HIV/AIDS, Food Security and the Role of the Natural Environment:

Evidence from the Agincourt Health and Demographic Surveillance Site

in Rural South Africa

Lori M. Hunter
Departments of Sociology and Environmental Studies
Institute of Behavioral Science, Programs on Population, Environment and Society
University of Colorado at Boulder, USA

Laura Patterson
Department of Sociology
Institute of Behavioral Science, Program on Environment and Society
University of Colorado at Boulder, USA

Wayne Twine
Centre for African Ecology
School of Animal, Plant and Environmental Sciences
University of the Witwatersrand, South Africa

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Abstract: HIV/AIDS mortality and environmental degradation dramatically shape household well-being in many rural communities. Yet, the connections between these phenomena have received little scholarly attention. We use data from the Agincourt Health and Demographic Surveillance Site in rural South Africa to examine the hypothesis that prime-age AIDS mortality represents a unique form of household shock, as well as examining the role of the natural environment in managing that shock. Specifically, we examine prime-age adult mortality-affected households in relation to (1) food security, (2) dependence on homestead gardens, and (3) dependence on wild local vegetation and meat. Results indicate that AIDS mortality households do not differ significantly from households experiencing prime-age adult mortality not related to AIDS, with the exception of the availability of household labor. Importantly, households affected by prime-aged adult mortality from all causes are worse off with regard to food security, compared to their non-mortality-affected counterparts. These findings challenge the contention that AIDS-related mortality, per se, is a distinct household shock. But in this study setting, the disease is nearly doubling the adult mortality rate and, in this sense, HIV/AIDS poses a significant threat to food security and may intensify pressure on local natural resources.

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Two important trends related to population dynamics and the environment are presently colliding to shape the sustainability of rural livelihoods in many poor nations. First, HIV/AIDS, characterized as "one of the deadliest epidemics of modern times" (Bongaarts et al. 2008: 199), has dramatically shaped mortality patterns over the past three decades, particularly in sub-Saharan Africa. Although recent evidence suggests the epidemic has peaked, southern Africa continues to experience the largest number of new infections per year (Bongaarts et al. 2008). Second, many regions are experiencing environmental degradation owing to numerous factors including social inequality and unsustainable resource use (Lufumpa 2005). Although natural resources represent a central component of the livelihoods of many rural households, the environmental dimensions of the African HIV/AIDS pandemic have received little scholarly attention (see Hunter, deSouza and Twine 2008 for exception). The research presented here contributes to our nascent understanding of the ways in which natural resource use in poor, rural regions of developing nations is being shaped, and re-shaped, by the loss of productive adult household members. Making use of demographic surveillance data from nearly 11,000 households in rural South Africa, we model food security as a dimension of household well-being, and examine households experiencing prime-age adult mortality in relation to (1) food security, (2) dependence on homestead gardens, and (3) dependence upon wild local vegetation and sources of meat. As background, we review literature on HIV/AIDS, natural resource dependence in rural sub-Saharan Africa, and the link between HIV/AIDS and food security.

Given the prominence of the pandemic in shaping demographic patterns, a better understanding is needed of its linkages with food security and use of natural resources to inform both public health and environmental conservation policies.

Background

HIV/AIDS: AIDS is the leading cause of death worldwide for people aged 15 to 49, with 39.5 million individuals (estimate range 34.1 – 47.1) infected with HIV as of 2006 (UNAIDS 2006). Nearly 5 million people were newly infected with HIV during 2006, and nearly 3 million died from AIDS-related illnesses during that same year (UNAIDS 2006). The "epicenter" of the pandemic is Southern Africa, particularly sub-Saharan Africa (UNAIDS 2006: 8). This region, with 10% of the world's population, is home to 70% of all people living with HIV, although prevalence rates appear to have stabilized at the level of 2 million new infections annually (UNAIDS 2004).

Within sub-Saharan Africa, the southern region remains most affected. South Africa, our study setting, has an adult prevalence of 21.5%, mid-range for the region, where the highest rate is found in Swaziland (38.8%) and the lowest in Zambia (16.5%) (UNAIDS 2004). Within South Africa, our study site is in Mpumalanga Province (formerly Limpopo), the most northerly of South Africa's nine provinces, where HIV-related tuberculosis and lower respiratory tract infections are among the leading causes of death (Thom 2004). Health indicators for the province suggest that the impacts of HIV/AIDS are only beginning to be felt. In 2000, in then-Limpopo Province, 21.5% of deaths were attributed to AIDS. It is projected that by 2010, this will rise to nearly 65 percent (Day and Gray 2003). South African health services are clearly feeling the impact of the pandemic, and this is likely to get substantially worse in the next 5-10

years (Johnson et al. 2003). In all, the study area represents an appropriate context in which to examine the implications of HIV/AIDS. In addition, although once mainly an urban phenomenon, HIV/AIDS has become an important social problem in rural Africa, with major implications for rural development (Dixon, McDonald and Roberts 2001; Rugalema and Khanye 2002; Vogel 2002).

The impacts of HIV/AIDS occur at multiple scales (e.g., household, national) while also taking multiple forms (e.g., social, economic). Many of these impacts can be expected to affect household food security, and it is necessary to model these associations empirically in order to better understand the implications of the pandemic. In poor, rural communities across Africa and much of the developing world, the use of natural resources acts as an important buffer against poverty and household shocks (Shackleton, Shackleton and Cousins 2001); HIV/AIDS is considered a critically important household shock (Baylies 2002). This project begins filling an empirical void in our understanding of the linkages between HIV/AIDS, adult mortality, and food security, with a focus on the role of the natural environment as a source of sustenance within mortality-impacted households.

Food Security: Food security is commonly defined as "access by all people at all times to enough food for an active, healthy life" (World Bank 1986:1). With specific attention to Africa, Devereux and Maxwell (2001:1) explain that "sub-Saharan Africa is the only region in the world currently facing widespread chronic food insecurity as well as persistent threats of famine." As for our study setting of South Africa, a recent report by the nation's Human Research Sciences Council (2004:16) estimated that more than 14 million people, or about 35% of the population, are vulnerable to food insecurity. In their study of food security in rural farming households in north-eastern Limpopo Province, Leroy et al. (2001) found that more than 80% of households

had insufficient sustenance. In children specifically, one anthropomorphic indicator of malnutrition is stunting, often presented as the proportion of children with height-for-age more than 2 standard deviations below the population mean. In 1999, the level of stunting among children in Limpopo Province (23.1%) was representative of that in the nation as a whole (23.8%) (Labadarios 2000).[i]

HIV/AIDS and Food Security: As South Africa's Human Research Sciences Council aptly stated (HRSC 2004:16), "All dimensions of food security – availability, stability, access and use of food – are affected where the prevalence of HIV/AIDS is high." Certainly the relationship among HIV, AIDS, livelihood strategies, and nutritional security is "complex and multidimensional" (Piwoz 2004). Further, the association between HIV, AIDS and food security is bi-directional. Poverty and desperation may drive people into HIV-related risky behavior (e.g. transactional sex) (Dunkle et al. 2004), while malnutrition itself physiologically increases the susceptibility to HIV infection (e.g., Pimoz and Preble 2000; Semba and Tang 1999). In turn, the various impacts of HIV/AIDS damage livelihoods, exacerbating food insecurity and again increasing the likelihood of risky behavior (HRSC 2004:17). The analytical focus of the project outlined here is on food insecurity as an implication of HIV/AIDS, specifically AIDS-related prime-age adult mortality.

Some scholars argue that the HIV/AIDS pandemic as related to food security has yielded a "new variant famine" (deWaal and Whiteside 2003) and that the influences of HIV/AIDS have worsened and exacerbated existing vulnerabilities to food insecurity, resulting in a "dual tragedy" (HRSC 2004:16). In general, HIV/AIDS significantly undermines a household's ability to provide for its basic needs (deWaal and Whiteside 2003; HRSC 2004; Piwoz 2004), food included. Research reveals that AIDS mortality affects food security through multiple impacts

such as reduced time for agricultural endeavors as a result of caring for sick family members (Drimie 2003). This may be particularly true for female household members, as women are often said to carry the brunt of the burden with regard to maintaining household food security (Akhter 2001, Gawaya 2008). Indeed, Gawaya (2008) reports that women produce approximately 60 – 70% of sub-Saharan Africa's food. And women are crucially involved in agricultural production, food processing and marketing, and nutrition and food safety (Akhter 2001); as such, the FAO in 1998 themed its World Food Day "Women Feed the World", in order to honor women's role in both household and national food security.

In a recent discussion of the impacts of HIV/AIDS on household livelihoods, Haddad and Gillespie (2001:489) bluntly state that "HIV/AIDS strips individuals, households, networks, and communities of assets." Human capital is lost as a result of lowered productivity (e.g., Barnett and Blaikie 1992), the diversion of the labor of healthy individuals (Jackson 2002), and the potential loss of remittances from employed migrant family members (Rugalema and Khanye 2002). Intergenerational knowledge transfer also suffers (Haddad and Gillespie 2001). HIV/AIDS also has important impacts on financial capital, as households incur expenses, and potentially debt, related to drug treatment, transport, and burial. Social capital may decline because of the weakening of institutions and the stigma associated with the illness. Research has also suggested that kin networks, a critical dimension of rural safety nets regarding food security, are undermined by HIV/AIDS (Mtika 2001). Physical capital may also be reduced through sale of productive equipment or the mortgaging of land (van Liere 2002).

The sustainability of natural capital may also be undermined by the HIV/AIDS pandemic (van Liere 2002) as communities and user groups become less able to collectively manage common property resources such as rangelands (Haddad and Gillespie 2001). Agricultural

productivity may be compromised by the loss of prime-age labor (e.g., deWaal and Whiteside 2003). Less labor-intensive and less nutritious crops may be farmed, or land may lie fallow, thereby threatening tenure (Haddad and Gillespie 2001).

