

## **HIV/AIDS and the Agricultural Sector in Eastern and Southern Africa: Anticipating the Consequences**

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### **Background**

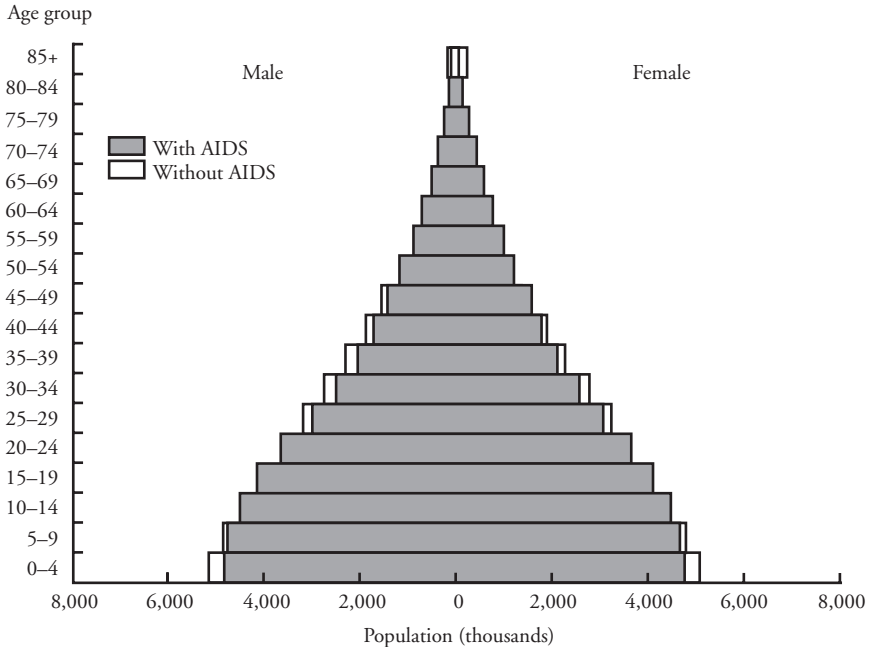
There is now widespread recognition that HIV/AIDS is not simply a health issue. Effectively combating the pandemic will require a coordinated multisectoral approach. Although many in the agricultural sector embrace the idea of playing a role in combating HIV/AIDS, there has been very little analysis by agricultural policy analysts to guide them. Despite the fact that the pandemic is now in its third decade in Africa, available analysis to date provides a very murky picture of how HIV/AIDS is affecting the agricultural sector: its structure, cropping systems, relative costs of inputs and factors of production, technological and institutional changes, and supply and demand for agricultural products. Until these issues are clarified, policymakers will be inadequately prepared to forecast anticipated changes to the agricultural sector and respond proactively.

This chapter is intended to respond to the need to better understand the implications of the AIDS pandemic for the agricultural sectors in the hardest-hit countries of eastern and southern Africa. The six countries of the world with estimated HIV prevalence rates exceeding 20 percent<sup>1</sup> are all in southern Africa: Botswana, Lesotho, Namibia, South Africa, Swaziland, and Zimbabwe (UN Census Bureau 2003). Five other countries, all in southern and eastern Africa (Cameroon, Central African Republic, Malawi, Zambia, and Mozambique), have HIV prevalence rates

between 10 and 20 percent. For shorthand, we hereafter refer to these countries as the “hardest hit” countries.

This chapter reviews available empirical evidence of the effects of AIDS on rural household livelihoods and discusses the implications for long-term processes of demographic and economic structural transformation. We highlight four processes that have been underemphasized in previous analyses: (1) the momentum of long-term population growth rates; (2) substantial underemployment in these countries’ informal sectors; (3) sectoral declines in farm sizes and land/labor ratios in the smallholder farming sectors; and (4) effects of food and input marketing reforms on shifts in cropping patterns. Understanding these trends is necessary to anticipate the consequences of the HIV/AIDS epidemic for the agricultural sector and to consider the implications for agricultural policy.

**Figure 8.1a Population in the medium variant (“with AIDS”) and in the no-AIDS scenario (“without AIDS”), by sex and age group, seven most highly affected countries, 2000**



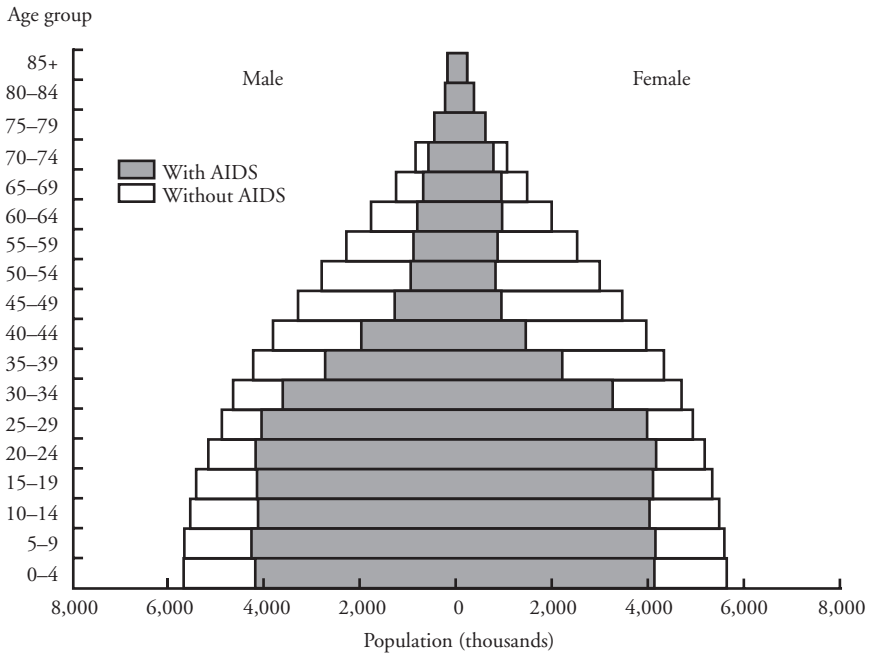
Source: U.S. Census Bureau (2003).

