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The impact of adult mortality and morbidity on agricultural productivity and rural livelihoods has long been recognized as an important issue in each of these countries and throughout Eastern and Southern Africa. These governments are committed to combating the causes and consequences of HIV/AIDS, in all sectors. This commitment has paved the way for national statistical agencies and Ministries of Agriculture to include morbidity and mortality information on national agricultural surveys, thereby enabling researchers to gain insights into how households respond to adult mortality and morbidity related to HIV/AIDS, and hopefully improve the design of interventions in rural sectors. The encouragement and intellectual guidance of many colleagues from Ministries of Health and Agriculture, local HIV/AIDS committees, as well as USAID country-level health and agriculture SO team members, has made an important contribution to our research. The authors also wish to acknowledge the time and information provided by the rural families who have participated in household surveys in each country, without which this research would not be possible. Their lives and their struggles to deal with this epidemic have motivated this work.

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EXECUTIVE SUMMARY

A CROSS-COUNTRY ANALYSIS OF HOUSEHOLD RESPONSES TO ADULT MORTALITY IN RURAL SUB-SAHARAN AFRICA: IMPLICATIONS FOR HIV/AIDS MITIGATION AND RURAL DEVELOPMENT POLICIES

A general assumption in some of the literature and in popular discussion is that AIDS-related mortality results in severe labor constraints and increased poverty rates and land scarcity among affected households. The subsequent implication of these assumptions is that HIV/AIDS mitigation policy should prioritize technology and assistance targeted to affected households: agricultural labor-saving technologies and food aid. Yet there is surprisingly little empirical research to date which can confirm whether this scenario is generally representative of affected households, and how behavior and welfare of affected households compare with that of the non-affected household population. Thus, it is not clear that these suggested mitigation policies are appropriate for a majority of affected households and more feasible or desirable relative to alternative investments. In particular, it is important to seek empirical information to establish the potential for effective food aid targeting in areas of high HIV incidence, while also minimizing negative overall rural income and productivity growth effects.

This paper summarizes and synthesizes across the results of a set of country studies on the effects of prime-age adult mortality on rural households in Kenya, Malawi, Mozambique, Rwanda, and Zambia. Each study is based on large representative rural household surveys. These findings have implications for the design of efforts to mitigate some of the most important effects of rural adult mortality, and for key development policies and priorities.

First, we demonstrate that using incidence of prime-age adult mortality due to illness in rural household survey data is a reasonable and cost-effective way to identify households that are most likely affected by HIV/AIDS-related mortality. Because of the strong contribution of AIDS deaths to total deaths in the prime-age range in these highly-infected countries, cases of adult mortality due to illness give a good indication of the effects of AIDS-related death. We likewise document rural adult mortality rates consistent with significant HIV/AIDS deaths in rural areas and population-based mortality rates form DHS, and the comparison of these findings to results estimated from sentinel site HIV prevalence data is internally consistent. Panel data in Kenya, Malawi, and Rwanda enable us to show that household dissolution rates across these particular surveys are relatively low, and thus lend credibility to the reliability of our estimates of the effects of prime-age mortality on household welfare.

Second, in contrast to the general assumption that HIV-related mortality is typically associated with household heads/spouses, the survey findings show that in four of the five countries researched here, a majority of deceased PA adults are not household heads/spouses, and thus not likely to be the primary breadwinners of the household. This suggests that the potential magnitude of rural PA mortality on rural household agricultural and off-farm incomes and orphaning rates may be less than those predicted by some of the literature. It also helps to explain the relatively low household dissolution rates found in the Kenya, Malawi, and Rwanda panel data sets.

When comparing the pre-death household position of deceased individuals with the household position of individuals in non-afflicted households, several noteworthy points emerge. In four of the five countries examined, the proportion of deceased females who were heads or spouses of heads in their households is lower than the proportion of female heads or

spouses in non-affected households. The emerging picture is one of younger female dependents being the primary casualty of prime-age adult mortality, not wives or female heads. The picture is more complicated among men. In Kenya, Malawi, and Rwanda, the proportion of deceased males who were heads or spouses in their households is higher than the proportion of male heads/spouses in non-affected households, while in Mozambique and Zambia, it is the reverse. While death of any kind undoubtedly brings hardship and suffering to affected households, it is important to note that the magnitude of the economic consequences appears to vary according to the extent to which the deceased tend to be primary breadwinners and core members of the household.

Third, in the case of Kenya, Malawi, and Rwanda, the rural HIV vectors associated with the infection of recently deceased rural adults (i.e. who were infected 5-10 years ago) do not appear to be associated with higher relative education, as has been found in previous research in Eastern Africa. The implication of these findings is that rural HIV prevention programs in these countries would require a range of media to reach both the illiterate and more educated rural population. In addition, these types of findings demonstrate that representative socioeconomic information on deceased and non-afflicted rural adults can be valuable in the design of HIV prevention programs.

Fourth, in contrast to the general assumption of labor scarcity among affected households, results of household composition analysis demonstrate that affected households do not uniformly appear to have less available PA labor than non-affected households, either because those affected are able to attract new PA members or because they had more PA adults prior to death. At the same time, the findings show that households with a head/spouse death have fewer *ex post* PA adults on average than households with a non-head/spouse death (and in most cases, households with a head/spouse death have fewer *ex post* PA adults than non-affected ones), with the exception of the Rwanda case. This demonstrates the heterogeneity of available *ex post* PA labor among affected households, and the importance of differentiating among affected household outcomes by characteristics of the deceased individual such as household position. In addition, the ex post dependency ratios of affected households vary considerably, and many affected households do not have higher ratios than those among non-affected households. However, higher mean dependency ratios are found in households with a head/spouse death, thus women in these households may well face increased demands on their time for domestic tasks and crop production.

Fifth, the results question the usefulness of a homogeneous conceptualization of “affected households,” especially in the context of proposals for targeted assistance, technology development, and other programs/policies. We find that in most cases, although affected households may well have suffered negative effects on household crop production and income, the average affected household has similar *ex post* land cultivated, total land area, cultivation rates, and total income. But perhaps most importantly, we find that the gender and household position of the deceased appear to strongly condition the effects on the household. For example, results of impact analysis in Kenya show that the death of a male household head is associated with larger negative impacts on household crop production, non-farm income, and asset levels than any other kind of adult death. In addition, the Kenya results demonstrate that initial asset levels also condition the effects of mortality on households, as the impact of adult mortality on household welfare is more severe for households in the bottom half of the distribution of household income per capita. Overall, these findings suggest that poorer households headed by HIV/AIDS widows are in especially precarious positions. Improved land tenure security for widows and the development of land

rental markets could enable such households to hold on to their land assets and to earn income from allowing others to make productive use of their land.

Sixth, the heterogeneity of both the *ex post* welfare indicators and the magnitude of the effects of adult mortality on household crop production and income have important policy implications. First, the finding that many affected households have similar household income and land/labor ratios in comparison with their non-affected neighbors suggests that it will be difficult to effectively target food aid, other assistance, or technologies to a homogeneously-defined group of "affected households." Yet certain sub-groups within the affected households may well have lower median incomes or land holdings after the death, as appears to be the case with households that have lost a male household head. It should be noted that this involves less than a third of cases in all the countries in this study. Given the importance of careful targeting to reach the "hardest-hit" households while minimizing negative overall rural income and productivity growth effects, the results suggest that further empirical and practical investigation is recommended on a country- and perhaps regionally-specific basis prior to targeting assistance. Another important consideration is the need for targeting to be undertaken in ways that avoid creating incentives for husbands to leave the area so that households can qualify as "female-headed" in order to obtain assistance.

Seventh, the evidence presented here is mixed as to how adult mortality is affecting cropping patterns. The *ex post* data on crop cultivation cannot speak to potential changes in crop cultivation across the country studies – namely, a shift among affected households towards roots and tubers and a shift away from higher-value crops. Yet the *ex post* results show that affected households do not tend to have more relative area cultivated to roots and tubers compared with non-affected households. However, analysis of mortality effects on cropping patterns in Kenya demonstrates that some shifts are occurring, although these shifts are strongly conditioned by the gender and household position of the deceased and the initial asset level of the affected household. In Rwanda, controlling for general cultivation shifts among the non-affected households due to changing relative prices, there was a significant increase in production of sweet potatoes among affected households, and a significant decrease in coffee production. These results suggest that some affected households are shifting to less remunerative crops due to either labor constraints or the inability to retain specific production/marketing knowledge of certain cash crops that is lost in the case of a male death. Addressing the gender bias in agricultural production and marketing knowledge and cash crop and non-farm opportunities could contribute significantly to improved income potential for many households.

Eighth, the lack of widespread effects on crop income among affected households as well as similar cultivation rates and area cultivated to roots and tubers relative to non-affected households questions the potential demand for many proposed labor-saving technologies (LSTs) for agriculture. These results suggest that for affected households as a group, the loss of family labor due to a death in the household may not necessarily mean that agricultural labor becomes the limiting input in agricultural production. The macro-level picture emerging from recent demographic population projections, which include the impact of AIDS-related deaths, demonstrates that although the epidemic will reduce life expectancy and population growth considerably in the hardest-hit countries, the epidemic will probably not result in a decline in the aggregate labor-to-available-land ratio. However, at the micro-level, the loss by some households of land, farm assets, and skilled labor be more significant than their loss of general agricultural labor and may result in greater income and asset inequality.

Ninth, available time-use data from Zambia suggests that the returns to investing in LSTs for domestic tasks such as food processing and water/fuel gathering is likely to be much higher than those for LSTs in agriculture given that more hours per household would likely be saved by the former, and that such technologies would also benefit many poor but non-affected households. Caution is therefore warranted before scarce agricultural research funds are inordinately diverted to labor saving crop and input technologies intended for HIV/AIDS-affected households. These results also suggest a need for an appropriate balance between investments in long term rural economic productivity growth and targeted assistance to AIDS affected households and communities. Emerging results from concurrent research drawing on the databases used in the present research will help inform questions of the extent of rural poverty and the kinds of programs needed to help stimulate broad-based rural economic productivity growth in the synthesis countries.

Tenth, in closing, it is important to highlight what we believe may be important, but have not been able to study. One important area of future research would be time use studies of adults and children, currently absent in almost all of the countries studied here. Such studies would provide information vital for the assessment of the potential costs and benefits of alternative labor-saving technologies. Another critical area for further research is the linkages between affected households and communities, as we will address in cooperating with RENEWAL on a study in Zambia on the interaction between households and communities affected by the HIV/AIDS epidemic. Social networks can be very important in times of stress, and there is a need to better understand how people rely on each other, and how HIV/AIDS may affect the ability of such social networks to function well and equitably. Targeting of assistance to affected households may help to support such networks, but it also may undermine them. Finally, emerging evidence suggests that the poorer strata of households in rural areas are increasingly likely to be victims and to suffer the most severe welfare losses resulting from adult mortality. If additional research confirms these patterns, there will be important HIV/AIDS mitigation as well as prevention implications that are inescapably tied to the need for greater emphasis and attention on agricultural and rural economic development policies to redress constraints to pro-poor and gender-sensitive economic growth. Likewise, research to develop more effective technologies and policies that can foster broad-based rural income growth will better enable communities as well as households to respond to those hardest-hit by the negative effects of AIDS-related adult mortality.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

A CROSS-COUNTRY ANALYSIS OF HOUSEHOLD RESPONSES TO ADULT MORTALITY IN RURAL SUB-SAHARAN AFRICA: IMPLICATIONS FOR HIV/AIDS MITIGATION AND RURAL DEVELOPMENT POLICIES[1]

by
David Mather, Cynthia Donovan, T.S. Jayne, Michael Weber, Antony Chapoto, Edward Mazhangara, Linda Bailey, Kyeongwon Yoo, Takashi Yamano and Elliot Mghenyi[2]

1. INTRODUCTION

Estimates of adult mortality in Sub-Saharan Africa have risen considerably since the onset of the HIV/AIDS epidemic, most notably in countries with higher HIV prevalence rates (Ngom and Clark, 2003). While there is general agreement that the epidemic will have serious effects on agriculture and rural development in Africa, HIV/AIDS mitigation and rural development policies are currently being proposed with little empirical information on which individuals and households living in rural areas are most affected, how they are affected, and how they are responding to the death of a prime-age adult.

1.1 Objective

The objective of this paper is to summarize and synthesize across the results of a set of studies on the effects of prime-age (PA) adult mortality on rural households in Kenya, Malawi, Mozambique, Rwanda, and Zambia. The Mozambique, Rwanda, and Zambia studies are based upon nationally-representative rural household survey data, while Kenya and Malawi studies utilize panel data. The synthesis evaluates the characteristics of affected (deceased) individuals and the *ex post* characteristics of affected households,[3] as well as the effects of PA adult mortality on household composition, area cultivated, crop income, off-farm income, and asset levels. The paper then discusses the implications of these findings for the design of efforts to mitigate some of the key effects of rural adult mortality and for key development policies and priorities.

1.2 Background

Absent the occasional political and/or journalistic debate, there is widespread scientific agreement as to the serious negative effects of the HIV/AIDS pandemic. The group

[1] Paper prepared for the International AIDS and Economics Network Pre-Conference, 9-10 July 2004, Bangkok, Thailand.

[2] Mather, Donovan, Jayne, Weber, Chapoto, Mazhangara, and Mghenyi are with the Department of Agricultural Economics, Michigan State University; Bailey and Yoo are with the Department of Economics, Michigan State University; Yamano is with the Foundation for Advanced Studies on International Development, Tokyo, Japan.

[3] Although others have referred to households incurring a death as "afflicted", we have noted that some households have objected to this label, hence we use the term "affected." Our use of the term 'non-affected household' is not meant to imply that households without a death are not potentially affected by a death in their extended family or the community, because the extended family and other community members may be affected when active adults fall ill and die. In addition, use of the term "affected households" in this paper refers only to cases of prime-age death due to illness and excludes cases of current illness, unless otherwise noted.

AfroBarometer has been innovative in marrying large scale and random public opinion survey data with epidemiological data about the HIV/AIDS epidemic in seven of the Southern African countries with the highest levels of HIV/AIDS to provide an independent corroboration of expected levels of AIDS illness and death across the region (Whiteside, et.al., 2003; AfroBarometer, 2004). This work generates some surprising findings in that notwithstanding high levels of AIDS-related death and common recognition of these problems by ordinary citizens, very few opinion poll respondents, when asked about their priorities for government intervention agendas, place HIV/AIDS ahead of options such as creating jobs, expanding the economy, and improving crime and security (Whiteside, et.al., 2003; AfroBarometer 2004).

But to respond effectively to a problem of this magnitude, it is necessary to understand details of the magnitude of and variations in effects of HIV/AIDS in order to develop effective ways of mitigating as well as preventing the pandemic. HIV/AIDS researchers and policy makers in Africa recognize a fundamental problem of "a lot of projection, but little data" (Babcock-Walters, 2004), and many different groups of researchers have been working to improve models, assumptions, and data, with special attention to improving the collection and use of data on HIV prevalence from antenatal centers in urban and rural areas.

A number of studies have modeled the impact of HIV/AIDS on economic growth (e.g., Bloom and Mahal, 1997; Cuddington and Hancock, 1995; Cuddington, 1993). These studies typically involve computable general equilibrium or neoclassical growth models in which most of the behavioral consequences are assumed rather than derived from micro-level empirical findings. Not surprisingly, available macro models differ substantially in their predicted effects on economic growth and development. For example, Cuddington (1993) estimates that an HIV prevalence of 10 percent implies a reduction in economic growth of less than 1 percent. By contrast, Sachs et al (2001) calculate that the 2.2 million AIDS-related deaths in 1999 cost Africa 35.1 percent of its gross national product. The wide variations between these predictions can be attributable to the paucity of quantitative micro-level information on how households respond to HIV/AIDS and the subsequent effects on agricultural production, non-farm income, and other key indicators of welfare.

Given the difficulty and cost of obtaining reliable estimates of AIDS-related mortality within households, particularly within Sub-Saharan Africa, it is perhaps not surprising that there are few empirical studies of the effects of HIV/AIDS on rural households. For example, some studies have used a combination of serological surveys to track the HIV status of sampled adults over time (Urassa *et al*, 2001) and/or "verbal autopsies" in which medical fieldworkers interview caregivers of the deceased to record information regarding signs and symptoms of the terminal illness, all of which helps to reduce the probability of incorrect diagnosis (Garenne *et al*, 2000; Urassa *et al*, 2001).

Due to the difficulties and costs of such approaches, the few available micro-level studies of the effects of HIV/AIDS on rural households have typically focused on geographic areas known to have high HIV prevalence, which are purposively chosen to ensure observation of ample numbers of directly-affected households. While providing valuable information on the effects of HIV/AIDS on rural households and communities, such studies are limited in their ability to extrapolate to understand national level impacts. Case study or rapid-appraisal methods carry the additional limitation that they often lack a representative non-affected population for comparison purposes (or for the construction of a counterfactual for measurement of impacts).

Some micro-level studies of household responses to a prime-age death in Sub-Saharan Africa report a multifaceted loss to a rural household's livelihood: the loss of on-farm labor, off-farm income from wage labor or own-business activities, technical knowledge of agricultural production and marketing, and access to land, to name a few. Because labor is one of the principal inputs in small-holder African agriculture, and because the majority of prime-age adults in rural areas in Sub-Saharan Africa are principally engaged in on-farm agricultural production, it is therefore assumed by much of the HIV/AIDS and agriculture literature that a prime-age adult death results in severe labor constraints for affected households. It is also often assumed that AIDS-related adult mortality results in increased poverty rates and land scarcity among affected households. There is little empirical research to date that can confirm whether or not this scenario is generally representative of affected households, how many affected households there may be, and how affected household behavior and outcomes compare with the non-affected household population. The design of effective mitigation interventions that involve targeting of assistance or technology depends vitally upon solid information on the characteristics of affected households and how they are responding to adult mortality. Furthermore, the absence of nationally-representative micro-level information on the effects of HIV/AIDS on rural households and communities remains a critical limitation for more reliable macro-level projections of these effects.