Many households in the study region supplement their food intake by cultivating homestead gardens, and an agricultural labor shortage may therefore threaten household food security. Ellis and Freeman (2004) emphasize the importance of agricultural plots in providing sustenance for rural households in sub-Saharan Africa. Working in rural Kenya, Tanzania, and Malawi, Ellis and Freeman (2004) found that 90%, 78%, and 97% (respectively) of crops grown by households were for direct consumption, as opposed to being sold at market. Yet, as Conelly and Chaiken (2000) note, population pressure and relatively small land holdings make rural Kenyan households still very dependent on purchased food.

Questions remain as to how the HIV/AIDS pandemic has affected these environmental elements of food security (Mather 2005, Jayne 2005). As noted by Kaschula (2008), wild foods may offer unique benefits to households impacted by AIDS by offering a nutritious and freely available food source, requiring minimal labor and financial labor costs. Indeed, Kaschula's research in two South African study sites (2008) demonstrated that wild foods were evident in nearly half of study households, although there was significantly greater likelihood of wild food use in AIDS-impacted households.

Of course, as previously discussed, labor shortages in mortality-impacted households represent logical concerns (Barnett and Blaikie 1992; deWaal and Whiteside 2003; Haddad and Gillespie 2001; Jackson 2002). Yet, many researchers have concluded that mortality-affected rural households do not, in fact, face the labor shortages long assumed they would (Mather et al. 2005, Jayne et al. 2005, Yamano and Jayne 2004). Additionally, although deWaal and

Whiteside (2003) and Haddad and Gillespie (2001) have proposed that AIDS-related mortality may decrease household agricultural productivity, Murphy (2008) argued that agricultural labor shortages in rural Kenya, and the concomitant decreases observed in productivity, result not from HIV/AIDS per se but from other ongoing processes, including male out-migration. Another factor, Murphy argues, is an emerging lack of interest in farming – in some cases because young people are seeking educational opportunities and careers outside agriculture (Murphy 2008). Likewise, Bryceson and Fonseca (2006) point out that declines in agricultural productivity in rural Malawi may be partially due to an HIV/AIDS-induced reduction in the household labor pool, but there are many other factors at play, including the removal of an important fertilizer subsidy. Clearly, further empirical research is needed to examine whether, and how, AIDS mortality poses a household shock with regard to food security. If so, it is important to further determine if AIDS mortality yields impact above-and-beyond that of adult mortality from other causes. The present work adds to this relatively sparse empirical knowledge base by examining the differences in food security outcomes, not only between mortality-affected households and their unaffected counterparts, but also between households experiencing AIDS-related adult mortality and those experiencing other forms of prime-age adult mortality.

HIV, AIDS, Food Security, and the Natural Environment: Rural livelihoods in the developing world are often characterized by land-based strategies such as crop production, animal husbandry, and natural resource harvesting (e.g., Kengni et al. 2004). Although a substantial amount of academic research has examined livestock and agricultural production in such contexts, work by Shackleton et al. (2001) stands out as highlighting the direct importance of wild indigenous natural resources in food security and rural livelihoods (see also Kaschula 2008). In general, work by Shackleton and colleagues suggests that proximate natural resources

are critical to household food security through both direct provisioning and harvesting for sale (Shackleton et al. 2001). As for levels of use, in the rural communities of Bushbuckridge, Limpopo Province, South Africa, Hansen (1998) found that 92% of households consumed wild herbs, 81% wild fruit, 77% insects, and 32% bushmeat. (In addition, nearly 98% of households grew food crops in garden plots or large fields outside the village [Giannecchini 2001].) Wild plant resources thus play an important role in nutrition and food security in rural households (High and Shackleton 2000), as do wild vertebrates and invertebrates.

Bringing together household experience with prime age adult mortality, food security, and use of local environmental resources, the current study explores connections that have been little examined in the peer-reviewed literature. Specifically, we use data from rural South Africa to examine the hypothesis that prime-age AIDS mortality represents a unique form of household shock, as well as the role of the natural environment in managing that shock

Research Setting, Data and Methods

Research Setting: Our research setting is the Agincourt Health and Demographic Surveillance Site (AHDSS) operated by the Rural Public Health and Health Transitions Research Unit (hereafter referred to as the Agincourt Unit) of the University of the Witwatersrand School of Public Health (Wits) and South Africa's Medical Research Council (MRC). The AHDSS (400 sq km, ~500 km northeast of Johannesburg) consists of 21 villages, comprising over 11,000 households and 69,000 people (see Figure 1). Factors influencing the original selection of this site included its location some distance from a tar road or township settlement and the presence of a health center with four satellite clinics as well as referral to three district hospitals 25-60 kilometers away. The area is fairly typical of rural communities across South Africa, and is

characterized by poverty, relatively high human densities, and high reliance on both natural resources and remittances from a large migrant population. There is limited formal sector employment, so a large proportion of adults are migrant laborers, working on commercial farms and in towns and cities across the country. Of all males between the ages of 30 and 49, 50% are migrant workers, as are 14% of females of the same age group. A significant proportion of households depend on the state pension of an elderly resident as the only reliable source of household income. Mozambican immigrants, displaced by civil war, comprise nearly 25% of the study area's population, and many villages have a distinct Mozambican section. Although sharing a common culture and language, the Mozambicans differ from their South African counterparts in that they are generally poorer, have less access to state pensions or disability grants, and follow a more traditional way of life. The mean household size in Agincourt ranges from 6.2 in the South African population to 6.5 in the Mozambican sector, although there is substantial variation around these means, and many households have more than 10 members.

(Figure 1 about here)

The area is dry (annual rainfall 550-700 mm) and heavily populated (~170 persons per sq km), with household plots too small to fully support subsistence agriculture. Water shortage is a serious problem in Agincourt, sanitation is generally poor, and most roads are unpaved. Service infrastructure (water supply, electricity, telephone lines, postal services), while seriously lacking, has benefited from recent development initiatives. With regard to environmental characteristics, the AHDSS is characterized by an east-west gradient in topography and rainfall, with higher rainfall in the higher-lying western foothills of the Drakensburg escarpment, and lower rainfall

on the eastern undulating plains (Shackleton et al. 2000). The vegetation is dominated by broadleaf dystrophic savanna woodland (Lowveld Sour Bushveld) in the higher, wetter west, grading into mixed savanna woodland (Lowveld) in the lower, drier east (Shackleton et al. 2000). The local rural communities are dependent on the natural environment for a range of uses, including grazing for livestock, fuelwood, wild foods, thatching grass, construction timber, and other domestic products (Shackleton and Shackleton 2000).

Data Source #1, Ongoing Demographic Surveillance System: Insight into the demographic characteristics of Agincourt residents is provided through the longitudinal demographic surveillance system (DSS) of the Agincourt Unit. Since 1992, annual census data have been collected, as well as special events updates (systematic recording of all births, deaths, and migrations). The resulting data are very rich in demographic detail, allowing identification of key household demographic characteristics (e.g., male/female headship, age composition, members' migration history). The mortality measures are discussed in more detail below.

Data Source #2, Food Security Census Module: In addition to the demographic surveillance, the unit'ss census occasionally incorporates topical modules designed to explore, in more depth, timely issues of importance with regard to public health. In 2004, a topical module incorporated questions on food security generally, staple foods, protein consumption, reliance on cultivation (both within and outside the homestead), and use of wild foods. These data were collected from the household head, or the most senior person available familiar with household conditions.

Research Methods: We use three research questions to organize our analyses and each analysis is done three times. First, we examine the differences in outcomes between households experiencing adult mortality of any type and those households experiencing no such mortality.

Second, we examine AIDS-mortality affected households in contrast to households experiencing adult mortality from another source. This step is undertaken to determine if AIDS mortality is, indeed, a distinct household shock as suggested by much of the previous literature. Third, we examine whether adult mortality, disaggregated by cause of death as well as household position of the deceased, is associated with our outcome measures. The second set of analyses incorporate only mortality-affected households (n=688), while the first and third also include non-mortality households (total n=9,674).

Research Question #1: Do households that experience prime-age adult mortality have lower food security than households without prime-age adult mortality experience? The Food Security Module provides two outcome variables relevant to this question. As an indication of general food security, we model the association between our primary predictor variables (adult mortality, AIDS-related adult mortality), the control variables (described below), and responses to the question "Has your household NOT had enough food to eat in the last month?" Although not as precise as measurement of individual caloric intake or anthropometric measures (used in many demographic and health surveys), such a measure allows more careful specification of household food security than the use of per capita food availability estimated through food supply at the national level (USDA 2001).

For a more detailed understanding of food insecurity, we then examine responses to the question "How often in the last month did your household not have enough to eat?" Responses are initially coded as follows: very often (15-30 days), often (8-14 days), sometimes (2-7 days), rarely (1 day), and never (0 days). Households are assigned the midpoint of their category's range.

Research Question #2: Is prime-age adult mortality experience associated with households' use of homestead gardens? Here, we make use of three outcome variables from the Food Security Module. First we examine responses to the question "Has your household grown food crops other than mealies in a garden on your homestead plot over the last year?" Mealies is the local staple, and to our knowledge, this question is unique to the Food Security Module of the Agincourt Unit 2004 Census. The question was developed specifically to reflect the analytical focus on the role of the local environment in household food security.

Second, we examine responses to the question "Have your fields/gardens produced enough crops to feed all the members of your household over the whole of the last year?" Notably, this question includes not only crops grown in a garden on the household's homestead plot, as did the previous question, but also crops grown on fields outside the household's homestead plot.

Third, if respondents felt their fields/gardens did not produce enough crops to feed the household, we queried as to why. Potential responses include: insufficient land, fertilizer, water, labor, or other. In response to prior literature emphasizing AIDS impact on labor (Barnett and Blaikie 1992; Jackson 2002), our focus within these analyses is the perception that productivity fell short due to lack of household labor.

Research Question #3: Are households that experience adult mortality more dependent upon wild local vegetation and meat sources than households without adult mortality experience? To answer this question, we make use of three outcome variables. First, we examine a variable reflecting whether households regularly supplement their diet by gathering from the bush. We then examine how many times per year households consume wild herbs (e.g., guxe) and wild fruit (e.g., marula) gathered from the bush.