**Effects of AIDS on Future Demographic Changes**

In most of eastern and southern Africa, where HIV prevalence rates generally exceed 10 percent, there will be many fewer adults in the coming decades compared to a “no-AIDS” scenario (U.S. Census Bureau 2003). By the year 2010, five countries in the region will be experiencing negative population growth rates: Botswana (–2.1 percent per year), Mozambique (–0.2 percent), Lesotho (–0.2 percent), Swaziland (–0.4 percent), and South Africa (–1.4 percent) (U.S. Census Bureau 2003). By 2020, AIDS mortality will produce population pyramids in these countries never seen before (Fig. 8.1).

By 2025, among the seven countries where HIV prevalence exceeds 20 percent, there will be roughly 20 million men in the working age years between 20 and 59 years as opposed to 31.5 million if AIDS had not existed. By contrast, there

**Figure 8.1b Projected population in the medium variant (“with AIDS”) and in the no-AIDS scenario (“without AIDS”), by sex and age group, seven most highly affected countries, 2025**



Source: U.S. Census Bureau (2003).

**Table 8.1 Comparison of total population size for the seven hardest-hit countries, 2000 versus 2025<sup>a</sup>**

Sex/age categories		Population projections (millions)		
		2000 estimate	2025 forecast “no-AIDS” scenario	2025 forecast “with AIDS”
Male	< 20 years	18.6	22.9	16.8
	20–59 years	17.5	32.1	18.6
	> 59 years	2.1	4.7	3.2
Female	< 20 years	18.9	23.0	16.4
	20–59 years	17.7	32.6	17.8
	> 59 years	2.3	5.4	3.5

<sup>a</sup> Botswana, Lesotho, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe.

Source: U.S. Census Bureau (2003).

will be only 18 million women in the 20 to 59 year age range as opposed to 32 million in the “no-AIDS” case. And because of the early death of so many adults of reproductive age, there will also be many fewer children born, also indicated in Figure 8.1. Population pyramids in five or six other countries will have similar shapes, though less extreme than those shown in Figure 8.1.<sup>2</sup>

However, it is also important to compare future projected population to current population. Notwithstanding the catastrophic death toll that is projected to occur over time in these countries, the absolute number of adults projected to be alive in 2025 is roughly similar to what it is today. This is because the momentum of population growth, in the absence of AIDS, would have produced much greater population sizes in the coming decades. Although AIDS is projected to erode population growth to roughly zero in the seven hardest-hit countries, the net result is a roughly stable number of working-age adults over time. Table 8.1 compares population estimates in 2000 and projected estimates for 2025 by age and sex categories in the seven countries where HIV prevalence is estimated to exceed 20 percent.

According to these demographic projections, there will be a slight increase in the number of men between 20 and 59 years of age between 2000 and 2025 and virtually no change in the number of women. The projections indicate a decline in the number of men and women below 20 years of age by 2025. Because AIDS will particularly influence the number of people under 20, both through the impact of increased child mortality and fewer adults living long enough to have children, dependency ratios may actually become slightly more favorable over time.

These projections are consistent with those of the United Nations (2003). According to its projections, countries with HIV prevalence above 20 percent will register annual population growth rates of roughly +0.2 percent between 2000 and

2025. Countries with HIV prevalence between 10 and 20 percent (Cameroon, Central African Republic, Kenya, Malawi, and Mozambique) will have population growth rates of +1.33 percent per year.

However, not reflected in the population figures in Table 8.1 is the loss of available labor as a result of periods of sickness, caregiving for those afflicted with the disease, and mourning periods after a death, which can be substantial (Government of Uganda 2003). Thus, the “effective” labor pool in the economy is likely to be overestimated if consideration is given only to changes in the absolute numbers of adults shown in Table 8.1. Moreover, people who survive into adulthood have already received substantial social investments (education, skills, food production), and it can be assumed that, in most cases, their lives enrich the lives of those around them. Their death translates into a loss to society of existing knowledge and skills as well as the transfer of knowledge to succeeding generations.

## **The Effects of HIV/AIDS on Agriculture and Rural Livelihoods: Current Understanding**

### **Potential Changes in Labor Markets as a Result of AIDS**

Understanding the future effects of AIDS on the agricultural sector requires an organizing conceptual framework of how labor is likely to shift between urban and rural areas and between agricultural and nonagricultural activities as the demographic changes shown in Figure 8.1 begin to manifest. The classic theory of rural–urban migration is based on the work of Harris and Todaro (1970). These models start from the observation that labor allocates itself into three broad employment categories: (1) the agricultural sector; (2) the formal sector, mainly in urban areas but also in small towns, commercial farms, mines, and rural civil service (where wages generally exceed those of agriculture); and (3) the “informal” sector. Many people who have migrated to urban areas in search of formal-sector jobs but could not obtain one often find themselves in the informal sector, where jobs and businesses are relatively easy to find but pay relatively little (e.g., petty trading, tailoring, crafts, shoe shining). The informal sector often masks substantial underemployment.

According to the Harris-Todaro model and its extensions, the fractions of the total labor force that reside in each of these three sectors (agriculture, the formal sector, and the informal sector) depend on (1) formal sector wage rates and benefits; (2) the returns to labor in agriculture or agricultural wage rates; and (3) the availability of formal-sector jobs compared to the number of people migrating off the farm to search for them, which influences the probability of actually finding formal employment in urban areas as opposed to generally less lucrative informal sector jobs.

Now, what happens if a sizable fraction of workers in all three sectors are forced to quit working because of illness, subsequent death, and related caregiving functions? According to these economic labor models, the answer depends on the size of the underemployed informal sector. If surplus labor exists in an underemployed informal sector, then rising costs of agricultural labor caused by incipient AIDS-related labor shortages will induce labor migration from the informal sector to agriculture.