This paper reports on a complementary approach to the investigation of the effects of adult mortality on rural households that is based on including a mortality/morbidity component in a nationally-representative rural demographic and socio-economic household survey, as has been demonstrated in recent research (Donovan *et al.*, 2003; Yamano and Jayne, 2004; Mather *et al*., 2004; Mazhangara, *forthcoming*; Mazhangara, Swinton and Khaila *forthcoming*; Yoo, Jayne, and Chapoto, *forthcoming*).[4] A simplified verbal autopsy is used to define an "affected" household as one which has suffered a prime-age death due to any illness within a given recall period (for cross-sectional surveys) or in the period between surveys (in the case of a panel). While not all adult deaths due to illness can be attributed to AIDS in any given country or region, recent epidemiological studies demonstrate that in Eastern and Southern Africa, HIV is the leading cause of disease-related death among adults between 15 to 49 years of age (Ainsworth and Semali, 1998; UNAIDS/WHO, 1998; Ngom and Clark, 2003). Moreover, the increasing literature on the dynamics of poverty requires a better understanding of the effects of prime-age adult mortality, regardless of cause, on household behavior and welfare.

[4] Links to these papers are available at http://www.aec.msu.edu/agecon/fs2/adult_death/adultdeath.htm.

2. DATA AND CONCEPTUAL ISSUES

2.1 Introduction

The rural household survey data sets used in this study were generally obtained from collaborative surveys with national statistical agencies or ministries of agriculture, and cover smallholder farm households. The sampling criteria defined rural smallholders as households with rights to some amount of land, involved in crop production, and cropping less than some specified amount of land. In no cases are large-scale farmers included in the samples.

In general, the approach was to work with host-country partners to combine information across a number of different aspects of household welfare in one national survey – information that is typically collected in a separate survey and cannot be linked at the household level. For example, national Demographic and Heath Surveys (DHS) contain important information on household demographics, health, knowledge of HIV and sexual behavior (Gersovitz, 2005), but these surveys do not collect information on household assets, livestock and crop production, agricultural and off-farm incomes, and expenditure behavior. Likewise, national income and expenditure surveys have typically not contained detailed health and mortality information, and few surveys use the same DHS sample frame and households. As a result, most large scale data collection activities in Africa have not been able to provide a nationally-representative picture that links household and individual economic attributes with health and mortality status. Our approach has been to work with national statistical organizations and other local groups to include a demographic/health/ mortality component on national surveys primary oriented toward agricultural and income information, in order to examine empirically the impact of prime-age adult mortality on rural households' demographic composition, agricultural production, cropping patterns, asset levels, and incomes. Because of this eclectic approach to adding on to existing national surveys, the surveys differ in important respects across countries, reflecting the priorities and funding constraints in each country (Table 1).

2.2 Country Data Sets

Kenya: The Kenya data are derived from a two-year panel survey (1997 and 2000) by the Kenya Agricultural Monitoring and Policy Analysis Project, a joint undertaking by Tegemeo Institute/Egerton University and Michigan State University. The survey contains 1,422 households and is designed to be representative of 24 districts within the eight agriculturally-oriented provinces of the country. These districts were chosen to be representative of the major crop producing provinces of the country, but excluded pastoral areas. The household attrition rate between the two surveys was 5.2%.[5]

Malawi: The Malawi data are derived from a thirteen-year panel survey (1990 and 2002). The benchmark is the CIMMYT/Ministry of Agriculture Maize Variety Adoption Survey 1989/90, which was designed as a module attached to the Annual Survey of Agriculture

[5] The reasons for attrition in Kenya were: the household moved away (19 cases), dissolved (nine cases), were not home or unable to be interviewed (45 cases), and refused to participate (five cases).

Table 1. Selected Characteristics of Rural Household Survey Datasets from Kenya, Malawi, Mozambique, Rwanda, and Zambia

Country	Sample Size	Population Representation	Panel or Cross Sectional Data	Year(s) of Survey Implementation	Time Period of HH Mortality Information	Time Period of HH Morbidity Information	Other Aspects / Components
Kenya	N=1422 N=1266	Representative of rural small-holders in agriculturally-oriented provinces	Panel	1997, 2000, 2002	4 years (1997-2000); 6 years (1997-2002)	n.a.	n.a.
Malawi	N=420	Representative of maize growers in principal maize-growing regions	Panel	1990, 2002	13 years (1990-2002)	n.a.	Community-level focus group discussions regarding HIV/AIDS
Mozambique	N=4908	Nationally representative of rural small- and medium-holders	Cross Section[6]	2002	4-year recall (1999-2002)	1-year recall (2002)	qualitative HH strategy response; community-level survey of infrastructure, agriculture, etc.
Rwanda	N=1395	Nationally representative of rural small-holders	Cross Section [7]	2002 [7]	4-year recall (1999-2002)	1-year recall (2002)	qualitative HH strategy response; simplied verbal autopsy
Zambia	N=6922	Nationally representative of rural small-holders	Cross Section	2000	5-year recall (1996-2000)	1-year recall (2000)	n.a.

Notes: 6) In Mozambique, we have recall data on the deaths, departures, and arrivals of household members over the 1999-2002 period, thus we have a panel on household composition for the 1999-2002 period.
7) In Rwanda, while household demographic information was collected only in 2002, household crop area and production information was collected in 2000, 2001, and 2002 for the same households. Thus, we have panel data on crop area and production for the 2000-2002 period.

(SAS) conducted on a subset of households from the 1989-90 national sampling frame (Smale et al, 1991). A total of 420 households were selected using population-base multistage random sampling from three of the five principal maize-producing areas of Malawi: Blantrye, Kasungu, and Mzuzu Agricultural Development Divisions. The Malawi Agricultural Productivity and Adult Mortality Survey (MAPAMS) was superimposed in 2002 onto the benchmark sample. The household attrition rate between the two surveys was 14.3%, resulting in a panel of 360 households.

Mozambique: The Mozambique data are derived from a 2002 survey implemented by the Mozambican Ministry of Agriculture and Rural Development (MADER) in collaboration with the National Institute of Statistics (INE). This survey of rural households is known as the Trabalho do Inquerito Agricola (TIA) 2002. The sample of 4,908 rural households was drawn using a stratified, clustered sample design that is nationally representative. In addition, in each sampled village (UPA), a community survey collected information on local infrastructure, agricultural prices, and other aspects. Although TIA 2002 is a cross-sectional dataset, the recall data modules on household arrivals, departures, and deaths enables the imputation of household composition in 1999.

Rwanda: The Rwanda data are derived from four household surveys: 1) a basic production and land use survey implemented by the Rwandan Ministry of Agriculture, Natural Resources and Forestry (MINAGRI), Division of Agricultural Statistics (DSA), and the Food Security Research Project (FSRP) involving seasonal visits for three years (2000-2002); 2) an FSRP/DSA demographic survey in 2001; 3) an FSRP/DSA rural labor and death history survey; and 4) the Household Living Standards Survey implemented by the Ministry of Finance and Economic Planning (MINECOFIN). All four surveys used nationally representative samples for rural residents and the samples overlapped for 1395 rural households. Of the 1584 households initially interviewed in the FSRP/DSA Demographic survey in February 2001, enumerators were able to re-interview 1520 in the 2002 RLDS, a retention rate of 96%.[8]

Zambia: The Zambia results are drawn from the nationally representative 1999/00 Post Harvest Survey (PHS) conducted by the Central Statistical Office in conjunction with the Ministry of Agriculture and Cooperatives (MACO). We also draw from the Supplemental PHS Survey (SS), which surveyed this same set of roughly 7,500 households in Zambia's small- and medium-scale farming sector in May/June 2001. The SS covers the same reference period as the PHS, the 1999/00 crop and marketing year, but collects additional information on non-farm income, adult mortality information including retrospective questions on mortality in the household over the previous five years, and basic socio-economic information on all individuals listed in the 1999/00 PHS demographic roster. Because of missing information on some households, the valid sample was reduced to 6,922 households.

2.3 Common Issues and Objectives Across the Country Studies

While the survey instruments in each country differed to some extent, in general, each collected information from the households concerning their agricultural and livestock

[8] The reasons for attrition in Rwanda were: the household moved away (45 cases), dissolved due to death (six cases), had illness/disability reportedly unrelated to HIV/AIDS (three cases), and other reasons or no information given (ten cases).

production and sales, off-farm activities, land use, and income and livelihood sources and services. Each instrument also included demographic sections, which recorded socioeconomic characteristics of each current member of the household -- as well as a mortality section to record information regarding household members who had either died or departed. These demographic sections on household deaths and departures elicited information on the departed individual's gender, age group, and a basic cause of departure, such as: seeking employment, marriage/divorce, death, etc. For deceased individuals, a further question asked for a basic cause of death, including as options: accident, murder, childbirth, disease/illness, etc.

In the case of the panel surveys in Kenya and Malawi, enumerators revisiting households sampled in the initial survey asked for the whereabouts of the members included in the demographic roster of the initial survey, and recorded cases of death, departure, and new arrival of individual members. The surveys in Mozambique, Rwanda, and Zambia used recall information to document the incidents of death (over a recall period of 3-4 years, depending upon the country) and chronic illness (extended illness within the prior 12 months) within the household. In Mozambique, the instrument also elicited information on departures and new arrivals during the recall period, thus panel data on household composition (1999-2002) can be imputed using this information and current (2002) survey information on household composition.

An overriding objective of the papers which form the basis of the analysis for this present synthesis was to evaluate the effects of HIV/AIDS on rural households. It was not possible to know whether household deaths from illness or events of chronic illness were related or not to HIV/AIDS, without invasive medical procedures.[9] However, there is evidence that many of these deaths are HIV-related, as is discussed further in the following section. In the absence of medical testing or extensive verbal autopsies, this research restricts analysis to using only cases of prime-age (PA) adult death due to illness, where prime-age is defined as adults between the ages of 15 and 49 (the high end-point varied from age 49 to 59, depending upon the country). The term "prime-age" is used because these people are (were) in the most important years for labor activities as well as the most sexually active years during which contraction of HIV is most probable. In this paper, we refer to “affected” households as those households that are directly and immediately affected by death due to illness. Likewise, we refer to “affected” individuals as those who died from illness.

The survey instruments for Kenya, Mozambique, Rwanda, and Zambia can be viewed and downloaded at: http://www.aec.msu.edu/agecon/fs2/adult_death/adultdeath.htm. Other details concerning the data sets are found in the papers (Donovan *et al.*, 2003; Yamano and Jayne, 2004; Mather *et al.*, 2004; Mazhangara, *forthcoming*; Yoo, Jayne, and Chapoto, *forthcoming*).

[9] Similar surveys (Donovan *et al*. 2003, Doctor and Weinreb, 2003) have tried to separate AIDS deaths from other illness-related deaths by including questions regarding symptoms of illness prior to death (verbal autopsies). An example of a study using seroprevalence testing led by medical professionals is The Nelson Mandela Study in South Africa (Shisana et al. 2002).

3. RELATIONSHIP BETWEEN ADULT MORTALITY AND HIV/AIDS

In this section, we are going to show that (a) measuring prime-age adult mortality gives us a good indication of the effects of HIV/AIDS-related death because of the strong contribution of AIDS deaths to total deaths in the prime-age (PA) range, and (b) regardless of cause, it is important to understand the impacts of prime-age adult mortality. Table 2 documents the findings on rural PA adult mortality rates (from illness) estimated from each country study, as well as adult mortality rates from DHS, and recent HIV prevalence by country. Across the five countries, rural PA adult mortality rates range from 4.9 to 9.4 PA adult deaths/1000 person-years, while recent HIV prevalence ranges from 8.9 to 19.6%. Our prime-age adult mortality rates (due to illness) are similar to those reported by DHS (for all PA deaths) for similar recall time periods.[10] DHS adult mortality rates tend to be slightly higher, though this is not surprising as 3 of the 4 DHS country studies reported combined urban/rural adult mortality rates (ours our rural), and because DHS mortality rates include all PA deaths whereas ours only include PA deaths due to illness.

3.1 Relationship Between Adult Mortality and HIV Prevalence Across Countries

Given the current urgency of understanding the effects of AIDS, it is important to ask the extent to which illness-related deaths observed in these data sets are due to AIDS. To address this question, this section first presents evidence of the relationship between adult mortality and HIV/AIDS across Sub-Saharan Africa and in the synthesis countries.

New research suggests that much of the recent increase in adult mortality rates *across* Sub-Saharan Africa is attributable to HIV/AIDS (Ngom and Clark, 2003), as demonstrated in Figure 1.[11] If we graphed age-specific mortality rates as in Figure 1 for an African country without HIV/AIDS (or pre-AIDS), we would expect to see very high mortality rates for 0-4 year-old group, and a subsequent decline until age 15 or so. Individuals who survive to age 15 are then not very likely to die before age 60, thus the graph of mortality rates from age 15 to age 60 would slope upwards but generally be somewhat flat. However, Ngom and Clark (2003) compare countries with high versus low prevalence rates (Figure 1). Those countries with prevalence rates between 20% and 40% are the "high prevalence" countries including, among others, South Africa, Botswana, Namibia, Zimbabwe, and Zambia. The "low HIV prevalence" group contains countries such as Ghana, Mali, and the Gambia with HIV prevalence rates of 1% to 3%. The "low HIV prevalence" group's probability of dying is

[10] DHS adult mortality rates are based on recall information on the deaths' of the respondent mother's siblings over a specified period (between 0-10 years, depending on the country).

[11] The figure was constructed using data from the WHO World Population Prospects database as follows: thirty-five African countries were ranked by adult HIV prevalence and divided into five groups of seven countries each labeled as one of the following: "high" prevalence (20 to 40%), "high-medium" (8.9 to 15%), "medium" (6 to 8.3%), "low-medium" (3.4 to 5.8%), and "low" (1 to 3%). Next, the group-average of the male probability of dying (of any cause) was plotted by age grouping.

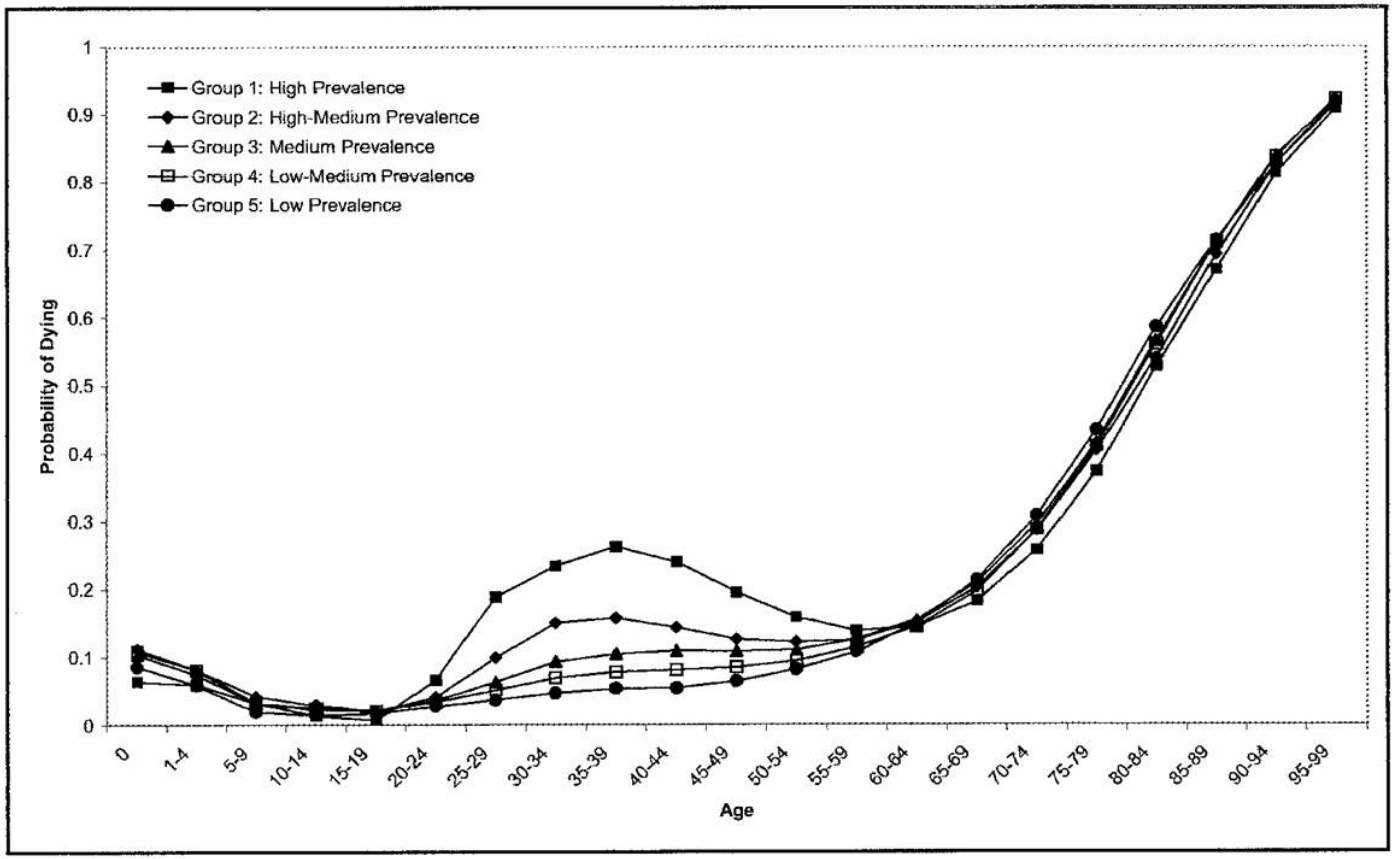
Table 2. Survey Findings on Prime-Age (15-49) Adult Mortality as Compared with Results from Demographic and Health Surveys (DHS) and Antenatal Clinic Surveys: Kenya, Malawi, Mozambique, Rwanda, and Zambia

			Rural households with PA death (due to illness)			DHS urban/rural PA adult mortality rate (all PA deaths)[2]		National adult HIV prevalence from antenatal sentinel site survey per country	
Country	No. of rural households in survey sample	No. of rural households in sample with at least one prime-age (PA) death	Survey reference time period (years)	Rural households with PA adult death (%)	Rural PA adult mortality rate[1] (Males - Females)	(Males - Females)	Year of DHS	(%)	Year of antenatal survey
Kenya	N = 1422	N = 83	4 years (1997-2000)	5.8	5.3 - 4.9	6.2 - 6.6	2003	13.5	2000
Malawi	N = 420	N = 72	13 years (1990-2002)	17.1	9.4	11.1 - 11.3	2000	15	2001
Mozambique	N = 4908	N = 202	4 years (1999-2002)	3.7	5.1 - 5.2	5.8 - 5.3	2003	13.6	2002
Rwanda	N = 1395	N = 96	4 years (1999-2002)	6.0	4.9	na	na	8.9	2001
Zambia	N = 6922	N = 574	5 years (1996-2000)	8.0	7.7	10.1 - 10.8[3]	2001	19.6	1999

Source: DHS mortality rates from DHS Kenya (2003), DHS Zambia (2001), Mozambique (2003), and Malawi (2000).
Notes: 1. Prime-age adult mortality rate = (PA adults/ 1000 person-years). 2.DHS adult mortality rates computed using sibling death histories from a recall period (Kenya 0-7 yrs; Malawi 0-6 yrs; Mozambique 0-10 yrs; Zambia 0-4 yrs). 3. DHS mortality rate for Zambia is rural.

