Community-Level Impacts of AIDS-Related Mortality: Panel Survey Evidence from Zambia

Thomas S. Jayne, Antony Chapoto, Elizabeth Byron, Mukelabai Ndiyoi, Petan Hamazakaza, Suneetha Kadiyala, and Stuart Gillespie

Abstract:
African rural communities display great heterogeneity in their farming systems, population densities, and local institutions which would suggest that the impacts of HIV/AIDS may differ across communities. Using nationally-representative longitudinal data on 5,420 households in 396 communities in rural Zambia, we find that communities having similar HIV prevalence and adult mortality rates show significant variations in indicators of economic and social welfare over time. Variation in community-level resilience to HIV/AIDS provides an opportunity to identify exogenous factors influencing community resilience. In general, we find that the effects of AIDS-related mortality on rural livelihoods are complex in that they depend significantly on initial community conditions such as the level of mean education, wealth, farm size, population density, connectedness with markets and infrastructure, and dependency ratios. Our results find relatively small independent effects of prime-age mortality on community crop output, mean income, and income per capita. However, the estimated effects become large in some communities displaying particular initial community conditions. These results provide important clues as to the factors influencing communities' resilience, or ability to withstand the impacts of increased AIDS-related mortality.

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This paper was presented at the Principal Paper session, "HIV/AIDS and Rural Food Security in Africa," Allied Social Sciences Association annual meeting, Boston, January 6-8, 2006.

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A growing literature has focused on understanding the effects of the HIV/AIDS pandemic on rural livelihoods and the agricultural sectors in Africa (Ainsworth, Fransen, and Over; Barnett and Whiteside; Gillespie and Kadiyala; Mather et al.). In some parts of southern Africa, HIV prevalence rates are as high as 30 percent among individuals between 15-45 years. Several nationwide household panel surveys from relatively hard-hit countries (Kenya, Tanzania, and Zambia) indicate that, over a 3-year survey interval, roughly 6-10% of rural households suffer one or more disease-related deaths of a prime-aged individual (Yamano and Jayne; Beegle; Chapoto and Jayne), and there is overwhelming evidence that most of the mortality in these age ranges is related to AIDS (Ngom and Clark).

However, efforts to accurately estimate the economic impacts of AIDS-related mortality are fraught with difficulties. To date, almost all quantitative micro-level studies have examined the effects of mortality at the household level, even though it is likely that mortality shocks are transmitted across households. This situation, in which a relatively small percentage of households incur a shock, but the shock is spread across households in a community, presents methodological challenges for estimating the full effects of the shock using household survey data. Most household-level panel studies, using difference-in-difference, household fixed-effects, or random-effects models, have measured the effects of mortality *in afflicted households* on differenced household-level outcomes, typically over a 2–5 year time frame, compared to differenced outcomes on non-afflicted households. Yet if non-afflicted households are likely to be indirectly affected by the mortality occurring around them, they may not be a valid control group. In communities hard-hit by HIV/AIDS, households not directly incurring a death may nevertheless be affected by taking in orphans, losing access to resources owned by kin-related "afflicted" households, or transferring resources to afflicted households. In addition, there are likely broader effects of high mortality rates on communities' economic and social structures. To date, little quantitative economic analysis has attempted to measure the effects of mortality on rural welfare other than at the household level. Moreover, relatively little quantitative research has been devoted to examining community "resilience", i.e., the factors explaining why some communities appear better able than others to withstand the impacts of AIDS-related mortality despite suffering similar adult mortality rates.

This study measures the effects of prime-age mortality on rural welfare using the "community" as the unit of observation. Data are drawn from a panel of 5,420 households surveyed in 393 rural communities in Zambia in 2001 and 2004. We compute community-level adult mortality rates from household data along with mean household welfare indicators for all communities. Village (SEA) fixed effects models on differenced outcomes are estimated to measure the relationship between mortality rates and indicators such as land cultivation, crop output, and per capita income at the community level, controlling for time-invariant unobservables and initial community conditions. This study is the first approach, as far as we know, to estimate the impacts of AIDS-related mortality on entire rural communities, or to examine the factors affecting community resilience, using micro-survey data. The findings should be important for governments and development agencies, especially in southern Africa where HIV prevalence rates are the highest in the world and where the full impacts of the disease remain largely speculative.

Methods and Data

Our approach in this paper is to determine the relationship between mortality and economic outcomes at the community-level, based on panel survey data of 5,420 households in 393 communities, or "Standard Enumerations Areas (SEAs)," the lowest geographic cluster used by the Central Statistical Office (CSO) of the Government of Zambia. In 2001 and 2004, the CSO conducted two linked nationally-representative household surveys (see Megill for sampling procedures) containing information on agricultural production and input use, assets, income, and demographic and socioeconomic information, including mortality and chronic illness. Of the 6,922 households interviewed in 2001, 5,420 (78.3%) were re-interviewed in May 2004. The re-interview rate rises to 88.7% if we exclude attrition caused by enumerators not re-visiting several SEAs in 2004 that were included in the 2001 survey. The re-interview rate climbs to 94.5% if we exclude attrition caused by adult household members being away from home during the enumeration period and those refusing to be interviewed.

Of the 5,420 households successfully re-interviewed, 547 (10.1%) had at least one disease-related prime-age death over the three-year period (table 1). Of these 547 households, 52 (9.6%) of them suffered multiple prime-age deaths. Adult mortality rates, defined as the number of disease-related mortalities in the 15-59 year age category per 1000 person years between May 2001 and May 2004, were computed for each community. Adult mortality rates (AMRs) among the 393 communities ranged from zero to 97, with the mean being 16.3.

