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ANALYSIS OF ADULT MORTALITY WITHIN RURAL HOUSEHOLDS IN MOZAMBIQUE AND IMPLICATIONS FOR POLICY

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Carlos Mucavele
National Director
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EXECUTIVE SUMMARY

While there is general agreement that HIV/AIDS will have serious effects on agriculture and rural development in Africa, HIV/AIDS mitigation policies are currently being proposed for Mozambique with little empirical information on which individuals and households are most affected, how they are affected, and how they are responding to the death of a prime-age adult. This paper uses nationally representative rural household survey data (TIA 2002) to evaluate the characteristics of affected individuals and households, household demographic changes and livelihood adjustment strategies taken in response to prime-age death. While not all prime-age (PA) adult deaths due to illness in Mozambique can be attributed to HIV/AIDS, this paper presents evidence from this and other research that suggests a strong relationship between PA adult mortality and HIV/AIDS, and thus enables households with a PA death due to illness to serve as a reasonable proxy for HIV/AIDS-affected households.

Although rural income growth from 1996-2002 mirrored the impressive performance of macroeconomic growth (50% growth in mean per capita real income during 1996-2002) in Mozambique during this time period, results from the TIA 2002 rural household survey show that rural household incomes in Mozambique are still very low and their distribution is highly unequal. Within this context of widespread rural poverty and stagnant agricultural productivity, HIV/AIDS prevalence in Mozambique has increased dramatically in since the mid-1990s. The recently released 2002 HIV/AIDS statistics from a survey of 36 antenatal clinics (predominantly urban) indicate an overall HIV prevalence of 13.6% nationally, although provincial estimates range from a high of 26.5% in Sofala, a coastal trade city in the Center to 7.5% in Cabo Delgado, a relatively remote province in the North (Ministério de Saude 2003). Basic mortality statistics from TIA 2002 show that 4.2% of households suffered the death of a PA adult from January 1999 to September 2002, most of which were due to illness, while another 2.7 % of households had a PA adult currently suffering from a prolonged illness during 2001/02.

Literature and popular discussion on AIDS in rural Africa typically associates HIV/AIDS-related mortality with household heads and their spouses. By contrast, our survey results show that while two-thirds of non-affected PA adults are household heads/spouses, only one-third of the affected PA adults in Mozambique were household heads/spouses. This demonstrates the importance of the insights provided by the counterfactual situation. A potential implication of this finding comes from recent research in Kenya, which 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 (Yamano and Jayne 2004).

Although some literature and popular discussion suggests that affected households face severe agricultural labor constraints, this paper presents several basic demographic findings that suggest that such constraints are not likely as severe as predicted, at least for many affected households. First, because affected households are on average larger than non-affected households prior to a PA death, their post-death labor availability is therefore comparable to that of non-affected households. Second, nearly one in eight households with a PA female death bring in a new PA female, thus these households may at least partially replace the economic activity of the deceased. Third, post-death household size and the number of PA adults among affected households in the south is larger than in the central and north regions, which implies that labor availability is more likely to be a problem in the later

regions. These results demonstrate the heterogeneity of household labor endowments and responses to PA death among affected households, which questions the general assumption that affected households always face severe agricultural labor constraints.

It is also often assumed that the effects of PA adult mortality on household agricultural production and income will result in the impoverishment of many affected households. Although affected households may have incurred significant losses of income and/or land access (we do not investigate this in this paper due to data limitations), the survey findings demonstrate that the average *ex post* (post–death) income of affected households is not significantly lower than that of non-affected households. This finding suggests that effective targeting of mitigation programs for HIV/AIDS-affected households would be difficult, as only some affected households appear to be poorer than non-affected households. Certain sub-groups within the affected households (those in the Center which have suffered the death of male head/spouse, for example) do appear to have lower median incomes or land holdings after the death (e.g., some widow-headed households or those with high dependency ratios. If careful targeting is desired, the results suggest that further empirical investigation would be required, since only some affected households appear to be poorer than non-affected households.

Analysis of strategies taken by affected households in response to PA adult mortality shows that 44% of affected households indicated crop area reduction while 22% indicate reduced weeding as adjustment strategies, suggesting that not all affected households appear to face a binding labor constraint in agriculture. Such heterogeneity of household responses to PA mortality implies limited potential demand by affected households for labor-saving agricultural technologies (LSTs). However, available time-use data from neighboring Zambia suggests that the returns to investing in LSTs for domestic tasks such as food processing and fuel/water gathering 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. 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. Given the extent of rural poverty and the need for broad-based rural economic productivity growth in Mozambique, these results indicate that policy makers must find an appropriate balance between investments in long-term rural economic productivity growth and targeted assistance to AIDS-affected households and communities.

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ANALYSIS OF ADULT MORTALITY WITHIN RURAL HOUSEHOLDS IN MOZAMBIQUE AND IMPLICATIONS FOR POLICY

by
David Mather, Higino Marrule, Cynthia Donovan, Michael Weber, and Albertina Alage[1]

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). In Mozambique, the most recent data from antenatal clinic surveys confirm that HIV prevalence among adults is high (13% national average) and increasing (Ministério de Saude 2003). While there is general agreement that the epidemic will have serious effects on agriculture and rural development in Mozambique, HIV/AIDS mitigation policies and programs 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.

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. However, there is little empirical research to date that can confirm whether or not this scenario is generally representative of affected households, 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.

In the Poverty Reduction Strategy Paper for Mozambique, the Council of Ministers highlighted the multi-dimensionality of poverty and the need to address the problems of vulnerability while enhancing the opportunities for empowerment and growth (Council of Ministers 2001). The wide range of livelihood strategies pursued by rural Mozambican households and their responses to the various possible shocks from weather, epidemics, and crop diseases suggests that policy decisions be taken with understanding of this heterogeneity (Selvester and Castro 2003). When adults fall ill for long periods and then die at an early age, whether due to HIV/AIDS, tuberculosis or other diseases, the livelihoods of families and the communities in which they live are negatively affected by the loss of labor, knowledge,

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and leadership embodied by the deceased. Because the vast majority of rural livelihoods are based in the agricultural sector, the Ministry of Agriculture and Rural Development (MADER) is developing strategies to address the needs of households affected by adult mortality (MADER 2003). However, it is currently developing these strategies without sufficient information on which households are most affected, how these households are affected, and what strategies these households are using to respond to the premature loss of an adult family member. This paper uses nationally representative rural household survey data from Mozambique to evaluate household demographic changes and adjustment strategies taken in response to prime-age (PA) death from illness, and to identify implications for the design of agricultural programs and policies.

1.1 Objectives

The first objective of this paper is to describe and offer support to our method of investigating the effect of prime-age mortality on rural households by adding a mortality component to on-going nationally-representative household surveys.

The second objective is to investigate *who* is afflicted with prime-age mortality due to illness, by analyzing the characteristics of the deceased individuals (gender, age, and position within the household at the time of death) and of the affected households (geographic location, and *ex post* income and landholding). This information can provide valuable insight to improve the targeting and effectiveness of HIV prevention programs.

The third objective is to investigate *how* the households with PA death or illness *respond* by adjusting household composition and their agricultural activities. To this end, information on household demographics for the 1999-2002 period is used to analyze changes in household size and composition over this period for both affected and non-affected households. The information from the death/departure and illness demographic sections regarding household response strategies are then evaluated by characteristics of the deceased individual (such as gender and position in the household) as well as of the household (such as income, landholding, etc.) to better understand the factors that influence the choice of adjustment response.

The fourth and final objective of the paper is to discuss the *implications* of household responses to prime-age death for agricultural policies and programs, and for their role in mitigating the effects of prime-age adult mortality.

1.2 Paper Organization

The paper is organized as follows. Section 2 provides background on rural Mozambique and thus provides the rural economic context in which the HIV/AIDS pandemic is unfolding. Section 3 describes the survey data and methodology used in this research. In Section 4, we describe available data on the relationship between HIV prevalence and adult mortality rates, within Mozambique and across Africa, which lends support to our method of using prime-age death due to illness as a rough proxy of HIV/AIDS-related death. In Section 5, we describe the characteristics of affected PA adults, such as age, gender, and household position, as compared with non-affected PA adults. In Section 6, we use information on household demographics for the 1999-2002 period to analyze both absolute levels and changes in

household size and composition over this period for both affected and non-affected households.

Section 7 compares 2002 household income, landholding, cropping characteristics and income diversification between households with and without a PA death during the 1999-2002 period. Because these observations are made after the PA death (in the case of affected households), they are termed *ex post* outcomes. In Section 8, we use probit analysis to analyze the characteristics of affected households that were more likely to have chosen a given response strategy, such as post-death asset levels, changes in household composition, the gender of person who was affected, and community factors. Section 9 discusses implications of the paper's findings for technology development, and Section 10 presents conclusions.

2. BACKGROUND ON RURAL MOZAMBIQUE

Mozambique has approximately 13.5 million rural households across three commonly identified regions: North, Center and South. The capital, Maputo, is the main urban zone in the country and is located in the far South, while the main agricultural production zones are in the Center and North. Since ending its 15 year civil war in 1992 and holding successful democratic elections in 1994, Mozambique has transformed its approach to economic development and achieved exceptional macroeconomic performance, with low and stable inflation, falling interest rates, and some of the highest economic growth rates in Africa. Comparison of household expenditure surveys from 1996/97 and 2002/03 suggests that there have been substantial improvements in poverty reduction during this time period, such that the rural poverty headcount dropped from 71.3% of rural households down to 55.3% of rural households, but it is not clear that agricultural growth was the driving force for these improvements in most provinces (National Directorate of Planning and Budget et al. 2004; Walker et al. 2004). However, despite rapid economic growth in recent years (8.1% average annual growth in GDP from 1992-2002), Mozambique remains one of the poorest countries in Africa, with a GDP/capita of US$200, 69% of the population below the national poverty line, an illiteracy rate of 54%, and an infant mortality rate of 125 deaths/1000 live births (World Bank 2003).

Results from a recent nationwide rural household survey, TIA 2002 (the same survey used in this paper and described below), show that rural household incomes in Mozambique are still very low and their distribution is highly unequal. For example, the mean household income of the highest per capita rural income quintile (US$ 126) in 2002 was 32 times higher than that of the lowest quintile (US$ 4) (Walker et al. 2004). In addition, the work of Simler and Nhate (2002) and Jayne et al. (2003) demonstrate that the largest part of the variation in per capita farm sizes and poverty levels in rural Mozambique is found within villages rather than between them. These results imply that poverty and inequality are widely distributed in rural Mozambique and are not simply regional or provincial phenomena.

Although rural income growth from 1996-2002 mirrored the impressive performance of macroeconomic growth (50% growth in mean per capita real income during 1996-2002), most of this growth was concentrated in the top 20% of rural households; median incomes increased by only about 10% (Walker et al. 2004). In addition, much of this growth occurred off the farm, especially in salaried wage labor in the largely donor-financed public and NGO sector, not from a sustainable growth dynamic such as increased agricultural productivity or rural micro-enterprise. Agriculture directly provides up to 75% of rural household incomes, mostly through the production of food for own consumption, and off farm income sources are limited in many areas of the country (Walker et al. 2004). The findings from these recent studies imply that broad-based productivity growth in the rural agricultural economy of Mozambique is required to feed broader non-farm growth and thereby to reduce the extremely high rates of rural poverty.

Within this context of widespread rural poverty and stagnant agricultural productivity, HIV/AIDS prevalence in Mozambique has increased dramatically in since the mid-1990s. The recently released 2002 HIV/AIDS statistics from a survey of 36 antenatal clinics (predominantly urban) indicate an overall HIV prevalence of 13.6% nationally, although provincial estimates range from a high of 26.5% in Sofala, a coastal trade city in the Center to 7.5% in Cabo Delgado, a relatively remote province in the North (Ministério de Saude 2003).

Overall, the highest HIV prevalence is in the Center, where some of the provinces have a significant amount of contact with neighboring Zimbabwe, Zambia, and Malawi (all of which have higher HIV prevalence than Mozambique) (Barreto et al. 2002b). Somewhat lower HIV prevalence is found in the South, where there is a strong link between migrant workers in South African mines and exposure to HIV/AIDS. The lowest HIV prevalence is found in the largely rural North, which is furthest from the major trade corridors and where there is a significant Muslim population (Barreto et al. 2002b).

3. METHOD AND DATA

3.1. Method

Given the difficulty and cost of obtaining reliable estimates of AIDS-related mortality within households, 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).[2]

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 affected households. While providing valuable information on the effects of HIV/AIDS on rural households and communities, the principal limitation of such studies is that their findings may be specific to a given agroecological zone or livelihoods structure and as such are not able to be extrapolated to a national scale. Case study or rapid-appraisal methods carry the additional limitation that they often lack a counterfactual sample population into which the reported effects on affected households may be put into perspective (i.e., changes in household demographics, agricultural production, and cropping patterns).

An alternative and complementary approach to the investigation of the effects of adult mortality on rural households is to include a mortality/morbidity component in a nationally-representative rural demographic and socio-economic household survey, as will be used in the present study and has been demonstrated in other recent research (Donovan et al. 2003; Yamano and Jayne 2004). 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). 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.[3] The term "prime-age" is used for adults in the 15-49 age group 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.[4]

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[2] 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), a promising approach. An example of a study using seroprevalence testing led by medical professionals is The Nelson Mandela Study in South Africa (Shisana and Simbayi 2002). However, this method may be cost-prohibitive in many cases.

[3] This is not to say that other households are unaffected, because entire communities and nations 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 PA death due to illness and excludes cases of PA chronic illness, unless otherwise noted. Future analysis will include more work on these people and households with chronic illness.

[4] The age range used for "prime age" corresponds to that used in the TIA 2002 demographic sections on departure and death, in which adult age groups were defined as: 15-24 years, 25-49, and 50+. The 15-49 age range is also used to define prime-age adults (UNAIDS/WHO 2002).

The use of a nationally representative sample of rural households enables us to evaluate the characteristics of *affected* individuals and households in comparison with *non-affected* individuals and households, and to extrapolate such findings to the regional and national levels. Because many proposed interventions involve the targeting of assistance and/or technology to affected households, it is vital to have information on both affected and non-affected households in order to assess the viability of such targeting efforts.

While an overriding objective of this research is to evaluate the effects of HIV/AIDS on rural households in Mozambique, as was noted earlier, 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. 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). Although only a certain percentage of adult deaths due to illness can be attributed to AIDS in any given country or region, Section 4.1 below demonstrates the strong relationship between rising PA adult mortality and the HIV/AIDS epidemic. 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.