Studies reveal that the informal sectors of eastern and southern Africa have swelled massively in recent decades, largely because of inadequate income opportunities in rural areas and the need for rural households to diversify their incomes by engaging in sectors whose returns are not highly correlated with those in agriculture (Bryceson and Potts 2005). Urbanization in these countries generally does not reflect a strong demand for urban labor but, rather, reflects the pushing out of labor from rural areas where population densities are high and where farm sizes have declined to levels inadequate to sustain all the members of succeeding generations. These points, taken together, might indicate that incipient agricultural labor shortages caused by AIDS may induce labor migration out of the urban informal sector into agriculture. In this way, underemployment in the informal sector is likely to act as a shock absorber to buffer the agricultural sector from labor shortages.

What is the evidence of migration of labor to agriculture? A growing number of empirical household-level studies from eastern and southern Africa indicate that family size of afflicted households does not decline by one member after the death of a prime-age adult (e.g., Beegle 2003; Mather et al. 2004; Yamano and Jayne 2004; Chapoto and Jayne 2005). These studies indicate that former resident adults often return to the farm to compensate for the loss of labor caused by the deceased adult. Although not all of these studies are able to determine the location from which new adult members are coming, there are indications that many returning adults are coming from urban and periurban areas.

This picture is supported by 1990 and 2000 national censuses in Zambia, where HIV prevalence is estimated at roughly 20 percent. By comparing the numbers of individuals and households identified as “agricultural” and “nonagricultural” as well as “urban” versus “rural,” we can draw inferences about labor migration over the decade of the 1990s. However, Zambia’s trends may not be representative of the region, but it is the only intercensus information in southern Africa that we have to draw on. Census figures reported here are prepared by the government Central Statistical Office (CSO). As shown in Table 8.2, the total population of Zambia grew from 7.38 million to 9.89 million people between 1990 and 2000, a 33.8 percent increase. Yet, over the same period, the rural population grew at a much higher rate than the urban population: the rural population grew by 43.6 percent compared to

**Table 8.2 National population within households and number of households, Zambia**

Population characteristics	1990	2000
Total population	7,383,097	9,885,591
Rural population	4,497,391	6,458,729
Urban population	2,885,706	3,426,862
Population of agricultural households, total	3,591,588	7,181,807
Population of agricultural households, rural	3,521,498	5,965,504
Population of agricultural households, urban	70,090	1,216,303
Population of nonagricultural households, rural	975,893	493,225

Source: Census 1990 and 2000, CSO, Zambia. The authors acknowledge Dr. Jones Govereh of the Zambia Food Security Research Project for compiling these numbers.

only 18.8 percent for urban areas, suggesting reverse migration from urban to rural areas. Some of this reverse migration is attributed to the decline of Zambia's copper industry. However, the growth in the number and proportion of Zambian households engaged in agriculture appears to be universal across all provinces and not confined to the Copperbelt Province, where the copper industry is centered (Govereh, Jayne, and Shaffer 2006).

Also according to the 1990 and 2000 censuses, the population of rural households engaged in agriculture grew from 3.521 million to 5.965 million people over the decade, a 69.4 percent increase. And the population of nonagricultural rural households actually declined from 975,893 to 493,225. These figures represent a huge shift in Zambia's labor force from urban to rural areas and from nonagricultural to at least partially agricultural activities. Certainly, a combination of factors have contributed to these trends, including the demise of the copper industry, increasing poverty leading to increased reliance on semisubsistence crop production, and AIDS. Unemployment and underemployment in Zambia's urban and informal sectors appear to have provided a ready labor pool for the agricultural sector over this period.

However, the supply of labor from the urban and informal sectors is not infinite. As the long-term effects of the disease progress through the next several decades, it is unclear whether the demand for agricultural labor will eventually outstrip the supply of underemployed labor in the informal sector. If the agricultural sector continues to absorb labor at a faster rate than the overall population growth rate (which for Zambia is projected to be 1 percent per year over the next decade), then labor shortages may indeed begin to manifest in future decades. However, there is

**Table 8.3 Land-to-person ratio (mean 10-year averages) in selected countries**

	1960–69	1970–79	1980–89	1990–99
Ethiopia	0.508	0.450	0.363	0.252
Kenya	0.459	0.350	0.280	0.229
Mozambique	0.389	0.367	0.298	0.249
Rwanda	0.215	0.211	0.197	0.161
Zambia	1.367	1.073	0.896	0.779
Zimbabwe	0.726	0.664	0.583	0.525

Sources: Compiled from data on FAOSTat web site: <http://faostat.fao.org/faostat/default.jsp>.

Note: Land-to-person ratio = (land cultivated to annual and permanent crops)/(population in agriculture).

little evidence to date to suggest that labor shortages in Zambian agriculture have been increasing.<sup>3</sup>

In fact, there continues to be strong evidence of increasing land pressures caused by population growth through the end of the 1990s. Data from FAO indicate that mean land-to-person ratios have declined substantially in the past half-century (Table 8.3). The pace of the decline in land-to-person ratios has not slowed during the 1990s, even in the hardest-hit countries. Declining land-to-person ratios are occurring as a result of the past momentum of rural population growth and limited availability of unused arable land. HIV/AIDS may slow down the secular decline in farm size and reduce the rate of rural outmigration in the hardest-hit countries.

Overall, the emerging picture is that, even in the hardest-hit countries of Africa, the labor force is unlikely to grow over the next several decades, but it will not shrink either. The quality of the labor force will be adversely affected by AIDS. The cost of skilled labor may rise if the AIDS disease depletes the ranks of the educated and skilled workers faster than they can be replenished. By contrast, the cost of agricultural labor is unlikely to rise because any upward pressure on agricultural wages is almost certain to induce reverse urban–rural migration from the under-employed informal sector and cross-border migration from regions where HIV prevalence is relatively low and where population pressures are already intense (parts of eastern Africa such as Burundi, Rwanda, and central Kenya). For many decades, excess demand for relatively unskilled labor has been dampened by regional migration. Malawi, for example, has historically served as a labor pool for commercial farms and mines in Zimbabwe and South Africa. Mozambique, Lesotho, and Swaziland have played similar roles for South Africa. Because these countries are all hard hit, excess demand for labor may draw forth different patterns of regional migration, perhaps involving densely populated areas of eastern Africa, though this is somewhat speculative.

