

HIV/AIDS, Forests and Futures
in Sub-Saharan Africa

Joleen Timko



HIV/AIDS and Forests

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Throughout Sub-Saharan Africa, the human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) pandemic is having devastating and tragic social, economic, and political impacts. HIV/AIDS is both a health issue and a development problem, with complex links to rural livelihoods, human capacity, and natural resource conservation. As the HIV/AIDS pandemic in Sub-Saharan Africa has spread, it appears that increased pressure has been placed on the already dwindling forest resources on which vulnerable populations depend. Evidently, forests and the products that they provide may well decrease the vulnerability of rural people by increasing their resilience to HIV/AIDS. Yet, despite decades of research regarding the impacts of HIV/AIDS on rural livelihoods in Sub-Saharan Africa, the links between HIV/AIDS, vulnerability, resilience, and wild natural capital has largely gone unexplored. Research on the interactions between the use of forest resources and contemporary epidemics in general, and on the environmental dimensions of the HIV/AIDS pandemic in particular, remain surprisingly slim. There has been a dearth of research on the contribution of forest products to the livelihoods of HIV/AIDS affected households; the long-term impacts of people living with HIV/AIDS on the management of forest resources; the impacts of forest degradation and deforestation on human health generally, and people affected by HIV/AIDS specifically; the role of the forest industry and its workers in the spread of HIV/AIDS; and the impacts of the disease on the future of forest management institutions and education. This paper offers a preliminary review and mapping of potential linkages and questions in each of these areas by focusing on three domains of the relationships between HIV/AIDS, forests and forestry: (1) the role of the forest industry (including foresters and truck drivers) in the spread of HIV/AIDS; (2) the interactions between HIV/AIDS-affected households and forest resources; and (3) the impacts of HIV/AIDS-related morbidity and mortality on the future of forestry and forest management institutions.

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Introduction

Throughout Sub-Saharan Africa, the human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) pandemic is having devastating and tragic social, economic, and political impacts (Barany *et al.* 2004). In this region where the highest prevalence of HIV in the world is found along with 35 of the 45 most highly affected countries (Drimie and Gandure 2005), HIV/AIDS can lead to an intensification of poverty, it 'can push some non-poor into poverty and some of the very poor further into destitution' (Drimie 2002: 6). The disease is thought to be responsible for undoing decades of economic and social development and causing rural disintegration (Villarreal *et al.* 2006). Losses due to AIDS of the most economically valuable members of communities – young adults – contribute to economic and social upheavals that can affect agricultural activities, land use, and land tenure. HIV/AIDS is both a health issue and a development problem, with complex links to rural livelihoods, human capacity, and natural resource conservation (Torell *et al.* 2006; Oglethorpe and Gelman 2007).

It has been estimated that over two-thirds of Africa's 600 million people rely on forest resources for both subsistence and to supplement their cash incomes (Arnold 2001; Kaimowitz 2003; CIFOR 2005; Sunderlin *et al.* 2005). Approximately 70% of the energy consumed in southern Africa is in the form of fuelwood or charcoal (Syampungani *et al.* 2009). Forest resources generally play a critical role as natural subsidies for rural households across the continent as they can be collected directly for subsistence use, or be 'transformed' through processing (e.g. carving wood for sale) to earn an income. Forest resources, both timber and non timber, are used in a variety of ways, including: as medicinal plants; animal food sources, including insects, molluscs, fish, crustaceans, amphibians, and bushmeat; plant food sources, including mushrooms, seeds, edible fruits, vegetables, and root crops; gums and resins; grass or twigs for making hand brushes; wood for woodcarving and fuelwood; charcoal; honey; chewsticks; canes, lianas, raffias, and twines for framing houses; and grass, bamboo, reeds, and leaves for roofing (Arnold 1994; Belcher *et al.* 2003; Horning 2004; Horning 2003; Jenkins *et al.* 2009; Jenkins and Racey 2008; Monela *et al.* 2000; Ndam and Marcelin 2004; Novy 1995; Shackleton and Shackleton 2004; Shyamsundar and Kramer 1997; Tadesse *et al.* 2007; Van Dijk and Wiersum 1999).

As the HIV/AIDS pandemic in Sub-Saharan Africa has spread, it appears that increased pressure has been placed on the already dwindling forest resources on which vulnerable populations depend. However, a recent systematic analysis of the empirical literature in this domain revealed that, while there is a link between a household's AIDS-related morbidity and mortality and its increased dependence on forest biodiversity, the evidence is not as convincing as much of the anecdotal information purports given the lack of empirical evidence to this effect (Timko *et al.* 2010). Forests and the products that they provide may well decrease the

vulnerability (the range of social, economic, political, environmental, or biological conditions that prevent people from protecting their own needs and interests (Shi and Stevens 2005)) of rural people by increasing their resilience (actively responding in ways that enable one to avoid the worst effects of the disease or to recover faster to an acceptably normal level (Loevinsohn 2008)) to HIV/AIDS.

Yet, despite decades of research regarding the impacts of HIV/AIDS on rural livelihoods in Sub-Saharan Africa, the links between HIV/AIDS, vulnerability, resilience, and wild natural capital has largely gone unexplored (Barany *et al.* 2004; Shackleton *et al.* 2006). Research on the interactions between the use of forest resources and contemporary epidemics in general, and on the environmental dimensions of the HIV/AIDS pandemic in particular, remain surprisingly slim (Holding Anyonge *et al.* 2006; Hunter *et al.* 2008). There has been a dearth of research on the contribution of forest products to the livelihoods of HIV/AIDS affected households (Torell *et al.* 2006; Barany *et al.* 2005; Shackleton *et al.* 2006);¹ the long-term impacts of people living with HIV/AIDS on the management of forest resources (Dwasi 2002); the impacts of forest degradation and deforestation on human health generally, and people affected by HIV/AIDS specifically; the role of the forest industry and its workers in the spread of HIV/AIDS (Barany *et al.* 2005); and the impacts of the disease on the future of forest management institutions and education. This paper offers a preliminary review and mapping of potential linkages and questions in each of these areas by focusing on three domains of the relationships between HIV/AIDS, forests and forestry: (1) the role of the forest industry (including foresters and truck drivers) in the spread of HIV/AIDS; (2) the interactions between HIV/AIDS-affected households and forest resources; and (3) the impacts of HIV/AIDS-related morbidity and mortality on the future of forestry and forest management institutions (Figure 1.0).

¹ HIV/AIDS-affected household broadly refers to households where one of the following exists: one or more prime-age adults (ages 15-49) is chronically ill; widow-headed households where a spouse died from AIDS; chronic illness and/or death of prime-aged adult within last 2 years; children living without parents or living with grandparents/elders; a household which has taken in an orphaned child, provided labour or cash to help care for a sick person, or has provided for survivors in a household where HIV/AIDS has had a direct impact (Barany *et al.* 2005).