3.2 Data

In 2002, the Mozambican Ministry of Agriculture and Rural Development (MADER) in collaboration with the National Institute of Statistics (INE) conducted a survey of rural households known as the Trabalho do Inquérito Agricola (TIA) 2002. The sample of 4,908 rural households was drawn using a stratified, clustered sample design that is nationally representative. The sample households were interviewed over a period of several weeks in August-September 2002 concerning a range of aspects: agricultural and livestock production and sales, off-farm activities, land use, and income sources and services. In addition, the household survey instrument included several demographic sections, which recorded socioeconomic characteristics of each current member of the household, and used recall information to document the incidents of death (covering 1999-02) and prolonged or chronic illness (illness during three of the prior 12 months) within the household, as well as the arrival (since 1999) and departure (1999-02) of individuals to and from the household. Finally, in each sampled village (UPA), a community survey collected information on local infrastructure, agricultural prices, and other aspects.

The demographic section 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.[5] For deceased individuals, a further question asked for a basic cause of death, including as options: accident, childbirth, non-prolonged illness, prolonged illness (three or more months of illness prior to death), and an open category. The demographic section on incidence of prolonged illness within the household also elicited information on each household member who fell ill and the member with primary responsibility for taking care of that ill member. Finally, each household which had experienced the death, departure, or chronic illness of a household member was asked to identify three principal strategies undertaken by the household to adjust their agricultural and

[5] See Donovan and Mather 2004 for more information on the survey instruments and some of their limitations.

livestock activities in response to the loss or illness of the given individual. The question was posed in an open-ended fashion and was asked individually for each case of an adult death, departure, or illness.

3.3 Incidence of Rural Mortality and Morbidity

Basic mortality statistics from TIA 2002 show that 4.2% of households suffered the death of a PA adult from January 1999 to September 2002, most of which were due to illness, while another 2.7 % of households had a PA adult currently suffering from a prolonged illness during 2001/02 (Table 1). It is likely that much of this illness and death is due to HIV/AIDS, given the relationship between HIV prevalence and adult mortality rates both across countries (Ngom and Clark 2003) and across provinces within Mozambique, as will be discussed below in greater detail. Of the 202 households with a PA death due to illness, few had more than one PA death (7%) or both a PA death and a chronically ill PA adult (3%). Given the relatively short period covered by the survey recall period (3.75 years), as well as the long period during which people may live with the HIV virus before showing symptoms, it is perhaps not surprising that we do not find more households in which more than one PA adult both demonstrate signs of HIV/AIDS. Observe also in Table 1 that there were more PA deaths than elderly deaths. Absent a pandemic like HIV/AIDS, we would expect a higher mortality rate among the elderly as compared with PA adults (Ngom and Clark 2003).

Table 1. Number of Sample Rural Households with Demographic Changes to Member New Arrivals, Death, Departure, and Illness Since January 1999, Mozambique

Households With Changes in Member Composition: Overall and by Age of Affected Household Member	Households in Sample	% of Households Nationally [1]
A. New Arrivals (all age groups) since January 1999 (excluding births in family)	561	9.5
Young Children (under 5 years old)	35	0.6
Children (5 to 14 years old)	138	2.4
Prime Age (15 to 49 years)	407	6.5
Elderly (50 + years)	34	0.8
B. Death (all age groups) since January 1999	578	10.6
Newborn/Infant (under 5 years old)	150	2.8
Children (5 to 14 years old)	61	1.3
Prime Age (15 to 49 years)[2]	231	4.3
Elderly (50 + years)	197	3.5
C. Departure for reasons other than death (all age groups) since January 1999	1047	19.3
Newborn/Infant (under 5 years old)	19	0.3
Children (5 to 14 years old)	120	2.6
Prime Age (15 to 49 years)	910	16.4
Elderly (50 + years)	57	1.0
D. Illness (all age groups) for at least three out of past twelve months	283	5.7
Newborn/Infant (under 5 years old)	20	0.4
Children (5 to 14 years old)	19	0.4
Prime Age (15 to 49 years)	141	2.7
Elderly (50 + years)	107	2.2
E. Combination of PA adult death due to illness and a PA adult illness in the same household	7	0.1
F. Combination of PA adult death due to illness and a PA adult new arrival in the same household	28	0.4
G. Households with 2 or more PA adult deaths from illness	14	0.4
H. Households with 2 or more PA adults with chronic illness	2	0.0

Source: TIA 2002

[1] There were 4,908 households in the nationally representative sample; population estimates of percentages of households are based on the weighted sample.

[2] Deaths from illness account for 202 of the 231 households with prime-age death.

4. RELATIONSHIP BETWEEN ADULT MORTALITY AND HIV/AIDS

4.1 Adult Mortality Rates in Sub-Saharan Africa

Given the current urgency of understanding the effects of HIV/AIDS on rural households in Mozambique, it is important to ask the extent to which the illness-related deaths observed in the TIA survey data are due to HIV/AIDS. To address this question, this section presents evidence of the relationship between adult mortality and HIV/AIDS across sub-Saharan Africa and within Mozambique.

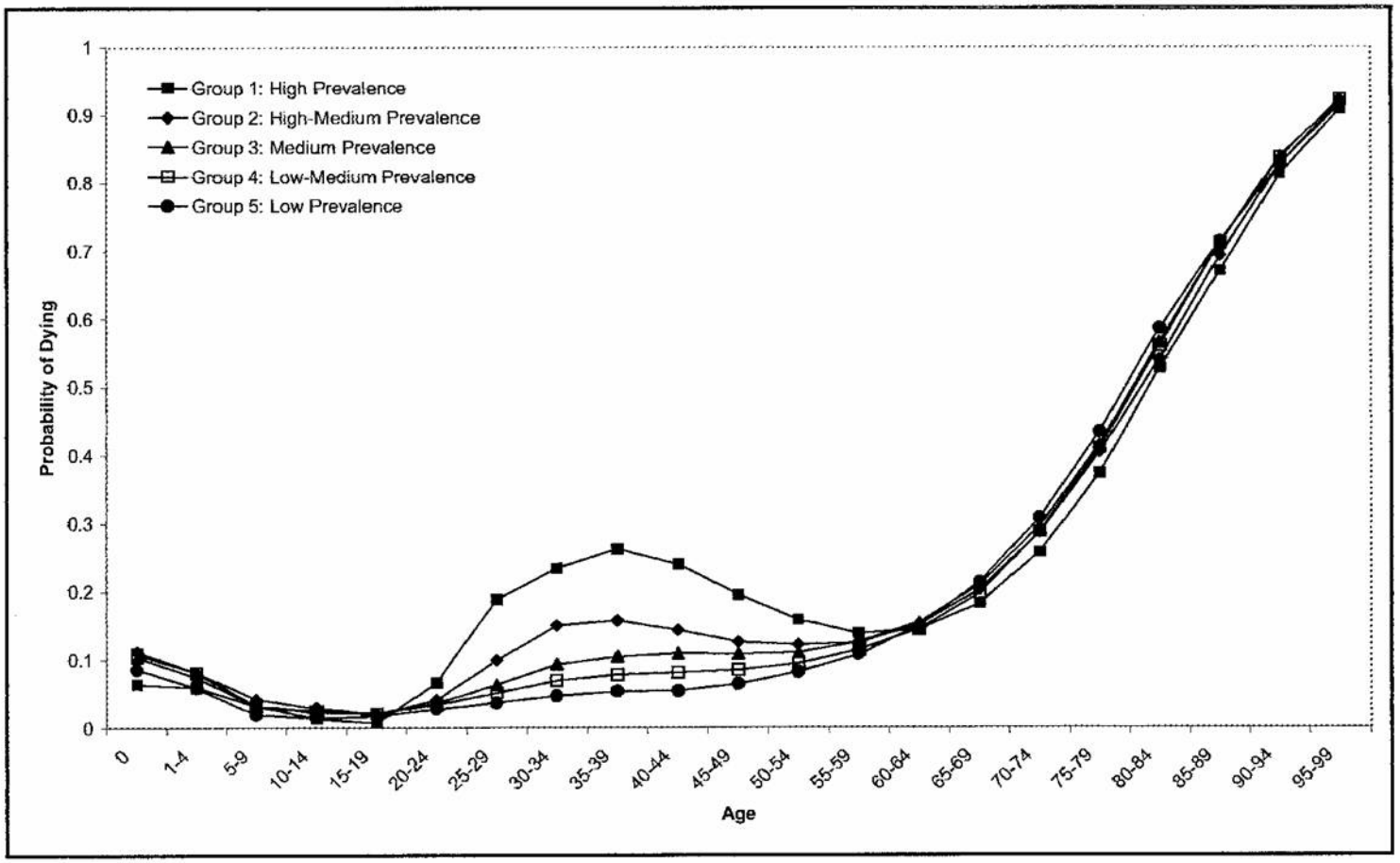
New research suggests that much of the recent increase in adult mortality rates *across* Sub-Saharan Africa is attributable to HIV/AIDS (Ngom and Clark 2003), as demonstrated in Figure 1.[6] If we graphed age-specific mortality rates as in Figure 1 for an African country without HIV/AIDS (or pre-AIDS), 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. 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 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 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 (Ngom and Clarke 2003). 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.

[6] 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.

Figure 1. Relationship Between 2001 Male Adult HIV Prevalence and the Probability of Dying 2000-2005 for 35 African Countries

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)



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).[7] 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.

4.2 Rural Adult Mortality Rates in Mozambique

In Figure 1, Mozambique is within the "medium-high" group with an HIV prevalence of 13%. As in other African countries with high and increasing HIV prevalence, estimated mortality rates of prime-age adults in Mozambique have increased considerably in recent years,[8] resulting in lower projected life expectancy (Table 2). Ideally, we would like to produce analysis similar to Figure 1 specific to Mozambique. That is, we would ideally want to compare current adult mortality rates from TIA 2002 with those from an empirical counterfactual – the "without AIDS" adult mortality scenario. However, the only other empirical adult mortality data to our knowledge is "sibling histories" of maternal respondents to DHS 1997 in Mozambique (another DHS was completed in 2003). In lieu of analysis of this DHS data, we compare adult mortality rates from TIA 2002 with model estimates of adult mortality.

Table 2. Mozambique Demographic Characteristics With and Without AIDS, 2002

Characteristic	Without AIDS	With AIDS	Change
Population Growth Rate (%)	2.4	1.5	- 0.9
Life Expectancy (years)	46.4	40.6	- 5.8
Crude Death Rate (deaths per 1,000 living persons per year)	14.0	23.0	9

Source: US Bureau of the Census, HIV/AIDS Surveillance Data Base, June 2000; and Instituto Nacional de Estatística, Database, Maputo, Mozambique

Mortality rates calculated from prime-age deaths over the 1999-2002 TIA survey period are 6.2 deaths/1,000 person years (PY), while the PA mortality rate due to illness is slightly lower at 5.2 deaths/PY. This latter figure is similar to Ngom and Clark's (2003) estimated HIV adult mortality rate for Mozambique of 7.6 deaths/PY. We would expect the TIA figure to be higher than that from the model considering that the former includes all deaths from illness, not just those expected from HIV. One reason for this discrepancy could be that the

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

[8] In SSA (including Mozambique), the predominant basis for estimates of life expectancy and adult mortality is an estimate of child mortality (from Demographic and Health Surveys) and the assumption of an age pattern of mortality from a family of model life tables (Hill 2003).

demographic model projections include HIV deaths in both urban and rural areas (whereas TIA only records rural deaths), and HIV prevalence is somewhat higher in the urban areas. Another explanation for the discrepancy could be that if adult death leads to household dissolution, then resulting recall data on household deaths would tend to underestimate mortality due to sample selection bias. However, very few panel data sets exist which enable researchers to measure household dissolution due to adult mortality. One such recent study using panel data from Kenya (Yamano and Jayne 2004) showed that less than one percent of households had dissolved between surveys implemented in 1997 and 2000, and the total attrition rate was 5%.

4.3 Rural Mortality by Province

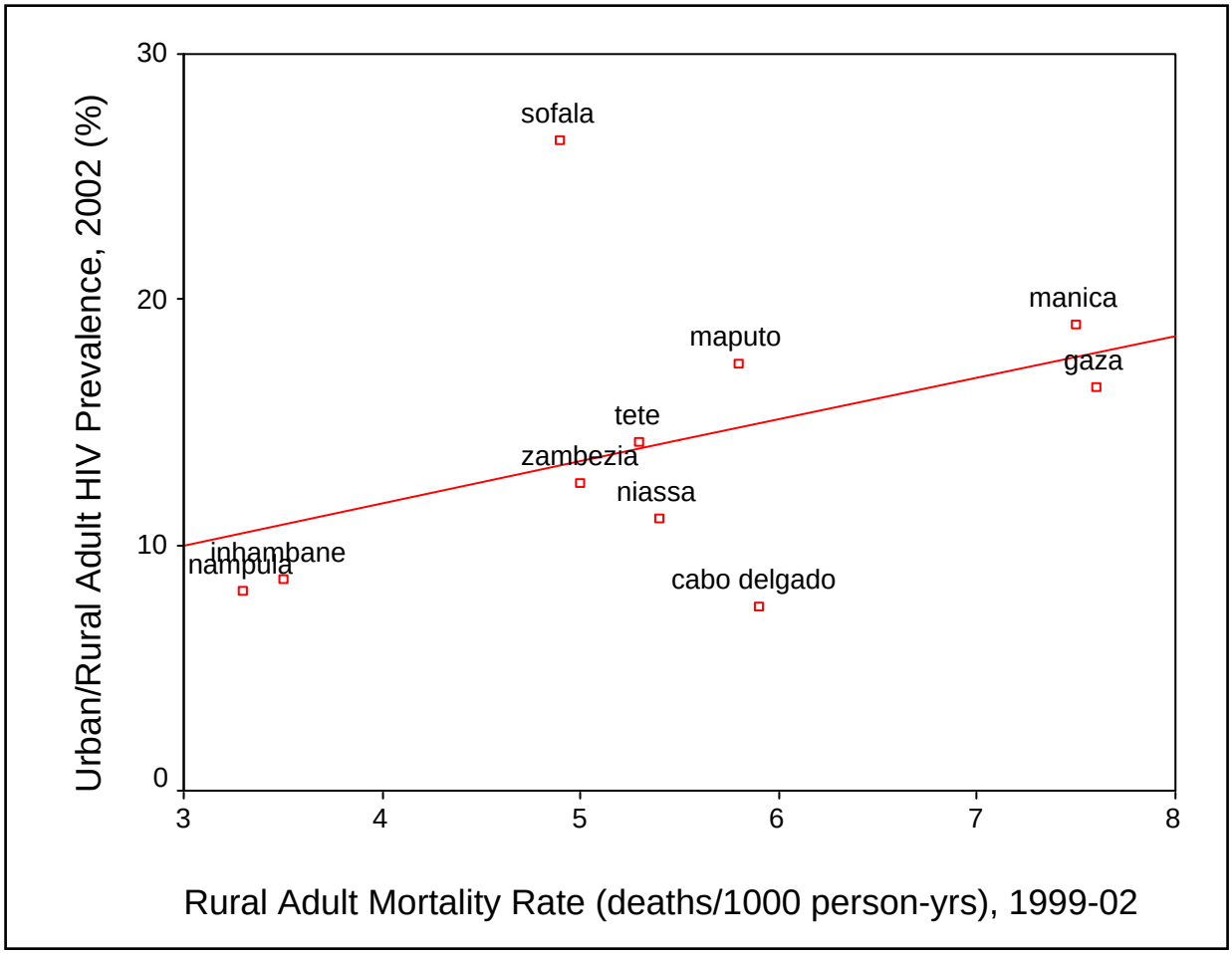
We next investigate the correlation between rural adult mortality rates from TIA recall data and antenatal HIV prevalence data by province, collected from surveys of 36 pre-natal clinics located in urban and rural areas of all ten provinces (Ministério de Saude 2003).[9] If there is a strong relationship 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.