### **Influences of AIDS on the Use of Capital in Agriculture**

Agriculture-led structural transformation has almost always involved increased intensification of capital in the farm production process (Johnston and Kilby 1975; Mellor 1976). The main types of capital-led intensification have featured fertilizers, improved hybrid seed, chemicals, and draft power. These technologies have also featured prominently in the brief “smallholder green revolution” successes of eastern and southern Africa (Byerlee and Eicher 1997).

Farm households tend to utilize remittance and off-farm income as a primary means to afford expensive assets such as oxen, plows, and fertilizer, which are used to capitalize farm production (Reardon, Crawford, and Kelly 1995). These sources of income are often jeopardized among AIDS-afflicted households, particularly those that are asset-poor and vulnerable to begin with (e.g., Donovan et al. 2003; FASAZ 2003; Mushati et al. 2003; Yamano and Jayne 2004). Cash constraints on farm intensification are compounded during illness and after a death, when medical and funeral expenses rise and caregiving by other members reduces their income-earning potential as well. Evidence indicates that households attempt to first sell off small animals and other assets with the least impact on long-term production potential. Cattle and productive farm equipment are sold in response to severe cash requirements after a death in the family (Yamano and Jayne 2004). To the extent that afflicted households shed assets and are forced to reduce their use of cash inputs in agriculture, the cumulative effect may be a decline in the proportion of small-scale farmers able to produce a marketable surplus from farming.

Afflicted households face a multifaceted loss of labor, capital, and knowledge. Unlike the loss of labor and knowledge, which represent a loss to entire communities, capital assets lost by afflicted households are generally redistributed within the rural economy rather than lost entirely. This may exacerbate rural inequality over time and, particularly, deplete the productive potential of relatively poor households.

### **Effects on Land Distribution**

Figure 8.1, which shows how the population pyramid of hard-hit countries will change over the long term, holds important implications for land allocation. As shown earlier, by 2025 the number of male and female adults in the age ranges between 40 and 64 years will be less than half of what it would have been in the absence of AIDS. As afflicted households lose productive members of their families, including those possessing the rights to their households' land, conflicts over the inheritance of land may escalate over the coming decades (Barnett and Blaikie 1992).

Poor and disadvantaged households in particular may have difficulty maintaining their rights to land after incurring a death. Widows and orphans are particularly

vulnerable to losing access or ownership rights to land after the death of the husband and father. The cumulative effects of loss of land rights may turn out to be an increase in the concentration of land within the small farm sector, with land being reallocated at the margin from poor households to relatively wealthy ones. This is a likely outcome if relatively wealthy households are better able to maintain their control over land after incurring a prime-age death in the family and also if they are able to gain control over land assets shed by poorer households that cannot continue to productively use their land after incurring a death. Land disputes and possible land concentration over time are consistent with broader economy-wide predictions that AIDS is likely to exacerbate income inequality in many countries (Lehutso-Phooko and Naidoo 2002).

Although an important coping strategy for afflicted households may be to rent out land that cannot be productively utilized after incurring a death, Barnett (1994) found that widows especially were reluctant to do this for fear of losing rights to their land. These problems of land tenure overlap with the problem of gender disparities. Much research has documented that widows and their dependents are in a more tenuous position with regard to maintaining control over land (Barnett and Blaikie 1992). When combined with evidence that female-headed households tend to be poorer in general than their male-headed household neighbors, governments and donors face a serious challenge to devise means to protect poor households' (and particularly poor female-headed households') rights to land within future poverty alleviation and rural development strategies.

### **Influences on Agricultural Production**

The microlevel empirical record on the effects of HIV/AIDS on agriculture is still quite limited but is growing rapidly. The time periods over which impacts are measured are mostly short-run, which probably understate the full impact on households and communities over time. Even given this short-run time dimension, the weight of the empirical evidence to date does indicate that AIDS is having a measurably adverse impact on household agricultural production, although these impacts are often mitigated by attracting new household members (or bringing back members residing away from home) to compensate for the lost labor and knowledge of the deceased. Effects appear to be highly sensitive to the age, sex, and position of the deceased, being the greatest in cases where the household head or spouse dies, and the initial level of wealth of the household (Drimie 2002).

For example, a study in Kenya found that rural households suffering a prime-age death between 1997 and 2000 generally incurred a decline in agricultural production relative to nonafflicted households, but the magnitude and statistical significance of this finding depended greatly on the sex, age, and position in the household

of the person who died as well as the household's initial (predeath) level of wealth (Yamano and Jayne 2004). The only statistically significant effects were observed in the case of male head-of-household death among households in the bottom half of the wealth distribution, but these effects were very severe. Households in this case suffered a 68 percent reduction in the value of net agricultural output (after deducting costs of inputs). Moreover, these results were robust to the year of death, suggesting that households that suffered a death in 1997 did not show any recovery compared to households that incurred a more recent death such as in 1999 or 2000.

Yamano and Jayne (2004) found that households suffering the death of head of household or spouse were largely unable to replace the labor lost through the death, whereas households suffering the death of another adult (other than the head or spouse) were largely able to attract new household members. This at least partially stabilizes the supply of family labor for agriculture but implies that off-farm and remittance incomes may in some cases be reduced, exacerbating capital constraints in agriculture. By contrast, Beegle (2003), using longitudinal data from the hard-hit Kagera District of Tanzania, found only short-run and temporary effects of AIDS-related mortality on households' agricultural activities, although it should be noted that the study is based on data collected in the early 1990s.