Main predictor variable (adult mortality experience): Due to the study site's public health origins, substantial effort has been expended on understanding processes related to mortality. Verbal autopsies (VAs) have been performed for each resident death, and the resulting transcripts used to identify those deaths likely attributable to HIV/AIDS. In the VAs, specially trained fieldworkers interview the closest caregiver of the deceased in the caregiver's mother tongue. The interview schedule is a modification of that previously used in Niakhar, Senegal, (Kahn et al. 2007) has been designed appropriate for all ages, translated into Shangaan (the local language), and modified to include only culturally accepted terminology. An open section of the questionnaire elicits from the respondent, in his or her own words, details of all symptoms and signs preceding death. This is followed by several filtering questions (e.g., *"Did the deceased have diarrhea?"*). When the answer is positive, detailed questions regarding that particular symptom are asked. If negative, the interview proceeds to the next filtering question. Emphasis is placed on the sequence and duration of signs and symptoms. Further sections address use of modern and traditional treatments, and lifestyle practices.

The VAs are then reviewed via clinician assessment involving three medical practitioners. Two doctors, blind to each other's findings, review the information and assign a probable cause of death. Where these correspond, the diagnosis is accepted. Where they differ, the practitioners discuss the case, and, if they achieve consensus, this is accepted as the cause of death. If not, a further blind assessment is made by a third independent practitioner. If two out of three diagnoses now correspond, the diagnosis is accepted; if not, the cause of death is described as "undetermined." Where possible a main (or underlying) cause, immediate cause, and contributory factors are identified. Classification is consistent with the International Classification of Diseases (ICD-10).

Since the VA approach remains a prototype technique, validation of results is necessary. This has been done for the Agincourt VA instrument and method by comparing VA final diagnoses with hospital reference diagnoses, and calculating the sensitivity, specificity, and predictive values (using standard formulas) for categories / individual causes of death (Kahn et al. 2007). To qualify as "gold standard" or reference diagnoses, district hospital records need to meet specified inclusion criteria pertaining to quality of recorded clinical information.

Within this project, we classify households on the basis of adult mortality experience disaggregated by the deceased's gender, position within the household (i.e., female household head, male household head, wife of the household head, male "other," and female "other," and probable cause of death (i.e., HIV/AIDS-related and non-HIV/AIDS-related; see Table 1). Such a perspective is particularly relevant given the gender dimensions of food security in developing nations (e.g., Akhter 2001). Households were considered to have experienced adult mortality if a prime-aged adult (aged 15-49) within the household died between November 1, 2001, and August 1, 2004. This time period represents approximately the three years prior to the fielding of the 2004 Food Security Module. Only prime-age adult mortality was examined, as this age range reflects the years of highest economic productivity for individuals within this study setting.

(Table 1 about here)

As noted above, we first examine whether mortality in general, regardless of cause of death or household position of the deceased affects our outcome variables. We then examine whether HIV/AIDS-related adult mortality represents a distinct household shock, as compared to adult mortality from other causes. Variation might be expected due to effort potentially diverted

to caring for an HIV-positive household member or to stigma associated with the disease (de Waal and Tumushabe 2003; Hammarskjold 2003; Piot and Pinstrup-Andersen 2002). This model does not disaggregate household mortality experience by household position of the deceased.

Following examination of the unique nature of HIV/AIDS-related prime-age adult mortality, we then examine the effects of adult mortality on food security and use of the local environment, disaggregated by both cause of death and the deceased's household position. These analyses are undertaken with data reflecting all households – both those that experienced prime-age adult mortality and those that did not.

Control Variables:

Household size. The ability of a household to meet members' nutritional requirements is influenced by household size (e.g., Garrett and Ruel 1999), and we reflect size through the inclusion of the number of individuals who reportedly regularly slept at the household the month of food security data collection.

Household composition. A household's nutritional needs, and its ability to meet those needs, are also shaped by age composition (e.g., Albertse and Mancusi-Materi 2000) as well as gender composition (e.g., Lemke 2003). In our analyses, households are considered "young" if at least one-third of their members are aged fewer than 15 years. Households are considered "old" if at least one-third of their members are of pensionable age: 60 years for women and 65 years for men. Household gender composition is measured by the ratio of working age (15-49) men to women who were members of the household the month of food security data collection.

Household assets. Household socioeconomic status (SES) may also be associated with food security. We measure SES through an "asset index" derived annually from an asset register

within the DSS. This index is disaggregated into three separate measures, reflecting the ownership of common consumer goods (e.g., radio, television, cellular phone), livestock and agricultural goods (e.g., pigs, chickens, cows), and goods that are particularly uncommon within this setting (e.g., satellite dish, motorbike, landline phone). SES data were collected in 2001 and 2003, and we use data for 2003 as our cross-sectional measure of SES. In addition, we incorporate change in SES 2001-2003. We do so because, a longitudinal measure of SES provides the ability to parse out the effect of a recent rise or fall in SES from that of the sheer magnitude of a household's SES. This may be useful when we reasonably expect a lag to exist between the gain or loss of assets and the effect of the household's newly acquired SES on wellbeing (Patterson et al. 2008).

Livelihood strategy. We examine two separate indicators of household livelihood strategy: (1) adults employed in the formal and informal sectors, and (2) receipt of pensions and grants. Employment in the formal and informal sectors is measured by a variable reflecting the proportion of adult household members (aged 15-49) employed in either the primary and secondary labor markets. These data were obtained from a module in the Agincourt census fielded between August-November, 2004. Two variables are also created to reflect the number of student grants and old-age pensions received by household. Finally, a dummy variable is created to reflect whether an adult within the household is receiving a government child support grant. A South African citizen can apply for a child support grant for each child under the age of fourteen who is under their care.

Characteristics of household head: Three variables are created to reflect the age, gender, and nationality of the household head as of August 1, 2004. The age of the household head is represented by a continuous variable. Gender and nationality are dummy variables, with

nationality coded "1" for South African and "0" for other. In most cases, "other" represents Mozambican background. Differentiating between households of South African and Mozambican origin is important, since this distinction is associated with households' placement within the local social structure as non-citizens are ineligible for social grants, a key source of household income within this setting.

Access to local vegetation: Two variables are constructed to capture variation in the natural environment surrounding each household's village since the state of the natural environment may be expected to influence the frequency of households' gathering food from the bush. A measure of the degree of vegetation cover surrounding each village is derived from a Landsat 5 TM image, taken on May 30, 2004. NDVI was calculated from this image using the NDVI model in ERDAS Imagine. To construct a measure of vegetation density, the sum of NDVI values obtained within a 1 km radius of each village is divided by the number of readings within that radius, generating an average NDVI for the area. Additionally, a variable is generated to reflect proximate villages , as measured by those intersecting the 1 km radius surrounding each household's village of residence. Such an indicator reflects the degree of competition for proximate resources. These calculations are derived from one kilometer radius surrounding each village as this may reflect a reasonable distance for one to travel on foot to collect natural resources.

(Table 2 about here)

Results

HIV/AIDS-related prime-age adult mortality as compared to other causes: An initial study objective was to determine, among only adult-mortality impacted households, whether AIDS mortality represents a distinct household shock with regard to our food security measures. As

shown in Table 4, a statistically significant difference was found between those households experiencing adult, HIV/AIDS-related mortality and those experiencing adult mortality from other causes for only one outcome variable – the perceived lack of household labor as an explanation for less than optimal productivity on homestead fields and/or plots (OR = 1.78; $p < 0.05$). These results provide support for the contention that AIDS affected households are especially susceptible to a lack of labor, compared to households affected by other types of adult mortality. Notably, however, although households affected by AIDS related adult mortality were more likely to assert the presence of a labor shortage as the reason for less than optimal productivity of homestead plots, they were nonetheless no more likely to indicate that that these plots were less than optimally productive, when compared to those households experiencing other types of adult mortality. In other words, *when* their plots were not productive enough to feed all household members, those affected by specifically AIDS related mortality were more likely to assert this was due to a lack of labor. But over all, their plots were equally likely to feed all household members compared to the plots of households experiencing non-AIDS related adult mortality.

Food security as associated with prime-age adult mortality: The following results are organized with respect to our three research questions. Estimates are presented in Table 3, 5, and 6.

Research Question #1: Do households that experience prime-age adult mortality have lower food security than households without prime-age adult mortality experience? When aggregated by household position and cause of death, those households experiencing prime-age adult mortality were no more likely than their non-mortality counterparts to report having gone without enough food to eat at least once in the past month. However, those experiencing prime

age adult mortality reported approximately one more day of hunger in the past month, compared to their non-mortality counterparts.

When mortality affected households were disaggregated by household position of the deceased, those experiencing the death of a male head were more likely to report going hungry in the past month (OR = 1.64, $p < 0.05$). Although mortality of an individual in any household position other than the male head was not associated with a greater likelihood of experiencing food insecurity in the past month, those experiencing the death of a female head or wife of head did report significantly more days of hunger in the past month than their non-mortality counterparts ($b = 1.76$, $p < 0.05$; $b = 1.92$, $p < 0.01$).

When disaggregated by household position and cause of death, only the AIDS-related death of the wife of the household head was significantly associated with the presence of food insecurity in the past month (OR = 2.37; $p < 0.05$). However, those households experiencing the non-AIDS related death of the male or female head of household, or the AIDS related death of the wife of the household head, were likely to have gone hungry on significantly more days in the past month than were their non-mortality counterparts ($b = 1.89$, $p < 0.01$; $b = 2.98$, $p < 0.01$; $b = 4.86$, $p < 0.01$).

Although results vary by the exact method of mortality disaggregation, over all, these findings indicate that food security is most negatively impacted when the deceased was a head of household or the wife of the head. Also, these findings suggest that AIDS mortality does not render households either uniformly less food secure or uniformly more food secure than those households experiencing adult mortality from other causes. Nonetheless, it does appear that for certain household positions – the wife of the head, for example – AIDS mortality in particular, as opposed to non-AIDS mortality, does pose a unique household shock.

