

HIV/AIDS AND THE AGRICULTURAL SECTOR IN EASTERN AND SOUTHERN AFRICA: ANTICIPATING THE CONSEQUENCES

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Abstract

This paper draws upon development economics theory, demographic projections, and empirical evidence to consider the likely consequences of the HIV/AIDS pandemic for the agricultural sector of the hardest-hit countries of Eastern and Southern Africa. We identify four processes that have been underemphasized in previous analysis: 1) the momentum of long-term population growth rates; 2) substantial underemployment in these countries' informal sectors; 3) sectoral declines in land-to-person ratios in the smallholder farming sectors; and 4) effects of food and input marketing reforms on shifts in cropping patterns. The paper concludes that the conventional wisdom encouraging prioritisation of labour-saving technology or crops has been over-generalised, although labour-saving agricultural technologies may be appropriate for certain types of households and regions. The most effective means for agricultural policy to respond to HIV/AIDS will entail stepping up support for agricultural science and technology development, extension systems, and input and crop market development to improve the agricultural sector's potential to raise living standards in highly affected rural communities.

Key Words: agricultural policy; HIV/AIDS; structural transformation; production factors.

JEL: Q18 - Agricultural Policy; Food Policy; J43 - Agricultural Labour Markets; O12 - Microeconomic Analyses of Economic Development; O33 – Technological Change.

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

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1. Background

There is now widespread recognition that HIV/AIDS is not simply a health issue. Effectively combating the pandemic will require a coordinated multi-sectoral approach. While many in the agricultural sector embrace the idea of playing a role to combat 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 as to 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, policy makers will be inadequately prepared to forecast anticipated changes to the agricultural sector and respond proactively.

This paper 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 seven countries of the world with estimated HIV-prevalence rates exceeding 20 percent¹ are all in southern Africa: Botswana, Lesotho, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe (US Census Bureau, 2002). Five other countries, all in southern and eastern Africa (Cameroon, Central African Republic, Kenya, Malawi, and Mozambique), have HIV-prevalence rates between 10-20 percent. For shorthand, we hereafter refer to these countries as the “hardest hit” countries.

This article 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 analysis: 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/labour ratios in the smallholder farming sectors; and 4) effects of food and input marketing reforms on shifts in cropping patterns. Understanding these trends are necessary to anticipate the consequences of the HIV/AIDS epidemic for the agricultural sector and to consider the implications for agricultural policy.

2. Effects of AIDS on Future Demographic Changes

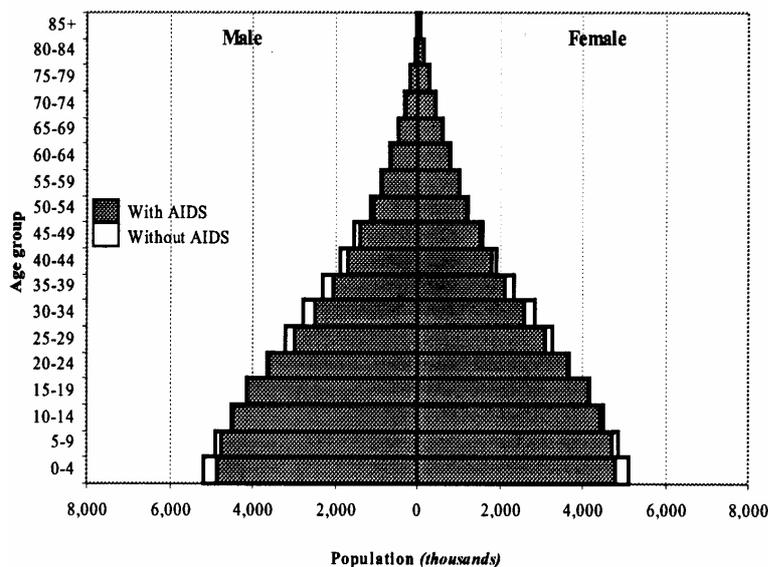
In most of eastern and southern Africa, where HIV prevalence rates generally exceed 10 percent, there will be many fewer adults in the coming decades compared to a “no-AIDS”

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

scenario (US Census Bureau, 2002).² 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) (US Census Bureau, as reported in Way, 2003, p. 5). By 2020, AIDS mortality will produce population pyramids in these countries never seen before (Figure 1).

By 2025, summing across 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 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 1. Population pyramids in 5-6 other countries will have similar shapes, though less extreme than those shown in Figure 1.³

Figure 1a. Population in the Medium Variant (“with AIDS”) and in the No-AIDS Scenario (“without AIDS”), by Sex and Age Group, 7 Most Highly Affected Countries, 2000.

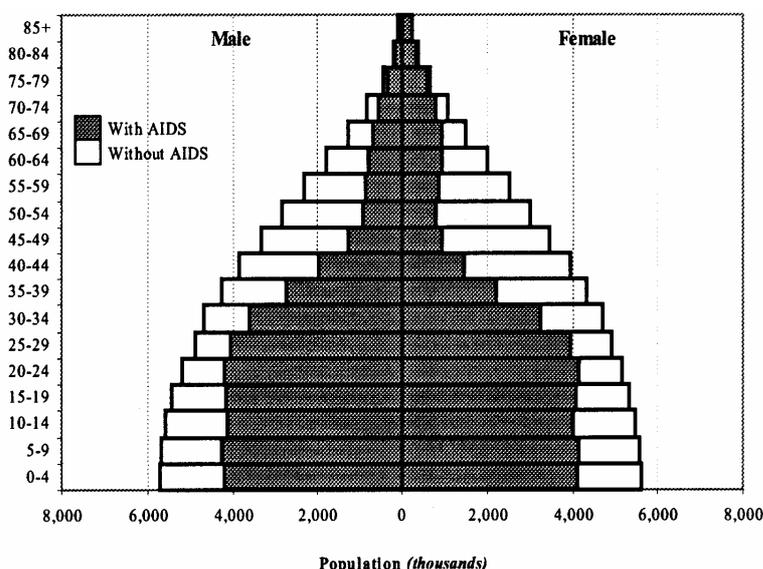


Source: US Census Bureau, 2003.