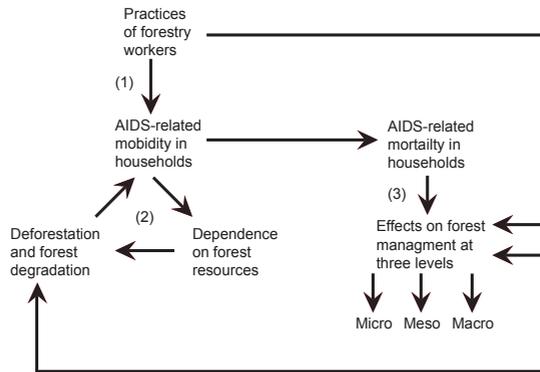


Figure 1.0. A conceptual framework depicting three sets of interlinkages on HIV/AIDS, forests, and forestry in Sub-Saharan Africa.

Perspectives on three sets of interlinkages between HIV/AIDS, forests, and forestry in Sub-Saharan Africa

Three sets of interlinkages on HIV/AIDS, forests, and forestry in Sub-Saharan Africa are specifically explored in this paper: (1) Unsafe practices and working conditions of workers affiliated with the forest industry can spread HIV to rural households; (2) HIV/AIDS morbidity can lead to an increased household dependence on forest resources, resulting in forest degradation and deforestation which can affect the resilience of HIV/AIDS-affected households; and (3) HIV/AIDS-related morbidity and mortality can affect forest management at three levels: the micro – or local – level, the meso – or village – level, and the macro – or organisational – level (*sensu* Loevinsohn and Gillespie 2003). Changes in the effectiveness of forest management institutions can affect both the practices of forestry workers, as well as rates of deforestation and forest degradation (Figure 1.0).

There are of course many influencing factors that affect each of these three broad domains and which are not adequately covered by this conceptual framework. For instance, poverty, migration, and conflict, among many others, also affect the transmission of HIV. Given the focus of this paper on forests and forestry, we necessarily isolate our discussion to the influence of forestry workers in this regard. The three sets of interlinkages covered in this paper are, in turn, highlighted and problematised in various ways in the literature, reflecting different perspectives and concerns. These, in turn, individually and collectively serve to make sense of what is a very complex reality (Rein and Schon 1993). In the midst of this simplification process, it is imperative not to lose sight of the important and influencing details. We need to be aware of how, why, and for whom these different dimensions of HIV/forest relationships are a problem, who is promoting these dimensions, and more normatively, what policy pathways are being proffered as each one could have starkly different implications for who gains and who loses (Leach *et al.* 2010; Leach 2008). Through the analysis presented in this paper, we seek to identify research questions that could provide us with the data required to develop a clearer understanding of the issue, and identify the implications for forest resources and local populations.

This paper is based on a review of relevant and published and grey literature available in this domain. By far the majority of the literature available on this topic is focused on Sub-Saharan Africa, thus we focus our analysis on that region. It is important to note that most of this literature is anecdotal rather than empirical, and only a small subset of these papers directly focuses on the interlinkages between forests and HIV/AIDS. Therefore it has been necessary to use literature from other fields, such as environmental health or international development, to support the linkages discussed in this paper. Published literature was accessed from online databases including PubMed, Web of Science, and Social Sciences

in Forestry. Search terms were kept deliberately broad in order to capture as much of the literature as possible, and included combinations such as: HIV forest; AIDS forest; deforestation HIV; deforestation AIDS; medicinal plant forest AIDS; medicinal plant forest HIV. Google Scholar was also used to find grey literature not appearing in these databases. Literature searches were carried out on several occasions in order to ensure the search was current, including searches in January 2009, October 2009, and April 2010. The perspectives identified in this paper emerged from the literature, and represent the main, recurring themes in the papers assessed. While I am confident that I have accurately represented these main themes, I acknowledge that there could be other themes not represented in the papers in my database.

1.1 Impacts of forestry (and foresters) on the spread of HIV/AIDS

A first set of interlinkages between HIV and forests identified in the literature highlights the possibility that forestry and foresters could be implicated in spreading HIV/AIDS. There are two obvious characteristics that make the forest industry susceptible to aiding in the spread of HIV/AIDS, both of which could be linked to the isolation of male workers in remote areas away from their families. The first characteristic has to do with the nature of the industry and its dependence on the transportation sector. A number of studies have been conducted into the interrelationships between migration, social and familial disruption, and the transmission of HIV. Migratory labour at mines in South Africa has been identified as a key factor in the spread of the disease (Campbell 2000; Campbell and Williams 1999; Meekers 2000; Yelapaala and Ali 2005). Migrant workers (including sex workers) on plantations have been implicated in the transmission of HIV (Agyei-Mensah 2001), as have population movements in response to ethnic conflicts and civil wars (Goliber 1997). Wood (1988) hypothesized that the diffusion of AIDS from cities into rural areas was facilitated by 'truck towns' whereby HIV carriers such as truck drivers infect prostitutes along these routes who in turn infect other travellers and rural villagers. Given the dependence of industrial forest operations on trucks and 'truck towns', it would seem feasible that this theory could hold true in the context of forestry. While the 'building blocks' for the transmission of HIV are present wherever logs from industrial forestry operations are transported from remote forested environments by truck, research linking the forestry sector, transportation routes, and the transmission of HIV have been limited (Topouzis 2007).

The second characteristic linking the forest industry to the spread of HIV/AIDS involves forestry workers (e.g. loggers) working away from their families for extended periods commissioning transactional (and many times unprotected) sex from local and migrant women (Oglethorpe and Gelman 2007; Barany *et al.* 2005; Colfer *et al.* 2006). This makes them especially vulnerable as it increases their likelihood of engaging in activities that could lead to HIV/AIDS, such as taking new, possibly multiple, sexual partners (Tobey *et al.* 2005; Torell *et al.* 2006). Road construction increases access into previously remote areas, which could increase the incidence of the disease (Birley 1995; Eisenberg *et al.* 2007). Colfer *et al.* (2006) note that higher HIV infection rates among loggers in Côte d'Ivoire were reported by van Haaften (1995). And a survey conducted by the Forest Industries Education and Training Authority in South Africa found that more than one third of workers employed in the forestry-contracting subsector were HIV positive (Steenkamp 2006 as cited in Topouzis 2007).

Recommendations for reducing the risk of forestry workers vis a vis HIV/AIDS appear to emphasize changing the working conditions of labourers and forestry

staff that may be increasing their vulnerability to HIV infection (such as lack of housing for families and prolonged separation from families) (Dwasi 2002; Topouzis 2007). Rosen *et al.* (2006) make practical recommendations such as paying salaries on Mondays rather than Fridays, depositing salaries directly into bank accounts rather than distributing cash, and providing transport vouchers to encourage employees to take their partners with them when they travel. Distributing condoms to personnel is also important, provided that both men and women know how to use them (Dwasi 2002).