We compute mean household welfare indicators for each community in the panel sample and use SEA-fixed effects by differencing these welfare/outcome variables ($Y_{2004} - Y_{2001}$). To measure the impacts of prime-age (PA) mortality on the community level outcome Y_i, we consider the following model:

$$Y_{it} = \gamma_t + t*D_i\alpha + t*X_i^O\beta + R_{it}\phi + t*C_i\theta + t*P\varphi + \mu_i + \varepsilon_{it} \quad i = 1,\ldots,N \quad t = 1,\ldots,T \qquad [1]$$

where Y_{it} denotes changes in community outcomes, such as land cultivated and gross value of output in community at time t; the parameter γ_t denotes a time-varying intercept; D_i is the prime-age mortality rate (AMR) between 2001 and 2004; x_i^o is a vector of initial mean household characteristics in 2001. Mean household characteristics in 2004 are likely to be influenced by PA mortality rates in the community and are hence endogenous. Therefore, we control only for initial pre-death mean household characteristics rather than their difference. R_{it} is a vector of community time-varying factors such as rainfall; C_i is a vector of time-invariant community factors in 2000; P is a vector of eight provincial dummies; μ_i captures the community-level fixed effects (assumed constant over time); and ε_{it} is an error term.

Differencing the time 1 and time 0, equation 1 yields:

$$\Delta Y_i = \gamma + D_i\alpha + X_i^O\beta + \Delta R_i\phi + C_i\theta + P\varphi + \Delta\varepsilon_i \quad i = 1,\ldots,N \qquad [2]$$

Estimation of equation 2 by OLS gives the impact of AMR on outcome ΔY as α.

X^0_i contains effective dependency ratios (the number of household members under 14 or over 59 plus chronically ill members divided by the number of healthy prime-age members), the percentage of adults spending at least 2 months away from home, a proxy for migration and mobility, which has been shown to be positively associated with HIV contraction (Epstein), community population, and initial assets in 2000 (stock of animals and draft equipment).

C_i contains the distance to the district capital, distance to the nearest tarmac road, proximity to the line of rail (all proxies for degree of interaction between members of the community and regional centers and transport routes, which are the main HIV transmission vectors in southern Africa), and community population in 2000.

To test whether the impact of prime-age mortality rates on changes in community outcomes is influenced by initial conditions (X^0_i) and community variables in 2000 (C_i), we introduce interaction terms between AMR and all the variables in X^0_i and C_i as shown in equation 3. This approach may provide insights into factors affecting community "resilience", i.e., why some communities appear better able than others to withstand the effects of AIDS despite incurring similar adult mortality rates. We also interact AMR with annual deviations in rainfall each year between 1999/2000 and 2002/2003 from the 10-year average between 1992/03 and 2002/03, to capture the potential interactions between drought and mortality on communities' economic indicators. We also tested for potential non-linearities in AMR, based on the hypothesis that the marginal impacts of mortality on community outcomes may be more severe as mortality rates rise. The resulting model estimated by OLS is as follows:

$$\Delta Y_i = \gamma + D_i\alpha + X_i^O\beta + X_i^O * D_i\beta' + \Delta R_i\varphi + \Delta R_i * D_i\varphi' + C_i\theta + C_i * D_i\theta' + P\varphi + \Delta\varepsilon_i \quad [3]$$

Model [3] was estimated using OLS for changes in logged (1) cropped area (including separate models for area to cereals, roots and tubers, and other crops); (2) gross value of agricultural output, (3) gross value of agricultural output per hectare; (3) total household income; and (4) household income per capita. While information on assets and consumption would have been useful in this study, comparable data was not available from the two surveys.

For each dependent variable, we report three models to assess the robustness of results. The first model in each of tables 2 through 5 shows results including all covariates in the D_i, R_i, X^o_i, C_i, and P vectors, with no interaction terms (columns 1 and 4). Because of space limitations, we cannot report all parameter estimates on one page so confine the tables to the main variables of interest. The second model (columns 2 and 5) includes all interaction terms, and the third (columns 3 and 6) show results after including a squared adult mortality rate term to account for potential non-linearities in impacts. The rationale here is that the marginal impact of increased mortality rates may be small at low levels of adult mortality, whereas communities may incur greater marginal impacts if mortality rates are sufficiently high to start unraveling their economic and social support systems.

We start by investigating whether spatial differences in prime-age mortality observed in the survey data accurately track spatial differences in HIV prevalence rates. Provincial HIV prevalence rates for 2001 were obtained from antenatal clinics as reported in Zambia's Demographic Health Survey (Ministry of Health).[1] A strong relationship between prime-age mortality and HIV prevalence rates would suggest that a large proportion of prime-age mortality observed in our household data is indeed due to AIDS-related causes.

Figure 1 presents a scatter plot of provincial HIV prevalence and rural adult mortality rates between 2001 and 2004 from our provincially-representative household data. The strength of these correlations is notable, especially considering that the provincial HIV prevalence rate is not disaggregated by urban/rural classification. The Pearson correlation coefficient of 0.84 suggests that the adult mortality rates observed in our survey data are closely associated with HIV-prevalence.

Model Results

Effects of Mortality on Land Cultivation

Table 2 presents the estimated relationships between community adult mortality rates and area cultivated. The log-level specifications provide estimates of percentage changes in the dependent variable as adult mortality rates vary. To put these impacts into perspective, we report the estimated differences in Y_i evaluated at the 25th percentile (zero) and at the 75th percentile (24.4 percent) of community mortality rates. All three models in columns 1, 2, and 3 indicate that total land cultivated in the community is negatively related to mortality rates, although this relationship is statistically significant only at the 10-percent level.