With regard to control variables, the first measure of socioeconomic status (SES) – that reflecting the possession of common consumer goods – is the only SES measure exhibiting a significant relationship with food security. A higher SES in 2003 was associated with lower odds of a household having gone hungry in the past month and also lesser days in the past month, on average, that the household did not have sufficient food (OR = 0.82, $p < 0.01$ and b = -0.46, $p < 0.01$, respectively). Additionally, households experiencing an increase in SES between 2001 and 2003 were significantly more likely to have gone without enough food to eat in the past month, and this was found to occur on significantly more days over the past month (OR = 1.09, $p < 0.01$ and b = 0.16, $p < 0.01$, respectively). This is logical, as households experiencing a recent increase in SES may still suffer some of the negative consequences associated with their previous lower socio-economic well-being.

The likelihood of a household having gone hungry at least once in the past month is positively associated with household size, receipt of child grants, female-headedness, South African-headedness, and density of proximate natural vegetation (OR = 1.02 , $p < 0.05$; OR = 1.20, $p < 0.01$; OR = 1.24 , $p < 0.01$; OR = 1.13 , $p < 0.05$; OR = 1.02 , $p < 0.01$). On the other hand, lesser likelihood of hunger is associated with an older age composition, increased labor market participation, and/or the receipt of an old age pensions (OR = 0.69, $p < 0.01$; OR = 0.39, $p < 0.01$; and OR = 0.92, $p < 0.01$, respectively).

Similarly, a positive association was found between the number of days within the past month without sufficient food and household size, receipt of a child grant, female-headedness, South African-headedness, density of proximate natural vegetation, and the number of proximate villages (b = 0.08, $p < 0.01$; b = 0.30, $p < 0.05$; b = 0.47, $p < 0.01$; b = 0.43, $p < 0.01$; b = 0.06, $p < 0.01$; b = 0.17, $p < 0.01$). Households with older or younger age structures, more employed

adults, and the receipt of more old age pensions experienced fewer days with insufficient food ($b = -0.68$, $p < 0.01$; $b = -0.48$, $p < 0.05$; $b = -2.08$, $p < 0.01$; and $b = -0.31$, $p < 0.01$, respectively).

Research Question #2: Is prime-age adult mortality experience associated with households' use of homestead gardens? When aggregated by household position and cause of death, no significant differences are found between prime-age adult mortality-impacted households and their non-mortality counterparts with regard to growing crops (other than maize or mealies) on homestead plots. However, when disaggregated by household position and cause of death of the deceased, non-AIDS related male mortality of an individual other than the head of household is associated with a lesser likelihood of growing these crops (OR = 0.70, $p < 0.05$).

With regard to ability of household fields and/or homestead plots to produce sufficient food over the past year to feed all household members, those experiencing adult mortality were actually more likely to report sufficient field and plot productivity, compared to non-mortality households (OR = 1.25, $p < 0.05$). When mortality is disaggregated by household position and cause of death, this effect is only significant for non-AIDS related male head mortality (OR = 1.68, $p < 0.05$).

Among households experiencing a shortage of field or plot productivity, those experiencing adult mortality in general were no more likely to say a lack of labor was to blame. However, when mortality experience was disaggregated by household position, those households experiencing the death of a female household head were more than twice as likely to report a lack of labor as a cause for sub-optimal field or plot productivity (OR = 2.22, $p < 0.05$). Interestingly, however, when disaggregated by both household position and cause of death, the effect of female head mortality is no longer significant; however, the AIDS-related death of a male other than the head of household is associated with a greater likelihood of reporting a labor

shortage (OR = 2.03, $p < 0.05$). This result was not apparent when mortality was disaggregated only by household position because the effect of non-AIDS related mortality of the male "other" actually shows the opposite trend. Although insignificant, the odds ratio for such mortality is 0.67. These results suggest that, although AIDS-related mortality does not show a consistent trend in contrast to non-AIDS related mortality when examined across all household positions, for certain position-outcome combinations, AIDS and non-AIDS related mortality do show strikingly different associations.

With regard to SES, higher values for both the "common" goods and agricultural goods SES indicators are associated with a higher likelihood of growing crops other than maize or mealies on homestead plots (OR = 1.12, $p < 0.01$; OR = 1.36, $p < 0.01$) and also a higher likelihood of households' fields and/or plots feeding all household members over the past year (OR = 1.07, $p < 0.01$; OR = 1.09, $p < 0.01$). Additionally, those households experiencing a recent increase in their agricultural goods SES measure are less likely to have grown crops (other than maize or mealies) on their homestead plots (OR = 0.90, $p < 0.01$). In addition, the agricultural goods SES index is the only SES measure associated with a perceived shortage of agricultural labor; those households with a higher value for this SES index in 2003 are less likely to report being unable to produce enough food on their fields and/or homestead plots due to a lack of labor (OR = 0.74, $p < 0.01$).

On other control variables, greater likelihood of growing crops (other than maize or mealies) on homestead plots is also associated with larger household size, older age composition, receipt of student and/or child grants, older household head, and higher proximate vegetation density as well as greater numbers of proximate villages (OR = 1.03, $p < 0.01$; OR = 1.26, $p < 0.05$; OR = 1.05, $p < 0.05$; OR = 1.21, $p < 0.01$; OR = 1.01, $p < 0.01$; OR = 1.06, $p < 0.01$; OR =

1.12, $p < 0.01$, respectively). Higher sex ratios and proportions of employed adult household members are associated with lesser likelihood (OR = 1.00 (rounded up), $p < 0.01$ and OR = 0.75, $p < 0.01$, respectively).

Households with the following characteristics are more likely to have sufficiently productive fields and/or plots: those with older heads, and those with greater proximate vegetation and more proximate villages (OR = 1.01, $p < 0.05$; OR = 1.05, $p < 0.01$; and OR = 1.25, $p < 0.01$, respectively). Insufficiently productive fields are more likely to be found in households with higher sex ratios (more men relative to women), and those with female heads (OR = 1.00 (rounded up), $p < 0.01$; and OR = 0.85, $p < 0.01$, respectively).

Lack of labor as a central reason for insufficient garden/plot productivity characterizes households with higher sex ratios, younger age composition, and South African heads (OR =1.00 (rounded down), $p < 0.01$; OR = 1.32, $p < 0.05$; and OR = 1.48, $p < 0.01$, respectively). Larger households, more old age pensions, receipt of a child grant, higher vegetation density, and a greater number of nearby villages are all associated with lesser likelihood (OR = 0.93, $p < 0.01$; OR = 0.87, $p < 0.05$; OR = 0.68, $p < 0.01$; OR = 0.97, $p < 0.01$; and OR = 0.93, $p < 0.01$, respectively).

Research Question #3: Are households that experience adult mortality more dependent upon local vegetation and meat sources than households without adult mortality experience? When mortality from all household positions and causes is aggregated, no significant differences in gathering from the bush are found between mortality-affected households and their unaffected counterparts. Likewise, mortality-affected households do not differentially consume wild herbs or fruit as compared to their unaffected counterparts.

However, when mortality is disaggregated by household position, and later, both household position and cause of death, mortality of the female head, and then non-AIDS related mortality of the male head, are found to decrease the household's likelihood of supplementing food intake by gathering from the bush (OR = 0.50, $p < 0.05$; OR = 0.63, $p < 0.05$). This is surprising, as it was hypothesized that households experiencing adult mortality may increase reliance on natural resources, as a relatively low cost addition to the household food supply. Similar to the finding noted above for labor shortages, the effect of non-AIDS related male head mortality only became apparent after disaggregating by both household position and cause of death, as the (insignificant) odds ratio for AIDS-related male head mortality is 1.29, opposite in direction from that for non-AIDS related mortality. This again suggests that for certain outcome-position combinations, AIDS-related mortality may have a significantly different impact than non-AIDS related mortality.

With regard to control variables, a greater common goods measure of SES is associated with lesser consumption of wild herbs ($b = -7.74$, $p < 0.01$). Additionally, households experiencing an increase in this SES measure between 2001 and 2003 are found to eat wild herbs significantly more often than those households with a stable or decreasing SES over that time period ($b = 3.76$, $p < 0.01$). The agricultural goods index shows the opposite pattern from this index, with a greater measure in 2003 being significantly related to households consuming more wild herbs over the past year ($b = 4.08$, $p < 0.01$).

Households with old age composition, receipt of more student and old age pensions, as well as receipt of a child grant, were all found to significantly increase the likelihood of households supplementing their food intake by gathering from the bush (OR = 1.42, $p < 0.01$; OR = 1.08, $p < 0.01$; OR = 1.14, $p < 0.01$; and OR = 1.12, $p < 0.05$, respectively). The

likelihood of bush supplementation was lesser for households with higher sex ratios, greater numbers of household adults employed in the labor market, a South African household head, more dense proximate vegetation and more proximate villages (OR = 1.00 (rounded up), $p < 0.01$; OR = 0.70, $p < 0.01$; OR = 0.65, $p < 0.01$; OR = 0.98, $p < 0.01$; and OR = 0.75, $p < 0.01$, respectively).

Wild herbs are more commonly consumed by larger households, those with more dense proximate vegetation and greater numbers of proximate villages ($b = 0.91$; $p < 0.05$; $b = 1.32$, $p < 0.01$; $b = 4.81$, $p < 0.01$, respectively). Lower wild herb consumption characterizes households with higher levels of employment and South African household heads ($b = -12.14$, $p < 0.01$ and $b = -13.01$, $p < 0.01$, respectively). Wild fruit is more commonly consumed by households with South African household heads, and more dense proximate vegetation ($b = 21.21$, $p < 0.01$ and $b = 2.66$, $p < 0.01$, respectively). No control variables were significantly associated with lessened wild fruit consumption.

