Interactions between HIV/AIDS and the Environment

A Review of the Evidence and Recommendations for Next Steps

International Union for Conservation of Nature - ESARO

IPPF International Planned Parenthood Federation
Africa Region

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A Review of the Evidence and Recommendations for Next Steps

Prepared by:

Susan Bolton[1] and Anna Talman[2]
University of Washington
Seattle, Washington USA

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[1] School of Forest Resources, College of the Environment, sbolton@uw.edu
[2] Department of Global Health, School of Public Health, atalman@gmail.com

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E-mail: info.esaro@iucn.org

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List of Acronyms

ABCG ..... African Biodiversity Collaborative Group

AIDS ..... Acquired Immune Deficiency Syndrome

ARO ..... Africa Regional Office

ARV..... Anti-retroviral (medication)

CBNRM ..... Community-Based Natural Resource Management

CBO..... Community Based Organization

ESARO ..... Eastern and Southern Africa Regional Office

EKZNW..... Ezemvelo KwaZulu Natal Wildlife

FAO..... United Nations Food and Agriculture Organization

GO ..... Governmental Organization

HELI..... Health and Environment Linkages Initiative

HIV..... Human Immunodeficiency Virus

IGA..... Income Generating Activity

IPPF..... International Planned Parenthood Federation

IUCN..... International Union for the Conservation of Nature

MDG ..... Millennium Development Goal

M&E..... Monitoring and Evaluation

NCAPD ..... National Coordinating Agency for Population and Development (Kenya)

NGO ..... Non-governmental Organization

OVC..... Orphan and Vulnerable Child(ren)

PLWHA ..... People Living with HIV/AIDS

PRB ..... Population Reference Bureau

SCC..... Swedish Cooperative Centre

UNAIDS ..... United Nations Joint Programme on HIV/AIDS

UNDP ..... United Nations Development Programme

UNEP..... United Nations Environment Programme

USAID..... United States Agency for International Development

UW..... University of Washington

VCT..... Voluntary Counseling and Testing (for HIV)

WEHAB..... Water, Energy, Health, Agriculture, and Biodiversity

WESM..... Wildlife and Environmental Society of Malawi

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Executive Summary

Humans and other species rely upon natural ecosystem processes and ecosystem services for their very survival. As the human population has grown, overuse or misuse of the environment and impairment of its ability to provide ecosystems services have led to shortages in critical human and other species needs. The last 10 years have seen an increase in the awareness of and interest in the complex interactions among population, health and the environment (PHE) and even more recently, an increase in awareness of linkages between HIV/AIDS and the environment, which could be considered as a subfield under the umbrella of PHE. Recent studies have brought to light a series of interacting and complex relationships, many with negative feedback loops, between HIV/AIDS and the environment. A comprehensive examination of these relationships and analyses of the quality and breadth of the evidence are lacking. We undertook a broad review of the published literature regarding the potential links between HIV/AIDS and the environment to assess the evidence for these connections and to provide guidance for possible next steps in addressing them through basic or operations research and intervention.

The connections between HIV/AIDS and the environment are complex, multifactoral, bi-directional, and involve indirect as well as direct pathways. In assessing the literature, we identified a number of topics linking HIV/AIDS and the environment. Some of the most important themes connecting the two are: food insecurity, natural resource use, agriculture and land tenure and use, the fisheries sector, gender issues, orphans and vulnerable children, migration, crisis situations, climate change, effects of environmental interventions on HIV/AIDS, and workforce and human capacity impacts of HIV/AIDS.

After evaluating the literature, we developed a conceptual framework (see Figures 1-4) for illustrating the complex interactions between HIV and the environment. Based on the tenets of prevention from the health arena and of addressing causal factors (ultimate) rather than symptoms (proximate) in the environmental literature, we have identified three major upstream factors that affect all aspects of the HIV/AIDS-environment nexus: social disruption, poverty and gender inequality. Poverty, gender inequality, and social conflict set the stage for enhanced susceptibility to HIV and the increased reliance on 'free' ecosystem services and biodiversity to meet increasing household needs that arise from having to cope with the effects of HIV/AIDS. We consider poverty to be the keystone of these three factors, that is, the factor which if altered will propagate the most important effects throughout the system. We define poverty in the broadest terms, not just as lack of money but also as the lack of access to information and resources with which to address basic human needs.

Coping ability is a linchpin in the pathway from poverty, gender inequality, and social disruption to HIV. Coping ability is affected by social and individual capital and reflects economic, psychosocial and physical resilience to adverse events. It is a key step mediating the role of upstream factors on the downstream effects of HIV infection, increased reliance on natural resources, and environmental degradation. Decreased coping ability makes people and communities more vulnerable to HIV/AIDS. HIV/AIDS in turn leads to increased dependence on natural resources, as households lose labor force, land tenure, and traditional knowledge, and are less able to maintain their previous livelihoods. This increased reliance on natural resources in turn makes communities even less able to cope, as they become more and more exposed to the vagaries of nature, weather, and availability of resources. Infection with HIV/AIDS also itself decreases coping ability, which may lead to both behavior that increases HIV transmission and also increased natural resource use. The cycle is self-reinforcing and reciprocal. The effects of climate change will further weaken communities' and households' coping ability, predisposing them to HIV vulnerability, risk behaviors, and infection.

To identify next steps in addressing HIV/AIDS and the environment, we evaluated strengths and weakness of the evidence related to interventions and knowledge of the interactions between HIV/AIDS and the environment. While it is clear that there is growing interest in mainstreaming and addressing HIV/AIDS and the environment in an integrated, multisectoral fashion, specific evidence regarding the success of interventions is still lacking. Monitoring and evaluation of conditions and/or outcomes is a critical concern for implementing interventions, and has too often been overlooked. In the research arena, the most glaring lack of evidence is studies that have a longitudinal focus with

repeated measures over several years, but research using comparison groups or randomization is also lacking. Snapshot information gives a quick glimpse of issues, but without long-term follow-up the view is likely distorted, especially when dealing with ecological, health-related, and socio-economic conditions that are in a state of flux. With respect to natural resources use, there is much agreement as to the pathways through which HIV/AIDS can result in overuse and damage of various resources such as timber and medicinal plants. What is conspicuously lacking is documentation of status and trends of the various natural resources and of the extent of use by HIV/AIDS affected households vs. poor households in general or those affected by other chronic diseases. Similar issues exist in the broader environmental arenas of the agricultural, livestock and fisheries sectors.

A meeting in Kenya between academic researchers and health and environment sector professionals resulted in the following research and action priorities.

- Compare prevalence and interactions between HIV/AIDS and the environment across different types of conservation areas to produce evidence supporting addressing HIV and the environment as an integrated topic.
- Identify relationships between environmental condition and HIV/AIDS prevalence. Do high quality environmental conditions and availability or unavailability of natural resources correlate with reduced prevalence of HIV/AIDS?
- Create a viable and active collaborative group with a designated coordinator to facilitate integration between health and environment sectors, disseminate information, and keep interested parties informed of activities and advances in the HIV/Environment arena.
- Conduct efficacy, effectiveness and operations research on existing models of implementing integrated HIV/environment interventions seeking evidence-based practical interventions for scaling up and disseminating.

Additionally we want to emphasize the following for future interventions and research:

- Incorporate better and more extensive monitoring and evaluation of all projects,
- Determine the interrelationships between HIV/AIDS and the upstream determinants of social conflict, poverty and gender inequality in terms of their effects on ecosystems, ecosystem services and natural resource use. Insofar as possible, address upstream factors with every intervention.
- Identify and measure appropriate ecological indicators to identify status and trends of critical resources affected by HIV/AIDS.
- Create inventories of known medicinal plants to track changes in numbers of plants and identify areas needing protection to avoid extirpation.
- Pursue additional pharmaceutical and clinical research regarding the effects of medicinal plants and their interactions with ART.
- Investigate the relationship between food insecurity and HIV/AIDS outcomes (for example, clarify the relationship between food insecurity and the effectiveness of ART, susceptibility to infection, and mother-to-child transmission).
- Improve understanding of land use/land tenure issues. Collect additional data on site-, gender-, age-, culture-specific uses of land and inheritance patterns.
- Quantify and predict food insecurity and human health effects of climate change.
- Build internal, national capacity for conducting research in developing countries.
- Advocate for integration at the policy-level. Convince policy-makers that integration is an important principle.
- Mainstream HIV/AIDS at the institutional level and implement internal workforce-based interventions.

Introduction

Humans and other species rely upon natural ecosystem processes and ecosystem services for their very survival. Ecosystem services are a necessary but not sufficient component of human well-being (Butler and Oluoch-Kosura 2006). There are also cultural and social aspects to human perceptions of well-being. The Millennium Ecosystem Assessment (2005 cited in Confanlonieri and McMichael 2007) lists general ecosystem services that provide benefits to humans as provisioning services such as clean air, clean water, food, new products from biodiversity, regulation and support services such as climate stability, flood control, filtration of contaminants, and also cultural services such as religious/sacred sites and leisure. As the human population has grown, overuse or misuse of the environment and impairment of its ability to provide ecosystems services have led to shortages in critical human and other species needs. The specter of climate change increases concerns about sustainability and integrity of health or well-being of biophysical and human systems (Ahmed et al. 2009; Besada and Sewankambo 2009; Bloem et al. 2010; Costello et al. 2009; Daily and Ehrlich 1996; Frumkin and McMichael 2008; McMichael et al. 2008a; McMichael et al. 2003; Myers and Patz 2009; Ramin and McMichael 2009; Tang et al. 2009; UNICEF Innocenti Research Centre 2008). Many authors have commented on the complex interactions between human well-being and the natural environment e.g., (Costanza et al. 2007; Kasperson and Dow 2005; Levy et al. 2005; McMichael et al. 2008b; Pimentel et al. 2007).

Even though integrated population, health and environment (PHE) community-based projects have existed for over 30 years (Finn 2007), the last 10 years have seen an increase in the awareness of and interest in the complex interactions among population, health and the environment. Global institutions have initiated various large-scale initiatives to address these issues such as the WEHAB Initiative (Water, Energy, Health, Agriculture, and Biodiversity) that emerged from the 2002 World Summit on Sustainable Development in Johannesburg, South Africa, and HELI (Health and Environment Linkages Initiative), begun by the World Health Organization and the United Nations Environment Program. WEHAB provides the framework for the eight Millenium Development Goals (MDG) (Mwaura 2007) that seek to make substantial gains towards improving the lives of the world's disadvantaged people by 2015. One weakness of itemizing the 8 MDGs (listed below) is that many of the goals are interlinked, and goal 7 ("Ensure environmental sustainablity") is critical to the success of most of the others (Pisupati and Warner 2003; Sachs et al. 2009).

Millennium Development Goals

Goal 1—Eradicate Extreme Poverty and Hunger

Goal 2— Achieve Universal Primary Education

Goal 3— Promote Gender Equality and Empower Women

Goal 4— Reduce Child Mortality

Goal 5— Improve Maternal Health

Goal 6— Combat HIV/AIDS, Malaria, and other Diseases

Goal 7— Ensure Environmental Sustainability

Goal 8— Develop a Global Partnership for Development

Millennium Development Goal 6 is to combat HIV/AIDS, malaria, and other diseases. The HIV/AIDS pandemic has had a tremendous effect on populations and economies throughout the world. UNAIDS estimates that 33.4 million people were living with HIV in 2008, and 2.0 million died of AIDS complications that year. The vast majority of people affected by the virus are living in sub-Sarahan Africa, where 22.4 million are infected, and adult prevalence is estimated at 5.2%, though prevalence varies widely by region, with national rates ranging between 1% and more than 25% on the continent (UNAIDS and Organization 2009).

There has been an increase in awareness of linkages between HIV/AIDS and the environment in the past few years. The arena of HIV/AIDS and the environment could be considered as a subfield under the umbrella of PHE. One might ask, what does HIV/AIDS have to do with the environment and vice versa? Recent studies have brought to light a series of interacting and complex relationships, many with negative feedback loops, between HIV/AIDS and the environment. The International Union for the Conservation on Nature (IUCN), the International Planned Parenthood Federation (IPPF) and others have funded workshops and reports on the relationships between HIV/AIDS and the environment in Eastern Africa (IUCN-IPPF-IRDC 2008; IUCN 2008a; IUCN 2008b; IUCN 2009; IUCN and IPPF 2009; Matiru and Osur 2008; Mvoyi et al. 2008; Mwakitwange and Bashemererwa 2008; Nakangu et al. 2008; Tassew 2008; Torell et al. 2007; Torell et al. 2006; Tumwine 2007).

Although on-the-ground circumstances make it difficult to know exactly how the disease affects the environment or vice versa, it is clear that people are changing their behavior in response to the pandemic. These changes go well beyond the realm of sexual behavior to affect coping decisions that change the access, use, and management of natural resources to secure individual, family, and community livelihoods (Frank and Unruh 2008). HIV/AIDS is thought to lead to overuse of natural resources, loss of traditional knowledge, loss of human capacity and labor, increased vulnerability of community-based natural resources management and diversion of conservation funds to meet HIV/AIDS-related costs (Torell et al. 2006).

The focus of most HIV/AIDS research and programs has been on prevention and treatment, with an emphasis on behavior modification. This narrow focus excludes the broader context of the disease and ignores some of the more ultimate, rather than proximate causes of the epidemic (Stillwaggon 2006). Poverty, gender inequality, and social conflict set the stage for enhanced susceptibility to HIV and the increased reliance on 'free' ecosystem services and biodiversity to meet increasing household needs that arising form having to cope with the effects of HIV/AIDS.

Goals

This report incorporates the findings of a literature review, including International Union for the Conservation of Nature Eastern and Southern Regional Office (IUCN-ESARO) and International Planned Parenthood Federation Africa Regional Office (IPPF-ARO) reports and other documents, a summary of discussions with professionals from IUCN, IPPF, the University of Nairobi (UoN), East African Wildlife Society, Swedish Cooperative Centre (SCC)/VI Agroforestry, Family Health Options Kenya (FHOK), and the University of Washington (UW), and results of field trips to provide the authors with urban and rural context to the problem in Kenya.

The goal of this report is to identify next steps towards addressing issues associated with HIV/AIDS and the environment. We will identify the strength of evidence from existing surveys, studies, and projects and suggest ways, where necessary, to strengthen this evidence. The primary aim is to produce convincing evidence-based data to enable policy makers at both the institutional and governmental levels to view HIV/AIDS through a broader lens and to implement interventions that can effectively address interactions between HIV/AIDS and the environment.

Objectives

- Synthesize the literature on issues associated with HIV/AIDS and the environment
- Identify and discuss examples of interventions to address HIV/AIDS and the environment
- Identify data and knowledge gaps
- Develop a conceptual framework to address the links between HIV/AIDS and the environment
- Suggest next steps for basic and operational research and for improving integrated interventions

Literature Review

Methods

We conducted a review of the literature to identify potential linkages between HIV/AIDS and the environment; the review includes documents from peer-reviewed journals, government, inter-government, and non-governmental agency reports, policy papers, and other documents, including materials available on the Internet. The search also included climate change effects on human health. It is important to note that this was not a detailed systematic review; we believe that we captured a representative, if not complete, sample of literature regarding HIV/AIDS and the environment. A selected annotated bibliography of the most relevant papers is included as Appendix 1.

Table 1: Types and numbers of publications reviewed

Type of Publication	No.
In Peer-Reviewed Journals:	
Original Research	39
Review Article	28
Case Study	9
Commentary	10
Policy Paper	4
Subtotal	90
In Sources other than Peer-Reviewed Journals	
Review Paper	33
Policy Paper	14
Presentation, Conference, or Workshop Paper	15
Published Guidelines or Tool-kit	11
Large Scale Demographic/ Health Survey	6
Case Study Paper	5
Thesis/Dissertation	2
Published Book	1
Subtotal	87
Grand Total	177

Keyword searches of online databases using Web of Science ISI, PubMed, and Google Scholar, as well as snowball methodology using the citations from each article reviewed, were used to find relevant literature. We also searched the websites of governmental, inter-governmental, and non-governmental agencies for related publications. IUCN-ESARO, IPPF-ARO, and National Coordinating Agency for Population and Development of Kenya (NCAPD) and Population Reference Bureau (PRB) also furnished reports and workshop proceedings, while collaborators at UW and UoN provided papers and materials for review. Key word searches included various combinations of the following terms: (HIV, AIDS, environment, natural resource management/use, agriculture, conservation, Africa, ecology, health, climate change, integrated, multisectoral).

This report focuses on sub-Saharan east Africa, but similar concerns about HIV/AIDS and the environment are arising globally, especially in rapidly developing regions of Asia, in small, developing nation-state islands (Hunter et al. 2008a) and in other parts of Africa, especially west Africa (Dwasi 2002).

The literature review captured a total of 177 relevant papers, reports, studies, and other materials. Table 1 details the types and numbers of publications reviewed.

Emerging Themes

The connections between HIV/AIDS and the environment are complex, multifactoral, bi-directional, and involve indirect as well as direct pathways. Complex cycles of interaction are everywhere. A number of themes emerged repeatedly in the literature, highlighting the most important types of interactions between the HIV/AIDS epidemic and the environment.

HIV transmission is often perceived as a consequence of human behaviors: unprotected sex, injection drug use, sharing needles. However, it is also important to note that much of the transmission in sub-Saharan occurs between stable heterosexual couples and through mother-to-child transmission. While transmission risk behaviors are, in fact, necessary for HIV-infection, it is important to note that these behaviors occur in context, that they are “conditioned by their environment”

(Stillwaggon, 2006: 219). HIV/AIDS flourishes in conditions of underdevelopment—food insecurity, poverty, social inequity, unequal power relations between the genders, poor access to health services and substandard infrastructure. People living in sub-Saharan Africa face myriad risks that burden them with a host of diseases. In the context of poverty, malnutrition, high prevalence of co-infections with other infectious diseases, and overburdened health systems, individuals may be more susceptible to acquiring HIV and less able to cope with HIV-related illnesses, both physically and economically. Eileen Stillwaggon (2006:69) writes,

> "The HIV/AIDS epidemic in sub-Saharan Africa is not an isolated phenomenon. It is a predictable outcome of an environment of poverty, worsening nutrition, chronic parasite infection, and limited access to medical care. In such circumstances, people are more susceptible to all infectious diseases, no matter how they are transmitted… Prevalence of HIV in Africa is not a special case but a brutal indicator of the nutritional, infectious, and parasitic diseases that have afflicted African people all along."

Major Themes Linking HIV/AIDS and the Environment:

- Food insecurity
- Natural resource use
- Agriculture and land use
- Fisheries sector practice
- Gender inequality
- Orphans and vulnerable children
- Migration
- Crisis situations
- Climate change
- Effects of environmental interventions on HIV/AIDS
- Workforce and human capacity impacts of HIV/AIDS

It is with this broad perspective on HIV as an infectious disease determined by more than simply "risk behaviors," and with an equally broad definition of "environment," that we examine the connections between the two. For the purposes of this report, we define environment as encompassing agriculture, fisheries, protected areas, natural resources, land use, and conservation.

Food Insecurity

Food insecurity is a linchpin in examining the connections between the environment and HIV/AIDS. Malnourished individuals are more susceptible to HIV infection, and tend to have worse outcomes once they are infected with HIV (Anema et al. 2009) and in order to feed themselves or their families may be more likely to engage in risk behaviors. There is growing evidence that antiretroviral treatment itself may be less effective in persons with inadequate nutrition (Anema et al. 2009; Bloem et al. 2010). The relationship between food insecurity and HIV/AIDS is, in fact, vicious; households affected by HIV/AIDS are subsequently less likely—because of loss of labor productivity, increased expenditure on treatment, etc.—to have adequate supplies of food (Kaschula 2008), and are more likely to consume fewer nutrient-rich foods (Onyango et al. 2009), increasing levels of malnutrition at the household level. Gillespie (2005) presents a detailed review of the relationships between HIV/AIDS and food insecurity.

