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Using Empirical Information in the Era of HIV/AIDS to Inform Mitigation and Rural Development Strategies: Selected Results from African Country Studies

by

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EXECUTIVE SUMMARY

It is widely believed the HIV/AIDS epidemic will have substantial socioeconomic impacts in Sub-Saharan Africa, including on the agricultural sector. While the implications of the disease for research in the health fields are well established, there is a growing awareness that the spread of HIV/AIDS is influenced by economic and social conditions, and the economic consequences of the disease can be influenced by policies and institutions that affect behavior. Agricultural economists have an important role to play in anticipating these consequences and identifying their implications as part of the work needed to better inform agricultural and rural development policy.

The determination of mitigation policies has lacked an empirical foundation regarding which households are most affected, how those households respond to illness and death, and the interventions that would best fit into their needs. While the few available micro-level and purposive studies have provided valuable information, such insights are limited in their ability to be extrapolated to the national level, due to small, concentrated samples, often without a representative non-affected population to provide a counterfactual or a context for interpreting the demographic and welfare characteristics of affected individuals and households.

This paper summarizes empirical results from a synthesis of a set of country studies undertaken by Michigan State University and partner institutions in five African countries, each of which is based upon large-scale rural household surveys. The results demonstrate that the post-death land/labor ratios and income of rural households directly affected by prime-age adult mortality are more heterogeneous than implied by some of the literature and discussion among development practitioners. Although affected households may well have suffered negative effects on household crop production and income, most affected households have similar *ex post* demographic characteristics, land/labor ratios, asset levels, and household incomes as compared to households without a death. However, there are some categories of affected households which appear to be in greater need of interventions, for those which have suffered the death of a household head or spouse tend to have lower *ex post* land/labor ratios and income relative to households without a death, and thus are more likely to be in poverty.

Results question the usefulness of a homogeneous conceptualization of 'affected households,' especially in the context of proposals for targeted assistance and technology development. The implications of this heterogeneity are important for the design of HIV/AIDS mitigation strategies, as well as for considering the HIV/AIDS epidemic within the context of rural poverty alleviation and growth strategies.

Results also highlight the value of representative survey research in investigating the characteristics of individuals and households affected and in measuring impacts of adult mortality within the context of a representative sample of the non-affected population. The general approach taken in these studies demonstrates that including a mortality/morbidity component in an ongoing large, representative rural household survey is a relatively cost-effective way to investigate the (pre-and/or post-death) characteristics of affected individuals and households and measure mortality impacts.

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1. INTRODUCTION

It is widely believed that the HIV/AIDS epidemic will have substantial socioeconomic impacts in Sub-Saharan Africa, including on the agricultural sector. While the implications of the disease for research in the health fields are becoming well established, there is a growing awareness that the spread of HIV/AIDS is influenced by economic and social conditions, and that the economic consequences of the disease can be influenced by policies and institutions that affect behavior. Social scientists, including agricultural economists, have a major role to play in identifying institutional and policy changes that may influence behavior to reduce the spread of the disease and mitigate its impacts. Moreover, because HIV prevalence rates in some African countries are estimated to exceed 20% among the prime-aged (15-49 years old) population, the disease is likely to have profound effects on the agricultural sectors of these countries, which already face serious development challenges. Agricultural economists therefore have an important role to play in anticipating these consequences and identifying their implications for agricultural and rural development policy.

To date, most attempts to assess the impacts on the agricultural sectors of hard-hit African countries have relied heavily on the simple logic that loss of an adult due to AIDS causes severe labor constraints in households, resulting in lower area cultivated and a shift toward less labor intensive (lower value) crops, such as cassava or sweet potatoes, and away from more labor intensive (higher value) cash crops (Toupouzis and du Guerny 1999; Harvey 2004). If these potential effects obtain and are combined with possible losses in off-farm or self-employment income from the person who had died, many affected households are expected to fall into poverty. The subsequent implication of this logic is that the HIV/AIDS mitigation policy should prioritize agricultural labor-saving technologies and other assistance such as food aid targeted to affected households. There is relatively little empirical research to date which can confirm whether this scenario is generally representative of affected households and their needs. Thus, while the epidemic will have serious effects on agriculture and rural development in Africa, the determination of mitigation policies has lacked an empirical foundation regarding which households are most affected, how those households respond to illness and death, and the interventions that would best fit into their needs.