Discussion and Conclusions

We present examination of a little-explored intersection – that between HIV/AIDS mortality, household food security and use of the local environment in rural communities of less developed settings. We tap into the strength provided by demographic surveillance allowing access to detailed mortality data for a large sample of households in an impoverished, fairly remote setting of rural South Africa.

We draw two primary lessons from these analyses. First, the death of a household head or wife of head most dramatically impacts household food security. These households are more

likely to have experienced hunger in the prior month, and also to have been hungry more often, than those experiencing no mortality.

Second, on most food security related outcomes, HIV/AIDS-related adult mortality does not appear to represent a unique household shock when compared to adult mortality from other causes. The exception to this is the perception that labor shortages are the cause of sub-optimal productivity on homestead fields and/or plots. Although no more likely to assert that their homestead fields and plots are less than optimally productive, *when* this is the case, households affected by AIDS related adult mortality are nearly twice as likely as households experiencing adult mortality from other causes to report labor shortages as the primary cause. These overall findings support the contention that AIDS mortality affected households may be especially susceptible to labor shortages, but contrast with the perception that the stigma associated with HIV/AIDS, as well as the long-term, and therefore potentially resource-intensive nature of the disease, exacerbates its household impact relative to other types of adult mortality (de Waal and Tumushabe 2003; Hammarskjold 2003; Piot and Pinstrup-Andersen 2002).

It is important to point out, however, that when mortality experience is disaggregated by cause of death as well as household position of the deceased, in some cases we do see a differential impact on our outcomes between AIDS related adult mortality and mortality from other causes. One rather extreme example is the effect of mortality of the wife of the household head on food security. For this particular household position and outcome, AIDS related mortality is associated with a nearly 2.5 times greater likelihood of experiencing food insecurity compared to non-mortality households, while non-AIDS related mortality has no significant relationship. This may lead one to believe that AIDS related adult mortality is generally harder on households than non-AIDS related mortality, as often suggested in the literature. But, when

examining the number of hungry days experienced by households, we find the opposite relationship; that is, for death of the head of household (both male and female), non-AIDS related mortality is associated with approximately 2-3 more hungry days in the past month, compared to non-mortality households, while AIDS related mortality shows no significant relationship. Because AIDS related mortality does not show a consistent trend across household positions – i.e. it is not consistently worse or consistently better for households than non-AIDS related adult mortality – we do not conclude that such mortality generally has a differential impact on households, compared to other types of adult mortality. However, results do suggest that important interactions may exist between cause of death and household position; this warrants attention in future research.

Linking food security to natural resource use yields surprising findings. Although we anticipated mortality-impacted households to exhibit greater use of proximate wild resources (e.g., Hunter et al. 2007), present results suggest that adult mortality-impacted households are not more likely to supplement their food intake by gathering from the bush. Households suffering the loss of a head of household were actually less likely to gather from the bush.

Two caveats deserve mention. First, although HIV/AIDS mortality does not appear particularly distinct, this is not to suggest that HIV/AIDS is not impacting food security. As shown in Table 1, HIV/AIDS is nearly doubling the prime-age adult mortality rate in this study setting, and therefore, as prime-age adult mortality in general is found to negatively impact food security, the HIV pandemic can be expected to have important overall impacts on food security. Such is particularly the case given recent estimates that suggest that southern Africa continues to experience the largest number of new infections per year (Bongaarts et al. 2008).

Second, it is important to note that our approach likely underestimates the impact of adult mortality in general, and HIV/AIDS specifically, on study households and communities. This is the case since we contrast those households affected by prime-age adult mortality with those "unaffected." Given the high prevalence of HIV/AIDS within this setting, few households actually remain "unaffected." Those households classified as "unaffected" herein may, in fact, be providing important assistance to "affected" households – for example, by taking in orphans or transferring resources to these households (Jayne 2006, Booysen 2003). Still, data on such social support are unavailable within this study site. This topic represents an important arena for further investigation.

It is also worth noting that socioeconomic status (SES) clearly shapes food security and natural resource use. In particular, variation in ownership of common consumer goods such as radio, television, and/or cellular phone appears to distinguish household well-being along these dimensions. Households with more of such goods tend to be more likely to have sufficiently productive household plots and, accordingly, to be more food secure. They are also less likely to rely on wild foods. Interestingly, the association between a household's recent change in SES and these measures suggests a lag exists between households acquiring a higher SES status and reaping the benefits associated with that higher status.

Overall, the examination sheds light on implications of the intersection between prime-age adult mortality, food security and natural resource use in a rural setting of South Africa. Mortality-impacted households experience greater hunger, although HIV/AIDS-mortality does not necessarily represent a unique shock. In this way, dietary interventions more generally targeting vulnerable households, including those of relatively low socio-economic status, appear particularly appropriate.

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Table 1. Sample Sizes for Adult Mortality Variables

Household position	Cause of death		Total
	AIDS	Non-AIDS	
Male head	45	101	146
Female head	32	37	69
Wife of head	41	57	98
Male "other"	79	166	245
Female "other"	106	131	237
Total	303	492	795

Table 2. Descriptive Profiles of Selected Dependent and Independent Variables

Variable	Mean	Min	Max	N
Food security				
Food insecure in last month	0.37	0	1	10,810
Number of times food insecure in past month	3.01	0	22.50	10,798
Dependence on homestead gardens				
Grow crops other than maize or mealies on plot	0.59	0	1	11,731
Fields/plot produced enough to feed household over past year	0.17	0	1	11,731
Fields/plot did not produce enough to feed household due to lack	0.11	0	1	11,731
Dependence on wild local vegetation				
Supplement food intake by gathering from bush	0.52	0	1	11,731
Number of times consumed wild herbs last year	114.03	0	1,560	6,123
Number of times consumed wild fruit last year	64.44	0	1,560	2,087
Mortality				
AIDS mortality	0.02	0	1	11,731
Male head mortality	0.01	0	1	11,731
Female head mortality	0.01	0	1	11,731
Wife of head mortality	0.01	0	1	11,731
Male "other" mortality	0.02	0	1	11,731
Female "other" mortality	0.02	0	1	11,731
Household sociodemographic characteristics				
Common goods SES 01-03	0.07	-7	5	10,002
Agricultural goods SES 01-03	-0.14	-4	4	10,002
Uncommon goods SES 01-03	-0.02	-2	2	10,002
Common goods SES 2003	2.54	0	8	11,228
Agricultural goods SES 2003	0.84	0	5	11,228
Uncommon goods SES 2003	0.03	0	3	11,228
Sex ratio	200.45	0	1000	11,731
Household size	6.37	1	44	11,731
Old age composition	0.09	0	1	11,731
Young age composition	0.09	0	1	11,731
Labor market participation	0.38	0	1	11,448
Number of student grants	1.59	0	15	11,731
Number of old age pensions	0.83	0	10	11,731
Receipt of child grant	0.51	0	1	11,597
Age of household head	50.43	7.17	104.33	11,563
Female headedness	0.36	0	1	11,563
South African headedness	0.72	0	1	11,557
Contextual factors				
Vegetation density	167.91	156.65	183	11,731
Village density	1.81	0	5	11,731

Table 3. Logistic Regressions and Linear Regressions for the Effects of Adult Mortality on Selected Outcome Variables

	Not enough food in past month			*Times hungry in past month*		
Food security	OR	OR	OR	b	b	b
Mortality						
Adult mortality	1.31***	1.18**	1.18	0.98***	0.73***	0.71***
Household sociodemographic characteristics						
Household size		1.02	1.02		0.07***	0.07***
Sex ratio		1.00	1.00		0.00	0.00
Old age composition		0.70***	0.70***		- 0.65***	- 0.63***
Young age composition		0.91	0.92		- 0.46**	- 0.45**
Common goods SES 01-03		1.10***	1.10***		0.17***	0.17***
Agricultural goods SES 01-03		1.01	1.01		0.05	0.07
Uncommon goods SES 01-03		0.88	0.91		- 0.26	- 0.21
Common goods SES 2003		0.82***	0.82***		- 0.47***	- 0.45***
Agricultural goods SES 2003		0.99	0.98		0.03	- 0.01
Uncommon goods SES 2003		0.86	0.85		- 0.25	- 0.22
Labor market participation		0.38***	0.39***		- 2.16***	- 2.12***
Number of student grants		1.03	1.03		- 0.08	- 0.07
Number of old age pensions		0.93**	0.93***		- 0.30***	- 0.31***
Receipt of child grant		1.19***	1.19***		0.31**	0.32**
Age of household head		1.00	1.00		- 0.01***	- 0.01***
Female headedness		1.24***	1.25***		0.48***	0.49***
South African headedness		1.17***	1.12**		0.50***	0.40***
Contextual factors						
Vegetation density			1.02***			0.06***
Village density			1.00			0.17***
Constant				2.96***	4.94***	- 5.78***
n	9001	9001	9001	8991	8991	8991
R-squared	0.00	0.04	0.05	0.00	0.05	0.05

Table 3 (continued) Logistic Regressions and Linear Regressions for the Effects of Adult Mortality on Selected Outcome Variables