Results in Column 1 indicate that a rise in community mortality rates from zero to 24.4 percent (which is the difference in mortality rates between the 25th and 75th percentile of all 393 communities) is associated with a 5.2-percent decline in the land area cultivated at the community level. Models 2 and 3 indicate that the negative impact of mortality on land cultivation is greater in areas where mean educational attainment is higher, possibly representing the differential loss of human capital-adjusted labor on outcomes. The negative impact of mortality on land cultivation is mitigated in relatively wealthy communities, as indicated by the positive coefficient on the interaction between asset levels and mortality rates. Relatively wealthy communities presumably have greater reserves and stocks of wealth to draw upon to cope with mortality-related shocks. When evaluated at mean levels for all other variables, models 2 and 3 indicate that a rise in community mortality rates from the 25th to 75th percentile is associated with a 6.0 to 9.7 percent decline in land area cultivated over the three-year time frame.

The effects of adult mortality on the area specifically under cereal crops (table 2, columns 4, 5, and 6) are similarly negative but smaller. Holding all other variables at their mean level, a rise in community mortality rates from the 25th to 75th percentile is associated with a 2.5 to 4.1 percent decline in area cultivated to cereals. Results in table 3 show a somewhat weaker relationship between adult mortality rates and cultivation of roots and tubers, as well as other crops (primarily cotton, groundnuts, soybeans, and vegetables). The findings on roots and tubers are particularly interesting because of the common perception that labor shocks associated with the HIV/AIDS pandemic have led to greater cultivation of less labor-intensive crops such as cassava and sweet potato. The results of the models presented in table 3 indicate that, if anything, high adult mortality rates negatively influence root and tuber cultivation in Zambia, although this relationship is imprecisely measured.

The two variables representing the percentage of households in the community with a chronically ill person and the proportion of households suffering from a disease-related death in 1996-2000 were both statistically insignificant in all models of cultivated area. The general picture is that the impact of mortality on land cultivated at the community level is negative, but relatively short-lived, since prior death rates do not appear to affect land cultivation or cropping patterns 3-8 years later.

Effects of Mortality on Crop Production

Table 4 reports changes in the gross value of crop output per farm and per hectare. In both sets of models, current adult mortality rates have little independent impact on changes in crop output or output per hectare. All the statistically significant effects in these models are due to the interaction between mortality and other community characteristics. For example, in columns 2 and 3, the evidence once again suggests that the effects of mortality are dependent on the degree of education within the community; crop production is more adversely affected by mortality in areas with relatively high initial educational attainment. We also find that the percentage of households in a community having chronically ill prime-age member appears to be statistically unrelated to crop production. The effect of recent mortality on crop output per hectare is greater in areas with relatively large landholdings, which might be expected to the extent that mortality exacerbates labor shortages in areas where land/labor ratios are already relatively high. Labor may be a less binding constraint on crop production in areas with relatively small farm sizes. The effect of mortality on changes in crop output per hectare also appears to be mitigated in areas along the rail line, which are relatively well connected to markets and physical infrastructure.

Prior mortality also appears to have persistent effects on output per hectare. In all three models of output per unit of land (columns 4, 5 and 6), the extent of prime-age mortality during 1996-2000 is negatively and significantly related to output per hectare in 2001-2004. An increase in the percentage of households suffering from prior (1996-2000) mortality from the 25th to 75th percentile of communities is associated with a 10.0 to 13.8 decline in the value of crop output per hectare between 2001 and 2004. These results suggest that adult mortality rates may have persistent effects over time and lead to a de-intensification of crop production, rather than a reduction in area cultivated, since the latter is only weakly related to 1996-2000 mortality rates.

Effects of Mortality on Changes in Total and Per Capita Community Income

Table 5 presents results on the effects of mortality on changes in mean household income and per capita income in communities between 2001 and 2004. The main effects of adult mortality rates on changes in community total income or income per capita are through interaction effects with other community characteristics. For example, once again, the adverse effects of mortality are greatest in more educated communities. This is consistent with explanations that the death of more educated people has a greater adverse effect on households and communities than the death of less educated people, especially considering that household income levels are positively correlated with educational attainment in our dataset. The effects of mortality are mitigated in densely populated areas, again suggesting that heavily populated areas are more resilient to labor shocks caused by AIDS. There is little independent impact of mortality or chronic illness rates on community income levels. Moreover, we find that the squared mortality rate variable is statistically significant in none of the estimated models. This result indicates that over the range of mortality rates observed in the data, there is little evidence of increasing marginal impacts as community mortality rates rise.

Conclusions

Governments and development agencies require accurate information on the impacts of increased mortality rates caused by AIDS on rural livelihoods in Africa. AIDS mitigation strategies also need to be based on a better understanding of the factors influencing communities' resilience to the impacts of the disease. Several previous studies have estimated the effects of prime-age mortality on afflicted households in relation to non-afflicted households. Yet in many communities of southern Africa, where HIV prevalence rates exceed 20 percent, it is questionable whether non-afflicted households are a valid control group because non-afflicted households may be adversely affected by the mortality occurring in neighboring households.

Using nationally representative household panel data from rural Zambia, we measure the effects of prime-age adult mortality rates on changes in a set of community level welfare indicators. We find that a rise in community mortality rates from zero to 24.4 percent (which is the difference in mortality rates between the 25th and 75th percentile of all 393 communities) is associated with a 6 percent decline in the land area cultivated at the community level. We find little evidence that cropped area is shifting toward labor-saving crops such as cassava in hard-hit areas, as is sometimes contended. Although cassava cultivation is rising rapidly in many parts of southern Africa, other factors related to agricultural policy need to be considered when examining the impact of HIV/AIDS on crop cultivation patterns and the broader agricultural sector (Jayne et al).