Some of the few available micro-level studies of the effects of HIV/AIDS on rural households have used a case study approach, focusing on geographic areas known to have high HIV prevalence. These areas are purposively chosen to ensure observation of ample numbers of directly-affected households. While providing valuable information, such studies are limited in their ability to extrapolate to the national level, due to small, concentrated samples, often without a representative non-affected population to provide a counterfactual or a context for interpreting the demographic and welfare characteristics of affected individuals and households.

This paper summarizes empirical results from a synthesis of a set of country studies undertaken by Michigan State University and partner institutions in five African countries, each of which is

based upon large-scale rural household surveys.[1] These studies investigate the effects of prime-age adult mortality on rural households by including a mortality/morbidity component in nationally-representative rural demographic and socio-economic household surveys. Our results demonstrate that although affected households may well have suffered negative effects on household crop production and income, the *ex post* land/labor ratios and household incomes of affected households are quite heterogeneous, the mean and median values of which are similar to those of households without a death. However, there are some affected households which appear to especially be in need of assistance, for those which suffered the death of a household head or spouse tend to have lower *ex post* land/labor ratios and income relative to households without a death, and thus are more likely to be in poverty. These results question the usefulness of a homogeneous conceptualization of 'affected households,' especially in the context of proposals for targeted assistance and technology development. The implications of this heterogeneity are important for the design of HIV/AIDS mitigation strategies, as well as for considering the HIV/AIDS epidemic within the context of rural poverty alleviation and growth strategies.

The results also demonstrate the value of large sample representative household survey research in investigating the characteristics of individuals and households affected and in measuring impacts of adult mortality within the context of a representative sample of the non-affected population. Combining demographic and mortality data with production and income data collected regularly from household surveys is a relatively cost-effective way to investigate the (pre-and/or post-death) characteristics of affected individuals and households and measure mortality impacts.

1.1. Data and Approach

In each of the country studies summarized here, researchers and their collaborators included a mortality and morbidity component in large representative rural demographic and socio-economic household surveys. The Kenya and Malawi studies are based on panel surveys separated by three and ten years, respectively, which facilitate measurement of impacts of prime-age mortality on behavior and welfare.[2] While panel components are in progress in Mozambique and Zambia, to date these studies (and that from Rwanda) are cross-sectional and utilize retrospective information on households' death history and general household demographics.[3] For comparability purposes in this paper, we examine the post-death (*ex post*) demographic, land, and income characteristics of affected and non-affected households in the five country studies, as well as among affected households which have lost a head of household or spouse as

[1] For details on these nationwide studies in Kenya, Rwanda, Malawi, Mozambique and Zambia, see Yamano and Jayne (2004); Yamano and Jayne (2004); Donvan et al. (2003); Mather et al. (2004a); Mazhangara (forthcoming); and Chapoto, Jayne, and Yoo (2004). These studies are summarized more fully in Mather et al. (2004b).

[2] A major difficulty in measuring the impact of adult mortality, especially mortality attributable to AIDS, is that it is caused by behavioral choices rather than by random events. If PA mortality is correlated with individual and household characteristics, prior to the onset of illness, such as social status, wealth, and mobility – which are also important determinants of, for example, school enrollment – failure to control for these characteristics may generate biased estimates of the impact of adult mortality on school attendance.

[3] In the cross-sectional surveys, respondents provided retrospective data on mortality within the household over a specified period (from 1999-2002 in Mozambique; 1999-2002 in Rwanda; 1996-2000 in Zambia).

compared with those which have lost a non-head/spouse adult.[4] Where possible, we complement the *ex post* analysis with impact results from the panel studies.

We define an "affected" household as one which has suffered a prime-age (PA) 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).[5] While not all adult deaths due to illness can be attributed to AIDS in any given country or region, recent epidemiological studies demonstrate that in Eastern and Southern Africa, HIV is the leading cause of disease-related death among adults between 15 and 49 years of age (UNAIDS/WHO 1998; Ngom and Clark 2003). Not surprisingly, variations in provincial-level mortality rates among PA individuals in our household survey data are highly correlated with variations in HIV prevalence rates at antenatal clinics (Mather et al. 2004a). Moreover, the increasing literature on the dynamics of poverty requires a better understanding of the effects of PA adult mortality, regardless of cause, on household behavior and welfare.