Table 2: Selected studies addressing connections between HIV, mortality, and natural resource use

Paper, Year	*Location*	*Natural Resource Consumed*	*Methodology*	*Findings Regarding Link to HIV*
Barany, ME 2003	Sub-Saharan Africa	Forest products	Literature review, theoretical analysis of role of forest products in rural livelihoods; research proposal	Natural resource use observed as both a short-term coping strategy and a longer-term livelihood strategy among HIV-affected households. Because food insecure, impoverished households have previously been observed to depend on natural resources, it follows that HIV-affected households will be more likely to depend on them.
Barany, ME et al. 2005	Malawi, Mozambique	Forest products	Key informant interviews, focus groups; Participatory Rural Appraisal (PRA) methods; qualitative and quantitative analysis	Adult mortality or illness increased use of traditional medicines and other forest products. 77% of affected households had made collection trips in the previous 18 months. Affected households five times more likely to collect fuelwood than unaffected households. Quality of natural resources negatively correlated with HIV prevalence.
Bryant, L et al. 2009	Global	Generalized natural resources	Analysis of National Adaptation Programs of Action submitted to the Global Environment Facility for funding	Food insecurity and demographic pressures (not HIV per se) leads to increased natural resource use.
Challe, JFX and L Price 2009	Tanzania	Endangered edible orchids	Interviews (n=224), statistical comparisons of groups	HIV-affected people, especially orphans, were as much as 10 times more likely to increase natural resource use. Orchid gathers noticed a decline in the availability of most of the species collected.
Dwasi, J 2002	Eastern and Southern Africa	Medicinal plants, timber, wildlife	Key-informant interviews	Traditional medical practitioners and HIV/AIDS patients have increased harvesting of plants and wildlife thought to be “cures” for HIV, as well as timber. Parks staff says the harvesting is detrimental and unsustainable.
Hunter, LM et al. 2008	South Africa	Fuelwood, water	District-level demographic survey, household survey (n=241)	Households affected by mortality and impoverished households more likely to depend on natural resources. Changes in “selection, use, level of consumption, and acquisition” of natural resources were observed.

Table 2: Selected studies addressing connections between HIV, mortality, and natural resource use (contd.)

Paper, Year	*Location*	*Natural Resource Consumed*	*Methodology*	*Findings Regarding Link to HIV*
Hunter, LM et al. 2007	South Africa	Wild foods	Household surveys (n=241) and qualitative interviews (n=31)	Household mortality decreases food security, but not uniformly—the gender of the deceased and the previous socio-economic status are important. Dependence on wild foods is not only a short-term coping strategy; it persists long after household shocks.
Kaschula, SA 2008	South Africa	Wild foods	Dietary recall surveys	AIDS-affected and orphan-fostering households were more food-insecure and more likely to use wild foods, but may decrease their wild food consumption because of labor and stigma concerns. Households using wild foods tended to be more economically resilient.
Mauambeta, DC 2003	Malawi	Timber for coffins and charcoal making, wildlife	Mainly anecdotal; some interviews with park personnel; animal counts	Animal numbers have decreased, and poaching and collection of timber for coffins has increased; park officials say this is related to HIV epidemic.
McGarry, DK and C Shackleton 2009	South Africa	Wild foods, including bush meat	Interviews and food diaries, statistical analysis	High-HIV-vulnerability children hunted for and ate more wild foods, but impact on local fauna "unclear." Two instances of capture of IUCN "red list" species were noted, however.
Ngwenya, BN and K Mosepele 2007	Namibia	Fisheries	Surveys and questionnaires	Fisheries act as a "safety net" for HIV/AIDS-affected families, mitigating effects of chronic poverty.
Ngwenya, BN and D Kgathi 2006	Namibia	Potable water	Surveys	Families caring for symptomatic HIV-patients used 20-80 additional liters of water per day, depending on type and severity of symptoms (e.g. diarrhea).
Shackleton, CM et al. 2007	South Africa	Drylands forest products	Case studies	HIV's effects on labor and livelihoods have exacerbated peoples' dependence on forests. Across Southern Africa, forests provide 4 – 30% of household income.
Torell, E et al. 2006	Tanzania	Wood, medicine, wildlife	Field study including interviews, focus groups, and Participatory Rural Appraisal (PRA) methods	AIDS contributes to an accelerated rate of natural resource extraction

Food insecurity is an unfortunate reality in much of sub-Saharan Africa. In 2008, the UN Food and Agriculture Organization calculated that 923 million people were undernourished globally; this is an increase of about 75 million people from 2005 (Anema et al. 2009). Women—both HIV-infected and uninfected—are more frequently affected by food insecurity globally (Anema et al. 2009). In one HIV-treatment facility in Kenya between 20 and 40% of the treatment cohort was malnourished (Mamlin et al. 2009). Women are more prone to nutritional deficiencies because of their unique nutritional needs, especially when they are pregnant or breastfeeding, and some cultures have household food hierarchies. In most of sub-Saharan Africa, women have higher work loads yet consume fewer calories due to cultural practices that favor men (FAO 2001, accessed 2010).

Natural Resource Use

Food insecure or impoverished households are considerably more likely to be affected by HIV and the resultant high mortality of AIDS (Barany 2003). These families are also more likely to depend on natural resources as a safety net (Andrew et al. 2003; Torell et al. 2006). Vulnerable families depend on the local environment for a number of different types of natural resources, including wild foods (plants and bush meat), natural water sources for consumption, washing, and household use, traditional plant and animal medicines, timber for building and coffin-making, raw materials for craft-making, and fuelwood or burning material for direct cooking and heating or conversion to charcoal. Natural resources are a "safety net" for families when HIV/AIDS and/or poverty restrict(s) them from otherwise maintaining a livelihood. Natural resource collection is generally less labor-intensive than agriculture, and requires little to no start-up capital (Barany 2003). This effect is observed elsewhere; impoverished families in Brazil have also been observed to use natural resources as a form of "natural insurance" (Pattanayak and Sills 2001).

A number of studies have addressed the connections between HIV infection, household mortality, and natural resource exploitation. Table 2 highlights the relevant findings of these papers. Both Barany (2003) and Ternström (2005) provide good case studies and reviews of the relationship between the HIV/AIDS epidemic and natural resource use.

There is some speculation that increased dependence on natural resources by families affected by HIV/AIDS will lead to over-harvesting of certain species, degradation of the environment, and a decrease in biodiversity. One study in southern Africa noted that the quality and availability of natural resources (in this case fuel wood) appears to be negatively correlated with HIV prevalence (Barany et al. 2005). Others note anecdotally that gatherers of natural resources have noticed a decline in prevalence, quality, predictability, or accessibility of the products (Challe and Price 2009; Dwasi 2002; Mauambeta 2003). Nonetheless, few papers address the environmental/ecosystem impacts of natural resource use, and even studies that address these effects maintain that the effect is "unclear" (McGarry and Shackleton 2009). A feature that is notably missing is quantification of the use of natural resources.

Agriculture and Land Use

In addition to contributing to a reported increase in natural resource usage, the HIV/AIDS epidemic has contributed to a substantial reported change in land use practices (Barnett et al. 1995; Drimie 2003). Because HIV/AIDS primarily affects individuals during their most productive wage earning period (people of working age between 18 and 45), illness and mortality from AIDS results in a labor shortage at the household level (e.g., Barany 2003; Parker et al. 2009; Torell et al. 2006). Though other factors, including drought, land degradation, crop disease, and a host of other issues also affect productivity and land use, it is interesting to note that a decrease in crop production has been observed since the beginning of the epidemic in sub-Saharan Africa (Barany 2003; Barnett et al. 1995). Transitions to lower labor-intensity farming techniques, to increased leasing or sharecropping of land, and even to increased fallowing of productive land have been observed (Barany 2003; Du Guerny and Hsu 2004). At the community level, increased mortality is negatively associated with the amount of land cultivated (Barnett et al. 1995; Jayne et al. 2006). Losses to community productivity and ability to cultivate land appear

Examples of Possible Impacts and Responses to HIV/AIDS in an Agricultural Household:

- Adult becomes sick
- He/she reduces work
- Replacement labor is “imported,” perhaps from relatives
- Other adults work longer hours on the farm
- Health care expenses rise
- Household consumes less food
- Farming switches to less labor-intensive crops and farming systems
- Household sells off some assets (e.g. livestock) for funds
- Nutritional status deteriorates
- Sick adult stops work
- Household devotes more time to sick adult, less to children and to farming
- Debts increase
- Children drop out of school to help with household labor
- Adult dies
- Funeral expenses are incurred
- Household fragments as adults migrate for work
- Household reduces cultivation of land, leaves land fallow
- Household turns to natural resources for fuel, food
- Inappropriate natural resource use leads to spread of pests and disease
- Effects of knowledge loss intensify
- Surviving family members lose access to land and property
- Solidarity networks become strained, possibly to point of exclusion
- Partner becomes sick
- Downward spiral accelerates

Adapted from Drimie and Gandure 2005 & Gillespie and Kadiyala 2005

2005). Farmers may also be more focused on short-term rather than long-term concerns, as the household's demand for "quick cash" outweighs future considerations in the face of what may seem imminent mortality (Torell et al. 2006). As an example, more fire may be used for the clearing of agricultural land (Oglethorpe and Gelman no date) because of its lower cost and labor demand. As a result, uncontrolled fires may enter and damage protected areas thus further impairing the ability of these systems to provide ecosystem services (Gelman et al. 2005).

HIV/AIDS-affected families have also been observed to gradually sell off household assets to gain income as a buffer against lost labor and lost productive value. Families that own livestock sell the animals to pay for food, treatment, or household expenses, which leads not only to a reduction in income, but also to a decrease in available manure and animal labor, which in turn further reduces food production (Hammarskojöld 2003). Erosion of household assets leaves families more vulnerable to further economic or health shocks (Barany et al. 2005). A "downward spiral" of livelihood degradation can thereby begin (Parker et al. 2009).

Inheritance and land tenure patterns are also being affected by the epidemic. Land fragmentation, lack of title deeds, and unclear land policies regarding what happens to land when the landholder dies are increasingly affecting families that have experienced AIDS mortality. Land grabbing from orphans and widows and the practice of widow inheritance further contribute to the vulnerability of HIV/AIDS-survivors (Kiai et al. 2002). Women's rights to land, though often officially codified in law, are often not in fact protected in practice (Drimie 2003).

In contrast, HIV/AIDS has occasionally been intentionally invoked to maintain or regain control of land (Frank and Unruh 2008), as governments sometimes have specific policies designed to protect the rights of the HIV/AIDS-affected.

Fisheries Sector Practices

HIV/AIDS affects production sectors other than agriculture. Illness may undermine fisherfolks' ability to travel long distances and perform labor-intensive fishing activities (Gordon 2005), thereby affecting livelihoods in much the same way as it does for farmers.

Fisherfolk are both highly dependent on natural resources (fisheries) for their livelihoods, and are highly vulnerable to HIV infection. Gordon (2005) reports on studies that show fisherfolk being 4.4-14.0 times more likely to be infected with HIV than the general population in nine of ten countries studied. Three of theses countries are in Africa, where rates of HIV in fisherfolk ranged from 4.5 to 5.8 times higher than in the general population. In Kenya and Uganda the rates were higher than those for truck drivers, a known high-risk group, and the Kenya study even hinted that rates were higher for fisherfolk than for sex workers. A variety of reasons have been suggested to explain the high prevalence of HIV in the fisheries sector including the age group of most fishermen (15-35), the migratory nature of many people involved in fishing, sudden influxes of cash from sales, irregular working hours, and limited access to health services.

In coastal areas experiencing decreasing fish abundance in artisanal fishing communities without access to boats safe for deep water or engines, low income from fishing can lead to food insecurity and risk behaviors that increase vulnerability to HIV (Torell et al. 2006). For instance, women have been reported to barter sex for fish (Gordon 2005; Torell et al. 2006).

Gender Issues

Gender inequality is often mentioned, both as a precondition for many of the deleterious links between HIV/AIDS and the environment, and also as an exacerbating factor. Women are more susceptible to HIV infection, both for biological reasons (the larger and thinner mucous membrane of the vagina allows for easier transmission), and for socio-cultural reasons, such as unequal sexual power relationships, sexual violence against women, and the perception that women should be naïve and passive in sexual relationships (Gupta et al. 2003). Furthermore, women tend to carry the majority of labor burden in household activities, childcare, and caring for the ill (Torell et al. 2006). In sub-Saharan Africa, women account for 70% of the agricultural workforce (Barany, 2003). Some food and water collecting activities—for which women bear the brunt of labor—are dangerous, and can themselves negatively affect women's health (Hyder et al. 2005). Women often have differential access to education, employment, credit, and information (Torell et al. 2006), and women, particularly widows, may have difficulties in accessing land, which is usually in their husbands' name (Kiai et al. 2002). Paychecks, land deeds, and income are often directed to men, who are generally more likely to spend household income on alcohol, commercial sex, and gambling, whereas women are more likely to channel income into school fees, medicines, and food (Kristof and Wudunn 2009). In parts of sub-Saharan Africa, the practice of widow-inheritance leaves widows penniless and vulnerable and can also increase the spread of HIV if either the widow or her inheritor is infected (Kiai et al. 2002). Women are also often subjected to coercive sex (Erulkar 2004) and food-insecure women have been documented to be more likely to engage in unprotected sex and to report low power in relationships (Weiser et al. 2007). Women are also generally more economically vulnerable, and are more likely in sub-Saharan Africa than men to depend on NGOs or other aid for survival (Kanyamurwa and Ampek 2007).

Orphans and Vulnerable Children

The intergenerational effects of the HIV/AIDS epidemic on the environment are striking, and are not limited to vertical (mother-to-child) transmission of the virus. Over 11.6 million children in sub-Saharan Africa have been orphaned by HIV/AIDS since the beginning of the pandemic (UNAIDS 2008 accessed 2010). Orphans and vulnerable children (OVCs) are less likely to have been the beneficiaries of knowledge transfer regarding livelihoods (Oglethorpe and Gelman 2008) and traditional social and ecological knowledge. Gaps in traditional knowledge of farming techniques, natural resources management, and identification, collection, and use of natural resources, including traditional medicines, have been observed (Oglethorpe and Gelman 2008; Oglethorpe and Gelman no date; Topouzis et al. 2001). Orphans, like HIV/AIDS-widows, are also often prone to land-grabbing by relatives or community members, and are extremely vulnerable in terms of livelihoods (Drimie 2002; Kiai et al. 2002). Intergenerational "transmission" of poverty is also common, with orphans and children affected by HIV/AIDS less likely to be able to climb out of poverty (Drimie 2002).

Migration

Migration has also been identified as a link between HIV/AIDS and the environment, and has bi-directional effects. Rural-to-urban migrants, seeking livelihoods in cities or fleeing untenable rural conditions (including lack of access to land and overly degraded land) are at increased risk of HIV infection because of enlarged sexual networks, increased substance abuse, higher population viral prevalence, social disruption and more casual and commercial sex (Mauambeta 2003; Ngigi 2006; Voeten et al. 2009). Meanwhile, seasonal or work-related migration similarly increases risk, primarily through partner concurrency, lack of availability of condoms and HIV/AIDS-education in remote areas, and increased commercial sex (Ball 2006; Gelman et al. 2005; Oglethorpe and Gelman no date; Torell et al. 2006). At the same time, urban-to-rural migration of the HIV-infected puts demands on relatives, in terms of labor and care, and on the natural environment, in terms of natural resources and ecosystems services (Andrew et al. 2003; Ngigi 2006). Migration of HIV-infected persons from cities also spreads the virus to lower-prevalence areas like the countryside.

Two special cases of migration link the HIV/AIDS pandemic and the natural environment. First, "climate refugees" (or "environmental refugees") are those who migrate because of degraded environments, natural disasters, and climate change (Bremner 2009, accessed 2010; Development Alternatives Inc. 2001). Second, "conservation refugees" are those who are forced out of their homes within protected or conservation areas and are obliged to migrate elsewhere (Dowie accessed 2010). Dowie estimates that up to 10 million people have been evicted from their homelands historically because of environmental/conservation activities. These "conservation" and "climate" refugees often migrate to urban areas, facing the same risks as other rural-to-urban migrants.

Crisis Situations

Emergencies, natural disasters, conflict, and generalized social disruption also endanger both the environment and those at risk or infected with HIV. A loss of community "champions" to HIV infection has been noted to decrease social cohesion generally, and perhaps to contribute to communities' decreased commitment to conservation efforts and natural resource management (Oglethorpe and Gelman no date). Likewise, loss of normal social controls over sexuality and natural resource use leads to increased HIV transmission and increased environmental degradation, respectively (UNEP UNAIDS 2008). Wars and conflicts impose a heavy burden. Sexual violence, crimes against persons and property, and general social disruption affect both people's health and the environment (Voeten et al. 2009).

Climate Change

Climate change appears to be contributing to environmental variability, via higher risk of extreme events (Costello et al. 2009; Myers and Patz 2009), which may lead to increased poverty, migration, and economic vulnerability (all risk factors for HIV transmission). Environmental changes also foster conditions that are favorable for disease transmission. Degraded environments produce fewer crops, contributing to malnutrition and all of its negative effects on health and immunity (Battisti and Naylor 2009; Bloem et al. 2010). Increased distances to reach water and decreased water quality threaten an increase in water-borne illness, an important class of opportunistic infection affecting PLWHA (Baker 2009). Meanwhile, each 2-3°C increase in temperature is expected to increase malaria transmission by 3 – 5%, which translates to several hundred million additional cases (McMichael et al. 2003). Because HIV and malaria have a synergistic relationship, with each malarial episode potentially increasing viral load of HIV by a one-log factor for up to eight weeks (Abu-Raddad et al. 2006). More malaria also means more HIV/AIDS through increased HIV infectiousness among co-infected HIV positive individuals, and/or increased exposure to HIV among HIV negative individuals who receive blood transfusions. Decreased plant diversity and species loss may limit access to valuable plants, including some identified as having medicinal or anti-HIV properties (Ezeaku and Davidson 2008). The health effects of climate change are neither negligible nor an uncertain future outcome: Costello et al. (2009) assert that nearly 1.9 million disability-adjusted life years were lost in Africa in the year 2000 alone because of climate-related factors.

Climate change will likely also produce changes in agriculture and land use across Africa. One prediction is that the majority of African countries will have 50% or greater

novel climate regimes—temperature and/or moisture patterns beyond current extremes—by the year 2050 (Burke et al. 2009). This will additionally affect land use practice already disturbed by the HIV/AIDS epidemic.

UNAIDS and UNEP produced a joint working paper on HIV/AIDS and climate change in 2008, in which they hypothesize an "HIV/AIDS-Climate Change Complex" (UNEP UNAIDS 2008). They identify food security, patterns of infectious disease, effects of pollution and heat stress on immunity, and issues of governance, policy, and conflict as the major points of interaction between climate change and the epidemic.

Impacts of Environmental Interventions on the HIV/AIDS Epidemic

Environmental or economic development activities themselves can in fact exacerbate existing health problems, including increasing people's vulnerability to HIV and/or worsening HIV/AIDS outcomes. For instance, remote conservation work that draws men away from their families for weeks or months at a time can result in lack of entertainment, boredom, loneliness and excessive use of alcohol, which can lead to risky sexual behavior. In areas with low levels of supervision or discipline, guards may accept sex in lieu of fines (Ball 2006; Gelman et al. 2005; Oglethorpe and Gelman no date; Torell et al. 2006). Condoms and HIV/AIDS information and education may be unavailable in the remote areas where conservation and development workers are posted (Gelman et al. 2005; Lopez et al. 2005).

