

FINAL REPORT

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AIDS mortality and Household Characteristics in Rural South Africa: Implications for Natural Resource Use and Development

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Submitted by

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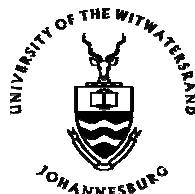
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PRIPODE



PART I: SUMMARY OF RESEARCH OPERATIONS

Introduction

This project sought to explore relationships between household characteristics and experience of a prime-age adult mortality, and household use patterns of key natural resources in a rural sub-district of South Africa. The implications of such associations for development in rural African settings were assessed in a context of rising adult mortality due to HIV/AIDS, increasing levels of environmental degradation, and the centrality of natural resources in rural livelihoods. The study was conducted in the far north east of South Africa, in the Agincourt sub-district of Bushbuckridge district, Limpopo Province. This first part of the report gives an overview of the research operations of this project, from preparation through to data interpretation and synthesis.

Research preparation

Ethics clearance

Ethics clearance was obtained from the research ethics committees of both the University of the Witwatersrand and University of Colorado. In compliance with the requirements for such clearance, we designed and submitted an informed consent form, which was used with household interviews.

Drawing the sample

The study was based on a sampling frame which involved two strata; households which had experienced the death of a prime-age adult (15-49 years) in the last two years, and a similar number of households which had not experienced a prime-age mortality over this time. Due to logistical constraints, total sample size for the household surveys had to be reduced from the originally planned 540 households to 248 households. Half of these had experienced a mortality of a prime-age age adult in the last two years, while the other half had not. The samples were drawn from the Agincourt Health and Population Unit's longitudinal demographic database, covering a population of approximately 12,000 rural households and 70,000 people across 21 villages in the Agincourt Demographic Surveillance Site. The data extend back to 1992. Samples were drawn from a subset of 13 villages.

Samples were obtained by running queries in the database to obtain all households which fitted the relevant criteria. For the “mortality” group, parameter criteria for the query were that a) the household had to have been existent for the last five years, b) the household had experienced the death of a member aged 15-49 at death in the last two years, c) the household did not experience a death in that age group in the three years preceding the last two year period, and d) the household was still in existence at the time of the most recent census (July 2003). For the “no mortality” group, parameter criteria for the query were that a) the household had to have been existent for the last five years, b) the household had not experienced the death of a member aged 15-49 at death in the last two years, c) the household did not experience a death in that age group in the three years preceding the last two year period, and d) the household was still in existence at the time of the most recent census. These criteria may have biased the sample towards certain types of “survivor” households, but this is unclear and would be useful for further study. The criteria were chosen in an attempt to investigate, through retrospective questioning, of the impact of the death of a prime age adult on the household reliance on natural resources over time. We then ran a random number generator function in the database to take a random sample of 124 households in each of the two sample categories. A random sub-sample of 30 households was drawn from the “mortality sample”, to be used in for qualitative interviews.

Designing the questionnaire

The survey questionnaire was divided into five sections (A-E). Section A related to respondent and household information. Sections B and C dealt with household use of fuelwood and water respectively. Each of the two sections were divided into subsections asking questions on consumption, harvesting/collecting, purchasing, and receiving from friends and neighbours. Questions were multiple choice, except for those dealing with masses/volumes used, and frequency of harvesting/collecting/buying/selling. Both sections asked about current resource use, and resource use five years ago (i.e. prior to the death of the household member in the households which had had a prime-age adult mortality in the last three years). Section D asked questions about attitudes and awareness on local environmental and develop issues and priorities. Section E dealt with time allocation of household members involved in resource harvesting/collecting, asking how these members would spend their extra time if they were not required to collect resources. The questionnaire was 16 pages long and took roughly an hour to complete.

Meetings with community leaders

Meetings were held with the community leaders of the selected study villages before the study commenced. This was done by a team member who spoke the local language. At these meetings, the project was explained, and permission was sought to proceed with the research. Permission was granted in all villages.

Refining and piloting

The questionnaire went through many versions during the design and refining stages. Comments from various colleagues were very valuable. The prototype version was then piloted during the fieldworker training. Based on our observations and useful comments from the fieldworkers, we made more changes, and the questionnaire went through a few more iterations before it was ready for the field.

