinea may also be significantly impacted.

There is agreement that the most important pathway in the HACC will be further deterioration of regional and global food security. At the individual level, nutrition is vital for good immune function, to reduce the risk of acquiring HIV if viral exposure does occur, and to slow the progression of HIV to AIDS and of AIDS to death. At larger scales, population nutrition is important for good governance, by helping to nurture and stimulate the “effective” demand populations need to reduce corruption and to more evenly distribute available resources. Any substantial decline in the availability and intake of calories or micronutrients brought about by CC is likely to increase poverty, impair learning and expand the number of migrants. The current decline in global food security, partly attributable to CC, is already causing disproportionate nutritional harm to migrants and otherwise impoverished populations, some of whom experience AIDS.

There is agreement that the second major pathway of the HACC is the CC-related alteration in the distribution of infectious diseases, which interact with AIDS. Of these, malaria is the most important, due to its high burden of disease (BOD). CC is projected to reduce malaria transmission in some regions, which experience a comparatively low rate of HIV, both now and in the future. This will reduce the beneficial impact to the BOD of AIDS for these populations. On the other hand, a large population with a high rate of HIV lives on the plateaus of sub-Saharan Africa (SSA), an area as yet little affected by malaria. If the climatic, eco-systemic and other factors for malaria transmission alter sufficiently in these plateau cities then the HIV burden of this population is likely to be substantially higher, and will also be worsened by increased poverty and greater food insecurity.

There are several other plausible biological pathways in the HACC. Of these, the relationship between CC, air pollution and immunity, and CC, heat stress and immunity are likely to be the most important. More speculative is the possibility that that CC will harm infrastructure and governance on a scale sufficient to aggravate and prolong the BOD of

AIDS. Again, the population of SSA is judged to be at the highest risk. This mechanism is plausible by interlinked pathways including more extreme weather events and “natural” disasters, increased mobility and additional migrants and refugees. These factors are also likely to aggravate gender inequalities, increasing the frequency of transactional and coercive sex — pathways likely to increase the BOD of AIDS among women and girls, via increased viral transmission and reduced access to treatment and prevention. At the global level, CC may exert an immense opportunity cost, diverting resources of the international community away from public health, including from HIV, poverty alleviation, and the other Millennium Development Goals (MDGs).

Suggestions for a future research agenda include the more accurate assessment of the pathways within the HACC, and an improved conceptual understanding of the linkages between conflict, behaviour, governance and values, environmental factors including climate, and food production, and between each of these macro-elements and sea level rise. This would be best done by an interdisciplinary working group. Another research gap is the effect of CC on human behaviour, including behavior related directly to HIV risk.

From science, the paper moves to strategies and policies. The struggle to address AIDS and CC has generated two vigorous global social movements, with, as yet, little formal interaction or collaboration. We suggest this gap is a microcosm of a separation between two even larger communities – those concerned with the environment and those concerned with social justice. Of course, this is a simplification, but on the whole our perception is that the environmental movement is insufficiently aware of poverty, while the social justice movement is still poorly informed about the environment. The work, advocacy and activism of the leaders and actors within each community who do recognise these linkages will be strengthened by this report.

AIDS has already killed tens of millions of people, while CC may dwarf this number. Those concerned to reduce CC can apply many lessons learned by the AIDS community. These include the need to challenge conventions and to seek benefit for the poorest and most marginalised – and to widen the CC movement’s emerging engagement with entrepreneurs, philanthropists and prominent personalities: tools instrumental in the growth of support for those with HIV. The AIDS constituency can benefit from the experience of humanitarian programmes, some of which already see AIDS and CC as cross-cutting issues.

Several actions to reduce the impact of CC on AIDS are proposed. These include the integration of HIV prevention and management into disaster management plans, particularly for populations in SSA, some of whom have already experienced extreme weather events. Means to enhance global and regional food security, especially in SSA, are vital, and much more can be done. A quarter of the world’s population is over-nourished, and a more equitable distribution of global food production will go far to defusing any future food crisis, and is likely to improve health for both over and under-fed people. Malaria treatment and prevention in SSA can also be improved. The CC community might also consider strengthening the UNFCCC including with formal links with agriculture, health and security.

Finally, a risk is perceived whereby a relatively privileged stratum of people and interests argue that issues of global health and global social justice must be put aside in the effort to pursue partial CC adaptation. This approach is highly dangerous for global health and global social cohesion. It would also likely generate profound longer-term risks for currently privileged populations pursuing this strategy. A stronger alliance between the AIDS and CC communities will help thwart the emergence of such a policy. A focus on the interconnections between CC, food security, AIDS, health in general and the links between these and the MDGs is key to breaking out of this “either or” myopia.

## INTRODUCTION

AIDS and CC are two of the most important “long wave” global issues of the recent past, the present and the future. However, despite the importance of these issues, their shared similarities and interactions have received little analysis. This report attempts to help fill that gap, building on a pioneering report by Gommers et al, commissioned by the United Nations Development Program (UNDP), National Center for Atmospheric Research (NCAR) and the Food and Agricultural Organization (FAO). [1]

In 2004 the United Nations Secretary-General’s High-Level Panel on Threats, Challenges and Change [2] identified six clusters of threats to a more secure world. Of these six clusters, two are relevant to the themes of this paper - environmental degradation and infectious disease. Climate change, due primarily to air pollution by invisible greenhouse gases (GHG) from the burning of fossil fuels, the clearing of forests, and agriculture, is a quintessential, and perhaps unifying example of global environmental degradation. A series of four intergovernmental reports into CC has over the last two decades sounded a progressively louder alarm, as the scientific consensus has shifted from doubt to scientific anxiety. Already, an increasing number of eminent climate scientists are warning that the 4<sup>th</sup> Intergovernmental Panel on Climate Change (IPCC) report, released in 2007, is too optimistic. [3, 4]

Due its novelty, enormity and economic disruption, AIDS has appropriately captured the global imagination as the most important of the newly emerging and re-emerging infectious diseases. By 2001, AIDS was the world’s fourth leading cause of death, after heart disease, stroke, and acute lower respiratory infection\ (5) The catastrophic recent decline in life expectancy in several countries in SSA is predominantly because of AIDS. [5]

In keeping with its special status, and in reaction to a previous phase in which the funds provided to combat AIDS were shamefully low, in recent years AIDS has received a much greater share of official development assistance. [6] However this comparative success has also caused a backlash. Critics have pointed to the dangers of disease-specific programmes, the duplication of services and claimed that the focus on AIDS is damaging to general health systems. [7, 8]

Concerns over the state of general health services in the South (developing countries) [9] are valid. However, some disease-specific programmes have been spectacularly successful, such as smallpox. [10] We live in an imperfect world. Attempts to strengthen more general health services in the South, or raise funds for other important conditions, such as childhood pneumonia have been less successful than have been attempts to raise awareness and funds to overcome AIDS. There are many reasons for this, some of which will be explored in this paper. Nonetheless, we believe that it is unreasonable and unhelpful to criticise the AIDS lobby for the appalling state of health in the South, when much larger and more obvious reasons exist, particularly the diversion of vast resources, financial and otherwise, to militarism.<sup>1</sup> [11] Although an old aphorism of public health is that disease control programs are culled when their disease burden is falling, thus guaranteeing the eventual resurgence of the disease, the global crisis of HIV is far from over (see figure 1). Culling, or even reducing the effort to address AIDS would be premature. More than half the global population with AIDS remains untreated by ARVs. HIV prophylaxis is used in only 9% of pregnancies among

1. The world’s expenditure on arms dwarfs its expenditure on health. Nobel Laureate Stiglitz and his co-author Bilmes estimate US\$3 trillion has been squandered in the Iraq war. In comparison, the funds spent on AIDS are trivial

HIV positive women. [12] Critics of the funding for HIV might better criticise militarism, agricultural subsidies by the European Union, or the abject failure of most OECD countries to honour their commitments to increase foreign aid and to minimise phantom aid. [13]

Having said that, UNAIDS and the AIDS lobby more generally should try where possible to integrate and co-ordinate their efforts with existing health services, as is already the case in some contexts and countries. [14] More generally, other lobby groups for health might learn from the AIDS community, in ways we suggest will be useful for the environmental community. While HIV is not the only health problem in the South, its scope surely justified an enormous response. That this response may finally be having some effect<sup>2</sup> (see figure 1) is a cause for cautious congratulation, not criticism.

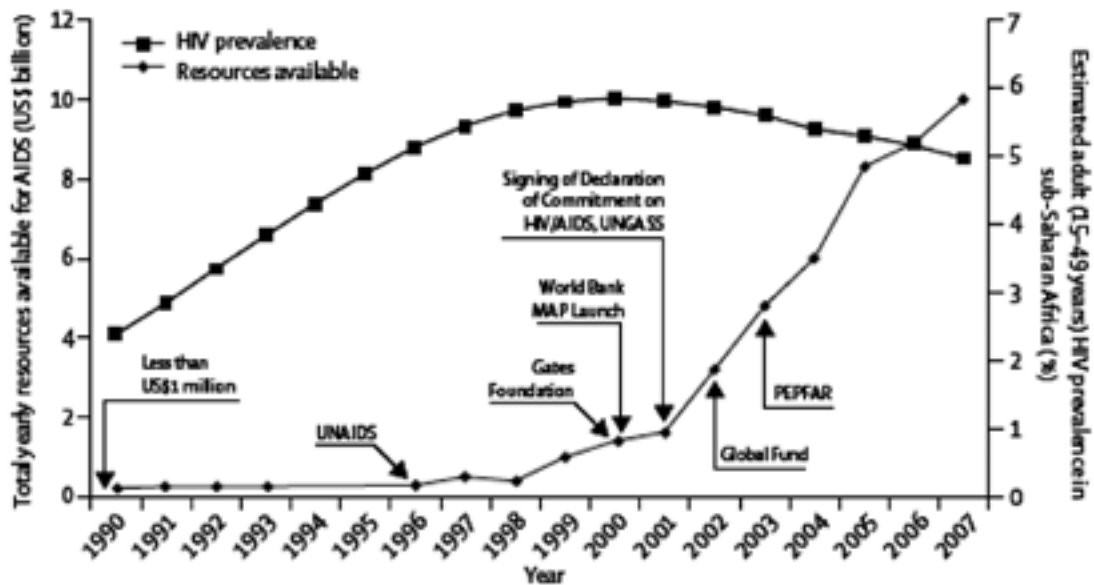


Figure 1 AIDS resources and prevalence, 1990-2007 [16]

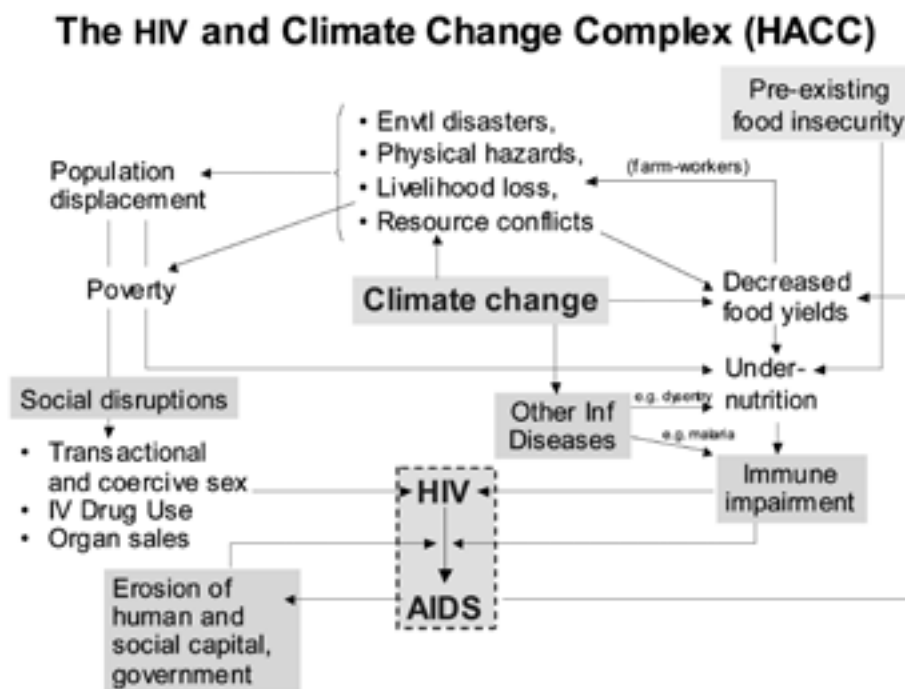
<sup>2</sup> There is debate over the importance and role of anti-HIV funding in the decline in incidence of HIV, which appears to have started prior to substantial anti-HIV funding, reflecting “the natural history of these epidemics as the pool of “most susceptible” declines, as the rapid initial chain-reaction of new infections partly subsides, and as some people largely spontaneously adopt safer sexual practice.” [15] Shelton JD. HIV myths should not be resuscitated [author’s reply]. *The Lancet*. 2008;371:1071-2, [16] Simms C. HIV myths should not be resuscitated [letter]. *The Lancet*. 2008;371:1070-1.