Interventions that give large cash incomes to men may lead to increased alcohol use and commercial sex (Oglethorpe and Gelman 2006). Likewise, facilitating tourism can sometimes facilitate HIV transmission (Torell et al. 2006). Road building creates more mobility and more possible routes for transmission (Stillwaggon 2006). Creating dams for hydroelectricity fosters schistosomaisis, which is linked to increased HIV transmission (Stillwaggon, 2006). Some environmental and development interventions, while not contributing directly to the HIV/AIDS epidemic, do exclude HIV-affected households by default. Rotating credit and savings associations might exclude orphans and vulnerable children under the age

Types of Interventions for Addressing HIV/AIDS-Environment Linkages:

- Facilitating policy and systems-level change
- Strengthening community institutions
- Promoting interventions in sustainable natural resources management
- Encouraging sustainable, environmentally friendly livelihoods
- Engaging in HIV/AIDS-specific programming at the community level
- Internal mainstreaming: workforce interventions at institutional level

of 18 because of a minimum age requirement (SCC 2008). Cooperatives might inadvertently exclude HIV-positive women, as their peers may be less likely to sign as collateral because of fears of illness or death. Labor-intensive improved farming techniques might not be practicable for families who have lost labor capacity to HIV/AIDS (SCC 2008).

Workforce and Human Capacity Impacts of HIV/AIDS

At the institutional level (NGOs, government agencies, and other organizations), there are a number of other important links between HIV/AIDS and environment. Perhaps the most salient is the issue of workforce. Staff of environmental and conservation organizations are not immune to HIV; since the beginning of the epidemic, organizations have seen an increase in absenteeism because of illness, the demands of caring for the ill, and frequent attendance at funerals (Cash and McCool 2007; Mauambeta 2003). Some organizations report an increase in demand for employee assistance programs and medical or other support provided by the employer (Mauambeta 2003). There are many reports of an increase in mortality in workforces (Ball 2006; Dwasi 2002; Mauambeta 2003; Meier no date; Ngoti and Baldus 2004; Zelothe 2008) and the corresponding decline in morale and capacity to perform job activities (Development Alternatives Inc. 2001; Oglethorpe and Gelman no date). Nonetheless, the precise extent of mortality and it effects on organizations in terms of productivity and economics have not been rigorously documented. Gelman et al. (2005) note that many conservation organizations are not open about staff losses related to HIV/AIDS because of issues related to stigma and confidentiality. Those organizations that have reported openly show significant losses: 14% of staff in the Wildlife and Environmental Society of Malawi and over 80% of extension workers in a fire awareness program in southern Africa. The loss of skilled professionals—many of whom are "investments" in terms of the education and on-the-job training they have received—has negative financial and programmatic impacts upon the functioning of the organization.

In the environmental sector specifically, loss of workforce has led to decreased patrolling of protected areas and national parks (UNDP 2007), which may contribute to higher levels of poaching and unregulated natural resource harvesting in or near parks.

Some institutions have also reported shifts in funding priorities from donor organizations, either towards HIV/AIDS-focused activities and away from environment, or conversely, away from HIV/AIDS-related programming towards environment (especially climate change) activities (Koro 2004, accessed 2009; Ngoti and Baldus 2004; Oglethorpe and Gelman no date).

Historical Perspective:

IUCN-ESARO and IPPF-ARO Work on Environment—HIV/AIDS Linkages

The links between HIV/AIDS and the environment gained international awareness in 2003 when the Vth World Parks Congress in Durban, South Africa identified it as an emerging issue. This was followed in 2004 by a resolution passed at the IIIrd IUCN World Conservation Congress in Bangkok, which asks the conservation community and collaborators to take actions that promote HIV/AIDS policies and procedures.

To better understand the links between HIV/AIDS and the environment, the International Development Research Centre (IRDC) funded a series of desk reviews under a program called "Making the Linkages – Conservation as a Core Asset for Livelihood Security in Eastern Africa." IUCN-ESARO and IPPF-ARO developed a memorandum of understanding to collaborate on desk reviews and workshops in East Africa. Desk reviews were conducted in Uganda, Kenya, Tanzania, and Ethiopia (Matiru and Osur 2008; Mwakitwange and Bashemererwa 2008; Tassew 2008; Tumwine 2007). Community workshops were also held with funding from IRDC, Ford Foundation and IPPF in 2007-2008 (IUCN-IDRC 2007; IUCN-IDRC 2008; IUCN-IPPF-IRDC 2008). These activities led to policy briefs and lessons learnt summaries (IUCN-IPPF-IRDC 2008; Kisilibo et al. 2008; Mvoyi et al. 2008; Nakangu et al. 2008) and a draft final report of the entire enterprise (IUCN-IPPF 2009).

Findings of the desk reviews and workshops are summarized (IUCN-IPPF 2009) as follows:

HIV/AIDS ⟶ Environment:

- HIV/AIDS victims are forced by poverty to rely heavily on natural resources to earn income through the sale and consumption of charcoal, timber, fuelwood, and wild fruits and for nutritional supplements and traditional medicines.
- There is a greater incentive to exploit resources for short-term benefits either consciously or unconsciously using unsustainable practices because people affected by HIV/AIDS expect to die sooner rather than later.
- Premature deaths result in lack of knowledge transfer on how to use the natural resources in a sustainable manner. This is coupled with loss of traditional knowledge on sustainable agricultural practices.
- Reduced access to livelihood assets (e.g. employment, access to credit, etc.) may result in increased reliance on environmental assets.
- There is also a change in land use, whereby agricultural land is left fallow or farming of less intensive (and usually less nutritious crops) increases.
- As a result of weakened state of HIV/AIDS patients and unclear land tenure policy, the women and children may lose their inheritance through land grabbing or loss of inheritance if the male owner dies.
- Increased encroachment on protected natural resources in search of herbal medicine and other resources results in conflict between communities and animals as well as with park wardens.
- Waste disposal of condoms, syringes and medicines that may be blood or bodily fluid contaminated is an issue.

Environment ⟶ HIV/AIDS:

- Environmental degradation such as soil erosion and loss of vegetation cover leads to reduced crop production and hence reduced macro- and micronutrient intake.
- Resource degradation also results in longer distances to fetch water, fuelwood, construction materials, and to reach grazing sites. This in turn leads to higher demands for labor, increased time to acquire resources, and increased demands for unavailable calories and nutrients, thus stressing individuals.
- Increased travel distances to resources increases the vulnerability of women to sexual violence.
- Deterioration of fresh water resources (wetland, rivers etc.) affects the availability of potable water.
- Environmental degradation can result in favorable conditions for disease outbreak (e.g. warmer climate in the highland – malaria).

- The environment provides traditional medicines, which are easy to access and widely accepted.
- Conservation or other work in remote places away from family increases the risk of HIV/AIDS infection.
- Eviction from forest reserves, national parks, etc. may lead to social instability and migration.
- Pollution and waste disposal especially affects people living with HIV/AIDS (PLWHA), who have special needs with respect to water, sanitation, and hygiene services.
- Healthy ecosystems provide for clean air, clean water, and moderate local climate, which may have an effect on HIV/AIDS and other infectious diseases.
- Climate change will significantly affect the vagaries of nature and climatic variability influences crop production.

Integrated Interventions: What do they look like?

A growing number of organizations and institutions are addressing HIV/AIDS and the environment, population, health and environment, or climate change and health in an integrated fashion. “Mainstreaming” of HIV/AIDS into other sector activities has become a fashionable—even expected—response to the epidemic. Many ministries, aid organizations, and NGOs have added interagency collaboration and mainstreaming of HIV/AIDS into their boilerplate. Fewer have made on-the-ground day-to-day actionable changes in activities and policies. Whether this is because of inadequate funding, territorial fears, unclear policy guidelines or other reasons is unclear.

Nonetheless, some important strides have been made in incorporating integrated, comprehensive responses to HIV/AIDS and environmental issues into government and

non-governmental programming. Though integrated population, health and environment community-based projects have existed since the 1970s (Finn 2007), recent years have seen an upswing in projects relating both to PHE and those related to integrating HIV/AIDS and environmental concerns.

Definitions

For the purposes of this report, we are defining mainstreaming, multisectoral approach, and integrated intervention as follows:

- Mainstreaming refers to the process of including HIV/AIDS considerations into existing programming and policy of organizations and sectors with focuses other than health/HIV. For instance, the Ministry of Education mainstreams HIV/AIDS (in part) by including awareness campaigns, HIV testing, and HIV/AIDS-specific policies into its teacher training. Mainstreaming HIV/AIDS into a project means that at every step of the project cycle, from budgeting to project planning to monitoring and evaluation, HIV/AIDS-related concerns are anticipated and incorporated into the process. Organizations are cognizant that their interventions may be affected by the HIV/AIDS epidemic, and that their interventions themselves may have an impact on HIV/AIDS. Mainstreaming can include—but is in no way limited to—internal institutional level policy-making and awareness programs directed at the institution's own workforce.
- By multisectoral approach, we mean a coordinated response to a problem that spans disciplinary and governmental divisions. A multisectoral approach to community economic development, for instance, would mean that Ministries of Health, Education, Finance, Women's Affairs, Rural Development, Environment, and Agriculture simultaneously address the barriers to development. Inclusion of civil society and private sector organizations further strengthens the response. A multisectoral response should ideally be more than several institutions or disciplines acting in parallel. A sound multisectoral approach must include collaboration, resource and data sharing, harmonization of monitoring and evaluation procedures, and umbrella policies.
- An integrated intervention is one that simultaneously—and by definition—addresses both health/HIV-concerns and concerns that are traditionally the "territory" of another sector (in this case, usually agriculture, environment, rural development, or conservation). That is, a project that promotes kitchen gardens to people living with or at risk of HIV can be seen as integrated in that it serves as both a response to malnutrition (which affects HIV/AIDS outcomes), and as a response to natural resource overuse (limiting people's dependence on the natural environment). In the grand scheme, even something as broad as poverty alleviation could be conceived of as an integrated intervention, as it simultaneously addresses risk factors for both HIV/AIDS and environmental degradation. However, for the purposes of this report, we generally define intervention at a smaller level: NGO or governmental programming and projects.

It is clear that mainstreaming, multisectoral approaches to HIV/AIDS, and integrated interventions are all important working principles for a successful response to the links we have identified between HIV/AIDS and the environment (De Souza et al. 2008; FAO 2005; Gillespie and Kadiyala 2005; e.g.,Hemrich and Topouzis 2000; Mullins 2002; Mwaura 2007; SCC 2008; Topouzis and du Guerny 1999; Topouzis et al. 2001; Villareal and Holding Anyonge 2004). Furthermore building strategic partnerships across disciplines and sectors is a critical component of any type of integrated intervention (Topouzis et al. 2001).

We maintain that as both HIV/AIDS and environmental concerns have multiple determinants, both proximate and ultimate, a multi-faceted approach to mitigating their impacts is warranted (Gillespie and Kadiyala 2005; Hemrich and Topouzis 2000; Stillwaggon 2006; Topouzis and du Guerny 1999). However, it is critical that any of these types of initiatives has "teeth." Hollow promises about cross-disciplinary work or a paragraph or two of HIV/AIDS-specific material added to a proposal do pitifully little to advance the cause of either environmental protection or HIV prevention.

- "Mainstreaming AIDS is interpreted to mean that AIDS-specific programs take a bite out of every other budget, such as having the transport ministry paint AIDS

ribbons on rail cars or having agricultural extension agents lecture farmers about sexual behavior. It is far more effective to find ways for each sector—whether it be trucking, commerce, agriculture, health care, government, or mining—to combat the conditions that produced the epidemic, whether they be biological, social, behavioral, economic, or environmental" (Stillwaggon 2006: 13).

Key Principles: Gender and Participation

Several key principles must guide interventions on the links between HIV/AIDS and the environment, no matter which sector(s) or at which level(s) they are implemented. The first is awareness of gender inequality as a concern for programming. Advocacy for gender equality at the household, community, institutional, national, and international levels is a vital component of every intervention addressing this nexus (e.g., Gupta et al. 2003; SCC 2008; Torell et al. 2007; Torell et al. 2006). Internal policies that reflect equality as a working principle (such as non-discriminatory hiring practices) should also be pursued. Gender equality is, in fact, one of the working principles of the Millennium Villages Project in achievement of the Millennium Development Goals (Kates 2007).

The second key principle is inclusive and broad-based participation. Stakeholders, including people living with HIV, children, women, and marginalized populations, should be considered throughout the project lifecycle (Ezeaku and Davidson 2008; Save the Children and Oxfam International 2002). Unless communities and stakeholders are included and take on meaningful roles, there will be no traction ("buy-in") for projects, and any intervention is likely to fail.

Types of Interventions for Addressing HIV/AIDS and the Environment

Below is a discussion of various interventions and approaches that have been attempted in the past for simultaneously addressing HIV/AIDS and the environment. For purposes of clarity, we have divided the types of interventions addressing links into six general categories. It is important to note that most organizations' approaches are, in fact, multifaceted and include several of these types of intervention. For instance, the International Fund for Agricultural Development, in its Strategy Paper on HIV/AIDS, identifies numerous priority areas for intervention, including overall incorporation of HIV/AIDS concerns into project planning—external mainstreaming—poverty alleviation, introduction of innovations in food security and nutrition, implementing socio-economic safety nets, and integrated workplace interventions—internal mainstreaming (Topouzis et al. 2001).

Nonetheless, for discussion, it is helpful to separate various types of intervention. We have arbitrarily (and loosely) organized these intervention types from the macro- to the micro- level. This in no way reflects the relative importance of each type of intervention.

Evidence for many of these intervention types comes from the grey literature: industry reports and toolkits. While well-researched and well-reasoned recommendations and theories certainly exist in both grey literature and published journals, actual evidence evaluating the impacts of intervention types is quite limited.

We shall now discuss each of these types of intervention in greater detail, providing examples of successful interventions, as appropriate.

Facilitating policy and systems-level change

Neither the HIV/AIDS epidemic nor environmental degradation can be stopped without systemic change of the factors that generated the problems in the first place (Hemrich and Topouzis 2000; Stillwaggon 2006). A full spectrum approach to HIV/AIDS prevention, treatment and support needs to link health to poverty alleviation, gender equality and human rights with an emphasis on education, health, agriculture, economic development and environmental issues (Oglethorpe and Gelman, 2008)

Policy affects all of the activities under its purview. National and international health, HIV/AIDS, environmental, conservation, land, agriculture, educational, trade, and finance policies—to name a few—play important roles in our ability to address both HIV/AIDS and the environment, and the links between the two. For

instance, national land policies may not yet be equipped to deal with the large scale mortality wrought by HIV/AIDS, leaving widows and orphans unable to inherit property, and therefore dependent for survival upon natural resources, NGO support systems, or risk behaviors like transactional sex (Kiai et al. 2002).

The highly sectoralized structure of most government entities is a barrier to implementing comprehensive interventions. Funding streams are similarly often vertically structured, and funding agencies may be reluctant to devote resources to activities they perceive as being outside of their "territory" or expertise. Harmonization of policy and the creation of "umbrella policies" will be necessary for true multisectoral work (Hemrich and Topouzis 2000). To move beyond competition and turf-guarding, incentives need to be identified to encourage multisectoral work.

International trade and aid policies must also be systematically evaluated to determine their friendliness for developing economies (Ezeaku and Davidson 2008; Lotze-Campen and Schellnhuber 2009; Save the Children and Oxfam International 2002).

Other structural interventions will likewise be vital for addressing the extensive, pernicious links between the environment and HIV/AIDS. As poverty, lack of infrastructure, and food insecurity inextricably link HIV/AIDS and the environment, interventions addressing poverty alleviation, sustainable food systems, infrastructure improvement, and economic development (e.g., Kates 2007) are vital for addressing the vicious cycles of increasing HIV/AIDS and increasing environmental destruction.

Critical interventions of this type must include water and sanitation programs, projects to increase food production or equitable distribution of food, and health systems-strengthening including access to primary care, maternal-child health programs, prevention of infectious diseases, and general health and hygiene promotion.

Small- or large-scale economic development projects bolster economies and foster resilience (FAO 2005; Topouzis et al. 2001; Villareal and Holding Anyonge 2004). When households are universally less vulnerable, the impact of any shock—be it disease such as HIV/AIDS, climate change, natural disasters, or conflict—is more easily managed (McMichael et al. 2008b; Stillwaggon 2006). Supporting education systems, and particularly girls' education will likewise foster resilience at a population level. Successful achievement of Millennium Development Goal 1, poverty alleviation, would likewise bring the poorest of the poor out of the highly vulnerable state in which they now live.

Systems level interventions must also work to address issues such as climate change, by developing plans to prevent, mitigate, and adapt to the vagaries of climate that the earth is likely to experience in coming years, and to "climate-proof" societies insofar as possible against the effects of extreme weather events and natural disasters (Frumkin and McMichael 2008; Save the Children and Oxfam International 2002). Interventions to slow the rate of global climate change are also important.

Migration issues are a final key issue that needs to be addressed by policy- and systems-level advocacy and change (Cernea and Schmidt-Soltau 2006; Frank and Unruh 2008; Jayne et al. 2004). Policies and eventualities for dealing with internally displaced people (IDPs), refugees, and international migrants must be bolstered.

Policy advocacy and systems strengthening have gained momentum in the literature as potential solutions to health and environmental woes (e.g. (Hemrich and Topouzis 2000), and are surely underway in a number of contexts. Documentation, monitoring and evaluation of this type of intervention, however, are lacking.

One key example of systems-level intervention in the HIV/AIDS-environment network is the Millennium Village Project. The Millennium Villages Project is a UN-sponsored initiative that aims to empower impoverished communities in rural Africa to achieve the Millennium Development Goals within 10 years. There are 78 millennium villages in sites in Kenya, Ethiopia, Ghana, Malawi, Mali, Nigeria, Senegal, Rwanda, Tanzania, and Uganda. The villages work with a variety of experts including scientists from Earth Institute at Columbia University and other institutions, as well as local development experts in agriculture, nutrition, health, education, energy, water, communications, and the environment (Mwaura 2007). In Sauri, Kenya, for instance, the Millennium Villages project (Kates 2007) is addressing the following major cross-sectoral issues (Table 3).

Table 3: Cross-sectoral issues addressed by the Millennium Village Project in Sauri, Kenya (Adapted from Mwaura, 2007)

Population security	Agriculture and food Issues Water supply Transport and communication Education Capacity building Housing, hygiene and energy
Health Issues	Health center HIV/AIDS
Environment Issues	Watershed protection Riparian zone protection Tree planting

Kates (2007) reports that Millennium Village Projects in Kenya, Ethiopia, and Malawi have reduced malaria prevalence by distributing bed nets and generated crop surpluses, enabled school feeding programs and provided cash earnings for farm families by distributing fertilizers and improved seed varieties which increased crop yields. Crop yields increased between 85% and 350% (Buse et al. 2008). In Koraro, Ethiopia, the clinic saw a 50% drop in suspected malaria cases between 2005 and 2006 (Buse et al. 2008). It is still too early to say if the Millennium Village Project approach will be successful. That fertilizer increases crop yields and that mosquito nets decrease the incidence of malaria was already known and do not provide strong evidence of the value of holist, system-level interventions. Rich (2007), following a visit to Sauri, Kenya, reports that there are the same underlying problems in Sauri as elsewhere, such as competing government entities, favoritism and gender inequities. He also spoke with critics of the project, most of whom feared reprisals for speaking out and only spoke on the condition of anonymity. Carr (2008) presents a detailed theoretical critique of the Millennium Village Project framework and notes that there are many problems with recognizing and addressing the diversity of people and problems at the village scale which are not being rectified.

A lingering concern for the Millennium Development Goals and the Millennium Village project is that of capacity building. Pisupati and Warner (2003) note the need for capacity building and increasing awareness for meeting the MDGs at all levels. They call for awareness raising, education, reporting, data gathering and inventories, public participation and research and training. This kind of capacity building and systems' improvement will be critical for addressing the structural factors that link HIV/AIDS and the environment. There is also no clear pathway to sustainability: that is, once the donor money is gone, who will provide/buy fertilizer, seeds, bednets, pay health clinic workers, etc.

Strengthening community institutions

Because deteriorating community institutions have been cited as contributing to the pernicious interactions between HIV/AIDS and environmental degradation (Andrew et al. 2003; Dwasi 2002; Oglethorpe and Gelman no date), interventions at this level are important. Capacity building for local institutions is an important step in addressing the HIV/AIDS and environmental issues that communities are facing.