A different set of studies have documented the adverse effects of worker HIV/AIDS on the commercial agricultural sector. For example, Fox et al. (2003) found a significant decline in labor productivity among HIV-positive tea pluckers in Kenya, and Rugalema (1999) found that agricultural companies reliant on hired labor are suffering from rising costs and falling profits as a result of the disease.

### **Accounting for Differences in Agricultural Systems**

Agricultural systems in eastern and southern Africa exhibit considerable heterogeneity. For example, areas of northern Zambia and northern Mozambique have relatively high land-to-labor ratios and use few capital inputs. By contrast, southern Malawi, parts of Rwanda, and the Central Highlands of Kenya are densely populated, have low land-to-labor ratios, and have exhibited substantial out-migration of labor for decades. Many other small-scale farmers in northern Zimbabwe and southern and central Zambia are relatively capitalized, relying on animal draft power for land preparation and inorganic fertilizer. Because of differences in factor endowments between regions, the effects of AIDS-related mortality on agricultural households are likely to vary substantially.

Land-labor-capital ratios also vary greatly within most countries of eastern and southern Africa. For example, nationwide surveys in five countries in the region show that after households are ranked by landholding size per capita, there are

**Table 8.4 Smallholder land distribution in selected African countries**

Country	(a) Sample households (n)	(b) Mean landholding size <sup>a</sup> (hectares)	(c) Farm size ranked by quartile <sup>a</sup> (hectares per person)				
			Mean	Lowest	2nd	3rd	Highest
Kenya, 1997	1,416	2.65	0.41	0.08	0.17	0.31	1.10
Ethiopia, 1995	2,658	1.17	0.24	0.03	0.12	0.22	0.58
Rwanda, 1984	2018	1.20	0.28	0.07	0.15	0.26	0.62
Rwanda, 1990	1,181	0.94	0.17	0.05	0.10	0.16	0.39
Rwanda, 2000	1,584	0.71	0.16	0.02	0.06	0.13	0.43
Malawi, 1998	5,657	0.99	0.22	0.08	0.15	0.25	0.60
Zambia, 2000	6,618	2.76	0.56	0.12	0.26	0.48	1.36
Mozambique, 2000	3,851	2.10	0.48	0.10	0.23	0.40	1.16

Source: Jayne et al. (2003a).

Note: Numbers for Ethiopia, Rwanda, Mozambique, and Zambia, including Gini coefficients, are weighted. Numbers for Kenya are sample statistics.

<sup>a</sup> Landholding size figures include rented land.

huge variations in land-to-person ratios within the small-scale farm sector in each country (Table 8.4). The 25 percent of smallholder households with the smallest farms typically controlled less than 0.1 hectare of land per person. These households are virtually landless, although this same group earns over 50 percent of its income from agriculture, except in the case of Kenya, where the agricultural income share of the bottom land quartile was exactly 50 percent (Jayne et al. 2003a). At least for this stratum of smallholder households, land is likely to remain a primary constraint on income growth, and it is not clear that the loss of a household member would change this much. At the other end of the spectrum, the 25 percent of smallholder households with the largest land-to-labor ratios controlled at least seven times more land per capita, generally in the range of 0.5 to 1.0 hectare per capita. This stratum of better-off farmers generally hire agricultural labor. Also, the death of a family member among these households (where labor-land ratios are relatively low) is likely to induce a search for attracting nonresident members back to the farm. These two processes, attempts to attract nonresident household members back to the farm and demand for hired labor by relatively large smallholder farms and large-scale farms, are likely to provide the incentives for reverse rural migration from the informal sectors in urban areas.

The situation as presented in Table 8.4 indicates that because of the heterogeneity in land-labor ratios within the small-scale sector, the limiting input into agricultural production will certainly differ between households controlling less than 0.1 hectare per capita and those controlling more than 2 hectares per capita. There

are strong reasons for anticipating that AIDS will progressively decapitalize highly afflicted rural communities, meaning a loss of savings, cattle assets and draft equipment, and other assets. The loss of capital assets that often substitute for labor in the production process may indeed raise the demand for labor.

Some studies have conjectured that HIV/AIDS is bringing about important changes in farming systems. Particular emphasis has been put on the recent shift in area cultivated from maize to roots and tubers, which has been observed in several countries in the region. For example, the proportion of crop area devoted to cassava and sweet potato in Malawi has risen from 4 percent to 10 percent over the past two decades. In some provinces of Zambia, cassava production has also risen dramatically in recent years (Govereh, Jayne, and Shaffer 2006).

It is possible that AIDS has contributed to these shifts in crop area. However, it is important to acknowledge that other major changes in agricultural policy have occurred in these countries that have also veered some farming systems in the region toward tuber crops. Most notably, many countries in eastern and southern Africa had formerly implemented state-led maize promotion policies featuring panterritorial producer prices, major investments in marketing board buying stations in smallholder farming areas, and subsidies on fertilizer distributed on credit to small farmers along with hybrid maize seed. These maize-marketing policies in Kenya, Malawi, Zambia, and Zimbabwe (among others) were either eliminated or scaled back significantly starting in the early 1990s as part of economy-wide structural adjustment programs. These policy changes clearly reduced the financial profitability of growing maize in the more remote areas, where maize production was formerly buoyed by panterritorial pricing, and has shifted cropping incentives toward other food crops, especially those relatively unresponsive to fertilizer application, such as cassava (Smale and Jayne 2003).

Many areas in southern Africa where cassava production has increased in recent years appear to be those where the profitability of maize production has declined in recent years rather than areas of especially high HIV prevalence. These provinces have faced major declines in the maize-fertilizer price ratios over the past 15 years as a result of changes in agricultural policy. By contrast, several provinces with relatively high HIV prevalence, Central (18.7%), Copperbelt (26.2%), and Lusaka Rural (27.2%), have recorded relatively little increase in the share of cropped area devoted to these roots and tubers (Chapoto and Jayne 2005). There has indeed been a general increase in cassava production over time in many parts of Zambia, but the survey data indicate that nonafflicted and afflicted households are incorporating cassava into their crop mix at similar rates. If afflicted households incurred several labor shocks, one would have expected to find afflicted households devoting a greater proportion of their land to cassava and to other laborsaving crops.