## THE LINKS BETWEEN CLIMATE CHANGE AND AIDS: a conceptual framework

Based on the literature review of the interactions between AIDS and CC, and based on our knowledge of the separate literatures of AIDS and CC we identify three important pathways which connect these two issues, which we call the HIV and CC complex (HACC). The main elements of this complex are shown in figure 2. Note that the chart can be conceived as an entire system. All parts are connected, and no simple fundamental cause or remedy exists, distinct from systematic reform. In many cases causation between the different elements is bi-directional.

Following the literature review this report will focus on several important elements shown in this chart. We first discuss food security (regional and global) and the links between malaria and other CC sensitive diseases. Finally, we discuss HIV, poverty, population displacement, employment, migration, refugees, gender inequality, and governance and conflict.

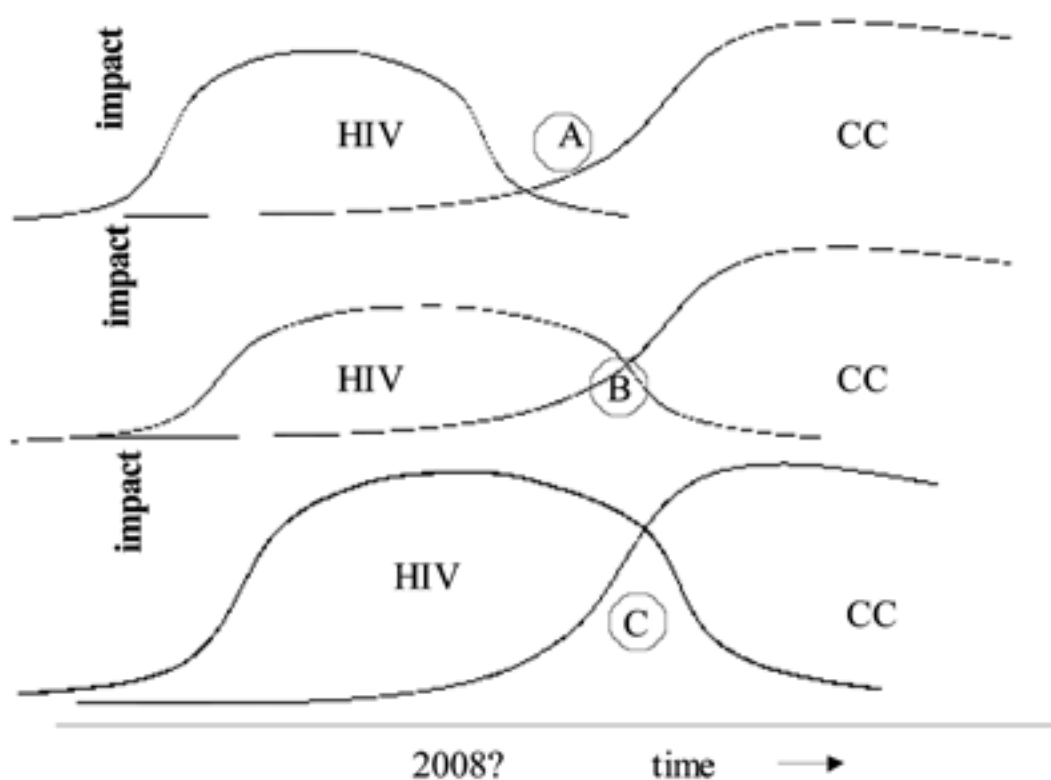


**Figure 2 The HIV and Climate Change Complex (HACC)**

Conceptual framework of main pathways discussed in this report. The chart can be conceived as an entire system. All parts are connected; no fundamental cause or remedy exists, distinct from systematic reform.

In addition, we stress two key points regarding the temporal and spatial distribution of the HACC. The maximum impact of CC is in the future, but it is increasingly likely not only that the maximum incidence but even the maximum impact of HIV has already occurred.

[15, 17] The HACC will vary according to the temporal and spatial overlap of these ranges. Figure 3 shows three conceptual scenarios. In the first scenario (A) the BOD of AIDS declines significantly over the next few decades, while the rate of impact of CC is comparatively slow. The interactions between CC and AIDS are comparatively modest. In the second scenario (B) the BOD of AIDS also declines, but at a slower rate than in scenario A. There is time for a significant interaction between the two long wave events. In scenario C the decline in the BOD of AIDS is slower, and significantly impeded by the interaction with CC. One mechanism by which this is plausible is that CC could cause a significant slowing in the global economy primarily through loss in global world output and higher disaster management related costs, leading to a reduced flow of cash remittances from North to South, greater unemployment caused by the impacts of the economic depression on labour markets, and through these, slower transfer of ideas beneficial to hindering the spread of HIV. While the chance of scenario C occurring is probably lower than of scenario A or B its likelihood is not considered trivial.



**Figure 3 Three scenarios of the temporal interaction between HIV and CC. Scenario A is the most optimistic – HIV wanes as CC impinges. Scenario C is the least optimistic – the HIV pandemic has longest to run and its burden of disease persists, in part because of the interaction with CC.**

We secondly emphasise that the HACC will have an uneven spatial distribution, but will be determined by the regional impact of CC, the regional epidemiology of HIV, and in some cases the regional epidemiology of infectious diseases associated with CC and AIDS. Each of these impacts varies by the physical and social geography – the regional climate, social and human resources, the distribution of income, wealth and power, health services, norms, culture, institutions and governance. Populations with higher baseline rates of HIV are in general much more vulnerable to CC. But not all populations with high baseline rates of HIV are equally vulnerable to CC. For example the BOD from AIDS of populations currently affected by high rates of malaria may change little if their governance and food security

remain little altered, even if the distribution of malaria widens. By far the highest BOD of AIDS is in SSA, and the HACC is most likely to be of importance in SSA. It is also plausible that the HACC will be of public health significance in several other regions; especially the New Guinea highlands and the Mekong Delta region. These two regions are discussed in more detail in the appendix.

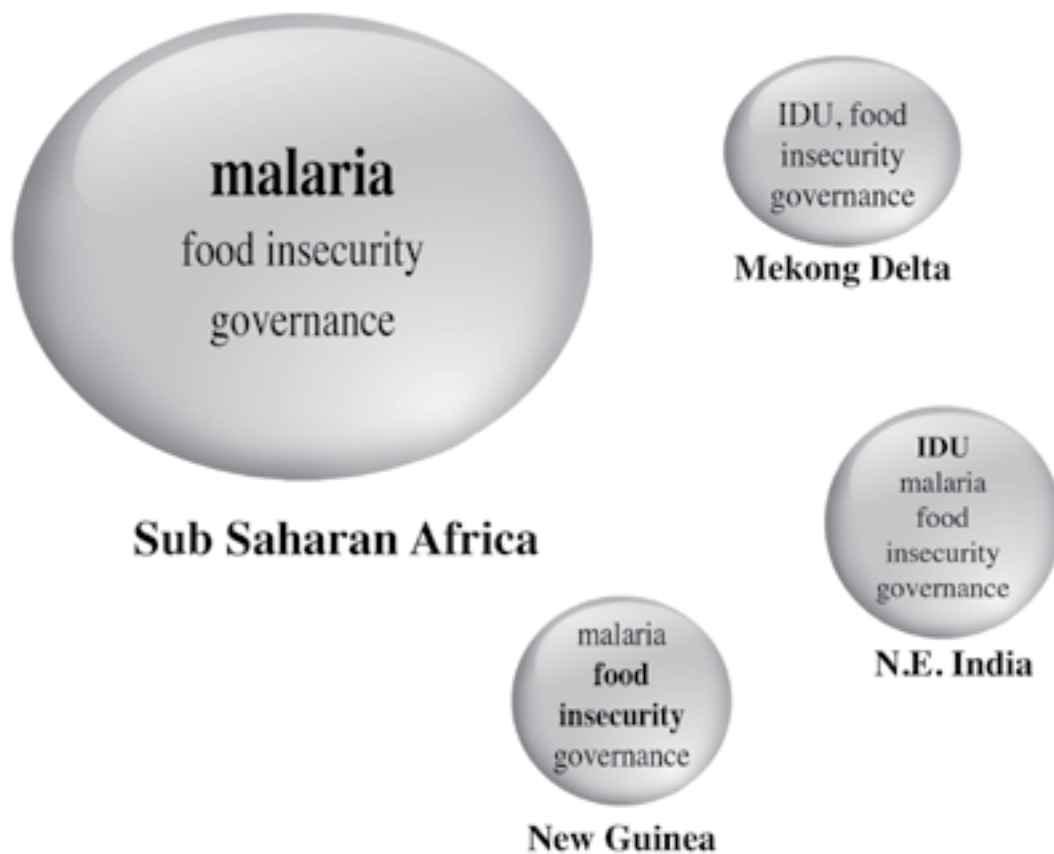


Figure 4: This shows the spatial variation of the HACC. The size of each circle is roughly proportional to the estimated future Burden on Disease of the HACC. Within each circle, the bolded figure shows the proximal risk factor which is likely to be the most important.

## Literature review

When reviewing the literature concerning the links between AIDS and CC Gommaes et al [1] noted that two then recently released substantial reports on CC and health failed to discuss AIDS in any depth. [18, 19] This situation is just starting to change. For example, in the CC and health literature, the review by Patz et al [20] makes no mention of HIV. The chapter concerning human health in the 4<sup>th</sup> recent report of the IPCC [21] describes how drought (and by implication) other forms of CC-associated food insecurity increase the risk of acquiring and of dying from infectious diseases, including, again by implication, HIV. The chapter also observes the synergism between HIV and drought on nutrition. [22] Its authors also allude to the HIV and CC complex (HACC) when they note, that in Africa and Asia the future course of the AIDS epidemic will significantly influence how well populations can cope with challenges from CC, such as the spread of climate-related infections (vector- or water-borne), food shortages, and increased frequency of storms, floods and droughts. Lastly, they observe that CC, especially if rapid and intense, is likely to delay progress in some regions towards achieving the Millennium Development Goals (MDG) targets, one of which is to reduce the incidence and prevalence of HIV.

There are many other papers which discuss emerging infectious diseases, including AIDS. In recent years the role of CC has frequently been mentioned in this work (eg [23, 24]) but the HACC is discussed rarely, if at all. Ebi et al [25] assess human health vulnerability under different CC scenarios. They do not discuss HIV in their paper, but there is little discussion of specific diseases, and the principles they discuss could readily be adapted to examine the HACC. Campbell-Lendrum and Woodruff [26] consider the BOD from CC. They cite the report by Gommaes et al [1] (which specifically examined an aspect of the HACC) but they do not specifically discuss the HACC. Instead, they cite this report as supporting the observation that climate can influence a wide range of diseases through multiple pathways. Similarly, consideration of the AIDS literature also suggests that HACC has received little attention. A rare exception to the general rule of non-discussion of the HACC is provided by Tanser et al. [27] These workers estimated an increase of 16-28% in person-months of exposure to malaria in Africa by 2100, on the assumption that future climates fall within simulated ranges, and they specifically commented on the link between HIV and malaria.