Community-based natural resource management (CBNRM) has increasingly been used as a participatory approach to natural resources protection and management. One group of researchers (Nkonya et al. 2008) studying CBNRM in Uganda noted several factors that affect the strength and capacity of communities to enact natural resource management. They found that the presence of government or NGO agriculture and environment projects in a community tends to encourage implementation of CBNRM, while insecure land tenure affects CBNRM negatively. They suggest that improving human capital, conditions of natural resources, and market access for communities will in turn strengthen their capacity to perform effective CBNRM.

Namibia's Association of Community Based Natural Resource Management Support Organizations (NACSO) is a good example of how strengthening community institutions can help to address both natural resource management and HIV/AIDS. NACSO not only reaches remote communities with support from their CBNRM programs, but also undertakes HIV/AIDS education and awareness interventions in these communities. NACSO has also successfully implemented monitoring and evaluation systems for CBNRM organizations (DeMotts 2008; Oglethorpe and Gelman 2008; Oglethorpe and Gelman no date).

Other community-based institutions are similarly well placed to have an impact on the environment-HIV/AIDS linkages. For instance, Topouzis and du Guerny (1999) call for changes in the agricultural extension model, which has traditionally been about commodity crops and conducted by and targeted to men. This system could be strengthened to better address issues of AIDS-widows struggling with food insecurity and to provide more information on locally produced and consumed crops. Other institutions, such as social, religious, economic, justice, and local governmental organizations also need bolstering to address the environment-HIV/AIDS linkages we have mentioned at the community level (FAO 2005).

Promoting interventions in sustainable natural resources management

Because of the connection between the HIV/AIDS epidemic and natural resource use, interventions that deal primarily with the use of natural resources can also incorporate aspects that are beneficial in addressing the environment-HIV/AIDS nexus.

One fundamental piece in considering the HIV/AIDS-effects of natural resource management programs is the improved management of protected areas (Dowie accessed 2010). Dowie reports that more that 10 million people have historically been displaced from their homelands because of conservation or environmental programs. These "conservation migrants" face increased risk of HIV infection and are less likely to be able to cope with any kind of shock, be it economic, environmental, or health-related. Minimizing conservation-based migration must be a priority in managing protected areas (Cernea and Schmidt-Soltau 2006; Dowie accessed 2010). Cernea and Schmidt-Soltau (2006) note that policies that displace people from protected areas sometimes backfire in their goal to protect biodiversity, as intensive harvesting at the borders of the protected areas threatens species.

There is a fine balance between protecting biodiversity, endangered species, and areas of particular environmental interest (such as national parks and protected areas), and protecting the livelihoods and food security of the people who depend upon natural resources. Some organizations have managed this issue by allowing controlled harvests of natural resources near—but not in—protected areas (Shackleton et al. 2007).

Reviving traditional knowledge systems regarding natural resource collection and use has also been used as a technique to minimize the environmental harm done by increased pressure on the natural environment for survival (Du Guerny and Hsu 2004; Garí 2004). Traditional knowledge systems often care well for the resource base (Du Guerny and Hsu 2004). Encouraging, educating, and supporting orphan (De Souza et al. 2008) and female (Oglethorpe and Gelman 2008) resource-users within traditional systems can particularly facilitate responsible use.

Junior Farmer Field Schools have been implemented in Zimbabwe with orphans and vulnerable children to build the skills of HIV/AIDS-affected children in rural areas to meet their dietary and income needs while also using natural resources sustainably. Of particular interest to the project is the development of livelihood options that allow orphans to support themselves while "producing appropriate behaviors that lessen the epidemic's impact on their generation" (De Souza et al. 2008: 222). The project uses hands-on, participatory learning, and incorporates health education and HIV-prevention messages as well. Though the program has been anecdotally described as benefiting both the children involved and the community as a whole, there has not yet been a formal assessment of its impacts (De Souza et al. 2008).

Interventions to manage sources of traditional medicines being used to treat opportunistic infections and to manage HIV/AIDS symptoms are also needed (Barany et al. 2005). Management can be based on the use of natural woodlands or on the domestication of species for cultivation. Barany et al. (2005) suggest that, where possible, support for the management of medicinal plants in natural settings, including sustainable harvesting methods and forming users' associations, should be attempted before resorting to domestication. Identification of priority species is an important first step in formulating management plans, and should be accomplished in coordination with traditional healers' associations.

Encouraging sustainable, environmentally friendly livelihoods

One of the more common and better-documented intervention types is the encouragement of livelihoods (income generating activities, or IGAs) that at once strengthen the economic base of vulnerable households, and promote ecologically sound techniques or technologies.

Natural resource-based income generation has been a popular intervention. Activities such as bee-keeping, animal husbandry, cultivating medicinal plants, kitchen gardens, encouraging use of animal manure as fertilizer, etc., simultaneously provide livelihoods for vulnerable families, and are beneficial (or at least not harmful) to the environment (Bukusuba et al. 2007; Ellis and Allison 2004; Ngoti and Baldus 2004; Topouzis et al. 2001). Note that examples of this type of intervention are often described in the literature, but that we found few published accounts with comprehensive analyses of the success of this type of intervention.

The Swedish Cooperative Centre (SCC)/VI Agroforestry encourage non-labor intensive livelihoods such as beekeeping, animal husbandry, and cultivating tree-seedlings to established groups of people living with or affected by HIV/AIDS in Kenya. The Aluor Widow's Group near Kisumu, Kenya, has dealt with issues of land tenure, low labor availability (most of its members are elderly, and many are living with HIV/AIDS themselves), and environmental threats such as flooding by working together as a group to produce goat's and cow's milk, local poultry, and timber- and fruit-tree seedlings as a mechanism for earning money and ensuring livelihoods (personal communication, 11 March 2010).

The introduction of labor saving and ecologically sound alternative technologies, such as biogas production, improved cooking stoves, bamboo coffins, and water purification techniques has also eased the burden on HIV/AIDS-affected households, while promoting technologies that have environmental benefits.

A project in Thika, Kenya, supported by Family Health Options Kenya (FHOK), has current and former female commercial sex workers producing and selling "jiko" improved cooking stoves as a means of generating income. The stoves use less fuel wood than the traditional three-stone stove and reduce the amount of smoke released in the cooking area. While the construction, sale and installation of stoves has not yet allowed most of the women to completely stop engaging in commercial sex (uptake has been slow because of a lack of disposable income at the community level for making a major purchase such as a stove), the support group members report that they are personally very happy with the technology, as it saves them time and money and produces less pollution, and they are hopeful that the project can be scaled up as a successful small business (personal communication, 22 Feb 2010).

Promotion of home or kitchen gardens is a particularly convenient integrated intervention for simultaneously addressing food insecurity, HIV vulnerability, and environmental concerns. Many of the foods that can be grown in small home gardens are highly nutritious, can provide a wide range of micronutrients, and are particularly suitable for meeting the nutritional needs of people living with HIV/AIDS (Garí 2004). Medicinal plants have also been successfully cultivated in home gardens (Oglethorpe and Gelman no date). Gardens are suitable for households that have lost labor,

Kitchen Gardens, Crop Diversity and the Promotion of Traditional Neglected Crops

- Enrich diets and improve nutrition
- Manage labor shortages through small size, closeness to home, fewer peaks in labor intensity
- Diversify household income
- Make better use of water, fertilizer, and pesticide inputs
- More resistant to ecological shocks (pests, drought, etc)
- Maintain sociocultural traditions, indigenous knowledge
- Possibly reduce dependence on natural resources

Adapted from (Frison et al. 2006; Garн 2004; Murphy 2008)

income sources, and traditional knowledge, and can increase food and livelihood security. They are usually close to the home, minimizing transport and time considerations, and are often maintained by women or orphans and vulnerable children (Murphy 2008). In areas with limited available land, plants can be grown in large sacks and vines can be trained up walls and onto roofs. A Kounkuey Design Initiative (KDI, a Harvard University School of Design organization) project in Kibera slum in Nairobi is making compost from household waste for use in sack gardens (personal communication 2/26/2010).

A related intervention is the introduction of alternative agricultural practices, including crop diversification and agroforestry projects. These interventions, which often require less labor than traditional agriculture, bolster food security and household assets for vulnerable families and promote sustainable land management practices. (Frison et al. 2006) have shown that food- and food-diversity based interventions are more successful than single-nutrient based ones for combating malnutrition. This type of intervention also protects "neglected" traditional crops, which may have significant nutritional value, require less intensive labor (because of extended harvesting periods) and fewer inputs in terms of fertilizers and pesticides, and may be more resistant to ecological shocks such as flood or drought (Garí 2004). Agrodiversity and alternative agriculture interventions simultaneously promote economic self-sufficiency, socio-cultural traditions and values, and biodiversity (Frison et al. 2006).

Swedish Cooperative Centre (SCC)/VI Agroforestry's intervention with the Oogo Village PLWHA Group in Western Kenya is a good example of a comprehensive agricultural livelihoods intervention. The group, which consists of 35 members (including 2 OVCs and 20 widows), has implemented a number of projects, including bee-keeping, husbandry of a dairy cow and poultry, a tilapia pond, intercropping, cultivation of indigenous nutritious vegetables, tree-planting for timber and fuelwood, and tissue cultures of various banana varieties. The group also works on stigma alleviation and HIV/AIDS awareness campaigns in the community and supports local orphans and vulnerable children with milk and money for school uniforms. While group members report that the community was at first skeptical—even hostile—towards the group, community members have now seen the success of the interventions and are supportive and have even come to the group's plot to learn improved farming techniques. The group also has a Village Savings and Loan group for microfinance of members' own individual income generating activities. The group has written a strategic plan for the next three years, and is working on publicity and documenting successes. The Kenya Agricultural Research Institute (KARI) has provided technical assistance, and is helping the group to conduct a trial of banana varieties—planted near one another and taken care of similarly—and group members will select their preferred variety for their own households based on the results (personal communication, 9 March 2010).

It is interesting to note that the character of the group, the local environmental situation, and other variables, including individual personalities and extent of illness, all have an impact on the success of a project. We visited a number of community groups attempting similar livelihoods interventions, and observed a wide range of success, enthusiasm, ownership and sustainability of the projects.

Ecotourism has also been explored as a possible intervention for promoting livelihoods in an environmentally friendly, sustainable manner. Tourism is a major industry and source of capital for many sub-Saharan countries. Beautiful landscapes, rich biodiversity, and exotic flora and fauna act as magnets for tourists, including many international visitors. Organizations have capitalized on this source of income to provide sustainable livelihoods while simultaneously working to preserve the environmental features that draw tourism to Africa in the first place.

The Il Ngwesi Community Ecotourism Project in Kenya is a salient example of an integrated ecotourism project that simultaneously addresses population, health/HIV/AIDS issues, and the environment. The project has achieved a number of impressive results in terms of holistic community development. It has constructed schools, provided bursaries for school attendance, created a radio security network backed up by armed community guards with vehicles, generated a source of income for a number of formerly unemployed women through craft-making and marketing, promoted

good pasture management including reducing problems of localized overgrazing, reintroduced locally extinct animal populations, established mobile clinic services, and initiated a major HIV/AIDS awareness campaign (Mwaura 2007). The success of the Il Ngwesi Community Ecotourism Project depended upon linking conservation and ecotourism to salient community concerns such as economic vulnerability, high levels of conflict, problems of health and access, and lack of educational opportunities.

Limitations to the use of ecotourism as an intervention may include: large start-up capital, reliance on technical knowledge and technologies that are not always available locally, and the risk that tourism may, in fact, exacerbate HIV transmission by increasing the size of sexual networks, providing large cash incomes largely to men, and possibly promoting commercial sex. Ecotourism interventions may also exclude the HIV/AIDS-affected because of tourists' negative reaction to seeing visibly sick workers (Lopez et al. 2005; Meier no date).

It is interesting to note that at least one paper (Ziervogel and Drimie 2008) maintains that livelihoods interventions will always be insufficient to stem the effects of HIV/AIDS on the environment unless national and local level political structures adequately support the processes and work to integrate them.

For example, there is an active youth group in the Mitumba slum in Nairobi, Kenya, working on garbage collection for community hygiene and aesthetics. However, because of space and financial constraints, the waste is being dumped in an open pit, which was recently plowed over by the city administration in the construction of a new bypass road. The pit is a site of open defecation and pests, which is immediately adjacent to the community, and is near a source of water. Poverty, land tenure issues, legal concerns, and inconsiderate political decisions limit the efficacy of even well intentioned and locally managed projects (personal communication 2/22/2010). Ziervogel and Drimie (2008) therefore suggest that "holistic environmental and social approaches" are necessary.

Engaging in HIV/AIDS-specific programming at the community level

Environmental, conservation, agricultural and related organizations can undertake HIV/AIDS-specific programming in communities, either in parallel with health sector activities, or ideally, as part of an integrated approach.

Environmental agencies have reported involvement in HIV prevention, treatment, care and support activities, such as opening a voluntary counseling and testing (VCT) center in a remote area, having conservation workers provide HIV/AIDS education and condoms, and hiring medical staff to be a part of their workforce (DeMotts 2008; Meier no date). These interventions occasionally include broader health-based initiatives, such as opening a small mobile primary care clinic, or advocating for child immunization (Gelman et al. 2005).

Interventions in this arena are often considered to be part of "external mainstreaming," that is, organizational thinking about how development, environmental, and conservation activities can exacerbate conditions that foster HIV transmission, or how to integrate HIV/AIDS activities into conservation/environmental work. It also includes considering HIV/AIDS issues in strategic planning, and including specific budget line items for HIV/AIDS-specific programming (SCC 2008; Topouzis et al. 2001).

Evaluation of this kind of mainstreaming or marginally integrated approach can be difficult. One systematic review examining the more common and better-documented implementation of integrated family planning and HIV/AIDS interventions was able to conclude only that integration had "mostly" positive or mixed results. Furthermore, the rigor of the studies examined was ranked at only 3.25 of 9 possible points on a scale that included metrics such as inclusion of pre/post intervention evaluation, use of a control group, control for confounders, etc. (Spaulding et al. 2009).

An example of this type of intervention would be the Wildlife and Environmental Society of Malawi's (WESM) direct support of community based organizations to provide HIV/AIDS awareness and prevention education, VCT services, and health services such as STD testing and treatment and family planning. WESM provides resources such as funding and transportation assistance to these organizations, and allows them to conduct activities in geographic areas (such as near protected areas) where these organizations do not typically operate. WESM's staff members themselves are also trained to conduct awareness campaigns in the remote areas where they work (Mauambeta 2003).

Internal mainstreaming: workforce interventions at institutional level

Internal mainstreaming of HIV/AIDS into conservation, environmental and development organizations is well documented in the gray literature (Ball 2006; Mauambeta 2003; Meier no date; Oglethorpe and Gelman no date; Rau 2003; SCC 2008; Zelothe 2008) and it is clear that this is an important—if not sufficient—response to the growing evidence of the links between HIV/AIDS and the environment. At the very least, internal mainstreaming should help stem the impacts of the epidemic within organizations' own workforce.

Examples of interventions undertaken include HIV/AIDS awareness, education, and behavior change campaigns, condom distribution, provision of healthcare at the workplace (including antiretroviral treatment), programs to reduce stigma and discrimination within the work environment, and employee financial and psychosocial support programs. Internal HIV/AIDS policies have been created at a number of organizations including IUCN, World Wildlife Fund, Ezemvelo KwaZulu Natal Wildlife, Wildlife and Environmental Society of Malawi, and Swedish Cooperative Centre to deal with the inevitable issues that an HIV/AIDS-affected workforce will face, such as time off for funeral attendance and caring for sick family members, non-discrimination policies aimed at protecting sick workers, and provision of health insurance and death benefits. A number of guidelines for internal mainstreaming have also been created (e.g., Cash and McCool 2007; Development Alternatives Inc. 2001; Mauambeta 2003; Mullins 2002; Office of the Senior Gender Advisor 2006; Oglethorpe and Gelman 2006; Topouzis et al. 2001; Torell et al. 2007).

Internal mainstreaming techniques include interventions to reduce staff vulnerability to HIV infection, for instance providing workers with safe housing or attempting to post workers near their families. Adaptation to workforce issues and loss of trained staff includes a move

Table 4: Internal mainstreaming activities for HIV/AIDS at two conservation organizations

	Wildlife and Environmental Society of Malawi (WESM)	*Ezemvelo KwaZulu Natal Wildlife (EKZNW)*
Effects of HIV/AIDS observed in workforce	Increased absenteeism, low attendance at meetings, increase in requests for short-term loans & employee assistance. Poaching and increased harvesting of natural resources observed as a result of decreased conservation workforce.	Increased absenteeism & turnover, loss of productivity, institutional memory impaired, natural resource use affected. Customers react badly to seeing visibly sick employees.
Internal HIV/AIDS policies and funding of HIV/AIDS activities	No internal policy yet created, but existing policies are largely inclusive of PLWHA. Convinced donors to allocate budget specifically for HIV/AIDS (5-7% of overall donor funding earmarked for HIV/AIDS activities).	Internal policy deals directly with HIV/AIDS, and has been reviewed in light of the epidemic. HIV/AIDS committee established. Strategic Plan includes a line item for HIV/AIDS, with indicators, deliverables, and measurement. Funding specifically earmarked for HIV/AIDS.
HIV/AIDS services offered to employees	Including HIV/AIDS education in new employee orientation. Established an HIV/AIDS resource center. "Social Welfare Committee" for assisting bereaved staff started. Designation of a staff HIV/AIDS-focal person. Condom distribution.	Benefits structure (including health insurance and retirement) reorganized to accommodate PLWHA. Three nurses and one social worker hired to provide in-house counseling. Linkage to ARV treatment. Condom distribution
Other interventions	Training of trainers for partner organizations to provide HIV/AIDS education and services.	Peer educators trained to offer health education on HIV prevention, and to work to decrease stigma and discrimination.

toward additional mentoring of junior staff, task shifting, and additional skills training to broaden the knowledge and skills base of the workforce (Oglethorpe and Gelman no date).

The Wildlife and Environmental Society of Malawi and Ezemvelo KwaZulu Natal Wildlife have both implemented fairly comprehensive workplace HIV/AIDS policies, as detailed in Table 4 (Mauambeta 2003; Meier no date).

Avoiding Unintended Consequences:

Part of responsible mainstreaming and integration means making every reasonable effort to anticipate unintended consequences of an intervention. There are many anecdotes about well-intentioned projects (in all sectors) going awry. One involves a training project with a group of facilitators and commercial sex workers aimed at educating the sex workers on safe sex. By day two of the workshop, most of the facilitators were not only having sex with the sex workers but also among themselves. Sadly, many of them became HIV-positive as all but one of the sex workers was HIV-infected at the time (personal communication, 17 February 2010). Another anecdote involves the Volta River Dam project, which in the 1950s and 1960s in Ghana displaced thousands of people from their land. Men went to work in factories and cities, while many women, destitute and with no skills or opportunities, resorted to commercial sex work. A 1995 survey found that in seven of the eight sentinel surveillance sites, HIV prevalence ranged between 1% and 4%. The eighth site, where the dam had affected land tenure, had HIV infection rates five to ten times above the level of average HIV prevalence in Ghana (Topouzis and du Guerny 1999). While causation is impossible to tease out of a complex situation like this one, it is clear that the infrastructure project may have had long-term unintended consequences in terms of HIV transmission.

Projects that increase cash income, especially to male heads of household can lead to disposable income that may be diverted to commercial sex. Livelihoods interventions may inadvertently exclude HIV/AIDS-affected households because they lack the physical capacity to engage in labor-intensive activities (SCC 2008; Thangata et al. 2007).

Topouzis and du Guerny (1999) present seven strong case studies detailing some possible unintended consequences (both positive and negative) of development projects on the HIV/AIDS epidemic. In planning programs, every effort must be made to anticipate—and manage—this kind of spillover when planning projects in any sector.

Strengths and Weaknesses of Intervention Practice

While it is clear that there is growing interest in mainstreaming and addressing HIV/AIDS and the environment in an integrated, multisectoral fashion, specific evidence regarding the successfulness of interventions is still lacking. Monitoring and evaluation is a critical concern for implementing interventions, and has too often been overlooked.

