Baba Sene

Nontimber Forest Benefits
and HIV/AIDS in Sub-Saharan Africa

Marc Barany, A.L. Hammett, Abdou Sene, and Beyhan Amichev

ABSTRACT

The HIV/AIDS epidemic is drastically reducing the agricultural workforce of sub-Saharan Africa, threatening household food security and the food supply throughout the region. Forests contribute to household nutrition and health and therefore should be considered in efforts to mitigate the socioeconomic impact of HIV/AIDS on rural agrarian households. Because little reference to forests and forest products exists in the literature concerned with the coping mechanisms of HIV/AIDS–affected households, we intend to draw attention to the importance of forest-based research in the context of these coping strategies.

Keywords: agroforestry; nontimber forest products; nutrition; policy

Nontimber products from forests and other tree systems continue to be an important component of household health and nutrition in Africa, a continent with a forest cover of 21 percent *(fig. 1)* (Food and Agriculture Organization of the United Nations [FAO] 2001b). Although undervalued by planners and policymakers (Katerere 1998), forests and trees provide food, fiber, fodder, fuel, and medicinal products (Nair 1990). In times of the year characterized by subsistence shortages, such as a season of hunger preceding the first harvest, or in times of famine and drought, forests can become crucial sources of nutrition (e.g., Shumba 2001). Forests also provide useful products and services in times of economic crisis or illness. Without much investment, many products and services of the forest can be transformed into food or income (Warner 1995; Lipper 2000). Neglecting to adequately recognize these nontimber values of forests, forest policy (or the lack thereof) often denies the socioeconomic benefits of forests to those who are dependent on them (Dewees 2000).

Above: **A villager displays tree fruits and other nontimber forest products at a market in Senegal.**

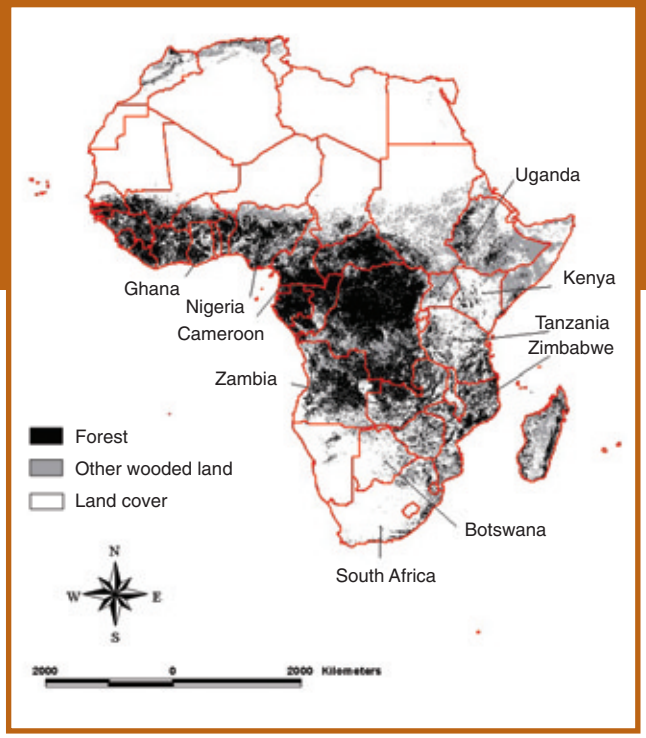

Figure 1. **Forest cover in Africa, based on 1992–93 and 1995–96 AVHRR (advanced very high resolution radiometer) data. *Source:* FAO (2001b).**

