

Food Security, Subsistence Agriculture, and AIDS in Kwazulu Natal, South Africa

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1 Introduction

The FAO defines food security at a household level as "the capacity of a household to procure a stable and sustainable basket of adequate food." As more and more people become ill and die from AIDS in sub-Saharan Africa, there is evidence that the ability of the poor to produce and purchase food is being reduced dramatically. Households stricken with the disease lose the labor, and therefore the wages, of the ill family member and also must divert resources to caring for the sick. (The period of illness before death during which a person is unable to work averages six months. Tibaijuka, 1997). Because it is a sexually transmitted disease, AIDS is most common among the productive-aged population and is highly likely to be passed from an infected spouse to a non-infected spouse, exacerbating the burden of illness on the household. Household food production is likely to suffer from AIDS related mortality and morbidity because affected households are deprived of labor for farming and often of cash for inputs. Some farming systems are considered more vulnerable than others to the effects of widespread illness and death. Specifically, systems with poor soil, little rainfall and a small range of crops. In South Africa, where only three percent of the land is considered of high potential for agriculture poor black families usually have the poorest quality land, making the threat of losses to income and productivity more serious. (Thirtle 1997).

Because many of the rural poor in South Africa rely on subsistence farming for food consumption, it is important to examine in what ways widespread morbidity and mortality affect small-scale agriculture and household food consumption. Specifically:

1. Does production of food increase relative to food purchases?
2. Does per capita food consumption decrease?

The answers to these questions can help determine appropriate responses to the growing AIDS crisis by indicating how food security is likely to be affected as mortality and morbidity increase over the next several years. The primary effects are expected to be through loss of labor and cash income. Health and nutrition are important determinants of susceptibility to illness and of how quickly a patient dies of AIDS once infected. Also, as household resources are stretched, children may be pulled from school or even sent out of the household, sometimes into prostitution. Extension services are inadequate and improving them would probably be a key feature of any policy concerning food security. Among other things, households need access to less labor intensive farming techniques and to credit for the purchase of inputs. As an environmental issue, households that are only barely surviving have little incentive to manage properly their natural resources. Labor saving techniques such as heavy use of pesticides and herbicides have the potential to worsen the health situation in already suffering areas.

2 Literature Review

2.1 AIDS and Economics

Much of the empirical research concerning the micro-economic effects of the AIDS crisis has been based on a World Bank study of the Kagera region of Tanzania, carried out from 1991 to 1994. Kagera suffered from high AIDS prevalence earlier than much of the rest of sub-Saharan Africa (cite.) Lund et al (2000) use the Kagera data to examine the ability of households afflicted by AIDS to smooth income. They find that during the earlier phase of the crisis, smoothing was easier, since fewer households in a single social network were likely to be afflicted. As the crisis worsened, wealthier households, not surprisingly, had better access to smoothing mechanisms, especially in the form of informal transfers. Poor households, whose social networks tend to include other poor households, were forced to rely on formal credit markets, a resource to which they had inadequate access even before the crisis. Other results of this analysis show that non-labor income (remittances, pensions), as well as household size and composition, are more

variable among households that have had an AIDS death.

Using the same dataset, Ainswoth and Semali (2000) find that children in houses that have had an adult death from AIDS experience negative health effects (controlling for mother to child transmission of HIV.) The extent of the effects depends on the child's relationship to the ill household member and on the gender.

Another study, using South African data from Kwazulu Natal, analyzed the losses to a sugar mill that resulted from high rates of AIDS infection among employees. (Morris, Burdge, Cheevers 1999.) The employees in the sample were almost exclusively male and had an HIV prevalence rate of twenty-four percent, somewhat below the provincial antenatal rate of thirty percent (in 1998). Ninety percent of the HIV positive men were married with an average number of wives of 1.36 and 6 dependents. Using costs of lost productivity, replacement workers, training, and medical care, the authors estimate the loss per year to the mill to be 7185.95 Rand (in USD?)