Training fieldworkers

The project field workers were drawn from the Agincourt Health and Population Unit's team of census field workers. They were thus all experienced in conducting household surveys. However, they needed to be orientated with regard to this particular project, and trained in the use of the survey questionnaire. A day-long workshop was run with the fieldworkers and data typist to familiarise them with objectives and general methods of this project, as well as to go through the questionnaire with them.

The next step was to practice using the questionnaire, which they did in pairs, under supervision, in households which were not part of the final sample. This process also helped us pilot and refine the questionnaire, based on feedback from the fieldworkers. The fieldworkers then practiced conducting the questionnaire in households on their own, under supervision. This was done until we were satisfied that they were all ready to begin with the fieldwork.

Data collection

Survey fieldwork started in early May 2004. A field supervisor met with the fieldworker team each morning, and allocated households to each fieldworker, providing them with maps on which all households were located and labelled. She allocated fieldworkers new households from the "replacements" lists if they had been unsuccessful in interviewing a

household after three attempts. The supervisor also collected and checked completed questionnaires at the end of each day. To ensure accuracy in the questioning and recording by fieldworkers, she sat in on surveys from time to time. Survey data collected took approximately six weeks. The fieldworkers and field supervisor were from the study area and spoke the local language fluently. Households were thus interviewed in their mother tongue.

The 30 qualitative interviews were conducted towards the end of the field campaign, after most households had been surveyed. The researchers were assisted by an interpreter who translated questions and responses. Interviews were recorded using a dictaphone. This data collection took approximately two weeks.

Data entry

The data from the quantitative surveys were entered from the questionnaires into a custom-designed database (using MS Access), developed by the AHPU data manager and PI Hunter. Data entry was conducted in the field site office by an experienced data typist. The data were saved onto a secure server. The database was regularly cross-checked with the questionnaires to ensure the accuracy of the data entry. Where the data typist encountered problems or inconsistencies in a questionnaire, this was sent back to the supervisor who conferred with the fieldworker who had collected the data, and where necessary, the household was revisited to clarify or correct the recorded responses. Data entry took approximately six weeks.

The qualitative interviews were translated and transcribed from tape to MS Word by an experienced translator and transcriber. This took approximately four weeks.

Data analysis and synthesis

Analysis of the data was done by the PI's, lead by Hunter, and assisted by graduate students (Johnson, Kirkland, Patterson and Lefakane). The survey data were analysed using descriptive statistics and multivariate logistic and ordinary least squares regression models. The qualitative data were analysed primarily by Hunter and Kirkland. Thematic areas were identified, and representative statements were coded and compared. Pseudonyms were used.

The analysed data were used to answer the first two key research questions, focusing on 1) the association between household characteristics and use of natural resources, and 2) the associations between household experience of a recent prime-age adult mortality and use of natural resources. The qualitative data were useful for giving further insight into patterns which emerged in the quantitative data. The findings were then interpreted and synthesised to answer the final research question, namely 3) the implications of our findings for rural development in the context of rising HIV/AIDS mortality, environmental degradation, and the centrality of natural capital in rural livelihoods in rural South Africa.

Publications and presentations

The following publications and presentations are based primarily or exclusively on data from this study. CICRED is acknowledge in all of these. More are envisaged to follow.

Policy briefs

- 1) Twine, W. & Hunter, L (2006) Adult mortality and household use of forest products in northeast South Africa. In S. Shackleton, *Forests as safety nets for mitigating the impacts of HIV/AIDS in southern Africa*. Forest Livelihood Briefs, Number 2, Center for International Forestry Research.

Journal articles (in prep., under review, forthcoming or in press)

- 1) Hunter, L.M., Twine, W., & Johnson, A. Population dynamics and the environment: Examining the natural resource context of the African HIV/AIDS pandemic. (In prep.)
- 2) Hunter, L.M., Twine, W. & Patterson, L. “Locusts are now our beef”: Adult mortality and household dietary use of local environmental resources in rural South Africa. *Scandinavian Journal of Public Health*. (Under review after corrections)
- 3) Kirkland, T., Hunter, L.M. & Twine, W. “The bush is no more”: Insights on institutional change and natural resource availability in rural South Africa. *Society and Natural Resources*. (Forthcoming)
- 4) Sherbanin, A. et al. Rural household micro-demographics, livelihoods and the environment. (In prep., Hunter and Twine contributing a section on morbidity and mortality, rural livelihoods, and environmental resources)