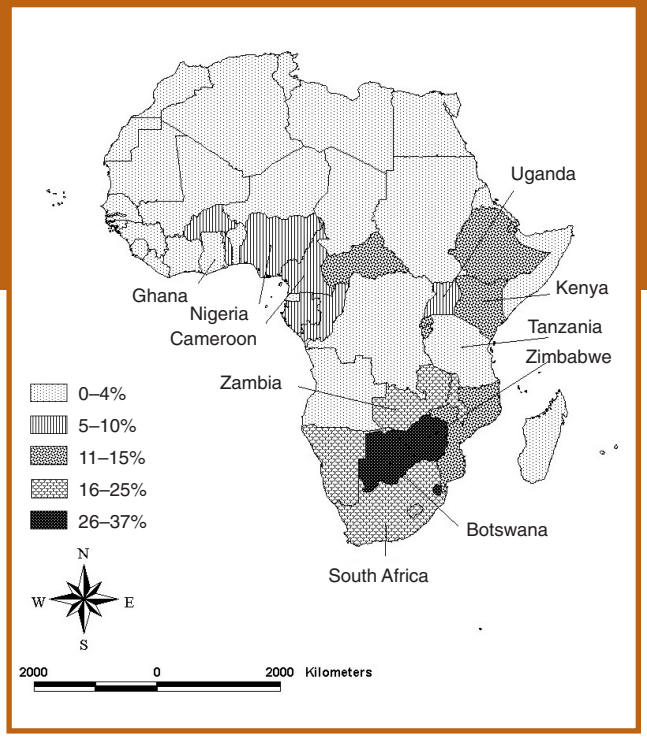

Figure 2. **Percentage of adults living with HIV/AIDS in Africa by country, 1999. *Source:* UNAIDS (2000).**

According to African forestry specialists, marginalization of forestry within policies external to the sector, such as agriculture, is one of the major constraints to sustainable forest management (FAO 1996; Mlay et al. 2000). Africa's forests are being converted to other uses at a rate of nearly 1 percent annually, the highest of any region in the world (FAO 2001b). As is the case in most developing regions, commercial agricultural expansion as a means toward industrialization reduces forest cover, both directly and indirectly. Unable to absorb the growing supply of labor, this approach to economic development creates frontier expansion by subsistence agriculturalists, the main cause of deforestation in Africa (FAO 2000). The reduction in forest cover, combined with the growing demand for forest products, has led to strict regulation of remaining natural forests and intensification of private forest management. Having large rural populations traditionally dependent on multiple nontimber forest products and services from communal lands, it is not surprising that one of the most pressing issues in African forestry sectors is forest resource access (Mlay et al. 2000). To effectively mainstream forest policy in socially sustainable national development programming will require further efforts to quantify the nontimber services rendered to society at large, as well as recognition of these values by both foresters and planners outside of the forest sector (such as agriculture and health).

This article makes a case for the integration of forestry within the planning programs of other sectors, and the need for foresters to be aware of forestry's broad role in human welfare. We look specifically at the current HIV/AIDS pandemic in sub-Saharan Africa and the potential nutritional and health values offered to households by forests and trees. Although forests have been neglected in research concerned with the socioeconomic effects of the pandemic, there clearly is a need to examine the implication of the disease on forest resource use, and the potential role of forestry (within the context of a multisector strategy) to address the HIV/AIDS crisis in sub-Saharan Africa.

HIV/AIDS and Agriculture

Already plagued by a history of food insecurity, per capita agricultural productivity across sub-Saharan Africa is decreasing further with the rise of HIV/AIDS (FAO 2001c). This HIV/AIDS–induced reduction of agricultural production could be devastating to the region. In Zimbabwe, the output of communal agriculture has fallen by 50 percent over the past five years, largely because of AIDS (Joint United Nations Program on HIV/AIDS [UNAIDS] 1999). Not only does this epidemic threaten rural populations that depend directly on agricultural harvests for survival, but a recent study shows that Kenya's commercial agriculture sector is particularly susceptible to the epidemic, suggesting a severe social and economic crisis (Rugalema 1999). Kenya's commercial agriculture sector accounts for nearly 30 percent of Africa's gross domestic product (Versi 1995).