The most recent World Disasters Report, which focuses on AIDS, does discuss some aspects of the HACC. It speculates that the shape of the global AIDS epidemic could be affected if CC causes significant population movement between areas with significantly different HIV prevalence levels. [28]

## Commission for Africa

In 2005 the Commission for Africa, chaired by Tony Blair, then United Kingdom Prime Minister, released *Our Common Interest*. [29] This 461 page report contains substantial analysis of the AIDS epidemic, and it does not ignore CC. It predicts that the frequency of extreme weather events will increase with the growing impact of CC and observes that in Africa this "could be seriously destabilising politically" (p 51). It observes that the low level of irrigation makes Africa especially vulnerable to CC (p 111). It also notes that "poverty interacts in a two-way process with environmental problems" (p 51) and that "the livelihoods of millions of Africans will be undermined" (if CC is not slowed).

The report further notes:

“AIDS is also undermining the traditional coping strategies of households, making the population as a whole more vulnerable. .. those with a good harvest would once lend to those with a poor one, but with lower productivity the surplus is less, so lending is reduced. HIV-affected households save and invest less and children are removed from school. ... there is a growing orphan crisis and in Zambia, by 2010 every third child will be an orphan. 90 per cent of orphans are looked after by the extended family – still – but it is unlikely that families will be able to absorb the growing problem without support. Such children are less likely to attend school and are far more vulnerable to exploitation, as child prostitutes, child soldiers, street children and domestic workers” (p 204).

Much of this analysis of how AIDS can impair human and social capital is of relevance to CC, which is likely to have similar and in some cases synergistic consequences.

*Our Common Interest* also cites the work of the Commission for HIV and Governance in Africa (CHGA). This high level Commission classified Africa’s struggles as having four main complex and interlocking causes: *political*, *structural* (including fragmentation, transport costs, and the roles of agriculture, manufacturing, and services) *environmental and technological* (including CC) and *human*, (including health) (p 106).

This analysis, by mentioning environmental and human as two of four major interlinked causes for African under-development thus implies the HACC. Again, there is again no explicit discussion of this complex in the Commission for Africa’s report.



## AIDS AND CLIMATE CHANGE: two long wave issues of global importance

The distinctiveness of HIV is highlighted by several factors. One is its protean clinical manifestations. Because the virus compromises the immune system, its victims present with a wide range of associated diseases, from “slim disease” to pneumonia, Kaposi’s sarcoma and HIV associated dementia. There is an important interaction between HIV and tuberculosis (TB), itself a disease with many disguises and which in some cases may intensify in distribution because of a CC-related increase in crowding, poverty and an impairment of health services. Many patients with HIV develop active TB. More cases of active TB are likely to mean more transmission of this bacillus, to populations with and without HIV. This is also of relevance because of the increasingly high rate of multi-drug resistant TB, including among populations where HIV is common, such as in South Africa. [30] Increased TB will exert an additional economic and public health burden.

HIV is well recognised to exert a profound social and economic effect in vulnerable populations, with or without co-existing TB, through its disproportionate impact on young adults, including many who would otherwise be highly economically productive. Though several other infectious diseases, including lower respiratory illnesses (LRIs), diarrhoea and malaria are also responsible for a high burden of disability-adjusted life years (DALYs), these mainly affect young children and infants. While it is well recognised that these diseases (especially malaria) also impede economic development [31] and cause profound human suffering, their social and economic burden is lower than from AIDS in those countries with a high incidence and prevalence of HIV.

MacKellar [6] points out that, based largely on the availability of cost-effective means of HIV prevention, the Copenhagen Consensus of economists rated slowing the spread of HIV as the highest-priority intervention for sustainable development. [32] MacKellar also points out that the special status given to HIV was made explicit by the WHO Commission on Macroeconomics and Health, which described the epidemic as a “distinct and unparalleled catastrophe” requiring “special consideration.” He further states that this view was bolstered by the joint World Bank–International Monetary Fund Development Committee (2003), which in a survey of global public goods identified HIV control as an area “especially” in need of attention and action.

In addition, the defining characteristic of HIV – its immunodeficiency – may have provided a pathway for the emergence of many other infectious diseases. Jones et al [23] speculate that the emergence of HIV contributed to the high rate of emerging infectious diseases, which they found peaked in the 1980s, the decade in which HIV started to affect large numbers of people.

Climate change might also be considered another “charismatic” global problem. It too has protean manifestations, including heatwaves, changed distributions of insects and

the diseases they sometimes bear, altered patterns of drought and storm frequency and severity, sea level rise, increased oceanic acidity and changes to food security, through many pathways. Like AIDS, CC is increasingly recognised as likely to impair governance and development on local, national and regional scales. [33] Though one of only many environmental challenges, CC interacts with many other environmental problems, including regional water scarcity, food security, declining biodiversity [34] and depletion of the stratospheric ozone layer. [35]



**Drought and storm frequency.** - Photo: Nexus7/Deramstime.com

The AIDS epidemic and CC each arouse substantial global anxiety. However, while concern over CC is increasing, anxiety about HIV may now be in decline, particularly due to the development of effective anti-retroviral treatment (ART). Mackellar [6] postulated a “fear factor” concerning HIV. He describes this as the concern in high income (donor) countries that the epidemic may affect their own populations if not controlled elsewhere. Similarly, wealthy countries and populations are starting to perceive that they may also be vulnerable to CC, although there is a wide-spread consensus that poor populations are far more at risk.

The AIDS epidemic and CC share three other similarities. First is the lag between impact and infection or in the case of HIV, initiation, and an ecological dimension. The delay between HIV acquisition and diagnosis has served to obscure individual and community recognition of the infectious nature of the disease and to foster community confusion and denial. Similarly, the decades-long gap between the recognition that the atmospheric concentration of GHG was altering [36] and the evidence for significant climatic change caused widespread uncertainty, and also contributed to the powerful forces which deny the reality of CC, and which attempt to discredit its proponents. [37] Secondly, the HIV epidemic has important inter-generational social consequences. In some cases the population pyramids of nations have been altered, with far-reaching consequences.

Hundreds of thousands, or even millions of orphans have been raised by their grandparents, people in turn whose own children died mainly of AIDS. If these orphans go on to acquire HIV then the supply of future grandparents will be much diminished, with uncertain but likely adverse consequences for human capital as the upcoming generation will have an insufficient social security network to rely on.

These issues also share an important ecological dimension. Goudsmit [38] argues that “instability” of the African environment was a major factor in the rise of today’s AIDS epidemic. He extends the consensus view that the viruses which led to HIV were originally transmitted into the human population because of close contact with bushmeat [39, 40] to suggest that human-caused reductions in the populations of non-human primates may have led to evolutionary pressure for HIV viruses to mutate and thrive in the human population. The scale of the HIV epidemic also has important ecological consequences, including through effects upon land use as a result of actions such as land development that favours informal dwellings due to decrease in household income [41], the results of impaired governance linked to human resource challenges caused by AIDS, and, through these, a possible increased vulnerability to the impact of CC. Climate change also has many important ecological consequences, including for land use, biodiversity, marine ecosystems, i.e. fisheries, corals, krill and consequent to increased oceanic acidity. [42]



## HIV AND CLIMATE CHANGE COMPLEX: food security

We identify regional and global food security as of crucial importance in linking CC and AIDS. The harmful impact of HIV upon regional agricultural capacity, especially in SSA is now well understood and documented. [43-45] In 2003 de Waal and Whiteside [45] called this “the new variant famine hypothesis”. They argued that the widespread food crisis in sub Saharan Africa (SSA) in the early 2000s could not be fully explained by the region’s periodic droughts (whether or not the frequency or severity of these droughts is changing). Instead, they proposed the high prevalence and incidence of HIV as an overarching reason to explain these changes. They suggested that the AIDS epidemic accounts for why many households are facing food shortages and have difficulty recovering from droughts. They identified four new factors: (1) household level labour shortages due to adult morbidity and mortality and a rise in numbers of dependants; (2) loss of assets and skills resulting from increased mortality; (3) the burden of care for sick adults and children orphaned by AIDS; and (4) vicious interaction exists between malnutrition and HIV. We agree that these feedbacks and links are highly plausible connections between HIV, regional agricultural productivity, and regional food security. According to the IPCC, there have also been several important climatic changes in SSA in recent decades. These include increased interannual rainfall variability since 1970, with higher rainfall anomalies and more intense and widespread droughts. In some parts of southern Africa (e.g., Angola, Namibia, Mozambique, Malawi and Zambia) a significant increase in heavy rainfall events has also been observed together with evidence for changes in seasonality and weather extremes. [46] These changes are consistent with anthropogenic CC, and it is likely that these trends will intensify. Thus, while much of the recent deterioration in food security in SSA is attributable to “new variant famine” it is likely that a part is also attributable to CC. Global food insecurity is also of increasing relevance to these issues.

### Regional Food security

There are many problems and threats to regional food security, but among these the role of CC is increasingly recognised and steadily expanding. Any fall in regional agricultural productivity is of concern. Direct consequences include poverty among farming populations, and high food prices, hunger, undernutrition, fatigue and impaired immunity amongst the general community. Food insecurity can easily trigger food riots and, if prolonged, political unrest and population movement, as migrants search for employment and to secure remittances for the population remaining at home. Undernutrition can help lock in poverty. Such factors – worsened poverty, undernutrition and population displacement – are likely to increase the burden of HIV among populations which harbour the virus, and whose norms, customs and culture increase the risk of transmission. [47] Lack of food can also enhance gastro intestinal side effects of some ARVs, and may thus inhibit proper treatment.

The increased progression of HIV to AIDS and of AIDS to death due to under-nutrition is well documented:

“Adults living with HIV endanger their health by going hungry. Many types of nutritional deficiencies suppress the immune system, and hence make infections more virulent. This is true of HIV, which replicates most rapidly in malnourished individuals, hastening progression from HIV to AIDS. HIV-positive status inhibits absorption of nutrients, and the body’s needs in fighting the infection are considerable. [45]

While the earlier belief that people living with HIV have higher protein requirements has been disproved, they still need about 15% more energy. For children living with HIV, energy requirements are as much as 50-100 % higher than normal. Good nutrition helps people living with HIV to resist opportunistic infections, which is particularly important in resource-poor settings where preventive health care services are limited. Malnutrition restricts the physical activity of HIV positive people, reducing their ability to work, which in agrarian economies lowers agricultural output, illness and death of agricultural workers, which in turn diminishes their contribution both to the household income and to the wider community. [48] Less well documented is whether under-nutrition may lead to a greater risk of HIV transmission in any unprotected sexual encounter. [49];

## Climate change and regional food insecurity in Africa

Many African countries are projected to experience a fall in cereal production potential because of CC. Over 85 million people are already undernourished in Africa. Over the past 30 years, rain across the Sahel has declined by 25%, contributing to hunger and conflict, from Niger to Darfur and across to Somalia. [50] Most, if not all, of sub-Saharan African (SSA) countries, however, operate well below their existing production potential because of a range of factors, mainly political and economic. These countries could potentially increase their food production with improved policies and practices - the extension of the “Green Revolution” to rural Africa. [51-53]

The 2007 IPCC report and a recent report from a UN Framework Convention on Climate Change workshop each project continued drying of (SSA) with mounting effects on health, crop yields, livelihoods, refugees, and conflict. [50] To this list of problems, we add AIDS.

## GLOBAL FOOD INSECURITY: climate change and AIDS

While CC and other factors are likely to lead to problems with regional food insecurity, local and regional health is also strongly influenced by global issues affecting agriculture, food prices and climate. In February 2008 the World Food Programme (WFP) warned that rising food and commodity prices meant that its fight to end undernutrition would have to be scaled back. [54] This UN agency now provides food to more than 90 million people worldwide including to many refugees. It also has an increasing role in development, for example through a school feeding programme, which reaches more than 21 million children in 74 countries. [55]

In 2008 the WFP director, Josette Sheeran, wrote: “

We could now be facing a perfect storm of challenges, including CC and increasingly severe droughts and floods, soaring food prices and the tightest supplies in recent history, declining levels of food aid, and HIV, which also aggravates food insecurity”. [56] Since then the WFP has warned that rising food prices constitute a “silent tsunami” which threatens to force an additional 100 million people into hunger.