Overall, there is a lack of empirical data regarding the influence of the forest industry on the spread of HIV/AIDS. Further research in this domain should include an investigation into the sexual practices and HIV prevalence of both logging truck operators and loggers based in remote camps, as well an understanding of how the forest industry can mitigate the spread of HIV/AIDS (Barany *et al.* 2001). It is also important to better understand the gendered aspects of the spread of HIV in the context of forestry. There has been extensive research into the social determinants of female vulnerability to HIV. Combined with women's susceptibility to HIV because of hormonal changes, vaginal microbial ecology, and physiology, social determinants include unequal power relations, poverty, cultural and sexual norms (including sexual coercion), lack of education, and violence (Smith 2002; Quinn and Overbaugh, 2005). In light of this vast body of knowledge, we need to apply it in the context of forests and forestry. How does women's standing in their families or communities relate to their risky sexual behaviour when it comes to dependence on important forest resources? If women were granted more control over their livelihoods and given increased opportunities to engage in income-generating activities, how would this affect their views on sex work as an income generating option (Torell *et al.* 2006)?

1.2 Interactions between HIV/AIDS-affected households and forest resources

A second set of interlinkages concerns interactions between HIV/AIDS-affected households and forest resources. These tend to be one of two types: the impacts of HIV/AIDS-affected households on forest resources, and the impacts of forest degradation and deforestation on the resilience of HIV/AIDS-affected households.

1.2.1 Impacts of HIV/AIDS-affected households on forest resources

Some authors assert that HIV/AIDS leads affected households to increase their dependence on forest resources, resulting in environmental degradation and deforestation. In some regions, it is said that HIV/AIDS has had 'insidious and negative impacts on the environment' (De Souza *et al.* 2008: 240). Zambia, Tanzania, Malawi, Mozambique, and Zimbabwe are countries in which HIV/AIDS is not only particularly prevalent, but are now amongst the countries with the highest rates of deforestation (Barany *et al.* 2005; Frank and Unruh 2008). In Malawi and Mozambique in particular, forest resources are being depleted much faster in areas where HIV prevalence is high, and community dependence on these resources continues to increase (Topouzis 2007). Based on their evidence, Barany *et al.* (2005) found that the quality of woodland resources in several study sites in Malawi and Mozambique were negatively associated with HIV prevalence. It is important to use caution when interpreting these findings as causation has not been proven. Further investigation into the drivers of these types of associations, whether resource depletion is creating more vulnerable livelihoods and hence greater vulnerability to HIV, or whether HIV and deforestation are the result of poverty, is required.

People living with HIV typically require up to 15 per cent more energy and 50 per cent more protein, as well as additional micronutrients, as compared to non-sufferers (Kaschula 2008), making a balanced diet crucial to maintaining or improving their immune system (ABCG 2002). Wild foods or forest resources can improve health, detoxify the effects of AIDS-related drug treatments (ABCG 2002), and can play a key role in enabling an infected person and their household to adapt to HIV/AIDS (Villarreal *et al.* 2006). Some non-timber forest resources have been found to be high in key nutrients required by people living with HIV/AIDS, particularly protein, fat, iron, zinc, and vitamins A and C (Barany *et al.* 2004). Fruits, berries, and leaves all produce nutritious foodstuffs that can boost the immune system and help protect against opportunistic disease (Villarreal *et al.* 2006), while 'wild meats, insects and fruit kernels provide high quality protein and wild leafy vegetables are key sources of micronutrients' (Kaschula 2008: 163).

Anecdotal evidence does appear to suggest that HIV/AIDS-affected households increase their reliance on forest resources – especially related to the increasing use of fuelwood, medicinal plants, and charcoal (Torell *et al.* 2006; Barany *et al.* 2005; Holding Anyonge *et al.* 2006; Topouzis 2007). For instance, HIV/AIDS-affected households with limited employment options could understandably increase their reliance on freely available forest resources as a consistent livelihood strategy to minimize the socioeconomic burden of HIV/AIDS (Barany *et al.* 2005; Shackleton *et al.* 2006). It is also claimed that across Sub-Saharan Africa, forest resources have suffered additional impact from HIV/AIDS as, for example: more timber is harvested to build coffins; more firewood is used for cooking, funerals, and ceremonies; there is increased experimentation and use of medicinal plants to treat the side effects of HIV/AIDS (e.g. shingles or diarrhea); there is a greater reliance on bushmeat and charcoal for alternative income purposes; and more forest lands are converted to cemeteries (Mauambeta 2003; Oglethorpe and Gelman 2007).

As already mentioned, while there is a link between a household's AIDS-related morbidity and mortality and its increased dependence on forest biodiversity, a lack of empirical evidence to this effect hinders our ability to understand the cause and effect relationships at play (Timko *et al.* 2010). This dearth of evidence clearly indicates a need to further our understanding by addressing outstanding gaps in our knowledge in a variety of African settings, including:

- What are the environmental implications, both positive and negative, of HIV/AIDS?
- What is the role of forest resources in supporting vulnerable households (sensu McGarry and Shackleton 2009)?
- How does the impact on forest resources from HIV/AIDS-affected households differ from their non HIV/AIDS-affected neighbours? In other words, do HIV/AIDS-affected households use forest resources in a markedly different manner than their unaffected neighbours?

This latter question is particularly important as Twine and Hunter (2008) found that AIDS mortality is not necessarily a unique household shock with regard to its impact on household food security, suggesting that policies and interventions should target vulnerable households more broadly. Answers to these and other research questions can enable us to develop recommendations that maximise the potential for 'win-win' for both human and environmental health. Policy options on this front could be of two types. First, those policies that mitigate interactions that both aggravate the impacts of HIV and AIDS on households and concomitantly affect forests negatively. For instance, when household labour and income are reduced, freely available forest resources could become more crucial in meeting subsistence needs, in particular fuelwood (Holding Anyonge *et al.* 2006). Therefore, policies could assist households in meeting their labour and/

or financial requirements by increasing the supply of wood and non-wood forest products (through forest planting, transport of wood from greater distances), facilitating a decrease in the demand (through the use of more efficient wood stoves, possibly the switch to other fuel types) to alleviate pressure on the natural environment (Holding Anyonge *et al.* 2006), or domesticating wild foods such as wild vegetables and indigenous fruits (Twine and Hunter 2008). Second, policy options should consider efforts to improve forest management for key products, such as medicinal plants, to ensure sustainability and increase yields, and empower and support local institutions and users to take on this responsibility (Shackleton *et al.* 2006). Kengni *et al.* (2004) also suggest investigating the potential of cultivating important wild food plants and enhancing their nutritional value through different methods of post harvest treatment, storage, preparation, etc.

While further study is warranted, given the scanty evidence attributing forest degradation and deforestation specifically to HIV/AIDS-sufferers, we must be cautious of any policy recommendations whereby local people are seen as the 'culprits' of deforestation, or where the sustainable management of forest resources takes primacy over care and compassion for households affected by HIV/AIDS. And even if the data does eventually substantiate claims that HIV/AIDS leads sufferers to increase their use of forest resources, policy options need to accommodate both ecological and human wellbeing/health systems.