Working papers

- 2) Hunter, L.M. & Twine, W. (2005) *Adult mortality, natural resources and food security: Evidence from the Agincourt field site in rural South Africa*. Working Paper EB2005-0001, Environment and Behavior Research Program, Institute of Behavioural Sciences, University of Colorado Boulder (USA).
<http://www.colorado.edu/ibs/pubs/eb/eb2005-0001.pdf>
- 3) Hunter, L. M., Twine, W & Johnson, A. (2005) *The Role of Natural Resources in Coping with Household Mortality: An Examination in Rural South Africa*. IBS Working Paper: EB2005-0004: <http://www.colorado.edu/ibs/pubs/eb/eb2005-0004.pdf>
- 4) Kirkland, T., Hunter, L.M., and Twine, W. (2005) *The bush is no more: Insights on Natural Resource Availability from the Agincourt Field Site in Rural South Africa*. Working Paper EB2005-0002, Environment and Behavior Research Program, Institute of Behavioural Sciences, University of Colorado Boulder (USA).
<http://www.colorado.edu/ibs/pubs/eb/eb2005-0002.pdf>

Presentations

- 1) Hunter, L.M. & Twine, W. Adult mortality, natural resources and food security: Evidence from the Agincourt field site in rural South Africa. *International Conference on HIV/AIDS and Food and Nutrition Security: From Evidence to Action*, Durban, South Africa, April 2005.
- 2) Hunter, L.M. & Twine, W. Adult mortality, food security and the natural environment: Evidence from the Agincourt field site in rural South Africa. *Invited presentation at the Agincourt Health and Population Unit Roundtable*, University of Witwatersrand Rural Facility, South Africa, June 2005.
- 3) Hunter, L.M., Twine, W. & Johnson, A. The natural resource context of HIV/AIDS mortality in rural South Africa. *25th Congress of International Union for the Scientific Study of Population*, Tours, France, July 2005.
- 4) Kirkland, T., Hunter, L.M. & Twine, W. "The Bush is No More": Insights on natural resource availability and institutional change in rural South Africa." *100th Annual Meeting of the American Sociological Association*, Philadelphia, USA, August 2005.
- 5) Twine, W. & Hunter, L.M. HIV/AIDS mortality and household reliance on natural resources in Bushbuckridge. *4th Kruger Park Networking Meeting*, Skukuza, South Africa, March 2006.

PART II: RESEARCH TEAM

Partner institutions

This project was a three-way collaboration between the Centre for African Ecology (CAE), University of the Witwatersrand, South Africa, Agincourt Health and Population Unit, (AHPU), University of the Witwatersrand, South Africa and the Institute for Behavioral Sciences (IBS), University of Colorado at Boulder, USA. Centre for African Ecology provided the ecological and resource use expertise, based on over a decade of human-environment research in the study region. The Agincourt Health and Population Unit contributed the demographic surveillance database, expertise on databases and demography, fieldworkers, and other logistical support. The Institute for Behavioral Sciences contributed expertise in social and population sciences. Table 1 summarises the full team.

The two PI's on the project were Wayne Twine, of the University of the Witwatersrand, and Lori Hunter, of the University of Colorado at Boulder. PI Twine was primarily responsible for developing the first draft of the questionnaire, training fieldworkers, supervising field operations, some data analysis, and general oversight of the project. PI Hunter helped refine the questionnaire, helped design the database, assisted with field supervision, conducted the qualitative interviews, and took the lead in data analysis.

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Table 1. Research team members and their roles

Name	Institution	Role	email
Wayne Twine	CAE, University of the Witwatersrand	PI	rcrd@global.co.za
Lori Hunter	IBS, University of Colorado	PI	Lori.Hunter@colorado.edu
Mark Collinson	AHPU, University of the Witwatersrand	Assisted with research design and logistics	mark@agincourt.co.za
Sam Clark	AHPU, University of the Witwatersrand / IBS, University of Colorado	Advice on research design	sam@samclark.net
Paul Mee	AHPU, University of the Witwatersrand	Database design	paulmee@agincourt.co.za
Norman Owen-Smith	CAE, University of the Witwatersrand	Advice and guidance	norman@biology.biol.wits.ac.za
Ennicah Ntlemo	AHPU, University of the Witwatersrand	Field supervisor	-
Ella Sihllangu	AHPU, University of the Witwatersrand	Fieldworker	-
Thelma Maake	AHPU, University of the Witwatersrand	Fieldworker	-
Nomsa Ubisi	AHPU, University of the Witwatersrand	Fieldworker	-
Ben Elliot Mkhonto	AHPU, University of the Witwatersrand	Fieldworker	-
Elly Mokoena	AHPU, University of the Witwatersrand	Qualitative Fieldworker	-
Mumsy Shabangu	AHPU, University of the Witwatersrand	Data Typist	-