Using data from Zimbabwe, Mutangadura (2000) examines the impact of adult female deaths on the household. She shows that the primary impacts are increased food insecurity, decreased schooling, increased work for children and increased burdens on elderly women to care for orphans. Households also sold off assets to cope with the illness and death.

2.2 AIDS and Agriculture

The fact that AIDS was likely to affect food security and agriculture was recognized in the late 1980s. Food production in much of sub-Saharan Africa had already been declining since the early 1980s and per-capita food consumption falling as population grew rapidly. Barnett and Blaikie (1989) predicted that a significant loss of labor would reduce not only the amount of crops grown but the variety, with a negative impact on nutrition. Barnett and Blaikie's research proposal led to a study of Southwestern Uganda, an early victim of the AIDS crisis. Comparing the effects of AIDS revealed in the Uganda study with the results of other studies in Tanzania and Zambia, Barnett et al. determined that impacts differed depending on the nature of the farming system, but overall, high morbidity and mortality rates led to a shift towards production of staple crops with fewer relish crops (vegetables and herbs added to food to improve flavor and nutritional value.) Labor had to be reallocated towards caring for the sick meaning less leisure and

less time farming. Less time to fetch fresh water (one of the primary duties of women) poses a health risk to all household members.

Many rural households in sub-Saharan Africa depend on remittances from urban relatives for cash income. The urban relatives are often the first to die, however, and the rural household members not only lose the remittances but may also have to take on the care of the dead relative's children. (Barnett et al.) Labor shortages in the rural areas are exacerbated by migration of those seeking wage work in the cities or simply fleeing the epidemic. Another affect revealed by the study of Uganda was that epidemic-related adoption of less labor intensive farming techniques sometimes led to the spread of plant diseases.

Another study on the Kagera Region of Tanzania determined that households with AIDS infected members devote an average of twenty-nine percent of their labor to AIDS-related work (Tibaijuka 1997.) Farming households with capital assets sold them to pay for medical care and households in general devoted virtually all of their available liquidity to health-related expenses. Another result was that the age of marriage for girls decreased because it is an easy way to get more labor for a household and because father's needed the bride-price as a way of supplementing income. The ratio of dependents to workers in households increased and impoverishment in general increased at both a household and community level. (Because of the nature of AIDS, it is rare that it is not extensive enough to be a community level problem. While individuals rarely report having HIV/AIDS, several communities in the Kwazulu Natal dataset reported HIV/AIDS as affecting large proportions of the community.) The Food and Agriculture Organization (FAO) has devoted considerable effort to studying and predicting the effects of the AIDS epidemic on small scale agriculture. One study estimates that small farm output in parts of Zimbabwe had fallen by fifty percent in five years. Loss of wages and remittances limits a family's ability to buy inputs and to replace lost labor with hired labor. During the illness and for a period after the death, labor is diverted first to caring for the sick person, then to mourning and making funeral arrangements.

Impacts may be even greater for female deaths than for male deaths since women perform the majority of household productive labor. With specialization of labor along gender lines, male household members are unlikely to devote labor to household chores like farming, childcare, and food preparation when a woman is ill. Worsening the effects of the lost labor is migration,

which is often not accompanied by remittances from young family members that seek work in urban areas.

Another issue raised by FAO work is that when adults die early, agricultural knowledge is not being passed between generations. This implies less efficient farming in the future and increasing food insecurity. It is also likely to lead to more migration to the informal settlements of urban areas where AIDS rampant.

3 Background

3.1 Kwazulu Natal

Kwazulu Natal is a South African province on the eastern coast (see map.) Africans in the region are primarily Zulu and not very urbanized. Only 42 percent of the population is urban (IFPRI). In Zulu culture, the husband owns all productive assets and only he can enter into contracts. While in some parts of sub-Saharan Africa these kinds of customs lead to women being deprived of farmland after the death of a husband, land transaction records in Kwazulu Natal indicate that many women inherit plots (although plots controlled by women are usually smaller and of poorer quality than those controlled by men.)(cite?)