A major workforce reduction is at the root of this agricultural demise. By 2020, 17 percent of Kenya's agricultural labor force could be lost due to AIDS (FAO 2001a). Most susceptible to AIDS mortality are adults between the ages of 15 and 50, the age group that typically makes up the bulk of a state's labor force. In Botswana, the estimated adult infection rate is 36 percent *(fig. 2)* (UNAIDS 2000). Compounding the epidemic's induced toll on the agricultural workforce is the oc-

James McKenna

Tree crops, such as these *Acacia* trees in Niger, support food production and are inexpensive to establish and manage.

currence of higher infection rates for women (who account for 70 percent of the agricultural labor force in sub-Saharan Africa) and their traditional role as caretakers (Baier 1997). A study in Tanzania shows that a woman whose husband is ill spends 60 percent less time on agricultural activities than she normally would (UNAIDS 1999).

HIV/AIDS and Nutrition

Farming households affected by HIV/AIDS–induced labor shortages have used various coping strategies (Engh et al. 2000) that ultimately lead to decreases in crop yields and buying power, exacerbating the effects of poverty (Egal and Valstar 1999). Contributing to this downward spiral of poverty and disease are the increasing costs of household health care, which represents 25 to 50 percent of the net annual income of most small farms (UNAIDS 1999).

As drugs remain too costly despite pharmaceutical price reductions (Farah 2001), and recent market orientation of health care systems is limiting access to medical treatment (e.g., Loewenson 2000), home-based care for AIDS patients is increasing (Nnko et al. 2000). Individuals infected with HIV must consume more food as their bodies require more nutrients; therefore, household food security and nutrition is important (FAO 2001c). In Uganda, food insecurity and malnutrition are the most critical concerns among female-headed AIDS-affected households (Topouzis and Hemrich 1996).

Rural household labor shortages and the resulting reduction in agricultural production suggest potential increased use of forests and tree systems, as they have traditionally contributed to nutrition and health with relatively low labor inputs. Evidence suggests that past epidemics have influenced such a shift from agrarian societies to forest-dependent societies (Balee 1992). Reversion to wild, uncultivated resources in sub-Saharan Africa has been documented more recently by a study in Zambia that found households to be substituting purchased food with indigenous or wild vegetables (UNAIDS 1999).

Forests, Nutrition, and Health

Wild supplies of food comprise much more of the diet of subsistence populations than is often realized (Hoskins 1990). Approximately 1,500 species of wild plants are collected for consumption in central and west Africa (Chege 1994). In some parts of Africa, diets based on staple grains depend largely on tree products to provide essential vitamins. For instance, many trees produce oil seeds, edible leaves, and fruits rich in important vitamins and nutritional elements (Hoskins 1990; Ogden 1990). After the oil palm, the shea-butter tree *(Butyrospermum paradoxm)* is the second most important source of fat in African diets (FAO 1995). In some areas, wild game from forests provides most of the protein eaten by rural populations (e.g., Bennett and Robinson 2000). Dietary supplementation with forest and tree products may play an important role in community nutrition, given growing evidence that malnutrition is a major underlying cause for the rapid expression of AIDS in Africa's HIV-infected individuals (Enwonwu and Warren 2001).

Perhaps one of the most important nontimber forest products to household nutrition and health is fuelwood. In some regions of Africa, fuelwood comprises between 61 and 86 percent of the primary energy consumption, with 74 to 97 percent of this consumed by households (Amous 2000). The availability of fuel often determines the nutritional value of meals (Egal et al. 2000), as cooking releases nutrients in grains and fibrous foods. For example, cassava *(Manihot esculenta),* a staple root crop of many people in the developing world, requires processing, often by fire, to remove toxic levels of cyanide in the preprocessed root. It has been hypothesized that access to this nontimber forest product is directly related to household food cooking time, frequency of parasitic diseases, and the workload of women among some communities (Anonymous 1990).