1.2.2 Impacts of forest degradation and deforestation on the resilience of HIV/AIDS-affected households

In rural areas, developmental and human health gains depend on ecosystem services (Costanza *et al.* 1997; Daily 1997), and environmental sustainability is a criterion for population health (McMichael 2002). In Sub-Saharan Africa, forests are the primary providers of medicines and fuelwood for rural people, and the potential negative health impacts of an impaired forest for HIV/AIDS-affected households could be catastrophic. For instance, Barany *et al.* (2005) found that the majority of households in two of their study sites were traveling further to collect firewood, and 93% of herbalists reported a general decrease over the last ten years in the availability of wild medicinal plants. Whether the change in forest resource availability is sudden (such as through industrial, clearcut logging) or gradual (such as through selective harvesting of medicinal plants over time), forest degradation has potentially negative implications for HIV/AIDS-affected households. Such impacts could include: loss of income generating options; increase in labour required to collect forest products; reduction in use of firewood (possibly leading to inadequate energy to meet household needs including cooking and sanitation); and reduced access to medicines (Barany *et al.* 2005).

There are growing health implications of environmental degradation (Tabor 2002), and global environmental changes, such as deforestation, pose various risks to human population health (McMichael 2002). It is thus imperative to examine the interaction between anthropogenic changes to environmental resources (Parkes *et al.* 2003), in this case forest resources, and the corresponding impacts on human health (Eisenberg *et al.* 2007; McMichael 1999; Ostfeld *et al.* 2002). For example, if important medicinal plant species become scarce, the result for an ill individual could be a loss of stamina and a compromised immune system. If this individual were a wage earner, other members of the household could be expected to collect forest resources that were previously purchased (Hunter *et al.* 2008; Hunter *et al.* 2007). As local forest resources become degraded and are lost, more time and effort (and hence, labour) would be required to obtain these products. One of the coping mechanisms that could be employed to deal with this would be to skip meals, as found by Kayambazinthu *et al.* (2005). The repercussions of this cycle then could be a continued decrease in stamina, increased vulnerability to further infections and other diseases, and less livelihood and food security. It is not difficult to imagine such scenarios whereby the complex and reinforcing impacts of HIV/AIDS-related illnesses and the slow decay of the forest environment could be debilitating for rural (and particularly HIV/AIDS-affected) households.

Despite much anecdotal information available in the literature, a recent systematic review of the empirical evidence in this domain found that there is a knowledge gap regarding how loss of forest resources impacts HIV/AIDS-affected households (Timko *et al.* 2010). The dominant perspective of most authors tends to focus on the inverse of this relationship, that is, how HIV/AIDS-affected households (negatively) impact the natural environment (see, for example, Barany *et al.* 2005; Holding Anyonge *et al.* 2006; Hunter *et al.* 2008; Shackleton *et al.* 2006; Topouzis 2007; Torell *et al.* 2006). Potential research questions to be examined in this domain include:

- How do forest degradation and deforestation affect the resilience of forest-dependent, HIV/AIDS-affected African households? How do these changes vary when resources are lost suddenly (such as through industrial scale logging) as compared to gradually (such as through selective subsistence harvesting)?
- Is there a 'positive feedback loop' whereby impoverished people living with HIV/AIDS in remote forest regions increasingly depend on forest resources for their livelihoods and food security, resulting in forest degradation and deforestation which compromises their future abilities to meet these critical needs?
- How are local people involved in the preparation of forest management plans? Is this process adequate for incorporating the vast non-timber values of forests, including the provision of environmental services such as medicinal plants for people living with HIV/AIDS?

While worthy of further analysis, these questions are focused on the local level 'operational' aspects of how forest loss can impact on HIV/AIDS-sufferers and vice versa. A potentially more impactful field of research, one requiring an environmental justice perspective, also beckons. In Sub-Saharan Africa, health care is predominantly a forest-based service (Barany *et al.* 2001). Traditional healers are the dominant providers of medical care in forested areas, often providing between 70 per cent and 95 per cent of primary health care (Colfer *et al.* 2006). Because of the remoteness of many rural, and particularly forest-dependent, communities, a lack of access to health care could be the primary cause for an increased reliance on forest medicines and traditional healers. Therefore efforts by development practitioners to address the lack of access to medical personnel beyond the traditional healer could help to stem the dependence on forest medicines and alleviate pressure on the forest. Research to this effect appears to be lacking.

The complex interactions between the health and wellbeing of an HIV/AIDS-affected population and environmental resources means that solutions cannot be sought from a purely medical standpoint. Instead, an interdisciplinary approach based on a combined ecology and health perspective is required. Concerted attention to developing an understanding among the many disciplines spanning the natural and social sciences at work in this field is essential (Wilcox *et al.* 2004), including anthropology and human ecology, economics, epidemiology, ethnobotany, forest ecology, pharmacology, politics, and economics (Colfer *et al.* 2006). Synergies between the social and physical environment as determinants of health create opportunities for both health protection and health promotion strategies (Parkes *et al.* 2003). Therefore, we must look beyond our existing frameworks that limit our ability to understand diseases (*sensu* Farmer 1996), in order to deal with complex environmental problems, and to develop adequate policy responses in these domains. For instance, specific policy options to safeguard the forest-resource related needs of HIV/AIDS-affected households in particular settings could include those that: ensure local values for forest resources (such as medicinal plants) are protected by forest management plans (Colfer *et al.* 2006; Holding Anyonge *et al.* 2006); promote agroforestry as a means to assisting rural residents to establish and manage tree crops, particularly those possessing medicinal properties (Barany *et al.* 2001); and examine rural health delivery to determine the environmental consequences of access, or a lack thereof, to health services. However, while more intensive forest management to increase the accessibility of forest resources is in itself a possible strategy, we must be cautious as to who would gain and who would lose from such activities.

1.3 Micro, meso, and macro-level impacts of HIV/AIDS on forest management

A third set of interlinkages between HIV and forests relates to the local, village, and governmental and non-governmental institutional level impacts of HIV/AIDS on forest management. Knowledge and the capacity to innovate are fundamental to enabling people or organisations to adapt to change. With forests acting as an insurance policy enabling individuals, communities, and organisations to adapt to changing conditions in the face of HIV and AIDS, the epidemic makes the better use and management of forests in Africa all the more urgent and imperative (Topouzis 2007). Yet HIV/AIDS fundamentally challenges forest management and knowledge transmission in a variety of ways. The effects of the disease on local forest use and management will vary depending upon whether they are considered at the micro – or local – level, at the meso – or village – level, or at the macro – or governmental and non-governmental institutional – level (*sensu* Loevinsohn and Gillespie 2003). This section explores in greater detail how HIV/AIDS can challenge forest management at each of these three levels.