	Grow crops other than maize or mealies			*Plots fed all household members last year*			*Suffer from lack of labour*		
Dependence on homestead gardens	OR	OR	OR	OR	OR	OR	OR	OR	OR
Mortality									
Adult mortality	1.07	0.99	0.97	1.26**	1.27**	1.25**	0.95	1.06	1.06
Household sociodemographic characteristics									
Household size		1.02**	1.03***		1.01	1.01		0.93***	0.93***
Sex ratio		1.00***	1.00***		1.00***	1.00***		1.00***	1.00***
Old age composition		1.22**	1.25**		1.16	1.17		1.03	1.02
Young age composition		0.97	0.99		1.08	1.09		1.34**	1.33**
Common goods SES 01-03		0.99	0.99		0.99	0.99		0.99	0.99
Agricultural goods SES 01-03		0.89***	0.90***		0.94	0.96		1.02	1.02
Uncommon goods SES 01-03		1.08	1.15		1.06	1.05		1.31	1.29
Common goods SES 2003		1.10***	1.13***		1.07***	1.09***		0.98	0.97
Agricultural goods SES 2003		1.40***	1.36***		1.26***	1.21***		0.73***	0.75***
Uncommon goods SES 2003		0.88	0.91		1.19	1.28		1.04	1.03
Labor market participation		0.73***	0.75***		0.98	1.01		1.11	1.10
Number of student grants		1.05**	1.05**		0.98	0.98		1.01	1.01
Number of old age pensions		1.05	1.04		1.01	1.01		0.87**	0.88**
Receipt of child grant		1.20***	1.21***		1.00	1.02		0.68***	0.68***
Age of household head		1.01***	1.01***		1.01**	1.01**		1.00	1.00
Female headedness		1.06	1.08		0.85***	0.86**		1.02	1.01
South African headedness		1.09	0.97		1.02	0.96		1.41***	1.49***
Contextual factors									
Vegetation density			1.06***			1.05***			0.97***
Village density			1.12***			1.25***			0.93**
n	9674	9674	9674	9674	9674	9674	9674	9674	9674
R-squared	0.00	0.05	0.07	0.00	0.02	0.03	0.00	0.06	0.06

Table 3 (continued) **Logistic Regressions and Linear Regressions for the Effects of Adult Mortality on Selected Outcome Variables**

	Gather from bush			*Times consumed herbs in past year*			*Times consumed fruit in past year*		
Dependence on wild local vegetation	OR	OR	OR	b	b	b	b	b	b
Mortality									
Adult mortality	0.96	0.89	0.89	1.39	- 1.03	- 1.14	- 9.13	- 9.79	- 5.97
Household sociodemographic characteristics									
Household size		0.99	1.00		0.96**	0.93**		0.25	0.29
Sex ratio		1.00***	1.00***		0.00	0.00		0.00	0.00
Old age composition		1.40***	1.41***		2.05	2.01		- 7.44	- 9.95
Young age composition		1.09	1.09		- 0.69	- 0.04		- 5.31	- 2.74
Common goods SES 01-03		1.02	1.01		3.85***	3.76***		1.40	1.07
Agricultural goods SES 01-03		1.00	0.99		- 1.42	- 1.10		3.84	4.11
Uncommon goods SES 01-03		0.91	0.98		2.10	3.16		- 9.03	- 8.67
Common goods SES 2003		0.99	0.97		- 8.38***	- 7.75***		0.13	0.71
Agricultural goods SES 2003		0.98	1.01		5.19***	4.22***		- 2.06	- 2.31
Uncommon goods SES 2003		1.09	0.97		-11.77	-10.40		-31.34	-29.83
Labor market participation		0.72***	0.71***		-13.59***	-12.54***		15.44	14.98
Number of student grants		1.08***	1.08***		0.72	0.82		2.71	3.07
Number of old age pensions		1.14***	1.13***		0.80	0.77		2.40	1.30
Receipt of child grant		1.14***	1.12**		- 3.85	- 3.96		- 1.59	- 2.75
Age of household head		1.00	1.00		0.09	0.11		- 0.13	- 0.14
Female headedness		1.05	1.05		3.52	3.66		3.33	3.27
South African headedness		0.68***	0.66***		-11.47***	-13.12***		30.58***	21.07***
Contextual factors									
Vegetation density			0.98***			1.33***			2.66***
Village density			0.75***			4.76***			- 2.12
Constant				113.04***	121.63***	-101.88***	63.92***	38.54***	-404.39***
n	9674	9674	9674	5168	5168	5168	1798	1798	1798
R-squared	0.00	0.03	0.04	0.00	0.05	0.06	0.00	0.03	0.06

*** p < 0.05; *** p < 0.01*

Table 4. Logistic Regressions and Linear Regressions for the Effects of HIV/AIDS-related Adult Mortality on Selected Outcome Variables[a]

	Not enough food in past month			*Times hungry in past month*		
Food security	OR	OR	OR	b	b	b
Mortality						
HIV/AIDS-related mortality	1.03	1.07	1.08	0.41	0.44	0.45
Household sociodemographic characteristics						
Household size		1.00	1.01		0.14	0.15
Sex ratio		1.00	1.00		0.00	0.00
Old age composition		0.84	0.83		0.13	0.10
Young age composition		1.26	1.24		0.84	0.83
Common goods SES 01-03		1.02	1.03		0.09	0.09
Agricultural goods SES 01-03		1.00	1.01		- 0.17	- 0.17
Uncommon goods SES 01-03		0.74	0.73		- 0.18	- 0.20
Common goods SES 2003		0.85***	0.85***		- 0.48***	- 0.48***
Agricultural goods SES 2003		0.88	0.87		- 0.32	- 0.31
Uncommon goods SES 2003		1.34	1.27		0.24	0.18
Labor market participation		0.29***	0.29***		- 3.13***	- 3.15***
Number of student grants		1.18**	1.18**		0.30	0.30
Number of old age pensions		1.04	1.03		- 0.66**	- 0.67**
Receipt of child grant		1.48**	1.48**		0.75	0.75
Age of household head		0.99	0.99		- 0.05***	- 0.05***
Female headedness		1.39	1.40		0.50	0.51
South African headedness		1.50**	1.43		1.12	1.09
Contextual factors						
Vegetation density			1.01			0.00
Village density			0.96			- 0.12
Constant				3.78***	5.91***	6.38
n	654	654	654	653	653	653
R-squared	0.00	0.07	0.07	0.00	0.06	0.06

Table 4 (continued). Logistic Regressions and Linear Regressions for the Effects of HIV/AIDS-related Adult Mortality on Selected Outcome Variables[a]

	Grow crops other than maize or mealies			*Plots fed all household members last year*			*Suffer from lack of labour*		
Dependence on homestead gardens	OR	OR	OR	OR	OR	OR	OR	OR	OR
Mortality									
HIV/AIDS-related mortality	0.95	0.92	0.95	1.02	1.03	1.04	1.51	1.68*	1.78**
Household sociodemographic characteristics									
Household size		1.01	1.01		1.02	1.01		0.85**	0.86**
Sex ratio		1.00	1.00		1.00	1.00		1.00	1.00
Old age composition		1.06	1.10		0.74	0.74		0.68	0.60
Young age composition		1.43	1.45		0.91	0.87		2.29	2.22
Common goods SES 01-03		1.04	1.05		1.03	1.04		1.01	1.03
Agricultural goods SES 01-03		0.83	0.85		1.08	1.11		1.16	1.14
Uncommon goods SES 01-03		1.06	1.13		10.05**	10.05**		0.97	0.84
Common goods SES 2003		1.00	1.03		1.12	1.15**		1.00	0.96
Agricultural goods SES 2003		1.91***	1.83***		1.32**	1.24		0.66	0.69
Uncommon goods SES 2003		0.43	0.39		0.15	0.17		2.26	2.23
Labor market participation		1.28	1.35		1.43	1.57		0.70	0.70
Number of student grants		1.07	1.08		0.99	1.00		1.07	1.08
Number of old age pensions		0.90	0.88		0.87	0.85		1.37	1.35
Receipt of child grant		1.29	1.32		0.85	0.88		0.70	0.71
Age of household head		1.00	1.01		1.00	1.00		1.00	1.00
Female headedness		1.12	1.13		1.02	1.02		0.57*	0.59
South African headedness		1.36	1.14		0.91	0.78		1.71	1.80
Contextual factors									
Vegetation density			1.09***			1.07***			0.95**
Village density			1.24***			1.25***			0.69**
n	688	688	688	688	688	688	688	688	688
R-squared	0.00	0.07	0.10	0.00	0.04	0.06	0.01	0.10	0.12

Table 4 (continued). Logistic Regressions and Linear Regressions for the Effects of HIV/AIDS-related Adult Mortality on Selected Outcome Variables[a]

	Gather from bush			*Times consumed herbs in past year*			*Times consumed fruit in past year*		
Dependence on wild local vegetation	OR	OR	OR	b	b	b	b	b	b
Mortality									
HIV/AIDS-related mortality	1.06	1.07	1.09	1.60	3.65	3.95	7.19	27.66	26.62
Household sociodemographic characteristics									
Household size		0.98	0.99		1.25	1.30		8.40***	8.86***
Sex ratio		1.00	1.00		0.01	0.01		0.00	0.01
Old age composition		1.57	1.51		23.51	23.04		140.98***	143.25***
Young age composition		1.15	1.14		28.64	27.84		27.65	21.76
Common goods SES 01-03		0.97	0.98		4.29	4.42		- 6.46	- 5.76
Agricultural goods SES 01-03		0.96	0.95		-10.48	-10.13		- 7.12	- 6.25
Uncommon goods SES 01-03		0.55	0.52		-21.98	-22.36		46.29	40.33
Common goods SES 2003		0.95	0.93		- 9.61***	- 9.55***		2.75	2.32
Agricultural goods SES 2003		0.93	0.98		19.20***	18.92***		19.58**	19.28
Uncommon goods SES 2003		2.47	2.31		- 0.14	- 1.24		-69.83	-63.17
Labor market participation		0.56	0.53**		-21.61	-20.91		-42.02	-43.57
Number of student grants		1.09	1.08		3.21	3.11		- 8.73	- 9.09
Number of old age pensions		1.14	1.14		- 5.70	- 5.80		-15.08	-16.54
Receipt of child grant		1.28	1.27		12.46	12.44		-13.88	-11.47
Age of household head		1.01	1.01		0.20	0.22		- 0.16	- 0.17
Female headedness		0.97	0.99		4.97	5.07		19.44	20.73
South African headedness		0.97	1.00		-17.51	-18.42		8.77	6.33
Contextual factors									
Vegetation density			0.96**			0.36			0.23
Village density			0.77***			0.19			- 4.29
Constant				113.83***	98.64***	36.97	51.82***	-12.93	-45.99
n	688	688	688	361	361	361	126	126	126
R-squared	0.00	0.03	0.04	0.00	0.07	0.07	0.00	0.15	0.14