PART III: RESEARCH FINDINGS

Research objectives

This project aims to address the following key questions within the context of a rural area in South Africa :

- 1) *What are the associations between natural resource selection, use, consumption and acquisition strategies and the household characteristics of size, composition and economic status in rural South Africa?*
- 2) *Beyond these household characteristics, how is prime-age adult mortality associated with the ways in which households select, use, consume, and acquire key natural resources?*
- 3) *What are the implications of these associations for development in the context of rising AIDS mortality among poor rural communities?*

Methodological approach

There is a significant lack of research on how population and economic factors interact to influence household use of natural resources in rural South Africa. This information is key to understanding the complex interactions between humans and the environment, and the development implications of these interactions, within these less developed communities, particularly in the face of high HIV/AIDS prevalence, environmental degradation and high reliance on natural resources. This project specifically addresses these issues, within the context of the affect of AIDS mortality, by investigating patterns of use of key natural resources by rural households, as influenced by a recent mortality of a household member in the productive age group most vulnerable to AIDS mortality, as well by household size, composition and wealth status. The project took a novel approach to understanding the population — environment — development (PED) relationship by focusing on the development implications of resource use, with household-level natural resource use acting as a mediating factor between population factors and development potential. We also carefully integrated consideration of the impacts of HIV/AIDS upon household dynamics, resource use, and relevant development implications.

The study drew on three data sources:

Data source #1: Agincourt Health and Population Unit's (AHPU) longitudinal demographic surveillance system (DSS), providing longitudinal household data, such as size, composition and economic status.

Data source #2: Cross-sectional survey of a random sample of 248 households, stratified by experience of a prime-age mortality in the last two years.

Data source #3: Qualitative interviews with 30 households drawn randomly from the sample of 124 households which had experienced a death of a prime-age household member during the last two years.

We compared household use of key natural resources between 124 households which had recently experienced a death of a household member within the productive age group most vulnerable to AIDS mortality (15-49 years), and 124 households which had not. Households within these two categories were randomly sampled from sub-samples drawn from the detailed AHPU DSS database. The survey data allowed empirical modelling of correlations between household use of fuelwood and water, and a household shock in the form of the death of a productive member, as well as with household size, composition, and wealth status (see Table 2 for household characteristics of the sample) The focus upon household size, composition and economic status as important parameters represents an important extension to prior research focused more centrally on aggregate population size and growth rates. This provided insight into the mechanisms behind the relationship between AIDS mortality and household resource use patterns. Having a solid demographic surveillance base was thus a strength of this project, demonstrating the value of a DSS as a foundation for cross-sectional and longitudinal studies. In addition to the survey data, in-depth, qualitative interviews were undertaken, yielding rich qualitative insight to supplement empirical modelling, also providing information on the use of wild foods by households impacted by an adult mortality. Development implications were examined through a focus upon time allocation and use of natural resources as a buffer against the economic shock of losing a productive household member.

Table 2. Household characteristics of the sampled households

Household Characteristics	Percentage or Mean	Min	Max	N
Household size	7.71	1	21	241
Composition				
Sex ratio (male:female)	0.81	0	4	241
Young age structure	70.50%			241
Older age structure	9.53%			241
Socio-Economic Status (SES)				
Possessions Index	3.19	1	5	239

Results

Before examining the effects of household characteristics and experience of adult mortality on household resource use, we consider general patterns of use of fuelwood and water in order to understand the context. Tables 3 and 4 show the descriptive statistics for fuelwood and water usage for all households included in the sample. Although the centrality of water in livelihoods is a given, the high reliance on fuelwood is an important finding. Over 90% of households used fuelwood, despite the fact that over 80% of all households had electricity (Table 3). This illustrates the context of poverty, in which electricity and appliances are expensive luxuries. Qualitative evidence from the interviews substantiates this fact. As an example, although the harvesting of live trees is prohibited by local rule, Asnath¹ explains that “dry wood are scarce and some people use electricity stoves but some don’t, then they are forced to cut down living trees” She specifically argues that “if jobs can be made available we can buy our own electricity stoves and we can stop getting to the bush to collect fuelwood.” Melias verifies this by saying “electricity is so expensive hence we chop down living trees despite restrictions.”