1.3.1 Micro-level impacts of HIV/AIDS: individuals and households

When people die at an early age, especially those most active in land and resource management, key aspects of local farming systems can be lost (Dwasi 2002; Oglethorpe and Gelman 2007). Ternström (2005) notes that death can result not only in information about how to use wild foods being lost, but also information about sustainable harvesting methods and information about which rules are efficient for keeping the use of the resources at a sustainable level. Orphaned children and inexperienced collectors may also not be able to acquire the skills to manage natural resources appropriately, as this knowledge is traditionally passed on between generations (Tobey *et al.* 2005; Torell *et al.* 2006; Hunter *et al.* 2008). The immediate results could be increased livelihood insecurity and unsustainable harvesting practices, while Oglethorpe and Gelman (2007) note the risk of future insecurity whereby orphans have only weak attachments to land and resources over the long term.

Whatever the impacts on the loss of knowledge, we must be aware that the prevailing presumptions are that sustainability indeed ever existed, or that changes in management that result from changes in knowledge are necessarily negative. As Tobey *et al.* (2005) note from their research in Tanzanian fishing villages, detailed appraisals are required to understand the potential impact of HIV/AIDS on the sustainability of (fishing) practices. Therefore, caution is required whenever policy recommendations result in forests being removed from local control and placed into centralised control under the auspices that the loss of local knowledge will automatically result in unsustainable use.

1.3.2 Meso-level impacts of HIV/AIDS: community-based forest management

HIV/AIDS can impact community-level institutions and efforts to manage forest resources. Community-based forest management, while varying from place to place, is generally based on rural village structures or groups within them and requires building, strengthening, and empowering the capacity of rural communities to manage their natural resources sustainably (Dwasi 2002). Village leaders often organise joint maintenance efforts, punish rule breaking, solve conflicts, take the initiative to adapt rules, and adopt new innovations, practices, technologies, and ideas (Dwasi 2002; Loevinsohn and Gillespie 2003). And with their skills and knowledge often passed down orally from generation to generation, these community-level institutions become increasingly vulnerable as villages lose both capacity and leadership, due to the death of individuals and as households must necessarily prioritise the care of their sick family members over forest management efforts (Oglethorpe and Gelman 2007). There is a danger that as these communal structures break down, so too does the framework for community-based forest management (Dwasi 2002).

Recommendations that have emerged to grapple with the impact of HIV/AIDS on community-level resource management institutions include: community-level committees should mainstream HIV/AIDS issues into their planning activities (Dwasi 2002; Torell *et al.* 2006); local ecological knowledge should be documented (Oglethorpe and Gelman 2007); the capacity of existing community-based institutions should be built by transferring technical skills for planning and management through training programs, including proper harvesting skills (Barany *et al.*, 2005); mentoring programs should be created whereby youth are able to learn about traditional medicine and local forestry practices and elders such as grandparents can work with their grandchildren and other youth to ensure that knowledge about practices is shared and used in the future (Dwasi 2002; Oglethorpe and Gelman 2007); and participatory approaches to local resource governance should be fostered.

We must however be sceptical of any policy recommendations that threaten those already disempowered or vulnerable. These can include such practices as widow or property inheritance where land is taken from a widow after her husband dies, leaving her more vulnerable, or those that result in land grabbing, all of which can result in vulnerable individuals being excluded from natural resources (Ternström 2005). As with much of the literature on forests and HIV/AIDS, little empirical evidence exists on the long-term effects of HIV/AIDS on institutions and social networks that control the use of local natural resources (Ternström 2005).

1.3.3 Macro-level impacts of HIV/AIDS: governmental and non-governmental institutions and organisations

AIDS is a leading cause of death in Africa and worldwide for prime-aged adults – ages 15–49 – the very people who work to support families, those responsible for building society, and those usually the most productive economically (Drimie 2002; Torell *et al.* 2006; Hunter *et al.* 2008). Because of this, HIV/AIDS can compromise the effectiveness with which government and conservation organisations are able to manage forests in at least two ways: through the loss of staff members in the immediate term, and through reduced recruitment of potential foresters into universities and forestry programs in the long term. This section explores perspectives on these two impacts in greater detail.

Losses of staff members in the immediate/short term due to HIV/AIDS can have a profound impact on the functioning of forestry and conservation organisations, both governmental and non-governmental. Sustainable forest management depends on well-functioning institutional structures (Loevinsohn and Gillespie 2003; Ternström 2005). And many types of forest management institutions can be severely affected by HIV/AIDS in a number of ways, impacting the effectiveness with which forest resources are managed. For example, high levels of staff absenteeism have been observed as workers must attend to the needs of the sick or attend funerals (Mauambeta 2003). The long-term absence of enforcement officials means the capacity to prevent poaching and illegal tree cutting can be compromised, enabling deforestation and forest degradation. When staff members such as park wardens, extension officers, or senior officials pass away, organisations lose management capacity, specialised knowledge and expertise, and institutional memory (Tobey *et al.* 2005; Torell *et al.* 2006; Topouzis 2007). The loss of skilled workers and the need to train new workers can reduce productivity and profitability (Topouzis 2007), a particularly serious concern in Africa where conservation capacity is already limited (Dwasi 2002; Oglethorpe and Gelman 2007). Accelerated rates of payment of terminal benefits by conservation government agencies can also create competition for scarce financial resources between HIV/AIDS demands and conservation activities (Dwasi 2002). And a lack of investment in agriculture and forestry could undermine technological progress and affect productivity (FAO 2003).

While the impacts of HIV/AIDS on forest management institutions have been observed anecdotally, assessments of the impacts of HIV/AIDS on workforces, conservation activities, and organisational finances are still needed (Dwasi 2002; Torell *et al.* 2006). There is a need to examine changes in customs, norms and traditions in light of disruptions to natural resource institutions (Ternström 2005). Analyses of the costs and benefits of different policy options for alleviating the impact of the disease on forest management institutions are also lacking (Rosen *et al.* 2006).

In spite of the lack of empirical evidence on the repercussions of HIV/AIDS at an organisational level, the anecdotal evidence in this field has provided important insights into the dynamics of the epidemic on the forest sector, and has led to a number of recommendations. These include: mainstreaming HIV/AIDS by building upon the strengths and sharing the burden between all agencies responsible at the intersection of health and environment, such as by hiring occupational nurses and social workers to assist conservation staff (Dwasi 2002); re-designing employee benefit schemes to address the immediate needs of HIV-positive employees and their families, while still ensuring that HIV-negative employees retain the longer term benefits they will need (Rosen *et al.* 2006); providing training and mentoring to rebuild community conservation and natural resource management skills lost due to AIDS, such as capacity building efforts that focus on different groups including orphans, youth, elderly, and women (Oglethorpe and Gelman 2007); developing better HIV/AIDS awareness programs and training courses and curricula for the workplace and technical and tertiary education institutions (Dwasi 2002; Topouzis 2007); developing mobile services that can be taken to remote forestry field sites (Rosen *et al.* 2006); and building upon the comparative advantages that already exist where institutions responsible for natural resource management and their responses to HIV/AIDS are concerned, including their often stable contacts with local communities and organisations in fairly inaccessible rural areas (Lopez *et al.* 2005).