**Agriculture.** -Photo: Uros Ravdar/Dreamstime.com

The rising world price of food is already harming refugee health. The supply lines of grain to the refugee camps in Darfur have been compromised, due to the value of the cargo. [57] Worse nutrition will increase the burden of HIV in affected camps, although the extent can be partially offset by customs, norms, health services and preventive

strategies. In 2008 the head of the International Food Policy Research Institute (IFPRI), Joachim von Braun, attributed 80% of the recent rise in food prices to increased global demand, mainly from increasingly wealthy populations in developing nations and the increased competition for food from biofuels. But von Braun also recognised the role of increasingly erratic weather and commented that, while currently small, the “CC factor” is “bound to get bigger”. [54] In contrast, Lobell and Field [58] argue that the negative impacts of climate trends on crop yields at the global scale can be detected since 1981. They conclude that since then, warming has resulted in annual combined losses of wheat, maize and barley representing roughly 40 Mt or \$5 billion per year, as of 2002. They also point out that these impacts are small relative to the technological yield gains over the same period. It is likely, however, that there will be increased divergence between these technical gains and the future harmful effects of CC, at least in those areas which are currently the major producers of grain.

Until very recently, the potential impact of CC on *global* food production has largely been seen as either unproblematic or an issue likely to be of concern several decades in the future. Early modelling work on CC and food security essentially predicted a world of winners and losers, but one in which the winners (high latitudes) would balance the losers (eg SSA and some equatorial regions). [59, 60] In these optimistic scenarios, CC would open up new swathes of agricultural territory, for example in Russia and Canada, which would balance any shortfall in China, India or Africa. At the same time, the “carbon fertilisation effect” (the theoretical enhancement of photosynthesis because of an increased concentration of carbon dioxide (CO<sub>2</sub>) was predicted to help overcome any decline in food yield, [61] whether due to warmer nocturnal temperatures, [62] more intense rainfall leading to increased waterlogging [63] or more droughts. When this work was collated and reviewed, bodies such as the first three working groups of the IPCC [58] and even the Millennium Ecosystem Assessment found little need for short term worry. [64] Indeed, the slowness of the global scientific community to appreciate the potential severity of CC and food security illustrate the scientific reticence which Hansen discusses concerning the gravity of sea level rise [65] and other forms of dangerous CC. [4]

The rising cost of food, irrespective of any decline in regional food security, has important implications for HIV affected populations. Rises in the price of food will harm most poor populations – with the important exception of the farming community, including within HIV-affected areas of Africa – if they are able to still grow a crop. But while some farmers and rural communities may improve their income due to CC there is wide consensus that such areas and groups will be the exception in Africa. [46, 50]

## CLIMATE CHANGE, INFECTIOUS DISEASE AND AIDS: vector borne diseases

Climate change is predicted to alter the distribution of several parasitic and vector-borne infectious diseases. In turn these changes will alter the epidemiology of HIV, and vice versa. Changes in temperature and rainfall patterns, including increased variability of rain, are increasingly being observed in Africa, including in parts of the African highlands. Though multifactorial, and controversial [66] there is growing consensus that these shifts are implicated in the more frequent outbreaks of epidemic malaria which have been observed in several parts of Africa in recent years). [67]

Populations traditionally free of malaria are at particular risk, due to their immunological naïveté. [46] Millions of people currently live in the plateaus and mountains of sub-Saharan Africa, largely unaffected by malaria, but with a high rate of HIV. While there are also some parts of Africa which may experience a lower rate of malaria due to CC [21] in the main they also experience a lower rate of HIV, due to different norms, customs and behaviours. [68, 69]

An important interaction exists between HIV and malaria, itself a leading cause of lost DALYs, ranked as having the fifth highest BOD among the infectious diseases, and responsible for about one third of the BOD of HIV. A harmful interaction between malaria and HIV was first reported in multigravid pregnant women in the late 1980s. [70] Since then, after initially conflicting studies, evidence has accumulated of a biologic and clinical interaction between HIV-1 infection in adults and children on malaria. [70]

In malaria-endemic SSA approximately 25 million women become pregnant each year. The vast majority of these women will have survived earlier episodes of malaria, and thus have some immunity. However, during pregnancy, this immunity wanes, thus enhancing the risk of infection with malarial parasites, including the most severe strain, *Plasmodium falciparum*.

The population attributable fraction due to HIV on maternal malaria in SSA has been estimated as 4.8% (95% confidence interval 3.9% – 5.8%). This translates to an additional number of malaria cases during pregnancy (because of HIV) of approximately half a million annually. [70] This interaction is bi-directional. That is to say, while HIV worsens malaria, untreated malaria infection can increase the HIV viral load. Children born to mothers co-infected with HIV and malaria are at a higher risk of placental malaria [71] and adverse birth outcomes. [70] Unfortunately, it is still uncertain if malaria infection increases the probability of mother to child transmission of HIV. [71]

Tanser et al [27] concluded that there is a potential increase of 16-28% in person-months of exposure to malaria in Africa by 2100, on the assumption that future climates fall within simulated ranges. They argue that this is also of concern because social conditions

and inadequate health infrastructure are likely to facilitate this rise, compounded by deteriorating malaria control programmes and possible links between HIV and malaria. [72]

In summary, CC is likely to increase the burden of malaria in some parts of Africa, and this is likely to worsen the impact of HIV. However it is still unclear whether this will directly increase HIV transmission (i.e. from mothers with HIV and malaria to children). In those parts of SSA with a high prevalence of HIV the BOD of malaria will also be higher. If the CCs enough to enable malaria transmission in densely populated highland cities, which are currently mostly malaria free, then the total BOD will be more than from malaria alone, due to this interaction with HIV.

### Other climate change-sensitive infectious diseases

It is well understood that that infection with some parasites and infectious agents other than malaria can also exacerbate or accelerate the progression of HIV infection. Some of these co-infections are also sensitive to CC. For example, leishmaniasis, a parasitic disease transmitted by the bite of sandflies, is an increasingly common cause of death in AIDS patients in parts of Asia, Europe and Africa where the parasite is present. [73] Changes in climate and other environmental conditions may alter the distribution of the sandfly (*Phlebotomus* spp.) host, potentially increasing the risk of co-infection of HIV patients in new areas. Similarly, in China, infections of schistosomiasis appear to be increasing, after many years of success with control programs. [74] This may be linked to CC, as distributions of the snail host of *Schistosoma japonicum* appear to have moved northward, correlating with warmer winter temperatures. [75] Evidence suggests that infection with *Schistosoma* spp. can also increase the susceptibility and progression of HIV. There is a considerable overlap of parasitic and other infectious diseases with HIV in many developing countries, particularly in Africa.

Infections caused by soil-transmitted helminths are the most common infections in the world and they weaken the body's resistance to other diseases [76], yet little research has been done on the effect of climate sensitivity in them. However, these organisms have a free-living larval stage, dependent on temperature, rainfall and soil moisture for survival. Variations in these climatic parameters may thus allow worms to survive in new areas. The KwaZulu-Natal area of South Africa has a higher prevalence of hookworm on the coastal plain, attributed to temperature, soil type and rainfall, but prevalence decreases as altitude increases. [77] This distribution may alter, if the climate becomes warmer and wetter in the higher areas. HIV may interact differently in patients with no inherited immunity to helminths and other pathogens.

## AIDS AND CLIMATE CHANGE COMPLEX: governance, conflict and poverty

The third major pathway which we identify as operant within the HACC is the most contentious and difficult to demonstrate. This concerns the complex multidirectional inter-relationships between CC, poverty, inequality, governance, migration, conflict and other social phenomena. We regard this area as an important topic for ongoing research.

Both adverse CC and AIDS bear on the risk of conflict, and also on the quality of governance. Resource scarcity, poverty and inequality are also central to these arguments. The BOD of AIDS is greatest among populations that are financially and materially poor on a global scale, particularly in SSA. Before that, we discuss the vexed relationship between poverty, wealth and HIV infection. We also introduce the concept of the “claste” system – a classification of the global population into four groupings, allied systemically but largely accidentally by complex economic, social and financial economic groupings. [78]

The aetiology of human conflict and displacement is complex, and theories which give preference to any single element should be regarded with scepticism. Factors which workers have identified as important contributors to conflict include governance, corruption, leadership, [79] poverty, [80] greed, inequality, ethnic division and political manipulation, human territoriality, youth bulges, [81, 82] epidemics and resource scarcity [83] – including that likely to be precipitated in many regions by CC. Apparently paradoxically, resource abundance has also been claimed to contribute to conflict, through the so called “honeypot effect” or “resource curse”. [84]

Some demographic factors also play a role in the causation of conflict and the quality of governance. High rates of population growth are generally associated with impaired development [85, 86] and with a reduction in per capita wealth, and this can increase the risk of conflict. “Youth bulges” – high numbers of un- and under-employed young men – are also causally related to conflict, not only because their presence is associated with poverty, but also because young men are comparatively easy to manipulate, and are more prone to violence. [81]

The crisis in Darfur, Sudan, which has created thousands of refugees, has a complex causation of ecological, climatic and political factors, [87] including, perhaps, anthropogenic CC. [88] Without compensatory improvements (such as from technological innovation, foreign aid or cash remittances) these factors are likely to reduce per capita wealth, thus increasing the risk of conflict.

In some populations the scale of the HIV epidemic has markedly reduced human capital, through means such as the deaths and illness of knowledge-holding adults with skills, from farming to teaching. Piot describes how in the first 10 months of 1998 Zambia lost

1,300 teachers from AIDS, the equivalent of about 2/3 of all teachers trained annually. [89] This loss also means a fall in the average age of teachers and other knowledge-holders, leading to qualitative as well as quantitative declines in teaching capacity. Substantial knowledge is also lost due to skilled out-migration.

Though impossible to accurately measure it is likely that human capital in societies which are severely affected by AIDS has declined. This then is likely to worsen the quality of civil society, and in some cases this may lead to clearly worsened governance and increased corruption. A high rate of AIDS is likely to reduce the incentives as well as the resources to invest in education, also due to the decreased life expectancy of many students. This AIDS-assisted decline in human capital and civil society may have been a factor in the economic and social collapse of Zimbabwe, although a parallel fall in governance has not been observed in Botswana, an adjoining nation with a similarly high AIDS incidence.

In summary, the confluence of reduced natural and physical capital due to CC is in some cases likely to worsen per capita poverty. Conflict on a sufficient scale can itself cause additional harm to natural, physical and social capital. In some cases this decline in multiple forms of capital may be exacerbated by enhanced HIV transmission. Beyond thresholds of decline these adverse effects are likely to become self-sustaining or "locked in" for prolonged periods, even for generations.

## Poverty, wealth, inequality, HIV and the global caste system

The discussion concerning poverty and HIV has of late become heated. [49, 69, 90-94, 95] We believe that much of this tension is unnecessary. There is truth to both sides of the argument, and we suggest that the arguments are more complex and nuanced than partisans may think.

Neither poverty nor wealth is necessary or sufficient for an individual to contract HIV in any country. Having said that, in almost all countries, individuals who are materially and financially better off will have disproportionate access to health services, treatment and knowledge. As a rule they will also be more assertive and have greater "entitlement". [96] It is also true that in the first 15 years of the global HIV epidemic the lion's share of attention, resistance and reaction to the epidemic occurred in and was driven by its rapid spread among an articulate, well-educated and comparatively affluent minority in the US – by far the most powerful and rich large country in the world.

But in the late 1980s and through the 1990s, activists in the North, [9] together with scientists like Jonathan Mann gradually realised the devastating scale and immense human suffering wrought by AIDS in parts of SSA. At that time, on a global scale, very few Africans – especially black Africans – had the material and other resources to be categorised as part of the first or second global "castes", the economically linked coalition of about a billion people who have access to most of the world's material and human resources. [78]

At that time, the epidemic nature of HIV was mostly confined among members of the global third caste. This group can be conceptualised as forming the bulk of the world's population, numbering at least four billion people in 2000. Most of this caste are working, or are the dependents of working people. Included in this group are poor



farmers, men economically forced to live in camps to work in South African mines, truck drivers in the South, many sex workers, the “floating population” of China [97] and the enormous numbers of expatriate construction workers, seamen, maids and others, whose remittances are so vital for many in the South. Few in this claste are undernourished in terms of protein or energy. This fate would place them in the fourth claste, whose numbers exceed 800 million.