Figure 1.

Median UN Projected Male Age-Specific Probability of Dying 2000-2005 by HIV Prevalence Group for 35 Countries in Africa with HIV Prevalence Estimates of 1.0 percentor Greater. (source: UN AIDS Wall Chart, accessed July, 2003, UN Population Prospects 2002 Revision, and the UNAIDS 'Barcelona Report' Report on the Global HIV/AIDS Epidemic, 2002)



perhaps representative of mortality rate behavior in the absence of HIV/AIDS – a "without-AIDS" scenario.

Ngom and Clarke (2003) then demonstrate that the probability that a 15-year old male dies before reaching the age of 60 (${}_{45}q_{15}$) is considerably higher for the high HIV prevalence country as compared with the low HIV prevalence country group. The difference in mortality among men age 15 to 60 in the high HIV prevalence group and that from the low HIV prevalence group is primarily explained by HIV rates. Ngom and Clarke (2003) provide additional evidence of the link between HIV prevalence and male adult mortality rates across countries by demonstrating that a simple log-linear regression between national HIV prevalence and ${}_{45}q_{15}$ for men explains up to 60 percent of the variation in HIV prevalence observed between countries. Prior to the arrival of HIV, countries such as South Africa and Botswana (currently in the high-prevalence HIV group) had some of the lowest adult mortality rates in Africa. In sum, this research suggests that there is a strong correlation between adult mortality rates and HIV prevalence across Sub-Saharan African countries. It is possible that some of the increase in adult mortality across Sub-Saharan Africa is due to recent increases in various opportunistic diseases, such as tuberculosis, which are more likely to occur when adults have a compromised immune system. Those diseases can confound any simple diagnosis as to cause of illness or death, and are important killers in the absence of HIV/AIDS. However, while it is true that deaths from malaria may be higher in some countries than others, malaria is primarily fatal to infants and very young children, not prime-age adults (WHO/UNICEF, 2003).[12] Recent evidence suggests that adults who are HIV positive may be subject to more severe and more life-threatening attacks of malaria (Grimwade *et al.*, 2004), but that link is still to be fully established.

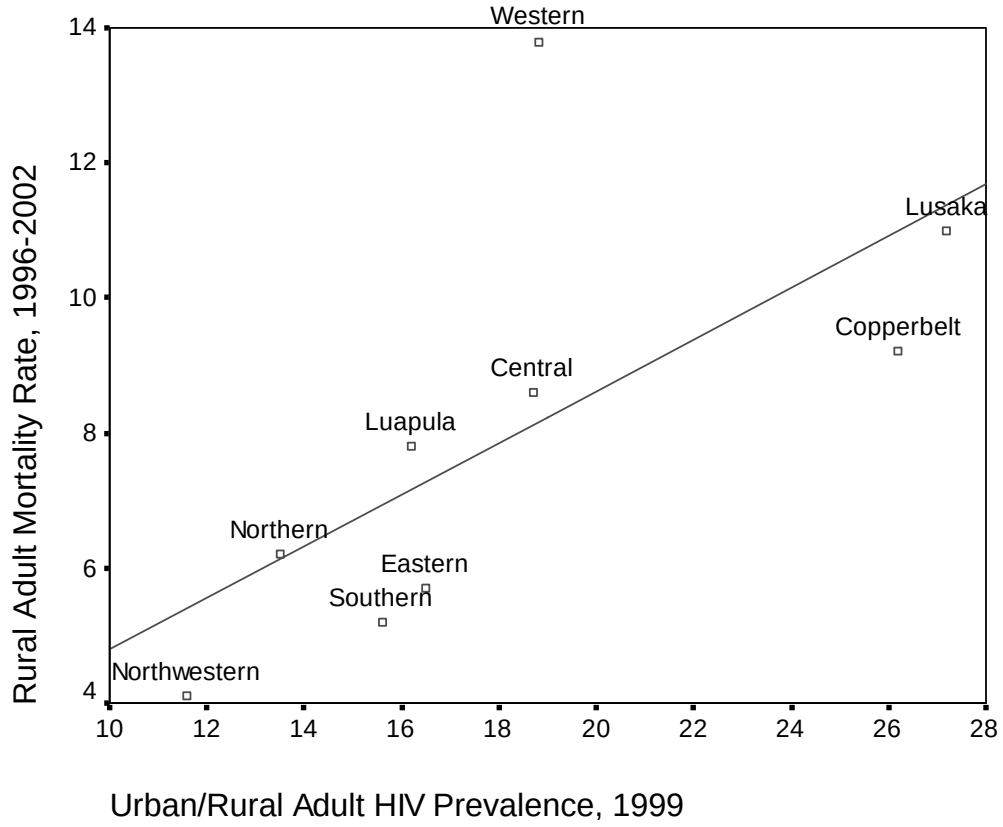
The catastrophic death toll that is projected to occur over time in these countries has led many analysts to conclude that the disease will cause acute labor shortages in the "high HIV prevalence" countries of Sub-Saharan Africa, thus requiring adjustments in crop technologies and farming systems to less labor-intensive production techniques. Undoubtedly, the human and social costs are indeed monumental. However, it is important to take account of the momentum of underlying population growth rates when projecting the trend in future population. Demographic projections of the US Census Bureau (2003), as discussed in Jayne et al. (2004), indicate that while AIDS is projected to erode population growth to roughly zero in the seven hardest-hit countries of Africa, the net result is a roughly stable number of working age adults over time. For example, in 2000, there were roughly 17.5 million men in the 20-59 year age range in Botswana, Lesotho, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe. The Census Bureau (2003) estimates that this number will climb marginally to 18.6 million by 2025 (compared to 32.1 million in the absence of the disease). There was roughly 17.7 million women in the 20-59 year age range in these seven countries in 2000, and this number is expected to be only 17.8 million in 2025 (compared with 32.6 million in the "no-AIDS scenario). While these figures suggest a monumental human catastrophe, they do not indicate any major decline in labor-to-available-land ratios. As indicated later in this report, it is possible that the greatest impact of AIDS on the factors of farm production may be in the stock of capital assets and in the knowledge base which enables households to earn cash income to purchase cash inputs, which may present very different implications for the priorities of agricultural research and extension systems among "high HIV prevalence" countries (Jayne et al. 2004).

[12] The report notes that 90% of malaria deaths are among children under five.

3.2 Rural Adult Mortality Rates and HIV Prevalence Within Countries

We next investigate the correlation between rural adult mortality rates from household survey data and antenatal HIV prevalence data *within* the study countries included in this synthesis and *across* provinces within these countries.[13] If there is a strong relationship between PA adult death and HIV/AIDS, we would logically expect that provinces with higher adult HIV prevalence (combined urban/rural prevalence) would also have higher rural adult mortality rates due to illness. A strong relationship is demonstrated by a scatterplot of provincial adult HIV prevalence and rural adult mortality in Zambia (Figure 2). For the countries in the

Figure 2. Correlation between Provincial Adult Mortality Rates from CSO 1996-2000 Household Survey Data and 1999 HIV+ Prevalence Rates, Zambia



Notes: Pearson correlation coefficient is 0.659.
Sources: Adult mortality rates derived from five year retrospective information as obtained from the 2001 Supplemental Survey to the 1999/00 Post Harvest Survey (see section 2.2 for details). HIV+ prevalence rates are from 1999 Sentinel Surveillance Site information published by the Ministry of Health.

[13] National estimates of HIV prevalence in sub-Saharan Africa are almost exclusively based upon surveys of antenatal clinics, the majority of which are located in urban areas. For example, the most recent HIV prevalence estimates from Mozambique are based upon surveys in 2003 of 36 pre-natal clinics located in urban and rural areas of all ten provinces (3-4 clinics per province, at least one of which is rural). Although this represents better coverage than previous samples (which included 20 clinics, few of which were in rural areas), Mozambique does not yet report HIV prevalence disaggregated by urban/rural area. However, as noted earlier, an increasing number of African countries (at least 6) have national population-based HIV seroprevalence data (from DHS and other sources), which is undoubtedly more accurate than demographic projections from antenatal clinic data.

study, Pearson correlations between provincial adult HIV prevalence and rural adult mortality range from 36% to 67% (Table 3).[14] However, the relatively low correlation found in Rwanda (32%) exceeds 50% when excluding the province with the highest urban HIV prevalence rates (where the rural rate may likely be considerably lower). These correlations demonstrate that country-level differences in provincial rural adult mortality rates are associated with differences in provincial adult HIV prevalence. The strength of these correlations are notable, especially considering that the provincial HIV prevalence rate is not disaggregated by urban/rural classification (except in the case of Rwanda), and suggest that survey data on rural adult mortality due to illness is at least partially tracking HIV-related death.

Table 3. Correlation Between Provincial Urban-Rural Prime-Age Adult HIV Prevalence and Rural Prime-Age Adult Mortality Rates, by Country

Country	Year of Urban/Rural PA Adult HIV Prevalence, by Province	Time Period of Rural PA Adult Mortality Rate, by Province	Pearson Correlation Coefficient and (p-value)
Kenya	2000	1997-2000	0.80
Mozambique	2001	1999-2002	0.54 (0.11)
Rwanda	2002	1998-2002	0.32 (0.34)
Zambia	1999	1996-2000	0.66 (0.05)

Similar evidence of correlation between rural adult mortality and HIV prevalence is seen in Kenya. When regional lagged HIV/AIDS prevalence rates are included in probit regressions of households experiencing a death over the panel survey period, the models all showed a highly significant correlation between lagged HIV/AIDS prevalence rates and household PA mortality (Yamano and Jayne, 2003).

In addition to the current contention regarding the likely household, community, and macro-level effects of HIV/AIDS, there is similar debate concerning HIV prevalence estimates themselves. These estimates are based upon antenatal clinic data, which continue to be the most readily available source of data for modeling the HIV epidemic in most countries. These data are used by epidemiological models to project current and future prevalence for the general population (by gender and age group). However, the antenatal clinic data are subject to various selection biases related to convenience sampling (sites may not always be randomly chosen), location of antenatal clinics (most are in urban areas), lower fertility rates among women with HIV infection (Gray et al, 1998), and other socio-demographic factors (e.g. age distribution of those attending antenatal clinics, level of education, socioeconomic status) (Rehle and Shisana, 2003). Moreover, there are insufficient data on the relative importance of these factors in different regions and countries, not to mention that such factors may vary over time.

[14] Given the typical time-lag of 5-10 years between HIV infection and AIDS-related death (a figure cited from developed country research), we ideally want to compare rural adult mortality around the year 2000 (our household survey data) to HIV prevalence in 1995. However, many of our survey countries only included rural antenatal clinics in their sample frame after 2000.

Comparisons between seroprevalence data from antenatal clinic surveys as compared with data from population-based surveys have indicated that data from pregnant women may differ significantly from the general female population data (Kigadye et al, 1993; Fontanet et al, 1998; Fylkesnes et al, 1998; Rehle and Shisana, 2003). The variation in the findings suggests that extrapolations from antenatal clinic data should be made with caution (Rehle and Shisana, 2003). In addition, differences among the modeling tools used by epidemiologists often result in varied estimates of current and projected HIV prevalence (*ibid*, 2003). Yet given the limitations of antenatal HIV prevalence data as briefly discussed here, they remain the most comprehensive information on HIV prevalence in nearly every Sub-Saharan African country.

However, there will likely be an increasing number of population-based seroprevalence surveys as DHS has begun to include voluntary HIV seroprevalence testing for a sub-sample of the DHS nationwide survey, in some countries (eg. DHS Kenya 2003, DHS Zambia 2001). However, so far, DHS has only linked some (limited) socioeconomic information to HIV status in Kenya, and nowhere have they yet linked HIV status and HIV knowledge and (declared) sexual behavior.

3.3 Actual and Predicted Illness-Related Deaths in Kenya

Another method of assessing the relationship between survey data on rural mortality and HIV/AIDS involves a comparison between observed mortality rates from household survey data ("with-AIDS" scenario) and the mortality rates of an HIV-negative adult population ("without-AIDS" scenario). Yamano and Jayne (2004) demonstrate such an approach, as commonly used in the epidemiology literature (eg. Boerma et al, 2002). They compare observed adult mortality rates in Kenya with HIV-negative mortality rates from a serological survey of Kisesa district in neighboring Tanzania. They found that the number of actual deaths for men age 35-44 in Kenya was almost double that of the rates predicted using the HIV-negative population from Tanzania. Among women in the 25-34 age group, actual deaths were four times higher than those predicted. These results suggest that, while epidemiological information on the cause of illness-related death among individuals in their sample is unavailable, AIDS accounts for a large proportion of the recorded deaths for the prime-age category. Similar comparisons are not done here for the other countries in our synthesis due to the lack of seroprevalence studies in the countries.

3.4 Attributes of Deceased and HIV Positive Adults

A fourth method of assessing the relationship between rural adult mortality rates from recall household survey data and HIV prevalence data is to compare the age and sex distribution of adults who are HIV positive with those who have died from illness. Antenatal clinic data in the synthesis countries (representative of years corresponding to that of the household survey recall periods) show that HIV prevalence among females rises quickly and then decreases with age. Thus, HIV positive adult females are predominantly in the 14-25 or 26-35 age group. The household survey data from the countries studied show that deceased females are also predominantly within the same (younger) age groups within the prime-age range (Table 4). This further suggests a logical consistency between rural adult mortality rates from household survey data and HIV prevalence data, even considering the 5-10 year expected lag between contraction of HIV and AIDS-related mortality.

Because seroprevalence testing of males is not included in the antenatal clinic data, male HIV prevalence is derived from epidemiological and demographic assumptions of the age and HIV prevalence of males in the population relative to that of the females tested at the antenatal clinic sites. The assumptions of these model projections are that HIV prevalence by age-group rises more slowly in men than in women, thus peak prevalence in men occurs at an older age. The nationally-representative seroprevalence survey, the 2002 Nelson Mandela HIV study in South Africa (Shisana et al, 2003), offers support for these assumptions regarding the differences in HIV prevalence between female and male adults. The household survey data from our countries of study seem to concur with this assumption, as deceased men are predominantly within older age group categories of the prime-age range, and the average age of the deceased is higher for men than women (Table 4).