The scatterplot (Figure 2; Table 3) of rural adult mortality and urban/rural HIV prevalence by province suggests considerable correlation, yet the Spearman correlation coefficient is a modest +0.32. However, this correlation exceeds 50% when excluding Sofala, the province with the highest combined urban/rural HIV prevalence. Sofala's high HIV prevalence (26%) is likely not highly correlated with TIA rural adult mortality because the HIV prevalence in that province is pushed upward by Beira, one of four major cities not included in the TIA (rural) survey. Nevertheless, the plot shows a rather consistent ranking by province: both HIV prevalence and adult mortality are relatively low in Nampula and Inhambane, near the national average in Tete, Zambezia and Niassa, and relatively high in Manica and Gaza.

The geographic distributions of PA adult mortality due to illness can also help to determine where rural mortality rates are already high as well as where they may be increasing, thus indicating where interventions may be needed. As depicted above in the scatterplot, both HIV prevalence and PA mortality rates in Mozambique are highly geographic in nature (Figure 2; Table 3). The provinces in the center along with Gaza and Maputo provinces stand out for their high percentage of PA adult deaths from illness. For example, while Gaza accounts for just 8.6% of the national rural PA adult population, the province has 12.7 % of all PA deaths due to illness. Manica and (rural) Maputo also have disproportionately high rates of PA death due to illness. These areas of high prevalence concur with current estimates of provincial HIV prevalence rates from the Ministry of Health (Ministério de

[9] 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.

Figure 2. Relationship Between 2002 Urban/Rural Adult HIV Prevalence and 1999-2002 Rural Adult Mortality Rate by Province, Mozambique



Saude 2003). These estimates from 2002, based on surveys of 36 pre-natal clinics across the country (including both urban and rural zones in all provinces), show that the highest rates of HIV prevalence are in the Center and South of the country.

The central provinces of Manica, Tete, and Sofala have a significant amount of contact with neighboring Zimbabwe, Zambia, and Malawi - all countries with higher HIV prevalence than Mozambique. In addition, many refugees were returned to the area after the signing of the Peace Accords in 1992 (Barreto et al. 2002b), having returned from those same countries. Gaza has higher than average rates of HIV incidence; this is not surprising for a province with strong links to the mines in South Africa, where prevalence is extremely high. Rural Maputo Province also has fairly high rates, with the Maputo Corridor transport route and nearby Maputo urban center. The lowest rates (about 6%) are found in the largely rural provinces: in the far north, where there are strong Muslim populations (Barreto et al. 2002b) and in Inhambane (9.6 %), further from the major trade corridors.

Table 3. Provincial Urban and Rural HIV Prevalence Rates and TIA 2002 Rural Mortality Rates for Adults 15-49 Years

Province	Adult Death Due to Illness in Rural Areas, 1999-2002 (1) [1]	Rural and Urban Adult HIV Prevalence, 2002 (2)
	---- % of adults within province ----	
Niassa	5.4	11.1
Cabo Delgado	5.9	7.5
Nampula	3.3	8.1
Zambezia	5.0	12.5
Tete	5.3	14.2
Manica	7.5	19.0
Sofala	4.9	26.5
Inhambane	3.5	8.6
Gaza	7.6	16.4
Maputo	5.8	17.4
National	5.2	13.6

Source: (1) TIA 2002 Rural Survey; (2) Ministério de Saúde (2003). Impacto Demografica do HIV/SIDA em Mocambique (based on observations from 36 urban and rural health posts across the country; figures are for age group 15-49 inclusive).

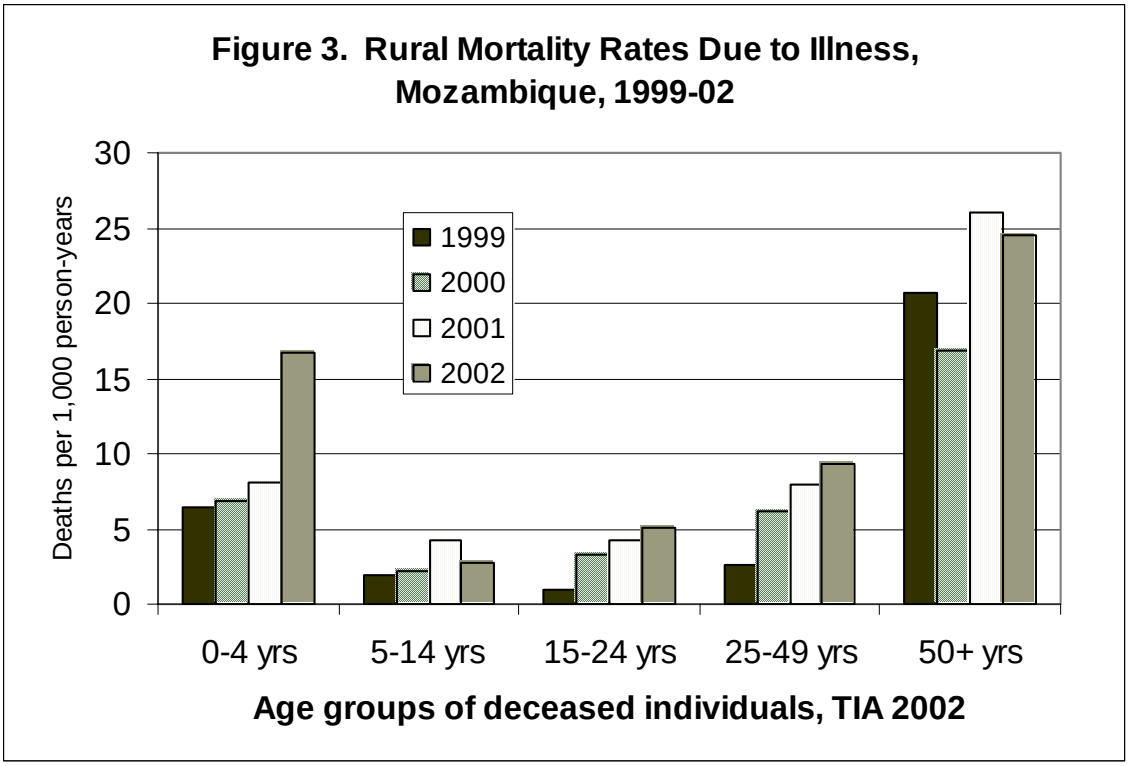
[1] Percentages are based on within category weighted estimates. "% of total" refers to percentage of those within the given category distributed across the provinces.

Some of the variation in HIV prevalence across provinces can be explained by differences in HIV knowledge. The Demographic and Health Survey (DHS) of 1997 in Mozambique included several questions regarding HIV knowledge, one of which was the question: "Do you know of a way to avoid HIV?" (Gaspar et al., 1998). One response to this question was "No way to avoid HIV." In Zambezia Province, with relatively high prevalence rates, the percentage of PA women who responded "No way to avoid HIV" was 47.3% whereas in Nampula Province, only 22.6% of women responded with "No way to avoid HIV." In fact, evidence of a correlation between HIV/AIDS knowledge and HIV prevalence can be seen in the high Spearman correlation of +0.53 between the percentage of DHS respondents (prime-age women age 15 to 49) who said there was "No way to avoid HIV" and HIV prevalence by province.

4.4 Rural Mortality Rates by Age Group

A final measure of the relationship between TIA rural adult mortality rates and HIV prevalence involves investigation of differences in mortality rates over time by age groups. Age-specific rural mortality rates from TIA 2002 follow *a priori* expectations, with the highest mortality rates for the 0-4 and 50+ age groups, with lower but increasing mortality for the age-groups between 5 and 49 years (Figure 3). These age-specific mortality rates increase over time from 1999 to 2002 for four out of the five age groups, which may be at least partially explained by the dramatic increase in HIV incidence rates in Mozambique in recent years. Yet, it is also possible that some of this increase is due to poorer recall for the earlier years (1999, 2000) compared with the year of the survey (2002). However, the fact that there is negligible increase over time for the group that we would expect to be least-affected by HIV (5-14 yrs), lends support to the argument that the increase in mortality rates for the other groups is largely attributable to increasing HIV prevalence over time.

Mortality rates for the 0-4 age group are much lower than expected (infant mortality estimates range from 125 to 150 deaths per 1,000 live births), although infant mortality is not likely to be fully captured in this survey for cultural reasons. The sharp increase over time in child mortality certainly supports the case that as HIV prevalence increases, the first age group to experience increased mortality is typically the youngest (0-4), due to mother-child transmission. However, the increase over time in mortality for the over-50 age group is surprising, given that adults over 60 would not be expected to contract HIV. Yet, this increase is likely explained by the fact that adults less than 50 may well contract HIV, yet not die of AIDS until after they are over 50 years of age (or simply that individuals over 50 contract HIV).



4.5 Summary of Relationship Between Adult Mortality and HIV/AIDS

While not all prime-age adult deaths due to illness in Mozambique can be attributed to HIV/AIDS, the evidence in this section suggests a strong relationship between PA adult mortality and the HIV/AIDS epidemic. Recent research demonstrates that there is a strong correlation between adult mortality rates and HIV prevalence across sub-Saharan African countries. Within Mozambique, a similar correlation is found between provincial rural adult mortality rates (restricted to deaths due to illness) from TIA 2002 household survey data and provincial urban/rural adult HIV prevalence. In addition, TIA rural mortality rates are similar (albeit lower) than recent estimates of "HIV-related adult mortality rates" for Mozambique as projected by epidemiological/demographic models. Finally, the pattern of increasing mortality over the 1999-2002 period within the TIA rural survey data – particularly for the age groups most likely affected by HIV/AIDS – suggests that HIV/AIDS is leading to increasingly higher mortality rates. With this evidence of the relationship between adult mortality rates and HIV/AIDS, we proceed to analyze responses to adult mortality by rural households in Mozambique, assuming that prime-age deaths due to illness represent a reasonable proxy for HIV-related deaths among prime-age adults.

5. CHARACTERISTICS OF AFFECTED INDIVIDUALS

5.1 Gender and Age

HIV/AIDS researchers have found differences throughout Sub-Saharan Africa between HIV prevalence for men and women, particularly by age group. Biologically, the risk of becoming infected with HIV during unprotected vaginal intercourse is between two and four times higher for women than for men (World Bank 1997). It is also believed that differences in HIV infection rates by gender can also stem from social, economic, and cultural inequalities associated with women's status in society, which thus render them more vulnerable to HIV infection than men (Loevinsohn and Gillespie 2003).

In Mozambique, our survey findings show that rural mortality rates are slightly different by both gender and age group. Affected prime-age (PA) women tend to be younger than affected PA men, and PA women are more likely than men die from illness (62 % of PA deaths from illness are female), even considering that PA women account for 54 % of PA adults in the general population (Table 4). These results also concur with previous estimates of HIV prevalence, which have shown women to represent about 57% of the total HIV positive population (Barreto et al. 2002a).

Table 4. Characteristics of Rural Non-Affected and Deceased Prime-Age Adults[1], Mozambique, 2002.

Individual Characteristic	Non-Affected PA Adults			Deceased PA Adults		
	All	Men	Women	All	Men	Women
	----- column % ------			----- column % ------		
Age Group (%)						
Age 15 to 24	41	41	42	27	21	31
Age 25 to 49	59	59	58	73	79	69
	100	100	100	100	100	100
Relationship to Household Head (%)						
Head/spouse[2]	66	60	70	27	40	13
Non-head/spouse ("other")	34	40	30	73	60	87
	100	100	100	100	100	100
Cases	12,056	5,477	6,579	217	105	112

Source: TIA 2002

[1] "Prime-age" includes adults age 15-49.

[2] For deceased individuals, household position imputed from characteristics of the deceased (age, gender), surviving HH members (age and marital status of current head), and the HH (presence of children, etc.). Ten percent of the deceased individuals could not be definitively classified by our criteria and were excluded from this calculation.

5.2 Position in the Household

Literature and popular discussion on AIDS in rural Africa typically associates HIV/AIDS-related mortality with household heads and their spouses. By contrast, our survey results show that while two-thirds of non-affected PA adults are household heads/spouses, only one-third of the affected PA adults in Mozambique were household heads/spouses (Table 4).[10] This demonstrates the importance of the insights provided by the counterfactual situation. A potential implication of this finding comes from recent research in Kenya, which 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 (Yamano and Jayne 2004). Assuming that a similar relationship exists in Mozambique between the gender and household position of the deceased and the magnitude of effects, we might expect the relatively low proportion of head/spouse deaths in Mozambique to lessen the potential magnitude of prime-age mortality on household livelihoods. This finding also has potential implications for the literature on targeting of HIV/AIDS prevention programs, given the disproportionately high number of deaths among non-household heads/spouses – especially among females within the non-household heads/spouse group.

[10] Although the TIA 2002 survey did not elicit information for deceased individuals apart from age group, gender, year of death, and death category, the household position of deceased adults can nevertheless be imputed using logical checks involving characteristics of the current household head (age, marital status) and of the household (new arrivals, presence of children, etc.).