We have observed that most of the interventions addressing HIV/AIDS and the environment are relatively small scale (the Millennium Village Project being the major exception), and are usually, and often appropriately, very specific to the geographic, cultural, and epidemiological profile of the project site. While this is probably useful programmatically in terms of successfully addressing the specific needs of the target community, it means that comparing interventions is extraordinarily difficult.

The language of mainstreaming is often vague; it is critical to define, insofar as possible, what precisely we mean when we talk of “capacity building,” “added value,” or “integration.” The use of appropriate indicators is one crucial step toward being able to understand a program’s true impact and to compare it to other similar interventions.

Disentangling the results of a single project—especially a multisectoral one—from background longitudinal changes, and confounding factors is a tricky endeavor. Improving methodologies for having a “control” or comparison group, for adjusting for confounders, for collecting longitudinal data (including good baseline information), and for detecting other changes that may be affecting the results of an intervention should be priorities. We did not find examples of existing community randomization or step-wedge trials for evaluating interventions, but these may be options for future studies.

There is a distinct feeling that organizations and individuals working on integrated HIV/AIDS-environment interventions are working in isolation. The small-scale and highly locally contextualized nature of many of the interventions is one barrier to scale-up and comparability. Information and experience sharing—developing a set of best practices and a framework from which to launch integrated projects—will be tremendously helpful in solidifying the good work that is already being done. The FRAME online network (http://www.frameweb.org), sponsored by the African Biodiversity Conservation Group (ABCG) and others is an example of a tool designed to let implementers share their stories, successes, and challenges in a public forum. Nonetheless, a barrier to implementing this kind of network is access; people working in environmental and conservation in Africa are often far from the kind of infrastructure, like affordable broadband Internet, which allows this type of communication to be truly fruitful.

There is always concern with highly funded subject areas such as HIV/AIDS, that funding dictates practice, that vertical programs create parallel systems, and that equally important community issues go unaddressed when HIV/AIDS takes the stage. Whenever possible, implementers should try to bolster existing community structures, to focus on the important (rather than strictly the fundable) questions, and to use participatory methods to conduct on-the-ground needs assessments in communities. HIV/AIDS is a development issue, as is environmental sustainability, and the two must be addressed in a context of sensitive, culturally competent, appropriate development work.

The excitement and momentum of multiple funders, NGOs, and other agencies wanting to get involved in mainstreaming and in integrated PHE or HIV/AIDS-environment programming rings with optimism of what can be achieved in this field. While there is promising growth in terms of both research and implementation, the field is still "new," and the subject is ripe for investigation and action. Ensuring both a strong base of evidence and sensibly monitored and well-evaluated interventions, however, will be critical for the success of the field.

Knowledge Gaps

There has been a clear surge in the past decade in enthusiasm, activity, and momentum for work—both research and implementation focused—on the links between HIV/AIDS and the environment. We had not anticipated finding as many materials on the subject as we did. Nonetheless, the vast majority of the evidence remains anecdotal and/or unreplicated. The anecdotal nature of much of the evidence does not imply that the conclusions reached are in error, but rather that data to back up many of the conclusions should be validated to provide a strong, evidence-based platform for program development and to maximize the return on investment in these new programs.

We read over 200 documents, of which 177 were included in the writing of this report. Many excellent reports from various agencies contain valuable information on the links between HIV/AIDS and the environment. There are also good guidelines and toolkits available from various agencies for how to mitigate the effects of HIV/AIDS, e.g., via mainstreaming. However, there are relatively few peer-reviewed cited research documents in these reports and many reports cite other reports. For example, of more than 140 citations in 4 IUCN-ESARO/IPPF-ARO desk reviews (Matiru and Osur 2008; Mwakitwange and Bashemererwa 2008; Tassew 2008; Tumwine 2007) on HIV/AIDS and the environment in East Africa, only 12 could be clearly identified as being in peer-reviewed journals, and 6 of those were medically related. Our review located 48 peer-reviewed original research articles. This implies a failure to get original research into the hands of policy makers for

Important Research Needs in Investigating HIV/AIDS-Environment Linkages:

- HIV/AIDS, natural resource use, and livelihoods related research needs
- Climate change related research needs
- Health and HIV transmission related research needs
- Issues of scale

Research Priorities for HIV/AIDS, natural resource use, and livelihoods related research:

- Traditional medicines, and natural resource use
- Socioeconomic effects, livelihoods and coping strategies
- Management, governance and markets
- Migration and land tenure

use in report writing and decision-making. The calls for better integration between academic researchers, policy makers and implementation personnel should be heeded.

Spatially, we focused on sub-Saharan Africa and found peer-reviewed original research articles from many countries, but given the number of countries in sub-Saharan Africa and the variations in ecological, cultural, political and socio-economic regions with countries, clearly the spatial coverage of research needs to be expanded.

The most glaring lack of research is studies that have a longitudinal focus with repeated measures over several years. Additionally, few of the studies utilize sufficiently robust comparison groups or randomized designs. Snapshot information gives a quick glimpse of issues, but without long-term follow-up the view is likely distorted, especially when dealing with ecological, health-related, and socio-economic conditions that are in a state of flux. The lack of spatially broad, longitudinal data leads many writers to issue grand generalizations based on information that is likely heavily constrained by specific time and place acquired data. Many of these generalizations make 'sense' but are not backed up by evidence, and may not truly function as universals. For instance, as shown in several papers on land tenure, although loss of land tenure due to AIDS mortality appears to be the norm, there are places where rules are in effect to guarantee that land is not lost.

With respect to natural resources use, there is much agreement as to the pathways through which HIV/AIDS can result in overuse and damage of various resources such as timber and medicinal plants. What is glaringly lacking is documentation of status and trends of the various resources and of the extent of use by HIV/AIDS affected households vs. poor households without HIV/AIDS. Similar issues exist in the broader environmental arenas of the agricultural, livestock and fisheries sectors.

Below, we discuss in more detail specific gaps identified in the literature.

The literature we reviewed is rife with calls for research to address a wide range of knowledge gaps. One of the overall themes in many of the documents is for better integrated, multisectoral research and approaches (Anema et al. 2009; Barany 2003; Costello et al. 2009; De Souza 2009; De Souza et al. 2008; Dwasi 2002; Hemrich and Topouzis 2000; Hunter et al. 2008a; Oglethorpe and Gelman 2008; Parker et al. 2009; Topouzis and du Guerny 1999). There is a pronounced need to link academic research with policy and intervention programs especially for monitoring and evaluation.

We artificially segmented the research needs into four categories but do not imply that these categories are isolated from one another. The categories include three "topic areas" requiring additional research, and one major challenge to conducting and comparing research studies: the issue of scale. We address the research needs within the following categories.

Remember that these categories are somewhat arbitrary and are used for organizational purposes only. In this section we describe specific calls for research found in the literature review. These will be distilled into recommendations in a later section.

HIV/AIDS, Natural Resource Use, and Livelihoods Research Needs

Perhaps the most often cited area of research need is the issue of clarifying the relationship between HIV/AIDS and livelihood security, including dependence on natural resources and the impacts of natural resource use on the environment, biodiversity, and conservation.

We identified four general categories needing additional research under this heading. The general categories that we identified in this category are loosely based upon four critical categories suggested by Barany et al. (2005).

Traditional medicine and natural resource use

More research is needed on the use of natural products and traditional medicines used to treat HIV/AIDS and the symptoms of opportunistic infections. Based on case study research in Malawi and Mozambique, Barany et al. (2005) identified various research needs ranging from the specific, e.g., interactions between Annona senegalensis (a Vitamin A rich fruit) and ARVs, to the more general such as investigating whether natural resource use is different where the use occurs largely in commercial private-sector managed forests such as in South Africa, Swaziland, and Zimbabwe, than in most countries that have mostly publicly-managed forests. (Oglethorpe and Gelman no date) note the need for continued research on medicinal plants. De Souza et al. (2008) call for documenting traditional ecologic knowledge and additional information on cultivation and use of traditional medicinal plants.

Socioeconomic effects, livelihoods, and coping strategies

The rural poor in general are dependent on natural resource-based livelihoods. It can be difficult to identify coping strategies and socioeconomic impacts that are specific to HIV/AIDS-affected households and not to poorer households in general or those affected by other chronic diseases. Households that lack resources often turn to 'free' natural resources to meet their daily needs. The interactions between natural resource-based livelihood strategies and other forms of coping strategies and social safety nets in relation to both HIV/AIDS and to poverty is an area needing additional research (Barany et al. 2005; De Souza et al. 2008).

To the extent possible, differences in types and amounts of natural resource use and livelihood coping strategies between HIV/AIDS-affected households and non-affected households need to be clarified. Hunter et al. (2008b) provide an enticing glimpse into differential household use of natural resources when faced with the death (from any cause, not just HIV/AIDS) of a productive adult member. They partitioned use into categories of deciding which resource to select, how much of that resource to use, and acquisition questions such as who will collect the resource, how will it be collected and where will it be collected. More work is needed in this arena.

Anecdotal reports of natural resource use abound but there is an urgent need to quantify the amount and type of use and the magnitude of effects on the resource being used (Oglethorpe and Gelman 2008). Until there is much better documentation and quantification of the type and extent of natural resource use, the direct effects of the HIV/AIDS pandemic on biodiversity will remain unclear (McGarry and Shackleton 2009).

There is also a lack of rigorous research addressing HIV/AIDS and conservation or natural resource use and management. (De Souza et al. 2008) specifically call for research addressing trends in natural resource use including fuelwood, charcoal making and bush meat trade, and for documenting best practices that can be replicated and/or modified in other settings. Identifying alternative materials where resources are known to be used unsustainably, such as timber for coffins in Kisumu, Kenya, is critical for protecting resources (Dwasi 2002).

Barany et al. (2005) call for more focused research on the differential use of natural resources by specific population groups, e.g. widows, orphans and the elderly. Oglethorpe and Gelman (2008) urgently call for research to quantify the impacts of HIV/AIDS on land, natural resources, and environmental organizations, while also implementing interventions focusing on HIV/AIDS and environment from a gender perspective, in the field and at policy level.

Torell et al. (2006) report an increase of women bartering sex for food or money in five of the eight coastal villages studied. Research to improve understanding of the tremendous gender inequality that currently exists in many areas is necessary to understand the root causes of risky sexual behavior, the HIV/AIDS epidemic and poor health in general, and unsustainable resource use.

We found little mention in the literature on the role of the livestock sector in terms of its importance for agricultural development, food security, and trade in the country/region and how it is affected by HIV/AIDS. One paper (Engh et al. 2000) recommends more research to assess the relationship between livestock and HIV/AIDS. This study from Namibia raises many researchable questions including documenting the effects of increased human medical costs on selling livestock or slaughtering them for funerals, how care and management of livestock is affected by HIV/AIDS incapacitation and

loss of adult knowledge, how the inheritance system deals with livestock, and how livestock production is affected by loss of extension staff. (Barnett et al. 1995) also mentioned livestock ownership as a buffering factor in the effect of HIV/AIDS on livelihoods. Another relatively unstudied area is the effect of HIV/AIDS on livelihoods of pastoralist societies (Topouzis and du Guerny 1999).

On a more human level, we do not know what long-term social, economic, environmental, and psychological effects will arise from the orphaning of millions of children (Gillespie and Kadiyala 2005).

Management, governance and markets

There are structural/policy related issues that either arise from or influence the effects of HIV/AIDS on different sections. Workforce loss is frequently raised as a growing concern in natural resource and conservation organizations, but there are few documented numbers available. Information is needed on the magnitude of loss within conservation organizations and other sectors regarding actual costs and loss of institutional knowledge (De Souza et al. 2008; Gelman et al. 2005; Hemrich and Topouzis 2000).

De Souza et al. (2008) identify several management and governance issues that will benefit from additional research. Identifying which types of past or on-going integrated projects and programs have had the most successful and sustainable outcomes will help guide future integrated approaches. It is also fruitful to assess the integrated model of extension delivery and determine the effectiveness of partnership activities coordinated at sub-country and district levels. Determining the actual costs and benefits of up-front budgeting for partnership activities and having dedicated administrators for building and sustaining partnerships is necessary for comparing this to other models of meeting integrated institutional or programmatic goals. Creating national level umbrella programs under which integration is encouraged would facilitate accomplishment of the above activities. Identifying areas where policies are in conflict or hinder integration will allow for policy improvement. Concrete information is lacking on how agriculture and other livelihood systems, policy and practice contribute to the spread of HIV in urban as well as rural areas (Gillespie and Kadiyala 2005).

Additional research on the costs and benefits of existing, successful inter-agency partnerships, such as one in Uganda between an AIDS group, an agricultural research group, and a women's group to address food insecurity in HIV/AIDS settings (De Souza et al. 2008) is needed in different development sectors to facilitate policy- and program-related decision making and to persuade agencies to internalize partnership management roles and practices.

Ellis and Allison (2004) address diversification of livelihoods in poverty settings and also identify research needs that have application to HIV/AIDS affected households specifically. Major research questions include how:

- land tenure reform affects the poor's access to land
- taxation and business licensing affects the poor's incentive and ability to develop income generating activities
- migration and remittances affect people's access to natural resources, and
- livelihoods diversification affects community based natural resource management.

Migration and land tenure

As noted in the literature review above, there are a variety of ways in which land tenure issues arise in HIV/AIDS cases and research is needed to better understand site-, gender- and age-specific context (Aliber and Walker 2006; Drimie 2003; Kiai et al. 2002). The disposition of land after adult owner death is often cited as strongly affecting AIDS widows. Loss of land may necessitate migration to find other ways to survive. Frank and Unruh (2008) noted differences in the ability of early arriving vs. later arriving migrants to access land tenure and their use of HIV/AIDS as a factor 'entitling' them to land. They argue that there is a need to look for nuanced responses in various settings based on perceptions to fully understand the many ways that HIV/AIDS affects land tenure.

Climate change-related research needs

A second major area in which authors have identified a pressing need for additional research is that of climate change. There is an increasing awareness that changing climates

will aggravate many health, environment and social problems including HIV/AIDS (Gommes et al. 2004). Continued documentation of actual and potential risks of climate change to health, livelihoods and vulnerabilities needs to continue (Besada and Sewankambo 2009; Costello et al. 2009; Daily and Ehrlich 1996; Frumkin and McMichael 2008; UNICEF Innocenti Research Centre 2008).

Food insecurity, linkages between HIV/AIDS and climate change-sensitive infections, and population displacement are plausible hypotheses of how climate change will affect HIV/AIDS, but are more conjectural than scientific (UNEP UNAIDS 2008). The effects of climate change on health will be spatially inconsistent and information is needed on local effects to improve local programmatic mitigation (Lotze-Campen and Schellnhuber 2009). More information is needed on seeds and crops that will perform in new climatic settings (IRG-USAID 2008). Many documents including (UNICEF Innocenti Research Centre 2008) list proposed strategies for adapting to climate change and reducing vulnerability, but there is little evidence-based research on which are most likely to be successful. Lists of climate change adaptation strategies seldom go beyond the intuitively obvious. There is a lack of understanding of the process of adaptation to predicted climate change, of the decision making process including the roles of various stakeholders, and of barriers and constraints including costs that limit adaptation to and mitigation of climate change (Confanlonieri and McMichael 2007).

Major challenges in research for quantifying and predicting health effects due to climate change include issues of scale and clarification of the usually complex, multifactoral, and indirect causal pathways (McMichael et al. 2003). Costello et al. (2009) call for research on five climate change/health topics:

- documentation of climate change risks to health and vulnerabilities
- health protection strategies
- health co-benefits of carbon dioxide (CO_2) reduction
- decision support systems for climate prediction (region specific), and
- financial cost estimates.

Additionally, McMichael et al. (2003) call for research to document baseline relationships between climate and health, early evidence for climate change, and scenario-based predictive models on health pathways.

Longitudinal studies and identification of economic and social indicators and trends related to climate change are a necessity, as are age and gender specific information (UNICEF Innocenti Research Centre 2008). As in the other topics discussed in research needs, strengthening of information, technological and scientific capacity in developing countries is crucial (Costello et al. 2009). In so far as climate change and health affect and are affected by sustainable development, more research on synergies among the three is also warranted (Halsnaes and Verhage 2007).

Health and transmission-related research needs

It is well beyond the scope of our expertise or the needs of this report to address all research needs related to health and transmission of HIV, but there are some intersections where information from health-based research will inform practices and outcomes in the HIV/AIDS and environment arena.

Although various studies have found a link between food insecurity and risk behavior, especially transactional sex, few have used validated scales or been longitudinal. Longitudinal research is also needed on the role of food insecurity on immunologic, virologic and mortality outcomes. Increased evaluation on the effect of targeted food assistance and sustainable livelihood strategies on HIV/AIDS transmission, treatment and outcome is also needed (Anema et al. 2009). Research on the aforementioned topics should also look at differential responses by age, gender and socio-economic-cultural background (Oglethorpe and Gelman 2008). Food insecurity as it relates to mother to child transmission and the mechanisms through which food insecurity might increase the risk of mother to child transmission are also needed (Anema et al. 2009).

Research on anti-HIV plant substances should undoubtedly be encouraged (Cos et al. 2004). More research is needed on the efficacy of traditional medicines, especially as they

affect anti-retroviral treatment. In addition, documentation and dissemination of nutritional values of common and/or overlooked native foods is lacking (Barany 2003), but could play an important role in improving health status.

Tourism, often seen as a mechanism to improve livelihoods, may also contribute to the spread of HIV/AIDS via workforce mobility, sex tourists, and alcohol and drug use in vacation setting. However, there is scant research on the relationship between tourism and HIV/AIDS prevalence and transmission (Ngoti and Baldus 2004).

Issues of Scale

One of the major issues associated with conducting research on the links between HIV/AIDS and the environment is that of scale. Understand the role of the environment on HIV/AIDS or vice versa often requires information gathered at relatively large spatial and temporal scales. Few studies are conducted at such scale. Simple summing of multiple, smaller scale studies does not work where there are feedbacks, compensations, and synergies.

Data on population, health, and environment (PHE) are often incompatible and incomparable because of differing scales of data collection. The effect of HIV/AIDS on individual household decision-making that affects the environment and land use is difficult to discern from aggregate data on prevalence and extent of infection (Hunter et al. 2008b). Issues related to stigma, unwillingness to know or declare HIV-status, and privacy complicate fully rectifying this gap.

Another issue is the lack of longitudinal data on virtually every topic of research relating to HIV/AIDS and the environment. Spatial and temporal data need to be collected on resource use, coping strategies, livelihood diversification, and institutional effects, as they relate to HIV/AIDS and the environment.

An interesting observation is that most of the research on adult mortality has focused on the individual or household level. Few studies addressed the effect of adult mortality at the community level (Drimie and Gandure 2005; Jayne et al. 2006). There is a distinct lack of information examining why some communities are more resilient to adult mortality than others (Jayne et al. 2006).

A Conceptual Framework for Linking HIV/AIDS and the Environment

After evaluating the literature, we have developed the following conceptual framework for illustrating the complex interactions between HIV/AIDS and the environment. Figures 1, 2, 3, and 4 demonstrate the most important linkages at the community and household levels, the connections between climate change and the HIV/AIDS pandemic, and the workforce effects of HIV at the institutional level. The diagrams were developed based on both the themes emerging from the literature review and a number of helpful conceptual frameworks developed by other authors (see also, Barany 2003; Torell et al. 2007; Ezeaku and Davidson 2008; McMichael et al. 2008b; Parker et al. 2009.

Upstream Factors: Poverty, Gender Inequality, and Social Disruption

Based on the tenets of prevention from the health arena and of addressing causal factors (ultimate) rather than symptoms (proximate) in the environmental literature, we have identified three major upstream factors (Figure 1) that affect all aspects of the HIV/AIDS/AIDS-environment nexus: social disruption, poverty and gender inequality. These three factors are intimately linked to one other and are the start and end of a negative feedback loop in the HIV/AIDS and environment cycle.