Table 4. Characteristics of Deceased and Non-Afflicted Individuals: Kenya, Mozambique, Rwanda, and Zambia

	Kenya (2000)				Malawi (2002)				Mozambique (2002)				Rwanda (2002)				Zambia (2000)			
	Non-Afflicted Individuals		Deceased Individuals		Non-Afflicted Individuals		Deceased Individuals		Non-Afflicted Individuals		Deceased Individuals		Non-Afflicted Individuals		Deceased Individuals		Non-Afflicted Individuals		Deceased Individuals	
Characteristic	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Relationship to HH head (%)																				
Head/Spouse	24	34	59	27	38	55	54	54	60	69	40	13	47	53	56	44	49	61	22	16
Other	76	67	41	73	62	45	46	46	40	31	60	87	53	47	44	56	51	39	78	84
Education (years) [1]	8.2	7.4	7.0	5.8	7.3	5.8	3.6	2.8	*not available*				71%	76%	80%	78%	*not available*			
Age (at death)	28.5	28.6	41.7	35.2	29.5	32.6	37.0	35.0	*not available*				28	29	40	35	31.6	31.1	33.5	30.8
Age group (%)																				
15-24	49.9	50.7	15.4	25.0	53.7	40.8	36.4	27.3	*40.7*	*41.7*	*21.0*	*31.0*	53.7	50.2	20.7	22.1	42.3	40.4	20.0	20.1
25-34	27.0	23.6	17.9	37.5	16.1	18.5	27.3	36.4	*59.3*	*58.3*	*79.0*	*69.0*	19.8	22.1	15.4	29.3	28.7	28.9	26.6	38.9
35-44	12.6	14.2	41.1	20.0	17.4	22.3	9.1	18.2	*100.0*	*100.0*	*100.0*	*100.0*	15.7	17.0	29.3	29.2	18.0	17.8	35.7	28.1
45-54	10.5	11.5	25.6	17.5	12.8	18.5	27.3	18.2	*** age groups for Mozambique*				10.8	10.7	34.6	19.3	11.1	12.8	17.7	13.0
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	*are 15-24 and 25-49*				100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Per capita Household income quartile (%)	*Ex ante (1997) quartiles*				*District ex ante (1990) quartiles*				*Ex post (2002) quartiles*				*Ex post (2002) quartiles*				*Ex post (2000) quartiles*			
Lowest	15.8	18.1	50.0	34.1	23.6	25.5	33.7	20.1	25.5	27.3	30.7	23.4	24.1	26.9	26.5	42.0	23.9	25.7	24.3	26.5
Mid-low	26.5	27.9	19.6	14.6	22.4	23.9	31.1	49.1	24.7	24.6	30.5	30.2	25.5	25.5	22.6	21.0	24.4	24.9	23.6	22.6
Mid-high	26.8	26.9	15.2	34.1	26.4	25.9	18.0	16.5	24.5	23.9	23.5	24.8	24.9	23.9	31.8	29.6	25.3	25.2	23.9	26.9
Highest	30.9	27.1	15.2	17.2	27.6	24.7	17.3	14.4	25.3	24.2	15.3	21.6	25.5	23.7	19.1	7.4	26.4	24.2	28.3	24.1
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cases:	3,772	3,779	46	41	472	501	35	39	5,477	6,579	105	112	1,865	2,358	36	37	9615	10213	373	477

Notes: 1. Education figures for Rwanda are: % of individuals who never attended school or did not complete primary school1990 income/cap quartiles, district

4. CHARACTERISTICS OF DECEASED INDIVIDUALS

4.1 Household Status of Deceased Household Members

Literature and popular discussion on AIDS in rural Africa typically associates HIV/AIDS-related mortality with household heads and their spouses. By contrast, the survey results from the five countries show that only in Malawi are a majority (53%) of deaths among heads/spouses (Table 5), though a considerable portion of deaths are still of non-heads/ spouses. In Rwanda, nearly one-half (49%) of deceased and non-affected adults are heads/ spouses, and in Kenya, a little less than half (44%) of deceased adults are heads/spouses while only about one-third of non-affected adults are heads/spouses. Mozambique and Zambia have the lowest percentage of head/spouse deaths (27% and 16%), while a much larger proportion of non-affected adults (65% and 54%) are heads/spouses. These results challenge the perception that it is mostly heads and/or spouses who die of HIV/AIDS, and clearly demonstrate the importance of the insights provided by the counterfactual situation.

Table 5. Gender and Household Position of Deceased and Non-Afflicted Prime-Age Adults, by Country

		All Adults		Male Adults		Female Adults	
Country	Household Position	Non-Afflicted	Deceased due to illness	Non-Afflicted	Deceased due to illness	Non-Afflicted	Deceased due to illness
		---- column % ----		---- column % ----		---- column % ----	
Kenya	Head/Spouse	29	44	24	59	34	27
	Other	71	56	76	41	67	73
		100	100	100	100	100	100
Malawi	Head/Spouse	47	54	38	55	54	54
	Other	53	46	62	45	46	46
		100	100	100	100	100	100
Mozambique	Head/Spouse	65	27	60	40	69	13
	Other	35	73	40	60	31	87
		100	100	100	100	100	100
Rwanda	Head/Spouse	51	49	47	56	53	44
	Other	49	51	53	44	47	56
		100	100	100	100	100	100
Zambia	Head/Spouse	69	46	62	49	76	44
	Other	31	54	39	51	24	56
		100	100	100	100	100	100

Source: Authors' estimates; Chapoto and Jayne (2005) for Zambia.

When comparing the pre-death household position of deceased individuals with the household position of individuals in non-afflicted households, several noteworthy points emerge. In four of the five countries examined, the proportion of deceased females who were heads or spouses of heads in their households is lower than the proportion of female heads or spouses in non-affected households. The emerging picture is one of younger female dependents being the primary casualty of prime-age adult mortality, not wives or female heads. The picture is more complicated among men. In Kenya, Malawi, and Rwanda, the proportion of deceased males who were heads or spouses in their households is higher than the proportion of male heads/spouses in non-affected households, while in Mozambique and

Zambia, it is the reverse. It is very important to explore the implications of these findings, and for future studies to carefully test for these patterns.

The few available empirical studies on the impacts of prime-age adult mortality on agricultural production and incomes indicate that the effects are more severe on households that are relatively poor prior to death (Drimie, 2002; Knodel et al., 2002; Yamano and Jayne, 2004). In addition, Yamano and Jayne (2004) found that the gender and household position of deceased prime-age adults had a significant effect in conditioning the impact of adult mortality on household composition, cropping, crop income, and assets. The implication of these results is that failure to recognize the heterogeneity of mortality effects tends to implicitly assume that the effects of death are similar across households, which neglects the possibility that some adult deaths are much more severe in their effects on the household than others.

Assuming that a similar relationship exists in the other countries studied here (as discussed later in this paper) between the magnitude of effects and the gender and household position of the deceased, we might expect the relatively low proportion of head/spouse deaths in countries such as Mozambique and Zambia could lessen the potential magnitude of the effects of prime-age mortality on household welfare in these countries, and perhaps result in a lower overall orphaning rate than expected.[15]

4.2 Income, Education, and Mobility of Deceased Household Members

Another important use of empirical information on the socioeconomic characteristics of individuals who die from illness is that it can serve as a key component to the design and targeting of HIV prevention programs. National Demographic and Health Surveys (DHS) have been periodically implemented in many African countries to investigate maternal and child health and fertility. In recent years, components which investigate respondents' knowledge of HIV and their sexual behavior have been added to DHS survey instruments. While this information can be analyzed by socioeconomic aspects of the respondent (mothers'/fathers') – such as gender, age, relationship to household head, education level, rural/urban residence, and region/province – such information is not collected for most deceased members, and information on chronic illness is only collected for infants. Thus, DHS surveys do not enable investigation of links between HIV knowledge, sexual behavior, socioeconomic characteristics of the respondent and his/her household, and morbidity and mortality (or HIV status, for that matter). The Nelson Mandela Study (Shisana and Simbayi, 2002) in South Africa is the only research to date in Africa that investigates links between socioeconomic characteristics, HIV knowledge and media access, sexual behavior, and HIV status using nationally representative sampling and seroprevalence testing. However, their approach is difficult and likely cost-prohibitive for most countries.

Given the cost and difficulty of large nationwide surveys and/or seroprevalence testing, it is perhaps not surprising that most existing studies of the socioeconomic correlates of HIV-related adult mortality in Africa have focused on regions known for high HIV prevalence. A review of such studies (Ainsworth and Semali, 1998) generally found a positive correlation between such socioeconomic characteristics as education, income/wealth, or occupation and "HIV-related" death among adults age 15-49 in various Sub-Saharan African countries. The

[15] In the cases of deaths of a "non-head/spouse", we do not know in most cases whether or not the adult left behind orphaned children. However, it is certainly more likely that a head/spouse death would create orphans than that of a younger, non-head/spouse member of the family.

general explanation for these findings has been that individuals with higher incomes are more likely to have effective demand for multiple partners. In addition, wealthier individuals are also more likely to be mobile and thus have more opportunities for casual sexual contacts.

However, over time, HIV prevalence is thought to increase among those with relatively less income and education as those with higher education are more likely to gain access to information on how HIV is spread and may be more able to act on this information. For example, DHS and WHO/GPA data show that in virtually every country studied, those with more education are more likely to use a condom in casual and commercial sex (Filmer, 1998). Recent research also demonstrates that relative economic disadvantage is found to significantly increase the likelihood of a variety of unsafe sexual behaviors and experiences in KwaZulu-Natal Province, South Africa (Hallman, 2004). In addition, it should be noted that if mobility is indeed an important factor in HIV infection, it is likely that vectors of mobility could be different across and within countries – not just over time – as is implied by the existing literature. For example, men in southern Mozambique who migrate to South Africa for mine work are likely mobile not because of wealth but due to a lack of it.

Our findings show that deceased prime-age men in rural Kenya tended to come from households that were relatively poorer than non-affected households, prior to death. As seen in Table 4, 69% of deceased men came from households within the lowest two quartiles of *ex ante* income per capita quartiles (Table 4). A similar pattern for both deceased prime-age men and women is found in rural Malawi, as 64% of deceased men and 69% of deceased women came from households within the lowest two district-specific quartiles of *ex ante* income per capita. While these results strongly suggest evidence of an association between low *ex ante* household income and illness-related PA death (for males in Kenya and for both males and females in Malawi), such a hypothesis is better investigated using a multivariate regression framework to better control for potential income differences or shocks across villages. Nevertheless, these results suggest either that HIV vectors in rural areas of these countries are different than those in the areas sampled in earlier studies, or that the vectors have changed over time, as discussed above.

The mean education of deceased adults in Kenya is slightly lower than the non-affected population average, and in Rwanda, and is considerably lower in Malawi (Table 4). In Rwanda, deceased male adults are somewhat likelier to not have finished primary school (Donovan et al, 2003) as compared to non-afflicted males (Table 4). In the case of these three countries, the rural HIV vectors associated with the infection of recently deceased rural adults (i.e. who were infected 5-10 years ago) do not appear to be associated with higher relative education, as has been found in previous research in Eastern Africa. Unfortunately, the cross-sectional nature of the survey data from Mozambique, Rwanda, and Zambia does not enable a measure of household income prior to death, nor did all of the surveys elicit information for deceased individuals on socioeconomic factors often associated with HIV/AIDS, such as education and occupation.

The implication of these findings is that rural HIV prevention programs in these countries would require a range of media to reach both the illiterate and more educated rural population. In addition, these types of findings demonstrate that representative socioeconomic information on deceased and non-afflicted rural adults can be valuable in the design of HIV prevention programs.

5. METHODS AND ISSUES IN MEASURING THE EFFECTS OF MORTALITY ON HOUSEHOLD OUTCOMES

5.1 Background

Before presenting additional findings from the country studies, we should clarify the inferences made possible by various types of data available and the methodologies used across the countries. We first discuss the importance of distinguishing between *ex ante* and *ex post* household observations, and the different kinds of inferences that they allow. We then briefly outline the different methods used in the country studies to measure the effects of adult mortality on household outcomes, such as household composition, agricultural production and productivity, and cropping systems.

5.2 Counterfactual Framework

To measure the effects of adult mortality on household outcomes, we use the counterfactual framework approach from the program evaluation literature in which each household has an outcome, either with or without treatment (y_1 or y_0). The 'treatment' group contains households experiencing at least one PA death during a given time period, and the control group comprises households not experiencing a PA death during the time period. Ideally, we want to compare the outcomes of the treatment group (those which have suffered a PA death) with their counterfactual outcome – what would have happened in the absence of PA death. Since we cannot observe each household in both treated and untreated states, i.e. with and without a PA death, we use information from the control group (the non-affected households) as a proxy for the outcome of the affected households had they not had a PA death. The challenge for quantitative impact evaluation centers around how well outcomes of the control group (non-affected households) serve in constructing the counterfactual for the treatment group (affected households). Sample selection bias is the main statistical problem which may confound the counterfactual.

While the samples in the country studies were selected at random, prime-age death in the household (the 'treatment') is not random, as the risks of contracting HIV/AIDS and other diseases may be correlated with income, wealth, education, mobility, and geographic location of the affected individual/household. For example, households living along main transport routes are more likely to be exposed to HIV. If HIV/AIDS is related to household characteristics and not distributed randomly among the household population, then it is likely that treatment and control groups have different average observable and unobservable characteristics. Failure to control for such differences in household characteristics between treatment and control groups can lead to biased estimates of the impact of PA death on household outcomes. In the following sub-sections, we discuss how these differences may confound comparisons between affected and non-affected household outcomes, and the methods we use to control for such biases.

Another potential source of selection bias in our estimates is household dissolution due to a PA death (de Waal, 2004). For example, consider the 2002 Mozambique survey which elicited recall information on household deaths from 1999-2002. If a household within a village selected by the sampling procedure suffered a PA death and subsequently dissolved prior to 2002, then that household could not be selected. Thus, information on PA mortality and its effects for that household would be unobserved, which would result in a downward bias on sample estimates of mortality rates and (possibly) on estimates of the effects of

mortality. As de Waal notes (2004), a cross-sectional survey contains no information on levels of household dissolution resulting from adult mortality.

However, panel data do contain information on attrition between the two surveys of the panel, and the reasons why households could not be re-interviewed. The results from the panel surveys in Kenya, Malawi, and Rwanda show that while household dissolution does occur as a result of adult mortality, the rate of dissolution due to mortality is not as high as that found in some of the literature (Urassa et al, 2001).[16] Of the households that could not be re-interviewed for the second survey in Kenya (5.6% over a four-year period), only 11% had dissolved. In this case, we have no way of knowing if mortality rates among these dissolved households (or other households who fell out of the sample by attrition) are higher or lower than among our sample households. If the mortality rate in these dissolved households is higher than the rate among sampled households, then the sample data will tend to underestimate actual mortality rates.

Of the households that could not be re-interviewed in Malawi (14.3% over a 13-year period), only 8 out of these 60 households (13%) had dissolved due to a death in the household, and 3 out of 60 (5%) had suffered a death in the household and had moved. Thus, 18% of non-repeating households had suffered a death during the 13-year time period as compared with 17% of households in the panel (Table 2). Of the households that could not be re-interviewed in Rwanda (4% over a 3-year period), only 8 out of these 64 households (12.5%) had a death and/or dissolved due to a death in the household. This percentage of households with a death (12.5%) is higher than that found among households in the sample (6%). The relatively low household attrition rates due to adult mortality in these three country studies suggest that bias due to death-related household dissolution is not likely to be large.

5.3 Comparison of *Ex Post* Household Outcomes

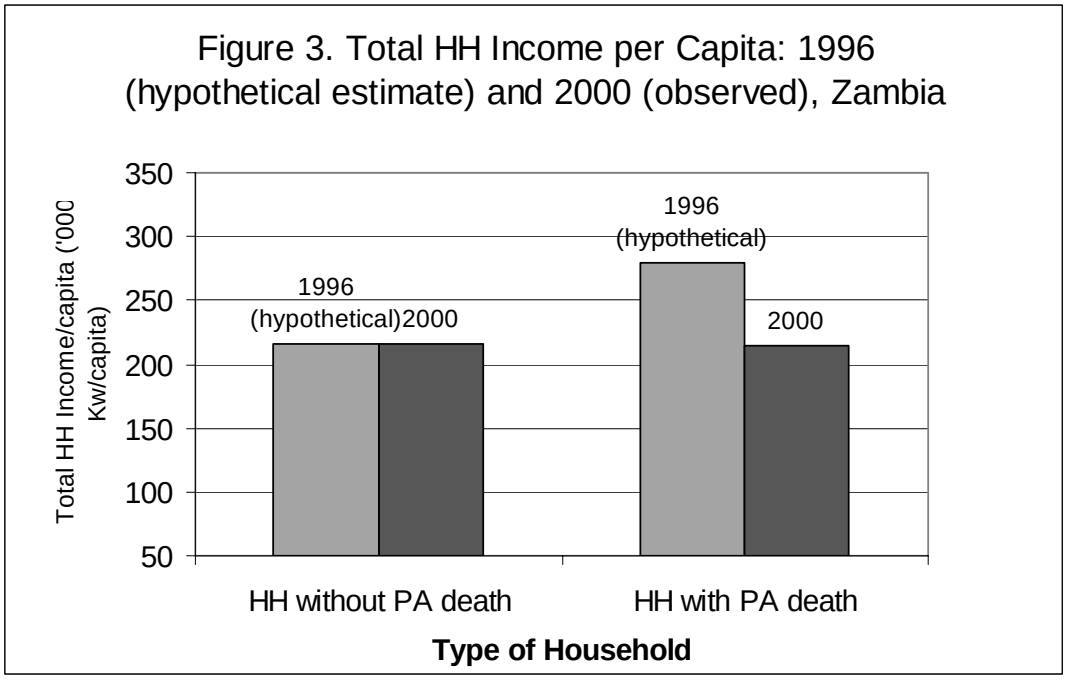
As described in an earlier section, the datasets in the countries studied contain panel and cross-sectional data. For the purpose of estimating the effects of PA mortality on household outcomes, a basic distinction between these types of data is that panel data contain measures of household outcomes (for both affected and non-affected households) both before (*ex ante*) and after (*ex post*) the household experiences a PA death, whereas, by contrast, cross-sectional data only contain measures of household outcomes after the PA death (*ex post*). An implication of this distinction for measurement of the impact of PA death on household outcomes is that comparisons of *ex post* outcomes of affected vs. non-affected households can lead to incorrect inferences of the impact of PA death (Figure 3).