In sub-Saharan Africa, health care is largely a forest-based service (Chege 1994). Forests and trees are valued by agrarian communities for their supply of medicinal products (Hoskins 1990), and plant-based remedies are used increasingly in the region to treat HIV/AIDS–related illnesses (Bodeker et al. 2000). In Tanzania, the Tanga AIDS Working Group treats AIDS patients with herbs prescribed by traditional healers (Hayman 2001). At the Mefopla Centre in Cameroon, efforts to boost the immune system of AIDS patients involve indigenous medicinal plants with enzyme-rich food, including cultivated tree nuts and wild fruits (Kinyuy 2001). Not only do forest and tree products directly contribute to nutrition and health, they also contribute to the accessibility of food and health care by increasing household purchasing power.

Local and Regional Economies

Nontimber forest products are commonly offered for sale and thereby provide employment. In Ghana, total household incomes derived from nontimber forest products range between 49 and 87 percent; while in Cameroon extractive activities around one forest tract contribute to over half of local in-

comes (Chege 1994). Markets for nontimber forest products are growing, as large urban centers and scarce forest resources create demands for high-value forest products. In west Africa, the roots of *Swartzia madagascar* are traded over distances exceeding 500 kilometers (Cunningham 1993). The understory plants belonging to the genus *Gnetum* are exported from central Africa to Europe (Mialoundama 1993).

Even when the amount of income generated by the sale of fruit and fuelwood is not large, these products play an important role in household expenses (Scherr 1995). Caterpillars that feed on the leaves of the mopane tree *(Colophospermum mopane)* are a cash crop in southern Africa; one report documents the reliance of an AIDS orphan on this economic activity in caring for her siblings (Menzel and D'Aluisio 1998). Overextraction of the caterpillar is threatening the sustainability of this activity, so efforts are under way to establish mopane farming. Both the direct and indirect values of nontimber forest products to nutrition and health justify their incorporation into cultivation systems.

Agroforests: Low-Input Production

Considering the household labor shortages associated with HIV/AIDS and the benefits of nontimber forest products to rural households, agroforestry seems an appropriate response to counter the negative effects of the epidemic on traditional agriculture production and household food security. Trees can support food production by reducing the risk of annual crop failure, compensating for seasonal scarcities, and providing an emergency food supply during droughts (Hoskins 1990). Tree crops are inexpensive to establish and manage compared to many high-value agricultural crops (Warner 1995), and for the small, nonmechanized farmer, incorporating multiuse trees into the crop field can save time and resources (Hamilton and Bliss 1998).

Labor and agroforestry systems. Where labor is scarce and a minimum management system is required, tree crops can become the farmer's primary preference (Arnold 1990), as they require less labor to cultivate, allow household labor to engage in other activities (Dewees and Saxena 1995), and allow households to spread harvesting labor more evenly throughout the year (Nair 1990). According to Hoekstra (1987), agroforestry can reduce the costs of labor by maximizing the productivity of biological systems; improving the efficiency of labor through positive interaction of trees and the human component (shading); and allowing for the combination of activities, such as grazing and fuelwood collection.

A study in Nigeria shows that when labor is the household's major farm input, returns to labor in agroforestry systems are four to eight times greater than those in monocropped fields (Arnold 1990). This inverse relationship between labor scarcity and tree systems is supported by the natural regeneration of forest resources where labor is in short supply.

Agricultural labor loss and fallow lands. As HIV/AIDS–affected households reduce cultivated land areas, more remote fields are left fallow and revert to bush (du Guerny 1999). A study of one such community in Uganda revealed that, in most cases, farmers abandoned about one-third of their land to bush (Barnett and Haslwimmer 1995). Another study from Tanzania reported that large farms inherited by young orphans were rapidly degenerating into bush because of the lack of care; the community typically would manage such farms, but traditional community organizations are breaking down because of the shortage of labor (UNAIDS 1999).

Bush-fallow systems traditionally have been used in sub-Saharan Africa to improve soil and produce forest products such as poles, firewood, and animal feed. Therefore, the current reversion of agricultural land to bush does not represent the complete loss of productivity suggested in the literature. But it does provide an opportunity to diversify land-use and household productivity. For example, 13 fodder tree species and seven species known to bear wild edible fruits have been found in *Acacia* fallow in Zambia (Chidumayo 1988). This increasing occurrence of bush-fallow succession suggests a new area for research concerning the formulation and recovery of fallow strategies that meet the needs of HIV/AIDS–affected households.