In general, this analysis finds that the effects of AIDS-related mortality on rural livelihoods appear to be complex in that they depend significantly on initial community conditions such as the level of mean education, wealth, farm size, population density, connectedness with markets and infrastructure, and dependency ratios. Our results find relatively small independent effects of prime-age mortality on community crop output, mean income, and income per capita. However, the estimated effects become large in some communities displaying particular initial community conditions. These results provide important clues as to the factors influencing communities' resilience, or ability to withstand the impacts of increased AIDS-related mortality. For example, we find that communities with relatively high mean education levels are more adversely affected by adult mortality. This may be because educated adults tend to be relatively productive, and as they become sick and die, households and their wider kin networks lose the income and fruits of their labor. We also find the relatively wealthy communities, as measured by mean value of productive assets, are better able to maintain their cereal production than poorer communities suffering similar mortality rates. Communities with bigger farms suffer greater declines in output per hectare than more populated areas with smaller farm sizes, suggesting that labor constraints may be less severe in the latter areas. Lastly, mortality rates in the preceding 3-8 years have a persistent negative impact on crop output per hectare, indicating a need to take into account communities' prior as well as current mortality rates in AIDS mitigation strategies.

In general, the findings of this study offer cautious support for the view that prime-age mortality is adversely affecting agrarian-based economic systems in regions hard-hit by the HIV/AIDS pandemic, yet the severity of these impacts varies greatly according to communities' specific characteristics and initial conditions. Consequently, our study cautions against sweeping generalizations about the impacts of AIDS on rural communities hard-hit by the disease. Further research from other areas and time periods is needed to build up a more solid empirical foundation to serve as a basis for the design of AIDS mitigation strategies.

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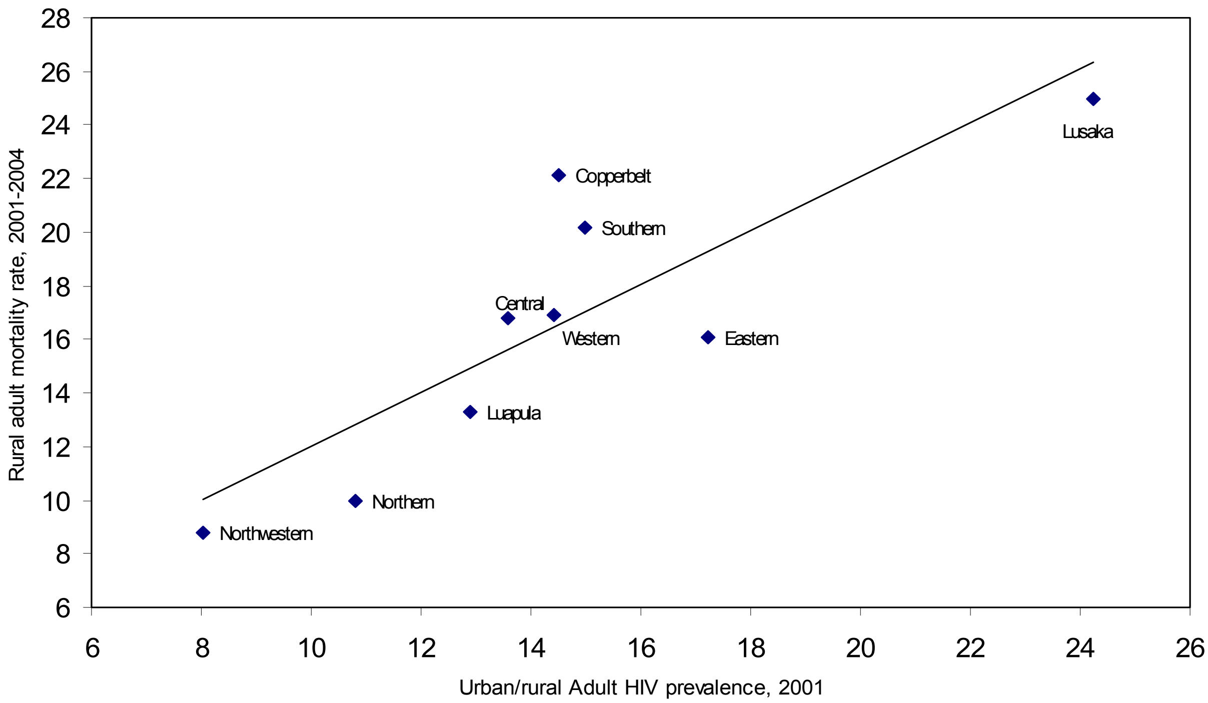
Acknowledgements

Support for this research has been provided by the RENEWAL Program to the Farming Systems Association of Zambia and to the Mt. Makulu Research Station, Ministry of Agriculture, Government of Zambia. Major support was also provided by the USAID/Zambia mission to the Food Security Research Project/Zambia, a joint collaboration between the Ministry of Agriculture and Cooperatives, Government of Zambia, the Agricultural Consultative Forum, and Michigan State University's Department of Agricultural Economics. Supplemental support was also provided to the Food Security III Cooperative Agreement (CDG-A-00-000021-00) by the United States Agency for International Development/Bureau for Economic Growth, Agriculture and Trade's Office, Washington, DC.

Endnotes

1. 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. The Zambia Demographic Health Survey figures are derived from blood sample testing of a randomly selected national sample of PA adults.