Using survey data results from Zambia, Figure 3 shows that the *ex post* (2000) mean household income per capita for affected and non-affected households is nearly identical. Therefore, if we were to assume the non-affected household mean income per capita in 2000 to be an appropriate counterfactual for affected households (i.e. the income those households would have earned in the absence of PA death), then we would conclude that adult mortality had no effect on household income. However, we do not have data on *ex ante* (1996) household income of the two groups. By contrast, if we were to assume that *ex ante* (1996)

[16] This study from Kisesa, Tanzania found that after the death of a male household head, 42.5% of households had dissolved (remaining members dispersed, or in the case of one-person households, the household no longer existed (Urassa et al, 2001). However, this dissolution rate is perhaps not representative of rural Tanzania considering that this peri-urban sample contained a high percentage of one-person households not typical of rural Tanzania.

mean household income per capita of affected households was higher than that of non-affected households in 1996, then we would conclude that affected households had substantially lower mean income than they did prior to the PA death. Therefore, given that we do not know the relative income levels of affected and non-affected households in 1996, it would be incorrect to use a comparison of household income data from 2000 for affected and non-affected households to make any inference concerning the effect of PA death on household income per capita.

However, comparisons of *ex post* household outcomes may still be very useful in investigating welfare indicators of affected and non-affected households *after* any initial (short-term) negative effects have hit the affected households. The *ex post* outcome comparisons are also valuable when evaluating possible targeting mechanisms. In the example given by Figure 3, what we *can* say using only *ex post* household outcomes is that the average post-death household income per capita (in 2000) of affected households is not lower than that of non-affected households.[17] In the following sections, we distinguish between 'comparison of *ex post* household outcomes between affected and non-affected households' and the 'effects of PA death on affected household outcomes.'



[17] In this paper, we calculate mean *ex post* household outcomes of non-affected households using only households from villages in which a death has occurred during the survey reference time period. This helps to reduce the influence of potential differences in observable characteristics across different areas of each country.

In addition, we calculate the mean and median *ex post* household outcomes of non-affected households using only households from villages in which a death has occurred during the survey reference time period. This helps to reduce the influence of differences in observable characteristics between affected and non-affected households across different areas of each country.

5.4 Construction of the Counterfactual Scenario

5.4.1 Difference-in-differences

The measurement of the effects of PA death on household outcomes therefore requires an estimation of affected households' counterfactual outcomes. Because panel data contain both *ex ante* and *ex post* observations of household outcomes, it enables the use of such methods as fixed effect regression and difference-in-differences analysis. The Kenya study by Yamano and Jayne (2004) uses difference-in-differences (DID) analysis, which controls for differences in unobserved household characteristics between the affected and non-affected groups, and average trends among the non-affected household population. In addition, they regress DID estimates against village dummy variables in order to control for area-specific time-variant effects that might be correlated both with PA death and the household outcome. This method is used for all of the Kenya effects analysis and for the analysis of panel data on household composition in Mozambique.

5.4.2 Propensity Score Matching

The training program evaluation literature has developed econometric methods which enable analysts to use cross-sectional data to construct counterfactual scenarios for the treatment group. These methods include the instrumental variables estimator, the 'Heckman' two-step estimator, and, more recently, propensity score matching methods, as recently introduced to the development literature (Jalan and Ravallion, 2003a; Jalan and Ravallion, 2003b).

Rosenbaum and Rubin (1983) provide a theoretical framework for the use of a single score variable to assist in the evaluation of the effects of treatment, based on comparison between the treatment and control groups. A probit regression is used to estimate the propensity score using a set of observable *ex ante* individual, household and community-level characteristics. Treated (affected household) cases are then matched to control cases with similar propensity scores, and effects of treatment on the treated are then computed by comparing the outcome of interest of each treated case with the mean from a group of control cases with the most similar observable characteristics. While the general use of this method does not control for potential differences in unobservable characteristics, recent experimental research suggests that selection bias from unobservables is often a relatively small part of total bias in estimates of treatment effects, compared with that which may come from difference in observable characteristics (Heckman et al, 1997). Nevertheless, the Rwanda analysis of effects uses propensity score matching on difference-in-differenced outcomes, thus controlling for any difference in unobservable characteristics (Donovan and Bailey, 2005).

5.5 Caveats

Several caveats need to be noted prior to proceeding to describe the results of *ex post* comparisons of affected and non-affected households and the econometric impact analyses in Kenya and Rwanda. First, with the exception of Malawi, the selected *ex post* characteristics of affected households (and estimated impacts) are essentially short-run given that the PA

death occurred one to four years prior to the observation. For example, the longer-term household income of households which suffered a head/spouse death could be worse (in a few years) than the income observed in our surveys (0-4 years post-death), especially in the event that the surviving widow/widower is HIV positive. Second, our household-level analysis does not capture potential community-level impacts of AIDS-related mortality, as noted by Drinkwater (2003). For example, households without a death could potentially be affected by a death in their extended family or the community. Third, further research is warranted to investigate if the 'non-head/spouse' PA deceased adults had recently moved back to their rural (observed) home, leaving affected urban households, for which mortality effects on their urban household are unobserved in our rural sample.

A final caveat is related to panel data. Ideally, in a panel study, the *ex ante* measurements are taken before HIV/AIDS has begun to affect the household. Since a person can have the disease for years before showing symptoms and then may be ill off and on for several years before death, it is difficult to ensure that the *ex ante* measurement of household outcomes (e.g., area cultivated) precedes any adjustments that the household may begin to make during the illness period. All of these reasons suggest that we must be as careful as possible to try not to underestimate the effects of HIV/AIDS on rural households.

6. HOUSEHOLD COMPOSITION

6.1 Introduction

Because the death of a PA adult reduces the affected household's labor supply and increases its dependency ratio, we would expect that households affected by PA death would respond by trying to replace adult labor and possibly sending away dependents. The qualitative and case study 'household coping' literature finds that some affected households respond to the loss of family labor by attempting to replace the lost labor through such means as increasing the labor hours of remaining family members, increasing available family labor by pulling children out of school, hiring additional labor, and mutual labor-sharing arrangements with other households. Qualitative data on household responses to adult mortality from our studies in Rwanda and Mozambique also showed that some affected households employed many of the "labor replacement" strategies cited above. However, there are other potential responses which surviving members may pursue to adjust its household composition in response to the PA death, such as attracting new PA adults or sending children to other households.

Yet, some of the theoretical literature on the effects of adult mortality proceeds to list the effects on agricultural activities that result from the loss of labor and/or wages formerly provided by the deceased PA adult without consideration for the potential for demographic responses by the household to adjust to this loss (Gillespie, 1989; Topouzis and du Guerny, 1999; du Guerny, 2002; Harvey, 2004). Results from the few empirical studies of the effects of adult mortality on household composition suggest varied responses. For example, Ainsworth and Semali (1995) found that rural households in Kagera, Tanzania were able to maintain their household sizes and dependency ratios even after suffering a prime-age death. However, studies in Chiang Mai in Thailand and Rakai in Uganda found that household size declined by about one person following a prime-age death, suggesting that on average, affected households in these areas were unable to attract new members (Janjaroen, 1998; Menon, Wawer, Konde-Lule, Sewanlambo, and Li, 1998).

Given the importance of family labor to rural household agricultural production, we proceed to examine the findings from our country studies on the effects of mortality on household composition. We first investigate post-death (*ex post*) observations of household composition across the five countries studied, comparing affected with non-affected households. Then, we use information from countries with panel data on household composition to examine the dynamics of household composition; the mobility of PA adults in and out of households and changes in household composition between the pre- and post-death surveys for both affected and non-affected households.

6.2 Prime-Age Labor

With the exception of Mozambique, we find that the average affected household has as many, if not more, PA adults *ex post* than non-affected households (Table 6). Using *ex post* number of PA adults as an indicator of available household labor, these results suggests that the average affected household does not have less available PA adult labor (within the household) than non-affected households, and questions the popular assumption that the typical affected household faces more severe labor constraints in agriculture than non-affected households.

Table 6. Ex ante and Ex post Demographic Characteristics of Rural Households With and Without PA Adult Death, By Country

Household Characteristic	Non-Affected HHs[1]	HH with PA Death	HH with Head / Spouse Death	HH with Other Death	HH with Male Death	HH with Female Death
	---------- mean value ----------					
Kenya (1997 - ex ante)						
Household Size (persons)	6.5	6.7	6.8	6.7	6.6	7.0
No. of Prime-Age Adults (persons)	--	--	--	--	--	--
Dependency Ratio	--	--	--	--	--	--
Kenya (2000 - ex post)						
Household Size (persons)	6.5	6.3	5.6	6.9	6.3	6.3
No. of Prime-Age Adults (persons)	3.4	3.3	2.8	3.6	3.3	3.2
Dependency Ratio	1.36	1.54	1.63	1.48	1.52	1.57
Malawi (1990 - ex ante)						
Household Size (persons)	5.0	5.7	5.1	6.6	5.7	5.8
No. of Prime-Age Adults (persons)	2.3	2.8	2.7	2.9	2.9	2.8
Dependency Ratio	1.28	1.22	1.10	1.40	1.17	1.20
Malawi (2002 - ex post)						
Household Size (persons)	5.5	5.2	4.5	6.2	4.9	5.6
No. of Prime-Age Adults (persons)	2.7	2.7	2.5	3.0	2.7	2.7
Dependency Ratio	1.16	1.04	0.91	1.25	0.94	1.25
Mozambique (1998 - ex ante)						
Household Size (persons)	4.7	5.6	4.9	5.9	5.3	6.1
No. of Prime-Age Adults (persons)	2.2	2.8	2.4	3.0	2.9	2.9
Effective Dependency Ratio[2]	1.28	1.21	1.04	1.24	0.97	1.40
Mozambique (2002 - ex post)						
Household Size (persons)	5.2	4.8	4.3	5.0	4.6	5.1
No. of Prime-Age Adults (persons)	2.3	2.0	1.6	2.1	1.9	2.1
Effective Dependency Ratio[2]	1.46	1.71	1.90	1.67	1.61	1.79
Rwanda (2002 - ex post)						
Household Size (persons)	4.9	5.2	5.5	4.8	5.4	5.0
No. of Prime-Age Adults (persons)	2.5	2.6	2.8	2.5	2.7	2.5
Effective Dependency Ratio[2]	1.2		1.5	1.1	1.5	1.1
Zambia (2000 - ex post)						
Household Size (persons)	5.7	6.5	5.3	6.7	6.4	6.5
No. of Prime-Age Adults (persons)	2.6	2.9	2.3	3.1	2.9	3.0
Effective Dependency Ratio[2]	1.47	1.62	1.90	1.50	1.67	1.57

Notes: 1. only includes households from villages with a death; 2. effective dependency ratio = (children + ill PA adults + elderly) / (healthy PA adults).

At the same time, there are important differences in the means of *ex post* PA adults among affected household sub-groups. In all cases except for that of Rwanda, households with a head/spouse death have fewer *ex post* PA adults than households with a non-head/spouse death (and in most cases, households with a head/spouse death have fewer *ex post* PA adults than non-affected households). This demonstrates the heterogeneity of ex post outcomes among affected households, and the importance of differentiating among affected household outcomes by characteristics of the deceased individual such as household position.

There are several potential explanations for the finding that the average affected household has as many PA adults ex post compared with non-affected households. First, for the countries for which we have *ex ante* data on household composition (Kenya, Malawi, and Mozambique), affected households have on average more PA adults and a larger household size prior to death (*ex ante*) relative to non-affected households. Therefore, losing a PA adult does not necessarily mean that affected households have fewer PA adults than non-affected households *ex post*, even if no new PA members arrive. Second, some affected households are able to attract new PA members, as explained below in more detail.

Affected households appear to be larger than non-affected households prior to death because the affected households tend to be "older" or further along a household life-cycle than non-affected households.[18] For example, in Mozambique, the heads/spouses in affected households (or those remaining in the event of a head/spouse death) tend to be older than heads/spouses of non-affected households. This is also internally consistent with our earlier finding that in four out of the five synthesis countries, a majority of the deceased PA individuals were not heads or spouses, which likely means that they were adult children. It follows that households with adult children are likely to be further along the typical household life-cycle than households with young children.

Another potential reason why affected households are larger ex ante than non-affected households could be that urban adults fall ill and return to their rural homes. However, in the case of Mozambique, where we do have relevant data, only 5% of "currently ill adults in 2002" have joined or re-joined the household since 1999.

6.3 Changes in Household Composition: Household Member Arrivals and Departures

Household size is typically somewhat dynamic as families and members progress through normal lifecycles, thus unanticipated death shocks, while severe for households, must be understood in the context of these dynamics. For example, 16% of Mozambican households experienced the departure of a PA adult (not including death) between 1999 and 2002, and many of these households reported making adjustments to their agricultural activities in response to the departure.

In addition to these typical dynamics in household composition, households suffering a PA death may respond by adjusting household composition through the arrival or departure of individuals, as found in some empirical studies. Our findings using panel recall data from Mozambique and Rwanda show that households with a PA female death are at least twice as likely as non-affected households to attract a new PA female to the household *ex post*.[19] By contrast, households with a PA male death are no more likely than a non-affected household to attract a new PA male. On departures of PA adults, in these two countries, remaining PA

[18] Another explanation for why affected households tend to be larger ex ante than non-affected households involves potential correlations between household size, income, and adult mortality. However, as described later in this paper, affected households have roughly the same ex ante income as non-affected households.

[19] These results are not meant to suggest that the newly arrived adult can fully replace the labor and knowledge embodied in the deceased adult – simply that some affected households do at least partially replace their lost labor.

males and females in affected households were less likely to leave than those in non-affected households.
The analysis in Kenya and Mozambique went further to investigate the effect of not only gender but also the household position of the deceased on changes in household composition. In Kenya, the death of a male head/spouse led to a -1.1 change in the number of men in the household, indicating that there was no replacement of PA men on average. A similar result was found for a female head/spouse death with respect to PA women in the household. However, there was evidence of partial replacement of females following the death of a non-head/spouse female (and similarly for males, though with a lower replacement rate). In Mozambique, we did not find significant effects on household composition related to household position of the deceased.

Another potential response to adult death could be to send children to other households in order to reduce the household's consumption demands. Yet, in Kenya, Mozambique and Rwanda, affected households were no more likely than non-affected households to send young children (age 0-4) away from the household.[20] The same result held for Mozambique and Rwanda for older children (age 5-14). However, in Kenya, households with a death of a female head/spouse had a significant decline in girls age 5-14, while households with the death of a non-head/spouse female saw a significant increase in the number of older boys (age 5-14).

6.4 Dependency Ratios

Dependency ratios are often used as a simple indicator of the how many people must be provided for by each prime-age adult in the household.[21] A dependency ratio of 2.5 indicates that each adult must support 2.5 dependents in terms of their needs, both consumption and care. With high dependency rates, PA adult members in households with ill adults and very young children will have to allocate their time between care and their other household chores or productive activities, thus reducing time available for those activities. Unless deceased PA adults are replaced by new PA adults, or children and/or elderly leave the household, the death of a PA male or female results in an increase in the household's dependency ratio (number of children and elderly and ill PA adults / number of PA adults).

In Kenya, Mozambique, Rwanda, and Zambia, the *ex post* dependency ratios of affected households are on average higher than those of the non-affected households, though perhaps not by as much as expected (Table 6). In Malawi, dependency ratios were the same for affected and non-affected households, though this result may not be surprising given the 13-year time period during which deaths and subsequent adjustments occurred.
There are several reasons why the difference between dependency ratios of affected and non-affected households is not as great as perhaps expected.

First, some affected households bring in new PA members, which would restore the dependency ratio. Secondly, in Mozambique, dependency ratios among affected households were lower *ex ante* than among non-affected households, because affected households tend to have more adults prior to death, yet about the same number of children as non-affected

[20] These results are not meant to suggest that children who lose a parent but remain in the household are able to avoid

[21] For countries with information on ill PA adults, we compute effective dependency ratios which place ill adults as dependents (in the numerator) rather than as a PA adult (in the denominator) (de Waal 2003).

households. In addition, it appears that female adult mortality in Mozambique is associated with lower fertility rates (fertility rates tend to decline among HIV-positive women), as households with a PA female death have on average a zero growth rate among the 0 to 4 age group during the 1999-2002 period, as compared with a positive growth rate (0.15) among non-affected households. A third explanation could be that if affected households are in general further along in the household lifecycle, they may already be at or near the end of child-bearing years. While another explanation could be that affected households are sending children away, our results show that children are not more likely to leave affected than non-affected households.

When we differentiate among the affected households by the household position of the deceased, it is clear that households with a head/spouse death have higher *ex post* dependency ratios than households with a non-head/spouse death (with the exception of Malawi and Zambia). The mean *ex post* dependency ratios of households with non-head/spouse deaths are in most cases the very similar to those of non-affected households.

There are several implications of these results. First, the dependency ratios of affected households vary considerably, and many affected households do not have higher ratios than those among non-affected households. However, higher mean dependency ratios are found in households with a head/spouse death, thus women in these households may well face increased demands on their time by domestic tasks and crop production.

6.5 Summary of Household Composition Findings

Although some literature and popular discussion suggests that, in general, affected households face severe agricultural labor constraints, our large-sample study findings suggest that such constraints are not likely as severe as predicted, at least for many affected households. There are various reasons to explain this important general finding. First, if affected households are on average larger than non-affected households prior to a PA death, their post-death labor availability may therefore still be comparable to that of non-affected households. Second, some affected households are able to attract new PA members. These results demonstrate the heterogeneity of both *ex ante* household labor endowments and *ex post* responses to PA death, which in turn questions the general assumption that affected households in general have fewer labor resources than non-affected households.