Some literature questions the reliability of household-level survey research on adult mortality, arguing that widespread household dissolution due to adult mortality would bias the characteristics of affected households and lead to underestimates of the effects of adult mortality on household income, crop production, etc. (de Waal 2003). Yet we find low total attrition rates in the Kenya and Malawi panels (5.6% from 1997-2000; 14% from 1990-2002). Moreover, only a small proportion of household attrition in these panel surveys is due to household dissolutions (Yamano and Jayne 2004; Mather et al. 2004a).

1.2. Characteristics of Deceased Individuals

In contrast to the general assumption that HIV-related mortality is typically associated with household heads/spouses, the survey findings show that in four of the five countries researched here, a majority of deceased PA adults are not household heads/spouses, and thus not likely to be the primary breadwinners of the household (Table 1). While death of any kind undoubtedly brings hardship and suffering to affected households, it is important to note that the magnitude of the economic consequences appears to vary significantly according to the extent to which the deceased tend to be primary breadwinners and core members of the household, as well as the household's *ex ante* asset levels (Yamano and Jayne 2004; Drimie 2002).[6] These results suggest the potential magnitude of rural PA mortality on rural household agricultural and off-farm

[4] With the exception of Malawi, the selected *ex post* characteristics of affected households are essentially short-run given that the PA death occurred one to four years prior to the observation. The longer-term situation of households which suffered a head/spouse death could be worse (in a few years) in the event that the widow/widower is HIV positive. In addition, the validity of using non-affected households as a control group could be questioned in the event that many non-affected households are indirectly affected by mortality around them.

[5] The age range defined as 'prime-age' differs by country, but is generally 15 to 49. The use of "affected households" in this paper refers only to cases of prime-age death due to illness and excludes cases of current illness, and does not mean to imply that households without a death are not potentially affected by a death in their community or family.

[6] Further research is warranted to investigate if the 'non-head/spouse' PA deceased adults had recently moved back to their rural (observed) home, leaving affected urban households (unobserved).

Table 1. Gender and Household Position of Deceased and Healthy Prime-age Adults by Country

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

Source: Mather et al. (2004b); Chapoto and Jayne (2005).

incomes may be less than those predicted by some of the literature. It may also help to explain the relatively low household dissolution rates found in the Kenya and Malawi panel data sets.

1.3. *Ex post* Household Characteristics of Affected and Non-affected Households

1.3.1. Labor Availability

Some of the theoretical literature on the effects of adult mortality proceeds to list the effects on agricultural activities that result from the loss of labor and/or wages formerly provided by the deceased PA adult without consideration of the potential for demographic responses by the household to adjust to this loss.[7] Our results demonstrate, with the exception of Mozambique, the average affected household has as many, if not more, PA adults *ex post* than non-affected households (Tables 2 and 3). One reason may be the entry of new household members,

[7] 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, while a study in Rakai, Uganda (Menon et al. 1998) found that, on average, affected households in these areas were unable to attract new members.

Table 2. Selected *ex post* Characteristics of Rural Households With and Without Prime-age Death: Kenya and Malawi

Household Characteristic		Kenya (2000)				Malawi (2002)			
		Non-Affected HHs[1]	HH with PA Death[2]	HH with Head / Spouse Death	HH with Other Death	Non-Affected HHs[1]	HH with PA Death[2]	HH with Head / Spouse Death	HH with Other Death
		------- mean value -------				------- mean value -------			
Household Size (persons)		6.5	6.3	5.6	6.9	5.5	5.2	4.5	6.2
No. of Prime-Age Adults (persons)		3.4	3.3	2.8	3.6	2.7	2.7	2.5	3.0
		------- median value -------				------- median value -------			
Cultivated Land Area (hectares)		1.11	1.21	1.21	1.21	0.94	0.92	0.76	1.36
Cultivated Land Area/capita (ha/capita)		0.20	0.20	0.17	0.20	0.20	0.21	0.19	0.26
Total Income ('000 local currency)		94.0	73.6	70.5	82.6	33.9	29.6	22.5	39.7
Total Income/capita ('000 l.c./capita)		15.0	13.3	13.6	11.7	7.9	6.6	5.8	7.8
		-- % of HH in each quartile --				-- % of HH in each quartile --			
Provincial quartiles of HH per Capita Income (%)	Lowest	24.4	27.7	28.6	27.1	26.3	22.3	24.4	19.2
	Mid-low	25.5	21.7	20.0	22.9	25.9	25.4	29.3	19.9
	Mid-high	24.6	30.1	25.7	33.3	24.6	28.6	23.1	36.5
	Highest	25.5	20.5	25.7	16.7	23.2	23.7	23.1	24.5
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of Households in analysis		702	83	35	48	288	72	45	27

Sources: Authors' estimates based on data from Tegemeo Institute, 2000 (Kenya); Mazhangara, forthcoming (Malawi)

notes: 1. Column only includes households from villages with at least one PA death.