Using data from Kagera District in Tanzania, Beegle (2003) also found that households experiencing a death did not shift cultivation toward subsistence food farming. She concludes that afflicted households were able to maintain their supply of labor by drawing new members to the farm, a finding highlighted in other empirical studies (Ainsworth, Ghosh, and Semali 1995; Menon et al. 1998; Mather et al. 2004). Donovan et al. (2003) also found no distinct gender-based differences in the composition of crops grown after the death of an adult in the household but did find an increase in sweet potato cultivation. They speculate that sweet potato may have become more attractive for households suffering a labor shock because of its more flexible planting and harvesting schedule compared to most other crops. Overall, these results suggest a need for caution in singling out labor as the main factor of production that is affected by rising adult mortality rates.

In summary, the evidence is mixed as to how AIDS is affecting agricultural systems and cropping patterns. There are good reasons to believe that capital constraints will become more binding over time as the number of deaths from the disease rises in the hardest-hit countries, which may force many afflicted households to adopt less capital-intensive technologies and crops. Efforts to better anticipate and respond to the stresses that AIDS will impose on rural communities will benefit from a careful identification of the different agricultural systems found in eastern and southern Africa. Even within a particular agricultural system, there is also great heterogeneity, such that appropriate programmatic responses to AIDS may be household-specific, conditioned by the gender and household position of the deceased individual, initial vulnerability before the onset of illness, and a household's ability to attract new members. If these emerging findings receive further empirical support from ongoing studies, then it will be necessary to move away from generalized conclusions about the main factors constraining afflicted households' ability to recover and begin formulating appropriate policy and programmatic responses based on the specific characteristics of the region, the regional economy, the localized farming system, the profitability and riskiness of alternative crops, and households' characteristics and available resources.

### **Conclusions and Policy Implications**

Governments and international organizations need solid guidance on the cost-effectiveness of alternative kinds of investments to simultaneously defeat the AIDS pandemic and the chronic poverty that characterized the region even before the onset of the disease but has been further exacerbated by it. Because every dollar invested in AIDS prevention, treatment, and mitigation cannot be used to promote basic education, improved agricultural technology, the development of infrastruc-

ture and markets, and other long-term investments necessary to raising living standards, it is crucial to achieve an effective balance between investments to prevent and treat HIV/AIDS and investments to promote long-run economic growth.

Effective responses to AIDS also requires an accurate understanding of how rural households respond to illness and death caused by AIDS. Over the past decade, a current orthodoxy has emerged concerning the effects of HIV/AIDS on agriculture. The most commonly cited effects are:

- Reduction in area cultivated
- Shifting area into less labor-intensive crops, such as cassava or sweet potatoes, and away from more labor-intensive (higher-value) cash crops
- Reduction in weeding labor, which contributes to lower yields and thus lower crop value
- Reduction in use of other inputs because of lack of finances resulting from the loss of wage income of the deceased and health/funeral expenses
- Declines in crop production, losses in off-farm income, and increased poverty

Although there are solid *a priori* reasons underlying these conclusions, many of them are subject to important methodological problems, based on highly qualitative methods that rely on nonverifiable interpretation of data, or are conceptual and speculative in nature.

Most quantitative household-level studies provide a less catastrophic assessment of the impact of rising AIDS-related mortality on the agricultural sector. Despite the conventional wisdom stated above, the limited number of longitudinal studies based on household survey data indicate that the impact of prime-age mortality on household welfare varies greatly, depending on the particular agricultural system and household-specific characteristics such as the age, sex, and position of the deceased in the household, the household's initial level of wealth, and ability to attract new members. Households are sometimes able to vary the proportion of inputs used to produce a given amount of crop output, and they can also vary their crop mix to adjust to shifts in availability of their resources. Examples of this include substituting hired labor for family labor (e.g., sharecropping arrangements), renting animal traction services for land preparation instead of preparing the land with family labor, substituting fertilizer application for labor, or reducing the amount of land cultivated to maintain a similar intensity of labor input on the smaller amount of land

under cultivation. Even highly resource-constrained small farmers do not produce agricultural products in fixed input proportions over time. Rather, they respond to changes in relative prices and adjust to other changes in their environment. To the extent that factors are substitutable, households incurring a shock to their own labor supply (for example, because of an AIDS-related death) can and will often vary the proportions of land, labor, and cash or adjust their cropping patterns based on the particular mix of resources that they possess after the death. Hence, the loss of family labor through a death in the household does not mean that labor necessarily becomes the limiting input in agricultural production, and hence, it does not necessarily follow that the appropriate policy response for agricultural research and extension systems is to focus inordinately on laborsaving agricultural technology. Laborsaving technology may indeed be appropriate for many households (those who already face high land-labor ratios and lack other resources that could be substituted for labor, such as cash for hiring labor). The main implication for crop research and extension systems is that a broad range of agricultural production technologies, appropriate for the wide range of land-labor-capital ratios found among small-scale farm households, are needed to respond to the AIDS disease.

However, the household survey analyses generating these findings and policy implications have their own methodological limitations. First, such studies to date have measured the effects of death in their households on household-level outcomes, typically over a 2- to 5-year time frame, compared to nonafflicted households. Yet because nonafflicted households are likely to be indirectly affected by the mortality occurring around them, nonafflicted households may not be a valid control group. A second problem concerns the often careless interpretation of cross-sectional survey data, which have little or no information on households' conditions before they were afflicted by mortality. By definition, cross-sectional data provide a snapshot of household conditions at a certain point in time. Cross-sectional data are capable of providing information on afflicted households' conditions only after a death has occurred, not before. But the study of AIDS is an inherently dynamic analysis that requires an understanding of how household behavior and welfare change over time, from before being afflicted, during the illness phase, the postdeath phase, and, one hopes, in the recovery process. Third, studies covering a relatively short time frame, whether qualitative or quantitative, are likely to fail to detect intergenerational effects such as the inability of deceased adults to pass along accumulated knowledge to future generations and the less tangible benefits that children receive from their parents (Bell, Devarajan, and Gersbach, 2003; Gertler, Levine, and Martinez 2003).