² While it is not our goal here to explain why HIV prevalence rates are so high in these countries compared to elsewhere in Africa, we note that these countries share unique structural features of their economies that exacerbated the spread of the disease. Migration, mostly by men, from their rural farms to urban areas, mines, and commercial farms for employment has been a fundamental economic and social feature of most of these countries. The separation of husband and wife, coupled with the concentration of men in housing complexes for long periods of time gave rise to social and sexual risk behavioral responses that have contributed to a much more rapid spread of the disease in these countries than elsewhere (Epstein, 2003). See also Chin (2003) for related epidemiological-based explanations of regional differences in the spread of the disease.

³ This assumes that current projections by UNAIDS and US 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 does not include men, who are likely to have lower rates of HIV infection than women (UNAIDS, 2002; Chin, 2003).

Figure 1b. Projected Population in the Medium Variant (“with AIDS”) and in the No-AIDS Scenario (“without AIDS”), by Sex and Age Group, 7 Most Highly Affected Countries, 2025.



Source: US Census Bureau, 2003.

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 numbers of adults projected to be alive in 2025 is roughly similar to what it is today. This is because the momentum of population growth, which, in the absence of AIDS, would have produced much greater population sizes in the coming decades. While 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 1 compares population estimates in 2000 and projected estimates for 2025, by age/sex categories in the seven countries where HIV prevalence is estimated to exceed 20 percent.

Table 1. Comparison of Total Population Size for the Seven Hardest-hit Countries, * 2000 vs. 2025

Sex/age categories		2000	2025	2025
		estimated	forecasted “no-AIDS” scenario	forecasted “with AIDS”
		----- Projected Population (millions) -----		
Males	< 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
Females	< 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

* Botswana, Lesotho, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe
Source: US Census Bureau, 2003.

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 males and females 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 favourable 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 1 is the loss of available labour due to periods of sickness, care-giving for those afflicted with the disease, and mourning periods after a death.⁴ Thus, the “effective” labour 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 1. Moreover, the effects of low population growth on the agricultural sector may be very different if the cause of low growth is a loss of adults rather than a decline in fertility. Curbing population growth through the death of adults creates myriad social disruptions, for example through the long-term difficulties faced by children of deceased parents (e.g., Gertler et al., 2003; Case, Paxson, and Ableidinger, 2003). 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.

3. The Effects of HIV/AIDS on Agriculture and Rural Livelihoods: Current Understanding

Incorporating HIV/AIDS into Structural Transformation Models

For four decades since the pioneering work of Bruce Johnston and John Mellor (1961), the foundation of rural development paradigms has been the structural transformation process. Every major country that has achieved substantial growth in real incomes over a long-term period has done so through a *structural transformation* of its economy involving:

- A process by which increasing proportions of employment and output of the economy are accounted for by sectors other than agriculture. The economy becomes less agriculturally oriented in a relative sense, although agriculture and, more broadly, the food system continue to grow absolutely and generate important growth linkages to

⁴ A Government of Uganda study (2003) found that the cultural practice of observing mourning for the deceased impinged on agricultural production and fishing. After incurring the loss of a family member, 70.8% of household respondents spent 1-2 days without working, while 32.0% revealed that they spent a week away from gardens and fishing activities. With regard to the loss of a community member who was not a member of the family, 59.0% of respondents spent 2-4 days without attending to their crops.

the rest of the economy. Structural transformation thus involves *a net resource transfer from agriculture to other sectors of the economy, over the long term.*

- Movement of the economy away from subsistence-oriented household-level production towards an integrated economy based on greater specialization, exchange, and the capturing of economies of scale. Many functions formerly conducted on the farm, such as input production and output processing, are shifted to off-farm elements of the economy.
- Labour migration is a critical feature of the structural transformation process. Over time, rural labour migrates from agricultural activities to employment opportunities in the rural and urban non-farm sectors, in response to the rising demand for non-farm goods and services fueled by agricultural income growth.

Agricultural growth is generally the catalyst for structural transformation. Because such a large share of the population in most African countries reside in rural areas and earn the bulk of their incomes from agriculture, raising agricultural incomes will be critical to raising the demand for off-farm jobs associated with the demographic transition.

There are many other important features of the structural transformation process, but our point here is to highlight the catalytic role of agricultural growth in starting these processes, and the need for agricultural surpluses and labour to be transferred in tandem for structural transformation to progress. Agricultural productivity growth and the surpluses generated from it drive migration of labour from rural to urban areas and from agriculture to non-agricultural activities, as greater purchasing power of farm households stimulates demand for non-farm jobs and businesses (Mellor, 1976; Johnston and Kilby, 1975).

How is HIV/AIDS affecting countries' ability to generate these structural transformation processes? The most obvious question posed by the information in Figure 1 concerns how the decline in the growth of the labour force will affect migration, the costs of labour, the competitiveness of labour-intensive sectors such as agriculture, the underlying farming systems, and the structural transformation process. These are complex issues, and unfortunately we have little empirical evidence to guide us. Moreover, because of the long-wave nature of the AIDS epidemic, the full impact of the disease will not manifest until the next several decades (Barnett and Whiteside, 2002). For this reason, assessments of what is happening now do not provide a reliable picture of what will be happening in the future. The following section discusses these issues in conceptual terms, incorporating applied evidence where available.

Potential Changes in Labour Markets Due to AIDS

Understanding the future effects of AIDS on the agricultural sector requires an organizing conceptual framework of how labour is likely to shift between urban and rural areas and between agricultural and non-agricultural activities as the demographic changes shown in Figure 1 begin to manifest. The classic theory of rural-urban migration is based on the work of Harris and Todaro (1970), with many refinements added to the model in recent years (e.g., Banerjee and Newman, 1997). These models start from the observation that labour allocates itself into three broad employment categories. The first, and most important in terms of sheer numbers, is the agricultural sector. The returns to agricultural labour are typically low,

especially in less favoured agro-ecologies and where population densities and labour/land ratios are high. The second source of employment is the formal sector, mainly in urban areas, but also in small towns, commercial farms, mines, and rural civil service. Wages in the formal sector generally exceed those of agriculture. However, migration of labour from agriculture to the formal sector is limited by skill requirements and the growth prospects of the formal sector. The third source of employment is the “informal” sector. Many people who have migrated to urban areas in search of formal sector jobs but couldn’t 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 labour 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 labour 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 labour models, the answer depends on the size of the underemployed informal sector. If surplus labour exists in an underemployed informal sector, then rising costs of agricultural labour caused by incipient AIDS-related labour shortages will induce labour 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, 2004). 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 labour 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 labour shortages.