Figure 1. Correlation between Provincial adult mortality rates from CSO 2001 and 2004 household survey data and 2001 HIV + Prevalence Rates, Zambia



Notes: Pearson correlation coefficient is 0.84.
Sources: Adult mortality rates derived from the 2001 and 2004 household surveys. HIV+ prevalence rates are from 2001 Sentinel Surveillance Site information published by the Central Statistical Office, the Ministry of Health, and Macro International 2003.

Table 1. Prevalence of prime-age (PA) mortality[a] by province, rural Zambia between May 2001 and May 2004.

Province	Households interviewed in 2001	Households re-interviewed in 2004	Descriptive results in 5,340 valid re-interviewed households					
			Household incurring at least one prime-age death due to illness				Cause of death	
			Male		Female		Disease	Other[d]
	(a)	(b)	(d)		(e)		(f)	(g)
	Number	Number (%)	Number	AMR[c]	number	AMR	number	
Central	714	573 (80.3)	34	14.4	34	16.1	68	4
Copperbelt	393	312 (79.4)	12	14.8	16	14.6	28	3
Eastern	1331	1126 (84.6)	68	14.6	71	18.5	139	7
Luapula	777	619 (79.7)	24	12.1	29	15.1	53	4
Lusaka	214	161 (75.2)	8	19.2	19	16.6	27	1
Northern	1363	1027 (75.3)	42	10.3	46	13.1	88	4
Northwestern	472	324 (68.6)	15	9.3	7	10.0	22	-
Southern	872	690 (79.1)	33	15.1	51	17.3	84	6
Western	786	588 (74.8)	18	16.4	44	17.7	62	1
Total	6922	5420 (78.3)	254	14.0	317	15.4	571	30

Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004

Notes: [a]Prime-age is defined as ages 15-59 for both men and women. [b]Of the 21.7% not re-interviewed, 0.2% were refusals, 10.2% moved out of SEA, 5.7% were recorded as dissolved, and 5.2% were categorized as "non-contact" (not home but still resident). [c]AMR (adult mortality rate)=Prime-age deaths/1000 prime-age person years for persons between 15-59 years of age. [d] Other deaths were caused by unexpected causes such as accidents, murder and snake bite, and were excluded from the analysis in Section 4.

Table 2. Changes in community land cultivated and area under cereals in 1999/00 and 2002/03

	Changes in natural logs of :					
	--------Total and cultivated------			-------Area under cereals--------		
	(1)	(2)	(3)	(4)	(5)	(6)
Adult mortality rate: 2001-2004[a]	-5.7e-03+	-3.5e-02+	-3.8e-02+	-8.5e-04	-1.6e-02+	-1.8e-02*
	(1.74)	(1.91)	(1.95)	(0.67)	(1.95)	(2.07)
Mortality rate squared			3.8e-05			1.9e-05
			(0.80)			(0.83)
% of households with ill PA adults	-1.1e-05	-3.8e-04	-1.0e-03	3.2e-05	-8.6e-05	4.3e-05
	(0.01)	(0.26)	(0.72)	(0.05)	(0.12)	(0.06)
% of HH with prior prime-age death	4.8e-04	7.7e-04	3.1e-03	-4.4e-04	-2.8e-04	1.0e-03
	(0.24)	(0.41)	(1.64)	(0.48)	(0.31)	(1.05)
Interaction terms						
AMR*1999/2000 rainfall deviations[b]	1.7e-05	1.7e-05	1.8e-05	1.5e-05*	1.3e-05+	1.4e-05+
	(1.08)	(1.13)	(1.17)	(2.11)	(1.69)	(1.86)
AMR*2000/2001 rainfall deviations	2.5e-05	2.4e-05+	2.7e-05+	4.7e-06	3.1e-06	3.7e-06
	(1.61)	(1.78)	(1.80)	(0.68)	(0.45)	(0.51)
AMR*2001/2002 rainfall deviations	1.9e-05	2.6e-05+	2.9e-05*	1.6e-05**	1.8e-05**	2.3e-05**
	(1.37)	(1.92)	(2.04)	(2.90)	(3.12)	(3.71)
AMR*2002/03 rainfall deviations	1.0e-05	1.4e-05*	1.6e-05**	3.9e-06	4.5e-06	6.7e-06*
	(1.63)	(2.35)	(2.59)	(1.38)	(1.43)	(2.07)
AMR*Educated in 2000[c]		-2.0e-03*	-2.0e-03*		-4.4e-04	-3.7e-04
		(2.54)	(2.30)		(1.03)	(0.78)
AMR*Effective dependency ratio in 2000[d]		7.2e-03*	7.1e-03+		3.2e-03*	3.7e-03*
		(2.14)	(1.96)		(2.00)	(2.14)
AMR*Value of assets in 2000		2.1e-03+	2.0e-03		9.0e-04	8.4e-04
		(1.68)	(1.58)		(1.63)	(1.44)
AMR*Landholding size in 2000		8.5e-04	7.9e-04		1.1e-04	5.3e-05
		(1.19)	(1.06)		(0.30)	(0.14)
AMR* Number of PA adult in SEA in 2000		5.2e-07	8.8e-07		2.0e-07	3.9e-07
		(0.95)	(1.39)		(0.64)	(1.18)
AMR*Distance to District Town		4.1e-05	4.4e-05		3.4e-05	2.5e-05
		(0.75)	(0.78)		(1.08)	(0.82)
AMR*Distance to nearest tarmac road		2.2e-05	1.6e-05		5.0e-06	1.4e-06
		(0.48)	(0.36)		(0.20)	(0.06)
AMR*District on line of rail		-5.0e-03	-4.9e-03		-2.5e-03	-2.6e-03
		(1.57)	(1.39)		(1.64)	(1.60)
Provincial dummies included	Yes	Yes	Yes	Yes	Yes	Yes
Constant	8.5e-01*	1.2e+00**	1.1e+00*	2.4e-01	4.6e-01*	5.6e-01*
	(2.51)	(2.64)	(2.35)	(1.50)	(2.14)	(2.59)
Joint tests						
AMR and AMR squared	-	-	1.98			2.25+
Mean household pre-death conditions in 2000	0.39	1.07	1.68	0.64	0.77	1.26
Community variables in 2000[e]	0.49	0.49	0.19	1.10	1.83	0.59
AMR*rainfall deviations from 12 year mean	3.45**	3.92**	3.43**	2.93**	3.21**	3.54**
AMR*household characteristics		1.78*	1.99*		1.02	1.21
All interactions		2.33**	3.04**		1.79*	3.08**
R-squared	0.20	0.24	0.17	0.23	0.26	0.17
Observations	393	393	393	393	393	393

Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004

Notes: ** 1% level of significance, * 5% level of significance and + 10% level of significance. Included but not reported in the table: 8 provincial dummies, all variables interacted with AMR. [a]AMR=prime-age deaths between 2001 and 2004/1000 person years. [b]Rainfall deviations from 10 year mean (1993-2002) . [c]Education is the mean number of years of schooling of the most educated in the household . [d]Effective dependency ratio is given by the sum of the number of elderly, children and chronically ill adults divided by number of prime-age adults. [e]Community characteristics include: Distance to nearest tarmac road, distance to the District town (Boma) and District on line of rail.

Table 3. Changes in community area under roots and tubers and other crops in 1999/00 and 2002/03

	Changes in natural logs of :					
	---Area under roots and tubers--			------Area under other crops-----		
	(1)	(2)	(3)	(4)	(5)	(6)
Adult mortality rate: 2001-2004[a]	-4.1e-03+	-9.2e-03	-1.0e-02	-2.0e-03+	-5.1e-03	-9.1e-03
	(1.83)	(0.91)	(1.01)	(1.80)	(0.83)	(1.38)
Mortality rate squared			1.0e-05			2.6e-05
			(0.41)			(1.47)
% of households with ill PA adults	-1.2e-04	-2.6e-04	-1.1e-03	1.1e-05	-8.7e-05	-2.1e-05
	(0.16)	(0.34)	(1.51)	(0.02)	(0.15)	(0.04)
% of HH with prior prime-age death	5.1e-04	5.2e-04	6.0e-04	3.7e-04	3.5e-04	-8.4e-05
	(0.43)	(0.43)	(0.51)	(0.40)	(0.37)	(0.09)
Interaction terms						
AMR*1999/2000 rainfall deviations[b]	-1.2e-05	-8.2e-06	-9.9e-06	-2.9e-06	-3.2e-06	-4.4e-06
	(1.07)	(0.71)	(0.85)	(0.43)	(0.48)	(0.65)
AMR*2000/2001 rainfall deviations	1.1e-05	1.4e-05	1.4e-05	9.1e-06+	9.2e-06+	1.0e-05+
	(1.17)	(1.55)	(1.60)	(1.84)	(1.89)	(1.95)
AMR*2001/2002 rainfall deviations	-8.4e-06	-6.8e-06	-1.0e-05	1.1e-06	2.3e-06	2.0e-06
	(1.21)	(0.83)	(1.21)	(0.25)	(0.47)	(0.37)
AMR*2002/03 rainfall deviations	1.9e-06	3.2e-06	2.7e-06	1.6e-06	2.4e-06	1.3e-06
	(0.56)	(0.96)	(0.83)	(0.82)	(1.32)	(0.71)
AMR*Educated in 2000[c]		-3.4e-04	-2.6e-04		-4.2e-04	-5.7e-04+
		(0.70)	(0.57)		(1.35)	(1.91)
AMR*Effective dependency ratio in 2000[d]		1.3e-03	6.8e-04		4.5e-04	3.0e-04
		(0.61)	(0.32)		(0.42)	(0.27)
AMR*Value of assets in 2000		2.3e-04	2.3e-04		5.3e-04	7.6e-04+
		(0.34)	(0.35)		(1.29)	(1.79)
AMR*Landholding size in 2000		4.6e-04	5.6e-04		2.1e-05	-6.2e-05
		(1.15)	(1.41)		(0.09)	(0.29)
AMR* Number of PA adult in SEA in 2000		1.6e-07	1.8e-07		-2.2e-07	-1.8e-07
		(0.54)	(0.60)		(0.79)	(0.65)
AMR*Distance to District Town		-1.7e-05	-9.4e-06		9.8e-07	2.1e-05
		(0.60)	(0.34)		(0.05)	(1.18)
AMR*Distance to nearest tarmac road		2.5e-05	1.9e-05		1.5e-06	4.0e-06
		(1.16)	(0.92)		(0.08)	(0.20)
AMR*District on line of rail		-1.5e-03	-1.4e-03		-1.4e-03	-1.0e-03
		(0.55)	(0.54)		(0.98)	(0.69)
Provincial dummies included	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-4.6e-03	3.7e-02	6.1e-02	-1.9e-02	2.2e-02	-8.6e-02
	(0.03)	(0.15)	(0.26)	(0.15)	(0.13)	(0.55)
Joint tests						
AMR and AMR squared	-	-	0.53			1.56
Mean household pre-death conditions in 2000	0.22	0.12	0.73	2.19*	0.90	1.44
Community variables in 2000[e]	1.42	0.64	0.76	1.56	0.27	0.36
AMR*rainfall deviations from 12 year mean	2.95**	2.37*	2.02*	0.94	1.07	1.36
AMR*household characteristics		0.51	0.62		2.28	4.10**
All interactions		1.51+	1.71*		1.75*	3.66**
R-squared	0.13	0.14	0.10	0.17	0.19	0.15
Observations	393	393	393	393	393	393

Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004

Notes: ** 1% level of significance, * 5% level of significance and + 10% level of significance. Included but not reported in the table: 8 provincial dummies, all variables interacted with AMR. [a]AMR=prime-age deaths between 2001 and 2004/1000 person years. [b]Rainfall deviations from 10 year mean (1993-2002) . [c]Education is the mean number of years of schooling of the most educated in the household . [d]Effective dependency ratio is given by the sum of the number of elderly, children and chronically ill adults divided by number of prime-age adults. [e]Community characteristics include: Distance to nearest tarmac road, distance to the District town (Boma) and District on line of rail.

Table 4. Changes in community gross value of output and gross output/ha in 1999/00 and 2002/03

	Changes in natural logs of :					
	-------Gross vale of output-------			----Gross value of output/ha-----		
	(1)	(2)	(3)	(4)	(5)	(6)
Adult mortality rate: 2001-2004[a]	-4.1e-03	9.8e-04	-3.8e-03	3.4e-04	3.1e-02	3.0e-02
	(0.97)	(0.04)	(0.15)	(0.07)	(1.23)	(1.17)
Mortality rate squared			7.5e-05			6.6e-06
			(1.08)			(0.09)
% of households with ill PA adults	-1.1e-03	-1.2e-03	-9.4e-04	-1.7e-03	-1.3e-03	-2.1e-04
	(0.71)	(0.75)	(0.58)	(0.93)	(0.69)	(0.12)
% of HH with prior prime-age death	-3.6e-03	-3.1e-03	-3.7e-03	-6.5e-03*	-6.2e-03*	-8.5e-03**
	(1.39)	(1.21)	(1.48)	(2.12)	(2.09)	(2.99)
Interaction terms						
AMR*1999/2000 rainfall deviations[b]	-2.6e-05	-2.9e-05+	-3.1e-05+	-3.8e-05*	-3.8e-05*	-4.2e-05*
	(1.57)	(1.68)	(1.70)	(2.24)	(2.32)	(2.48)
AMR*2000/2001 rainfall deviations	1.8e-05	1.3e-05	1.2e-05	-4.7e-06	-1.5e-05	-1.9e-05
	(0.92)	(0.59)	(0.52)	(0.22)	(0.72)	(0.86)
AMR*2001/2002 rainfall deviations	-1.7e-06	-2.5e-06	-3.0e-06	-3.0e-05+	-3.4e-05+	-3.9e-05+
	(0.10)	(0.13)	(0.16)	(1.65)	(1.68)	(1.95)
AMR*2002/03 rainfall deviations	-2.0e-06	-2.9e-06	-4.1e-06	-1.4e-05+	-2.1e-05**	-2.5e-05**
	(0.30)	(0.39)	(0.60)	(1.88)	(2.75)	(3.32)
AMR*Educated in 2000[c]		-1.9e-03+	-2.6e-03*		-9.1e-04	-1.5e-03
		(1.82)	(2.57)		(0.62)	(1.04)
AMR*Effective dependency ratio in 2000[d]		6.8e-04	6.8e-04		-5.9e-03	-5.0e-03
		(0.13)	(0.12)		(1.27)	(1.06)
AMR*Value of assets in 2000		4.0e-04	6.5e-04		-1.0e-03	-7.5e-04
		(0.27)	(0.43)		(0.62)	(0.45)
AMR*Landholding size in 2000		-5.7e-04	-9.2e-04		-1.8e-03*	-2.1e-03**
		(0.85)	(1.33)		(2.51)	(2.62)
AMR* Number of PA adult in SEA in 2000		6.4e-07	1.0e-06		3.0e-07	2.8e-07
		(1.03)	(1.41)		(0.35)	(0.30)
AMR*Distance to District Town		2.2e-05	6.3e-05		5.0e-05	8.0e-05
		(0.35)	(0.98)		(0.66)	(1.10)
AMR*Distance to nearest tarmac road		-1.5e-05	-1.3e-05		-3.8e-05	-3.3e-05
		(0.29)	(0.25)		(0.75)	(0.64)
AMR*District on line of rail		-1.9e-03	-6.8e-04		6.5e-03+	7.3e-03+
		(0.47)	(0.15)		(1.80)	(1.93)
Provincial dummies included	Yes	Yes	Yes	Yes	Yes	Yes
Constant	6.9e-01+	5.9e-01	6.6e-01	-6.3e-01	-1.0e+00+	-6.8e-01
	(1.80)	(1.13)	(1.37)	(1.41)	(1.78)	(1.25)
Joint tests						
AMR and AMR squared	-	-	0.60			0.76
Mean household pre-death conditions in 2000	1.05	1.31	1.59	0.98	1.20	2.58*
Community variables in 2000[e]	0.61	0.20	0.79	0.74	0.11	0.69
AMR*rainfall deviations from 12 year mean	1.62	1.70*	1.72+	1.70*	2.41*	2.53**
AMR*household characteristics		1.35	1.57+		1.92*	1.91*
All interactions		1.65*	1.95**		1.63*	2.10**
R-squared	0.14	0.15	0.10	0.16	0.18	0.13
Observations	393	393	393	393	393	393

Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004

Notes: ** 1% level of significance, * 5% level of significance and + 10% level of significance. Included but not reported in the table: 8 provincial dummies, all variables interacted with AMR. [a]AMR=prime-age deaths between 2001 and 2004/1000 person years. [b]Rainfall deviations from 10 year mean (1993-2002) . [c]Education is the mean number of years of schooling of the most educated in the household . [d]Effective dependency ratio is given by the sum of the number of elderly, children and chronically ill adults divided by number of prime-age adults. [e]Community characteristics include: Distance to nearest tarmac road, distance to the District town (Boma) and District on line of rail.