6. HOUSEHOLD DEMOGRAPHICS

6.1 Introduction

Because the death of a PA adult reduces the affected household's labor supply and increases its dependency ratio, surviving members may pursue various responses to adjust its household composition in response to the PA death,[11] such as attracting new PA adults or sending children or elderly adults to other households. Yet some studies on household responses to adult mortality proceed to list the effects on agricultural activities that result from the loss of labor and/or wages formerly provided by the deceased PA adult (du Guerny 2002; Topouzis and du Guerny 1999; Gillespie 1989), without consideration for the potential for demographic responses by the household to adjust to this loss, as demonstrated in other research. 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.

In Kenya, Yamano and Jayne (2004) compared the effects of adult mortality on household size by gender of the deceased and found a significant decline in the case of a male death but not in the case of a female death. Further disaggregating adult mortality by both gender and household position, they found a significant decline in household size in the case of the death of a male or female household head or spouse but not with the death of a non-household head or spouse (male or female). 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 et al. 1998).

Given the importance of labor availability to rural household livelihoods in Mozambique, we proceed by investigating the mobility of PA adults in and out of households, then examine both absolute levels as well as changes in household size and composition from 1999 to 2002, comparing non-affected and affected households. Investigation of such changes requires either a panel dataset or information on the current household composition combined with information on arrivals and departures over the given recall period, since the labor available to a given household in 2002 is a function of its size in 1999 as well as any arrivals or departures from 1999-2002.[12] Although TIA 2002 is a cross-sectional dataset, we are able to impute household composition in 1999 by combining household data on current household members (2002) with recall data that was collected on new arrivals to the household since 1999 and deaths/departures since 1999.[13] We then compare various aspects of household composition in 1999 and 2002 for affected and non-affected households. The results are discussed below.

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[11] In this paper, use of the term "PA death" refers only to cases of PA death due to illness, unless otherwise specified.

[12] There is at least one necessary caveat in analysis of changes in household composition, whether using panel or recall data: apart from the obvious loss of the deceased from the household composition, it is not possible to know whether changes in household composition among affected households are related to the death itself.

[13] In order to assign individuals to the proper age group in which they resided in 1999, we adjusted each individual's age in 2002 to reflect their actual age in 1999. This means, for example, that a 3-year old child in 2002 would not have been born in 1999.

6.2 Mobility of Individuals In and Out of Households

Household size should be somewhat dynamic as families and members progress through normal lifecycles. In addition, one potential household response to adult mortality is to adjust household composition through new arrivals or departures of individuals. TIA 2002 survey results on household arrivals show that households with a PA female death are nearly three times as likely as non-affected households to bring in a new PA female (Table 5). By contrast, households with a PA male death are no more likely than non-affected households to bring in a new PA male. Other studies (Ainsworth and Semali 1995; Yamano and Jayne 2004) have also found that households with deaths were more likely to have received new co-residents than non-affected households.

Survey results on household departures shows that there is considerable mobility of PA adults throughout the sample population, as one in six non-affected Mozambican households experiences the departure of a PA male or female (Table 5). However, a household that has suffered a PA male death is less likely (as compared to a non-affected household) to experience the departure of an additional PA male for other reasons (Table 5). Likewise, a household with a PA female death is less likely to experience an additional PA female departure. This suggests that households which lose a PA male or female are not more likely than the non-affected households to send away PA members to engage in off-farm work.[14] There do not appear to be significant differences in arrivals and departures by region, except that affected households in the central region are less likely to bring in new PA members than affected households in the south or north.

Table 5. Characteristics of Rural Households With and Without Prime-age Death, Mozambique, 1999-2002

Household Characteristic	Non-Affected HH (%)	HH with PA Male Death From Illness (%)	HH with PA Female Death From Illness (%)
Arrival of PA male (% households)	2.3	2.0	3.4
Arrival of PA female	4.2	6.8	11.7
Arrival of one or more children age 0-14	0.6	1.7	1.5
Departure of one or more PA males	8.9	3.6	10.4
Departure of one or more PA females	8.9	10.6	5.8
Departure of one or more children age 0-14	3.0	0.5	1.3
Cases	4572	104	106

Source: TIA 2002

[14] Ideally, this comparison might be made based on the number of remaining PA adults, as some affected households may have fewer remaining PA adults and thus a lower probability of a PA departure.

6.3 Household Size

Household size is typically analyzed in simple number terms or based on the number of adult equivalents, in which children and elderly are converted to "adult equivalents" (AE) based on energy consumption needs. AE are often calculated to compare households across perceived consumption needs, but also labor availability.[15]

The observation that average absolute changes in household size from 1999-2002 are less than one indicates that at least some households that suffer a PA death either bring in new PA members or have children that move from the 5-14 age category to the PA age category and do not leave the household (Table 6a). Among affected households, the greater likelihood of a newly arrived PA female in the case of female death helps explain why the change in PA women from 1999-2002 is -0.82 while the change in PA males is -0.97 in case of male death.

A more in-depth way to compare changes in demographics is to use a difference-in-differences approach in which households with a male death or with a female death are compared to households without death or current illness, as demonstrated by Yamano and Jayne (2004). This approach computes changes in household outcomes which account for the counterfactual scenario (no adult death), and thus control for the average demographic trends in the non-affected population over the time period. The DID results substantiate what the simple means show, that households with a male death tend to lose a full adult male, reducing the total PA adults in the household and increasing the dependency ratio. In addition, households with a female death tend to lose somewhat less than a full person and do not have such an increase in dependency ratio for they are more likely to bring in new people and less likely to add additional children (Table 6b).

It should be further noted that a while a male death leads to a smaller decrease in household size than that from a female death (-1.11 to -1.34, respectively), when considering household size in AE terms, the reverse is found (-1.04 to -0.87) (Table 6b). An explanation for this is that in the event of female death, fertility appears to decline (-0.14 change in young children with female death, compared with 0.05 change following male death) while the number of PA adults declines less (-0.81 to -0.98). This implies that affected households with female deaths will on average not see an increase in young children yet will experience a smaller decrease in PA adults (due to higher replacement rates), as compared with households with a male death. The result is expressed in smaller increases in dependency ratios for female death households, and more PA adults – both of which suggest that households that suffer a female death will have more PA adult labor and fewer dependency demands.

[15] For example, a child needs 1,200 kcal per day in consumption, an amount that is 50% of what a typical adult needs. Thus a child is converted to be 0.5 adult equivalent. Similarly the elderly have lower consumption needs and are converted to 0.85 adult equivalents. Thus, a household with five children and two adults would have fewer “adult equivalents” than households with seven adults.

Table 6a. Absolute Changes in Household Composition for Affected and Non-affected Rural Households, Mozambique, 1999-2002

	NATIONAL				SOUTH				CENTRAL				NORTH			
Household Composition	Non-Aff. HH	HH with PA Male Death	HH with PA Female Death	HH w/ > 1 PA Death	Non-Aff. HH	HH with PA Male Death	HH with PA Female Death	HH w/ > 1 PA Death	Non-Aff. HH	HH with PA Male Death	HH with PA Female Death	HH w/ > 1 PA Death	Non-Aff. HH	HH with PA Male Death	HH with PA Female Death	HH w/ > 1 PA Death
HH size, 1999	4.53	4.98	5.87	8.09	5.15	5.71	6.03	9.23	4.62	4.93	6.27	7.88	4.15	4.52	5.08	6.98
HH size, 2002	4.97	4.42	5.05	5.99	5.49	4.97	4.87	7.27	5.14	4.38	5.38	5.19	4.54	4.09	4.60	5.42
Change 1999-02	0.44	-0.56	-0.82	-2.10	0.34	-0.74	-1.16	-1.95	0.52	-0.56	-0.90	-2.69	0.39	-0.43	-0.48	-1.55
PA adults 1999	2.15	2.73	2.74	4.29	2.46	3.18	2.41	4.24	2.16	2.70	3.09	4.70	1.99	2.47	2.32	3.85
PA adults 2002	2.18	1.84	2.02	2.64	2.47	2.35	1.67	2.56	2.23	1.71	2.33	2.53	2.00	1.68	1.69	2.88
Change 1999-02	0.04	-0.89	-0.72	-1.65	0.01	-0.82	-0.75	-1.68	0.07	-0.99	-0.76	-2.17	0.01	-0.78	-0.63	-0.98
PA men 1999	0.99	1.51	0.86	1.88	1.06	1.74	0.54	1.78	1.01	1.49	1.13	2.22	0.94	1.36	0.58	1.58
PA men 2002	1.01	0.54	0.96	1.33	1.06	0.94	0.55	1.46	1.04	0.44	1.16	1.00	0.95	0.40	0.85	1.58
Change 1999-02	0.02	-0.97	0.10	-0.55	0.00	-0.80	0.02	-0.32	0.03	-1.05	0.03	-1.22	0.01	-0.96	0.26	0.00
PA women 1999	1.16	1.23	1.88	2.41	1.39	1.43	1.88	2.46	1.15	1.21	1.97	2.48	1.05	1.10	1.74	2.28
PA women 2002	1.17	1.30	1.06	1.31	1.41	1.41	1.11	1.10	1.19	1.27	1.17	1.53	1.05	1.28	0.84	1.30
Change 1999-02	0.02	0.08	-0.82	-1.10	0.02	-0.02	-0.76	-1.36	0.04	0.05	-0.79	-0.95	0.00	0.18	-0.89	-0.98
Boys 5-14, 99	0.65	0.66	0.93	0.89	0.66	0.87	0.68	0.84	0.68	0.64	1.00	0.74	0.61	0.55	0.96	1.15
Boys 5-14, 02	0.76	0.77	0.98	1.07	0.72	0.87	0.71	1.09	0.81	0.77	1.10	1.11	0.72	0.71	0.93	1.00
Change 1999-02	0.11	0.11	0.05	0.17	0.06	-0.01	0.03	0.24	0.12	0.14	0.10	0.37	0.11	0.16	-0.03	-0.15
Girls, 5-14, 99	0.62	0.62	0.72	0.79	0.70	0.44	0.51	1.03	0.65	0.71	0.87	0.97	0.53	0.62	0.60	0.28
Girls, 5-14, 02	0.72	0.54	0.65	0.71	0.74	0.39	0.49	1.28	0.76	0.63	0.71	0.49	0.66	0.53	0.63	0.28
Change 1999-02	0.11	-0.08	-0.07	-0.08	0.04	-0.05	-0.01	0.25	0.11	-0.08	-0.16	-0.48	0.13	-0.09	0.03	0.00
Children 0-4, '99	0.69	0.56	0.64	0.78	0.63	0.48	0.48	1.17	0.73	0.60	0.78	0.46	0.67	0.56	0.49	0.70
Children 0-4, '02	0.84	0.78	0.65	0.39	0.78	0.67	0.59	0.36	0.91	0.86	0.72	0.05	0.79	0.73	0.57	0.85
Change 1999-02	0.15	0.22	0.01	-0.39	0.15	0.20	0.11	-0.81	0.18	0.26	-0.06	-0.41	0.11	0.17	0.08	0.15
Elderly, 1999	0.40	0.42	0.77	1.34	0.69	0.74	1.83	1.95	0.36	0.32	0.48	1.01	0.32	0.33	0.65	1.00
Elderly, 2002	0.47	0.48	0.75	1.19	0.77	0.69	1.42	1.99	0.43	0.41	0.51	1.01	0.37	0.44	0.78	0.42
Change 1999-02	0.06	0.06	-0.02	-0.15	0.08	-0.06	-0.42	0.03	0.07	0.09	0.03	0.01	0.05	0.10	0.13	-0.58
Dep ratio 99	1.23	0.97	1.45	1.00	1.25	0.95	2.02	1.25	1.25	1.00	1.17	0.84	1.19	0.94	1.61	0.88
Dep ratio 02	1.40	1.58	1.76	1.61	1.36	1.47	1.96	1.49	1.45	1.66	1.58	2.10	1.37	1.54	2.02	1.11
Change 1999-02	0.17	0.70	0.36	0.69	0.09	0.51	0.31	0.37	0.18	0.78	0.40	1.25	0.18	0.71	0.30	0.23
HH size '99 (AE)	3.16	3.65	4.07	5.89	3.63	4.26	4.18	6.54	3.21	3.61	4.36	5.88	2.90	3.28	3.49	5.11
HH size '02 (AE)	3.42	2.94	3.53	4.38	3.82	3.46	3.35	5.29	3.53	2.85	3.78	3.84	3.13	2.69	3.21	3.95
Change 1999-02	0.26	-0.71	-0.54	-1.51	0.19	-0.80	-0.83	-1.25	0.32	-0.75	-0.58	-2.04	0.23	-0.59	-0.28	-1.16
Cases	4684	95	91	14	1245	37	28	6	2103	40	43	5	1336	18	20	3

Source: TIA 2002 Notes: All figures are mean values; "Non-Affected" households did not experienced a PA adult death during 1999-2002

Table 6b. Difference-in-Differences Analysis of Rural Household Composition by Gender of Deceased Prime-age Adults, Mozambique, 1999-2002

	Households With Male Prime-age Death			Households With Female Prime-age Death			Households Without Prime-age Death			Difference-in-Differences	
	X_{1999} (A)	X_{2002} (B)	ΔX^M (C)	X_{1999} (D)	X_{2002} (E)	ΔX^F (F)	X_{1999} (G)	X_{2002} (H)	ΔX_O (I)	Male PA death $\Delta X^M - \Delta X_O$ (J)	Female PA death $\Delta X^F - \Delta X_O$ (K)
Household Composition											
Household Size	4.98	4.42	-0.56	5.87	5.05	-0.82	4.53	4.97	0.44	-1.11	-1.34
			-6.16			*-5.73*			*26.32*	*-11.26*	*-9.36*
Male adults	1.63	0.69	-0.95	1.19	1.32	0.13	1.20	1.25	0.05	-0.99	0.01
			-22.04			*1.63*			*5.86*	*-21.43*	*0.18*
Female adults	1.52	1.64	0.12	2.33	1.46	-0.87	1.35	1.40	0.05	-0.01	-0.92
			1.74			*-13.23*			*5.97*	*-0.11*	*-14.25*
Boys	0.66	0.77	0.11	0.93	0.98	0.05	0.65	0.76	0.11	0.00	-0.06
			1.94			*0.56*			*11.11*	*-0.07*	*-0.77*
Girls	0.62	0.54	-0.08	0.72	0.65	-0.07	0.62	0.72	0.11	-0.21	-0.20
			-1.24			*-1.01*			*11.15*	*-3.43*	*-2.82*
Young Children	0.56	0.78	0.22	0.64	0.65	0.01	0.69	0.84	0.15	0.05	-0.14
			2.38			*0.14*			*10.51*	*0.57*	*-1.71*
Household Size (AE)	3.65	2.94	-0.71	4.07	3.53	-0.54	3.16	3.42	0.26	-1.04	-0.87
			-13.21			*-5.72*			*25.15*	*-17.31*	*-9.01*
Dependency ratio	0.97	1.58	0.70	1.45	1.76	0.36	1.23	1.40	0.17	0.54	0.23
			6.83			*2.70*			*11.60*	*5.12*	*1.71*
PA adults	2.73	1.84	-0.89	2.74	2.02	-0.72	2.15	2.18	0.04	-0.98	-0.81
			-11.87			*-9.04*			*2.96*	*-12.70*	*-9.90*
Elderly adults	0.42	0.48	0.06	0.77	0.75	-0.02	0.40	0.47	0.06	-0.02	-0.09
			1.13			*-0.30*			*11.74*	*-0.30*	*-1.39*
Cases		95			91			4684			

Source: TIA 2002

Notes: t-stats are in small font and italics; households with more than one prime-age death are excluded (n=14)

Investigating changes in household size and composition alone may limit our understanding of which households are more likely to be labor-constrained, and how labor availability differs (or not) among affected and non-affected households. To that end, comparison of absolute levels of household composition among affected and non-affected households demonstrates that households suffering a male or female PA death from 1999-2002 were on average larger than non-affected households in 1999 (Table 6a). In fact, households which suffered a PA female death are still larger than non-affected households in both number and AE terms in 2002. This is perhaps explained by the fact that 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, thus we would expect that affected households would tend to be "older" or further along a household life-cycle than non-affected households. In fact, in 1999, affected households had on average more PA adults, more elderly members, and at least as many children as non-affected households.