Finally, along with the short term impacts listed above, HIV/AIDS can have a long term impact through an ongoing reduced recruitment of potential foresters into universities and forestry programmes. Foresters hired by governments and NGOs typically require a body of knowledge and skills obtained through training and research (Dwasi 2002). HIV/AIDS can impact on long-term forest conservation efforts by compromising the recruitment of potential foresters into universities and forestry programmes. It can lead to a reduced rate of human capital accumulation as fewer children are sent to school in general, with even fewer people having the opportunity to become educated as conservation practitioners (Torell *et al.* 2006). It would appear that no empirical research has yet been conducted on this topic, and our literature review did not reveal any policy recommendations (questionable or otherwise) on this topic. Therefore, this should be considered an area requiring further inquiry.

Interlinkages, perspectives and policy development

The purpose of this paper has been to elucidate three sets of linkages between HIV/AIDS, forests, and forestry in Sub-Saharan Africa (Figure 1.0). Each is complex, influenced by many external factors entirely separate from the realm of forests and forestry. Each is also open to a variety of perspectives, with authors and actors from different backgrounds and positions highlighting different aspects associated with different perceived problems. Stemming from these perspectives, many policy options can and have been developed in regard to HIV/AIDS, forest resources, and the forestry industry in various parts of Africa. These include, for instance, changing workplace practices in the forest industry to reduce the transmission of HIV; alleviating those interactions that both aggravate the impacts of HIV/AIDS on households and concomitantly affect forests negatively; and supporting efforts to improve forest management for key products, such as medicinal plants, to ensure sustainability and increase yields, and empower and support local institutions and users to take on this responsibility.

Those policy options covered through the literature review in this paper do not appear to unduly bias forest resources and conservation over local livelihoods and human health needs. However, there are still gaps in our knowledge, important research questions remain unanswered, and a diligence to who gains and who loses from various policy pathways must be retained (Leach 2008). For instance, we must question how the systemic gender inequality affecting many women in developing countries influences their choice to pursue risky sexual behaviour as an income-generating strategy, and develop policy options to enable women to seek incomes outside of prostitution. We must be cautious of any policy recommendations whereby local people are seen as the 'culprits' of deforestation, or where the sustainable management of forest resources takes primacy over care and compassion for households affected by HIV/AIDS. We must be sceptical of any policy recommendations that prohibit widows from inheriting their deceased husband's property, or that result in land grabbing, all of which can result in vulnerable individuals being excluded from natural resources. We must be cautious of any policy that results in forests being removed from local control and placed into centralised control, under the auspices that the loss of local knowledge will automatically result in unsustainable use or that centralised forest management is the only means to ensure sustainability. Indeed, we must be aware of the presumption that sustainability – seen as a static state – indeed ever existed.

Forests and forest resources are fundamental to poverty alleviation in Africa, and their role is even greater in HIV/AIDS-affected regions as they may well decrease the vulnerability of rural people by increasing their resilience to HIV/AIDS. With constant attention to understanding who benefits and who suffers from various policy options, there are opportunities to develop pathways that make forests

and their important resources available to those who need them the most – the impoverished and HIV-affected rural people living in close proximity to forests. At the same time, forest industries must be supported so that they, along with other forest management and conservation institutions, including community institutions, effectively and equitably respond to the implications of HIV/AIDS on their organisations and chart a course forward to ensure forest resources are sustained into the future.

References

- ABCG (Africa Biodiversity Collaborative Group) (2002) 'HIV/AIDS and Natural Resource Management Linkages', workshop proceedings, Nairobi, Kenya
- Agyei-Mensah, S. (2001) 'Twelve Years of HIV/AIDS in Ghana: Puzzles of Interpretation', *Canadian Journal of African Studies* 35: 441-472
- (1995) *Socio-economic benefits and issues in non-wood forest products use*, Report of the International Expert Consultation on Non-wood Forest Products, Rome: FAO
- (1994) *Non-farm employment in small-scale forest-based enterprises: Policy and environmental issues*, Working Paper #11, University of Wisconsin-Madison: EPAT/MUCIA Research & Training
- Barany, M., Holding Anyonge, C., Kayambazinthu, D. and Siteo, A. (2005) 'Firewood, food, and medicine: Interactions between forests, vulnerability and rural responses to HIV/AIDS', Proceedings from the IFPRI Conference: HIV/AIDS and Food and Nutrition Security, Durban, South Africa
- Barany, M., Hammett, A.L., Stadler, K.E., and Kengni, E. (2004) 'Non-timber forest products in the food security and nutrition of smallholders afflicted by HIV/AIDS in Sub-Saharan Africa', *Forests, Trees and Livelihoods* 14: 3-18
- Barany, M., Hammett, A.L., Sene, A., and Amichev, B. (2001) 'Nontimber Forest Benefits and HIV/AIDS in Sub-Saharan Africa', *Journal of Forestry* 99: 26-41
- Belcher, B., Ruiz-Perez, M. and Achdiawan, R. (2003) 'Global patterns and trends in NTFP Development', conference presentation, The International Conference on Rural Livelihoods, Forests and Biodiversity, Bonn, Germany
- Birley, M.H. (1995) *The Health Impact Assessment of Development Projects*. London: Her Majesty's Stationery Office
- Campbell, C. (2000) 'Selling sex in the time of AIDS: the psycho-social context of condom Use by sex workers on a southern African mine', *Social Science and Medicine* 50: 479-494
- Campbell, C. and Williams, B. (1999) 'Beyond the biomedical and behavioural: towards an integrated approach to HIV Prevention in the southern African mining industry', *Social Science and Medicine* 48: 1625-1639
- CIFOR (Centre for International Forestry Research). (2005) *Contributing to African Development Through Forests Strategy for Engagement in Sub-Saharan Africa*, Bogor: CIFOR