We consider poverty to be the keystone of these three factors, that is, the factor which if altered will propagate the most important effects throughout the system. We define poverty in the broadest terms, not just as lack of money but also as the lack of access to information and resources with which to address basic human needs. The Universal Declaration of Human Rights states that nutrition, water, sanitation, shelter, education, and health are basic requirements of human well-being, and we argue that health is dependent on the sufficient presence of all of the other rights. Poverty can generate conditions of food insecurity, inadequate water and sanitation, poor health and a multi-disease health burden, lack of access to public goods such as education and health care, and tenuous property rights. The impoverished, because of the burdens of these

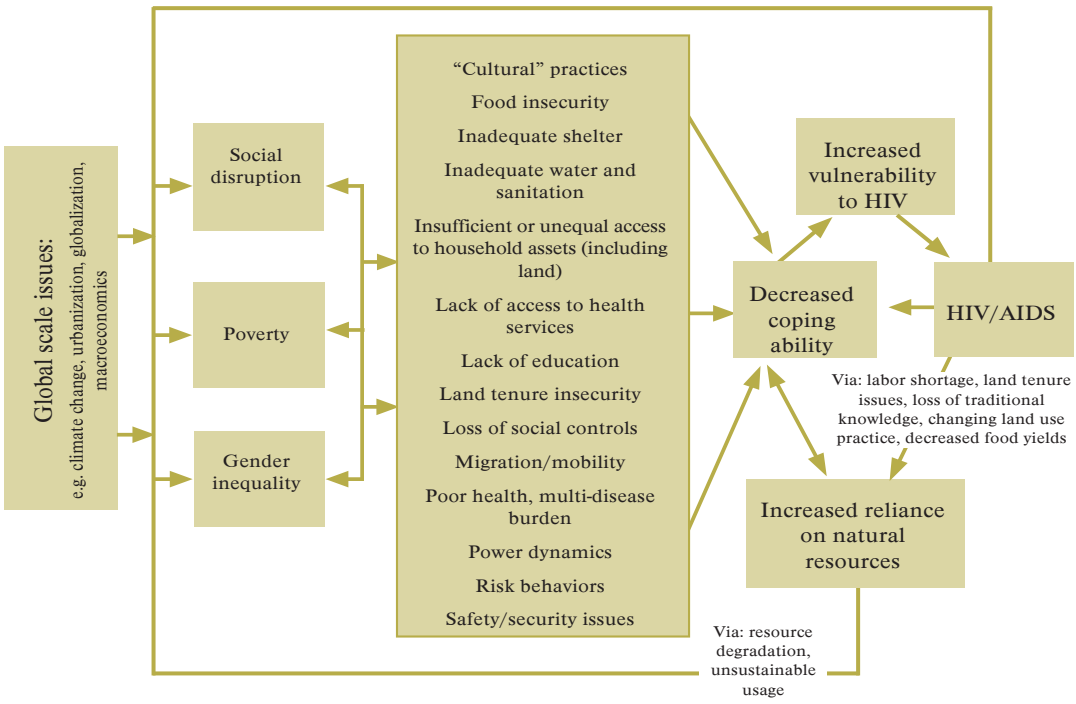

Figure 1: Linkages between HIV/AIDS and the environment at the community level

multiple stressors, have a decreased coping ability for meeting basic needs. Poverty is furthermore often "hereditary," with children of impoverished parents unable to climb out of the poverty trap because of the disadvantages in terms of access to health and health services, education, and information into which they were born. The connections between HIV/AIDS and the natural environment assume a backdrop of poverty. Pervasive poverty "sets the stage" for the vicious interactions between the pandemic and the environment.

Like poverty, gender inequality is an upstream determinant of the both the HIV/AIDS pandemic and of the pernicious interactions that connect HIV/AIDS and the natural environment. It is a condition upon which these connections are predicated, and, like poverty, represents one of the ultimate causes of both the epidemic and of the vicious cycles. Gender inequality takes many forms, including:

- Lack of access of women and girls to income, education, resources, information, adequate nutrition, water and sanitation, and health services
- Women and girls' heavier burden of health problems and safety and security issues
- Power differential in sexual relationships, and the expectation that women will be passive and ignorant in matters relating to sex.
- Discriminatory "cultural practices" such as early marriage, famine marriages, female genital cutting, and widow inheritance that can endanger women and girls

Like poverty, this inequality predisposes women to be less able to cope with vicissitudes, be they economic, psychosocial, physical, or environmental.

Social disruption, in the form of conflict, migration, and the loss of social controls, is another important upstream factor affecting the interactions between HIV/AIDS and the environment. HIV/AIDS flourishes in conditions of inequality, lax social controls, conflict, and mobility. Likewise, systems out of control are likely to foster environmental disruption. As traditional structures that govern human interactions and use natural resources erode, communities are less likely to be able to cope with everyday needs. People affected by war, landlessness, or forced migration are already especially vulnerable and susceptible to HIV.

Coping Ability: The Key Factor

Coping ability is a linchpin in the flowchart of Figure 1. We conceptualize decreased coping ability as the key step mediating between the upstream determinants of social disruption, poverty, and gender inequality, and the downstream effects of HIV infection, increased reliance on natural resources, and environmental degradation.

Coping ability is resilience, capacity for adapting to changes, and ability to recover after a disturbance. Decreased coping ability means vulnerability to every kind of insult, including HIV infection. That is, people affected by poverty, food insecurity, landlessness, lack of access to resources and services, oppression, pervasive inequalities, and the atrocities of war are in every way less able to deal with problems of every sort. Coping ability is affected by social and individual capital and reflects economic, psychosocial and physical resilience to adverse events.

HIV/AIDS does not occur in isolation. It flourishes in conditions of underdevelopment and inequality, as do nearly all infectious diseases and social ills. The boxes in Figure 1 for "increased vulnerability to HIV" and "HIV/AIDS" could just as easily be replaced with "diarrheal disease," "teen pregnancy," or "childhood mortality."

The increased pressures wrought upon people by social disruptions, poverty, and gender inequality make them more vulnerable to HIV infection and also make them less likely to be able to deal with—cope with—the negative outcomes of HIV/AIDS.

A Vicious Circle

As we see it, the interaction between HIV/AIDS and the environment hinges upon the vicious circle contained in the right-hand side of Figure 1. This cycle is predicated upon the upstream effects of poverty, gender inequality, and social disruption, and begins and ends with decreased coping ability.

Decreased coping ability makes people and communities more vulnerable to HIV/AIDS. HIV/AIDS in turn leads to increased dependence on natural resources, as households lose labor force, land tenure, and traditional knowledge,

and are less able to maintain their previous livelihoods. This increased reliance on natural resources in turn makes communities even less able to cope, as they become more and more exposed to the vagaries of nature, weather, and availability of resources. Infection with HIV/AIDS also itself decreases coping ability, which may lead to both behavior that increases HIV transmission and also increase natural resource use. The cycle is self-reinforcing and reciprocal.

Furthermore, these downstream "effects," in turn, feed back into the three upstream determinants—poverty, social disruption, and gender inequality. Because increased reliance on natural resources may lead to unsustainable land use and resource degradation, it forms a feedback loop, increasing poverty and again decreasing coping ability. HIV infection likewise feeds back, generating more social disruption as institutions continue to erode, contributing to increased poverty, and reinforcing gender inequality, as women are overrepresented among the HIV-infected and –affected. Intergenerational poverty, as AIDS-orphans are left with few resources, is another compounding factor in this vicious circle.

It is also important to note that the vicious cycle can be completed without ever involving HIV infection. As illustrated by Figure 1, a direct path from poverty, through impaired coping, can lead directly to increased reliance on the natural environment, bypassing HIV infection, and creates a second self-reinforcing loop. Teasing out the effects of poverty and the effects of HIV/AIDS on natural resource consumption and its environmental effects is addressed in this report as a future research priority.

Zooming In: Connections at the Individual Level

The dynamic discussed above and detailed in Figure 1 focuses primarily on the community level. We will now "zoom in," to examine the connections between HIV/AIDS and the natural environment at the individual or household level, depicted in Figure 2.

As with the community-level interactions, the individual/household interactions between HIV/AIDS and the environment are characterized by interconnecting feedback loops.

Let us start at the center of the diagram, with HIV vulnerability, transmission probability, and morbidity. As discussed elsewhere, these are conditioned by lack of health services, multi-disease burden, and malnutrition, as well as by the risk behaviors necessary for acquiring the virus. Nutrition, in turn,

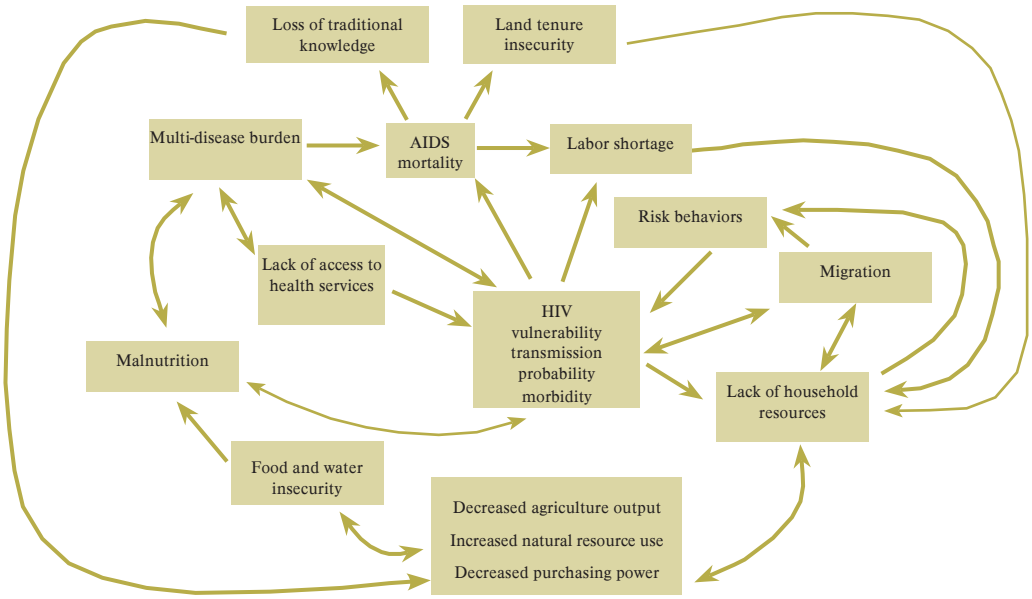

Figure 2: Linkages between HIV/AIDS and the environment at the household level

is determined in part by food and water security, for which households depend upon agriculture, natural resources, and purchasing power. If a household lacks resources (e.g., capital, knowledge, land, livestock), it will be unable to maintain a livelihood, and therefore unable to provide food and water security for itself, making its members more vulnerable to malnutrition, and therefore to HIV infection (among other ills).

Stepping back in the cycle, lack of household resources can be conditioned by migration, lack of labor availability at the household level, and landlessness. These conditions, in turn, are deeply affected by HIV/AIDS illness and mortality.

Loss of traditional knowledge through HIV/AIDS mortality also directly affects livelihood mechanisms such as agriculture and natural resource collection, and feeds back into a lack of household resources. Lack of household resources can lead to migration, risky behaviors (such as commercial sex), and back to HIV vulnerability, completing the vicious circle.

Note that environmental degradation is not included in Figure 2, because this diagram focuses specifically on the individual/household level, and large scale degradation occurs with an aggregation of households and multiple pressures on the environment.

Zooming Out: Connections to Global Environmental Change

As we see it, global environmental change—"climate change"—will have important and wide-ranging effects on the relationship between HIV/AIDS and the environment, and it is therefore important to examine these interactions on a larger scale.

Figure 3 shows the vicious cycle between climate change and its immediate effects, decreased coping ability, increased HIV/AIDS, economic instability, increased natural resource use, and environmental degradation. As in Figure 1, discussed above, this cycle takes place against a background of social disruption, poverty, and gender inequality.

The effects of climate change on the natural environment, including biodiversity loss, natural disasters, precarious food and water security, and an increase in vector-borne disease, will certainly have an impact on human health and well-being (McMichael et al. 2003). Through increased poverty, social disruption, forced migration, and conflict, the effects of climate change will further weaken communities' and households' coping ability, predisposing them to HIV vulnerability, risk behaviors, and infection. As discussed previously, HIV/AIDS then produces increased natural resource use through labor shortages, loss of traditional knowledge, etc., and natural resource use can feed back to generate additional climate change, through degrading the land and natural resources.

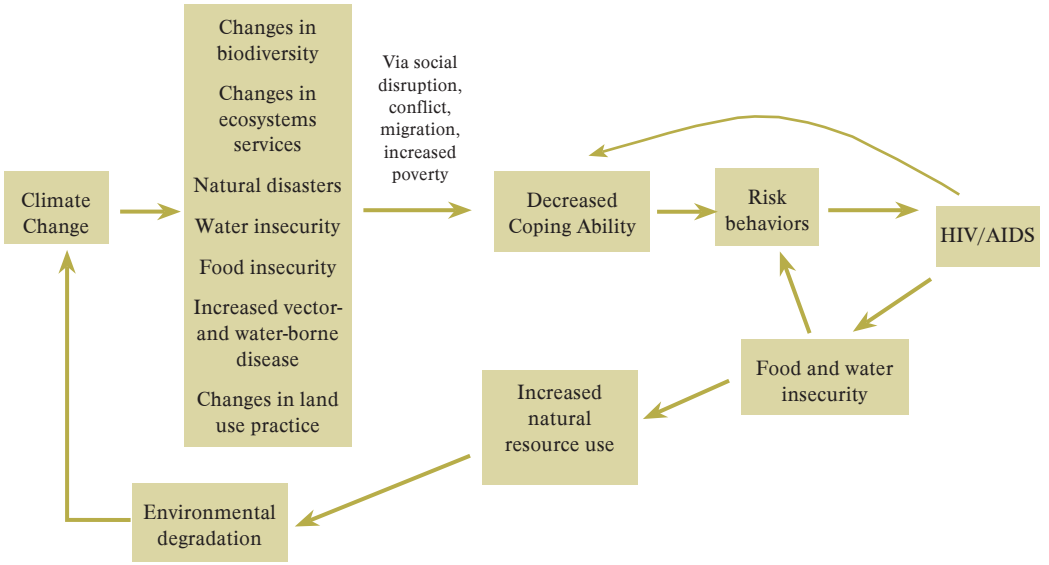

Figure 3: Effects of climate change on the links between HIV/AIDS and the environment

Institutional Effects of HIV/AIDS on Conservation/Environmental Organizations

Figure 4 illustrates effects of HIV/AIDS on conservation/environmental organizations. Because protected areas are often in remote regions, personnel are frequently posted for long periods of time away from their families and rotated from site to site. This coupled with the lack of HIV awareness or access to condoms can increase the risk of HIV infection. Staff members who become HIV-positive or have family members who are infected are less available or less capable of performing their duties. Organizational productivity drops due to loss of leadership and trained professionals, loss of institutional memory, and low morale. These losses in turn decrease the ability of the organization to perform programmatic tasks such as research, law enforcement, tourism, protected area management and community work. Inadequate performance of or inability to perform these tasks can result in an increase in overharvesting and other illegal activities that degrade the protected resources. There may also be a loss of up-to-date information on status of the resources and funding diversions to other activities such as HIV treatment that affect protection of the resources.

Tensions

When we began to discuss the way forward after having reviewed and evaluated the existing evidence on the interactions between HIV/AIDS and the environment, a number of salient tensions arose.

- There is a tension between acknowledging that upstream determinants (ultimate, rather than proximate factors) are absolutely key to stemming the problems associated with HIV/AIDS and the environment, while conceding that the proximate factors are more easily actionable and researchable. The upstream

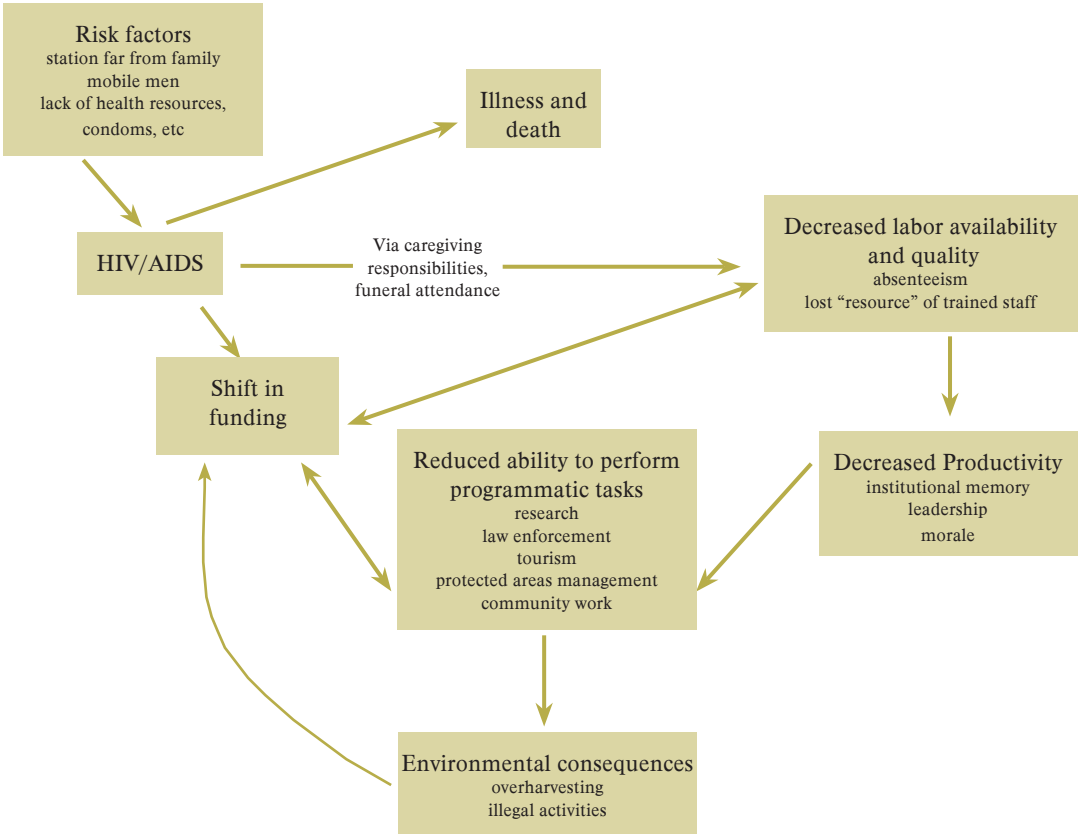

Figure 4: Institutional level linkages between HIV/AIDS and the environment within conservation/environmental organizations

determinants of the interactions between HIV/AIDS and the environment—poverty, social disruption, and gender inequality—are beyond the scope of any one agency or government's purview, but are nonetheless critical to address, and have been shown in population-based epidemiological studies to affect HIV/AIDS prevalence profoundly. Interventions addressing the proximate causes are less verified in the literature as being effective, but have traditionally been the focus of HIV-prevention campaigns because of their practicality.

- A disciplinary tension between public health and the environmental sector also exists. The priorities of public health organizations may differ from, and even conflict with, those of environmental organizations. For instance, the public health literature glows about the benefits of wild foods as nutritional supplements for people living with HIV/AIDS, while the environmental literature worries about the biodiversity effects of wild food collection. What one field may see as an opportunity, the other may perceive as a threat.
- A tension between site-specificity and replicability/comparability of research and interventions is another issue. Most research and implementation of interventions addressing HIV/AIDS and the environment has been relatively small-scale, and has been highly contextualized by the local geographical, cultural, agricultural, and epidemiological climate. While this is usually appropriate scientifically or programmatically, it makes for challenges in comparing or replicating studies or interventions in other settings.

The Way Forward: Recommendations

Recommendations Discussed at Collaborator's Meeting, 5 March 2010

A planning meeting identifying next steps in moving forward with an HIV/AIDS and the Environment Program between the University of Washington and partners in Africa was held 5 March 2010 at the IUCN-ESARO headquarters in Nairobi, Kenya. Twelve persons attended, representing the University of Washington, University of Nairobi, IUCN (ESARO and the Uganda Office), the International Planned Parenthood Federation (Africa Region) and the East African Wildlife Society. Introductions were made, followed by brainstorming sessions on research topics and intervention action of interest to the group. A priority matrix voting system was used to identify the consensus priorities in research and interventions. The group expressed a strong desire to avoid research for research's sake. The following general research topics were identified, discussed and then prioritized as indicated below.