On the basis of available evidence and projections, three trends are likely to emerge. First, as the supply of skilled and semiskilled labor becomes relatively con-

strained as the disease progresses, the costs of skilled labor in the (mostly non-agricultural) formal sector is likely to rise. This means that knowledge-intensive activities, both in agriculture and nonagriculture, may suffer a decline in competitiveness unless steps are taken to accelerate skill training and general human capital development. However, the increased risks of premature death from HIV/AIDS erode the returns to investing in human capital development. Aggressive public sector initiatives may be necessary to maintain growth in human capital development throughout the economy and in the agricultural sector (e.g., agricultural extension agents) despite the continuous drain on human capital by AIDS. Macroeconomic models that do not account for the complex effects of AIDS on human capital and intergenerational knowledge transfers are probably underestimating the economic and social consequences of the disease.

Second, AIDS may slow the rate of labor migration from rural to urban areas in the hardest-hit countries. Several household-survey analyses have already shown evidence of urban-to-rural labor migration among afflicted households (e.g., Ainsworth, Ghosh, and Semali's [1995] study of Kagera District in Tanzania and Menon et al.'s [1998] study of Rakai District in Uganda). Migration of labor from urban to rural areas may help rural households and communities preserve existing farming systems or slow the transition to less labor-intensive ones. However, the process of urban-to-rural migration as a mitigating effect of the AIDS disease on rural labor depends on the assumption of widespread underemployment in the informal sector, and that the returns to labor in agriculture are enough to induce underemployed urbanites back to the farm.

Third, agricultural systems are likely to become less capital-intensive in hard-hit areas as assets and wealth are depleted. The effects of AIDS on agriculture appear to strike hardest on the poor, and the disease may exacerbate income inequalities as poor households sell off assets and land to those who can afford to buy.

### **Potential Agricultural Sector Recommendations to Mitigate the Effects of AIDS**

This section discusses potential agricultural policies and programmatic responses of four types to mitigate the impacts of HIV/AIDS: (1) factor use and input market; (2) agricultural research and extension systems; (3) commodity markets; and (4) gender-differentiated resource allocation.

#### *Policies and Programs Affecting Factor Use and Input Markets*

- *Land Tenure/Security Policies:* Research findings have underscored the need to reduce insecurity of land tenure for women (and their dependents) who lose

their husband (father). The limited available evidence indicates that widows and their dependents are most vulnerable to losing their land and becoming substantially poorer after suffering the premature death of the husband. Policies that improved women's rights (e.g., land tenure security for widows) might also reduce the spread of AIDS associated with women resorting to risky behaviors caused by poverty and disenfranchisement.

- *Development of Land Rental Markets:* Relatedly, government efforts to ensure that landowners will not lose their land if they rent it out to others will help in the development of viable land rental markets. Evidence suggests that land rental markets are constrained in many cases by landowners' fears that they will lose their land if they allow others to use it repeatedly. For AIDS-afflicted households that do suffer from a shortage of family labor, their welfare could be enhanced by well-functioning land rental markets that allowed them to earn income from allowing others to make productive use of the land.
- *Strategies to Promote Labor-Saving Modes of Land Preparation and Weeding:* The importance of land preparation and weeding in total labor input to crop cultivation calls for increased public investment to make laborsaving land preparation and weeding technologies more accessible to nonafflicted as well as afflicted farm households. Conservation farming techniques that shift land preparation labor to the dry season may be particularly attractive in many areas. In other areas, strategies to rapidly increase the stock and health of animal assets within the small-scale farm sector as well as the stock of animal and draft equipment such as plows and harrows may be important. Enhancing farmers' incentives and ability to acquire draft animals and equipment will help alleviate the crucial labor burden of land preparation. Moreover, relatively asset-poor households that still cannot afford to buy such assets themselves will nevertheless be in a better position to utilize such services through the increased availability of oxen and equipment through draft rental markets. In short, there may be increasing payoffs to increasing public goods investments in livestock veterinary and extension services and, where feasible, stimulating new investment in private veterinary services. There are some examples, as in Mali, where a successful system of private veterinary drug retailers has developed.
- *Invest in Improving Access to Water and Fuel:* Borehole sinking and agroforestry projects can reduce time spent on these labor-intensive tasks (Gillespie 1989). These may have a high benefit-to-cost ratio in terms of health effects and simultaneously increase the amount of labor that could be freed up for pro-

ductive income-earning activities. Benefits will be especially high for women, who do most of the water and fuel fetching.

*Policies and Programs Affecting Agricultural Research and Extension Systems*

- *Agricultural Seed Development and Dissemination:* Given the wide variations in land-to-labor ratios found throughout eastern and southern Africa, labor-saving technologies may not be appropriate for all afflicted households or in all hard-hit communities. Payoffs to research in improved seed technology (generally considered to be land-saving) have historically been very high (Oehmke and Crawford 1996), and it is unlikely that seed research will be any less valuable given the existence of AIDS. In fact, the past record of payoffs to improved seed development may make this one of the most effective means to raise the livelihoods of afflicted and nonafflicted households alike over the longer run.

Despite the likelihood of more severe capital constraints over time, low-external-input technologies are unlikely to contribute much to AIDS mitigation. It is possible that low-input technologies are appropriate in a limited number of household situations. For the most part, however, low-external-input technologies without soil fertility enhancement mean substantially lower yields and production and lower returns to land and labor.

It is in this vein that caution is warranted about promoting new crops simply because they are laborsaving or possess important nutritive qualities. Although these are important criteria, the promotion of new crops also needs to be assessed in terms of its effect on returns to land and labor and broader agricultural and rural development objectives. For example, if the promotion of the crop would shift cropping patterns and displace other crops that yield higher production per unit of land and labor input, then there may be adverse effects on agricultural productivity, crop income, and food security. The trade-offs between superior nutritive value of certain crops versus lower overall value of output produced need to be assessed in greater detail to determine whether production of certain crops ought to be promoted.