2. PA death occurred between 1997-2000 (Kenya) or 1990-2002 (Malawi).

Table 3. Selected *ex post* Characteristics of Rural Households With and Without Death: Mozambique, Rwanda, and Zambia

		Mozambique (2002)				Rwanda (2002)				Zambia (2000)			
Household Characteristic		Non-Affected HHs[1]	HH with PA Death[2]	HH with Head / Spouse Death	HH with Other Death	Non-Affected HHs[1]	HH with PA Death[2]	HH with Head / Spouse Death	HH with Other Death	Non-Affected HHs[1]	HH with PA Death[2]	HH with Head / Spouse Death	HH with Other Death
		------- mean value -------				---- mean value ----				---- mean value ----			
Household Size (persons)		5.2	4.8	4.3	5.0	4.9	5.2	5.5	4.8	5.7	6.5	5.3	6.7
No. of Prime-Age Adults (persons)		2.3	2.0	1.6	2.1	2.5	2.6	2.8	2.5	2.6	2.9	2.3	3.1
		------- median value -------				------- median value -------				------- median value -------			
Cultivated Land Area (hectares)		1.36	1.10	1.20	1.08	0.63	0.57	0.59	0.54	1.43	1.56	1.46	1.58
Cultivated Land Area/capita (ha/cap)		0.31	0.28	0.33	0.26	0.15	0.13	0.13	0.13	0.30	0.30	0.32	0.30
% cultivated area in roots/tubers (%)		26%	30%	42%	25%	46%	45%	50%	38%	55%	52%	51%	52%
Area/capita in roots/tubers (ha/cap)		0.079	0.082	0.148	0.057	0.065	0.057	0.065	0.047	0.171	0.148	0.165	0.140
Total Income ('000 local currency)		3,114	2,673	2,118	3,293	212	191	209	159	950	1,006	808	1,108
Total Income/capita ('000 l.c./cap)		731	555	491	614	45	39	44	36	192	186	173	193
		-- % of HH in each quartile --				-- % of HH in each quartile --				-- % of HH in each quartile --			
Provincial quartiles	Lowest	25.0	25.3	22.2	27.9	24.5	31.1	32.6	30.7	24.3	27.6	28.4	27.3
of HH per Capita	Mid-low	24.2	30.9	44.5	26.1	24.8	26.1	19.7	33.5	25.2	22.7	24.3	22.0
Income (%)	Mid-high	25.5	20.5	14.9	20.2	25.0	24.6	22.7	26.5	25.0	23.8	20.6	25.1
	Highest	25.3	23.3	18.3	25.7	25.7	18.2	25.1	9.4	25.5	25.9	26.7	25.6
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of Households in analysis		1,317	202	44	138	657	64	35	30	4,606	725	147	536

Sources: Authors' estimates based on data from TIA 2002 Rural Household Survey (Mozambique); FSRP/DSA Rural labor and deaths survey, 2002 and FSRP/DSA Demographics Survey, 2001 and Household Living Standards Survey, 2002 (Rwanda) / Supplement to PHS 1999/2000 (Zambia).

notes: 1. Column only includes households in villages with at least one PA death.

2. PA death occurred between 1999-2002 (Mozambique, Rwanda) or 1996-2000 (Zambia).

especially in the case of a PA female death, as was found in Mozambique and Rwanda using recall data (Mather et al. 2004a). Another explanation is that households which lose a non-head/spouse adult tend to have on average more PA adults and a larger household size prior to death (*ex ante*) relative to non-affected households, as we found in Kenya, Malawi, and Mozambique. However, in Kenya and Mozambique, the lowest mean *ex post* number of PA adults is found among households with a head/spouse death, suggesting that these households may be more likely to face labor constraints (particularly those which lose a male head/spouse).