[a]Reference category is non-AIDS-related adult mortality.
*** p < 0.05; *** p < 0.01*

Table 5. Logistic Regressions and Linear Regressions for the Effects of Adult Mortality on Selected Outcome Variables

	Not enough food in past month			*Times hungry in past month*		
Food security	OR	OR	OR	b	b	b
Mortality						
Male head	2.09***	1.66***	1.64**	2.45***	1.83***	1.77
Female head	1.79**	1.40	1.38	2.55***	1.76**	1.76**
Wife of head	1.01	1.20	1.20	1.59***	1.93***	1.92***
Male "other"	1.24	1.22	1.21	0.17	0.16	0.13
Female "other"	1.13	1.03	1.03	0.32	0.16	0.16
Household sociodemographic characteristics						
Household size		1.02**	1.02**		0.08***	0.08***
Sex ratio		1.00	1.00		0.00	0.00
Old age composition		0.70***	0.70***		- 0.67***	- 0.65***
Young age composition		0.91	0.91		- 0.50**	- 0.49**
Common goods SES 01-03		1.10***	1.09***		0.17***	0.16***
Agricultural goods SES 01-03		1.01	1.01		0.05	0.07
Uncommon goods SES 01-03		0.87	0.90		- 0.28	- 0.23
Common goods SES 2003		0.82***	0.82***		- 0.47***	- 0.46***
Agricultural goods SES 2003		0.98	0.98		0.02	- 0.02
Uncommon goods SES 2003		0.87	0.86		- 0.23	- 0.20
Labor market participation		0.39***	0.39***		- 2.11***	- 2.08***
Number of student grants		1.03	1.03		- 0.09	- 0.09
Number of old age pensions		0.93**	0.92***		- 0.30***	- 0.31***
Receipt of child grant		1.20***	1.20***		0.30**	0.31**
Age of household head		1.00	1.00		- 0.01**	- 0.01**
Female headedness		1.23***	1.24***		0.46***	0.47***
South African headedness		1.17***	1.12**		0.53***	0.42***
Contextual factors						
Vegetation density			1.02***			0.06***
Village density			1.00			0.17***
Constant				2.95***	4.75***	- 5.84***
n	8,958	8,958	8,958	8948	8948	8948
R-squared	0.00	0.04	0.05	0.01	0.05	0.05

Table 5 (continued). Logistic Regressions and Linear Regressions for the Effects of Adult Mortality on Selected Outcome Variables

	Grow crops other than maize or mealies			*Plots fed all household members last year*			*Suffer from lack of labour*		
Dependence on homestead gardens	OR	OR	OR	OR	OR	OR	OR	OR	OR
Mortality									
Male head	1.31	1.39	1.32	1.42	1.70**	1.64**	0.88	0.88	0.93
Female head	0.64	0.92	0.93	0.56	0.73	0.76	2.79***	2.23**	2.22**
Wife of head	0.74	0.86	0.86	1.19	1.30	1.28	1.14	1.08	1.07
Male "other"	1.03	0.84	0.81	1.32	1.19	1.16	0.88	1.08	1.09
Female "other"	1.22	0.95	0.95	1.16	1.08	1.08	0.66	0.85	0.85
Household sociodemographic characteristics									
Household size		1.03**	1.03***		1.01	1.01		0.93***	0.93***
Sex ratio		1.00***	1.00***		1.00***	1.00***		1.00***	1.00***
Old age composition		1.23**	1.25**		1.17	1.18		1.02	1.01
Young age composition		0.97	0.99		1.08	1.10		1.34**	1.32**
Common goods SES 01-03		0.99	0.99		0.99	0.99		0.99	0.99
Agricultural goods SES 01-03		0.89***	0.90***		0.94	0.95		1.02	1.02
Uncommon goods SES 01-03		1.07	1.13		1.06	1.05		1.32	1.30
Common goods SES 2003		1.10***	1.12***		1.07***	1.09***		0.98	0.97
Agricultural goods SES 2003		1.40***	1.36***		1.27***	1.22***		0.73***	0.74***
Uncommon goods SES 2003		0.89	0.92		1.19	1.28		1.03	1.02
Labor market participation		0.74***	0.75***		0.99	1.01		1.11	1.10
Number of student grants		1.05**	1.05**		0.98	0.99		1.01	1.01
Number of old age pensions		1.05	1.04		1.01	1.01		0.87**	0.87**
Receipt of child grant		1.20***	1.21***		0.99	1.01		0.68***	0.68***
Age of household head		1.01***	1.01***		1.01**	1.01**		1.00	1.00
Female headedness		1.05	1.07		0.85***	0.85***		1.02	1.01
South African headedness		1.09	0.97		1.02	0.97		1.41***	1.48***
Contextual factors									
Vegetation density			1.06***			1.05***			0.97***
Village density			1.12***			1.25***			0.93**
n	9,628	9,628	9,628	9,628	9,628	9,628	9,628	9,628	9,628
R-squared	0.00	0.05	0.07	0.00	0.02	0.03	0.00	0.06	0.06

Table 5 (continued). Logistic Regressions and Linear Regressions for the Effects of Adult Mortality on Selected Outcome Variables

	Gather from bush			*Times consumed herbs in past year*			*Times consumed fruit in past year*		
Dependence on wild local vegetation	OR	OR	OR	b	b	b	b	b	b
Mortality									
Male head	0.87	0.76	0.79	- 0.45	- 1.94	- 3.31	- 6.32	- 8.65	- 6.16
Female head	0.54**	0.54**	0.50**	9.83	6.58	8.14	9.04	11.70	19.55
Wife of head	0.85	0.93	0.95	4.76	7.60	7.18	-16.23	- 7.17	- 3.84
Male "other"	0.98	0.88	0.87	12.48	10.75	10.60	-11.59	- 8.91	- 5.44
Female "other"	1.25	1.14	1.16	- 3.24	- 7.47	- 6.99	2.97	- 1.24	- 0.56
Household sociodemographic characteristics									
Household size		0.99	1.00		0.95**	0.92**		0.25	0.28
Sex ratio		1.00***	1.00***		0.00	0.00		0.00	0.00
Old age composition		1.40***	1.41***		1.69	1.67		- 7.85	-10.36
Young age composition		1.09	1.10		- 0.78	- 0.15		- 5.40	- 2.74
Common goods SES 01-03		1.02	1.02		3.87***	3.78***		1.31	0.95
Agricultural goods SES 01-03		1.00	0.99		- 1.35	- 1.02		3.89	4.18
Uncommon goods SES 01-03		0.91	0.98		2.03	3.07		- 9.99	- 9.04
Common goods SES 2003		0.98	0.97*		- 8.38***	- 7.75***		0.17	0.78
Agricultural goods SES 2003		0.97	1.01		5.10***	4.13***		- 1.91	- 2.19
Uncommon goods SES 2003		1.10	0.97		-12.24	-10.86		-31.22	-29.97
Labor market participation		0.72***	0.70***		-13.29***	-12.24***		15.23	14.92
Number of student grants		1.08***	1.08***		0.82	0.92		2.73	3.12
Number of old age pensions		1.15***	1.14***		0.79	0.78		2.33	1.29
Receipt of child grant		1.14***	1.12**		- 3.95	- 4.07*		- 1.80	- 3.04
Age of household head		1.00	1.00		0.09	0.10		- 0.12	- 0.12
Female headedness		1.05	1.06		3.76	3.91		3.38	3.19
South African headedness		0.68***	0.65***		-11.39***	-13.02***		30.63***	21.18***
Contextual factors									
Vegetation density			0.98***			1.32***			2.67***
Village density			0.75***			4.78***			- 2.15
Constant				112.93***	130.70***	-100.09***	63.97***	38.07***	-405.75***
n	9,628	9,628	9,628	5,143	5,143	5,143	1,788	1,788	1,788
R-squared	0.00	0.03	0.04	0.00	0.05	0.06	0.00	0.02	0.07

*** p < 0.05; *** p < 0.01*

Table 6. Logistic Regressions and Linear Regressions for the Effects of Adult Mortality on Selected Outcome Variables

	Not enough food in past month			*Times hungry in past month*		
Food security	OR	OR	OR	b	b	b
Mortality						
Male head - AIDS	2.25**	1.87	1.88	1.78	1.20	1.11
Male head - non-AIDS	1.96***	1.52	1.50	2.57***	1.93***	1.89***
Female head - AIDS	1.48	1.22	1.19	1.11	0.48	0.42
Female head - non-AIDS	2.09	1.53	1.54	3.85***	2.90***	2.98***
Wife - AIDS	1.96**	2.37**	2.37**	4.54***	4.89***	4.86***
Wife - non-AIDS	0.49	0.58	0.58	- 1.07	- 0.72	- 0.72
Male "other" - AIDS	0.94	0.89	0.89	- 0.34	- 0.38	- 0.39
Male "other" - non-AIDS	1.43**	1.42**	1.40	0.39	0.38	0.34
Female "other" - AIDS	1.28	1.13	1.15	0.95	0.71	0.76
Female "other" - non-AIDS	0.99	0.91	0.91	- 0.32	- 0.42	- 0.46
Household sociodemographic characteristics						
Household size		1.02**	1.02**		0.08***	0.08***
Sex ratio		1.00	1.00		0.00	0.00
Old age composition		0.69***	0.69***		- 0.70***	- 0.68***
Young age composition		0.91	0.92		- 0.49**	- 0.48**
Common goods SES 01-03		1.10***	1.09***		0.16***	0.16***
Agricultural goods SES 01-03		1.01	1.01		0.05	0.07
Uncommon goods SES 01-03		0.87	0.89		- 0.30	- 0.24
Common goods SES 2003		0.82***	0.82***		- 0.47***	- 0.46***
Agricultural goods SES 2003		0.98	0.98		0.03	- 0.02
Uncommon goods SES 2003		0.87	0.85		- 0.23	- 0.19
Labor market participation		0.39***	0.39***		- 2.11***	- 2.08***
Number of student grants		1.03	1.03		- 0.09	- 0.09
Number of old age pensions		0.93**	0.92***		- 0.30***	- 0.31***
Receipt of child grant		1.19***	1.20***		0.29**	0.30**
Age of household head		1.00	1.00		- 0.01**	- 0.01
Female headedness		1.23***	1.24***		0.45***	0.47***
South African headedness		1.18***	1.13**		0.54***	0.43***
Contextual factors						
Vegetation density			1.02***			0.06***
Village density			1.00			0.17***
Constant				2.96***	4.75***	- 5.89***
n	8,958	8,958	8,958	8948	8948	8948
R-squared	0.00	0.05	0.05	0.01	0.05	0.05