At the same time, the more disaggregated results from Kenya demonstrate the sensitivity of effects of adult mortality on household composition to the gender and household position of the deceased as well as the region of the country. In Kenya, the death of a male or female household head leads to significant reductions in household size and number of PA adults, while the deaths of other members do not lead to significant reductions, due to the higher likelihood of new arrivals in that case. This suggests that, in Kenya, households which suffer the death of a household head or spouse are more likely to face labor constraints than households which lose a non-head or spouse member. These results demonstrate the importance of accounting for the gender and household position of the deceased when trying to identify the effects of prime-age mortality on rural households.

7. LAND USE

7.1 Background on Land Issues

An emerging popular conceptualization on the responses of rural households in Africa to adult mortality argues that the most common household responses to prime-age death concerning agriculture include the following (Topouzis and du Guerny 1999; Topouzis 2000; Harvey, 2004):

- Reduction in area cultivated;
- Shifting area into less labor-intensive (lower-value) 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.
- Negative effects of adult mortality on agricultural production, as well as losses in off-farm or self-employment income from the deceased, will force many affected households into poverty

This conceptualization is based largely upon logic of how households respond to PA adult mortality. Some organizations conclude that the subsequent implication of this conceptualization is that HIV/AIDS mitigation policy should prioritize technology and assistance targeted to affected households: food aid and agricultural labor-saving technologies. Yet, some researchers question the extent to which the hypothetical responses and effects listed above are generalizeable to the variable economic and social conditions in Sub-Saharan Africa. Thus, it is not clear that these suggested mitigation policies are appropriate for a majority (or even a minority) of affected households, and whether these policies are feasible or desirable relative to alternative investments.

For example, Barnett et al. (1995) conclude from case study research in Uganda, Tanzania, and Zambia, that the effects of adult mortality on rural livelihoods may vary considerably across and within countries given numerous factors such as the extent of HIV infection, labor requirements of the predominant cropping system, population density, and the size of the local labor market. More recent work from Dorward (2003) uses a non-linear programming model and a household typology in Malawi to predict input and output responses to various shocks, such as price, drought, and adult illness. They find that responses to adult illness such as reduced area cultivated and outcomes such as lower yields vary considerably by characteristics of the household, such as percentage loss in household labor, income and asset levels.

Another recent study (Beegle 2003) used panel data from Kagera, Tanzania, and found that although some farm activities were temporarily scaled back after a male death and wage income fell, affected households did not shift towards subsistence crops. Putting these findings in context, Beegle (2003) also notes that the areas of highest AIDS-related mortality in Tanzania (such as Kagera) are in the Lake Victoria basin, an area with high population density and, thus, a large labor supply and relatively high labor/land ratios.

It is also often assumed by some theoretical literature on the effects of HIV/AIDS on rural households that the negative effects of adult mortality on agricultural production, as well as losses in off-farm or self-employment income from the deceased, will force many affected

households into poverty. Yet some of the few available empirical studies on the impacts of prime-age adult mortality on agricultural production and incomes indicates that the effects tend to be more severe on households that were relatively poor to begin with (Drimie, 2002). In addition, among affected households, poorer households are less likely to receive financial assistance from social networks – as well as less total assistance when received – as compared to less-poor households (Lundberg et al, 2000).

We therefore hypothesize that the effects of adult mortality on rural households are heterogeneous, and that the magnitude and significance of the effects will be largely conditioned by the gender and household position of the deceased individual as well as the household's initial (pre-death) endowments. This heterogeneity has implications for the appropriateness of attempts to target interventions to mitigate the effects of adult mortality. Specifically, the following sections summarize results from our country studies that address the *ex post* land and income characteristics of affected and non-affected households, as well as the effects of PA adult mortality on land use and income.

7.2 Total land area

The availability of land for cultivation is one of the key aspects thought to change with an adult death, particularly with male deaths. Widows and children may lose their land rights, resulting in less total land. While we do not have any data on initial levels of total land owned in the panel sets from Kenya and Malawi, we can evaluate total access to land in Mozambique, Rwanda and Zambia. *Ex post* measures of total land show that affected households in Mozambique and Rwanda have slightly lower total land ex post, while affected households in Zambia have higher median total area than non-affected households. In Rwanda, a few households indicated that selling land was one of the strategies that they pursued and that losing access to land was one of the effects of losing a household member (Donovan et al. 2003), but these cannot be measured with the current datasets.

7.3 Area Cultivated

If affected households face agricultural labor constraints in general, then we might expect total land cultivated of affected households to be lower than those of their non-affected neighbors. Our findings are that, with the exception of Zambia, *ex post* median area cultivated is somewhat lower among affected households as compared with non-affected households (Tables 7-9). Yet, *ex post* area cultivated per capita is similar to that of non-affected households in Malawi, Mozambique, Rwanda, and Zambia. For the countries with data on total area owned (Mozambique, Rwanda, and Zambia), *ex post* cultivation rates (% of total area which is cultivated) among affected households are nearly the same as those of affected households (Table 9). These results suggest that land/labor ratios of many affected households are similar to those of non-affected households, which perhaps is not that surprising given many affected households have similar household size and numbers of PA adults as compared with non-affected households, as described earlier.

Comparison of *ex post* land/labor ratios across different types of affected households shows no general pattern across the countries (Tables 7-9). However, results from impact analysis in Kenya demonstrate that the effects of PA death on total land cultivated are sensitive to the gender and household position of the deceased (Yamano and Jayne, 2004). They found larger (but insignificant) mean reductions in total area cultivated following the deaths of male or female heads as compared with those of non-head/spouse members.

Table 7. Ex ante and Ex post Characteristics of Rural Households With and Without PA Adult Death: Kenya

Household Characteristic		Kenya (1997 - ex ante) Non-Affected HHs[1]	HH with PA Death[2]	HH with Head/Sp Death	HH with Other Death	Kenya (2000 - ex post) Non-Affected HHs[1]	HH with PA Death[2]	HH with Head/Sp Death	HH with Other Death
		---- median value ----				---- median value ----			
Total Land Area (acres)		--	--	--	--	--	--	--	--
Cultivated Land Area (acres)		2.75	3.00	3.00	3.00	3.28	3.00	3.12	3.00
% of Total Land Area cultivated (%)		--	--	--	--	--	--	--	--
Total Land Area/capita (ac/capita)		--	--	--	--	--	--	--	--
Cultivated Land Area/capita (ac/capita)		0.50	0.50	0.41	0.50	0.56	0.51	0.54	0.50
		-- % of HH in each quartile --				-- % of HH in each quartile --			
Provincial quartiles of per capita HH cultivated area	Lowest	24.4	20.5	22.9	18.8	24.4	33.7	37.1	31.3
	Mid-low	25.8	27.7	31.4	25.0	25.5	18.1	11.4	22.9
	Mid-high	24.6	27.7	28.6	27.1	24.6	24.1	25.7	22.9
	Highest	25.2	24.1	17.1	29.2	25.5	24.1	25.7	22.9
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of Households in analysis		702	83	35	48	702	83	35	48

Notes: 1. only includes households from villages with a death during 1990-2002; 2. deaths over period from 1997-2000

Table 8. Ex ante and Ex post Characteristics of Rural Households With and Without PA Adult Death: Malawi

Household Characteristic		Malawi (1990 - ex ante) Non-Affected HHs[1]	HH with PA Death[2]	HH with Head/Sp Death	HH with Other Death	Malawi (2002 - ex post) Non-Affected HHs[1]	HH with PA Death[2]	HH with Head/Sp Death	HH with Other Death
		---- median value ----				---- median value ----			
Total Land Area (ha)		--	--	--	--	--	--	--	--
Cultivated Land Area (ha) [4]		1.09	0.96	1.01	1.05	0.94	0.92	0.76	1.36
% of Total Land Area cultivated (%)		--	--	--	--	--	--	--	--
Total Land Area/capita (Ha/capita)		--	--	--	--	--	--	--	--
Cultivated Land Area/capita (ha/capita)		0.24	0.19	0.21	0.18	0.20	0.21	0.19	0.26
		-- % of HH in each quartile --				-- % of HH in each quartile --			
District quartiles of per capita HH cultivated area	Lowest	23.6	33.7	28.0	41.9	25.7	25.9	30.0	19.9
	Mid-low	25.5	25.4	22.6	29.4	25.8	23.9	30.9	13.6
	Mid-high	25.9	24.0	26.8	19.9	25.5	26.9	16.1	43.0
	Highest	25.1	16.9	22.5	8.8	23.0	23.2	23.0	23.6
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of Households in analysis		288	72	45	27	288	72	45	27

Notes: 1. only includes households from villages with a death during 1990-2002; 2. deaths over period from 1990-2002

Table 9. Ex post Characteristics of Rural Households With and Without PA Adult Death: Mozambique, Rwanda, and Zambia

Household Characteristic		Mozambique (2002 - ex post)				Rwanda (2002 - ex post)				Zambia (2000 - ex post)			
		Non-Affected HHs[1]	HH with PA Death[2]	HH with Head / Spouse Death	HH with Other Death	Non-Affected HHs[1]	HH with PA Death[2]	HH with Head / Spouse Death	HH with Other Death	Non-Affected HHs[1]	HH with PA Death[2]	HH with Head / Spouse Death	HH with Other Death
		---- median value ----				---- median value ----				---- median value ----			
Total Land Area (ha)		1.31	1.10	1.25	0.99	0.57	0.52	0.54	0.52	1.75	2.03	1.75	2.03
Cultivated Land Area (ha)		1.10	0.88	0.94	0.81	0.46	0.46	0.46	0.48	1.01	1.06	1.20	1.06
% of Total Land Area cultivated (%)		87%	85%	83%	85%	81%	81%	81%	79%	62%	60%	65%	59%
% of cultivated area in roots/tubers (%)[3]		19%	22%	36%	18%	42%	40%	48%	37%	54%	50%	47%	50%
Area in roots/tubers (ha)		0.20	0.20	0.23	0.17	0.19	0.17	0.18	0.14	0.50	0.50	0.50	0.50
Area/capita in roots/tubers (ha/capita)		0.043	0.042	0.059	0.037	0.044	0.037	0.037	0.039	0.108	0.083	0.087	0.083
Total Land Area/capita (Ha/capita)		0.27	0.25	0.27	0.24	0.127	0.127	0.103	0.144	0.35	0.34	0.38	0.35
Cultivated Land Area/capita (ha/capita)		0.23	0.20	0.22	0.19	0.105	0.097	0.087	0.102	0.20	0.20	0.21	0.20
		-- % of HH in each quartile --				-- % of HH in each quartile --				-- % of HH in each quartile -			
Provincial Quartiles of HH per Capita Total Land Area[3] (%)	Lowest	23.9	31.1	21.3	34.0	25.6	22.1	18.2	26.4	24.6	28.0	22.1	29.4
	Mid-low	25.7	21.2	23.4	21.8	23.7	35.5	41.4	29.7	25.2	23.7	24.2	23.6
	Mid-high	25.1	24.9	20.4	23.8	25.1	21.5	19.8	23.2	25.2	23.8	25.1	22.7
	Highest	25.3	22.8	34.8	20.4	25.6	20.9	20.6	20.7	25.1	24.5	28.6	24.2
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of Households in analysis		1,317	202	44	138	657	64	35	30	4,606	725	149	536

Notes: 1. only includes villages with a death during recall period. 2. Period in which HH experienced prime-age death: between 1999-2002 (Mozambique); between 1998-2002 (Rwanda); between 1996-2000 (Zambia). 3. Root/tuber results computed only for households with root/tuber production.

7.4 Crop Selection

Another agricultural response to PA death suggested in the household coping literature is that affected households tend to shift towards less labor-intensive crops, such as roots and tubers. While such crops typically demand less overall labor and allow for more flexibility in the timing of labor inputs, they tend to be lower in market value and nutrition than cash and grain crops. Particular emphasis has been put on the recent shift in area cultivated from maize to roots and tubers, observed in several countries in eastern and southern Africa. While these crop shifts could be related to HIV/AIDS-related illness and death, it is important to acknowledge that recent crop and input policy changes in many eastern and southern African countries have affected the relative output/input price ratios for grain crops relative to roots and tubers, reducing the profitability in some areas of grains as compared to roots and tubers (Jayne *et al*, 2004). The potential for such national and/or regional cropping trends exemplifies the value of the investigating cropping patterns of affected households in comparison with the non-affected population.

For Mozambique, Rwanda, and Zambia, we compare the *ex post* percentage of area cultivated to roots and tubers among affected and non-affected households (only those which grow roots/tubers), as well as the area in roots/tubers per capita (Table 9). While we cannot infer from median *ex post* results alone whether or not affected household cropping has changed over time, the results still demonstrate that the median *ex post* cultivation of roots and tubers – labor-saving crops – is not higher among most affected households, as compared with non-affected households.

Using panel data from Kenya, Yamano and Jayne (2004) found no significant shifts toward root and tuber cultivation in the case of death of any household member, but did find other significant shifts in cropping patterns for households within the lower half of the income distribution which suffered a household head/spouse death. For example, households with a male head/spouse death incurred a significant decline in area cultivated to sugarcane, tea, and horticultural crops, a result related not to labor shortage per se but due to loss of the man's land title which serves as a pre-condition to participation in outgrower schemes. Similarly, in Rwanda, Donovan and Bailey (2005) found a significant decrease in coffee and beer banana production among households with a PA death. They also found a significant increase in production of sweet potatoes among households with a chronically-ill PA adult. The Rwandan sweet potato and beer banana results are likely due to the labor flexibility of the former and labor demands for processing for the latter, though the reduction in coffee production may be due to loss of male adults and their connections with coffee brokers. The Kenya and Rwanda impact results suggest that when gender is a main determinant of participation in an economic activity, as with many cash crops, the loss of the participating adult (male) may leave the surviving spouse without access to the activity. Addressing the gender bias in agricultural production and marketing knowledge and opportunities could contribute significantly to improved income potential for many households.

In summary, the evidence presented here is mixed as to how adult mortality is affecting cropping patterns. The *ex post* data on crop cultivation cannot speak to potential changes in crop cultivation across the country studies – namely, a shift among affected households towards roots and tubers and a shift away from higher-value crops. Yet, the *ex post* results show that the average affected household does not tend to have more relative area cultivated to roots and tubers compared with the average non-affected household. However, analysis of mortality effects on cropping patterns in Kenya and Rwanda demonstrates that some affected households are shifting towards roots and tubers, although these shifts are strongly conditioned by the gender and household position of the deceased and the initial asset level of the affected household.

8. ASSETS AND INCOME

8.1 Total Agricultural Production and Productivity

If adult mortality causes a household to reduce its household labor, land, and other inputs employed in agricultural production, then we would expect to find negative effects of mortality on the total value of household agricultural production. Analysis of the effects of mortality on crop income in Kenya found that most affected households generally incurred a decline in value of agricultural production relative to non-affected households (Yamano and Jayne, 2004). While their analysis found significant losses only in the case of households with a head/spouse death, these effects were severe, as households in this case suffered a 68 percent reduction in the value of net agricultural output.

Given the inherent limitations to inference from comparison of *ex post* crop income between affected and non-affected households, we cannot use *ex post* comparisons to infer mortality impacts. Yet for various reasons, we still might expect affected households to have lower *ex post* crop income relative to non-affected households. First, although we did not find that median affected households had cultivated less land per capita than non-affected households, affected households may apply less weeding labor to their crops. Second, the loss of an adult, especially a male adult, might lead to the loss of cash crop production or marketing knowledge. We find that, with the exception of Zambia, affected household median *ex post* crop income, crop income per capita, and crop income per hectare tends to be lower than that of non-affected households across the synthesis countries (Table 10). However, the inherent limitations of *ex post* comparisons are seen in that in Kenya and Malawi, crop income was lower for affected households prior to death (ex ante) as well as after (ex post).

Comparing crop income just among affected households, those with a head/spouse death tend to have lower median crop income than those with a non-head/spouse death in some countries (Rwanda and Zambia) yet not in the others. The more apparent trend is that households which lost a male adult tend to have lower crop income than households which lost a female, a result perhaps tied to gender bias in higher-value crop production and marketing.

8.2 Non-Farm Income

Non-farm income is an important share of total household income in Kenya (35%) and Zambia (30%). Although less important to total income of the average rural household in the other synthesis countries, non-farm income nevertheless plays an important role in household income diversification. Because farm households tend to use non-farm income to help build their stock of farm assets and finance inputs such as fertilizer, it is important to assess the non-farm income of affected and non-affected households, as well as their access to this income source.