While affected households are larger on average than non-affected households at a national level, there are important differences in household size across the three regions of the country. Both affected and non-affected households are largest on average in the south, smaller by roughly half an individual in the center, then smaller still by another half an individual in the north (Table 6a). Looking more carefully at the data by age group, among both affected and non-affected households, those in the south have on average nearly double the number of elderly members, more PA adults, and about the same number of children as households in the central and north regions.

Perhaps the most striking difference across the regions is that, among households with a PA male death, there is still on average at least one PA male per household in 2002 (i.e., after a PA male death), while affected households in the central and north regions average 0.49 and 0.47 PA males, respectively. This means that many households in the center and north which have lost a PA male have no PA male in the household in 2002. By contrast, among households that lost a PA female, there is less difference post-mortem in the number of PA females across the regions, and affected households in each region average at least one PA female. The results suggest that the effect of adult mortality on household labor availability (and thus potential household labor shortages) varies by region, and thus household cultivation and labor input into on-farm agricultural activities may likely differ as well by region.

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. The use of an effective dependency ratio would place ill adults as dependents (in the numerator) rather than as a PA adult (in the denominator) (de Waal 2003). Since for the purposes of this paper we have excluded households with a chronically ill adult, focusing analysis on the contrast between households with a death and those without, and there are few households with both illness and death, we work with the standard dependency ratio. A dependency ratio of 2.5 indicates that each adult must support 2.5 dependents in terms of their needs, both consumption and care. A higher dependency ratio thus means that some "dependent" members may well require attention from PA adults, such as young children or the very elderly, which is time that cannot be spent on other household chores or productive activities. Unless deceased PA adults are replaced

by new PA adults, the death of a PA male or female results in an increase in the household's dependency ratio (# of children and elderly / # PA adults).

The post-death dependency ratios of affected households are on average higher than those of the non-affected households, though not by much (Table 6a). This difference is not as great as perhaps expected due to the fact that affected households tend to have more adults prior to death, yet about the same number of children as non-affected households. In addition, it appears that female adult mortality is associated with lower fertility rates, as households with a female PA death have on average a zero growth rate among the 0 to 4 age group, as compared with a positive growth rate (0.15) among non-affected households, during the 1999-2002 period.

6.5 Caregivers

The presence of a chronically ill adult in a household may have various effects on a household's allocation of labor, land, and other assets. The illness not only deprives the household of the ill person's labor during the period of illness, but may also require the reallocation of a portion of the time of the ill person's caregiver from farm or non-farm activities (or school) towards caregiving. Thus, the characteristics of both the ill adult and the caregiver may influence how the family adjusts to a prime-age illness within the household.

The majority of caregivers to ill adults in the survey are either the spouse of the ill adult (44%) or his/her mother/father (30%) (Table 7a). In addition, about 60% of caregivers are female (Table 7b), which may partly be explained by the fact that women traditionally perform the vast majority of domestic tasks – including care for children, the elderly, and the ill – and are more likely than men to work on the farm rather than off. This suggests that time devoted to caregiving is more likely to increase constraints on the domestic, farm and non-farm activities of women in the household than those of men.

Table 7a. Characteristics of Caregivers and the Chronically Ill Prime-age Adults They Attend, Mozambique, 2002

	Gender of Chronically Ill Prime-Age Adult						
	Male	Female	All		Male	Female	All
Relation of Caregiver to Ill Prime-age Adult	(row %)			cases in row	(column %)		
spouse	40	60	100	63	56	53	44
son/daughter	8	92	100	8	1	7	6
mother/father	44	56	100	43	27	21	30
grand (father/mother)	88	12	100	3	4	0	2
brother/sister	48	52	100	10	9	6	7
daughter-in-law / son-in-law	11	89	100	5	1	5	4
other parent	3	97	100	7	0	7	5
not parent	0	100	100	1	0	2	1
himself / herself	99	1	100	3	2	0	2
Total (row %)	41	59	100				
Total (column (%)					100	100	100
no. of cases in column	56	87		143	58	85	

Source: TIA 2002

Table 7b. Characteristics of Caregivers and the Chronically Ill Prime-age Adults They Attend, Mozambique, 2002

	Gender of Chronically Ill Prime-Age Adult						
	Male	Female	All		Male	Female	Total
Caregiver Gender	(row %)			cases in row	(column %)		
Male	11	89	100	57	13	65	45
Female	61	39	100	86		35	55
Total (row %)	38	62	100				
Total (column (%)					100	100	100
no. of cases in column				143	58	85	

Source: TIA 2002

6.6 Orphans and Child-Headed Households

An oft-mentioned and assumed effect of AIDS-related adult mortality is an increase in the number of child-headed households and orphans. Defining a child-head as a head of household less than 18 years of age (a conservative assumption), 0.2% of sampled households have a head who is less than 18 years of age. Yet within this group, only 44% are of age 14 (the minimum value found) or 15.

We would expect that child-headed households would be more likely to be found among households with a PA death and in villages with death and illness. However, no households which have suffered a PA death are currently headed by someone less than 18, and the incidence of "child-headed households" is 0.3% in villages with no PA illness or death from illness, while it is actually lower 0.2% in villages which have recorded PA illness or death from illness.

The TIA survey instrument records a child's relationship to current household head as "son/daughter", "other relative", or "no relation," and did not specifically ask households to define children as "orphans". Therefore, it is not possible to distinguish between children that have arrived through marriage (but who are not considered by the current head to be his/her "son/daughter"), nieces/nephews that are living with an aunt/uncle for economic reasons, or orphans, who could be related to the head or not. With these data limitations in mind, the survey results show that 22% of non-affected households have children that are "other relatives" of the head and 0.4% had children defined as "no relation" to the head.

Another method of investigating orphaning rates involves reported new arrivals and their reasons for joining the household. Among children newly arrived to the household since 1999, about one-third arrived due to "death in another household" (38% of new arrivals age 0-4; 29% of new arrivals age 5-14). If we classify these new arrival children as orphans (i.e., we assume they lost one or both parents), then 0.7% of households are hosting an orphan (N=65 children). In addition, 75% of these "orphans" reside in households in the lowest two quartiles of income per capita. This method would tend to underestimate orphans because it only considers children who have joined a household since 1999.

A recent (draft) WFP study in Busia, Kenya, which recorded specific information on orphans in the sample households, found surprisingly low orphaning rates and suggested that rural households (at present) are better able to take in orphans than are urban households. The study also found that orphans were typically taken in to wealthier households.

6.7 Summary of Demographic Findings

Although some literature and popular discussion suggests that affected households face severe agricultural labor constraints, this paper presents several basic demographic findings that suggest that such constraints are not likely as severe as predicted, at least for many affected households. First, because affected households are on average larger than non-affected households prior to a PA death, their post-death labor availability is therefore comparable to that of non-affected households. Second, nearly one in eight households with a PA female death bring in a new PA female, thus these households may at least partially replace the economic activity of the deceased. Third, post-death household size and the number of PA adults among affected households in the south is larger than in the central and

north regions, which implies that labor availability is more likely to be a problem in the later regions. Finally, households in the south that have lost a PA male still have on average one PA male in 2002, though many affected households in the south do not have a PA male ex post. Thus, affected households in the central and north regions are more likely to face labor constraints than those in the south. These results demonstrate the heterogeneity of household labor endowments and responses to PA death which in turn questions the general assumption that affected households always face severe agricultural labor constraints.

7. *EX POST* HOUSEHOLD INCOME, LAND, AND CROPPING CHARACTERISTICS

7.1 Per Capita Household Income and Landholding

Some literature on the effects of HIV/AIDS on rural households holds that the labor constraints resulting from prime-age mortality typically forces affected rural households to reduce cultivation rates, shift out of cash crop production, and reduce labor for weeding (du Guerny 2002). In addition, reduced cultivation rates and/or loss of a male head may result in reduced access to land. As a result of these negative effects on agricultural production -- in addition to losses in off-farm or self-employment income from the deceased – it is often assumed that many affected households will be forced into poverty.

Due to the cross-sectional nature of the TIA 2002 survey data on household outcomes such as total and cultivated land area, crop production, off-farm income, assets and total income, it is not possible to measure household-level changes over time in such variables with conventional methods. In addition, comparing the *ex post* (post-death) outcomes for affected and non-affected households cannot likewise produce measures of "effects" of mortality on rural household outcomes, since outcomes in 1999 (*ex ante*) may have differed substantially between the affected and non-affected households. Thus, while we do not here attempt to measure the effect of adult mortality on household outcomes, comparison of *ex post* outcomes of affected and non-affected households can nevertheless provide important information relevant to informing HIV/AIDS mitigation strategies and their possible targeting.

At the national level, median incomes of households with a PA male death are lower than those of non-affected households, although there is no significant difference among the means of these groups, in part due to high variance of the estimates (Table 8a).[16] However, households with a PA male death are more prevalent in the two lowest income per capita quartiles (61%), while households with a PA female death are somewhat more prevalent (60%) in the lowest two quartiles of land holding per capita. Yet, these national-level results can be somewhat misleading given substantial variation in *ex post* indicators across the three regions. For example, in the South, there is little to no difference between median income/capita of affected households or of their distribution among income and land quartiles. In the Center, households with a PA male death have substantially lower median per capita income, while median per capita income of households with a PA female death are somewhat lower than those of non-affected households. In the North, households with a male PA death have somewhat lower median per capita income, although the largest difference is found in the high percentage (75%) of households with a PA female death among the lowest two land quartiles[17]. Thus, while the welfare indicators of many affected households are similar to those of non-affected households, only in the center region do we find a rather large percentage of affected households worse off in terms of *ex post* income per capita than

[16]Although adult mortality often results in asset loss (Yamano and Jayne 2004), we do not analyze this in Mozambique due to very low percentage of farmers with oxen, ploughs, or other farm implements.

[17] This may be due to the importance of the matrilineal system in the North, under which land rights may be rescinded from households with a female death.

their non-affected counterparts. This result questions the efficacy of targeting mitigation efforts such as food aid based on the general category of "AIDS-affected households."

Other potential indicators of households most in need of targeted assistance might be widow-headed households and those with high dependency ratios (greater than 2).[18] Table 8b presents median values of income and landholding for these two population sub-groups, which are divided into those that suffered a PA death from 1999-2002 and those that did not. The results show that the median widow-headed household with a recent PA death is not substantially poorer than non-affected households in terms of income/AE or total land area, although they are somewhat more likely to fall in the lowest two income quartiles (61%). Surprisingly, both widow groups are not more likely to fall in the lowest two land quartiles (54% and 40%). However, while households with high dependency ratios have higher median total income compared with non-affected households, their high AE results in somewhat lower median income/AE. These results further illustrate the difficulty in efficiently targeting mitigation efforts based on such household indicators, especially considering that "widow-headed" households represent only 27% of all affected households, while those with high dependency ratios represent only 21%.

[18] Households with a dependency ratio greater than two represent approximately 20 percent of the sample.