Forestry Research

The forestry sector has been almost completely excluded from assessments of HIV/AIDS impacts in sub-Saharan Africa. Alhough there is scant literature or research concerned with HIV/AIDS and forestry, there are reports that concretely confirm this proposed utility. In addition to the earlier example of the AIDS orphan who earns money collecting mopane caterpillars, in July 2001 the BBC reported on an AIDS orphan in Zambia who collects fuelwood for a local charcoal industry. On a broader scale is the increasing pressure on wild stocks of plants used in traditional medicine (Bodeker et al. 2000), which emphasizes the need to address sustainability issues.

The lack and inconclusiveness of literature and observations supports what we feel is the need to understand the current and potential role of forestry in mitigating the socioeconomic effects of the HIV/AIDS epidemic. Holistic planning and policy in a multisectoral response to the epidemic will rely on research on the management of and access to nontimber forest resources, the inclusion of nontimber forest products into low-input agricultural systems, marketing and processing of nontimber forest products to diversify household incomes, indigenous knowledge rights, and documentation and data dissemination concerning forest resources.

Managing Nontimber Forest Resources

Nontimber forest products are derived mainly from common-property forests and woodlands (FAO 1993). The supply of and demand for nontimber forest products within various forest resources need to be addressed. Where supplies are abundant and markets are strong, resources may be overutilized. Another important factor is the declining availability of forest foods as increasing populations, severe forest degradation, and privatization and regulation of formerly common lands reduce accessibility to remaining forest resources by dependent populations.

Agroforestry and the domestication of forest products. Population growth and deforestation historically has led to the domestication of many indigenous forest plants and to their incorporation into agricultural systems primarily for the benefit of small farmers (Leakey and Izac 1996). Through domestication, many of these products can be made more attractive to farmers and more marketable. According to agricultural development theory, farmers adopt new practices when there arise clear economic incentives to do so. Information on the relationship between design and management factors, tree growth, and crop competition would help farmers in their selection of marketable tree species (Scherr 1995).

Marketing nontimber forest products. The decline in the ability of household labor to generate necessary yields from agricultural production calls for programs to help improve and diversify the income of affected households. Urbanizing populations and shrinking resources have led to a strong trade in nontimber forest products. In many countries, small, forest-based enterprises are among the top employers of rural poor and landless people (Nair 1990). In HIV/AIDS–affected households, the loss of the male head of household (who traditionally holds the role of marketer) has driven many families to rely on selling their produce to unscrupulous middlemen. Even for those households able to produce a surplus, marketing remains a major bottleneck.

Women's access to forest resources. With heavily constrained labor pools and with women carrying out most of the household work, women's labor burden must be alleviated. This is especially important in the context of HIV/AIDS, as women are much more likely to become the caretakers of infected individuals (Nnko et al. 2000). Women's work can be reduced through labor-saving efforts such as improving access to fuelwood (UNAIDS 1999). In sub-Saharan Africa, access to land by women who have been left widowed can be automatically constrained by traditional tenure arrangements (FAO 2001c). The more time they spend collecting fuelwood, the less time they have for food production, child care, and income generation (Ogden 1990). Improving women's access to forest resources can make available more labor for the household's survival.

Intellectual property rights. Indigenous knowledge of trees and forests is an important resource and is being actively investigated for botanical remedies of diseases such as HIV/AIDS (FAO 1993). Recently efforts have been made to bring together indigenous knowledge of medicinal plants with medical research and development institutions. The International Conference on Traditional Medicine on HIV/AIDS and Malaria in Abuja, Nigeria, focused on the traditional treatment of HIV/AIDS and provided guidelines for the biochemical evaluation and standardization of traditional medicinal products (Anonymous 2000). The World Bank Indigenous Knowledge for Development Program, US National Institutes of Health, and representatives of African traditional healers have agreed to collaborate on the validation of herbal treatments of HIV/AIDS–related opportunistic infections (World Bank 2001). These efforts to promote traditional medicine practices in sub-Saharan Africa suggest an increasing pressure on medicinal resources, creating questions of management and rights to these resources.