Of course, within the third claste there still exists a vast divergence of wealth and power. In general women in the third claste are less powerful than third claste men. The claste analysis is important not only to understanding the debate about poverty, wealth, inequality and AIDS, but also about CC, human well-being and “environmental brinkmanship”. [78] These aspects will be returned to.



**Woman in impoverished countryside in Asia.**

*-Photo: Nikhil Gangavane/Dreamstime.com*

As a general rule, people in the second claste exist in a milieu of similar people whose lives, social networks, education, entertainment and media feedback emphasise, provide and reinforce daily issues relating mainly to the second claste. Second claste people dominate the countries of the North, whose governments in the main, have for more than a generation shamelessly broken their pledges to allocate 0.7% of their income to overseas development. [98] These pledges have been ignored because these governments know that the vast majority of their second claste supporters have no genuine interest in seeing the South develop.

We are not claiming that second claste people are intrinsically selfish or morally flawed, in comparison with any other group, but rather that they inhabit a world in which the reality and problems of the two poorer castes are largely invisible. But there are exceptions, not only in the second but also in the first claste.<sup>3</sup> Activists from both castes have been vital in recognising and starting to address the global importance of both AIDS and CC.

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<sup>3</sup> The first claste are that tiny fraction of the global population whose wealth or status give them extraordinary influence – examples include Ted Turner, Bill Gates, Queen Elizabeth II and the Pope.

HIV infection among adults in nine countries of SSA still exceeds 12%. [69] In contrast the rate in the US has never exceeded 1%. (UNAIDS/WHO. Report on the Global HIV Epidemic, June 1998, cited by [99]) That HIV is related to poverty at the global scale [92, 93] is also shown by the effort which has gone into fundraising for AIDS over the last two decades, and the slow spread of global ARV therapy. Indeed, even Epstein and Halperin, two of the leading critics of the argument that AIDS is related to poverty concede that “very few (of the people with AIDS in Africa) are “rich” by western standards” (quotes around “rich” in original). [94] If this statement is true of “people” then it is even truer of countries – none of these countries in SSA are “rich” by western (i.e. Northern) standards.

However, it is also true that relative national poverty is insufficient to drive large scale AIDS epidemics. Other factors are clearly needed, and the low rate of male circumcision and the high rate of concurrent sexual networking in SSA are the most likely plausible candidates. [47] In such countries, inequality is also important. Material poverty at a national level is likely to also drive the epidemic on the scale seen in SSA, by impeding the nimbleness and self-organisational capacity needed to thwart this. [100]

If the reader needs further convincing, recall the comparatively rapid and effective response to HIV within highly sexually active gay populations within the North. While campaigns to reduce sexual networking have been tried in the South (notably Uganda, Kenya and eastern Zimbabwe) [47] they have not yet been pursued with the required vigour and success. [69] This is for many reasons, including some which are highly correlated with poverty, such as fatalism. [101] Not before time, such fatalism appears to be changing, at least in some countries of SSA. [102]

The above arguments reveal very little about the distribution of HIV risk and HIV burden *within* the third claste. There is increasing recognition that the distribution among the comparatively poor global strata that disproportionately carry the burden of HIV is itself skewed. [49] But to argue that within the third claste it is the poorest fraction that experiences the highest or lowest risk of HIV infection may itself be simplistic. [90] For example, among Kenyan women, the HIV prevalence in the highest quintile has been shown to be over three times that of the lowest quintile. [82] It is possible that some of the poorest quintile in Kenya can be classed as part of the fourth global claste, and that the burden of HIV within the fourth claste is relatively less than within the third claste.

Within the predominantly heterosexual epidemic in SSA there may well be a general principle that it is the comparatively mobile and well-off people who are at higher risk of acquiring and disseminating HIV. This population constitutes a large fraction of the global epidemic and this is an important qualifier. However, this assertion warrants further analysis. Millions of people have already died from HIV in SSA. Of the people in SSA with HIV in 2008, it is likely that those who have survived with the disease for the longest time will be disproportionately better off, constituting a form of survival bias.

The situation for the third claste population outside SSA may be even more complex, due to different dynamic factors that drive the epidemics. Some of these factors, such as circumcision status are unlikely to follow an income gradient. While the duration and frequency of concurrent sexual relationships may be positively correlated with income, there is as yet no evidence that these factors are sufficiently common to drive a large scale HIV epidemic in populations outside SSA. [47] It seems also plausible to argue

that there are many sub-populations within the third claste beyond SSA who actually are disproportionately poor, including some IDUs, some sex workers and the “bloodheads” of China. As Wellings et al ask: “the crucial question (is) not of who is buying the sex, but of who is selling it. The answer, for the most part, is poor women.”[93] Finally, HIV is a condition which impoverishes families and communities, even if some of those who acquired it were once comparatively well off citizens in a poor country.

## Population displacement, migration, refugees and HIV

There is wide agreement that CC will create many new migrants and refugees, [103-105] through several mechanisms, including an increased and changed frequency, severity and distribution of severe storms, [106] droughts [107] and floods. [108] Sea level rise perhaps captures the public imagination more than any other single manifestation of CC, because of its obvious potential to disrupt coastal infrastructure, to flood low lying fertile areas, to contaminate fresh water lenses in coastal islands and, in some cases, to obliterate entire island nations. Although concerns of catastrophic sea level rise in this century have long been raised, [109] the consensus view until very recently has been that substantial sea level rise is more likely to be a problem for the 22<sup>nd</sup> rather than the 21<sup>st</sup> century. Unfortunately, this is no longer the case. Sea level is rising faster than the worst-case scenario of recent IPCC forecasts. New understandings of ice shelf dynamics are making more scientists worried about a much faster reduction in the size of the Greenland and Western Antarctic ice shelves. [65, 110]



**Floods.** -Photo: UNCHR/B.Bannon

These elements, aggravated by and interacting with food insecurity and increased poverty, are all likely to reduce available health services and to cause temporary and sometimes permanent population dislocation. It has long been considered plausible that these combined factors will accelerate the progression of HIV, and also lead to many new infections – especially in populations which have significant baseline epidemics, or whose social and/or economic characteristics are more conducive to dissemination of the virus. But studies into the relationship between extreme weather events and HIV are difficult to

conduct, and are done infrequently. To date, we have found little evidence that HIV rates have increased after emergencies, such as Hurricane Mitch or the 2000 Mozambique floods.

Following the devastation wrought by the 1998 Hurricane Mitch, which claimed at least 11,000 lives [111] NGOs were reported as suspending their HIV-prevention programmes, providing shelter and food instead. One of the affected countries, Honduras, already had one of the highest number of adult HIV infections in the region. The country's health infrastructure was severely damaged, and the number of women and children in sex work increased, and sexual violence was reported to have "soared". [112] Yet to date we have no proof that HIV rates increased in these Central American nations, though a modest increase because of remains plausible.

Similarly, three reports have recently been published by the Overseas Development Institute in partnership with WFP and UNAIDS. These have investigated the impact of emergencies (respectively flooding, storms and chronic drought) upon people living with and affected by HIV and AIDS. These studies were conducted in Mozambique, Haiti and northern Kenya. [113-115] Consistent with the reports following Hurricane Mitch, all of these studies reported increased transactional sex and vulnerability. In Haiti increased promiscuity was also observed among people displaced by storms. But, again, none of these studies showed evidence of increased HIV transmission, although in Mozambique a comment was made that any increase in HIV, were it to occur, would be difficult to confirm because of poor record keeping. [114]

The question of migration and the spread of HIV is also contested. The 2008 World Disasters Report contains a comprehensive discussion of the geographically and occupationally complex relationship between migration and HIV. Migrants often experience the xenophobia of their receiving populations. Elements of this fear and stigmatisation can extend to a belief that migrants introduce HIV. In fact, the reality is often the reverse, [116] particularly for highly vulnerable trafficked populations. [28] However, in some countries with relatively low HIV prevalence (such as Bangladesh, Pakistan and the Philippines) *returning* migrants have been found more likely to have HIV than the local population. [28] Even if returning migrants do sometimes carry HIV, the characteristics of the majority populations in such countries mean that this is unlikely to have a significant population health effect since travel and migration by HIV-infected people in itself doesn't pose a public health risk. That is to say, even in these cases, returning migrants who are infected should not be stigmatised as placing population health at high risk.

### **Does violent conflict fuel more HIV?**

Another contested area relates to conflict and HIV. Above, we have concluded that CC is likely to increase the risk of conflict. But does conflict increase the transmission of HIV in populations already affected by HIV? Similar to the case following refugee-producing extreme weather events, many authors and organizations have made this general claim. [28, 117, 118] This claim has seemed plausible through several putative mechanisms, including the breakdown of law, order and health services during conflict, increased migrant and refugee populations and the likelihood of increased transactional sex, including within refugee camps. Rape is also frequently employed as a weapon of war, and there are concerns that rape is also an important source of increased HIV spread.

However, the evidence supporting a substantial increase in HIV due to these mechanisms is contested. O'Hare and Southall examined child and maternal mortality data for 42 countries in SSA. [119] They found that health was substantially worse in those countries affected by recent conflict, but they made no comment on HIV rates. Other recent work, especially by Paul Spiegel and colleagues has challenged the previous claims that conflict and rape fuels HIV. [118, 120] Plausible reasons proposed for this apparent paradox include reduction in mobility and accessibility of populations (e.g. night-time curfews, less movement on the road) and other means that might reduce casual sexual activity, and the disproportionate numbers of women and girls in refugee settings. In addition, most of the perpetrators of conflict-associated rape are young, live in rural settings, and probably have a low prevalence of HIV infection. [121]

The long term effects of conflict upon HIV transmission are less certain. Jewkes points out that experience in South Africa and Mozambique suggest that there could be substantial risks of HIV spread during the phase of post-conflict reconstruction. She also speculates that the exposure to trauma in childhood might result in increased use of violence, including sexual violence, in later years as well as additional sexual risk-taking. [121] The co-existence of the hotspot of HIV in SSA and the hotspot of conflict in SSA may have common and interacting roots. Finally, new problems can always arise. For example the supply of anti-retrovirals to thousands of HIV patients in Kenya was threatened by the prolonged violence which followed the elections at the end of 2007. In this case, rapid and co-ordinated action by non-government organizations and the Kenyan government minimised the harm. [28] Such responses are not guaranteed. The possibility that future emergencies, including conflict, could increase the HIV burden, especially if the scale of conflict reaches a sufficient threshold, should not be discarded.

### **Summary: CC, emergencies, conflict and governance**

To date, there is little evidence that CC has aggravated HIV transmission and there are limited data to support the hypothesis that future emergency, conflict and migration related consequences of CC will aggravate AIDS. Yet this should not cause complacency. The provision of HIV treatment and the spread of knowledge and behaviour affecting HIV transmission will always depend upon governance and civil society. Climate change, interacting and co-evolving with other factors, has the potential to disrupt future governance and civil society beyond critical thresholds, which could in turn increase HIV transmission. These thresholds have not been passed. This could change.

### **Gender inequality, climate change, and HIV transmission**

In many modern populations HIV disproportionately affects young and poor women. Many women are at increased risk of contracting HIV because of biological and cultural factors. These include patriarchal values through which some men feel "entitled" to sex, and the lower social, economic and power status of most women compared with men. [122]

The overall fraction of infected women alive in SSA in 2007 was reported by UNAIDS as 61%, [123] and there are claims that in some SSA populations the ratio of young infected women to young infected men is as high as three to one. [114] Globally, UNAIDS reports

that the number of infected men equals the number of infected women, at 15.4 million. [123] This implies that among adults living outside SSA only 27% are to women.