- *Conservation Agriculture Approaches that Provide Productivity Improvements and Economize on Labor Input:* This proposal also relates to the previous set of proposals affecting agricultural input use. By using labor in the dry season for land preparation, conservation agriculture methods may assist in ameliorating the severe labor constraint at land preparation periods. When the first rains come and planting needs to quickly follow, those farmers practicing conservation

agriculture would have been able to spread the work out over time and achieve it (Haggblade and Tembo 2003).

- *Programs to Educate and Change Behaviors of Agricultural Extension Workers:* Agricultural extension systems have been adversely affected by the AIDS epidemic as many workers have died. Agricultural extension workers possess attributes known to be correlated with HIV contraction: mobility, education, and relative affluence. There is a need to focus on attitude and sex behavior change among agricultural extension workers and to utilize them as forces for positive behavior change in the community.
- *Programs to Increase the Number of Trained Agricultural Extension Workers:* As men and women die of AIDS, much of their accumulated knowledge and skill is lost to the succeeding generation. Problems of intergenerational knowledge transfer, if not redressed, will reduce the productivity of labor in agriculture as well as the contribution of people to society and the contribution of society to individuals (Bell, Devarajan, and Gersbach 2003). This highlights the importance of education and skill development, which goes far beyond the ministry of agriculture. However, an important role for the ministry of agriculture is to rehabilitate the agricultural extension system. This means more than reviving the number of extension agents and contacts with farmers but also improving the mode of transmitting information to farmers.

#### *Policies and Programs Affecting Commodity Marketing Systems*

- *Improved Input and Commodity Marketing Systems:* Although this issue is important irrespective of its relation to HIV/AIDS, we include it here to highlight the fact that one of the most important ways to reduce the impacts of AIDS is to strengthen the resilience of the rural economy. Efforts to improve the competitiveness and productivity of smallholder agriculture are likely to be among the most important ways to help afflicted households and communities cope with the ravages of AIDS. Agricultural markets for inputs and commodities are central to this process.

Greater public goods investments in road, rail, and port development, and communications infrastructure, are also crucial. High domestic transportation costs have clearly impeded fertilizer use in the region, as they account for roughly half of the total price borne by farmers and contribute to the fact that fertilizer prices are among the highest in the world (Jayne et al. 2003b).

*Policies and Programs Affecting Gender-Differentiated Allocation of Resources*

- *Redress Gender Biases in Agricultural Programs:* It is primarily men who receive the specialized crop husbandry and marketing knowledge to grow these crops under out-grower and cooperative arrangements.

Marked gender inequalities in the access and ownership of productive resources make the whole society more vulnerable in the wake of an external shock such as AIDS. In large parts of Africa, although men traditionally control and own many resources, women gain access and use rights through marriage. When marriage links are broken through the death of the spouse, and women are denied access or use of the resources or lose them through property grabbing, they are frequently left with only their body to gain access to food, money, or rights. Programs that seek to ensure gender equality in participation and access will have a protective effect for the society. In addition, they will have an empowerment effect on women, further protecting them against HIV.

- *Education Campaigns Aimed at Reducing Widow Inheritance:* Studies in Kenya and Uganda indicate that the widespread traditional practice of widows being “inherited” by one of the deceased husband’s brothers is no longer mandatory (Rugalema 1999; Government of Uganda 2003). It is now well recognized that this custom has exacerbated the spread of AIDS. Unfortunately, initiatives to stop these practices may leave widows in a weak economic position, which has been observed in some cases to contribute to other types of risky sexual behavior. Alternative approaches to caring for widows and their dependents are necessary to reduce the spread of the disease.

### **Concluding Remarks**

Based on projections of future demographic change in the hardest-hit countries of eastern and southern Africa, the full impacts of HIV/AIDS on the agricultural sector are only just starting to manifest and will intensify over the next several decades. It is critical that agricultural policymakers anticipate the changes that HIV/AIDS will bring to the agricultural and rural sector and proactively respond through the development of policies and programs that factor in these projected impacts of the disease.

One of the most important ways in which agricultural policy can contribute to reducing the spread and consequences of AIDS is to contribute effectively to poverty reduction. Risky sexual behaviors are at least partially related to limited opportunities

to earn a livelihood through other means. Moreover, raising households' and communities' living standards over the long-run through productivity-enhancing investments in agricultural technology generation and diffusion, improved crop marketing systems, basic education, infrastructure, and governance will improve their ability to withstand the social and economic stresses caused by the disease. Greater focus on these productivity-enhancing investments is likely to be a critical part of an effective response to the HIV/AIDS pandemic, and the extent to which progress is made in these areas over the next 20 years is likely to greatly influence living standards in these hardest-hit countries of eastern and southern Africa.

## Notes

The authors acknowledge support from the FAO; the Food Security III Cooperative Agreement, funded by USAID; and the Tegemeo Agricultural Monitoring and Policy Analysis Project, funded by USAID/Kenya. This chapter has benefited from the comments of Clare Bishop, Cynthia Donovan, Natasha Mesko, James Shaffer, John Staatz, and Michael Weber. The views expressed in this chapter reflect the views of the authors only.

1. Prevalence rates refer to the estimated percentage of HIV-positive adults between 15 and 49 years of age.

2. This assumes that current projections by UNAIDS and U.S. Census Bureau are correct. These estimates are acknowledged to be potentially overstated because (1) they are based on blood tests of women visiting antenatal clinics located mainly in urban areas, which are considered to have higher prevalence rates than in rural areas; and (2) the antenatal data do not include men, who are likely to have lower rates of HIV infection than women (UNAIDS 2002; Chin 2003).

3. The information available to us from the Zambia census was not disaggregated by gender, and it would be important in a more detailed analysis to consider potential differences in, and implications of, migratory patterns by gender.

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