- Colfer, C.J.P., Sheil, D., and Kishi, M. (2006) *Forests and Human Health: Assessing the Evidence*, CIFOR Occasional Paper No. 45, Bogor: CIFOR
- Costanza, R., D'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P. and van den Belt, M. (1997) 'The value of the world's ecosystem services and natural capital', *Nature* 387: 253-261
- Daily G. (1997) *Nature's Services: Societal Dependence on Natural Ecosystems*. Washington, DC: Island Press
- De Souza, R.M., Heinrich, G., Senefeld, S., Coon, K., Sebanja, P., Ogden, J., Mauambeta, D., Gelman, N. and Oglethorpe J. (2008) 'Using innovation in address HIV, AIDS, and environment links: intervention case studies from Zimbabwe, Uganda, and Malawi', *Population and Environment* 29: 219-246
- Drimie, S. and Gandure, S. (2005) *The Impacts of HIV/AIDS on Rural Livelihoods in Southern Africa: An Inventory and Literature Review*, FAO (Zimbabwe) <http://www.zimrelief.info/files/attachments/doclib/Impact%20of%20HIV%20&%20AIDS%20on%20Livelihood%20in%20Southern%20Africa.pdf> (17 February 2009)
- Drimie, S. (2002) *The impact of HIV/AIDS on rural households and land issues in Southern and Eastern Africa*, FAO (South Africa) <ftp://ftp.fao.org/docrep/nonfao/ad696e/ad696e00.pdf> (14 March 2010)
- Dwasi, J. (2002) 'HIV/AIDS and Natural Resource Management in Africa: Findings from Kenya, Namibia, South Africa, and Uganda', unpublished report http://www.framework.org/adl/en-US/2323/file/327/Final_Draft_of_Jane_Dwasi_Report.doc (12 February 2009)
- Eisenberg, J.N., Desai M.A., Levy, K., Bates, S.J., Liang, S., Naumoff, K. and Scott, J.C. (2007) 'Environmental Determinants of Infectious Disease: A Framework for Tracking Causal Links and Guiding Public Health Research', *Environmental Health Perspectives* 115: 1216-1223
- Farmer, P. (1996) 'Social Inequalities and Emerging Infectious Diseases', *Emerging Infectious Diseases* 2: 259-269
- FAO (Food and Agriculture Organization of the United Nations) (2003) *Forestry Outlook Study for Africa: Regional Report – opportunities and challenges towards 2020*, FAO Forestry Paper 141, Rome: FAO
- Frank, E. and Unruh, J. (2008) 'Demarcating forest, containing disease: land and HIV/AIDS in southern Zambia', *Population and Environment* 29: 108-132
- Goliber, T.J. (1997) 'Population and Reproductive Health in Sub-Saharan Africa', *Population Bulletin* 52: 2-44
- Holding Anyonge, C., Rugalema, G., Kayambazinhu, D., Siteo, A. and Barany, M. (2006) 'Fuelwood, food and medicine: the role of forests in the response to HIV and AIDS in rural areas of southern Africa', *Unasylva* 224: 20-23

- Horning, N.R. (2004) 'The limits of rules: when rules promote forest conservation and when they do not – insights from Bara country, Madagascar', unpublished PhD thesis, New York: Cornell University
- (2003) 'The cost of ignoring rules: how Madagascar's biodiversity and rural livelihoods have suffered from institutional shortcomings', conference presentation, International Conference on Rural Livelihoods, Forests and Biodiversity, Bonn, Germany
- Hunter, L., Twine, W., and Johnson, A. (2008) *Adult Mortality and Natural Resource Use in Rural South Africa: Evidence from Agincourt Health and Demographic Surveillance Site*. Working Paper EB2005-0004, Boulder, CO: Institute of Behavioral Science, University of Colorado at Boulder
- Hunter, L., Twine, W., and Patterson, L. (2007) "'Locusts are now our beef": Adult mortality and household dietary use of local environmental resources in rural South Africa', *Scandinavian Journal of Public Health* 35: 165-174
- Jenkins, R.K.B., Rabearivelo, A., Andre, C.T.C.W.M., Randrianavelona, R. and Randrianantoandro, C. (2009) 'The harvest of endemic amphibians for food in eastern Madagascar', *Tropical Conservation Science* 2: 25-33
- Jenkins, R.K.B and Racey, P.A. (2008) 'Bats as bushmeat in Madagascar', *Madagascar Conservation & Development* 3: 22-30
- Kaimowitz, D. (2003) 'Not by bread alone...forests and rural livelihoods in sub-Saharan Africa' pp. 45-63 in T. Oksanen, B. Pajari and T. Tuomasjukka (eds) *Forests in poverty reduction strategies: capturing the potential*, EFI Proceedings No 47, Joensuu, Finland: European Forest Institute
- Kaschula, S.A. (2008) 'Wild foods and household food security responses to AIDS: evidence from South Africa', *Population and Environment* 29:162-185
- Kayambazinthu, D., Barany, M., Mumba, R., and Holding Anyonge, C. (2005) *Miombo woodlands and HIV/AIDS interactions: Malawi country report*, Forestry Policy and Institutions Working Paper 6, Rome: FAO
- Kengni, E., Mbofung, C.M.F., Tchouanguep, M.F., and Tchoundjeu, Z. (2004) 'The nutritional role of indigenous foods in mitigating the HIV/AIDS crisis in West and Central Africa', *International Forestry Review* 6: 149-160
- Leach, M. (2008) *Haemorrhagic Fevers in Africa: Narratives, Politics and Pathways of Disease and Response*, STEPS Working Paper 14, Brighton: STEPS Centre
- Leach, M., Scoones, I. and Stirling, A. (2010) *Dynamic Sustainabilities: Technology, environment, social justice*. London: Earthscan
- Loevinsohn, M. (2008) *Innovation in agriculture and NRM in communities confronting HIV/AIDS: a review of international experience*, PROLINNOVA Working Paper 18, Wageningen, Netherlands: PROLINNOVA
- Loevinsohn, M. and Gillespie, S. (2003) *HIV/AIDS, Food Security, and Rural Livelihoods: Understanding and Responding*, Washington, DC: IFRPI

- Lopez, P., Bergmann, U., Dresrusse, P., Frode, A., M. Hoppe, and Rotzinger, S. (2005) 'Linking protected area management and HIV/AIDS prevention – experiences from Ankarafantsika National Park, Madagascar', *PARKS* 15: 25-36
- Mauambeta, D.C. (2003) *HIV/AIDS Mainstreaming in Conservation: The case of Wildlife and Environmental Society in Malawi*, Imbe, Malawi: Wildlife and Environmental Society of Malawi, http://www.frameweb.org/adl/en-US/2308/file/209/WESM_AIDS_Paper.pdf (16 February 2009)
- McGarry, D.K. and Shackleton, C.M. (2009) 'Is HIV/AIDS jeopardizing biodiversity?', *Environmental Conservation* 36: 5-7
- McMichael, T. (2002) 'The Biosphere, Health, and "Sustainability"', *Science* 297: 1093
- (1999) 'Prisoners of the Proximate: Loosening the Constraints on Epidemiology in an Age of Change', *American Journal of Epidemiology* 149: 887-897
- Meekers, D. (2000) 'Going underground and going after women: trends in sexual risk behaviour among gold miners in South Africa', *International Journal of STD and AIDS* 11: 21–26
- Monela, G.C., Kajembe, G.C., Kaoneka, A.R.S. and Kowero, G. (2000) 'Household livelihood strategies in the miombo woodlands of Tanzania: emerging trends', *Tanzania Journal of Forestry and Nature Conservation* 73: 17-33
- Ndam, N. and Marcelin, M.T. (2004) 'Chop, but no broke pot': the case of *Prunus Africana* on Mount Cameroon' chapter 3 in T. Sunderland and O. Ndoye (eds) *Forest products, livelihoods and conservation: case studies of non-timber forest product systems, Volume 2 – Africa*, Bogor: CIFOR
- Novy, J.W. (1995) 'Medicinal plants of the eastern region of Madagascar', *Journal of Ethnopharmacology* 55: 119-126
- Oglethorpe, J. and Gelman, N. (2007) *HIV/AIDS and the Environment: Impacts of AIDS and Ways to Reduce Them*, Washington DC: World Wildlife Fund, http://www.ehproject.org/PDF/phe/hiv_environment-factsheet2007.pdf (12 February 2009)
- Ostfeld, R.S., Meffe, G.K., and Pearl, M.C. (2002) 'Conservation Medicine: The Birth of Another Crisis Discipline' chapter 3 in A.A. Aguirre, R.S. Ostfeld, G.M. Tabor, C. House, and M.C. Pearl (eds) *Conservation Medicine: Ecological Health in Practice*, Oxford, UK: Oxford University Press
- Parkes, M., Panelli, R., and Weinstein, P. (2003) 'Converging Paradigms for Environmental Health Theory and Practice', *Environmental Health Perspectives* 111: 669-675
- Quinn, T.C. and Overbaugh, J. (2005) 'HIV/AIDS in Women: An Expanding Epidemic', *Science* 308: 1582-1583