Table 6 (continued). Logistic Regressions and Linear Regressions for the Effects of Adult Mortality on Selected Outcome Variables

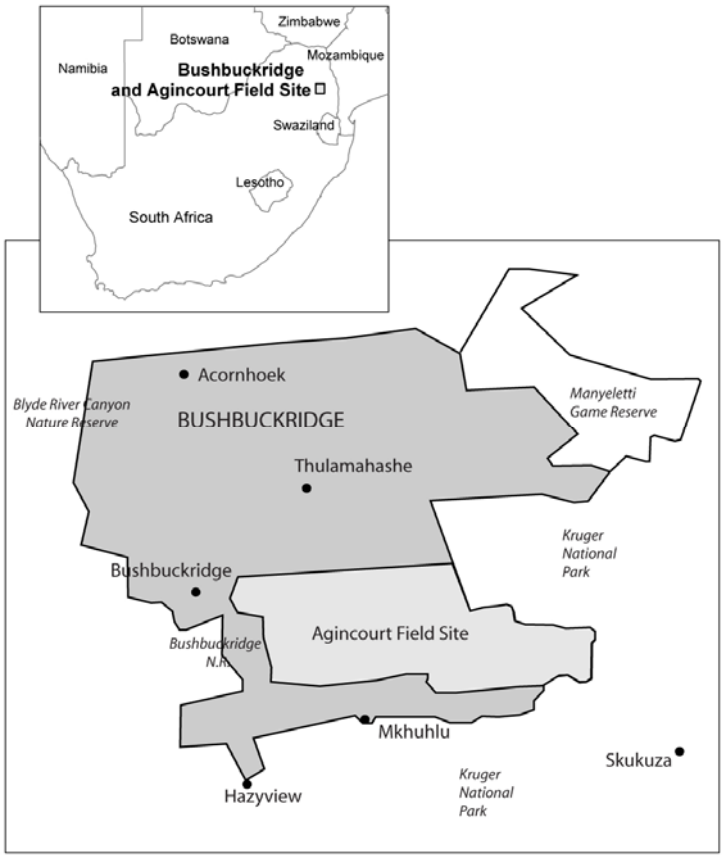
	Grow crops other than maize or mealies			*Plots fed all household members last year*			*Suffer from lack of labour*		
Dependence on homestead gardens	OR	OR	OR	OR	OR	OR	OR	OR	OR
Mortality									
Male head - AIDS	1.40	1.64	1.54	1.39	1.73	1.55	0.98	0.90	0.96
Male head - non-AIDS	1.28	1.31	1.24	1.43	1.69**	1.68**	0.81	0.84	0.87
Female head - AIDS	0.77	1.07	1.03	0.42	0.51	0.50	2.98**	2.31	2.35
Female head - non-AIDS	0.54	0.81	0.85	0.74	1.03	1.14	2.65**	2.18	2.12
Wife - AIDS	0.59	0.67	0.65	1.21	1.41	1.37	1.26	1.29	1.30
Wife - non-AIDS	0.89	1.05	1.07	1.16	1.19	1.19	1.05	0.94	0.92
Male "other" - AIDS	1.36	1.09	1.12	1.31	1.16	1.15	1.53	2.07**	2.03**
Male "other" - non-AIDS	0.89	0.74	0.70**	1.33	1.22	1.19	0.58	0.66	0.67
Female "other" - AIDS	1.22	0.95	0.98	1.40	1.31	1.37	0.55	0.73	0.72
Female "other" - non-AIDS	1.24	0.97	0.95	0.98	0.91	0.87	0.76	0.97	0.98
Household sociodemographic characteristics									
Household size		1.03***	1.03***		1.01	1.01		0.93***	0.93***
Sex ratio		1.00***	1.00***		1.00***	1.00***		1.00***	1.00***
Old age composition		1.23**	1.26**		1.17	1.18		1.02	1.01
Young age composition		0.97	0.99		1.09	1.10		1.34**	1.32**
Common goods SES 01-03		0.99	0.99		0.99	0.99		0.99	1.00
Agricultural goods SES 01-03		0.89***	0.90***		0.94	0.95		1.03	1.02
Uncommon goods SES 01-03		1.07	1.14		1.06	1.05		1.32	1.30
Common goods SES 2003		1.10***	1.12***		1.07***	1.09***		0.98	0.97
Agricultural goods SES 2003		1.39***	1.36***		1.27***	1.22***		0.73***	0.74***
Uncommon goods SES 2003		0.89	0.92		1.19	1.28		1.04	1.02
Labor market participation		0.74***	0.75***		0.99	1.01		1.11	1.10
Number of student grants		1.05**	1.05**		0.98	0.99		1.01	1.01
Number of old age pensions		1.05	1.04		1.01	1.01		0.87**	0.87**
Receipt of child grant		1.20***	1.21***		0.99	1.01		0.68***	0.68***
Age of household head		1.01***	1.01***		1.01**	1.01**		1.00	1.00
Female headedness		1.05	1.07		0.85***	0.85***		1.02	1.01
South African headedness		1.09*	0.97		1.03	0.97		1.41***	1.48***
Contextual factors									
Vegetation density			1.06***			1.05***			0.97***
Village density			1.12***			1.25***			0.93**
n	9,628	9,628	9,628	9,628	9,628	9,628	9,628	9,628	9,628
R-squared	0.00	0.05	0.07	0.00	0.02	0.03	0.00	0.06	0.06

Table 6 (continued). Logistic Regressions and Linear Regressions for the Effects of Adult Mortality on Selected Outcome Variables

	Gather from bush			*Times consumed herbs in past year*			*Times consumed fruit in past year*		
Dependence on wild local vegetation	OR	OR	OR	b	b	b	b	b	b
Mortality									
Male head - AIDS	1.17	1.11	1.29	- 3.37	1.02	- 0.85	-15.89	-25.00	-20.00
Male head - non-AIDS	0.76	0.65	0.63**	1.16	- 3.17	- 4.24	3.45	6.83	6.76
Female head - AIDS	0.54	0.57	0.54	6.26	8.34	7.37	118.60*	109.23	115.72
Female head - non-AIDS	0.55	0.51	0.46	12.96	4.36	8.64	-63.03	-50.16	-41.37
Wife - AIDS	0.89	0.91	0.94	0.16	1.79	- 0.57	-29.87	-17.40	-10.79
Wife - non-AIDS	0.81	0.92	0.92	8.38	12.16	13.18	2.61	3.89	2.22
Male "other" - AIDS	1.03	0.92	0.93	3.16	1.35	1.74	-21.20	-23.39	-17.59
Male "other" - non-AIDS	0.91	0.82	0.80	17.55	15.64	15.31	- 5.17	0.53	2.30
Female "other" - AIDS	1.20	1.08	1.07	3.45	- 4.59	- 2.58	10.70	12.70	13.03
Female "other" - non-AIDS	1.30	1.20	1.25	- 8.61	- 9.61	-10.25	0.38	-10.35	- 9.72
Household sociodemographic characteristics									
Household size		0.99	1.00		0.95**	0.91**		0.22	0.25
Sex ratio		1.00***	1.00***		0.00	0.00		0.00	0.00
Old age composition		1.41***	1.42***		1.63	1.64		- 7.53	-10.03
Young age composition		1.09	1.10		- 0.81	- 0.16		- 5.71	- 2.99
Common goods SES 01-03		1.02	1.02		3.86***	3.76***		1.28	0.93
Agricultural goods SES 01-03		1.01	0.99		- 1.34	- 1.01		4.23	4.47
Uncommon goods SES 01-03		0.91	0.98		1.96	3.03		-10.45	- 9.40
Common goods SES 2003		0.98	0.97		- 8.37***	- 7.74***		0.35	0.94
Agricultural goods SES 2003		0.97	1.01		5.07***	4.08***		- 2.16	- 2.40
Uncommon goods SES 2003		1.10	0.97		-12.39	-11.02		-31.58	-30.34
Labor market participation		0.72***	0.70***		-13.21***	-12.14***		15.07	14.77
Number of student grants		1.08***	1.08***		0.84	0.94		2.78	3.15
Number of old age pensions		1.15***	1.14***		0.77	0.76		2.24	1.21
Receipt of child grant		1.14***	1.12**		- 3.91	- 4.02		- 1.71	- 2.94
Age of household head		1.00	1.00		0.09	0.11		- 0.12	- 0.12
Female headedness		1.05	1.06		3.78	3.92		3.46	3.27
South African headedness		0.68***	0.65***		-11.42***	-13.01***		30.54***	21.12***
Contextual factors									
Vegetation density			0.98***			1.32***			2.66***
Village density			0.75***			4.81***			- 2.15
Constant				112.93***	130.61***	-100.74***	63.90***	38.29***	-403.68***
n	9,628	9,628	9,628	5,143	5,143	5,143	1,788	1,788	1,788
R-squared	0.00	0.03	0.04	0.00	0.05	0.06	0.00	0.02	0.06

*** p < 0.05; *** p < 0.01*

Figure 1: Study Area, Agincourt Health and Demographic Surveillance Site, South Africa



[i] Much of the currently available public health background at the provincial level characterizes Limpopo Province, the former provincial home of the Agincourt field site. In 2007, boundaries were changed and the site is now within Mpumalanga Province.