Table 8a. Characteristics of Selected Households With and Without Prime-age Death, Mozambique, 2002

Household Characteristics (median values)			National			South			Central			North		
			Non-Affected HH	HH with PA Male Death	HH with PA Female Death	Non-Affected HH	HH with PA Male Death	HH with PA Female Death	Non-Affected HH	HH with PA Male Death	HH with PA Female Death	Non-Affected HH	HH with PA Male Death	HH with PA Female Death
Total Land Area	hectares (ha)		1.25	1.25	1.10	1.43	1.41	1.41	1.28	0.95	1.25	1.19	1.25	0.88
Cultivated Land Area	hectares (ha)		1.05	0.88	0.88	0.99	0.81	0.95	1.16	0.88	0.88	0.97	0.75	0.66
% of Total Land Area cultivated			84%	71%	80%	69%	58%	67%	91%	93%	70%	82%	60%	75%
Adult Equivalents	(AE)		3.27	2.85	3.94	3.57	3.40	3.07	3.40	2.85	4.15	3.08	2.85	3.35
Total Land Area/AE	ha/AE		0.39	0.37	0.33	0.40	0.42	0.36	0.39	0.35	0.37	0.39	0.41	0.29
Cultivated Land Area/AE	ha/AE		0.33	0.32	0.27	0.31	0.29	0.35	0.35	0.32	0.23	0.33	0.32	0.25
Total Income	1000 meticais		3,415	2,357	3,697	4,550	3,152	4,512	3,296	1,679	3,434	3,166	2,271	2,558
Total Income/AE	1000 met/AE		1,088	953	1,019	1,378	1,372	1,597	1,018	661	847	1,062	997	1,019
Total Income/capita	1000 met/capita		781	615	687	995	990	1,166	728	426	628	758	623	563
% of HHs in lowest two quartiles of income/pc			50%	61%	53%	51%	49%	49%	50%	67%	56%	50%	56%	54%
% of HHs in lowest two quartiles of total land/pc			50%	54%	60%	50%	50%	51%	50%	56%	52%	50%	48%	75%
		quartile means[2] (1000 met/capita)	-- % of HH in each quartile --			-- % of HH in each quartile --			-- % of HH in each quartile --			-- % of HH in each quartile --		
Quartiles of 2002	Lowest	133	24.9	31.1	24.3	25.5	27.0	14.7	24.9	38.5	18.8	24.8	23.2	28.2
HH per capita [1]	Mid-low	558	24.9	29.7	29.0	25.2	21.5	34.3	24.7	28.7	36.8	24.8	32.4	26.1
Income (%)	Mid-high	1,151	24.9	23.8	24.6	24.6	25.9	27.6	25.1	17.0	19.0	25.2	21.9	21.5
	Highest	4,350	25.3	15.5	22.0	24.6	25.6	23.4	25.4	15.9	25.5	25.2	22.4	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
		(ha/capita)												
Quartiles of 2002	Lowest	0.09	24.2	24.3	33.4	25.8	12.5	23.9	24.4	28.8	35.1	25.0	27.7	39.8
HH per capita [1]	Mid-low	0.22	25.4	30.1	26.3	24.1	37.4	26.6	25.4	27.5	16.5	24.6	20.5	35.4
total land area (%)	Mid-high	0.37	25.2	23.4	22.0	24.9	23.9	23.6	25.1	21.1	31.4	25.1	33.7	12.9
	Highest	0.95	25.2	22.2	18.4	25.2	26.2	25.9	25.1	22.6	17.0	25.3	18.1	11.8
			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			4572	104	106	1215	40	34	2050	44	49	1307	20	23

Source: TIA 2002 Rural survey

[1] Income/capita and Land/capita Quartiles computed at national level for first three columns, and at regional level for regional columns

[2] Quartile means refer only to national level

Table 8b. Characteristics of Selected Households With and Without Prime-age Death, Mozambique, 2002

Household Characteristics (median values)			National			Affected HHs		Non-Affected HH	
			Non-Affected HH	HH with PA Male Death	HH with PA Female Death	Widow-Headed HH	HH with d.ratio > 2.0[1]	Widow-Headed HH	HH with d.ratio > 2.0[1]
Total Land Area		hectares (ha)	1.25	1.25	1.10	0.94	0.92	0.94	1.41
Cultivated Land Area		hectares (ha)	1.05	0.88	0.88	0.84	0.73	0.81	1.10
% of Total Land Area cultivated			84%	71%	80%	89%	80%	87%	78%
Adult Equivalents		(AE)	3.27	2.85	3.94	2.48	4.15	2.13	4.53
Total Land Area/AE		ha/AE	0.39	0.37	0.33	0.41	0.27	0.51	0.32
Cultivated Land Area/AE		ha/AE	0.33	0.32	0.27	0.32	0.19	0.41	0.26
Total Income		1000 meticais	3,415	2,357	3,697	1,679	3,697	1,638	3,840
Total Income/AE		1000 met/AE	1,088	953	1,019	953	847	831	865
% of HHs in lowest two quartiles of income/pc			50%	61%	53%	61%	57%	59%	62%
% of HHs in lowest two quartiles of total land/pc			50%	54%	60%	54%	87%	40%	65%
		quartile means (1000 met/capita)	-- % of HH in each quartile --			--- % of HH in each quartile ----			
Quartiles of 2002 HH per capita[2] Income (%)	Lowest	133	24.9	31.1	24.3	30.9	30.3	32.4	33.0
	Mid-low	558	24.9	29.7	29.0	30.4	27.0	26.8	28.6
	Mid-high	1,151	24.9	23.8	24.6	26.4	36.4	23.6	22.6
	Highest	4,350	25.3	15.5	22.0	12.2	6.3	17.1	15.8
			100.0	100.0	100.0	100.0	100.0	100.0	100.0
		(ha/capita)							
Quartiles of 2002 HH per capita[2] total land area (%)	Lowest	0.09	24.2	24.3	33.4	21.0	47.4	18.3	32.0
	Mid-low	0.22	25.4	30.1	26.3	32.7	39.6	21.6	33.2
	Mid-high	0.37	25.2	23.4	22.0	19.3	4.3	24.8	22.6
	Highest	0.95	25.2	22.2	18.4	27.0	8.7	35.3	12.3
			100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of Households in Analysis			4572	104	106	55	43	414	692

Source: TIA 2002 Rural survey

Notes: affected = HH with prime-age death from 1999-2002; non-affected = HH without prime-age death from 1999-2002

[1] Dependency ratio calculated as: (no. of children & elderly adults) / (no. of prime-age adults)

[2] Income/capita and Land/capita Quartiles computed at national level for all columns

7.2 Cultivation Rates

If Mozambican farm households face agricultural labor constraints in general, then we might expect cultivation rates (cultivated area as a proportion of total area) of affected households to be lower than those of their non-affected neighbors. The survey results show that median cultivation rates of affected households are somewhat lower for households with a male death in the south and north, and households with a female death in the central region, as compared to non-affected households (Table 8a). Surprisingly, the cultivation rates of widow-headed households (Table 8b) are higher than those of non-affected households. However, the fact that median cultivated area per AE is similar for most affected and non-affected households (with the exception of female-death households in the center and north) suggests that although the amount of land allocated for staple and cash crop production may have fallen for some affected households, it didn't fall more than what might be expected given that affected households have lower AE (and thus lower consumption requirements). In fact, this example suggests that care by used when employing cultivation rates as an indicator of labor availability and/or household welfare.

7.3 Income and Crop Diversification

Another oft-reported effect of adult mortality is reduced household income and crop diversification, especially in the event of male death (as males typically are more likely to engage in off-farm activities and/or production and marketing of cash crops). While off-farm opportunities are increasing in some areas of Mozambique, the vast majority of household income is derived from crop and livestock production. And while just over half of rural Mozambican households grow non-staple crops, the median ratio of "staple crop income/total crop income" and "total crop income/ total household income" are still quite high (median of 83%; Table 9). Thus, differences in income and crop diversification between affected and non-affected households in the Mozambican context may be difficult to observe simply because many households are heavily dependent on staple crops.

With that in mind, and considering only villages in which a death by illness has occurred,[19] affected households do not appear less likely to grow a non-staple crop. In addition, non-staple crop income relative to both total crop income and total household income are not considerably lower for affected households (Table 9). However, considering the share of crop income as a proportion of total HH income, the median household with a male death relies more heavily on crop income than non-affected households and households with a female death in the center and north. The results on crop and income diversification are not surprising, as men are more likely to be involved in cash crop schemes such as for tobacco, and are much more likely to be engaged in off-farm or own business activities than women. Thus, the death of a household male may result in the household relying even more heavily on crop income.

[19] Because cropping patterns can differ significantly by geographic area, and because incidence of PA death is not distributed randomly, calculations for "non-affected households" in this table only includes households in villages with at least one PA death.

Table 9. Median Cropping and Income Diversification Characteristics of Households With and Without PA Death, Mozambique, 2002

Household Characteristic	National			South			Central			North		
	Non-Affected HH[1]	HH with PA Male Death	HH with PA Female Death	Non-Affected HH[1]	HH with PA Male Death	HH with PA Female Death	Non-Affected HH[1]	HH with PA Male Death	HH with PA Female Death	Non-Affected HH[1]	HH with PA Male Death	HH with PA Female Death
Households growing cassava[2]												
Total Area (ha)	1.31	1.26	1.30	1.44	1.88	1.90	1.37	1.25	1.44	1.15	1.25	0.88
Cultivated Area (ha)	1.13	0.88	0.95	1.07	0.81	1.11	1.25	0.94	1.04	0.94	0.75	0.66
Cultivation rate (%)	86%	70%	73%	74%	43%	58%	91%	75%	72%	82%	60%	75%
HHs which grow cassava (%)	69%	64%	77%	72%	76%	80%	63%	52%	70%	78%	73%	88%
Cultivated area in cassava (%)	19%	25%	19%	17%	20%	23%	15%	20%	15%	25%	37%	21%
Cases[2]	816	61	73	324	26	24	307	21	30	185	14	19
Households growing non-staple crops[3]												
Total Area (ha)	1.46	1.28	1.46	1.57	1.88	1.88	1.44	0.95	1.46	1.41	1.51	1.30
Cultivated Area (ha)	1.24	1.00	1.18	1.12	1.00	1.11	1.28	0.95	1.28	1.17	1.03	1.08
HHs which grow non-staple crop (%)	59%	56%	67%	62%	54%	81%	58%	46%	68%	58%	74%	56%
Non-staple crop income / Total Crop Income	11%	7%	9%	11%	6%	27%	9%	4%	7%	15%	15%	9%
Non-staple crop income / Total HH Income	7%	6%	4%	5%	4%	7%	5%	3%	4%	10%	10%	4%
Cases[3]	710	55	63	254	20	19	310	21	31	146	14	13
Household shares of crop and non-ag income[4]												
Crop income / Total HH Income	83%	91%	74%	75%	75%	51%	81%	87%	74%	88%	100%	86%
Non-ag income / Total HH Income	17%	4%	33%	25%	18%	41%	19%	16%	38%	8%	0%	11%
Cases	4572	104	106	1215	40	34	2050	44	49	1307	20	23

Source: TIA 2002

[1] Calculations only include non-affected households in villages with a prime-age death from illness 1999-2002

[2] Calculations and case numers reflect only farmers who grew cassava, with exception of "HHs which grow cassava"

[3] Calculations and case numers reflect only farmers who grew non-staple crops (vegetables, fruits, tobacco, cashew, spices, etc), with exception of "HHs which grow non-staple crops"

[4] "Non-ag" income includes income from wage/salary, own business, remittances/pensions, but does not include income from livestock or land rental

7.4 Summary of *Ex Post* Household Characteristics

Although affected households may have incurred significant losses of income and/or land access, the available survey data enable us to conclude that they are not considerably poorer *ex post* than non-affected households. Certain sub-groups within the affected households (those in the Center which have suffered the death of male head/spouse, for example) may well have lower median incomes or land holdings after the death, as may some widow-headed households or those with high dependency ratios. Yet, effective targeting of the "hardest-hit" affected households would appear to be difficult and to require further empirical investigation, since only some affected households appear to be poorer than other households.

8. HOUSEHOLD STRATEGIES IN RESPONSE TO PRIME-AGE MORBIDITY AND MORTALITY

8.1 Introduction

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

- 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.

Yet this conceptualization is based largely upon logic and is grounded in relatively few empirical studies of how rural households are responding to prime-age adult mortality. Some research questions the extent to which these responses are generalizeable to the variable economic and social conditions in sub-Saharan Africa. 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.

Other examples include work recent research by Yamano and Jayne (2004), who use a panel data set from Kenya to investigate the effects of adult mortality on household outcomes and do not find significant reductions in area cultivated and relative shifts away from cash crops except in the case of the death of a male head/spouse (although the death of a female head/spouse led to a significant reduction in area under cereals). 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. However, Beegle (2003) also notes that the areas of highest AIDS-related mortality in Tanzania (as in Kenya) are in the Lake Victoria basin, an area with high population density and, thus, a large labor supply and relatively high labor/land ratios.

The paucity of empirical studies of rural household responses to prime-age adult mortality in Africa, as well as the relatively contentious nature of the findings from existing studies, suggests that there is an urgent need for more work in this area. This paper contributes to this information gap by investigating household responses to adult mortality in Mozambique, and whether and how these responses vary by characteristics of the deceased individual, the affected household, and the community.

8.2 Household Strategy Responses to Prime-Age Chronic Illness and Death

In the Mozambican survey, each household which had experienced the death, departure for other reasons, or chronic illness of a household member was asked to identify three principal strategies undertaken by the household to adjust their agricultural and livestock activities in response to the loss or illness of the given individual.[20] The question was posed in an open-ended fashion and was asked individually for each case of an adult death, departure, or illness. While the earlier sections have focused on households with a death, considered to be attributable to HIV/AIDS and other causes related to disease, strategies after death may be conditioned by the strategies adopted by the households during the long period of illness preceding death. Since we do not have the illness strategies identified for households with a death, we will use the households with current illness to help identify those illness-related strategies.

An initial univariate look at the household responses to adult illness and death points towards four principal findings (Table 10). First, the reported household strategies are similar to those found in other response literature, such as: reduction in area cultivated, labor applied, and assets; labor replacement or shifting among remaining household members; reduced consumption; and increased use of children for income activities. Second, the wide variety of response strategies cited by affected households highlights the difficulty in generalizing household responses across the group of affected households. This illustrates the value of investigating the characteristics of affected households and individuals that are associated with specific strategy choices, as is done below, to better understand why strategy use varies across affected households. Third, two of the most frequently cited responses to adult illness and death include reduction in area cultivated (adult illness (38%) and death (44%)) and reduced time spent weeding (12% and 22%).[21] Thus, some households appear to be adjusting land and remaining labor in such a way that suggests that these households are labor-constrained.[22] But the majority of affected households do not appear to be reducing area cultivated or weeding labor, which implies that many affected households are not as labor-constrained as conventional wisdom suggests.

[20] The observation that households employ strategies to cope with the loss of family members does not imply that they can necessarily maintain their former levels of agricultural output, income, or other measures of welfare.

[21] In this section, 'death' refers to the death of a prime-age adult due to illness.

[22] The open-ended nature of the question, which only allowed for three principal (though unranked) strategies - rather than use of more direct questions regarding changes in area cultivated, labor applied, assets, consumption, child-related strategies, etc.) - could result in underestimates of actual strategy use, given that a household could have pursued strategies in many areas, but mentioned only the three most significant to them.