In many developing countries women become infected with HIV at younger ages than men. The disproportionate lack of education available to women and girls in many cultures is both a manifestation and powerful contributor to female vulnerability, including, in some cases, to the acquisition of HIV. In its simplest form, girls are often removed from school, (especially in developing countries) to care for sick family members, or to take the role of a deceased or incapacitated older woman. This lack of education then restricts their future educational and economic prospects. Knowledge about HIV is an important means by which women can protect themselves from the disease. [122] In contrast, little general education, especially one in which functional literacy is not attained, reduces the capacity for further self-education, including for health education.

Poor education also reduces individual and community receptivity to many forms of modern knowledge, and this likely includes the means of transmission and prevention of HIV, especially where this knowledge clashes with "common-sense" cultural beliefs [124] transmitted by respected individuals or groups. In turn, poor education and the resultant privileging of traditional beliefs slow the dissemination of new ideas and values, thus ensuring that older beliefs are transmitted to future generations. While in many cases reverence for ancient beliefs and values is socially protective, this is not always so. Some ancient beliefs can help to perpetuate cycles of poverty, disease and discrimination, including against women and girls.

The need to provide sex in exchange for money, shelter or temporary protection clearly exposes women to an increased number of partners and this may enhance HIV acquisition. And, even if the means to reduce the risk of HIV transmission are available, known, understood and wanted by the female partner, gender inequality can still mean that women lack the bargaining power to ensure their use. [122, 125] In some cultures and societies, including in parts of SSA, young women are also culturally exposed to partnerships with older men, who are likely to carry and to transmit HIV at a higher rate than young men. [126] Any situation of conflict increases the risk of the sexual transmission of HIV, including via rape, which is often used as a weapon of war. [112] In these situations women are rarely able to negotiate the conditions of safe sex, and in some populations this increases their risk of contracting HIV. In some countries, HIV infection rates among the military are up to five times higher than in civilian populations, even in peacetime. In the 1990s conflict in Bosnia, up to 40,000 women were raped. Studies show that soldiers and men in these situations no longer feel bound by social conventions, making them a threat to the occupants of refugee camps (up to 95% of whom are women and children) where they may work as guards.

Peacekeeping efforts have sometimes been reported as leading to vulnerability to HIV transmission. For instance, in the UNTAC peacekeeping mission to Cambodia between 1991 and 1995, local NGOs reported that sex workers doubled their nightly number of customers. Studies of returning Uruguayan and American soldiers showed they were infected with a particular sub-type of HIV found only in South-East Asia and Central Africa. [112]

A specific example of the link between poverty, gender and HIV comes from the Nkhota-kota region, on Lake Malawi. This region has a strong 'fish-for-sex' culture, whereby male fishermen often use sex as a bargaining tool. Women consider sex as an economic necessity in order to obtain food and resources for survival, both of which contribute to having direct implications of HIV infection rates in this area. [125] Another example of a culture of transactional sex is between miners, truck drivers and young indigenous women in several parts of rural Australia. Note that, as yet little if any HIV transmission has been documented through this route, presumably because the background rate of HIV in this population remains low.<sup>4</sup>

There are many plausible means by which CC is likely to reduce the average income of populations, for example because of a CC associated drought or storm. When this happens, an increased fraction of that society's women and girls are likely to be forced into transactional sex in order to survive. Of course, the likelihood and intensity of this shift will vary by the degree of impoverisation as well as culture, history and other values. But even in affluent societies, sub-populations of women are likely to exist who will be driven to increased levels of transactional sex.



**Fishing.** -Photo: Louie Schoeman/Dreamstime.com

In Lake Tanganyika fishing records indicated a 30% reduction in annual fish catch since the 1970s. [127] Most of this decline has been attributed to CC. [128] It is plausible that a variant of the 'fish-for-sex' culture described above in the Lake Malawi area also operates around Lake Tanganyika, and other of the vitally important great lakes of central Africa. It is also plausible that the fish catch in these other lakes will decline, due in part to CC. Fish is a particularly valuable source of protein and fatty acids. Any decline in the economy and in nutrition is not only likely to aggravate existing gender inequality and HIV transmission in the African great lakes, but could also trigger conflict in this densely populated and volatile central African region.

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<sup>4</sup> Probably too, less of this transactional sex is unprotected. However it is also possible that significant levels of HIV transmission are occurring, but have as yet not been reported.

## Poverty, HIV and other transactional behaviours relevant to HIV

The multidirectional relationship between poverty, undernutrition, migration and gender inequality has been discussed above. In addition, poverty can precipitate transactional behaviours other than sex that may increase the risk of HIV transmission, such as the selling of blood and organs. In general, recipients of blood products and organs are at the highest risk, and while adequate testing should eliminate this, this is still not always true.[129] However, occasionally blood *sellers* have also acquired HIV, sometimes in large numbers. The best documented case of this occurred in China in the 1990s, when tens of thousands of people are thought to have acquired HIV because of the recycling of pooled red blood cells, following the extraction of the more valuable plasma. [130]

At least 100 million Chinese workers engage in the migrant labour market. [97] Selling blood is a popular way to make ends meet. So-called “blood heads” earn an itinerant living in the countryside, coordinating the purchase of blood from local residents for blood-products companies in the cities. Over the years, such activity has caused thousands of infections, especially in rural areas. In many poor interior counties, blood transfusions are the main cause of HIV infection. Preliminary studies indicate that specific strains of HIV follow migrant workers travelling back and forth to urban areas from such counties as Shanghai. [131]

## Climate change, intravenous drug use and HIV

There are no data to indicate whether CC may impact on the supply and demand for injectable drugs, including for heroin. While we have been unable to identify any modelling of the impact of CC on the production of the opium poppy it is probable that the climatic region suitable for its large scale growing will shift. This may *reduce* the supply of opium, because even if the geographic area where opium can be grown were to remain constant, the farming population in any newly suitable poppy-growing areas is unlikely to have the culture or expertise to foster as intensive production of opium as occurs where it is traditionally grown. Similarly, there are no data to show if CC may increase the demand for narcotics, but if this were to happen it could be via widespread social dislocation, food insecurity, poor governance, refugee camps and increased mental depression. Consistent with this speculation is the suggestion, made several decades ago by the human ecologist René Dubos that humans would increasingly seek synthetic stimulation as urbanisation increased and contact with wild nature became rarer. [132] While electronic games and entertainment are likely to partially meet this need for artificial stimulation, intravenous drug use (IDU) could also increase, bringing HIV with it. In some regions of the world the use of narcotics and IDU is more culturally acceptable, such as the Golden Triangle and North East India. These places could be hotspots for enhanced HIV transmission in a climate changed world. Again, such bleak, post-collapse scenarios may seem far-fetched. But an increasing number of scientists, writers and futurists are indeed contemplating such a future. [133-136]



## A RESEARCH AGENDA FOR EXPLORING THE HACC

It is desirable, from both a scientific and policy position, that the links between AIDS and CC be better understood and quantified. While the three main links outlined above (food insecurity, links between AIDS and CC-sensitive infections, and population displacement and governance) are highly plausible, they can at present be considered as hypotheses that are more conjectural than scientific. Furthermore, even if all three broad pathways are valid, it is likely that some elements within these categories are more important, and also more amenable to intervention.

For example, if CC increases malaria in SSA by  $x\%$  how much will this change the HIV burden? If CC increases conflict and dislocation in SSA by  $y\%$  how much will this change AIDS burden? This effort will facilitate prioritisation and maximise the use of limited resources. Should preventive strategies which seek to identify cost effective interventions to reduce the CC/HIV burden be single disease focused, multisectorial, or perhaps vary with local conditions? Progress in this research agenda will also have benefits for the AIDS and the CC constituencies, by linking the two relevant scientific communities.

We also propose that an improved conceptual understanding of the linkages between the many social factors involved in the HACC will be of broad scientific value. These factors include social factors (e.g. behaviour, values, governance and conflict), environmental factors (e.g. climate, food production, water, sea level rise) and between the two of these macro-elements. This would be best done by an interdisciplinary working group.

There are also several other, more speculative pathways which may act within the HACC. Of these, the relationship between CC, air pollution with particulates and ozone is the best documented. High temperatures have been shown to raise the levels of ozone and particulate matter, [137] particularly in areas which already have significant air pollution. Increased air pollution is likely to impair immunity, and this may add to the BOD of AIDS. A relationship between CC, heat stress and immunity is also plausible, including through a pathway of persistently disturbed sleep due to the run of night nights that occur during heatwaves, and which are particularly troublesome for unadapted populations. The inter-relationship between the HACC and emergencies is also a topic for future research.

We finally suggest that research be developed to consider and identify “hotspot” regions other than SSA that may be at special risk of HACC. Possible candidates include North East India, New Guinea and the Mekong Delta region. Regional meetings could help stimulate policy makers.



## THE HISTORY OF TWO GLOBAL MOVEMENTS: AIDS and climate change

Like all great social movements, the development of the global groups which have arisen to reduce the impact of CC and AIDS contains numerous individuals, milestones, organizations, triumphs and setbacks. The HIV movement and the CC movement have much in common. Yet, the relationship between these two movements and constituencies has been curiously muted. At a fundamental level, elements of each movement can be conceptualised as manifestation of a broader global social justice movement. This section provides an overview of these movements, some of their key actors, and seeks to show how they can learn from and help one another.

In 1983, within two year of the first reports in the US which led to the recognition of AIDS, a series of investigations was started to determine the extent of AIDS within central and sub-Saharan Africa.[138] When HIV was first described there was substantial underestimation of the potential spread and severity of the epidemic.[139] By 1986 the global scale of the epidemic was clearly recognised by some, and there were calls in the literature for “worldwide co-operation” to deal with its growing threat.[140] One of the authors of this paper, Professor Jonathan Mann, went on to become the first director of WHO’s Global Program on AIDS (GPA) and is rightly lauded as greatly raising the global profile of AIDS. But in 1992 Caldwell et al still lamented the “underreaction to AIDS in sub-Saharan Africa” [101].

AIDS activist groups formed quickly in both the US and UK. In 1987 the prominent AIDS activist group, ACT UP, held its first march in New York, and the following year saw the celebration of the first world AIDS day. Many celebrities have played an important role in demystifying and changing attitudes towards HIV. Sometimes, these roles have been conscious, such as when Princess Diana first refused to wear protective gloves when visiting AIDS patients in 1987. [141] Others events involving celebrities, such as the death of Hollywood star Rock Hudson in 1985 helped humanise AIDS, at least to Western audiences. Entrepreneurs and philanthropists have also played special roles, including Ted Turner and Bill and Melinda Gates.

However, through the 1980s and much of the 1990s, most activism against AIDS remained focussed on the epidemic within high income populations, especially the gay community in the US.[142] As one reviewer commented “People with AIDS were wealthier, better educated, more assertive and better organized than victims of many other epidemic diseases.”[143] But this description in fact applied for only a tiny fraction of the affected population at that time. Most people with AIDS were desperately poor, lived far from the US, and were becoming even poorer.

Recalling this time, Mann’s colleague Daniel Tarantola stated: “In the 1980’s, the spread of HIV .. appeared uncontrollable and seemed to create a political paralysis among health

officials worldwide. “Jonathan (Mann) determined to project an image of the epidemic that was one of a disease that could be managed, could be controlled in some ways. He defined the problem not only as a terrible viral disease, but as a social problem to be solved.”[144] But in 1990, Mann resigned as head of WHO AIDS Program in protest of what he saw as the inadequate UN response, and in conflict with former WHO Director General Hiroshi Nakajima. According to some reports, where Mann envisioned expansion of WHO’s AIDS programs, Nakajima wanted to downplay the effort.