What is the evidence of migration of labor to agriculture? To examine this issue, we draw upon the 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 “non-agricultural,” as well as “urban” vs. “rural,” we can draw inferences about labor migration over the decade of the 1990s. Census figures reported here are prepared by the government Central Statistical Office (CSO). As shown in Table 2, the total population of Zambia grew from 7,383 million to 9,886 million people between 1990 and 2000 – a 33.8% increase. Yet over the same period, the rural population grew at a much higher rate than the urban population. Rural population grew by 43.6% compared to only 18.8% 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, as shown in Table 3, 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.

Table 2. National Population within Households and Number of Households, Zambia

Population Characteristics	1,990	2,000
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 non-agricultural households – rural	975,893	493,225
Number of households		
Total number of hhs	1,070,014	1,797,380
Number of Rural hhs	651,796	1,174,314
Number of Urban hhs	418,218	623,066
Total number of agric hhs	520,520	1,305,783
Number of Rural agric hhs	510,362	1,084,637
Number of Urban agric hhs	10,158	221,146
		0
Number of rural non-ag hhs	141,434	89,677

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

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% increase. And the population of non-agricultural rural households actually declined from 975,893 to 493,225. These figures represent a huge shift in Zambia’s labour force from urban to rural areas, and from non-agriculture 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 semi-subsistence crop production,

Table 3. 1990 and 2000 Census Information on the Number of Farms and the Population Engaged in Farming by Province.

<i>1990 Census</i>	ZAMBIA	Central	Eastern	Southern	Northern	N/western	Copperbelt	Lusaka	Western	Luapula
Urban farm households (n)	10,158	906	1,224	431	1,046	867	2,220	504	382	2,578
Rural farm households (n)	510,362	48,777	130,578	57,060	87,140	38,921	21,888	12,801	47,569	65,628
Mean persons per farm households	6.9	7.2	6.8	7.4	6.4	6.6	7.1	7.4	6.7	6.6
Population of agric households	3,591,588	357,718	896,254	425,433	564,390	262,601	171,167	98,457	321,272	450,160
Population of adults (>=12yrs)	2,249,642	225,467	565,992	253,310	350,045	165,649	111,083	61,731	205,455	287,870
Farm population as % of total population	49	50	93	47	66	68	12	10	53	86
<i>2000 Census</i>										
Urban farm households (n)	221,110	18,787	9,437	13,666	18,458	8,454	101,840	28,993	6,237	15,238
Rural farm households (n)	1,084,637	114,322	221,683	130,535	200,657	86,880	55,730	30,691	122,859	121,316
Mean persons per farm households	5.16	5.74	4.91	6.02	4.68	5.02	5.60	5.73	4.80	4.59
Population of agric households	6,742,665	763,630	1,135,045	868,643	1,025,765	478,269	882,257	341,710	619,923	627,423
Population of Adults (>=12yrs)	4,416,815	495,571	729,710	551,591	667,894	311,694	591,101	233,883	427,691	407,680
Farm population as % of total population	68	75	87	72	81	82	56	25	81	81

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

and AIDS. Unemployment and underemployment in Zambia's urban and informal sectors appears 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% per year over the next decade), then labor shortages may indeed begin to manifest in future decades. However, there is little evidence to date to suggest that labour shortages in Zambian agriculture have been increasing.⁵

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 4). The pace of the decline in land-to-person ratios has not slowed during the 1990s even in the most hardest-hit countries. Declining land-to-person ratios are occurring due to 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. This will probably either reduce the rate of rural outmigration, or as discussed above, may even reverse the net direction of migration back to rural areas.

Table 4. 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).

Only if unemployed and underemployed labour in the informal sector were insufficient to satisfy the incipient demand for labour in agriculture would HIV/AIDS cause a secular rise in agricultural wages. In this case, real food prices would be expected to rise over time, as labour shortages start to depress agricultural production.

The formal sector, by contrast, may well experience labour shortages and rising labour costs to the extent that the death of skilled workers cannot be replenished from the ranks of the less-

⁵ While the information available to us from the Zambia census was not disaggregated by gender, it would be important in more detailed analysis to consider potential differences in, and implications of, migratory patterns by gender.

skilled informal sector or agricultural sector. The loss of skilled and educated labour may be particularly acute considering that the AIDS disease has particularly affected relatively educated individuals with high socioeconomic status, at least in the early years of the disease. Studies from Rwanda, Tanzania, Uganda and Kenya have shown a positive relation between socioeconomic status (education, wealth, and type of occupation) and HIV infection (e.g., Ainsworth and Semali, 1998; Kirungu and Ntozi, 1997; Menon et al., 1998; Armstrong, 1995; Barongo et al., 1992; Wannan et al., 1997). There are indications, however that, as time progresses, the disease is progressively less correlated with socioeconomic status as it becomes more generalized through society (Mather et al., 2004).

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

Impacts 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 (Mellor, 1976; Johnston and Kilby, 1975). 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 (see Eicher, 1995, for the case of Zimbabwe during the 1980s; Karanja, 1997, for Kenya during the 1965-1980 period; and Howard and Mungoma for Zambia during the second half of the 1980s).

Farm households tend to utilize remittance and off-farm income as a primary means to afford expensive assets such as oxen, ploughs, and fertilizer, which are used to capitalize farm production (Reardon, Crawford, and Kelly, 1995; Marenja et al., 2003). These sources of income are often jeopardized among AIDS-afflicted households, particularly those that are asset-poor and vulnerable to begin with (e.g., Mushati et al., 2003; FASAZ, 2003; Yamano and Jayne, 2004; Donovan et al., 2003). Cash constraints on farm intensification are compounded during illness and after a death, when medical and funeral expenses rise and care-giving 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 incurring a death in the family (Yamano and Jayne, 2004). To the extent that afflicted households shed assets and are forced to reduce their usage

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 labour, capital, and knowledge. Unlike the loss of labour and knowledge, which represent a loss to entire communities, capital assets lost by afflicted households are generally re-distributed 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.