Table 10. Household Strategies in Response to Prime-age Adult Chronic Illness and Death Due to Illness, Mozambique

Household Strategy	Cases of PA Adults with Chronic Illness [1]			Cases of PA Adult Deaths Due to Illness [1]		
	All	Males	Females	All	Males	Females
1. Labor replacement strategies	---- % of cases ----			---- % of cases ----		
Contracted labor to cultivate land	7.1	11.5	4.6	7.4	8.4	6.6
Increased labor use of other family members	5.4	5.8	5.1	3.7	4.9	2.7
Increased use of self-help (mutual help) with neighbors	5.4	3.7	6.4	6.8	9.1	4.9
Obtained more labor by bringing back a family member who had left the HH	0.7	0.0	1.1	0.4	0.0	0.7
Adopted or brought in children from other households	0.0	0.0	0.0	0.6	1.1	0.1
Increased use of children for income activities	5.7	2.6	7.5	4.0	6.0	2.3
Removed one or more children from school	2.8	0.6	4.1	2.7	2.0	3.3
2. Ag technology, input, cropping changes						
Cultivate less land	38.0	28.1	43.8	44.3	52.2	37.8
Reduced the labor time for weeding	12.0	10.9	12.7	22.3	25.0	20.1
Adopted or increased crops that demand less labor	4.1	0.1	6.5	3.1	3.1	3.2
3. Asset-based strategies						
Lent land to others	2.8	2.3	3.1	4.3	4.3	4.4
Rented or sold land to others	0.9	2.3	0.0	0.7	0.4	1.0
Sought loan or donation	0.7	1.1	0.6	1.7	1.1	2.1
Force to spend most of household savings	14.3	16.7	12.8	11.9	8.1	15.0
Sold large animals, such as oxen, sheep, goats, pigs, to meet urgent needs	1.3	3.1	0.2	5.3	8.3	2.9
Sold some other household asset to meet urgent needs	7.0	16.5	1.4	12.1	14.7	10.0
4. Consumption-based strategies						
Significantly reduced the quality of the diet (eat less meat, fish, vegetables)	7.4	5.4	8.5	14.1	18.4	10.5
Sent children away to live with relatives	2.0	0.0	3.3	7.8	3.9	11.0
5. Child-related strategies						
Increased use of children for income activities	5.7	2.6	7.5	4.0	6.0	2.3
Removed one or more children from school	2.8	0.6	4.1	2.7	2.0	3.3
Sent children away to live with relatives	2.0	0.0	3.3	7.8	3.9	11.0
Adopted or brought in children from other households	0.0	0.0	0.0	0.6	1.1	0.1
Other	2.9	3.7	2.4	0.0	0.0	0.0
No strategy stated	39.8	40.0	39.6	33.8	27.0	39.4
Cases	143	58	85	217	105	112

Source: TIA 2002

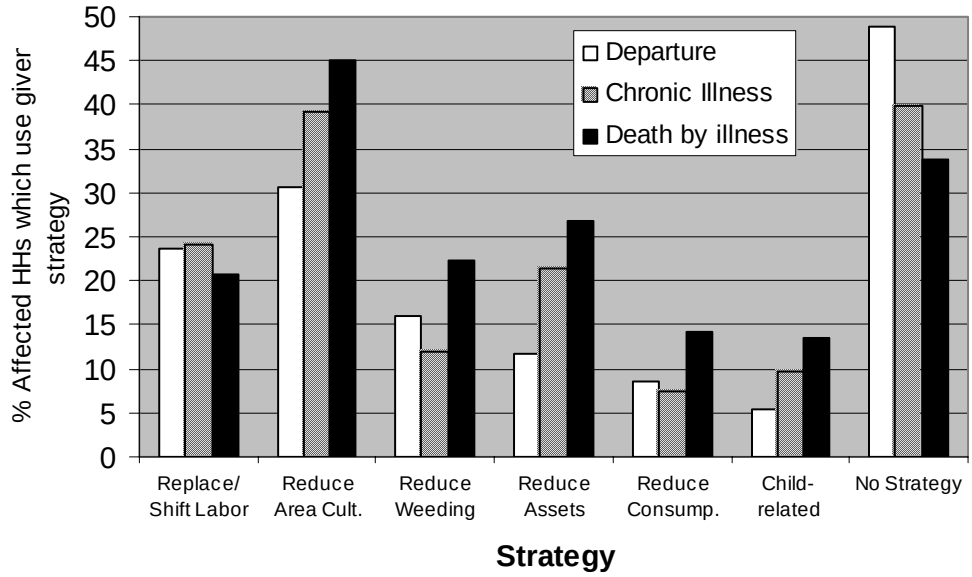
[1] Columns do not sum to 100% because households were asked for up to 3 strategies.

The fourth principal finding is related to the second in that nearly a third of the households with either adult illness (40%) or mortality (34%) declared that they had 'no strategy' response. While the relatively high percentage of households which responded with 'no strategies' could possibly be a result of respondent fatigue (the mortality component was at the end of the extensive household survey), the following analysis demonstrates that characteristics of the affected individuals and households help to explain why the agricultural activities of some households appear to be less affected by adult illness and death. In the following sections, the strategies from Table 10 are organized into six groups to facilitate comparisons by characteristics of the affected individual and of the household.

8.3. Comparison of Household Strategy Responses to Prime-Age Departure, Chronic Illness, and Death

Comparison of the likelihood of strategy use by event (departure, illness or death of a prime-age adult) leads to several findings (Figure 4). First, it is not surprising that households were more likely to state use of strategies if there was a death rather than an illness or departure for other reasons. Second, the use of strategies in response to chronic illness suggests that some households begin to adjust labor, land, and assets during the illness period, thus potentially reducing their flexibility of response later (i.e., they may not cite asset reduction as a strategy after the death of the individual if assets were already depleted during that individual's period of illness). Third, strategy use in response to adult departures demonstrate that death and illness are not the only events that reduce household's labor and assets; 16.4% of Mozambican households lose adult children to migration and marriage, and are forced to adjust to the loss of that individual's contributions to agricultural activities (Figure 4). However, unlike in the case of illness or death, many departures (such as migration) may well have a positive net impact on the household if remittances are sent back by the departed family member.

Figure 4. Response to Departure, Illness, and Death by Illness of a Prime-Age Adult, Mozambique 1999-2002



8.4 Household Strategy Responses by Gender of the Deceased Adult

There are several important gender differences in household responses to adult death (Figure 5b). First, a male death is less likely to result in a response of 'no strategy' than a female death, suggesting that a male death is more likely to force the household to adjust their agricultural activities due to the loss of that individual. In addition, a male death is more likely to result in efforts to replace/shift labor, reduce area cultivated, and to reduce weeding labor, than a female death. On the other hand, a female death is more likely to result in child-related strategies, which may be due to the fact that women typically provide most child care duties for the family, and that children may be closer substitutes for a typical rural woman's labor activities (weeding, gathering water, firewood, cooking, etc.) than for those of a man (especially non-farm activities).

8.5 Comparing Household Strategies in Response to Chronic Illness and Death

Another gender difference in household response to adult death is found in comparing strategies used in response to chronic illness as opposed to death (Figure 5a, 5b). Households with female rather than male illness are more likely to reduce area cultivated (48% to 28%), yet in response to death, the percentage for females stays the same while that for male death jumps to 52%. This suggests that households begin to adjust agricultural activities during the period of a woman's illness, while the adjustment for a man is more likely to occur after death. This could be explained by the fact that women tend to supply more overall labor to the household economy, thus when a woman falls ill, the household is less likely to be able to maintain the household's former levels of domestic and on-farm labor.

Figure 5a. Strategies in Response to Prime-Age Adult Chronic Illness by Gender, Mozambique, 1999-2002

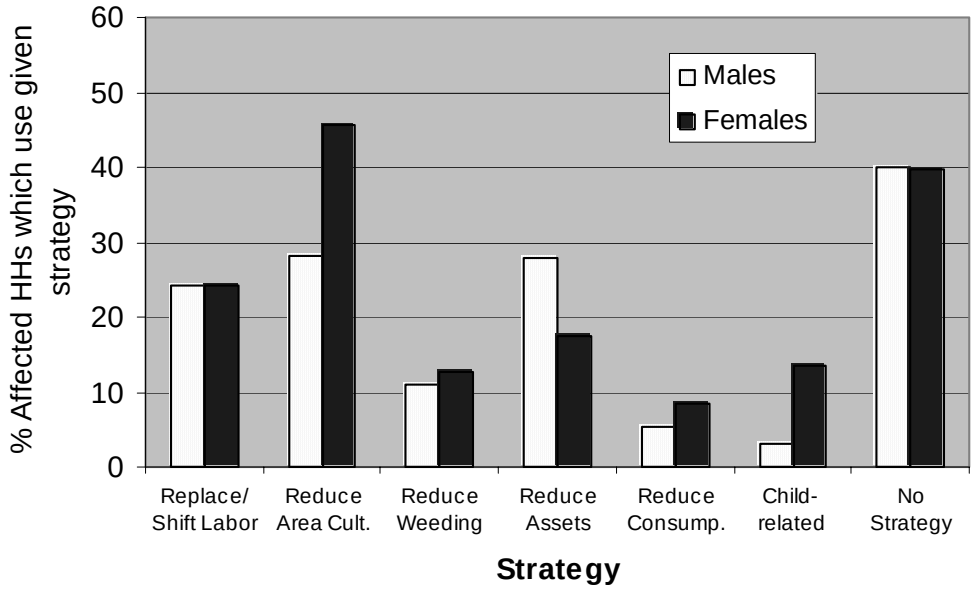
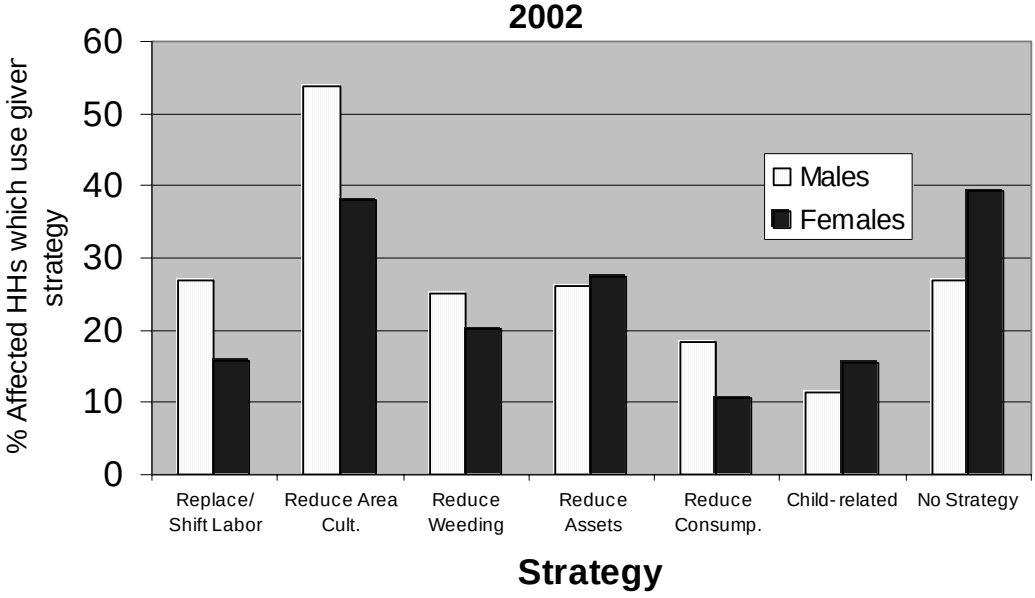
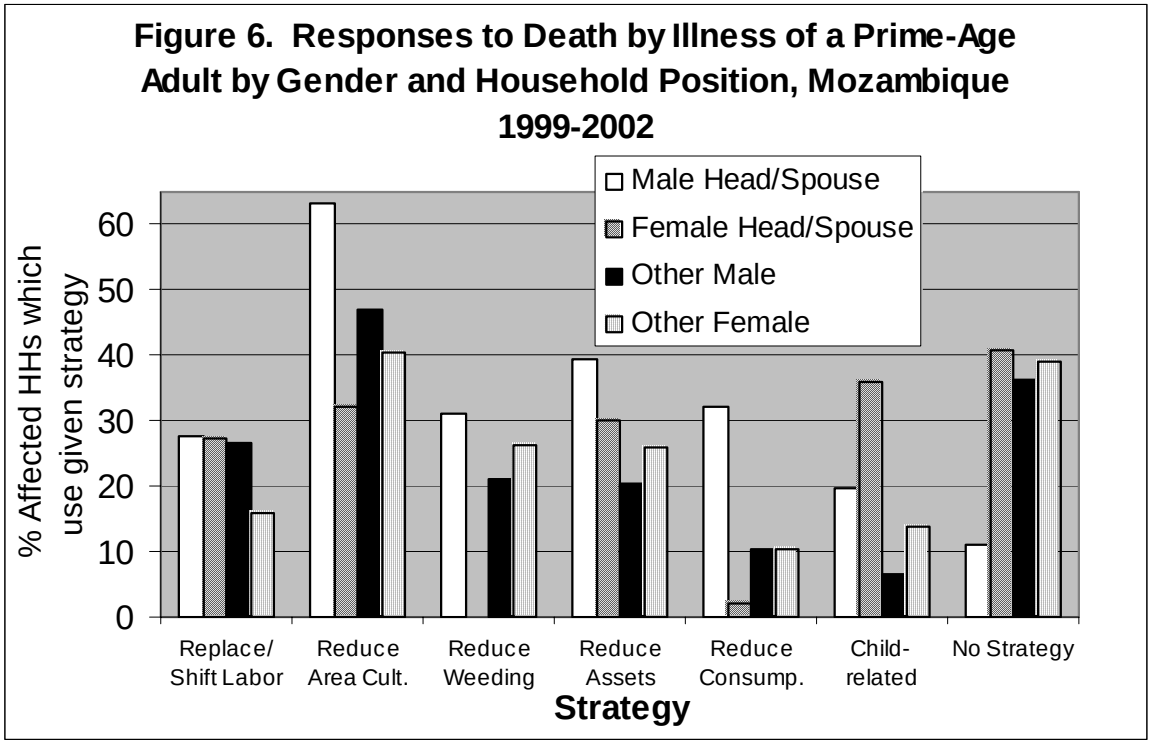


Figure 5b. Strategies in Response to Prime-Age Adult Death From Illness by Gender, Mozambique, 1999-2002



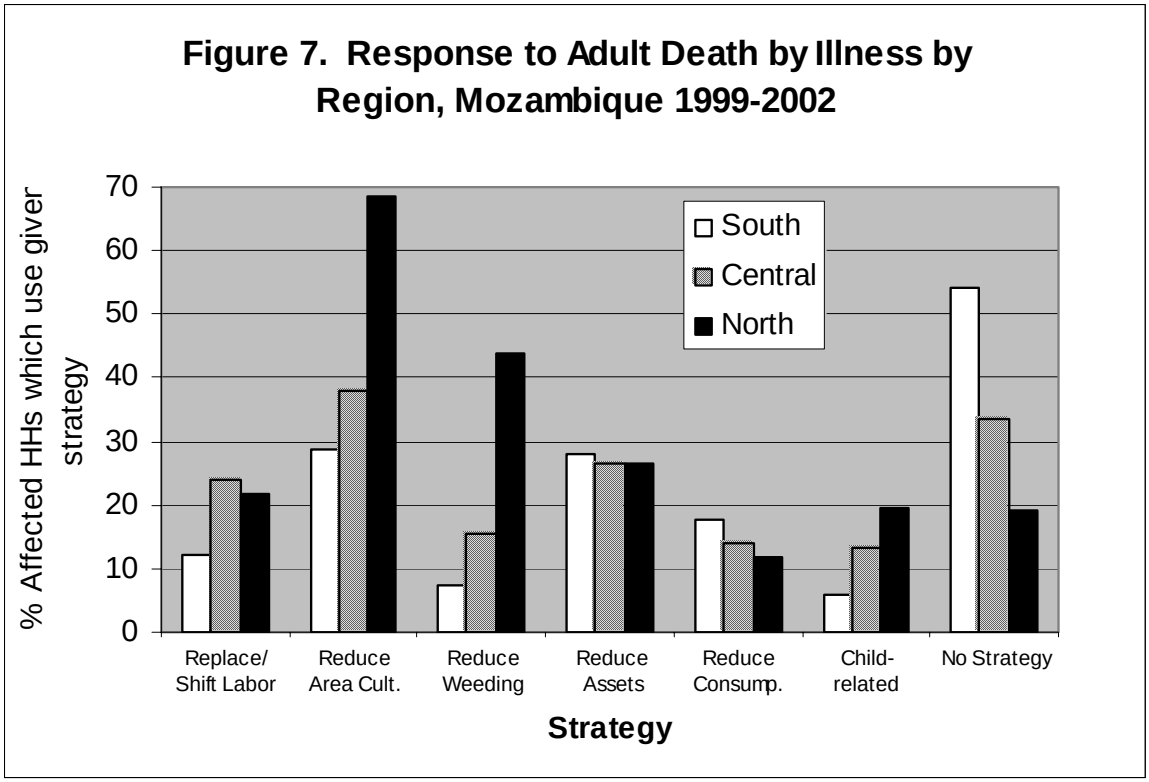
8.6 Household Strategies by Gender and Household Position of the Deceased

As shown in Figure 6, strategy use varies considerably by the gender and household position of the deceased, with strategy responses more likely given the death of a male head/spouse. First, the death of a male head/spouse is very unlikely to result in a 'no strategy' response, as only 11% of these households reported 'no strategy.' The strategies that are indicated by these households with a male head/spouse death include reduction of area, assets and consumption. Considering that the respondent may be the widow, bias cannot be excluded. When a female head/spouse dies, there is higher likelihood of child-related strategies being declared. Labor replacement/shifting is similar across the people of different roles in the household.