- Rein, M. and Schön, D. (1993) 'Reframing Policy Discourse' pp. 145-166 in F. Fischer and J. Forester (eds) *The Argumentative Turn in Policy Analysis and Planning*, Durham, NC: Duke University Press
- Rosen, S., Hamazakaza, P., Feeley, R. and Fox, M. (2006) *The Impact of AIDS on Government Service Delivery: The Case of the Zambia Wildlife Authority*, Health and Development Discussion Paper No. 8, Centre for International Health and Development: Boston University of Public Health
- Shackleton, S., Kaschula, S., Twine, W., Hunter, L., Holding Anyonge, C. and Petheram, L. (2006) *Forests as safety nets for mitigating the impacts of HIV/AIDS in southern Africa*, Bogor: CIFOR
- Shackleton, C. and Shackleton, S. (2004) 'The importance of non-timber forest products in rural livelihood security and as safety nets: a review of evidence from South Africa', *South African Journal of Science* 100: 658-664
- Shi, L. and Stevens, G. (2005) *Vulnerable populations in the United States*, San Francisco: Jossey-Bass
- Shyamsundar, P. and Kramer, R. (1997) 'Biodiversity conservation: at what cost? A study of households in the vicinity of Madagascar's Mantadia National Park', *Ambio* 26: 180-184
- Smith, M.K. (2002) 'Gender, Poverty, and Intergenerational Vulnerability to HIV/AIDS', *Gender and Development* 10(3): 63-70
- Steenkamp, J. (2006) The impact of HIV/AIDS on the forestry contracting sub-sector and the implications for broad-based black economic empowerment in South Africa, extended abstract and presentation, 2006 IUFRO Forest Plantations Meeting, Charleston, South Carolina
- Sunderlin, W.D., Angelsen, A., Belcher, B., Burgers, P., Nasi R., Santoso, L. and Wunder, S. (2005) 'Livelihoods, forests, and conservation in developing countries: an overview', *World Development* 33: 1383-1402
- Syampungani, S., Chirwa, P.W., Akinnifesi, F.K., Sileshi, G. and Ajayi, O.C. (2009) 'The miombo woodlands at the cross roads: Potential threats, sustainable livelihoods, policy gaps and challenges', *Natural Resources Forum* 33: 150-159
- Tabor, G.M. (2002) 'Defining Conservation Medicine', chapter 2 in A.A. Aguirre, R.S. Ostfeld, G.M. Tabor, C. House, and M.C. Pearl (eds) *Conservation Medicine: Ecological Health in Practice*, Oxford, UK: Oxford University Press
- Tadesse, W., Desalegn, G. and Alia, R. (2007) 'Natural gum and resin bearing species of Ethiopia and their potential applications', *Instituto Nacional de Investigacion y Tecnologia y Alimentaria* (INIA) 16: 211-221
- Ternström, I. (2005) 'HIV/AIDS - The true tragedy of the Commons? Exploring the effects of HIV/AIDS on management and use of local natural resources', workshop presentation, Trieste, Italy: the Abdus Salam International Centre for Theoretical Physics.

- Timko, J.A., Kozak, R.A. and Innes, J.L. (2010) 'HIV/AIDS and forests in Sub-Saharan Africa: exploring the links between morbidity, mortality, and dependence on biodiversity', *Biodiversity* 11: 45-48
- Tobey, J., Torell, E., Thaxton, M., Crawford, B., Kalangahe, B., Issa, A. and Madulu, N. (2005) 'HIV/AIDS and Threats to Coastal Biodiversity in Tanzania Cross-Sectoral Dimensions of HIV/AIDS, Gender, and Population Dynamics in Critical Areas', mimeo, University of Rhode Island: Coastal Resources Center
- Topouzis, D.N. (2007) 'HIV/AIDS: a risk to the social and economic sustainability of forestry in Sub-Saharan Africa?', *International Forestry Review* 9: 558-562
- Torell, E., Tobey, J., Thaxton, M., Crawford, B., Kalangahe, B., Madulu, N., Issa, A., Makota, V., and Sallema, R. (2006) 'Examining the linkages between AIDS and biodiversity conservation in coastal Tanzania', *Ocean & Coastal Management* 49: 792-811
- Twine, W. and Hunter, L. (2008) *AIDS Mortality and the role of natural resources in household food security in a rural district of South Africa*, HIV, Livelihoods, Food and Nutrition security: findings from renewal research (2007-2008) Brief 11, Washington, DC: IFPRI
- Van Dijk, H. and Wiersum, F. (1999) NTFP resource management as an option for multiple-use forest management in Cameroon, pp.114-122 in H. Van Dijk and M.A.F. Ros-Tonen (eds) *NTFP Research in the Tropenbos Programme: Results and Perspectives*, Wageningen, Netherlands: The Tropenbos Foundation
- Van Haften, H.E. (1995) *Personal Diary—CIFOR C&I Study in Côte d'Ivoire*, Bogor: CIFOR
- Villarreal, M., Holding Anyonge, C., Swallow, B., and Kewsiga, F. (2006) 'The challenge of HIV/AIDS: Where does agroforestry fit in?' chapter 23 in D. Garrity, A. Okono, M. Grayson, and S. Parrott (eds) *World Agroforestry into the Future*, Nairobi: World Agroforestry Centre
- Wilcox, B.A., Aguirre, A.A., Daszak, P., Horwitz, P., Martens, P., Parkes, M., Patz, J.A. and Waltner-Toews, D. (2004) 'EcoHealth: A Transdisciplinary Imperative for a Sustainable Future', *EcoHealth* 1: 3-5
- Wood, W.B. (1988) 'AIDS North and South: Diffusion Patterns of a Global Epidemic and a Research Agenda for Geographers', *Professional Geographer* 40: 266-79
- Yelpaala, K. and Ali, S.H. (2005) 'Multiple scales of diamond mining in Akwatia, Ghana: addressing environmental and human development impact', *Resources Policy* 30: 145-155