Gender roles are very important, making adjustment to AIDS illness and death difficult. Men may be able to alleviate a labor shortage brought on by the death of a wife by marrying again (polygamy is common) but women do not have that choice.

3.2 AIDS in Kwazulu Natal and South Africa

At over four million, South Africa has the most HIV infected people of any country in the world. In Kwazulu Natal, at least a third of adults are infected with the AIDS virus. As they become ill and die, family members will have to take time from other labor to care for them, leaving less time for the production of food and income. According to the FAO, food security is already precarious among poor subsistence farmers and is worsening with the growing AIDS crisis. In addition, there is no end in sight to the AIDS crisis. The disease is still spreading rapidly and by 2010, AIDS deaths are expected to exceed dramatically all other causes for most age groups (MRCSA 2001.)

3.3 Agriculture in Kwazulu Natal

In rural Kwazulu Natal, many families engage in subsistence agriculture to supplement other sources of income. Of households that farm small plots, fifty percent have access to less than one hectare (National Department of Agriculture-SA). Most farming families depend on wages, remittances and pensions as sources of cash and use farm production primarily for own consumption. Sugar cane is the most important cash crop but most families that rely on subsistence agriculture for consumption do not sell any of their output. Land reform was undertaken in 1994 but by 1997, only 7 percent of available land had been redistributed in Kwazulu Natal. Much of the available rural land is allocated to households by tribal authorities. Because of an extremely uncertain tenure situation, there is virtually no market for rental of land.

4 Research Questions

The section below describes the model that I will use to answer questions about changes in production and consumption of food resulting from illness and death in the household. As described above, the questions that I will try to answer are:

1. Does production of food increase relative to food purchases?
2. Does per capita food consumption decrease?

All of these questions will be examined at various points in time, beginning with illness to after death, in order to determine how the effects of death and illness differ. I also expect the effects to differ depending on the gender of the infected person.

The first question refers to the relative size of purchases and production of food. According to the National Department of Agriculture in South Africa, poor rural households in Kwazulu Natal rely primarily on wages, remittances, and pensions as sources of liquidity. When wage-earning family members become ill, wages cease and available liquidity is spent on health care. The same is true after the death of a household member receiving a pension.

Primary wage earners are likely to be male and liquidity from wages and

pensions will be difficult to replace given the lower earning power of women and very high unemployment. Household members engage in a variety of formal and informal income generating activities, and some (females) will devote a significant amount of time to caring for the sick and performing household work. Labor is fairly specialized along gender lines in Kwazulu Natal, with men holding more and better full time wage work and women doing most of the farming. This makes it more difficult to substitute labor during an illness and after death. Women in the formal and informal labor markets are usually in the most menial jobs and earn less than men (NDA). Because of this liquidity is not likely to increase enough after the death of a male wage earner to offset the lost wages. The return from farming activities may be greater than the return to wage labor, so the household will attempt to maintain its food consumption by growing more food and purchasing less. With the death of a female, male household members are unlikely to take over the farming and household work, meaning less labor is devoted to farming, food preparation and child care.

Given the lower endowment of labor during illness and after death, it is unlikely that households will be able to maintain pre-illness food consumption levels, unless the household draws labor from other sources, such as taking children out of school (this issue will be addressed later.) Finally, given the nature of AIDS, it is likely that the death of a male household death implies the current or future illness and death of his wife (and vice-versa.) If the illness and death of one family member is not followed by the illness of another, then death may actually be a positive shock (relative to illness) because death frees up labor from caring for the sick. Households may be better off after death than they were during the illness, but not as well off as before the illness.