Table 5. Changes in community household income and per capita income in 1999/00 and 2002/03

	Changes in natural logs of :					
	-------Household income-------			--Household income per capita--		
	(1)	(2)	(3)	(4)	(5)	(6)
Adult mortality rate: 2001-2004[a]	-4.9e-03	-8.8e-03	2.5e-03	-5.1e-03	6.8e-03	2.2e-02
	(1.35)	(0.31)	(0.09)	(1.46)	(0.24)	(0.80)
Mortality rate squared			-5.9e-05			-1.0e-04
			(0.75)			(1.35)
% of households with ill PA adults	-2.3e-04	-2.6e-04	-4.5e-04	-3.3e-03+	-3.0e-03+	-2.8e-03
	(0.14)	(0.15)	(0.26)	(1.91)	(1.69)	(1.60)
% of HH with prior prime-age death	-5.4e-03+	-4.4e-03	-3.1e-03	-4.7e-03	-3.7e-03	-3.3e-03
	(1.82)	(1.54)	(1.16)	(1.55)	(1.26)	(1.18)
Interaction terms						
AMR*1999/2000 rainfall deviations[b]	-3.2e-05	-3.6e-05	-2.9e-05	-3.7e-05+	-3.8e-05+	-3.5e-05
	(1.47)	(1.61)	(1.26)	(1.76)	(1.72)	(1.59)
AMR*2000/2001 rainfall deviations	1.9e-05	1.0e-05	5.0e-06	2.2e-05	1.0e-05	2.0e-06
	(0.96)	(0.47)	(0.22)	(1.02)	(0.45)	(0.09)
AMR*2001/2002 rainfall deviations	-2.0e-05	-2.4e-05	-2.2e-05	-1.3e-05	-1.9e-05	-2.7e-05+
	(0.93)	(1.30)	(1.18)	(0.69)	(1.13)	(1.67)
AMR*2002/03 rainfall deviations	-1.2e-05+	-1.5e-05+	-1.1e-05	-8.7e-06	-1.2e-05	-1.3e-05
	(1.68)	(1.72)	(1.31)	(1.22)	(1.36)	(1.52)
AMR*Educated in 2000[c]		-2.3e-03*	-2.8e-03*		-2.2e-03+	-2.7e-03*
		(2.02)	(2.40)		(1.93)	(2.29)
AMR*Effective dependency ratio in 2000[d]		3.1e-03	3.5e-03		-4.8e-05	4.2e-04
		(0.47)	(0.50)		(0.01)	(0.05)
AMR*Value of assets in 2000		3.5e-04	1.1e-04		-6.8e-04	-1.0e-03
		(0.18)	(0.06)		(0.36)	(0.55)
AMR*Landholding size in 2000		-6.7e-04	-6.2e-04		-4.6e-04	-3.8e-04
		(0.81)	(0.71)		(0.54)	(0.42)
AMR* Number of PA adult in SEA in 2000		1.8e-06*	2.0e-06*		1.9e-06*	1.9e-06+
		(2.09)	(1.98)		(2.07)	(1.96)
AMR*Distance to District Town		1.0e-04	5.4e-05		1.2e-04	8.4e-05
		(1.36)	(0.65)		(1.36)	(0.88)
AMR*Distance to nearest tarmac road		-1.3e-05	-1.6e-05		-5.1e-05	-5.0e-05
		(0.23)	(0.27)		(0.78)	(0.70)
AMR*District on line of rail		-3.4e-03	-4.0e-03		2.1e-03	9.6e-04
		(0.68)	(0.79)		(0.45)	(0.20)
Provincial dummies included	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-2.8e-01	-2.7e-01	1.9e-01	-4.8e-01	-7.0e-01	-5.2e-01
	(0.52)	(0.42)	(0.35)	(0.97)	(1.05)	(0.87)
Joint tests						
AMR and AMR squared	-	-	0.29			1.09
Mean household pre-death conditions in 2000	1.12	1.17	1.50	2.46*	2.07*	1.70
Community variables in 2000[e]	1.14	0.95	0.60	0.16	0.60	0.73
AMR*rainfall deviations from 12 year mean	1.43	1.31	0.85	1.69+	1.43	0.86
AMR*household characteristics		1.48	1.11		2.01	1.24
All interactions		1.92**	1.66*		1.97**	1.52*
R-squared	0.11	0.14	0.09	0.09	0.12	0.08
Observations	393	393	393	393	393	393

Source: CSO/MACO/FSRP Post Harvest Survey 1999/2000 and Supplemental Survey, 2001 and 2004

Notes: ** 1% level of significance, * 5% level of significance and + 10% level of significance. Included but not reported in the table: 8 provincial dummies, all variables interacted with AMR. [a]AMR=prime-age deaths between 2001 and 2004/1000 person years. [b]Rainfall deviations from 10 year mean (1993-2002) . [c]Education is the mean number of years of schooling of the most educated in the household . [d]Effective dependency ratio is given by the sum of the number of elderly, children and chronically ill adults divided by number of prime-age adults. [e]Community characteristics include: Distance to nearest tarmac road, distance to the District town (Boma) and District on line of rail.