Table 10. Ex ante and Ex post Crop Income of Rural Households With and Without PA Adult Death, By Country

Household Characteristic	Non-Affected HHs[1]	HH with PA Death	HH with Head/Sp Death	HH with Other Death	HH with Male Death	HH with Female Death
			---------- median value ----------			
Kenya (1997 - ex ante)						
Crop income ('000 Ksh)	20.4	17.2	18.2	13.4	15.7	18.1
Crop income/capita ('000 Ksh/cap)	3.4	2.5	3.2	1.8	2.2	3.1
Crop income/ha ('000 Ksh/acre)	8.2	6.8	9.0	5.4	7.4	5.9
Kenya (2000 - ex post)						
Crop income ('000 Ksh)	29.6	21.6	23.3	19.9	20.9	21.9
Crop income/capita ('000 Ksh/cap)	4.9	3.7	4.4	3.3	3.2	3.9
Crop income/ha ('000 Ksh/acre)	10.2	8.2	8.4	7.8	7.5	8.8
Malawi (1990 - ex ante)						
Crop income ('000 Mk)	6.4	5.2	5.2	5.7	6.5	5.3
Crop income/capita ('000 Mk/cap)	1.4	1.0	1.3	1.0	1.2	1.0
Crop income/ha ('000 Mk/acre)	6.0	5.8	6.7	4.0	6.8	4.5
Malawi (2002 - ex post)						
Crop income ('000 Mk)	14.8	14.9	14.3	17.2	15.0	14.1
Crop income/capita ('000 Mk/cap)	2.9	2.4	2.3	3.4	2.5	2.2
Crop income/ha ('000 Mk/acre)	13.8	12.3	16.4	8.8	11.6	15.2
Mozambique (2002 - ex post)						
Crop Income (contos)	1,795	1,479	1,391	1,631	1,243	1,648
Crop income/capita (contos/cap)	377	346	365	319	365	327
Crop Income/ha (contos/acre)	1,608	1,479	1,844	1,287	1,210	1,947
Rwanda (2002 - ex post)						
Crop Income ('000 FRw)	101.4	71.7	63.3	71.7	71.7	65.8
Crop income/capita ('000 FRw/cap)	22.2	16.3	13.1	21.9	14.9	16.9
Crop Income/ha ('000 FRw/acre)	210.4	182.7	140.3	222.8	140.3	218.1
Zambia (2000 - ex post)						
Crop Income ('000 Kw)	530	574	572	572	633	541
Crop income/capita ('000 Kw/cap)	105	105	116	102	107	100
Crop Income/ha ('000 Kw/acre)	512	549	516	556	546	551

Notes: 1. only includes households from villages with a death.

Previous research suggests that non-farm income sources are often jeopardized among affected households, particularly among those that are asset poor and vulnerable to begin with. On the other hand, other observers suggest that the loss of a PA adult might lead remaining adults to be 'pushed' into low-wage non-farm work, thus it is difficult to hypothesize *a priori* the effect of adult mortality on a household's non-farm income except to recognize that the skills or characteristics necessary for some non-farm activities are not necessarily held by surviving household members. In particular, non-farm income sources are often specific to a certain gender, education, or experience level, such that loss of a PA adult may result in loss of that type of income if there is not another PA adult in the household with similar characteristics. Thus, a reduction in the number of PA adults in the household suggests that non-farm income would likely fall, especially considering non-farm labor which cannot be as easily replaced (substituted) by remaining family members, as for example, the labor input into staple food production.

Table 11. Ex ante and Ex post Non-farm Income of Rural Households With and Without PA Adult Death, Among Households with Non-farm Income, By Country

Household Characteristic	Non-Affected HHs[1]	HH with PA Death	HH with Head / Spouse Death	HH with Other Death	HH with Male Death	HH with Female Death
	---------- median value ----------					
Kenya (1997 - ex ante)						
% of households with non-farm inc. (%)	79%	73%	83%	67%	71%	78%
Non-farm Income ('000 Ksh)	45.4	38.2	39.6	36.1	49.4	33.0
Non-farm Income/capita ('000 Ksh/cap)	6.8	6.6	6.6	6.6	7.1	6.6
Kenya (2000 - ex post)						
% of households with non-farm inc. (%)	84%	86%	86%	85%	82%	90%
Non-farm Income ('000 Ksh)	31.2	19.0	20.0	16.5	16.5	32.6
Non-farm Income/capita ('000 Ksh/cap)	5.2	3.1	3.2	3.1	2.6	6.4
Malawi (1990 - ex ante)						
% of households with non-farm inc. (%)	88%	79%	81%	77%	72%	85%
Non-farm Income ('000 Mk)	1,341	1,585	1,742	667	893	2,414
Non-farm Income/capita ('000 Mk/cap)	289	265	468	146	179	428
Malawi (2002 - ex post)						
% of households with non-farm inc. (%)	74%	83%	78%	89%	81%	82%
Non-farm Income ('000 Mk)	2,718	2,417	2,132	5,066	2,075	3,551
Non-farm Income/capita ('000 Mk/capita)	547	537	479	856	433	840
Mozambique (2002 - ex post)						
% of households with non-farm	67%	59%	51%	62%	52%	66%
Non-farm Income (contos)	1,200	1,740	800	2,220	1,450	2,400
Non-farm Income/capita (contos/capita)	265	400	139	448	329	465
Rwanda (2002 - ex post)						
% of households with non-farm	90%	92%	96%	87%	87%	96%
Zambia (2000 - ex post)						
% of households with non-farm	66%	68%	64%	68%	67%	69%
Non-farm Income ('000 Kw)	333	298	193	319	294	345
Non-farm Income/capita ('000 Kw/cap)	70	56	34	56	56	58

Notes: 1. only includes households from villages with a death.

The *ex post* results in our case countries show that about the same percentage of affected households have non-farm income as non-affected households, although it should be noted that returns to non-farm activities vary widely depending upon the specific activity (Table 11). As expected, median *ex post* non-farm income per capita is somewhat lower for affected households in all countries save Mozambique, where it is higher, yet the difference is only large in Kenya (Table 13 to 15).[22] Results among different types of affected households are mixed, though in general, households with a head/spouse or a male death tend to have lower median non-farm income than households with a non-head or female death. More specifically, households with a head/spouse death tend to have lower *ex post* non-farm incomes than those with a non-head/spouse death in Malawi, Mozambique, and Zambia. And in Kenya, Malawi and Mozambique, households with a male death have lower median non-farm income per capita than households with a female death.

In Kenya, average non-farm income declines among all households from 1997 to 2000. Although affected households have larger median reductions in off-farm income, only those for households with a male head are significant in DID analysis (Yamano and Jayne, 2004).

[22] In our tables, non-farm income includes income from wage and salaried labor, remittances, and own business activities.

This perhaps relates to gender disparities in education, typically a principal determinant of access to the most remunerative off-farm income sources.

8.3 Assets

Households can mitigate the short-run effects of adult mortality and other shocks by selling assets such as farm equipment and small and large livestock. Asset depletion is cited as a common response to adult morbidity and mortality in the household coping literature, and other studies have found large reductions in asset holdings due to adult mortality (Barnett and Blaikie, 1992). Our qualitative recall data from Mozambique and Rwanda on household responses to adult mortality also show that some affected households liquidate assets such as small livestock and cash reserves in response to illness and death (Donovan et al, 2003; Mather et al, 2004). Asset depletion can increase households' vulnerability to income shocks, and may decrease household use of cash inputs and animal traction in crop cultivation, which will tend to result in lower productivity and overall crop production. In addition, prime-age mortality may reduce both the stock and the inter-generational transfer of human capital with respect to location-specific farm management practices.[23] Notwithstanding the importance of different types of household assets, this section looks at the data on total farm asset values available in the synthesis countries.

Impact analysis in Kenya shows a decline in mean asset values among all Kenyan households between 1997 and 2000, but larger mean decreases among affected households (though insignificant except in the case of small livestock) (Yamano and Jayne, 2004). Within the context of a decline in asset values among non-affected households, only part of the (larger) decline in asset values among affected households from 1997 to 2000 can be attributed to adult mortality. This example helps demonstrate the value of panel data in measuring impact, and why *ex post* comparisons of affected and non-affected households should not be used to infer impact (changes in asset levels).

Comparison of *ex post* farm assets in Kenya, Zambia, and Mozambique[24] shows that affected households in Kenya and Mozambique have lower median asset levels than non-affected households (Tables 12 and 14). In all three countries, households with a head/spouse death have lower ex post median assets than households with a non-head/spouse death. However, in Zambia, households with a non-head/spouse death in Zambia actually have a higher median asset value than non-affected households, which suggests that these households were wealthier ex ante than non-affected households. While impact magnitude cannot be inferred from *ex post* comparisons of assets, these comparisons do suggest that many affected households have lower asset levels than non-affected households, and that households with a head/spouse death tend to have the lowest asset levels. These results show that these households are most in need of programs intended to maintain or rebuild household asset levels. Such programs might include those which offer animals and training for raising small ruminants, pigs and poultry and, in some areas, increasing draft equipment and oxen availability for the poorest households through rental markets or community ownership.

[23] One aspect of Edward Mazhangara's forthcoming Ph.D. dissertation will involve the estimation of the impact of 'knowledge-loss' on farm production using panel data from Malawi (Mazhangara, forthcoming).
[24] Farm assets includes farm equipment and livestock in Kenya and Zambia, and livestock in Mozambique.

Table 12. Ex ante and Ex post Income Characteristics of Rural Households With and Without PA Adult Death: Kenya

Household Characteristic		Kenya (1997 - ex ante) Non-Affected HHs[1]	HH with PA Death[2]	HH with Head / Spouse Death	HH with Other Death	Kenya (2000 - ex post) Non-Affected HHs[1]	HH with PA Death[2]	HH with Head / Spouse Death	HH with Other Death
		---- median value ----				---- median value ----			
Value of Farm Assets ('000 Ksh)		34.0	37.0	25.1	44.7	27.0	20.0	16.0	23.3
Total Income ('000 Ksh)		94.0	73.6	70.5	82.6	98.3	69.7	69.7	71.2
Total Income/capita ('000 Ksh/capita)		15.0	13.3	13.6	11.7	15.8	11.0	11.6	10.1
		-- % of HH in each quartile --				-- % of HH in each quartile --			
Provincial quartiles	Lowest	24.4	27.7	25.7	29.2	24.4	27.7	28.6	27.1
of per capita HH	Mid-low	25.8	19.3	17.1	20.8	25.5	21.7	20.0	22.9
Income (%)	Mid-high	24.6	30.1	37.1	25.0	24.6	30.1	25.7	33.3
	Highest	25.2	22.9	20.0	25.0	25.5	20.5	25.7	16.7
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of Households in analysis		702	83	35	48	702	83	35	48

Notes: 1. only includes households from villages with a death during 1997-2002; 2. deaths over period from 1997-2000

Table 13. Ex ante and Ex post Income Characteristics of Rural Households With and Without PA Adult Death: Malawi

Household Characteristic		Malawi (1990 - ex ante) Non-Affected HHs[1]	HH with PA Death[2]	HH with Head / Spouse Death	HH with Other Death	Malawi (2002 - ex post) Non-Affected HHs[1]	HH with PA Death[2]	HH with Head / Spouse Death	HH with Other Death
		---- median value ----				---- median value ----			
Total Income ('000 Mk)		9.0	9.5	10.2	9.3	18.1	19.0	14.7	28.2
Total Income/capita ('000 Mk/capita)		2.3	1.5	2.4	1.2	3.5	4.1	3.3	5.5
		-- % of HH in each quartile --				-- % of HH in each quartile --			
District quartiles of per capita HH Income (%)	Lowest	24.9	27.4	28.1	26.3	26.3	22.3	24.4	19.2
	Mid-low	23.1	35.5	22.1	54.7	25.9	25.4	29.3	19.9
	Mid-high	26.5	21.7	27.3	13.8	24.6	28.6	23.1	36.5
	Highest	25.5	15.4	22.5	5.3	23.2	23.7	23.1	24.5
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of Households in analysis		288	72	45	27	288	72	45	27

Notes: 1. only includes households from villages with a death.

Table 14. Ex post Income Characteristics of Rural Households With and Without PA Adult Death: Mozambique, Rwanda, and Zambia

Household Characteristic		Mozambique (2002 - ex post)				Rwanda (2002 - ex post)				Zambia (2000 - ex post)			
		Non-Affected HHs[1]	HH with PA Death	HH with Head/Sp Death	HH with Other Death	Non-Affected HHs[1]	HH with PA Death	HH with Head/Sp Death	HH with Other Death	Non-Affected HHs[1]	HH with PA Death	HH with Head/Sp Death	HH with Other Death
		---- median value ----				---- median value ----				---- median value ----			
Value of Farm Assets (local curr.)[2]		260	150	180	135	--	--	--	--	1,890	2,188	1,313	2,258
Total Income (local currency)		3,114	2,673	2,118	3,293	211.8	190.6	209.3	159.4	950	1,006	808	1,108
Total Income/capita (l.c./capita)		731	555	491	614	45.5	38.7	44.5	36.2	192	186	173	193
		-- % of HH in each quartile --				-- % of HH in each quartile --				-- % of HH in each quartile -			
Provincial quartiles of HH per Capita Income (%)	Lowest	25.0	25.3	22.2	27.9	24.5	31.1	32.6	30.7	24.3	27.6	28.4	27.3
	Mid-low	24.2	30.9	44.5	26.1	24.8	26.1	19.7	33.5	25.2	22.7	24.3	22.0
	Mid-high	25.5	20.5	14.9	20.2	25.0	24.6	22.7	26.5	25.0	23.8	20.6	25.1
	Highest	25.3	23.3	18.3	25.7	25.7	18.2	25.1	9.4	25.5	25.9	26.7	25.6
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of Households in analysis		1,317	202	44	138	657	64	35	30	4,606	725	149	536

Notes: 1. only includes villages with a death. 2. Assets in Mozambique only include value of livestock at the end of the period.

8.4 Total Household Income

Most analysts view total household income as an imperfect yet important measure of poverty and need. Consumption and measures of health and nutritional status are also frequently used as complementary indicators of need, but were not available for the cases presented here (with the exception of expenditure data in Rwanda). In this section, we focus on total household income as a measure of the general *ex post* welfare of both affected and non-affected households. The following results are presented with the caveat that these *ex post* observations have only experienced the short-term effects of mortality, and do not include any potential longer-term household effects and community-level effects. An exception to this is the Malawi case, for which we have a 13-year panel.

In Kenya, Mozambique, and Rwanda, affected households have lower median *ex post* total household income, although many affected households are still in the higher income quartiles post-death (Tables 12, 13 & 14). Yet it should be noted that in Kenya, affected households had lower median income *ex ante* than non-affected households (Table 12). Affected households in Malawi and Zambia have higher or similar median total income compared with non-affected households, suggesting that *ex ante* income of affected households in Zambia was likely higher than the non-affected average (as we found earlier with respect to asset values). Thus, while median income of affected households as a group is somewhat lower in three countries, the distribution of households across income quintiles suggests that affected households are not uniformly poorer than on-affected households.

However, we find important differences in *ex post* income per capita among different types of affected households. For example, in Malawi, Mozambique, and Zambia, households with a head/spouse death have lower median income per capita as compared with households with a non-head/spouse death. This pattern is reversed in Rwanda, and in Kenya, income per capita is similar among affected household types.

Using income as a *ex post* indicator of general household welfare, these results demonstrate that, although affected households may well have experienced significant negative welfare effects due to the loss of a PA adult member, the *ex post* welfare of affected households is not uniformly worse than that of non-affected households. This result questions the efficacy of targeting mitigation efforts such as food aid based on the general category of "AIDS-affected households." Earlier sections demonstrated that households with a male head/spouse death were especially likely to suffer the largest effects of mortality on crop and non-farm income. These results suggest that effective targeting of assistance to the "hardest-hit" affected households would require further empirical investigation and recognition that some households are likely to be more vulnerable to the effects of adult mortality than others.

Using these results to help promote more effective targeting of food aid is important in order to more effectively reach the needy which suffer negative welfare impacts from AIDS-related adult mortality. At the same time, it is also important to avoid potential negative effects on rural development and poverty reduction that may obtain when poorly-targeted food aid results in adverse product price effects, and on the other hand to achieve some of the potential positive effects food aid can have on factor markets, providing it helps stimulate productivity growth in smallholder agriculture (Abdulai et.al., 2004). Renewed interest in improved food aid targeting is also driven by the fact that is has grown more scarce in recent years, and by the clear understanding that improved targeting can help resolve problems as well as help achieve its important humanitarian objectives (Barrett, 2002; Harvey, 2004).

8.5 Overall Rural Household Income and Poverty Analysis

The basic nation-wide rural household production and income surveys that have been conducted jointly with our respective African collaborators in each country study are being used to examine general rural income and productivity issues and to assess the extent of rural poverty, household and geographical factors associated with poverty, and trends in poverty rates over time. While these research results are still forthcoming (Gamba et al., forthcoming; Chapoto et al. forthcoming; McKay and Loveridge, 2005; Boughton et al. forthcoming, and Walker et al., 2004), there are several consistent findings that are emerging. As part of the future research agenda, these findings will help inform discussion of investment priorities for stimulating overall rural economic growth and productivity. These findings will also be relevant to the more general questions which the AfroBarometer (2003) opinion research polls (noted earlier in this paper) have raised from ordinary citizens concerning their priority rankings for government investment in creating jobs, expanding the economy, improving crime and security, as well as preventing and mitigating the effects of HIV/AIDS on rural and urban populations.

One of the key findings from our poverty and income work is that household landholding size is significantly associated with income (Jayne et al, 2003). Given the dominance of agriculture in total household income, poverty is concentrated among households with relatively small landholdings. Second, and as expected, poverty is concentrated among households with relatively little formal education. Third, poverty is associated with low levels of productive assets. Fourth, and perhaps surprisingly, while there are regional variations in median income levels and rural poverty rates, regional differences explain a relatively small amount of the variation in household incomes across the national samples. In addition, proximity to tarmac roads, rail lines, and district towns contributes modestly to household incomes.