Levels of use of both fuelwood and water are relatively frugal, (Tables 3 & 4), indicating poor availability or access. Most households (78.4%) used 100 litres or less per day. The substantial proportion of households purchasing fuelwood also points to local scarcity of this resource around some villages, mainly due to overexploitation and land-use change. For both resources, the female head or wife and her daughters were primarily responsible for household provisioning.

¹ Pseudonyms are used throughout.

Table 3. Descriptive profiles of household fuelwood use.

<i>Resource Use</i>	<i>Percentage or Mean</i>	<i>Min</i>	<i>Max</i>	<i>N</i>
Use wood for fuel (%)	92.8%			241
Wood uses				
Cooking	90.8%			227
Heating water for bathing	85.4%			225
Brewing traditional beer	3.3%			227
Heating house	1.3%			227
Alternative Fuels				
Electricity for cooking	31.3%			241
Electricity for lighting	82.5%			241
Level of use				
Wood per day in summer (in kg)	8.70	0	22	171
Wood per day in winter (in kg)	10.38	0	29	171
Acquisition Strategies				
Purchases wood	44.6%			241
Male head harvests	13.8%			241
Female head or wife harvests	36.2%			241
Son harvests	7.9%			241
Daughter harvests	34.6%			241
Other	14.1%			241

Table 4. Descriptive profiles of household water use.

<i>Resource Use</i>	<i>Percentage or Mean</i>	<i>Min</i>	<i>Max</i>	<i>N</i>
Water Uses				
Drinking	100.0%			248
Cooking	100.0%			248
Bathing	97.6%			248
Washing	98.4%			248
Water for plants	29.8%			248
Water for making bricks	18.2%			248
Water for animals	8.9%			248
Brewing traditional beer	6.1%			248
Level of use				
Water per day in summer (in litres)	82.73	10	225	236
Water per day in winter (in litres)	69.67	3	225	235
Acquisition Details				
Purchases water	0.4%			248
Minutes to collect	54.18	1	660	201
Male head collects	15.7%			248
Female head or wife collects	43.6%			248
Son collects	23.0%			248
Daughter collects	50.8%			248
Other	10.1%			248

1) What are the associations between natural resource selection, use, consumption and acquisition strategies and the household characteristics of size, composition and economic status in rural South Africa?

Our first research question sets the stage for examination of mortality impacts by initially exploring other household factors as associated with resource use. Here we draw upon the literature to consider particular arenas of potential impact: selection of resources to be used, decisions with regard to uses for resources, levels of consumption, as well as acquisition strategies with regard to collection and/or purchase. Findings are summarised in Tables 5 and 6, under “Research Question # 1”.

Selection strategies

The first aspect of resource use considered was resource selection strategies. Since water is an essential, non-substitutable resource, selection was only considered for fuelwood, as a selected energy source. The results of the multivariate regression analysis (Table 5) suggest that in rural South Africa, household characteristics have few significant effects on the selection of fuel wood or electricity (a fairly common alternative for cooking and lighting) for energy purposes. Regarding electricity as an alternative, this energy source was less often used by larger households, a plausible estimate given that larger households have more individuals for which to provide and more hands available for wood collection.

Table 5 also reveals that village context makes a difference in the use of electricity for cooking and/or lighting. cursory exploration of specific village locations as related to electricity use does, in fact, suggest that households located in villages with relatively fewer proximate fuel wood resources are more likely to make use of electricity as an alternative energy form. This association is the subject of ongoing analyses.