Mann clearly understood the social and human rights aspects of AIDS. Following his premature and tragic death in 1998 at the age of 51, former WHO director general Halfdan Mahler credited Mann as laying “the foundation for the right approach to AIDS” by focusing on the human-rights and social aspects of the epidemic. [145] Mann repeatedly called for a broadening of the focus of global public health, [146] and also stressed the close relationship between the struggle against AIDS and the even broader struggle for human rights. We believe that this human rights dimension is critical to strengthening an alliance between the CC and AIDS constituencies. Like AIDS, CC threatens the health of many vulnerable populations. Universal access to HIV prevention, treatment, care and mitigation is a human rights question similar to the question on who will suffer most from climate change related adverse impacts, who will benefit from cc adaptation efforts and so on

It can be argued that activism lagged in Africa for several interacting reasons, including poverty, and lack of self-organisational skills. [100] However, denial by most SSA governments also contributed. [147, 148] Strongly held contrarian views about the causation of HIV were sometimes given undue prominence. [149] A lack of effective global leadership, especially from conservative religious groups, also contributed to transmission of the epidemic. [98, 150, 151] Other reasons includes taboos about sexuality, the cost of condoms, opportunity costs, and perhaps a feeling of embarrassment and stigma, in that it might have been more politically acceptable for some Africans to consider the disease as imposed rather than “home-grown”. But for whatever reason, this period of comparative domestic and global neglect – despite the best efforts of Mann and others – facilitated the spread of the epidemic to millions of additional people, and the wreaking of political and social havoc on so many SSA countries.

In addition, AIDS activists in wealthy countries who might have taken a more active role in Africa were, until the development of effective ART in the mid-1990s, pre-occupied with raising the alarm in the West. But perhaps when ARTs were developed they then turned some of their energy to thinking more broadly.

Towards the end of the 20<sup>th</sup> century the situation started to improve (see figure 1). Michael Merson, who succeeded Mann as head of the GPA for five years identifies several factors which converged around the turn of the Millennium, and which finally triggered the start of the necessary global response long advocated by UNAIDS. These include increased support by the World Bank, a reduced cost of ARVs (itself in large part due to activism), the example of Brazil in making ARVs widely available, the 2000 AIDS conference in Durban, and a changed attitude by some powerful religious groups, based mainly in the US, which started to support condom distribution and other sex-related prevention programs, in order to reduce the numbers of children being orphaned by AIDS. Merson also identifies the spread of HIV into Russia, China, and India which

prompted concern that AIDS could destabilize global political and economic systems beyond sub-Saharan Africa and threaten global security. [152] Of relevance to this position paper, US Vice President Al Gore, recently a co-recipient of the Nobel Peace Prize for his role in alerting the world to the perils of CC, played an important role at the UN Security Council meeting Merson does not speculate on why so many happened at once, but perhaps the hope brought about by the new Millennium also contributed.



**Al Gore chairing a session on AIDS at the UN Security Council.**

*-Photo: UN Secretariat, New York*

Several other writers have also commented on these improvements [153], including the intense lobbying from special interest groups [154] and the generosity of billionaires. [155] Steven Lewis, the UN special envoy for AIDS, has also played an important role. In turn Lewis credits the role of the former US ambassador to the UN, Richard Holbrooke. [98] However, the recent global effort has yet to live up to its full potential, partly because of a separate strategy used by the USA. [156, 157]

The struggle to combat the HIV epidemic has many similarities with the effort to avoid and now to minimise CC. Although the basic science of anthropogenic CC can be traced to Fourier, Tyndall, Arrhenius and other 19<sup>th</sup> century scientists [36] it was not until the 1970s that the global scientific community started to take CC seriously. [36] This was followed by the establishment of the IPCC in 1988, and the United Nations Framework in Convention on Climate Change (UNFCCC) in 1992. And, even now, in 2008, there is limited genuine understanding or global consensus over the importance of CC. The most significant emitter of GHG, the USA, has still not ratified the Kyoto Protocol, the global treaty which provides the first internationally binding legal step on the pathway to address CC.

This belated response to CC has many causes, including the complexity of the issue,

scientific difficulty in distinguishing the “signal” of anthropogenic CC from the “noise” of natural climate variability, and scientific underestimation of the likely speed and severity of CC. Other factors have also played important roles in this slow response, including “groupthink” of most scenario teams, which privilege Western values and hesitate to challenge the status quo. [158] Hansen has described “scientific reticence” which leads to the favouring of more conservative scenarios. [65] Disinformation campaigns by lobby groups perceived at risk of economic harm from the policies needed to slow or reverse CC have also been important. [159, 160]

Discrimination and indifference towards the population at greatest risk of CC – the poor [161] – has also been central. Although vast in number, poor populations lack the economic power to effectively lobby on a scale proportionate to their number or risk. This phenomenon is not dissimilar to those affected and vulnerable to HIV.

## EMERGING LESSONS AND OPPORTUNITIES FOR AN AIDS/CC ALLIANCE

The consequences of the delay in dealing with both AIDS and CC were apparent long ago to the activists, but in both cases too little has been achieved. In 2008, it is again possible to see how the future may unfold. Though a “fine mesh” forecast of the future is impossible, many broad principles are foreseeable. [158] And it is even now possible that prudent and farsighted action could reduce the worst possibilities for 2030 and beyond, just as visionary action in 1986 might have averted millions of deaths from AIDS, and the release of millions of tons of greenhouse gases.

A strategic approach to restoring and reinforcing connectedness between the AIDS and CC communities and constituencies is highly desirable if there is to be any chance of achieving this goal. This requires a capacity for global thinking and action, and a transformation from isolation to connectedness. It might not seem obvious, but we believe that a global alliance between the AIDS and CC constituencies will be of mutual benefit, and is likely to bring results far beyond that which either group can achieve alone, as these two groups address common vulnerabilities discussed in this paper. As yet there has been little formal interaction between these two groups. We believe that this gap is a microcosm of the gulf between two even larger communities – those concerned with the environment and those concerned with social justice. Yet, this gap also represents an opportunity, not least because each community has many actors who actually do recognise the linkages.



**HIV treatment in rural health facility.** -Photo: UNAIDS/C.Sattlberger

Despite the success of these two great social movements, AIDS and CC remain formidable problems. HIV has already killed scores of millions, while CC has the capacity to dwarf this number. Those concerned with reducing CC can apply many lessons learned by the AIDS community. Among these lessons are the need to bravely challenge conventions and to work for the benefit of the poorest and most marginalised – and to widen the CC movement's emerging engagement with entrepreneurs, philanthropists and prominent personalities, tools which have been instrumental in the growth of the HIV community. The CC community might also consider forming an umbrella UN body like UNAIDS. Alternatively, the scope of the UNFCCC might be broadened to including formal links with agriculture, health and security.

But there is an even more important reason for the AIDS and CC communities to co-operate. We perceive an important and growing risk for the CC community is that the CC discourse may be "hijacked" by a relatively privileged stratum of people and interests who are prepared to overlook the even more important issues of global health and global social justice, in the pursuit of achieving their own adaptation to CC. While an approach to CC which focuses mainly on the protection of ecosystems and infrastructure within wealthy countries may be superficially attractive for some CC activists, it poses profound risks for global health and co-operation. In the medium term it also poses enormous risks for the rich communities who seek to shelter in their sequestered worlds.

The strategy that we fear may evolve can be characterised as one of a "Security First" world, one of four scenarios foreseen by the UNEP in its Fourth Global Environmental Outlook. [162] This scenario is summarised as one which strives "to improve, or at least maintain, human well-being for mainly the rich and powerful in society. *Security First*, which could also be described as *Me First*, has as its focus a minority: rich, national and regional. It emphasizes sustainable development only in the context of maximizing access to and use of the environment by the powerful. Contrary to the Brundtland doctrine of interconnected crises, responses under *Security First* reinforce the silos of management, and the UN circle is viewed with suspicion, particularly by some rich and powerful segments of society".

In the worst case this ideology world could see an uncritical privileging of market forces, with insufficient recognition that such a world is unfair for those who lack baseline resources. In the worst case, this ideology risks the abandonment of millions, or even hundreds of millions of people to poverty, hunger and disease. [163] There are less extreme versions of this ideology, such as the promotion of biofuels as a "solution" for CC, [164] and calls to offset pipe and chimney emissions of GHG from the developed nations by halting deforestation in the South – without recognising the contribution made to Southern deforestation by wealthy countries, in the form of demand for the forest and agricultural products made possible by forest clearance.

The *Security First* world can also be analysed using the claste system. [78] In this analysis the CC crisis has largely been caused by the second claste, most of whom, until recently, lived in the North. There are four possible solutions to the problem of global CC, and to the even larger problem of adverse global environmental change, of which CC is a subset. One is that the problems have been vastly exaggerated. A second strategy is to work for impressive technological breakthroughs, enabling the continuation of the existing claste structure without global ecological breakdown. A third strategy is to reduce global inequalities, so as to weaken the tensions between populations and to

increase global co-operation. This strategy would also lead to the greatest improvement in global health, and present the best scenario for HIV control. The fourth scenario is that of *Security First*, in which the second cluste tries to defend itself from those it perceives as enemies. In the end, this leads to a lawless world outside the secured zone, an even higher cumulative carbon emission (because technological leapfrogging is abandoned), and more ecological destruction and chaos.

In 2003 Catherine Campbell published a book called "Letting Them Die: Why HIV Prevention Programmes Fail". [165] A reviewer [166] pointed out that the title of this book is from a satirist called Pieter-Dirk Uys, who wrote "In the old South Africa we killed people. Now we're just letting them die." Tens of millions of people have already died from HIV. The causes for this catastrophe are complex, but it is unarguable that much more could have been done to reduce this toll, were there the political will to provide the needed resources. In contrast, consider the catastrophe of the Black Death in 14<sup>th</sup> century Europe, which in a few years killed one third of the population in several countries.

In the case of the Black Death, the cause for the death toll was scientific ignorance. But for more than two decades scientific ignorance cannot be used as the primary explanation for the AIDS death toll. A more accurate reason is the global unwillingness to provide the needed resources. As Peter Piot, the executive director of UNAIDS, said at the opening ceremony of the 14th International AIDS Conference held in Barcelona, in 2002: "Treatment is technically feasible in every part of the world." I don't know a single place in the world where the real reason AIDS treatment is unavailable is that the health infrastructure has exhausted its capacity to deliver it. It's not knowledge that's the barrier. It's political will." [167]

The lack of global political will to deal with the unequal burden of AIDS is a reason why poor populations should fear the implications of CC. It is *not* implausible that a future world could evolve in which comparatively comfortable populations find reasons to largely ignore the chaos that could develop from CC. An alliance between the AIDS and CC communities is likely to reducing the risk of this scenario. It would have a greater moral force than either community acting alone, and could capture global imagination. We propose several practical strategies to illustrate and strengthen this co-operation. Perhaps the most ambitious is to call the UN Security Council (UNSC) to convene a special session to discuss the security threat of the HACC. The UNSC has already discussed the security implications of AIDS and CC, separately. Indeed, the first such meeting, in 2000, which involved US Vice President Al Gore, co-recipient of the 2007 Nobel Peace Prize for his work on CC coincided and arguably amplified the large funding increase for HIV which occurred at the turn of the millennium. The involvement of Gore in the proposed meeting is highly desirable.

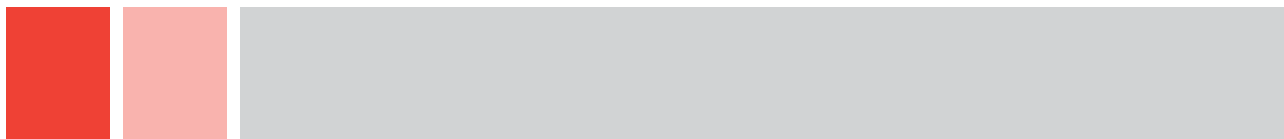
Another recommendation is to raise funds for a state of the art carbon-neutral electricity generating station (e.g. solar thermal) built in SSA, perhaps using the Clean Development Mechanism. The need to facilitate technological leapfrogging in the South has long been called for [168] and is increasingly urgent. [169] The lobbying for these funds could draw together Bill Clinton – now an ardent AIDS activist – and his former vice president Al Gore, arguably the world's most effective CC activist. Singers and movie stars, from Bono to Bob Geldoff and Brad Pitt might also be persuaded to endorse such a vision. Of course, some critics will argue that the funds that would be raised for this showcase power station would be better employed for direct expenditure on health services,



including education and ART. But a “green” power station may tap into funds and raise interest through avenues which are outside traditional forms of overseas development assistance (ODA). In any case, the infusion of human and technological capital involved in such a venture would have many indirect benefits to SSA. It would also be a powerful and lasting symbol and manifestation of the co-operation of the AIDS and CC communities.