Continuing traditional knowledge. While the importance of nontimber forest products is likely to increase, the tremendous base of knowledge about their use is threatened as HIV/AIDS creates a large population of children who are growing up without parents. There are 12.1 million HIV/AIDS orphans in sub-Saharan Africa, almost 92 percent of the global total (UNAIDS 2000). Traditionally, rural children learn many of their farming skills by working alongside their parents (du Guerny 1998), and a study in Kenya shows that only 7 percent of agricultural households headed by orphans had adequate knowledge of agricultural production (FAO 2001a). When traditional information systems break down because of the illness or death of a parent, there appear to be no replacement mechanisms for the children who remain.

Conclusions

HIV/AIDS has produced long-term shockwaves that change the agroecological landscape of Africa (Rugalema 1999). The socioeconomic effects of HIV/AIDS on agrarian households suggest that natural forests and agroforestry systems can play an important role in rural household coping strategies. The effectiveness of these coping strategies depends on wider societal policy. Although appropriate forest policy requires a comprehensive research foundation, to date there appears to have been little or no effort made to understand the role of forestry in mitigating the dilemmas of HIV/AIDS–affected households. This gap in the literature reflects a neglect of the traditionally strong dependence of local peoples on forest resources for health and nutrition and the compatibility of agroforestry systems with the productive challenges associated with low household labor supplies.

Acknowledging this potential role for forestry should open the door to rapid assessments of perception, use, and management of nontimber forest resources among affected communities. Because many with the disease do not have a long life expectancy, there is a need to focus on research that can yield benefits in the short term, such as marketing support, access to forest resources, and tenure systems. However, long-term strategies, such as fallow improvement techniques, domestication of medicinal or marketable nontimber forest resources, and appropriate agroforestry system design are justified by the nature of the HIV/AIDS epidemic, which will have long-term impacts on affected communities.

Prioritization of these research themes by governments, nongovernment organizations, and international forestry institutions is the first step toward a scientific basis for the integration of forest policy with nonforestry sectors such as agriculture, health, and education. Strengthening links between these sectors, such as medicinal plant resources and primary health care systems, may stimulate local forest-based economies and minimize the high costs associated with expensive drug treatments. The cost of treatment

of HIV/AIDS and related infections is expected to exceed 60 percent of government health expenditures in Zimbabwe by 2005 (FAO 2001c). Capacity building for a cost-effective, multisectoral strategy will require a new dialogue among professionals from multiple disciplines. However, this capacity building may be impeded by the magnitude of the epidemic, which has left many development institutions unable to achieve their intended goals.

Although the implications of forestry research and planning for HIV/AIDS–affected societies can lead to long-term benefits, the time available to develop appropriate strategies is severely limited by the epidemic's toll on human resources in sub-Saharan Africa. Nontraditional mechanisms for information dissemination, such as extension services, are not immune from the high mortality rates of this epidemic. We believe that there is an immediate need for a coordinated effort to understand and include forestry in the response to HIV/AIDS in sub-Saharan Africa.

Literature Cited

AMOUS, S. 2000. The role of wood energy in Africa. In *Wood energy for tomorrow.* Rome: FAO.

ANONYMOUS. 1990 The impact of fuelwood scarcity on dietary patterns: Hypotheses for research. *Unasylva* 41(1):29–34.

ANONYMOUS. 2000. Traditional medicine practice and practitioners are accorded formal status in the Nigerian national health system, and will contribute to the fight against HIV/AIDS. *The Guardian,* December 6.

ARNOLD, J.E. 1990. Tree components in farming systems. *Unasylva* 160:37–42.

BAIER, E. 1997. *The impact of HIV/AIDS on rural households/communities and the need for multisectoral prevention and mitigation strategies to combat the epidemic in rural areas*. Rome: FAO.