In general however, the surveys and interviews suggest that there is little variation in type of energy used, with nearly all households making use of fuelwood as the primary source. The principal factors shaping the use of alternatives are village context and socio-economic status, with income often allowing for the purchase of electricity. Electricity clearly does make life “easier,” because even when income is very limited, as in the case of Mumsy’s small monthly contribution from her grandmother, she explains “*I spend it on food and electricity.*”

Use strategies

With regard to specific uses of natural resources, household characteristics only distinguish, in a statistically significant sense, decisions with regard to heating water when considering the use of fuelwood. Households with a higher SES were more likely to use wood for heating water. However, we primarily find a pattern of non-significance in that few of the included household characteristics distinguish household's strategies with regard to energy use. Indeed, the interviews also reveal little variation across households in use of wood. Cooking and heating water are, again, nearly universal uses of fuelwood, while only a handful of households use fuelwood for brewing traditional beer or heating the home (Table 3). In one of the few households where wood is used for heating the home, Peggy explains "*now that it is winter, we use more fuelwood because people like warming up themselves by sitting around fire.*"

Household characteristics had relatively little impact on household use of water. The universal use of water for basic domestic consumption was expected, and water was generally used sparingly for these purposes due to difficulty in obtaining it. Other uses, such as for brewing traditional beer, watering plants, water for animals, and for making bricks, showed no significant associations with household characteristics (Table 6). The small but significant influence of village on the use of water for watering plants reflects the west-east rainfall gradient in the study site, which influences the need to water plants.

Level of use

Focusing on the level of fuelwood consumed, sex ratio possesses the ability to significantly distinguish the outcome variables, net of the models' other predictors. Specifically, controlling for household size, age composition, and socio-economic status, households with relatively more men tended to use higher levels of wood in both summer and winter (Table 5). In addition, households with older age structure and higher SES tended to use slightly more wood in the summer. The interviews also provide evidence that households are clearly very conservative in their resource utilization as daily homestead fires are carefully tended, burning only the requisite amount of wood. Even so, the survey data curiously reveal a fairly wide variation in level of use, ranging from a minimum of 1 kg daily to over 20 kg daily. Higher SES accounts for some of this variation, with households characterized by more possessions typically using slightly higher levels of fuel wood.

A significant negative association existed between SES and daily winter consumption of water (Table 6). This strong relationship is difficult to account for. Village was a significant discriminator of daily consumption of water in both summer and winter, highlighting the variation in water availability between villages. The wide variation in daily consumption, ranging from 3 to 225 litres, is a function of village water supply and household SES.

Acquisition strategies

Natural resource acquisition strategies represent an important dimension of household decision-making in that collection involves decisions regarding who will collect, the collection location, and the associated costs of collection in terms of time, money and/or bartered assets. The results of the regression models suggest that household composition and socio-economic status each have limited, but statistically significant effects on whom fuelwood and water is acquired (Tables 5 & 6). In particular, larger households are more likely to have a male head who harvests wood or collects water. The male head is also more likely to harvest wood in households with more males. As would be expected, female heads are less likely to collect wood or water in households with relatively more male members. A daughter was less likely to collect water in households with higher SES. Households with a higher SES required less time to collect water, primarily due to better access, usually from taps in their yards. The daily task of collecting water had associated opportunity costs due to the time spent collecting. Households spent, on average, 54.1 minutes per day collecting water. This was significantly higher (double) if the female head collected the water (mean of 105 minutes).

The interviews shed qualitative light on decisions with regard to fuelwood collection strategies. Specifically, the in-person dialogues often reveal tradeoffs with regard to time and money. As an example, Virginia offers a description of such tradeoffs whereby her household uses wood *“from the field ... for cooking and for boiling water”* although they also purchase wood on occasion *“because [wood] is not available nearby hence we sometimes buy....”* This is not to say, however, that Virginia’s household has disposable income. Rather, when asked the source of the cash used to purchase fuelwood, she contends that *“we get this from relatives.”* However, due to the absence of regular income, some households have no option but to acquire scarce fuelwood through harvesting. As explained by Sbongile *“we get [wood] from the bush next to the mountains ... it’s not easy to find them and we get them from far and we take a long time.”* Her household does not purchase fuelwood since their only source of

income is a very small and irregular contribution from her mother's old age pension. This cash is *“used to buy mealie meal (maize meal, a staple grain) and other groceries. But because we are many at home, the money becomes too little and she also uses it for the funeral insurance.”* Sbongile would like to buy natural resources, as opposed to collecting, as she explains: *“If we had money we were going to purchase fuelwood or hire someone to collect water because sometimes you feel tired but with no option.”*

Sbongile and Virginia are not alone. A substantial portion of the interviews revealed the pressure that scarcity brings with regard to acquisition of fuelwood. One respondent, Beatrice, even revealed that she illegally collects fuelwood from the game reserve in which she works. She explains that *“.... I sometimes pick up some small pieces of fuelwood and put them in my bag. But we are not given the permission to collect, we steal them ... we devise some plans to get them out of the reserve, like putting them in my bag where I put something to eat so they cannot recognize them.”*

Table 5. Coefficients from the multivariate models for fuelwood use.