5 Identification and Estimation

The primary difficulty in estimating this model is the endogeneity of death and illness. Whether a family experiences an illness or death will be correlated with variables that also determine changes in the family's agricultural output and consumption. Comparing families that experience death and illness with those that do not can be thought of as trying to estimate a treatment effect, with families experiencing illness and death considered to have received the "treatment." (Note: deaths and illness of people of all ages will

be considered since the elderly contribute to the household through household labor but, more importantly, through pension receipts.) The analysis in this section will be based on methods suggested in the program evaluation literature.

The first method is to use an instrumental variables approach (see Imbens and Angrist 1994), using an instrument that is correlated with the incidence of illness and death in a household but not with other determinants of changes in agricultural production and consumption.

A second approach would be to use a propensity matching scores method in which probability of treatment is estimated based on “pre-treatment” characteristics of households. Treated and non-treated households are then matched on propensity scores, creating a control group with which outcomes for the treatment group can be compared. (see Hirano, Imbens and Ridder 2000, Ichimura and Taber 2001 for a discussion of this estimator.) Hirano et al show that this estimator is unbiased and can be efficient with proper use of the propensity scores in estimation. Specifics of the estimation using both techniques are discussed below.

5.1 Instrumental Variables

An appropriate instrumental variable must be correlated with illness and death but not with other determinants of changes in agricultural output. One possibility is to use a dummy variable indicating the presence of NGO funded health or sex education programs. Government-run programs would not be as useful since the presence of one program is likely to be correlated with the presence of others, like agricultural extension services.

The equation to be estimated is the following:

$$\begin{aligned}
 Q_{it} = & \alpha_t + \beta_1 A_{it} + \beta_2 W_{it} + \beta_3 E_{it} + \beta_4 I_{it} \\
 & + \beta_5 X_{ct} + \beta_6 S_{ct} + \beta_7 HS_{it} + \beta_8 GH_{it} \\
 & + \beta_9 IV_{ct} + \epsilon_{it}
 \end{aligned}
 \tag{1}$$

This equation will be estimated in first differences.

Q_{it} is quantity produced (measurement of this quantity is discussed below.)

μ_t is a time-specific constant.

A_{it} is land cultivated by household i at time t .

W_{it} is whether the household had a wage earner present or received remittances or pension at time t .

E_{it} is the labor endowment of the household at time t .

I_{it} is farming technology of household at time t (measurement discussed in the next section.)

X_{ct} is the presence of an extension program in the community.

S_{ct} is a community level shock.

HS_{it} is an uncorrelated household shock.

GH_{it} is the gender of the household head.

IV_{it} is the fitted value of the IV from the first stage of estimation.

ϵ is a disturbance term that captures measurement error and omitted variables.

5.2 Propensity Score Matching Method

A propensity matching model will also be used for estimation. The value of the propensity matching method is that it allows for the comparison of treated and non-treated households that are matched on “pre-treatment” variables. Ideally, a treatment effect would be measured by comparing, for a single household, outcomes with and without treatment. Since this cannot be done, control and treatment households will be matched as closely as possible based on an estimated propensity score, defined as the probability that a household experiences a death or illness.

The treatment effects is:

$$E(Y_o|X) = E(Y_o|X) - E(Y_1 - Y_o|X)T \quad (2)$$

Where Y_o is the outcome without treatment, Y_1 is the outcome with treatment, X is a vector of pre-treatment characteristics, and $T = 0$ for no treatment and $T = 1$ for treatment. The propensity score is defined as the probability that a household receives the treatment, given pre-treatment characteristics, X . Propensity scores are defined as:

$$P(X) = E(T|X) \quad (3)$$

The probability of treatment, given X will be estimated using a logit. Treatment probabilities will be estimated both for being ill and for having a death. The matrix X in equation (8) will contain pre-treatment variables, household and community-level characteristics that influence the probability of

death and illness. Variables to be included:

Occupation of household members

presence of prime age adults and/or the elderly

Community level availability of health and sex education services

It is true that education and income have been found to be positively correlated with HIV infection but that effect takes place primarily through occupation.