BALEE, W. 1992. People of the fallow: A historical ecology of foraging in lowland South America. In *Conservation of neotropical forests. Working from traditional resource use,* eds. K.H. Redford and C. Padoch, 35–57. New York: Columbia University Press.

BARNETT, T., and M. HASLWIMMER. 1995. *The effects of HIV/AIDS on farming systems in Africa.* Rome: FAO.

BENNETT, E.L., and J.G. ROBINSON. 2000. *Hunting of wildlife in tropical forests: Implications for biodiversity and forest peoples.* Washington, DC: World Bank.

BODEKER, G., D. KABATESI, R. KING, and J. HOMSY. 2000. A regional task force on traditional medicine and AIDS. *Lancet* 355(9211):1284.

CHEGE, N. 1994. Africa's non-timber forest economy. *World Watch* 7(4):19–24.

CHIDUMAYO, E.N. 1988. Integration and role of planted trees in a bush-fallow cultivation system in central Zambia. *Agroforestry Systems* 7:63–76.

CUNNINGHAM, A.B. 1993. *African medicinal plants: Setting priorities at the interface between conservation and primary healthcare.* Paris: UNESCO.

DEWEES, P.A. 2000. *Social and economical aspects of miombo woodland management in southern Africa: Options and opportunities for research.* Bogor, Indonesia: CIFOR.

DEWEES, P.A., and N.C. SAXENA.1995. Tree planting and household land and labor allocation: Case studies from Kenya and India. In *Tree management in farmer strategies: Responses to agricultural intensification,* eds. J.E. Arnold and P.A. Dewees, 242–67. Oxford, UK: Oxford Science Publications.

DU GUERNY, J. 1998. Rural children living in farm systems affected by HIV/AIDS: Some issues for the rights of the child on the basis of FAO studies in Africa. Paper presented to UNHCR Committee on the Rights of the Child. Geneva.

———. 1999. AIDS and agriculture in Africa: Can agricultural policy make a difference? *Food, Nutrition, and Agriculture* 25:12–19.

EGAL, F., and A. VALSTAR. 1999. HIV/AIDS and nutrition: Helping families and communities to cope. *Food, Nutrition, and Agriculture* 25:20–26.

EGAL, F., A. NGOM, and P. NDIONE. 2000. Integration of food security and nutrition inforestry planning: The role of participatory approaches. *Unasylva* 51(3): 19–23.

ENGH, I.E., L. STLOUKAL, and J. DU GUERNY. 2000. *HIV/AIDS in Namibia: The impact on the livestock sector.* Rome: FAO.

ENWONWU, C., AND R. WARREN. 2001. Nutrition and HIV/AIDS in sub-Saharan Africa. In *Nutrition and AIDS,* 2nd ed., ed. R.R. Watson, 175–92. Boca Raton, FL: CRC Press.

FARAH, D. 2001. Seeking a remedy for AIDS in Africa: Continent's woes limit reach of cheaper drugs. *Washington Post,* June 12, p. A17.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO). 1993. *More than wood. Special options on multiple use forests*. Rome.

———. 1995. *The international expert consultation on non-wood forest products.* Rome.

———. 1996. *Forestry policies of selected countries in Africa*. Rome.

———. 2000. *State of the world's forests: 1999*. Rome.

———. 2001a. *AIDS: A threat to rural Africa.* Rome.

———. 2001b. *Forest resources assessment*. Rome.

———. 2001c. The impact of HIV/AIDS on food security. Paper presented at the *27th Session of the Committee on World Food Security*. Rome.

HAMILTON, J., AND J. BLISS. 1998. Agroforestry extension in Paraguay: The participant's perspective. *Journal of Forestry* 96(12):15–19.

HAYMAN, A. 2001. *Tanzania: Traditional healers counsel of patients and effectively treat HIV-AIDS related symptoms.* Washington, DC: World Bank.

HOEKSTRA, D.A. 1987. Economics of agroforestry. *Agroforestry Systems* 5:293–300.