Men and women tend to own assets and money separately, and tend to have separate income-earning activities. Yet because care giving usually falls on women, it appears that the rise of prolonged sickness and care due to AIDS has reduced the time available for women to engage in income-earning activities more so than for men (Opiyo, 2001), and this trend is likely to become even more pronounced in future decades in the hardest-hit countries as the casualties of the disease escalate.

Effects on Land Distribution

Figure 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 40-64 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 and/or ownership rights to land after the death of the husband/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).

While 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. As will be discussed later, a major challenge for agricultural and land policy is to provide greater security of tenure for vulnerable households, especially those headed by widows, and more generally, to protect the rights of owners who wish to rent land. Developing land rental markets is envisioned to assist afflicted households earn revenue from renting land that would otherwise go unutilized.

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 (Mazhangara, 2003; Barnett and Blaikie, 1992). When

combined with evidence that female-headed households tend to be poorer in general than their male-headed household neighbours, 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.

Impacts on Agricultural Production

The micro-level 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 labour 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 head-of-household or spouse dies – and the initial level of wealth of the household.

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 non-afflicted households, but the magnitude and statistical significance of this finding depending greatly on the sex, age, and position in the household of the person who died, as well as the household's initial (pre-death) 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 who suffered a death in 1997 did not show any recovery compared to households that incurred a more recent death, e.g., 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 labour 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 labour 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.

The few available empirical studies on the impacts of prime-age adult mortality on incomes indicate that the effects are more severe on households that were relatively poor to begin with (Drimie, 2002; Yamano and Jayne, 2004). Relatively poor households appear to suffer the most after incurring an AIDS-related death in the household because they are less able to cope with the economic and social shocks that it generates.⁶

⁶ Yamano and Jayne did not find significant losses in cultivated land or net crop output among households in the upper half of the asset distribution. Possible reasons for the significant loss in crop output among relatively poor households include (a) they are less capable of paying hired labour to compensate for lost family labour; and (b) they have less savings to spend down and are hence more vulnerable to selling off productive assets to pay for immediate cash needs.

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 labour productivity among HIV positive tea pluckers in Kenya, while Rugalema (1999) found that agricultural companies reliant on hired labour are suffering from rising costs and falling profits due to the disease.

4. 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-labour 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-labour ratios, and have exhibited substantial out-migration of labour for decades. Other many small-scale farmers in northern Zimbabwe, 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-labour-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 ranking households by landholding size per capita, there are huge variations in land-to-person ratios within the small-scale farm sector in each country (Table 5). The 25 percent of smallholder households with the smallest farms typically controlled less than 0.1 hectares of land per person. These households are virtually landless although this same group earns over 50% of its income from agriculture, except in the case of Kenya where the agricultural income share of the bottom land quartile was exactly 50% (Jayne et al., 2003a). At least for this strata 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-labour ratios controlled at least seven times more land per capita, generally in the range of 0.5 to 1.0 hectares per capita. This strata of better-off farmers generally hire agricultural labour. Also, the death of a family member among these households (where labour-land ratios are relatively low) is likely to induce a search for attracting non-resident members back to the farm. These two processes – attempts to attract non-resident household members back to the farm and demand for hired labour 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 5 indicates that because of the heterogeneity in land/labour ratios within the small-scale sector, the limiting input into agricultural production will certainly differ between households controlling less than 0.1 hectares per capita vs. 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 labour in the production process may indeed raise the demand for labour.

Table 5. Smallholder Land Distribution in Selected African Countries

Country	(a) sample households (n)	(b) Mean landholding size ¹ (ha)	(c) Farm size ranked by quartile ¹ (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

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

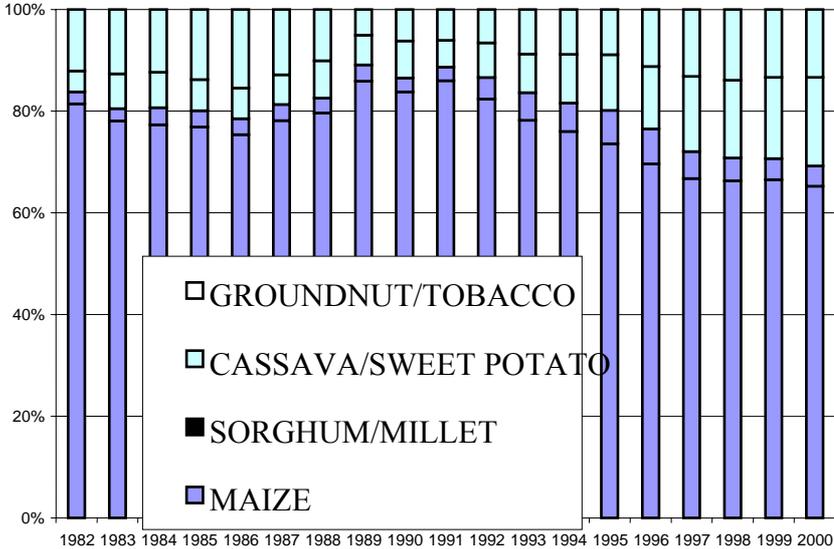
¹ landholding size figures include rented land.

Source: Jayne et al., 2003a.

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 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 (Figure 2). In the some provinces of Zambia, cassava production has also risen dramatically in recent years (Figure 3).