There are two different “treatments” to be considered in this case. Effects are likely to differ between households without illness or death, households that have a currently ill member, and households that have experienced a death. In the context of the data, these households fall into the following categories:

Table I.

1993	1994-1997	1998
ill	death	had death in past 5 years
well	illness and death	only see death
well	illness	illness
well	well	well

Clearly there are more categories of households that will exist in the data but the number of observations will limit the number that can be considered. Analysis will focus on the above four, taking into account gender. Once households are matched, yield and consumption will be regressed on the same set of variables as above, minus the IV. Equations will also be estimated dividing rural and urban households and dividing households by the gender of the sick or deceased person.

Once propensity scores have been estimated, there are multiple ways of using them in analysis. The most apparent is to use the propensity score to match households that have had a death with households that have not (controls), and compare the estimation results of the regressions (see Dehejia and Wahba 1998.)

5.2.1 Estimation Issues

Attrition bias could be a problem if households non-randomly fail to appear in the second year. 84.1 percent (89.6 percent of Africans) of 1993 households were reinterviewed in 1998, including 63 households that had moved

and were tracked to new locations. Of those that were not, four had died off completely by 1998 (Malucci 2000.)

6 The Data

The data is a panel dataset called The Kwazulu Natal Income Dynamics Survey, with panels in 1993 and 1998. The first round was conducted in 1993 to provide a large household database for South Africa and was not originally intended to be a panel. Adding a second round in 1998, however, provided an opportunity to examine the changes brought about by the end of apartheid. The dataset provides community, household, and individual level data on numerous socio-economic and demographic characteristics, including expenditures, remittances and income, education, health, anthropometry, employment, and agricultural activities. Community data include presence of health and education programs, number and quality of schools, community organizations, and community level shocks.

The first round of the survey includes 1393 Indian and African households (white households were dropped for the second round.) In 1998, 1171 of those households were reinterviewed. The 1998 survey also added several sections related to social capital measures, questioning households about involvement in community organizations.

6.1 Regression Variables

6.1.1 Dependent Variables

Death and illness

Although deaths are not identified as having been caused by HIV/AIDS, the effect of illness and death is likely to be the same on a household, regardless of the illness. In addition, the Medical Research Council of South Africa estimates that 26 percent of all adult deaths were due to AIDS in 1998 and the proportion is even higher if only prime-age adults are included in the analysis. Estimates using only prime age adults and all adults can be compared to see if the effect is significantly different.

Death is reported in one of two ways. Individuals that appear in the 1993 survey and have died before 1998 are identified as having died in a particular year. In addition, households can report several different kinds of shock, one

of which is death. Not all households that report death as a shock though, have an identifiable household member that died. The disadvantage of using this measure is that no information is available on the gender, age, or occupation of the deceased. Both of these measures may prove useful, depending on what information the question requires. Illness is also reported in more than one way, although all are self-reported and therefore not ideal. People can report being ill and the number of days they have been unable to work due to illness. They also evaluate how difficult it is for them to perform certain tasks. Because the effect of death and illness is expected to appear as a loss of labor, the first measure will more probably accurately capture loss of labor.

Output and Consumption Measures

Estimation will include three different measures of output/consumption (RHS variables will be the same for both): changes in total calories of food produced/consumed, changes in yields of major crops produced, and changes in amounts of major crops produced. Detailed information on food purchases and production is available in the data. Community-level price information is also available but because most households do not sell their output, they can be excluded at this point.

Technology and Inputs

The use of hybrid maize will be used as a measure of technology. (Specifically, if it is adopted between 1993 and 1998.)

7 Extensions

There are several additional questions to be examined using this data. The above questions address the issue of what happens to food production and consumption when a household experiences death or illness. The next step will involve questions about how it happens. These questions would need to address how labor allocation, expenditure patterns, and land use change, among other things. In addition, something I have already begun is to examine the effects of illness and death on school enrollment. Finally, it might be possible to examine households' coping mechanisms by using the data on social capital and access to credit.