1.3.2. Land/labor Ratios

If affected households face agricultural labor constraints in general, then we might expect total land cultivated of affected households to be lower than those of their non-affected neighbors. While *ex post* median area cultivated is somewhat lower among affected households as compared with non-affected households for all countries except Zambia, *ex post* area cultivated per capita is similar to that of non-affected households (Tables 2 and 3). Comparison of *ex post* land/labor ratios across different types of affected households shows no pattern across the countries. However, the Kenyan impact analysis found larger (but insignificant) mean reductions in total area cultivated following the deaths of male or female heads as compared with those of non-head/spouse members (Yamano and Jayne 2004). These results suggest that land/labor ratios of many affected households are similar to those of non-affected households, and imply that agricultural labor may not be the household's principal production constraint. It is possible that the greatest impact of AIDS on the factors of farm production may be in the stock of capital assets and in the knowledge base which enables households to earn cash income to purchase cash inputs, which may present very different implications for the priorities of agricultural research and extension systems among "high HIV prevalence" countries (Jayne et al. 2005).

Overall, our findings question blanket recommendations of prioritizing labor-saving technologies (LST) in agriculture, as it is unclear that some proposed agricultural LSTs would be appropriate for a majority of affected households. Available time-use data from Zambia (Blackden 2003) suggest the returns to investing in LSTs for domestic tasks, such as food processing and water/fuel gathering, are likely to be much higher than those for LSTs in agriculture given that more hours per household would likely be saved by the former, particularly among women, and that such technologies would be of particular benefit to the hardest-hit households yet also benefit many poor but non-affected households (Barwell 1996).

1.3.3. Cropping Systems

Another agricultural response to PA death suggested in the household coping literature is that affected households tend to shift toward less labor-intensive crops, such as roots and tubers. While such crops typically demand less overall labor and allow for more flexibility in the timing of labor inputs, they tend to be lower in value and nutrition than cash and grain crops. Particular emphasis has been put on the recent shift in area cultivated from maize to roots and tubers, observed in several countries in eastern and southern Africa. While these crop shifts could be related to HIV/AIDS-related illness and death, it is important to acknowledge that recent crop

and input policy changes in many eastern and southern African countries have affected the relative output/input price ratios for grain crops relative to roots and tubers, reducing the profitability in some areas of grains as compared to roots and tubers (Jayne et al. 2005). The potential for such national and/or regional cropping trends exemplifies the value of the investigating cropping patterns of affected households in comparison with the non-affected population.

For Mozambique, Rwanda, and Zambia, we compare the *ex post* percentage of area cultivated to roots and tubers among affected and non-affected households (Table 3). While we cannot infer from mean *ex post* results alone whether or not affected household cropping has changed over time, the results still demonstrate that the *ex post* cultivation of roots and tubers – labor-saving crops – is not on average higher among most affected households, as compared with non-affected households.

Impact analysis using panel data from Tanzania found that although some farm activities were temporarily scaled back after a male death and wage income fell, affected households did not shift toward subsistence crops (Beegle 2003). Likewise, Yamano and Jayne (2004) found no significant shifts toward root and tuber cultivation in the case of death of any household member, but did find other significant shifts in cropping patterns for households within the lower half of the income distribution which suffered a household head/spouse death. For example, households with a male head/spouse death incurred a significant decline in area cultivated to sugarcane, tea, and horticultural crops, a result related not to labor shortage *per se* but due to loss of the man's land title which serves as a pre-condition to participation in outgrower schemes.

Similarly, propensity score matching analysis in Rwanda found a significant decrease in coffee and beer banana production among households with a PA death (Donovan and Bailey 2005), although also a significant increase in production of sweet potatoes among households with a chronically-ill PA adult. The Rwandan sweet potato and beer banana results are likely due to the labor flexibility of the former and labor demands for processing the latter, though the reduction in coffee production may be due to loss of male adults and their connections with coffee brokers. The Kenya and Rwanda impact results suggest that when gender is a main determinant of participation in an economic activity, as with many cash crops, the loss of the participating adult (male) may leave the surviving spouse without access to the activity. Addressing the gender bias in agricultural production and marketing knowledge and opportunities could contribute significantly to improved income potential for many households.