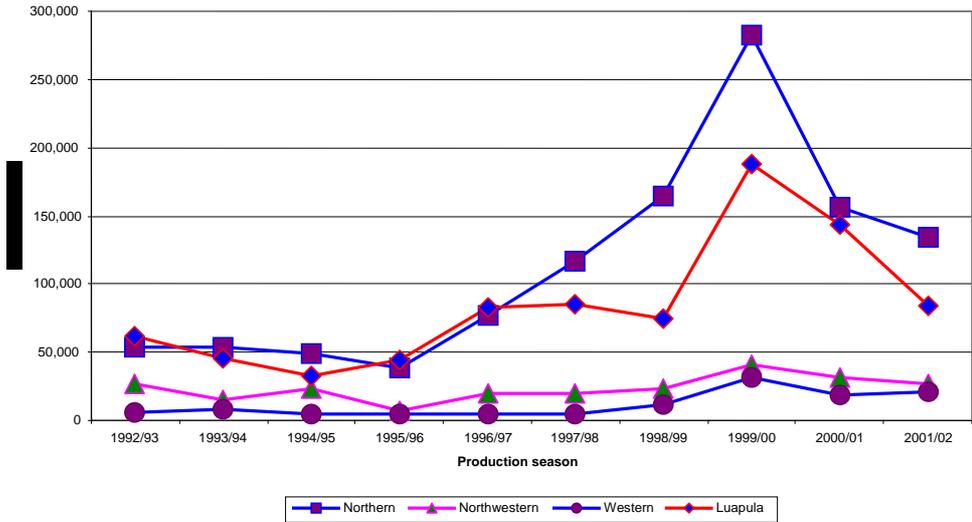
It is possible that AIDS has contributed to these shifts in crop area. However, it is important to acknowledge that other major changes in agricultural policy have occurred in these countries which have also veered some farming systems in the region toward tuber crops. Most notably, many countries in eastern and southern Africa had formerly implemented state-led maize promotion policies featuring pan-territorial 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 pan-territorial pricing, and has shifted cropping incentives toward other food crops, especially those relatively unresponsive to fertilizer application, such as cassava (Smale and Jayne, 2003).

Figure 2. Changes in Percentage Area Distribution among Maize and Competing Major Crops, Malawi 1982-2000



Source: Malawi Official Crop Estimates, 1982-2000

Figure 3. Cassava Production by Small- and Medium-Scale Farms in the Four Major Provinces Where Cassava is Produced in Zambia, 1992/93- 2001/02.



Source: Post-Harvest survey data, Central Statistical Office, Lusaka

Many areas 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. Taking the case of Zambia, for example, the provinces with the lowest rate of HIV prevalence – Northern (13.5%), Northwestern (11.6%), and Luapula (16.2%) have registered the greatest increase in the share of cropped area devoted to cassava and sweet potato. 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.⁷ Moreover, based on analysis of 6,922 households from a nationally representative survey in Zambia in 2001, households afflicted by a prime-age death did not tend to have more relative area cultivated to roots and tubers compared to their non-afflicted neighbors (Chapoto, Yoo, 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 non-afflicted and afflicted households are incorporating cassava into their crop mix at similar rates. If afflicted households incurred several labour shocks, one would have expected to find afflicted households devoting a greater proportion of their land to cassava and other labour saving crops.

Using data from Kagera District in Tanzania, Beegle (2003) also found that households experiencing a death did not shift cultivation towards subsistence food farming. She concludes that afflicted households were able to maintain their supply of labour by drawing back 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 labour 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 labour as the main factor of production that is affected by rising adult mortality rates.

Sociologists and anthropologists have an important role to play in determining how different social institutions and their implementation affect the ability of surviving spouses and their dependents to retain their productive assets to maintain their livelihoods. Villarreal's (2002) discussion of AIDS among the Luo people in Western Kenya indicates how social norms affect the vulnerability of women after losing their spouse, and how their disadvantaged economic position even increases their susceptibility to contracting the disease. Mazhangara (2003) describes how matrilineal and patrilineal inheritance rights affect the distribution of property, land, and children after the death of the husband or wife. The spread of the disease and peoples' *ex post* vulnerability to its effects appear to be related to gender inequality (Matangadura, 2001). External attempts to impose changes in local social norms and rules may be met with opposition from those in control. Yet more open discussion and analysis of the effects of existing inheritance rules and gender rights on poverty, social problems, and the spread of AIDS may help to bring about endogenous changes that help maintain the cohesion of rural communities. This would be a particularly relevant topic for participatory poverty reduction strategy processes.

⁷ HIV prevalence data are from the 1998 sentinel surveillance survey in 1998 (Ministry of Health, 1999) and include both urban and rural areas. Data on area cultivated is from Chapoto, Yoo, and Jayne (2005).

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 rise 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 prior to 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.

5. Conclusions and Policy Implications

Decisions need to be made now regarding how to respond to the disease. Because resources are scarce, there is a gap between desired and available levels of funding and human resources for HIV prevention (e.g., vaccines, behavior change), treatment (e.g., ARV therapies), and mitigating the impacts of AIDS (e.g., social and economic programs to protect the living standards of afflicted households and hard-hit communities). Moreover, every dollar invested in AIDS prevention, treatment, and mitigation cannot be used to promote basic education, improved agricultural technology, the development of infrastructure and markets, and other long-term investments necessary to raising living standards. Therefore, 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.

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; and
- Reduction in use of other inputs due to 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.

While 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 non-verifiable interpretation of data, or are conceptual and speculative in nature.

Most quantitative household-level studies provide a less catastrophic assessment of impacts 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 impacts of prime-age mortality on households' 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 households' initial level of wealth, 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 labour for family labour (e.g., sharecropping arrangements), renting animal traction services for land preparation instead of preparing the land with family labour, substituting fertilizer application for labour, or reducing the amount of land cultivated to maintain a similar intensity of labour 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 labour supply (for example due to an AIDS-related death), can and will often vary the proportions of land, labour, 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 labour due to a death in the household does not mean that labour 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 labour-saving agricultural technology. Labour-saving technology may indeed be appropriate for many households (those who already face high land/labour ratios and lack other resources which could be substituted for labour, such as cash for hiring labour). 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/labour/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 2-5 year time frame, compared to non-afflicted households. Yet because non-afflicted households are likely to be indirectly affected by the mortality occurring around them, non-afflicted households may not be a valid control group. A second problem concerns the often careless interpretation of cross-sectional survey data, which has little or no information on households' conditions prior to being afflicted by mortality. By definition, cross sectional data provides a snapshot of household conditions at a certain point in time. Cross-sectional data is capable of providing information on afflicted households' conditions only *after* having incurred a death, not *before*. But the study of AIDS is an inherently dynamic analysis that requires an understanding of how household behavior and welfare changes over time, from before being afflicted, during the illness phase, the post-death phase, and hopefully the recovery process. Third, studies covering a relatively short time frame – whether qualitative or quantitative – are likely to fail to detect inter-generational 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 et al, 2003). It is with these caveats in mind that we should view available empirical studies on the effects of HIV/AIDS on the agricultural sector and rural economy.