Priority Research Topics in Order of Interest

1. Compare prevalence and interactions between HIV/AIDS and the environment across different types of conservation areas: governmental, private, and community based protected areas. This includes HIV/AIDS effects on workforces protecting and managing the areas, use of local households (with and without HIV) of resources in and around the protected areas, status and trends of resources within and near the protected areas, responses of management agencies to HIV/AIDS, and financial costs to agencies related to HIV/AIDS including replacement of trained staff and the effect of the environment on HIV/AIDS, e.g. access to and use traditional medicines and wild land foods.
2. Use district level data on status of environment and prevalence of HIV/AIDS to identify relationships between environmental condition and prevalence. Do high quality environmental conditions and availability or unavailability of natural resources correlate with reduced prevalence of HIV/AIDS?
3. Investigate migration impulses to areas of abundant resources, including employment from development projects such as roads and ports and the cut flower industry as well as protected areas or areas with better soils and rainfall for farming. How are the areas with better natural resources or increased employment opportunities being managed to mitigate increased susceptibility to HIV? How has the influx of migrants affected natural or social resources in the areas receiving them? Try to control for the effect of poverty vs. effect of HIV/AIDS on those migrating.
4. Conduct policy analysis to identify where policy is creating negative effects on HIV/AIDS-environment interactions and identify ways to neutralize such policies. This includes both protected areas and agricultural areas as affected by governmental policies. How do the policies affect susceptibility to HIV and/or protection of natural resources? Include consideration of increased interest in payment for environmental services. How can those services be quantified, who will pay and who will receive? Also what effect is consideration of climate change having on policy?
5. Track funding streams in the conservation, climate change and HIV/AIDS arenas. Are funds being diverted from one category to another? Do funds for a topic reflect policies in place concerning that topic?

Intervention priorities

1. Develop a collaborative group with a designated coordinator to facilitate integration, dissemination of information, and keep interested parties informed of activities and advances in the HIV/AIDS-environment arena. Build a consortium consisting of UW, UoN, IUCN-ESARO, IPPF-ARO, SCC/VI Agriforestry and East African Wildlife Society as the initial core group. Consider adding other partners at a later date. Establish a secretariat and assign responsibilities and roles in moving the project forward. Formalize relationships between organizations; partnerships are currently loose and dependent on individuals' interest in collaboration. Make collaboration an institutional responsibility. This collaborative group will ideally provide structures, skills, and human resources, and seek funding for moving forward with joint projects in research and/or implementation of interventions.

2. Conduct efficacy, effectiveness, and operations research on existing models of implementing integrated HIV/environment interventions, seeking evidence-based, practical interventions for scaling up and disseminating. Systematically test existing integrated interventions to understand the most critical steps and principles in implementation. Form a set of guidelines for integrating HIV/AIDS and environment projects, then test and modify it. These guidelines could then be used for scaling up evidence-based interventions at the regional level. Examples of models to be tested included community ecotourism, environmentally based income generating activities (IGAs), and comparisons of parallel interventions in urban and rural settings. Essentially, seek out the most successful interventions and practices for scaling-up and disseminating.

3. Build capacity at the local level. While many organizations have seen enthusiasm at the community level for addressing the HIV/AIDS epidemic in conjunction with conservation or environmental issues, capacity for doing so is lacking. Conservation organizations typically do not have staff well versed in HIV/AIDS issues and health organizations typically do not have expertise in conservation. A number of highly motivated groups (such as community conservation groups and HIV/AIDS support groups) have already been mobilized, and there is a consensus that capitalizing on the strengths and momentum of these groups will help to move integrated projects forward. Capacity building, in the form of information/experience sharing, additional training, and sensitization is needed at the level of the community-based organization (CBO). Likewise, organizations, including those at higher levels such as government and policy-making bodies, need additional training and capacity building on integrating projects. Developing a standardized curriculum and training trainers to build capacity on integration/mainstreaming is a priority.

4. Form networks of interested HIV- and environmentally-focused CBOs and create a clearinghouse or resource center for information sharing. This kind of experience-sharing is valuable at both the local level and at the national level, and should be encouraged by forming virtual or physical libraries or resource centers. Experience-sharing should also ideally help to minimize duplication of effort and to allow for partnerships between organizations working in similar geographic or programming areas. Encourage workshops or site visits between organizations to disseminate success stories. On a related note, strengthen and reinvigorate the national level networks that already exist for PHE.

Recommendations from Literature Review and Site Visits in Kenya

We agree that the recommendations that came out of the collaborator's meeting (detailed above) are fruitful avenues for addressing the linkages between HIV/AIDS and the environment. Below, we present several additional areas of research and intervention that were prominent in the literature that should be pursued.

Monitoring and Evaluation is Critical

Monitoring and evaluation (M&E), including development of standardized variables, measures, methodologies, and indices, is a fundamental principle for research or implementation. Without comparable data and methods, it is difficult to assess spatial, temporal, environmental and cultural differences among studies. In addition, implementation science (also known as operations research) is urgently needed, as is work "translating" research and policy to action.

In the research arena, there are a number of subject areas in which development of standardized measures would be useful. Explicit monitoring of the effects that poverty alleviation projects have on ecosystems and their services is needed along with multidisciplinary science to identify cost-effective solutions (Sachs et al. 2009). Standardized measures for a variety of factors regarding food insecurity are also needed, as effective assessment of the role of food insecurity in health and HIV/AIDS depends on measurable, repeatable and agreed-upon indicators. This includes measures to address various components of food insecurity such as quantity, quality, safety and socially-appropriate methods of procurement of food, validated short questionnaires to assess levels of food insecurity, and operational assessments to determine effectiveness of interventions (Anema et al. 2009).

We have developed the following list of common problems in developing an appropriate monitoring and evaluation system:

- Baseline data are often lacking, making the outcomes and impacts of any intervention difficult to measure.
- There is a need to streamline M&E systems. Program implementers are often burdened with multiple, different reporting systems for each funder, project, or sector. Simultaneously, there is a need to hew to accepted plans and indicators within a field or for a particular donor. Sometimes conflicting plans or indicators from various donors must be juggled.
- There is a lack of appropriate, valid indicators that accurately measure what the program is achieving. Indicators for successful monitoring and evaluation must be (Finn 2007):
    - Valid – accurately measuring a behavior, practice or task;
    - Reliable – consistently measurable in the same way by different observers;
    - Precise – operationally defined in clear terms;
    - Measurable – quantifiable using available tools and methods;
    - Timely – providing measurement at time intervals that are relevant and appropriate for program goals and activities; and
    - Programmatically important – linked to achieving program objectives
- Deciding on the level and aggregation of data is a challenge. Data can be difficult to compare across disciplines if one discipline looks, for instance, at data on the provincial level, while another examines the district level, or if one disaggregates by age and gender while the other does not.
- Monitoring and evaluation considerations must be taken into account from the inception of a project; it is difficult to "go back" and include provisions for documentation and data collection after a project has begun.
- Inclusiveness of stakeholders' (both internal and external) concerns must be considered in developing a plan.
- It is difficult to define outcomes, outputs, and impacts, and to tease out what a specific project or program's effects are when multiple interventions taking place and background change is happening.
- Resistance is sometimes encountered at the community or program implementation level to monitoring and evaluation schemes. M&E is often seen as being punitive or threatening. Fostering an attitude that is receptive to monitoring and evaluation among implementers and partners is critical.
- Ensuring accurate and thorough data collection in resource-constrained settings can be challenging.
- There is a lack of methodology for documenting "intangibles," such as psychosocial and socio-cultural effects. For example, what role do the personalities and backgrounds of the individuals involved in either transmitting or receiving information during interventions affect outcomes?

Guidance for preparing monitoring and evaluation plans is available. USAID and MEASURE Evaluation's toolkit, "A Guide for Monitoring and Evaluating Population-Health-Environment Programs" provides a good starting place for thinking about developing indicators and a plan for M&E (Finn 2007). While the kit has been piloted, it needs to be tested in multiple settings. Each field site has a unique set of conditions and history, yet consistency is needed in measurements so that data can be aggregated across sites for adaptive management purposes. The balance between uniform consistency and unique settings will be difficult to find.

Documenting the "added value" of integrated interventions is a particular challenge for convincing policy-makers and funding agencies that integrating HIV/AIDS and environmental interventions is worthwhile. Added value can be economic, as in streamlining expenses, sharing costs across sectors, and making a project more cost effective. Added value can also be programmatic; for instance, conservation efforts may in fact be more effective if health interventions are also implemented at the community level, because of increased community commitment to the conservation project and decreased labor lost to illness.

Additional Research Recommendations

In addition to those presented above, we recommend the following topics as possible areas of interest for further research on the interactions between HIV/AIDS and environment.

- Determine the interrelationships between HIV/AIDS and the upstream determinants of social conflict, poverty and gender inequality in terms of their effects on ecosystems, ecosystem services and natural resource use.
- Identify and measure appropriate ecological indicators to identify status and trends of critical resources affected by HIV/AIDS.
- Examine and measure how resource overuse leads to breakdown of ecosystem function and how that leads to further food insecurity and poor health, feeding back to HIV/AIDS.
- Create inventories of known medicinal plants to track changes in numbers of plants and identify areas needing protection to avoid extirpation.
- Pursue additional pharmaceutical and clinical research regarding the effects of medicinal plants and their interactions with ART.
- Investigate the relationship between food insecurity and HIV/AIDS outcomes (for example, clarify the relationship between food insecurity and the effectiveness of ART, susceptibility to infection, and mother-to-child transmission).
- Improve understanding of land use/land tenure issues. Collect additional data on site-, gender-, age-, culture-specific uses of land and inheritance patterns.
- Quantify and predict food insecurity and human health effects of climate change.

Additionally, we recommend building internal, national capacity for conducting research in developing countries.

Additional Intervention Recommendations

Similarly, we have identified the following areas of interest in implementing integrated HIV/AIDS-environment interventions.

- Insofar as possible, address upstream factors of poverty, gender inequality, and social disruption with every intervention.
- Advocate for integration at the policy-level. Convince policy-makers that integration is an important principle. Use evidence-based research and monitored and evaluated interventions to document the added value of integration. Use research data to influence policy- and decision-making.
- As mentioned in the collaborator's meeting, evaluate various interventions systematically and identify best practices for scaling up. Examples of interventions to test include:
    - environmentally sound livelihoods such as ecotourism and natural-resource based livelihoods
    - sustainable agriculture practices
    - alternative technologies, and
    - natural resource management practices.
- Mainstream HIV/AIDS at the institutional level and implement internal workforce-based interventions. An organizational policy for HIV/AIDS and measures for dealing with the consequences of the disease within the implementing organization are prerequisite for conducting any other kind of integrated intervention and should continue at all levels of institutions and organizations.

Integrating Interventions is a Process

Table 5 illustrates a continuum from parallel interventions occurring in multiple sectors to fully integrated projects. Organizations may not be able to transition overnight from working only in their own sector on their own mandate to wholeheartedly incorporating messages, techniques, and indicators from other sectors. Any step toward integration is a step in the right direction; the transition need not be made all at once. Table 5 uses the specific example of mainstreaming/integrating HIV/AIDS or health concerns into the purview of environmental organizations. Note that, with minor adjustments, the direction of flow could be reversed, indicating mainstreaming/integrating environmental considerations into the work of HIV/AIDS organizations.

Table 5: A framework for integration of environmental and health programming
Adapted from (Oglethorpe et al. 2008)

ELEMENT 1: Relationship of Environmental Organization to Health/Development Partners

Work in: Parallel	Coordinate Efforts	Integrate Efforts

Increasing operational efficiency →

ELEMENT 2: Relationship of Environmental Priorities to Community Health Priorities

Barter—project addresses community health priorities in exchange for community engagement in key environmental activities	Entry point—project addresses community health priorities to generate community goodwill towards environmental activities	Bridge—project addresses community health priorities that are closely related to environmental priorities in hopes that later community will comprehend linkage to environmental protection	Symbiotic—project addresses health and environmental priorities that are identical for the environmental organization and community, so community goodwill towards environmental protection occurs organically

Increasing degree of conceptual linkage →

ELEMENT 3: Level of Integration in Activities, including Communication

Activities separate by sector	Separate activities with integrated messages	Integrated activities with integrated messages

Increasing degree of integration →

ELEMENT 4: Level of Integration in Project Indicators and Results

Indicators and results totally separate by sector	Indicators and results providing some synergy and benefits to each sector but not strongly linked	Good synergies and significant benefits between environmental and health sectors

Increasing degree of integration →

Summary and Conclusions

The focus of most HIV/AIDS research and programs has been on prevention and treatment, with an emphasis on behavior modification. This narrow focus excludes the broader context of the disease and ignores some of the more ultimate, rather than proximate causes of the epidemic. Poverty, gender inequality, and social conflict set the stage for enhanced susceptibility to HIV and the increased reliance on 'free' ecosystem services and biodiversity to meet increasing household needs that arising from having to cope with the effects of HIV/AIDS.

There has been a clear surge in the past decade in enthusiasm, activity, and momentum for work—both research and implementation focused—on the links between HIV/AIDS and the environment. We reviewed existing literature on the interactions between HIV/AIDS and the environment. We had not anticipated finding as many materials, especially peer-reviewed literature, on the subject as we did. The lack of peer-reviewed citations in many of the prominent agency documents implies a failure to get original research into the hands of policy makers for use in report writing and policy development. Nonetheless, the vast majority of the evidence remains anecdotal and/or unreplicated. The anecdotal nature of much of the evidence does not imply that the conclusions reached are in error, but rather that many of the conclusions should be validated to provide a strong, evidence-based platform for program development and to maximize the return on investment in these new programs.

There is a clear need for research in more countries, regions, and socio-ecological settings. Research on HIV/AIDS and the environment that extends for several years is largely non-existent. In terms of natural resource use, it is unclear to what extent reliance on natural resources is driven by lack of resources in poor households versus households affected by HIV/AIDS. Monitoring and evaluation of projects is lacking, which makes it difficult to identify good practices that can be scaled-up to assist more communities. Mainstreaming HIV/AIDS into programmatic efforts outside of the health sector is a step towards a more integrated approach to HIV/AIDS and the environment.

The excitement and momentum of multiple funders, NGOs, and other agencies wanting to get involved in mainstreaming and in integrated PHE or HIV/AIDS-environment programming rings with optimism of what can be achieved in this field. While there is promising growth in terms of both research and implementation, the field is still "new," and the subject is ripe for investigation and action. Ensuring both a strong base of evidence and sensibly monitored and well-evaluated interventions, however, will be critical for the success of the field.

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	YEAR	DOCUMENT TITLE	AUTHORS	TYPE OF PUBLICATION	COUNTRY/REGION	MAJOR FOCUS
	2003	Land use and livelihoods	Andrew, M et al.	Non-journal review	South Africa	• Under-farming because of labor shortage (along with other factors) • Poorer households more likely to use natural resources • Urban to rural migration increases natural resource demand • Decreasing livestock numbers as households sell off stock to cope with HIV • Institutional lack of capacity (HIV HR concerns) leads to poorer land management and reform
•	2009	Food insecurity and HIV/AIDS: current knowledge, gaps, and research priorities	Anema, A et al.	Journal review	Global	• HIV & food insecurity interact in a vicious cycle • High rates of food insecurity in HIV, malnutrition leads to increased transmission, risk behaviors, decreased immunity, decreased access to treatment and care, decreased CD4, incomplete viral suppression, and decreased survival; correlation between malnutrition and poor access to health services. Women most at risk. • Good review, nice bibliography
•	2009	Feeling the heat: Child survival in a changing climate	Baker, L	Non-journal review	Global	• Climate change will affect water- and vector-borne disease, hunger/malnutrition, weakened health systems, livelihoods, urbanization/migration • Gender as an important issue • Gives policy recommendations: "climate-proofing" systems, safety nets; recommends participatory approach
•	2006	Making the connection: AIDS and water	Ball, AM	Journal case study	Zambia	• Case study of mainstreaming HIV into the water sector
•	2003	Non-timber forest products in the livelihood and coping strategies of households and communities affected by HIV/AIDS	Barany, ME	Thesis/ dissertation	Sub-Saharan Africa	• HIV-affected households and non-timber forest products • 15,000 plants are consumed in Africa • HIV increases dependence on natural products • Traditional med & plants over-harvesting • Workforce issues • Natural resources are low-input

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	1995	The social and economic impact of HIV/AIDS on farming systems and livelihoods in rural Africa: Some experience and lessons from Uganda, Tanzania and Zambia	Barnett, T et al.	Journal research	Uganda, Tanzania, Zambia	• Links between HIV/AIDS and livelihoods in Uganda, Tanzania, and Zambia • Early paper detailing labor and economic impacts of HIV/AIDS
	2010	Castel-Gandolfo Workshop: Introduction to the impact of climate change, economic crisis, and increase in food prices on malnutrition	Bloem, MW et al.	Journal conference proceeding	Global	• Food insecurity leads to malnutrition, micronutrient deficiencies, and "hidden hunger", which in turn decrease immunity, ART response, and worsen HIV outcomes • Need for a "nutritional standard of care" in HIV treatment
	2009	Shifts in African crop climates by 2050 and the implications for crop improvement and genetic resources conservation	Burke, MB et al.	Journal research	Africa	• Majority of African countries with have more than 50% "novel" climate by 2050
	2007	Meeting the challenges of HIV/AIDS in conservation agency workforces: A technical guide	Cash, JA and McCool, SF	Non-journal guideline or toolkit	Southern Africa Central Africa - Congo River basin	• Human resources guide regarding HIV for environmental agencies • Workforce effects of HIV epidemic include loss of experience-based knowledge in staff, absenteeism, change in employee abilities
	2006	Poverty risks and national parks: Policy issues in conservation and resettlement	Cernea, MM and Schmidt-Soltau, K	Journal case study		• Advocates "double sustainability" of livelihoods and biodiversity • Population displaced by protected areas in Central Africa is approximately 100,000 (projected 250,000 by 2012) • Eviction leads to: increased morbidity and mortality, food insecurity, landlessness, homelessness, marginalization, joblessness, and decreased access to common property

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	2009	Endangered edible orchids and vulnerable gatherers in the context of HIV/AIDS in the Southern Highlands of Tanzania	Challe, JF and Price, LL	Journal research	Tanzania	• HIV-affected people, especially orphans, increase natural resource use, including of endangered species
•	2007	Global environmental change and human health Science plan and implementation strategy	Confalonieri, U and McMichael, A	Non-journal review	Global	• Interactions between global environmental change and HIV • Science plan includes activities for future work
	2008	Mitigating an elephantine epidemic: Gendered spaces for HIV/AIDS outreach through Namibian conservancies	DeMotts, R	Journal case study	Namibia	• Using conservation agencies to address HIV/AIDS decreases stigma • HIV/AIDS education should be "embedded" in conservation field-workers' duties • Mitigation efforts must be gender-sensitive and tailored to the local situation
•	2008	Using innovation to address HIV, AIDS, and environment links: Intervention case studies from Zimbabwe, Uganda, and Malawi	De Souza, RM et al	Journal case study	Zimbabwe, Uganda, Malawi	• Case studies of interventions to address HIV and environment simultaneously • Orphans and vulnerable children have less access to traditional knowledge • Gender & natural resource use, land • Internal workforce issues & mainstreaming • Food security issues • Need to document "added-value" of integrated programs
	web	Conservation Refugees	Dowie, M (orionmagazine .org/index.ph p/ articles/161)	Non-journal review	Global	• Conservation endeavors sometimes cause forced migration; 10 million people have been displaced historically
•	2002	The impact of HIV on rural households and land issues in Southern and Eastern Africa	Drimie, S	Non-journal review	Southern and Eastern Africa	• Rural impacts of HIV • Explores HIV-poverty connection in some detail • Migration, poverty-driven commercial sex, • Decreased food production • Household coping strategies
•	2005	The Impacts of HIV/AIDS on rural livelihoods in Southern Africa: An inventory and literature review	Drimie, S and Gandure, S	Non-journal research	Zimbabwe	• HIV/AIDS effects on livelihoods in Southern Africa • Coping strategies • Identifies research gaps and suggests interventions