HOSKINS, M. 1990. The contribution of forestry to food security. *Unasylva* 41(1):3–13.

JOINT UNITED NATIONS PROGRAM ON HIV/AIDS (UNAIDS). 1999. *A review of household and community responses to the HIV/AIDS epidemic in the rural areas of sub-Saharan Africa*. Geneva.

———. 2000. *Report on the global HIV/AIDS epidemic, June 2000.* Geneva.

KATERERE, Y. 1998. Nontimber products key in Central Africa's forest. *Forum* 13(1):85–88.

KINYUY, W. 2001. *Cameroon: Traditional food preparations improve immune system of HIV/AIDS patients*. Washington, DC: World Bank.

LEAKEY, R., and A.M. IZAC. 1996. Linkages between domestication and commercialization of non-timber forest products: Implications for agroforestry. In *Domestication and commercialization of non-timber forest products in agroforestry systems*, eds. R.R.B. Leakey, A.B. Temu, M. Melnyk, and P. Vantomme, 1–7. Rome: FAO.

LIPPER, L. 2000. Forest degradation and food security. *Unasylva* 51(3):24–31.

LOEWENSON, R. 2000. Public participation in health systems in Zimbabwe. *IDS Bulletin* 31(1):14–20.

MENZEL, P., and F. D'ALUISIO. 1998. *Man eating bugs: The art and science of eating insects.* Berkeley, CA: Ten Speed Press.

MIALOUNDAMA, F. 1993. Nutritional and socioeconomic value of *Gnetum* leaves in Central African forest. In *Tropical forests, people, and food: Biocultural interactions and applications to development,* eds. C.M. Hadlik, A. Hladik, O.F. Linares, H. Pagezy, A. Semple, and M. Hadley, 177–82. Paris: UNESCO.

MLAY, G., F. TURUKA, G. KOWERO, and R. KACHULE. 2000. Agricultural sector policies and forestry development in selected countries in southern Africa. Paper presented at *Workshop on policies, governance, and harvesting in miombo woodlands,* October 7–14, Arusha, Tanzania.

NAIR, P.K. 1990. *The prospects for agroforestry in the tropics.* Washington, DC: World Bank.

NNKO, S., B. CHIDUO, F. WILSON, W. MSUYA, and G. MWALUKO. 2000. Tanzania: AIDS care—learning from experience. *Review of African Political Economy* 86:547–57.

OGDEN, C. 1990. Building nutritional considerations into forestry development efforts. *Unasylva* 41(1): 20–28.

RUGALEMA, G. 1999. *HIV/AIDS and the commercial agricultural sector of Kenya: Impact, vulnerability, susceptibility and coping strategies.* Rome: FAO.

SCHERR, S.J. 1995. Economic factors in farmer adoption of agroforestry: Patterns observed in western Kenya. *World Development* 23(5):787–804.

SHUMBA, O. 2001. Farmers' responses to reduce the risks of drought. *LEISA Magazine* 17(1):8–9.

TOPOUZIS, D., and G. HEMRICH. 1996. *The socioeconomic impact of HIV/AIDS on rural families in Uganda*. New York: UNDP.

VERSI, A. 1995. Agriculture: Backbone of Kenya's economy. *African Business* 196:14.

WARNER, K. 1995. Patterns of tree growing by farmers in eastern Africa. In *Tree management in farmer strategies: Responses to agricultural intensification,* eds. J.E. Arnold and P.A. Dewees, 90–137. Oxford, UK: Oxford Science Publications.

WORLD BANK. 2001. *Indigenous Knowledge Program for Development*. Washington, DC.

Marc Barany (mbarany@vt.edu) is research assistant, A.L. Hammett is associate professor, Abdou Sene is research associate, and Beyhan Amichev is graduate research assistant, College of Natural Resources, Virginia Polytechnic Institute and State University, Department of Wood Science and Forest Products, 210 Cheatham Hall (0323), Blacksburg, VA 24061.

Funding provided through the Community-based Natural Resources Management Project (USAID 685-0305).