While much of the AIDS-agriculture literature to date has conjectured that AIDS would have a major effect on the availability and cost of labour, it is possible that capital constraints and knowledge may become a more severe impediment on maintaining agricultural output and productivity. Based on the discussion and review of empirical evidence in this section, Table 3 presents a broad, long-term prognosis of possible shifts in the availability and cost of the major factors of agricultural production.

Table 6. Conjectured Impacts of AIDS on Use and Cost of Factors of Production in Agriculture

	Effect of AIDS on availability and cost of resources used in agriculture							
	Capital assets used in agriculture		Labour in agriculture		Land		Knowledge/skills used in agriculture	
	supply	cost	supply	cost	supply	cost	supply	cost
Hardest-hit countries (HIV prevalence > 20%)	↓↓ R	↑↑	↓?	--	R	--	↓↓	↑
Countries with HIV prevalence between 5-20%	↓ R	↑	↓?	--	R	--	↓	↑

Key: ↑ = increase; ↑↑ = major increase; ↓ = decline; ↓↓ = major decline; R = redistribution from afflicted households to others; ? = depends on policy and availability of underutilized labour in the informal sector; -- = no anticipated major impact.

From this discussion, three trends are likely to emerge. First, as the supply of skilled and semi-skilled labour becomes relatively constrained as the disease progresses, the costs of skilled labour in the (mostly non-agricultural) formal sector is likely to rise. This means that knowledge-intensive activities, both in agriculture and non-agriculture, 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 due to HIV/AIDS erodes 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 due to AIDS. Macro-economic 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, mortality among rural households may induce a reverse migration of unskilled labour from urban to rural areas to make up for the loss of agricultural labour caused by AIDS. Several empirical studies of hard-hit areas have already shown evidence of this trend in urban-to-rural labour migration (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, and the national study of Zambia by Chapoto et al., 2005). Migration of labour from urban to rural areas may help rural households and communities preserve existing farming systems, or slow

the transition to less labour-intensive ones. However, the process of urban-to-rural migration as a mitigating effect of the AIDS disease on rural labour depends on the assumption of widespread underemployment in the informal sector, and that the returns to labour 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 Sectoral Recommendations for Consideration in Light of AIDS

This section provides illustrative examples of policies related to agriculture and rural development that may mitigate the impact of AIDS or reduce its transmission. Further evaluation and refinement of these proposals would be needed in each specific country context. These examples are separated into four categories: policies and programmes affecting (1) factor use and input market; (2) agricultural research and extension systems; (3) commodity markets; and (4) gender-differentiated resource allocation.

Policies and programmes 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 and suffering the premature death of the husband. Policies designed to improve women's rights (e.g., land tenure security for widows) would reduce the spread of AIDS associated with women resorting to risky behaviours due to unequal gender relations.
- *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 labour, 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 labour-saving modes of land preparation and weeding:* The importance of land preparation and weeding in total labour input to crop cultivation calls for increased public investment to make labour-saving land preparation and weeding technologies more accessible to non-afflicted as well as afflicted farm households. Conservation farming techniques that shift land preparation labour 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 ploughs and harrows may be important. Enhancing farmers' incentives and ability to acquire draft animals

and equipment will help alleviate the crucial labour 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 very successful system of private veterinary drug retailers has developed.

- *Invest in improving access to water and fuel* (e.g., borehole sinking, agroforestry projects) to reduce time spent on these labour-intensive tasks (Gillespie, 1989). These may have a high benefit-cost ratio in terms of health effects and simultaneously increase the amount of labour that could be freed up for productive income-earning activities. Benefits will be especially high for women, who do most of the water and fuel fetching.

Policies and programmes affecting agricultural research and extension systems:

- *Agricultural Seed Development and Dissemination.* Given the wide variations in land-to-labour ratios found throughout eastern and southern Africa, labour 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, 1994) 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 non-afflicted 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 labour. Promoting such a response in the aggregate would most likely contribute to poverty and misery rather than alleviate it (Haggblade and Tembo, 2003).

It is in this vein that caution is warranted about promoting new crops simply because they are labour-saving or possess important nutritive qualities. While these are important criteria, the promotion of new crops also needs to be assessed in terms of its effect on returns to land and labour, 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 labour 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 vs. lower overall value of output produced need to be assessed in greater detail to determine whether production of certain crops ought to be promoted. Since resources are scarce, proposals to promote the use of food crops with desirable nutritive qualities will likely come at the expense of production of other crops, with uncertain effects on overall crop income or the quantity of food produced. There has been little cost-benefit

analysis to date indicating whether such proposals represent the most effective use of resources to save lives and build up resilience to the effects of the disease.

- *Conservation agriculture approaches that provide productivity improvements and economize on labour input:* This proposal also relates to the previous set of proposals affecting agricultural input use. By using labour in the dry season for land preparation, conservation agriculture methods may assist in ameliorating the severe labour 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 achieved it. Challenges in practicing conservation agriculture arise, however, due to the high weeding needs in the early years, as well as the total time spent in land preparation for those early years (Hagglblade and Tembo, 2003).
- *Programmes to educate and change behaviours 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 behaviour change among agricultural extension workers and utilize them as forces for positive behaviour change in the community.
- *Programmes 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 labour 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. The detailed design of extension system rehabilitation is beyond the scope of this paper. Our main point here is to highlight the important role of more effective agricultural extension systems in overcoming AIDS-related problems of intergenerational transfer of agricultural husbandry and marketing knowledge.
- *Programmes to make agricultural extension systems viable and effective in AIDS-affected contexts:* The contents of extension services also need to change in order to be responsive to the AIDS epidemic. Not only will more extension workers be needed, but knowledge and skills they transmit need to be in line with the changes in the societies and their access to labour, agricultural inputs and services. Extension services need to cater to the knowledge needs of women, the elderly and the very young. Extension contents need to incorporate conservation agriculture and other labour saving technologies and practices that address the specific labour shortages arising as a consequence of the epidemic, especially among the most vulnerable groups and among those rendered vulnerable due to the epidemic.