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•	2004	Environment and agriculture interactions: Implications for HIV and other infectious diseases	du Guerny, J and Hsu, LN	Non-journal review	Global, SE Asia and Africa	• HIV and agriculture sector interactions • Labor force issues: time, energy, and knowledge • Strategies for response to HIV/AIDS include labor-saving technologies, reviving nutritious traditional crops, and cultivating botanical medicines • Nice synthesis, with a good bibliography
•	2002	HIV/AIDS and natural resources management in Africa: Findings from Kenya, Namibia, South Africa, and Uganda	Dwasi, J	Non-journal case study	Kenya, Namibia, South Africa, Uganda	• HIV negatively affects management and conservation of natural resources • Issues include: workforce, financing, changes in conservation activities, harvesting of medicinal plants, destruction of social structures upon which CBNRM is based, land use changes, and loss of traditional knowledge • Provides examples/case studies of interventions
	2004	Livelihood diversification and natural resource access	Ellis, F and Allison, F	Non-journal review	Sub-Saharan Africa	• Livelihoods diversification means greater household coping ability • The poorest tend to be "locked in" to either subsistence farming or dependence on common-pool natural resources • Land-tenure and gender issues can be barriers to livelihoods diversification
	2000	HIV/AIDS in Namibia: The impact on the livestock sector	Engh, I et al.	Non-journal case study	Namibia	• HIV-affected households sell off livestock as a coping mechanism • Longer-term effects unclear
•	2008	Analytical situation of land degradation and sustainable management strategies in Africa	Ezeaku, PI and Davidson, A	Journal review	Africa	• Sustainable land management in Africa • Brain drain • Increased natural resource use and unsustainable land use • Monitoring and evaluation needed
	2007	A guide for monitoring and evaluating population-health-environment programs	Finn, T	Non-journal guideline or toolkit	Global	• Good guidance for developing indicators and variables in population, health, environment programs
•	2008	Farming as a livelihood source for the urban poor of Nakuru, Kenya	Foeken, DWJ and SO Owuor	Journal research	Kenya	• Diversification of income-sources, urban agriculture very important for urban residents • Urban-rural linkages key: income to rural areas, food to urban areas common. • "Multi-spatial" households common. • Poorest least likely to take part in farming–lack of access to land and capital

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•	2008	Demarcating forest, containing disease: Land and HIV/AIDS in southern Zambia	Frank, E and Unruh, J	Journal research	Zambia	• HIV/AIDS affects land use, is sometimes purposefully invoked to retain or regain control of land
•	2006	Agricultural biodiversity, nutrition, and health: Making a difference to hunger and nutrition in the developing world	Frison, EA et al.	Journal review	Global	• Analysis of traditional foods; "neglected" foods • Food- and food-diversity based interventions are more successful than single-nutrient based ones. • Need to rely on indigenous knowledge taxonomic & nutrition info re: traditional foods are needed
	2008	Climate change and public health: thinking, communicating, acting	Frumkin, H and McMichael, A	Journal commentary	Global	• Commentary: integrating public health and climate change interventions is beneficial to both, but requires innovation
•	2004	Plant diversity, sustainable rural livelihoods, and the HIV/AIDS crisis	Gari, JA	Non-journal review	Global (Africa and SE Asia focus)	• Mobilizing local resources to mitigate HIV effects • Use of agrobiodiversity and "neglected" traditional knowledge and crops
•	2005	Impact of HIV/AIDS: how can it be anticipated and managed	Gelman, N and Oglethorpe, J	Journal case study/review	Sub-Saharan Africa	• Issues facing protected areas/parks specifically in terms of HIV/AIDS • Human resources concerns, diversion of funding, loss of traditional knowledge, natural resource use
•	2005	HIV/AIDS and food and nutrition security: From evidence to action	Gillespie, S and Kadiyala, S	Non-journal review	Global	• HIV and food security • Good review, lots of case studies and examples, excellent bibliography
	2005	HIV in the fisheries sector in Africa	Gordon, A	Non-journal review	Sub-Saharan Africa	• HIV vulnerabilities of fisherfolk • Fishers 4.4-10 times more likely to be HIV-infected than general population. In some countries, fishers are at higher risk than some "risk groups" such as truck drivers and even commercial sex workers • HIV impacts on fishing communities
	2003	Integrating gender into HIV/AIDS programmes: a review paper	Gupta, GR, et al.	Non-journal guideline or toolkit	Global	• Overview of gender aspects of the epidemic • trategies for incorporating gender concerns throughout HIV/AIDS interventions
•	2003	The environment, natural resources, and HIV/AIDS	Hammarskjıld, M	Non-journal review	Sub-Saharan Africa	• Natural resources, agriculture, and ecological consequences of HIV • * Workforce issues

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•	2000	Multi-sectoral responses to HIV/AIDS: Constraints and opportunities for technical co-operation	Hemrich, G and Topouzis, D	Journal policy paper	Sub-Saharan Africa	• Need to shift away from HIV-specific programming to broader development-based interventions, with specifically HIV-focuses projects as needed, especially b/c HIV is determined by same issues as underdevelopment • Constraints: lack of multi-sectoral policy mandates from donors, donor sectoral funding, sectoral government agencies, lack of operational strategies
•	2008	Adult mortality and natural resource use in rural South Africa: Evidence from the Agincourt Health and Demographic Surveillance site	Hunter, LM et al.	Journal research	S. Africa	• HIV and natural resource use • Higher natural resource use/dependence among mortality-affected, impoverished households • "Selection, use, level of consumption, acquisition of natural resources" important • "Yes, there are definitely changes" in natural resource consumption
	2008	The environmental dimensions of the HIV/AIDS pandemic: A call for scholarship and evidence-based intervention	Hunter, LM et al.	Journal commentary	Global	• Introduction to a special issue on HIV and the environment; good overview of the associated issues
	2007	"Locusts are now our beef": Adult mortality and household dietary use of local environmental resources in rural South Africa	Hunter, LM, et al.	Journal research	South Africa	• "All dimensions of food security...are affected when HIV is high" • Mortality decreases food security, but not uniformly–the gender of the dead and the household SES are important • Dependence on the bush is not only a short-term coping mechanism
•	2008	Impacts of climate change on rural livelihoods in Madagascar and the potential for adaptation	International Resources Group (IRG)	Non-journal research/review	Madagascar	• Climate change leads to increased vulnerability (food/water), increased pressures (e.g. distance to find fish), increased variability of crop seasons. • Formal assessment of households' experience of climate change
	2006	International Union for the Conservation of Nature (IUCN) HIV/AIDS policy (draft)	Office of the Senior Gender Advisor- IUCN	Non-journal policy paper	Global	• Example of internal workplace HIV/AIDS policy of a conservation agency

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•	2004	Interactions between the agricultural sector and the HIV pandemic: Implications for agricultural policy	Jayne, T et al.	Non-journal policy paper	Africa	• Preparing the agriculture sector for the effects of HIV/AIDS • Increased rural inequality, decrease in assets and wealth leads to less capital-intensive agriculture, loss of knowledge transfer • Improved technology and a focus on productivity are needed
•	2006	Community-level impacts of AIDS-related mortality: Panel survey evidence from Zambia	Jayne, T et al.	Journal research	Zambia	• HIV mortality affects the community as a whole, not only the family of the deceased • Deaths in communities with more education are more devastating • Higher income communities are protected from the shocks associated with mortality
	2007	Gender differentiation in community responses to AIDS in rural Uganda	Kanyamurwa, JM and Ampek GT	Journal research	Uganda	• Human resources losses, access to natural resources, capital in male and female headed households differ • Women are more vulnerable to affects of AIDS mortality–few assets and land access, more dependent on NGO system • Loss of leaders leads to decrease in social cohesion
	2008	Wild foods and household food security responses to AIDS	Kaschula, SA	Journal research	S. Africa	• Wild food use is affected by HIV-mortality
	2007	The African Millennium Villages	Kates, RW, editor	Journal review	Africa	• Early review of outcomes of Millennium Villages Project; suggests moderate levels of success
	2002	The impact of HIV/AIDS on the land issue in Kenya	Kiai, W et al.	Non-journal research/review	Kenya	• HIV presents new challenges to land policy and land tenure systems in Kenya • Widows and orphans have poor access to land • Widow inheritance and land grabbing are common in Kenya
•	2005	Linking protected area management and HIV/AIDS prevention–experiences from Ankarafantsika National Park, Madagascar	Lopez, P et al.	Journal case study/review	Madagascar	• Tourism may be affected, and may be a risk factor for HIV transmission • Mobile men increase transmission risk
	2009	Climate impacts and adaptation options in agriculture: What we know and what we don't know	Lotze-Campen, H and Schellnhuber, HJ	Journal review	Global	• Climate change will have major food security and agricultural effects

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•	2009	Integrating nutrition support for food-insecure patients and their dependents into an HIV care and treatment program in western Kenya	Mamlin J, et al.	Journal policy paper	Kenya	• Medical care is necessary but insufficient for addressing HIV epidemic • Food supplementation given at the household level to ART patient • Food insecurity in 20-40% of patients enrolled in HIV care • Challenges to food supplementation include funding, dependency, sustainability, monitoring and evaluation
•	2003	HIV/AIDS mainstreaming in conservation: the case of the Wildlife and Environmental Society of Malawi	Mauambeta, DDC	Non-journal case study	Malawi	• Good example of workplace HIV/AIDS Policy, internal mainstreaming at a conservation organization
	2009	Is HIV jeopardizing biodiversity?	McGarry, DK and Shackleton, CM	Journal commentary	Primarily sub-Saharan Africa, South Africa	• High-HIV vulnerability children consumed more wild foods, but impact on biodiversity is "unclear"
	2003	Climate change and human health: risks and responses	McMichael, AJ et al.	Non-journal review	Global	• Overarching links between climate change and health; climate change and infectious disease, policy implications
•	2008	Global environmental change and health: impacts, inequality, and the health sector	McMichael, AJ et al.	Journal commentary	Global (focus on Africa)	• It's impossible to separate environmental and health/ development goals or practices
	no date	HIV/AIDS and the environment: What are the linkages? Impacts on conservation capacity. Ezemvelo KwaZulu Natal Wildlife Human Resources, presentation	Meier, B	Non-journal presentation	Tanzania	• Example of internal workplace HIV/AIDS policy of a conservation agency
	2009	Social determinants of health and health inequalities in Nakuru, Kenya	Muchukuri, E and FR Grenier	Journal research	Kenya	• Access to water, food, waste management, housing, health services, and transportation have an impact on health
	2002	Mainstreaming HIV/AIDS into development: What it can look like	Mullins, D	Non-journal guideline or toolkit	Southern Africa	• Guidelines for mainstreaming HIV into development projects
•	2008	AIDS and kitchen gardens: Insights from a village in Western Kenya	Murphy, LL	Journal research	Kenya	• HIV/AIDS affects labor productivity, land tenure, management, loss of traditional knowledge, natural resource exploitation, increase in fallowed land • AIDS increases kitchen garden use, which are repositories of neglected species, increase vegetation cover, protect watersheds, preserve germplasm (but could mine soil) • Natural resource dependence is dependent on poverty, not HIV-infection

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•	2007	Population, health, and environment integration and cross-sectoral collaboration: Kenya country level assessment report	Mwaura, F	Non-journal review	Kenya	• Population Health and Environment (PHE) case studies in Kenya • Many examples of PHE interventions
	2009	Emerging threats to human health from global environmental change	Myers, SS and Patz, JA	Journal review	Global	• Major threats to human health from climate change include increased infectious diseases and changing patterns of these diseases, water and food scarcity, natural disasters, and population displacement
	2007	HIV/AIDS, artisanal fishing and food security in the Okavango Delta, Botswana	Ngwenya, BN and Mosepele, K	Journal research	Botswana	• HIV/AIDS seriously impacts fishing activities, which are a safety net for families. HIV/AIDS therefore affects food security in fishing communities • Fisheries sector policies generally neglect HIV/AIDS
•	2007	HIV/AIDS and the environment: Impacts of AIDS and ways to reduce them: A fact sheet for the conservation community	Oglethorpe, J and Gelman, N	Non-journal guideline or toolkit	Global	• HIV impact mitigation for conservation organizations • Human capacity, loss of investment in training, staff time, diversion of money, morale down • Natural resource use increased, loss of leadership, traditional knowledge, effect on women, change in farming and land use • HIV often spread through natural resource extraction (e.g. fisheries, logging, remote conservation work)
•	2008	AIDS, women, land, and natural resources in Africa	Oglethorpe, J and Gelman, N	Journal review	Africa	• Women, natural resource use, and HIV/AIDS • Natural resources are a safety net • Women don't have time for sound natural resource management • Issues include: land-grabbing, property rights, loss of traditional knowledge, resource depletion, medicinal plants • Easier to poach because of HR decreases due to HIV • Poverty and landlessness lead to increased risk behaviors • Recommends livelihoods and female empowerment, and programs for orphan and vulnerable children as interventions
•	no date	HIV/AIDS and conservation: what can the conservation sector do? World Wildlife Fund, African Biodiversity Collaborative Group, International Union for the Conservation of Nature, presentation	Oglethorpe, J and Gelman, N	Non-journal presentation	Africa	• Broad review of HIV/AIDS issues for conservation community, including lost capacity and workforce, as well as land use and natural resources related effects • Includes mainstreaming and intervention ideas

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	2008	Healthy people, healthy ecosystems: A manual on integrating health and family planning into conservation projects	Oglethorpe, J et al.	Non-journal guideline or toolkit	Global	• Guidelines for integrating population and health into environment/conservation projects
•	2009	A qualitative study of the impact of HIV on agricultural households in Southeastern Uganda	Parker, DC et al.	Journal research	Uganda	• HIV affects labor productivity, leads to decreased household assets, worse land tenure, and change in agricultural activities
	2003	Biodiversity and the Millennium Development Goals	Pisupati, B and Warner, E	Non-journal review	Global, but with regional details	• Biodiversity and climate change issues impact the achievement of the MDGs
•	2003	The link between conservation and HIV: what can be done?: Report of a special side event, World Parks Conference, Durban	Quinlan, T	Non-journal workshop	Africa	• Parks and reserves are vulnerable because of workforce concerns • Internal HIV/AIDS Policies at institutional level
	2005	HIV/AIDS and the public sector workforce: An action guide for managers	Rau, B	Non-journal guideline or toolkit	Global	• Guidelines for creating and strengthening HIV prevention, care, treatment, and support systems for government agencies
	2007	The importance of dry woodlands and forests in rural livelihoods and poverty alleviation in South Africa	Shackleton, CM et al.	Journal case study	South Africa	• HIV has exacerbated people's dependence on forests • Forestry good contribute 4-30% of household income across Southern Africa • Forests integral to maintaining livelihoods and mitigating extreme poverty
•	2006	AIDS and the ecology of poverty	Stillwaggon, E	Book	Global	• HIV-infection is determined by number of different factors, not just risk behaviors • Poverty and multi-disease burden are major risks for HIV • Policy and interventions must be broadened beyond behavior alone
	2010	Macronutrient supplementation and food prices in HIV treatment	Sztam, KA et al.	Journal review	Global	• Malnutrition and HIV are a dual burden; standard of care needed for food in HIV patients
•	2005	HIV/AIDS–the true tragedy of the commons?: Exploring the effects of HIV/AIDS on management and use of local natural resources	Ternstrцm, I	Non-journal review	Global	• HIV leads to increased natural resource use and a disruption in social controls governing their use–eroding social networks

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	2007	Predicted impact of HIV on improved fallow adoption and rural household food security in Malawi	Thangata, PH et al.	Journal research	Malawi	• Effect of HIV depends on gender of the affected family member (male death more devastating in terms of food security) • Movement to agro-forestry as an intervention to increase food production
•	1999	Sustainable agricultural rural development and vulnerability to the HIV epidemic	Topouzis, D and du Guerny, J	Non-journal policy paper	Africa focus	• Rural impacts of HIV • Rural migration of PLWHA means rural areas bear the brunt of the epidemic's economic affects • HIV leads to loss of labor, decreased assets/income, human resources losses at institutional level, increased expenditures at household level, increased number of dependents, and loss of knowledge
•	2001	Strategy Paper on HIV/AIDS for East and Southern Africa	Topouzis, D, et al.	Non-journal policy paper	Sub-Saharan Africa	• HIV and the agricultural sector • Includes how to integrate/mainstream HIV at all levels of project, from inception to implementation • Good overview of the gender aspects of the epidemic
•	2006	Examining the linkages between AIDS and biodiversity conservation in coastal Tanzania	Torell, E et al.	Journal research	Tanzania	• Many agriculture-sector specific intervention ideas • HIV and fisheries and marine conservation areas • HIV/AIDS leads to accelerated rate of natural resource extraction (wood, meds, wildlife), decreased availability of labor and management capacity, and loss of traditional knowledge • Mobility (e.g. fishers) and seasonal migration increase risk, as does tourism • Protected areas decrease the natural resource use options for vulnerable households • Reducing gender inequality and poverty and providing livelihoods mitigates effects
•	2007	Guidelines for mitigating the impacts of HIV/AIDS on coastal biodiversity and natural resource management	Torell, E et al.	Non-journal guideline or toolkit	Sub-Saharan Africa coasts, Tanzania	• HIV/AIDS leads to accelerated natural resource extraction, decreased labor capacity, decreased management capacity, and loss of traditional skills
•	2008	Climate change and AIDS: A joint working paper	UNEP, UNAIDS	Non-journal review	Primarily sub-Saharan Africa	• HIV/AIDS and Climate Change "Complex" revolves around food security, infectious disease, and governance/ conflict/poverty
	2004	HIV/AIDS and the forestry and wildlife sectors: Key points towards a policy discussion	Villareal, M and Holding Anyonge, C	Non-journal policy paper	Global	• Multisectoral response to HIV is needed, and should include forestry • Collaboration on traditional medicines, agroforestry projects, and nutrition education and skills building suggested

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	2009	Strong association between in-migration and HIV prevalence in urban sub-Saharan Africa	Voeten, HA et al.	Journal research	Urban sub-Saharan Africa	• Migration to urban settings leads to : increased sexual network size, casual and commercial sex (spousal separation, weaker social control) • Conflict leads to rape, disruption of norms, collapse of system, decreased access to condoms
	2007	Food insufficiency is associated with high-risk sexual behavior among women in Botswana and Swaziland	Weiser, SD, et al.	Journal research	Botswana and Swaziland	• Women who are food insecure are more likely to report unprotected sex, low power in relationships
	2003	Measuring the impacts of working-age adult mortality on small-scale farm households in Kenya	Yamano, T and Jayne, TS	Journal research	Kenya	• Effects of adult mortality on livelihoods are sensitive to gender and position within the household of the deceased • Household socio-economic status buffers effects of adult mortality • Effects of mortality are long lasting: did not decay over the three year study-period
	2008	HIV/AIDS impacts on conservation capacity. USAID, presentation	Zelothe, J	Non-journal presentation	Tanzania	• Example of internal workplace HIV/AIDS policy of a conservation agency
•	2008	The integration of support for HIV/AIDS and livelihood security: district level institutional analysis in southern Africa	Ziervogel, G and Drimie, S	Journal review	Southern Africa	• Livelihoods interventions across the “AIDS timeline” are presented • Organizations are beginning to address food issues in an environmentally conscious manner, but the are needs more emphasis (e.g. seeds, new varietals, kitchen gardens) •

IUCN Eastern and Southern Africa Regional Office
P.O. Box 68200–00200
Nairobi Kenya
W: +254 20 249 3561/65/70
M: +254 724 256 804; + 254 734 768 770
F: +254 20 890615
E–mail: info.esaro@iucn.org
www.iucn.org/places/esaro