IN MOZAMBIQUE, THE RESULTS FROM TWO LARGE-SAMPLE HOUSEHOLD SURVEYS CAN BE COMPARED FOR GENERAL TRENDS IN RURAL INCOMES, AGRICULTURAL GROWTH AND OTHER ASPECTS. WHILE THERE ARE SIGNS OF INCOME GROWTH IN SOME RURAL AREAS, INCOME GROWTH THROUGH AGRICULTURE IS CONFINED TO AREAS WITH SPECIFIC CASH CROPS, PARTICULARLY TOBACCO. THESE SOURCES OF INCOME ARE DOMINATED BY MALES AND SO WHEN HIV/AIDS RESULTS IN THE DEATH OF A PA ADULT MALE, THE HOUSEHOLD WILL LOSE ACCESS TO THESE ACTIVITIES AND INCOME. ANALYSIS OF THE 2002 HOUSEHOLD DATA FOUND THAT ACCESS TO AGRICULTURAL EXTENSION WAS NOT ASSOCIATED WITH SIGNIFICANTLY HIGHER AGRICULTURAL INCOMES. THIS TOO BRINGS INTO QUESTION AN EMPHASIS ON AGRICULTURAL TECHNOLOGIES WITHOUT CONCURRENT MAJOR INVESTMENTS IN EXTENSION SERVICES, IN THE CONTEXT OF MOZAMBIQUE.

In Kenya, the use of longitudinal data has also provided an opportunity to examine the extent to which households under the poverty line in one year remain chronically impoverished or move above and below the poverty line according to exogenous shocks. Initial findings to date indicate that about 2/3rds of households that fall below the poverty line in one year will continue to remain there several years into the future, while the other 1/3 are able to climb

out of poverty. Unfortunately, we also found that about 1/3 of the households above the poverty line in one year fell below it several years later, which was somewhat due to weather-related disturbances. In general, households incurring an adult death in the intervening period were not more likely to be under the poverty line several years later. However, there was a significant drop in household income when the death was a male household head and the household was relatively asset-poor to begin with.

9. DISCUSSION: IMPLICATIONS OF FINDINGS FOR TECHNOLOGY DEVELOPMENT

While some literature recommends that priority be put on developing labor-saving agricultural technology in response to AIDS-related labor loss (du Guerny 2002), there are several reasons to question this strategy, especially as a blanket recommendation. Given scarce financial and human capital resources in most Sub-Saharan African countries, decision makers should consider how the potential returns to labor-saving technologies (LSTs) for agriculture might compare with technologies which could reduce labor demands for household domestic tasks such as food processing (hammermills or other food processing technologies for maize and cassava) and gathering water and fuel (community wells; fuel-efficient stoves).

As indicated in the literature on gender and development, women's labor time in Sub-Saharan Africa is particularly constrained, even more so with the loss of a PA adult due to AIDS (Blackden 2003). Women invest in both agricultural production and in household domestic activities, such as obtaining water and cooking fuel, processing food for consumption, and tending children and the ill. While detailed household labor studies are not available for most of the countries studied here, a recent study in Zambia (with manual cultivation practices similar to those used in Mozambique and Rwanda) indicated that 48% of women's time was spent in agriculture, with the remaining spent on household duties (Blackden 2003). Therefore, relaxing the constraint on women's time obtaining water, gathering fuel, and processing food could yield large benefits for both affected and non-affected households (Barwell 1996). For example, a simple well may save considerable time spent searching for water.

As presented earlier, analysis of demographic changes and *ex post* income of affected households in the country studies suggests that households with a PA male death are less likely to attract a new PA adult member to the household and are more likely to be poorer than those with a PA female death. In addition, women perform the majority of caretaking labor for chronically ill adults. Thus, the illness or death of a PA adult (especially that of a male) will put even greater pressure on demands for household domestic activities, since women are already over-employed in the sense of working more hours per day. This suggests that among affected households, LSTs for domestic tasks are more likely to be generally applicable than many LSTs aimed at agriculture. As du Guerny states, "considering the time and energy necessary for fuel and water collection and their negative impact on production, these are two areas where LSTs would be essential to maintain food security… until these problems are solved, probably nothing very much can be done on the agriculture side (p. 15, 2002)." Bonnard (2002) also argues that domestic task LSTs may provide substantial benefits for affected households.[25]

By contrast, it is still unclear that some of the proposed LSTs for agriculture would be appropriate for many affected households. As described above, land/labor ratios among affected households in countries presented here, are similar to those of non-affected households. As shown earlier, even in the "high HIV prevalence" countries, aggregate labor-to-land ratios are unlikely to decline over the next 20 years. Secondly, the introduction of less labor-intensive crops and cultural practices is often mentioned as an appropriate mitigating solution. Yet we do not find that the average affected household cultivates

[25] While this section discusses technology issues, there are other mitigation efforts that might relieve stress on household labor, such as home-based care programs for the ill. See Breslin (2003) for an example of this work.

relatively more area to roots and tubers than the average non-affected household, even though there are many existing cultivars available.[26] Since a shift to cassava in place of maize can imply increased labor for food processing, while it also displaces specific nutrients in the diet, cassava may not been seen by the families as the most appropriate action to take in response to adult mortality.

Another example is that of conservation farming, which reduces weeding labor demands over time but involves substantial upfront labor costs (Haggblade and Tembo, 2003). Likewise, herbicides reduce weeding labor demand but require both financial means to purchase them and training on their proper use, unlikely to be widely available in the poorer countries in our sample, especially for women. As Evers and Walters (2001) indicate, rigid gender differentiation in labor allocation and unequal access to opportunities mean that changes in agricultural technology may not be accessed by women unless other constraints are reduced.

For countries such as Kenya and Zambia, an example of a more appropriate LST for agriculture is that of promoting capital-intensive factors such as livestock and draft equipment in order to save labor in land preparation. Such a policy would ideally focus on improving the access to such land preparation technology for relatively small and poor households. Another important consideration is to compare the feasibility and costs of development and dissemination of alternative LSTs. LSTs for domestic tasks would likely require little further local development and/or testing, as would be the case for most crop or input technologies. In addition, while specialized programs may be required for the promotion and financing for domestic task LSTs, these investment costs would generate benefits for many households living in poverty, not just the targeted households affected by HIV/AIDS.

More fundamentally, the development and dissemination of agricultural LSTs face the challenge that the research and extension systems (governmental and non-governmental) in the study countries (with the potential exception of Kenya) currently reach very few farmers. Shifting the focus of the limited financial and human capacity of national agricultural research and extension system to respond to perceived demands of a relatively small group of geographically-dispersed farm households would undoubtedly strain the capacity of the system, and would likely divert resources from the development and dissemination of technologies appropriate for the vast majority of farm households. In addition, effectively targeting geographically-dispersed "affected households" would be difficult, not to mention that much of the dissemination of agricultural technologies typically occurs via farmer-to-farmer adoption, which would be highly unlikely in this case.

In summary, prioritization of public sector investment in the development and dissemination of technologies aimed at mitigating the effects of prime-age adult mortality ideally requires in-depth evaluation of household constraints and opportunities, as well as consideration of the need for balance between investments in long-term rural economic productivity growth and targeted assistance to AIDS-affected households and communities affected and non-affected households. Assessing which LSTs to prioritize should involve investigation of the characteristics of affected households, whose labor time is most constrained, who would benefit from LSTs, who has effective access to new technologies, and which technologies promote efficiency of allocation of public resources across sectors.

[26] As noted earlier in the paper, we did find significant shifts towards root and tuber cultivation in the case of a male head death in Kenya (yet not for other deaths), and a significant increase in sweet potato production for households with a male death in Rwanda.

While definitive answers to these questions for the study countries are not yet possible, this research sheds light on some aspects. The results from analysis of household composition and crop production and income suggest that while many affected households may suffer welfare losses from PA mortality, the loss of family labor due to a death in the household may not necessarily mean that agricultural labor becomes the limiting input in agricultural production for a majority of affected households. In addition, available time-use data from Zambia suggest that the returns to investing in LSTs for rural household domestic tasks is likely to be much higher than that for LSTs in agriculture given that more hours per household would likely be saved by the former, and that such technologies would also benefit many poor but non-affected households.

10. CONCLUSIONS

A general assumption in some of the literature and in popular discussion is that AIDS-related mortality results in severe labor constraints and increased poverty rates and land scarcity among affected households. The subsequent implication of these assumptions is that HIV/AIDS mitigation policy should prioritize technology and assistance targeted to affected households: agricultural labor-saving technologies and food aid. Yet there is surprisingly little empirical research to date which can confirm whether this scenario is generally representative of affected households, and how affected household behavior and welfare compare with the non-affected household population. Thus, it is not clear that these suggested mitigation policies are appropriate for a majority of affected households and more feasible or desirable relative to alternative investments. In particular, it is important to seek empirical information to establish the potential for effective food aid targeting in areas of high HIV incidence, while also minimizing negative overall rural income and productivity growth effects.

This paper summarizes and synthesizes across the results of a set of country studies on the effects of prime-age adult mortality on rural households in Kenya, Malawi, Mozambique, Rwanda, and Zambia. Each study is based on large representative rural household surveys. These findings have implications for the design of efforts to mitigate some of the most important effects of rural adult mortality, and for key development policies and priorities.

First, we demonstrate that using incidence of prime-age adult mortality due to illness in rural household survey data is a reasonable and cost-effective way to identify households that are most likely affected by HIV/AIDS-related mortality. Because of the strong contribution of AIDS deaths to total deaths in the prime-age range in these highly-infected countries, cases of adult mortality due to illness give a good indication of the effects of AIDS-related death. We likewise document rural adult mortality rates consistent with significant HIV/AIDS deaths in rural areas and population-based mortality rates from DHS, and the comparison of these findings to results estimated from sentinel site HIV prevalence is internally consistent. Panel data in Kenya, Malawi, and Rwanda enable us to show that household dissolution rates across these particular surveys are relatively low, and thus lend credibility to the reliability of our estimates of the effects of prime-age mortality on household welfare.

Second, in contrast to the general assumption that HIV-related mortality is typically associated with household heads/spouses, the survey findings show that in four of the five countries researched here, a majority of deceased PA adults are not household heads/spouses, and thus not likely to be the primary breadwinners of the household. This suggests that the potential magnitude of rural PA mortality on rural household agricultural and off-farm incomes and orphaning rates may be less than those predicted by some of the literature. It also helps to explain the relatively low household dissolution rates found in the Kenya, Malawi, and Rwanda panel data sets.

When comparing the pre-death household position of deceased individuals with the household position of individuals in non-afflicted households, several noteworthy points emerge. In four of the five countries examined, the proportion of deceased females who were heads or spouses of heads in their households is lower than the proportion of female heads or spouses in non-affected households. The emerging picture is one of younger female dependents being the primary casualty of prime-age adult mortality, not wives or female heads. The picture is more complicated among men. In Kenya, Malawi, and Rwanda, the proportion of deceased males who were heads or spouses in their households is higher than

the proportion of male heads/spouses in non-affected households, while in Mozambique and Zambia, it is the reverse. While death of any kind undoubtedly brings hardship and suffering to affected households, it is important to note that the magnitude of the economic consequences appears to vary according to the extent to which the deceased tend to be primary breadwinners and core members of the household.

Third, in the case of Kenya, Malawi, and Rwanda, the rural HIV vectors associated with the infection of recently deceased rural adults (i.e. who were infected 5-10 years ago) do not appear to be associated with higher relative education, as has been found in previous research in Eastern Africa. The implication of these findings is that rural HIV prevention programs in these countries would require a range of media to reach both the illiterate and more educated rural population. In addition, these types of findings demonstrate that representative socioeconomic information on deceased and non-afflicted rural adults can be valuable in the design of HIV prevention programs.

Fourth, in contrast to the general assumption of labor scarcity among affected households, results of household composition analysis demonstrate that affected households do not uniformly appear to have less available PA labor than non-affected households, either because those affected are able to attract new PA members or because they had more PA adults prior to death. At the same time, the findings show that households with a head/spouse death have fewer *ex post* PA adults on average than households with a non-head/spouse death (and in most cases, households with a head/spouse death have fewer *ex post* PA adults than non-affected ones), with the exception of the Rwanda case. This demonstrates the heterogeneity of available *ex post* PA labor among affected households, and the importance of differentiating among affected household outcomes by characteristics of the deceased individual such as household position. In addition, the *ex post* dependency ratios of affected households vary considerably, and many affected households do not have higher ratios than those among non-affected households. However, higher mean dependency ratios are found in households with a head/spouse death, thus women in these households may well face increased demands on their time for domestic tasks and crop production.

Fifth, the results question the usefulness of a homogeneous conceptualization of "affected households," especially in the context of proposals for targeted assistance, technology development, and other programs/policies. We find that in most cases, although affected households may well have suffered negative effects on household crop production and income, the average affected household has similar ex post land cultivated, total land area, cultivation rates, and total income. But perhaps most importantly, we find that the gender and household position of the deceased appear to strongly condition the effects on the household. For example, impact analysis results from Kenya show that the death of a male household head is associated with larger negative impacts on household crop production, non-farm income, and asset levels than any other kind of adult death. In addition, the Kenya results demonstrate that initial asset levels also condition the effects of mortality on households, as the impact of adult mortality on household welfare is more severe for households in the bottom half of the distribution of household income per capita. Overall, these findings suggest that poorer households headed by HIV/AIDS widows are in especially precarious positions. Improved land tenure security for widows and the development of land rental markets could enable such households to hold on to their land assets and to earn income from allowing others to make productive use of their land.

Sixth, the heterogeneity of both the *ex post* welfare indicators and the magnitude of the effects of adult mortality on household crop production and income have important policy

implications. First, the finding that many affected households have similar household income and land/labor ratios in comparison with their non-affected neighbors suggests that it will be difficult to effectively target food aid, other assistance, or technologies to a homogeneously-defined group of "affected households." Yet certain sub-groups within the affected households may well have lower median incomes or land holdings after the death, as appears to be the case with households that have lost a male household head. It should be noted that this involves less than a third of cases in all the countries in this study. Given the importance of careful targeting to reach the "hardest-hit" households while minimizing negative overall rural income and productivity growth effects, the results suggest that empirical and practical investigation is recommended on a country- and perhaps regionally-specific basis prior to targeting assistance. Another important consideration is the need for targeting to be undertaken in ways that avoid creating incentives for husbands to leave the area so that households can qualify as "female-headed" in order to obtain assistance.

Seventh, the evidence presented here is mixed as to how adult mortality is affecting cropping patterns. The *ex post* data on crop cultivation cannot speak to potential changes in crop cultivation across the country studies – namely, a shift among affected households towards roots and tubers and away from higher-value crops. Yet, the *ex post* results show that affected households do not tend to have more relative area cultivated to roots and tubers compared with non-affected households. However, analysis of mortality effects on cropping patterns in Kenya demonstrates that some shifts are occurring, although these shifts are strongly conditioned by the gender and household position of the deceased and the initial asset level of the affected household. In Rwanda, controlling for general cultivation shifts among the non-affected households due to changing relative prices, there was a significant increase in production of sweet potatoes among affected households, and a significant decrease in coffee production. These results suggest that some affected households are shifting to less remunerative crops due to either labor constraints or the inability to retain specific production/marketing knowledge of certain cash crops that is lost in the case of a male death. Addressing the gender bias in agricultural production and marketing knowledge and cash crop and non-farm opportunities could contribute significantly to improved income potential for many households.

Eighth, the lack of widespread effects on crop income among affected households as well as similar cultivation rates and area cultivated to roots and tubers relative to non-affected households questions the potential demand for many proposed labor-saving technologies (LSTs) for agriculture. These results suggest that for affected households as a group, the loss of family labor due to a death in the household may not necessarily mean that agricultural labor becomes the limiting input in agricultural production. The macro-level picture emerging from recent demographic population projections, which include the impact of AIDS-related deaths, demonstrates that although the epidemic will reduce life expectancy and population growth considerably in the hardest-hit countries, the epidemic will probably not result in a decline in the aggregate labor-to-available-land ratio. However, at the micro-level, the loss by some

households of land, farm assets, and skilled labor may be more significant than their loss of general agricultural labor and may result in greater income and asset inequality.

Ninth, available time-use data from Zambia suggests that the returns to investing in LSTs for domestic tasks such as food processing and water/fuel gathering is likely to be much higher than those for LSTs in agriculture given that more hours per household would likely be saved by the former, and that such technologies would also benefit many poor but non-affected

households. Caution is therefore warranted before scarce agricultural research funds are inordinately diverted to labor saving crop and input technologies intended for HIV/AIDS-affected households. These results also suggest a need for an appropriate balance between investments in long term rural economic productivity growth and targeted assistance to AIDS affected households and communities. Emerging results from concurrent research drawing on the databases used in the present research will help inform questions of the extent of rural poverty and the kinds of programs needed to help stimulate broad-based rural economic productivity growth in the synthesis countries.

Tenth, in closing, it is important to highlight what we believe may be important, but have not been able to study. One important area of future research would be time use studies of adults and children, currently absent in almost all of the countries studied here. Such studies would provide information vital for the assessment of the potential costs and benefits of alternative labor-saving technologies. Another critical area for further research is the linkages between affected households and communities, as we will address in cooperating with RENEWAL on a study in Zambia on the interaction between households and communities affected by the HIV/AIDS epidemic. Social networks can be very important in times of stress, and there is a need to better understand how people rely on each other, and how HIV/AIDS may affect the ability of such social networks to function well and equitably. Targeting of assistance to affected households may help to support such networks, but it also may undermine them. Finally, emerging evidence suggests that the poorer strata of households in rural areas are increasingly likely to be victims and to suffer the most severe welfare losses resulting from adult mortality. If additional research confirms these patterns, there will be important HIV/AIDS mitigation as well as prevention implications that are inescapably tied to the need for greater emphasis and attention on agricultural and rural economic development policies to redress constraints to pro-poor and gender-sensitive economic growth. Likewise, research to develop more effective technologies and policies that can foster broad-based rural income growth will better enable communities as well as households to respond to those hardest-hit by the negative effects of AIDS-related adult mortality.

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