Policies and programmes affecting commodity marketing systems:

- *Improved Input and Commodity Marketing Systems:* While 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 rural economy. Agricultural markets for inputs and commodities are central to this process (Johnston and Mellor, 1961; Mellor, 1976).

Intensification of smallholder agriculture requires greater access to inputs such as fertilizer and improved seed as well as reliable access commodity traders at prices greater than production costs. Instituting well functioning input and output systems has been difficult in much of the region. While some controversy remains over the appropriate direction for future marketing policy, there is little doubt that greater public goods investments in road, rail, and port development, as well as communications infrastructure, are 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., 2003).

The development of competitive commodity markets for export crops has also been impeded by high marketing costs. 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.

Policies and programmes affecting gender-differentiated allocation of resources

- *Redress Gender Biases in Agricultural Programmes:* Access to credit and inputs through out grower schemes – recipients are usually men, not women. 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, while 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 only with their body to gain access to food, money or rights. The AIDS epidemic has evidenced the inherent danger in acute gender inequalities in access to resources. Therefore, programmes 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. All agricultural policies and programmes should be revised in order to take gender issues adequately into account. They should ensure equal access to valuable resources such as land, knowledge, skills, credit, extension, and equal participation in all activities.

- *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 husbands' brothers is not longer mandatory (Government of Uganda, 2003; Rugalema, 1999). 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 behaviour. Alternative approaches to caring for widows and their dependents are necessary to reduce the spread of the disease.

Concluding remarks

Mitigating the spread and the consequences of HIV/AIDS requires a coordinated approach involving agencies responsible for agriculture, health, trade and commerce, and finance. 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 policy makers anticipate the changes that HIV/AIDS will bring to the agricultural and rural sector, and proactively respond through the development of policies and programmes that factor in these projected impacts of the disease. Because many policies and programmes take years to implement and provide tangible results with a time lag after implementation, there is urgency to put in place an appropriate set of public investments and programmes that can cushion the blow by the time the long-wave impacts of AIDS are in full force, rather than respond reactively after crises caused by structural changes in the economy have already manifested.

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 behaviours 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.

REFERENCES

- Ainsworth, M. 1998. Setting government priorities in preventing HIV/AIDS. *Finance and Development*, pp. 18-21, March 1998.
- Ainsworth, M., S. Ghosh, and I. Semali. 1995. The impact of adult deaths on household composition in Kagera Region, Tanzania. Unpublished manuscript, Policy Research Department, World Bank, Washington, D.C.
- Ainsworth, M., and I. Semali. 1998. Who Is Most Likely to Die of AIDS? Socioeconomic Correlates of Adult Deaths in Kagera Region, Tanzania, in: Ainsworth, M., Franssen, L., Over, M. (Eds.) *Confronting AIDS: Evidence from the Developing World*, European Commission, Brussels.
- Banerjee, A., and A. Newman. 1997. A Dual-Economy Model of Migration and Development. *Review of Economic Studies* 96, 203-219.
- Barnett, T. 1994. The Effects of HIV/AIDS on Farming Systems and Rural Livelihoods in Uganda, Tanzania, and Zambia. Norwich, UK.
- Barnett, T., and P. Blaikie. 1992. *AIDS in Africa: its present and future impact*. Belhaven Press, London.
- Barnett, T., and A. Whiteside. 2002. *AIDS in the Twenty-First Century: Disease and Globalization*. Palgrave Macmillan, Basingstoke, UK.
- Beegle, K. 2003. Labour Effects of Adult Mortality in Tanzanian Households, World Bank Working Paper, Washington.
- Bell, C., S. Devarajan, and H. Gersbach. 2003. Long Run Economic Costs of AIDS: Theory and Application to South Africa. Report posted on Development Gateway; url: <http://www.developmentgateway.org>
- Chapoto, A., K. K. Yoo, and T.S. Jayne. 2005. Prime-age Mortality and Rural Household Livelihoods in Zambia: A Cross-Sectional Analysis. Working Paper 12, Food Security Research Project Zambia, Lusaka, 2005.
- Chin, J. 2003. Understanding the Epidemiology and Transmission Dynamics of the HIV/AIDS Pandemic. School of Public Health, University of California/Berkeley. Paper presented at USAID, Washington, D.C., October, 2003.
- Donovan, C., L. Bailey, E. Mpyisi, and M. Weber. 2003. Prime-Age Adult Morbidity and Mortality in Rural Rwanda: Effects on Household Income, Agricultural Production and Food Security Strategies, Research Report, Food Security Research Project, Ministry of Agriculture, Livestock, and Forestry, Kigali.
- Drimie, S. 2002. HIV/AIDS and Land: Case Studies from Kenya, Lesotho, and South Africa. Report for Southern Africa Regional Office of the Food and Agricultural Organization (FAO), Human Sciences Research Council, Pretoria, South Africa.