	<u>Use Wood</u>	<u>Alternative Energy</u>		<u>Uses of Wood</u>		<u>Level of Use</u>		<u>Acquisition Strategies</u>				
	yes/no	Electricity for cooking	Electricity for lighting	Cooking	Heating water	Wood per day (kg, summer)	Wood per day (kg, winter)	Buy wood	Male head harvests	Female head/ wife harvests	Son harvests	Daughter harvests
<i>Research Question #1: What are the associations between household size, composition and economic status, and natural resource use?</i>												
Household Size	-0.01	-0.10*	0.03	0.03	0.09	0.04	0.10	-0.01	0.18**	-0.03	-0.08	0.03
Household Composition												
Sex Ratio	-0.41	0.20	0.07	-0.33	-0.49	1.92**	1.93**	0.10	0.35	-0.42*	0.07	0.07
Young Age Structure	-0.67	0.20	-0.70	-0.63	-0.34	0.48	-1.80	-0.22	-0.51	-0.26	-0.55	0.07
Older Age Structure	0.15	-1.27	-0.70	0.50	1.38	2.64*	3.67	0.06	0.89	0.25	-0.99	0.18
SES												
Possessions Index	0.50	0.11	0.19	0.33	0.14**	0.99*	0.61	-0.06	0.18	-0.10	-0.05	-0.12
Village	-0.04	-0.06*	-0.25**	-0.04	-0.09	-0.01	-0.02	-0.01	-0.01	-0.01	0.02	-0.07
<i>Research Question #2: Beyond these household characteristics, how is mortality experience associated with natural resources?</i>												
Adult Mortality within past 2 years	3.39*	-1.27	0.28	3.48**	3.02	3.47	-0.17	0.01	2.84*	-0.54	-1.89	1.20
Mortality*SES	-0.83*	0.09	-0.19	-0.69*	-0.64**	-1.21	0.61	0.05	-0.36	-0.05	0.64	-0.30
Years since mortality	-0.40	0.36	0.13	-0.56	-0.49	0.13	0.61	-0.14	-0.89**	0.23	-0.59	-0.05
Constant	2.32*	-0.09	3.68	2.15*	2.19**	4.12	9.05	0.19	-3.79**	0.64	-1.27	-0.17
R²	0.08	0.06	0.20	0.08	0.10	0.11	0.09	0.01	0.11	0.04	0.08	0.04
N	239	239	239	239	239	169	169	239	239	239	239	239

*p<0.05;**p<0.01

1: Data Source: Agincourt Health and Population Unit, Population & Environment Survey, June 2004.

Table 6. Coefficients from the multivariate models for water use.

	<u>Uses of Water</u>				<u>Level of Use</u>			<u>Acquisition Strategies</u>			
	Brewing Trad. Beer	Water for plants	Water for animals	Water for making bricks	Daily consumption (litres summer)	Daily consumption (litres winter)	Minutes to Collect	Male head collects	Female head/ wife collects	Son collects	Daughter collects
Research Question #1: What are the associations between household size, composition and economic status, and natural resource use?											
Household Size	0.12	-0.04	0.05	-0.10	0.33	11.20	0.92	0.13*	-0.05	-0.09	0.01
Household Composition											
Sex Ratio	-0.35	0.01	0.14	0.00	2.19	2.12	7.26	0.53**	-0.37*	0.08	0.12
Young Age Structure	-0.51	-0.43	0.26	-0.25	5.91	7.51	10.56	0.21	-0.04	0.07	-0.16
Older Age Structure	0.57	-0.12	-0.50	0.84	5.29	8.91	-2.34	0.99	-0.16	-0.62	0.27
SES											
Possessions Index	-0.40	0.00	-0.01	0.09	-3.30	-6.24**	-11.28*	0.12	-0.13	0.12	-0.26*
Village	-0.03	-0.01*	-0.06	0.03	-1.71**	-2.22**	0.83	-0.01	-0.04	-0.02	-0.04
Research Question #2: Beyond these household characteristics, how is mortality experience associated with natural resources?											
Adult Mortality within past 2 years	2.393	0.27	0.92	0.33	-10.87	2.12	-36.46	0.21	-0.38	-0.06	0.78
Mortality*SES	-0.43	0.01	-0.05	-0.37	3.78	1.28	8.82	0.20	0.04	0.13	-0.18
Years since mortality	-0.10	-0.18	-0.66	0.22	3.58	1.84	12.36	-0.70*	0.08	-0.32	-0.01
Constant	-2.73	0.43	-2.30*	-1.72*	98.46**	87.43**	67.41*	-3.27**	1.25*	-0.65	0.78
R²	0.09	0.04	0.05	0.07	0.05	0.10	0.08	0.11	0.04	0.03	0.03
N	240	240	240	240	228	227	195	240	240	240	240