1.3.4. Total Household Income

Most analysts view total household income as an imperfect yet important measure of poverty and need. Although affected households may well have experienced significant negative welfare effects due to the loss of a PA adult member, the *ex post* total income of affected households is not uniformly worse than that of non-affected households (Tables 2 and 3). The sub-groups of affected households in Kenya are on average unambiguously poorer *ex post* than non-affected households (Table 2), yet these households were on average poorer *ex ante* (Mather et al. 2004a). The other country cases demonstrate that some sub-groups of affected households (particularly those with a head/spouse death) are more prevalent in the lower *ex post* income per capita

quartiles, although many affected households are still in the higher income quartiles *ex post* (Tables 2 and 3).[8]

These results suggest that the targeting of mitigation efforts such as food aid should be based on empirical evaluation to identify those affected households most likely to be in need, rather than on a homogenous conceptualization of 'affected households.' Morbidity and mortality are insufficient indicators to ensure that food aid distribution reaches the households most in need of assistance while avoiding potential negative effects on rural development and poverty reduction that may obtain if poorly-targeted food aid results in adverse product price effects (Abdulai, Barrett, and Hazell 2004).

[8] Comparison of *ex post* farm asset levels in Kenya and Zambia (Mather et al. 2004b) shows that mean asset levels are similar between non-affected households and those with a non-head/spouse death, yet are clearly lower for those with a head/spouse death.

2. CONCLUSIONS

Development planners require accurate information on which individuals and households are affected by prime-age (PA) adult mortality and how households are affected by, and respond to, the death of PA members. While these issues have been extensively discussed in conceptual terms, and explored empirically in a few purposively selected areas, there is a paucity of quantitative information on the pre- and post-death characteristics of affected individuals and households derived from representative survey research, which enable comparison with a representative non-affected household population and allow for generalization to the national level in the context of broader rural development needs.

This paper provides selected empirical results from a synthesis of a set of country studies, each of which is based upon large representative rural household income surveys. In contrast to the general assumption that HIV-related mortality is typically associated with household heads/spouses, the survey findings show that in four of the five countries researched here, a majority of deceased PA adults are not household heads/spouses, and thus not likely to be the primary breadwinners of the household. This suggests that the potential magnitude of rural PA mortality on rural household agricultural and off-farm incomes may be less than those predicted by some of the literature. We also find that the *ex post* land/labor ratios and total income of rural households directly affected by PA adult mortality are more heterogeneous than implied by some of the literature. Although affected households may well have suffered negative effects on household crop production and income, most affected households have similar *ex post* land/labor ratios and income levels as compared to households without a death. However, households which have suffered the death of household head or spouse form a particular subset of affected households which tend to have lower *ex post* land/labor ratios and incomes relative to non-affected households, and are thus more likely to be in need of assistance.

The results question the usefulness of a homogeneous conceptualization of 'affected households,' especially in the context of proposals for targeted assistance and technology development. The implications of this heterogeneity are important for the design of HIV/AIDS mitigation strategies, as well as for considering the HIV/AIDS epidemic within the context of rural poverty alleviation and growth strategies. For example, indicators beyond 'adult mortality' are required to help identify affected households most in need of immediate assistance (such as households with a male head death) as well as what technology is most appropriate and beneficial for 'affected households.. Yet there are potential mitigation responses which appear to be appropriate to the needs of hardest-hit households while also benefitting other poor but non-affected households at the same time: improved land tenure; LSTs for water, fuel, and food processing; and redressing gender bias in extension and education, thus access to cash crop and non-farm income opportunities. While it is important to provide a safety net for the hardest-hit households to protect their assets, investing in pro-poor agricultural productivity growth is one of the most effective means to respond to the HIV/AIDS epidemic.

The results also demonstrate the value of representative survey research in investigating the characteristics of individuals and households affected and in measuring impacts of adult mortality within the context of a representative sample of the non-affected population. Combining demographic and mortality data with production and income data collected regularly

in household surveys is a relatively cost-effective way to investigate the (pre-and/or post-death) characteristics of affected individuals and households and measure mortality impacts. Important areas for additional future research are time use studies of adults and children, which provide information vital for the assessment of the potential costs and benefits of alternative labor-saving technologies. There is also widespread recognition that AIDS may affect rural communities in ways not always detectable at the household level. Future research is therefore needed to better understand the community-level impacts of AIDS-related mortality, as demonstrated by Drinkwater (2003).

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