8.7 Household Strategies by Region

Strategy use varies considerably by region (Figure 7). For example, affected households in the North are much more likely to reduce area cultivated and weeding labor, possibly because household size and number of PA adults is somewhat smaller ex ante. Households in the Center region have larger area and weeding effects than in the South, perhaps because southern households tend to be more diversified into off-farm income and livestock, with agriculture a less important activity. The implication of this finding is that interventions designed to mitigate the loss of labor and other possible effects of death shocks in Mozambique should be aware of regional differences in household labor availability, on-farm labor demands, and household responses to adult mortality.



8.8 Probit Analysis of Household Strategy Use: Reduction in Area Cultivated

To understand the factors related to selecting a particular strategy, probit regression analysis was conducted on the most frequently-used strategy, “reduction in area cultivated.” In this estimation, only affected households are included, and those selecting a strategy are compared to those not selecting a strategy, in terms of characteristics of the affected household, the deceased individual, and the village.

The probit analysis shows that there are various significant factors associated with the choice of "area reduction” as a response strategy (Table 11). First, area reduction is more likely to occur in the central and north regions, which, as noted previously, may be due to the larger reliance on agriculture relative to the south, as well as smaller family sizes on average before and after death. Among the household characteristic factors, neither of the coefficients on household income/AE or total household landholding/AE are significant, which is surprising as we would expect wealthier households to be better able to adjust to labor loss (by hiring labor, for instance), while we would expect households with higher land/labor ratios to be more likely to reduce area cultivated. However, the signs of these coefficients are as expected (positive for landholding and negative for income). Another household characteristic is “percentage change in HH AE from 1999 to 2002", the coefficient for which is large and significant, suggesting that households that lose a large relative amount of available labor are more likely to have to reduce area cultivated.

Turning to characteristics of the deceased, the death of a male head/spouse is associated with a significant increase in the likelihood of area reduction. This may be explained by the fact that male heads are more likely than non-head males to engage full-time in on-farm

agricultural activities. A dummy variable to control for deaths which occurred earlier (1999-2000) in the recall period (1999-2002) is insignificant, suggesting that there is no difference among affected households in strategy use.

The coefficient on a village dummy for "principal access road to village is paved" is significant and negative, indicating that villages with better access may have more dynamic labor markets. The coefficient on a separate village dummy measuring the log of agricultural population density is insignificant but of the expected negative sign; villages with more individuals engaged principally in agriculture per cultivated hectare would be expected to have fewer off-farm opportunities and thus more potential slack agricultural labor. Another village dummy with labor market interpretation is that for "factory", whose coefficient is significant and positive, perhaps implying that the presence of a factory increases the opportunity cost of time in the village, and thus the opportunity cost to an affected family of either hiring additional labor or shifting labor from another activity into on-farm work.

Village dummies are also included for the presence of a hammer mill and the location of the principal water source (out of the village). We would expect a hammer mill to help save the time spent by women on food preparation, while a water source within the village may save time in water collection. The coefficient for presence of a hammer mill in the village is not significant, but is of the expected (negative) sign. The coefficient for "principal water source located outside" the village is not significant and is unexpectedly negative.

Table 11. Probit Estimates of Use of Strategy "Reduction in Area Cultivated" by Households with a Prime-Age Adult Death due to Illness

Factors	Reported Use of Strategy "Reduction in Area Cultivated" (Yes=1, No=0)	Mean Value
Constant	-0.312*** (-3.30)	
Central Region	0.172* (1.73)	0.438
North Region	0.535*** (4.83)	0.207
HH Characteristics:		
2002 HH Total Area /Adult Equivalents (AE)	0.013 (0.43)	0.635
2002 HH Total Income / AE	-0.000 (-1.01)	2198
% change in HH Adult Equivalents 1999-2002	0.449** (2.40)	0.168
Characteristics of the Deceased Prime-age adult:		
Male Head/Spouse	0.238** (2.20)	0.138
Death occurred in 1999 or 2000	0.089 (1.17)	0.406
Village factors:		
Principal access road to village is paved	- 0.197** (-2.14)	0.245
Factory	0.383** (2.26)	0.057
Hammer Mill in this village or adjoining village	-0.124 (-1.47)	0.471
Principal village water source is outside of village	-0.061 (-0.64)	0.183
Log(Agricultural Population Density)[a]	-0.112 (-1.15)	0.182
[a] (# prime-age adults in village / total village area cultivated) *** significant at the 0.01 level ** significant at the 0.05 level * significant at the 0.10 level Coefficients calculated as dF / dX (z stat in parentheses)	N = 212 LR chi2(12) = 49.5 prob > chi2 = 0.0000 Log Likelihood= -118.0 Psueudo R2 = 0.173	

Source: TIA 2002

8.9 Probit Analysis of Household Strategy Use: Reduction in Weeding Labor

Similar probit analysis of the strategy of "reduction in weeding labor" yields only a significant and positive coefficient on "% loss in household AE" (0.19) -- smaller in magnitude than that found for the strategy of cultivated area reduction – and on the north region dummy (0.33). The lack of significant coefficients may be explained by the relatively small number of cases in which this strategy was used (n=47) and that earlier descriptive analysis showed little difference in use of this strategy by gender or household position of the deceased. The lack of difference in use of this strategy by characteristics of the deceased suggests that the demand for weeding labor is less timely and/or less specific to household members (and thus more easily replaced by remaining family labor) than labor required for land cultivation.

8.10 Summary of Household Strategy Responses

In summary, it should be noted that the observation that households employ different strategies to cope with the loss of family members does not imply that they can necessarily maintain their former levels of agricultural output, income, or other measures of welfare. Nevertheless, the significant effects of household compositional changes, characteristics of the deceased, and region on strategy choice demonstrates that household responses to adult mortality are considerably more heterogeneous than depicted by some of the literature. This heterogeneity has implications for the appropriateness and/or the targeting of interventions to mitigate the effects of adult mortality.

For example, the loss of family labor due to a death in the household does not necessarily mean that agricultural labor becomes the household's principal production constraint – some affected households are able to replace agricultural labor through hiring, arrival of new members, or mutual help. Other households may vary the proportions of land, labor and cash inputs used, and/or adjust their cropping patterns, based upon their post-death mix of resources (Jayne et al. 2004). The finding that 44% of affected households indicated crop area reduction while 22% indicate reduced weeding as adjustment strategies provides further evidence that not all affected households appear to face a binding labor constraint in agriculture. 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. Given the extent of rural poverty and the lack of broad-based rural economic productivity growth in Mozambique (Walker et al. 2004), 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, as discussed below in more detail.

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 Mozambique, as in many 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 in Mozambique are not available,[23] a recent study in neighboring Zambia (with similar manual cultivation practices) 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).

As presented earlier, analysis of demographic changes and *ex post* income of affected households in Mozambique 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.

By contrast, it is still unclear that some of the proposed LSTs for agriculture would be appropriate for many affected households, a majority of which have not responded to a PA death by reducing cultivated area or weeding labor, and thus do not appear to face a binding labor constraint in agriculture. For example, the introduction of less labor-intensive crops

[23] A study from Zambezia province (Hilton 2001) which collected labor data on crop production (but not other household activities) demonstrates that women provide roughly 1-15% more labor time across various crops than men, which corroborates rapid appraisal estimates which claim that women account for approximately 63% of agricultural labor in Mozambique (Arndt 2002).

and cultural practices is often mentioned as an appropriate mitigating solution, yet if less labor-intensive crops were appropriate, would we not expect to see affected households with more relative area in cassava than non-affected households? Besides that, a shift to cassava in place of maize can imply increased labor for food processing and displace specific nutrients in the diet. Another example is that of conservation farming, which reduces weeding labor demands over time but involves substantial upfront labor costs. Likewise, herbicides reduce weeding labor demand but require both financial means to purchase them and training on their proper use, both unlikely to be available in Mozambique, 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.

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 Mozambique are relatively young and currently reach very few farmers. Few farmers have had access to and adopted improved varieties or cultural practices. Thus, shifting the focus of the limited financial and human capacity of the Mozambican 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.

While definitive answers to these questions for Mozambique are not yet possible, this research sheds light on some aspects. Both the results from analysis of household composition and factors associated with choice of response strategy with respect to area cultivated and weeding labor 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 neighboring Zambia suggests 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 AND IMPLICATIONS

While there is general agreement that HIV/AIDS will have serious effects on agriculture and rural development in Africa, HIV/AIDS mitigation policies are currently being proposed with little empirical information on which individuals and households are most affected, how they are affected, and how they are responding to the death of a prime-age adult. 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 outcomes compare with the non-affected household population. Thus, it is not clear that these suggested mitigation policies are more appropriate for a majority of affected households and more feasible relative to alternative investments.

This paper uses nationally representative rural household survey data from Mozambique to evaluate the characteristics of affected individuals and households, household demographic changes and livelihood adjustment strategies taken in response to prime-age death. Research in Southern Africa and elsewhere has demonstrated that the increases in PA adult mortality in regions affected by HIV can be largely attributed to HIV/AIDS. Thus identifying those households with such a death can proxy for identifying HIV/AIDS-affected households, particularly where death from accidents and murders can be excluded, as was done in this research in Mozambique.

The geographic patterns of PA adult deaths in the TIA survey correlate well with recent HIV/AIDS prevalence statistics, with few exceptions where the overall prevalence rates are strongly based on urban measurements with high prevalence (as in Sofala Province), lending validity to the approach. Given the relatively low marginal costs of adding such modules to existing rural household surveys, this method may be appropriate in many countries in the region, providing vital information for policy makers on rural mortality rates, as well as information on rural household income, agricultural production, etc.

Survey findings on the characteristics of affected individuals show that affected PA women tend to be younger than affected PA men, and that PA women are more likely than men to die from illness (62%). These results concur with previous estimates of HIV prevalence in Mozambique, which have shown women to represent a majority of the total HIV positive population. However, in contrast to the general assumption that HIV-related mortality is typically associated with household heads/spouses, the survey findings show that only one-third of affected PA adults in Mozambique were household heads/spouses, while two-thirds of non-affected PA adults are household heads/spouses. Because household heads/spouses are more active in on-farm agriculture and more likely to have children than "other" household members, this would suggest that the potential magnitude of rural PA mortality on agriculture and orphaning rates may be less than those predicted by some of the literature.

Given the potentially negative effects of a PA adult death on the labor available to an affected household, we investigate changes in household composition from 1999-2002 for both affected and non-affected households. The results demonstrate that affected households do

not uniformly appear to have less available PA labor than non-affected households, either because affected households are able to attract new PA members or because they had more PA adults prior to death.

Although affected households may have incurred significant losses of income and/or land access, the survey findings demonstrate that the average *ex post* income of affected households is not significantly lower than that of non-affected households. These findings have important implications for potential targeting of HIV/AIDS mitigation programs. Certain sub-groups within the affected households (those in the center of the country which have suffered the death of male head/spouse, for example) may well have lower median incomes or land holdings after the death, as may some widow-headed households or those with high dependency ratios. Yet, results from this research demonstrate that effective targeting of the "hardest-hit" affected households would appear to be difficult. If careful targeting is desired, the results suggest that further empirical investigation would be required, since only some affected households appear to be poorer than non-affected households.

Analysis of strategy responses of affected households shows that 44% of affected households indicated crop area reduction while 22% indicate reduced weeding as adjustment strategies, suggesting that not all affected households appear to face a binding labor constraint in agriculture. Other strategies indicate why this may be the case, as some affected households attempt to replace lost agricultural labor through hiring, arrival of new members, or mutual help.

Probit analysis of the characteristics of affected households shows significant effects of household compositional changes, characteristics of the deceased, and region on a household's use of cultivated area reduction as a response strategy. This further demonstrates that household responses to adult mortality are considerably more heterogeneous than depicted by some of the literature.

Among other things, this heterogeneity of household responses to PA mortality has significant implications for technological policies such as the development of labor-saving agricultural technologies. Given scarce financial and human capital resources for applied technology research in Mozambique, as in many 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 well; fuel-efficient stoves). While definitive analysis of these options for Mozambique is not yet possible, this and other research begins to shed light on the comparison.

Both the demographic change results and those of response strategy choice with respect to area cultivated and weeding labor suggest for many affected households, 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. In addition, available time-use data from neighboring Zambia suggests that the returns to investing in LSTs for 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. 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. Given the extent of rural poverty

and the lack of broad-based rural economic productivity growth in Mozambique, 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.

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