- Eicher, C. K. 1995. Zimbabwe's Maize-Based Green Revolution: Preconditions for Replication, *World Development*, Vol. 23 No. 5, pp. 805-818.
- Epstein, H. 2003. AIDS in South Africa: The Invisible Cure. *New York Times Review of Books*, 50(12), July 17, 2003.
- FASAZ (Farming System Association of Zambia). 2003. Inter-linkages between HIV/AIDS, Agricultural Production, and Food Security. Integrated Support to Sustainable Development and Food Security Programme, Food and Agriculture Organization of the United Nations (FAO), Rome.
- Fox, M., S. Rosen, W. MacLeod, M. Wasunna, M. Bii, G. Foglia, and G. Simon. 2003. The Impact of HIV/AIDS on Labour Productivity in Kenya. Draft discussion paper, Center for International Health and Development, Boston University, Boston.
- Gertler, P., D. Levine, and S. Martinez. 2003. "The presence and presents of parents: do parents matter for more than their money?" Unpublished manuscript, U.C. Berkeley.
- Gillespie, S. 1989. Potential Impact of AIDS on Farming Systems: A Case Study from Rwanda. *Land Use Policy*, October: 301-312.
- Government of Uganda. 2003. The Impact of HIV/AIDS on Agricultural Production and Mainstreaming HIV/AIDS into Agricultural Extension in Uganda. Ministry of Agriculture, Animal Industry and Fisheries, Kampala.
- Haggblade, S., and G. Tembo, 2003. Conservation Farming in Zambia. Discussion Paper, Environment, Productivity, and Technology Division, International Food Policy Research Institute, Washington D.C.
- Harris, J., and M. Todaro. 1970. Migration, Unemployment, and Development.: A Two-Sector Analysis. *American Economic Review* 40, 126-142.
- Howard, J., and C. Mungoma. 1997. Zambia's Stop-and-Go Maize Revolution. In D. Byerlee and C. Eicher (ed), *Africa's Emerging Maize Revolution*, Boulder, CO: Lynn Reinner Publishers.
- Jayne, T.S., J. Govereh, M. Wanzala, and M. Demeke. 2003. Fertilizer Market Development: A Comparative Analysis of Ethiopia, Kenya, and Zambia. *Food Policy*, Vol. 28(4): 293-316.
- Jayne, T. S., T. Yamano, M. Weber, D. Tschirley, R. Benfica, A. Chapoto, and B. Zulu. 2003a. Smallholder Income and Land Distribution in Africa: Implications for Poverty Reduction Strategies. *Food Policy*, Vol. 28 (3): 253-275.
- Johnston, B.F., and J. Mellor. 1961. The Role of Agriculture in Economic Development. *American Economic Review* 51(4): 566-593.
- Johnston, B. F., and P. Kilby. 1975. *Agriculture and Structural Transformation: Economic Strategies in Late-Developing Countries*. Oxford University Press, New York.

- Lehutso-Phooko, and J. Naidoo. 2002. Income Inequality Prospects with HIV/AIDS – A Social Dimension. In *Labour Markets and Social Frontiers*, Number 2, October, pp. 11-16, South Africa Reserve Bank.
- Marenja, P., W. Oluoch-Kosura, F. Place, and C. Barrett. 2003. Education, Non-farm Income, and Farm Investment in Land-scare Western Kenya, BASIS Brief 14, Department of Agricultural Economics, University of Wisconsin, Madison.
- Matangadura, G. 2001. Women and AIDS in Southern Africa: The Case of Zimbabwe and Its Policy Implications. *Journal of Culture and African Women Studies* 1 (2).
- Mather, D., C. Donovan, T. S. Jayne, M. Weber, E. Mazhangara, L. Bailey, K. Yoo, T. Yamano, and E. Mghenyi. 2004. A Cross-Country Analysis of Household Responses to Adult Mortality in Rural Sub-Saharan Africa: Implications for HIV/AIDS Mitigation and Rural Development Policies. International Development Working Paper 82, Department of Agricultural Economics, Michigan State University, East Lansing.
- Mazhangara, E. 2003. The HIV Pandemic in Malawi: What Farmers Face and How They Cope With AIDS. Presentation, November 7, African Studies Center, Michigan State University, East Lansing, MI.
- Mellor, J. 1976. *The New Economics of Growth: A Strategy for India and the Developing World*, Cornell University Press, Ithaca.
- Menon, R., M. J. Wawer, J. K. Konde-Lule, N. K. Sewanlambo, and C. Li. 1998. The economic impact of adult mortality on households in Rakai district, Uganda. In Ainsworth, M., Fransen, L., Over, M. (Eds.) *Confronting AIDS: Evidence from the developing world*. European Commission, Brussels.
- Ministry of Health. 1999. HIV/AIDS in Zambia. Ministry of Health, Lusaka.
- Mushati, P., S. Gregson, M. Mlilo, J. Lewis, and C. Zvidzai. 2003. Adult Mortality and the Economic Sustainability of Households in Towns, Estates, and Villages in AIDS-affected Eastern Zimbabwe. Paper presented at the Scientific Meeting on Empirical Evidence for the Demographic and Socio-Economic Impact of AIDS, Durban, South Africa, 26-28 March 2003. University of Durban.
- Opiyo, P. 2001. HIV/AIDS, Gender and Livelihood in Siaya District, Kenya: An Analysis of AIDS Impact on Rural Households. MS. Thesis. Wageningen University.
- Reardon, T., E. Crawford, and V. Kelly. 1995. Promoting Farm Investment for Sustainable Intensification of Agriculture, International Development Paper 18, Department of Agricultural Economics, Michigan State University, East Lansing.
- Rugalema, G. 1999. HIV/AIDS and the Commercial Agricultural Sector of Kenya. Report. FAO/UNDP, Rome.
- Smale, M., and T. S. Jayne. 2003. Seeds of Success: Maize in Historical Retrospective. *Successes in African Agriculture: Building for the Future*. Steven Haggblade (ed). International Food Policy Research Institute, Washington, D.C.

- UNAIDS. 2002. Report on the Global HIV/AIDS Epidemic. UNAIDS, June 2002.
- United Nations. 2003. The Impact of HIV/AIDS on Mortality. Population Division, United Nations Secretariat, New York.
- US Census Bureau. 2002. The AIDS Pandemic in the 21st Century. Report for XIV International conference on AIDS, Barcelona, July 2002, International Program Center, U.S. Census Bureau.
- Villarreal, M. 2002. AIDS Among the Luo. Draft report, FAO, Rome.
- Way, P. 2003. The Future of Adult Mortality under the AIDS Threat: Estimating and Projecting Incidence; Projecting Mortality with HIV/AIDS. Population Division, Department of Economic and Social Affairs, United Nations Secretariat, NY.
- Yamano, T., and T. S. Jayne. 2004. Measuring the Impacts of Working Age Adult Mortality among Small-Scale Farm Households in Kenya. *World Development* 32(1), January.