Chinese aid could include Shi Zhengrong, Chairman and CEO Suntech Power, China, and a member of the Global Leadership for Climate Action (GLCA). This is funded in part by the UN Foundation, established by another visionary entrepreneur, Ted Turner. Increased Chinese aid in Africa to promote sustainable development has several benefits, and could lead to reciprocal investment by an embarrassed North. This would also be a public relations coup for China, and go some way to neutralising the criticism of many Chinese investments and aid policies in Africa.

Other strategies we suggest to explore and develop this co-operation include publishing. UNAIDS and UNEP could contribute to the next edition of “Up in Smoke” a report released by a coalition of environmental and development NGOs. [33] This report broke new ground when first released. [170] Indeed, the current position paper is a similar step. A leading journal, such as the Lancet, could commission a paper on the HACC. Leading AIDS journals could call for CC authors to speculate on how CC and AIDS might interact; leading CC journals could similarly call for papers to be written by AIDS experts.



## CONCLUSION

Climate change and AIDS each exemplify a global emergency. In each case the population which faces the greatest risk is comparatively poor. Each case represents a challenge and an opportunity for the global community. While the *interaction* between these two long wave events – even in SSA – will probably be modest there is a non trivial possibility that the interaction could be sizeable.

We propose several strategies to reduce the likelihood of such a significant interaction. One is to enhance the education and governance of developing countries affected by HIV. This will likely improve national resilience, enabling a better response to CC and to AIDS. Mechanisms to enhance regional and global food security, especially in sub-Saharan Africa, are important. There is much that can be done to bring the Green Revolution to sub-Saharan Africa. At the same time, if the economic capacity of sub-Saharan Africa can be enhanced then African populations will better be able to afford to purchase some of the global production of grain and meat. Because much of the world is overnourished, a more equitable distribution of global food would not be at the expense of health elsewhere, but would likely improve global health.

In isolation, CC and AIDS each impose a substantial risk to future human health and well-being. In combination, SSA the BOD of AIDS may be exacerbated and prolonged by CC. Yet, if sufficient global expertise and will can be found, there is still time to avoid many of the worst consequences. A pharmaceutical remedy for HIV now exists, and much more is now known about the disease's epidemiology and means of transmission and prevention. Together with other steps, the response to CC by countries at the greatest risk of the HACC can also be improved. We have finally suggested some strategies by which UNAIDS and UNEP may be able to help draw the AIDS and CC constituencies closer together, for mutual benefit. We believe that this would be strongly in the self interest of both groups.

## APPENDIX 1: Regions at special risk

This appendix discusses three areas at risk outside SSA (see figure 4). We stress that many comments on the future are inherently speculative, yet not all elements of the near to mid-term fall in this category. [158] We can, for example, be confident that human behaviour will be recognisable. Some aspects of psychology and emotions will be different, but people will remain essentially human. People will still take risks, and at times behave irrationally. Sex workers, drug users, and people who attempt to help and to harm others will also exist. Although these scenarios are speculative, to postulate that sea level rise and the other consequences of CC will have no effect on AIDS seems, to us, to be even less plausible.

### Sub-Saharan Africa

The area and population with the greatest risk of enhanced AIDS due to CC appears to be SSA, for reasons discussed in detail above. This area has a high prevalence and incidence of HIV and parts of it have a high rate and vulnerability to malaria. It also experiences comparatively poor governance and, in part, conflict.

While the epidemiology of the HIV epidemic in Sub-Saharan Africa is substantially different to that in Asia [171] (as reflected by the recent substantial downward revision of the number of cases in India) we nevertheless identify three Asian regions which may be at special risk due to the combination of CC and AIDS.

### Mekong Delta

The most recent UN AIDS update reports that within Asia national HIV prevalence remains highest in South-East Asia. But while the epidemics in Cambodia, Myanmar and Thailand show declines in HIV prevalence, those in Indonesia (especially in the Papua province) and Vietnam are growing. [172] Unfortunately, the epidemics in Vietnam and New Guinea (both its western - Indonesian - province and its eastern – independent part) also appear to be at risk from CC. In 2008 the World Bank warned that Vietnam - with a 3,200km coastline and two of the largest low-lying river deltas in the world, leads the world's developing countries in the risk it faces from CC.

The current decline in incidence of HIV in Cambodia and some parts of Vietnam is gratifying. But the question is whether in (say) 50 years time, could the human behaviour which led to an AIDS outbreak in (say) 1995 re-occur, under conditions of impaired governance secondary to CC?

The outlook for governance in Vietnam may seem better compared with NE India, but the people of the Mekong delta may be at an increased risk of HIV transmission because

of several cultural factors, in addition to its geographical proximity to the existing “nidus” of HIV in Cambodia and Ho Chi Mina City. Cambodia may itself also at future risk of an increase in HIV transmission due the interaction of poor governance, and enhanced poverty from the upstream damming of the Mekong, with resultant declines in fisheries and soil fertility. There is a significant background level of HIV in South Vietnam, though less than the hypothesised 1% which some experts believe heralds impending takeoff. Any substantial flooding or other CC caused calamity in the Mekong delta (including more severe typhoons, possibly exacerbated by excessive mangrove from aquaculture is likely to drive more transactional sex in a population with little male circumcision. Coastal Vietnam in general and the Mekong basin in particular demonstrate important similarities to and differences with Bangladesh, another Asian nation which faces issues of sea level rise and vulnerable governance. Although parts of Bangladesh have quite high rates of STDs, and there has been speculation that poor squatter areas in Dhaka might sustain an HIV epidemic [173] widespread male circumcision, and possibly other factors among its mainly Muslim population, combined with its low level of IDU makes a large epidemic seem unlikely, even if the effect of CC becomes much greater.

## New Guinea

Both Papua New Guinea and West Papua (a part of Indonesia) may also be vulnerable to an interaction between AIDS and CC. Both parts of the island, and particularly the highlands, are vulnerable to El Niño Southern Oscillation (ENSO) related droughts, with periodic famine. Papua New Guinea has the most “African” of epidemics in the Pacific (ref). Both parts of the island are likely to remain trapped in poverty, caught by a vicious circle of high fertility, conflict, poor governance, and, in the case of West Papua, by discrimination by a remote and allegedly discriminatory government. Many parts of the island and its surrounding islets are also at risk of sea level rise.

## APPENDIX 2: List of Participants, Consensus Building Meeting on Climate Change and AIDS in Nyon, Switzerland, on 20 May 2008

1. Appadurai, Arivudai Nambi, Leader, Climate Change Programme, Swaminathan Foundation, Chennai, India
2. Araujo, Islene, Migration Health Programme Coordinator, IOM, Geneva
3. Butler, Colin, Research Fellow, Australian National University
4. Campbell-Lendrum, Diarmid, Scientist, WHO, Geneva
5. Dhanapala, Kiran, Focal Point for UNAIDS, ILO, Geneva
6. Fages, Veronique Maeva, HIV/AIDS Advisor, UNDP, Geneva
7. Gillespie, Stuart, Research Fellow, International Food Policy Research Institute, Geneva
8. Godwin, Peter, Senior Advisor, National Centre for HIV/AIDS, Dermatology and STDs, Cambodia
9. Guichard, Anne Claire, UNAIDS, Geneva
10. Gunaratnam, Praveena, Programme Officer, UNAIDS, Geneva
11. Hamouda, Eisa, Senior Operations Officer, UNHCR, Geneva
12. Hieber-Girardet, Loretta, Senior HIV/AIDS Advisor, OCHA, Geneva
13. Lilleorg, Kristina, Policy and Research Dept, IOM, Geneva
14. McMichael, Anthony, Professor, Australian National University
15. Menne, Bettina, Medical Officer, WHO-Europe, Rome
16. Martineau, Tim, Director, Executive Office, UNAIDS, Geneva
17. Morah, Erasmus, Country Coordinator and Representative to UNEP, UNAIDS, Kenya
18. Paul, Seema, Chief, Policy Coordination, UNAIDS, Geneva
19. Petros, Gebrewold, UNAIDS Liaison Officer, UNHCR, Geneva
20. Rajbhandari, Nabina, Humanitarian Response Advisor, UNAIDS, Geneva
21. Seppänen, Sari, Programme Officer, UNAIDS, Kenya
22. Slotte, Henrik, Chief, Post Conflict and Disaster Branch, UNEP, Geneva
23. Spalton, Anthony, Senior Officer, Risk Reduction, International Federation of Red Cross and Red Crescent Societies, Geneva
24. Whiteside, Alan, Professor, University of KwaZulu-Natal, South Africa (also representing Mike Brklacich, Professor, and May Chazan, Carleton University, Canada)
25. Yoo, Jechul, Senior Programme Officer, UNEP, Nairobi

## APPENDIX 3: Acronyms

<b>AIDS</b>	Acquired Immunodeficiency Syndrome
<b>ARV</b>	Anti Retroviral Treatment
<b>BOD</b>	Burden of Disease
<b>CC</b>	Climate Change
<b>CHGA</b>	Commission for HIV and Governance in Africa
<b>DALY</b>	Disability adjusted life years
<b>ENSO</b>	El Niño Southern Oscillation
<b>FAO</b>	Food and Agricultural Organization
<b>GLCA</b>	Global Leadership for Climate Action
<b>GPA</b>	Global Program on AIDS
<b>HACC</b>	HIV and Climate Change Complex
<b>HIV</b>	Human Immunodeficiency Virus
<b>IFPRI</b>	International Food Policy Research Institute
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>IDU</b>	Intravenous Drug User
<b>LRI</b>	Lower Respiratory Illness
<b>MDG</b>	Millennium Development Goals
<b>NCAR</b>	National Center for Atmospheric Research
<b>NGO</b>	Non Government Organisation
<b>OCHA</b>	UN Office for the Co-ordination of Humanitarian Affairs
<b>ODA</b>	Overseas Development Assistance
<b>SSA</b>	Sub Saharan Africa
<b>TB</b>	Tuberculosis
<b>UNAIDS</b>	Joint United Nations Programme on HIV/AIDS
<b>UNDP</b>	United Nations Development Programme
<b>UNEP</b>	United Nations Environment Programme
<b>UNFCC</b>	United Nations Framework in Convention on Climate Change
<b>UNSC</b>	United Nations Security Council
<b>WFP</b>	World Food Programme
<b>WHO</b>	World Health Organisation

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UNEP is the United Nations system's designated entity for addressing environmental issues at the global and regional level. Its mandate is to coordinate the development of environmental policy consensus by keeping the global environment under review and bringing emerging issues to the attention of governments and the international community for action.

UNEP works with many partners, including UN entities, international organizations, national governments, nongovernmental organizations, business, industry, the media and civil society. Its mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.

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The Joint United Nations Programme on HIV/AIDS (UNAIDS) brings together ten UN agencies in a common effort to fight the epidemic: the Office of the United Nations High Commissioner for Refugees (UNHCR), the United Nations Children's Fund (UNICEF), the World Food Programme (WFP), the United Nations Development Programme (UNDP), the United Nations Population Fund (UNFPA), the United Nations Office on Drugs and Crime (UNODC), the International Labour Organisation (ILO), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the World Health Organization (WHO), and the World Bank.

UNAIDS, as a cosponsored programme, unites the responses to the epidemic of its ten cosponsoring organizations and supplements these efforts with special initiatives. Its purpose is to lead and assist an expansion of the international response to AIDS on all fronts. UNAIDS works with a broad range of partners – governmental and nongovernmental, business, scientific and lay – to share knowledge, skills and best practices across boundaries.



**UNAIDS**  
JOINT UNITED NATIONS PROGRAMME ON HIV/AIDS

UNHCR  
UNICEF  
WFP  
UNDP  
UNFPA  
UNODC  
ILO  
UNESCO  
WHO  
WORLD BANK