*p<0.05;**p<0.01

1: Data Source: Anglicourt Health and Population Unit, Population & Environment Survey, June 2004.

2) Beyond these household characteristics, how is adult mortality experience associated with the ways in which households select, use, consume and acquire key natural resources?

Our second question focuses more directly on the relationship between household experience of the death of a prime-age adult member and patterns in household resource use. Results of the multivariate models relating to this question are summarised in Tables 5 and 6 under “Research Question #2”.

Selection strategies

Recent adult mortality experience was associated with an increased likelihood of a household making use of wood, although the negative coefficient for mortality*SES suggests that this association is lesser for households of higher socio-economic status (Table 5). The implication is that poorer households impacted by an adult mortality are most likely to use fuelwood as their primary energy source. The mortality experience did not have a converse significant effect on the probability of using electricity for cooking or lighting.

Use strategies

Related to the results for fuelwood selection strategies, households experiencing a mortality were more likely to use fuelwood for cooking (Table 5). The significant negative coefficients for use of wood for cooking and heating for mortality*SES once again suggest a weaker association between mortality and wood use for households of higher SES. In addition, the negative estimates for years since mortality nearly reach statistical significance with $p < 0.08$ for prediction of cooking with wood and $p < 0.07$ for prediction of heating water with wood. Although not reaching the $p < 0.05$ threshold, these estimates suggest that the association between these outcomes and adult mortality experience lessens with the passing of time. An interesting short-term impact was the widespread use of large amounts of fuelwood (mean = 750 kg) for catering purposes at funerals (84% of “mortality” households).

Household experience of an adult death poorly accounted for household use of water for non-essential purposes (Table 6). The near-significant ($p < 0.07$) negative association between years since mortality and use of water for animals hints at the possibility of households selling off livestock over time as a coping strategy following the loss of a breadwinner. However, although this pattern has been documented for AIDS-impacted rural households (Haddad & Gillespie 2001), this is unsubstantiated in this study, and is merely conjecture.

Level of use

Although households experiencing an adult mortality were more likely to use fuelwood, they were not more likely to use significantly more than comparable households which had not had a recent death (Table 5). Similarly, mortality experience had no significant effect on household daily consumption of water (Table 6). These results point once again to the fact that these resources are, in general, used sparingly, and consumption levels are determined more by factors such as local availability and SES, than by recent mortality. As illustrated by Asnara in her interview, water sources are often unreliable and “*sometimes we spend 2-3 days without water.*”

Acquisition strategies

Loss of an adult had an impact on household collection strategies for fuelwood and water. Male heads were more likely to collect wood in mortality-impacted households (Table 5). In examining the gender of the deceased within households with a male head collecting wood, we find that gender is evenly split. It is possible, then, that male heads are called to collection duty in households in crisis. This is further suggested by the negative coefficient estimate for years since mortality, as the likelihood of male heads harvesting wood declines as time passes. A similar pattern emerges for the collection of water (Table 6).

Mortality experience had no discernable influence on household decision to buy wood instead of collecting it. However, despite these results, the qualitative interviews indicated that collecting, rather than buying, fuelwood was one of the cost-saving strategies engaged in by households which had lost a breadwinner (discussed in more detail below). The non-significant coefficients for purchasing wood in the “mortality” models may be as a result of confounding factors such as local availability, SES, and the absence of the role of the diseased in the household economy in the models. Purchasing water was not included as a water acquisition strategy in the multivariate models, as so few households indicated that they bought water (Table 4).

The interviews revealed substantive and important impacts of an adult mortality on household coping strategies, but these impacts were nuanced and represented by matters of degree. The dialogues suggest that mortality impacts are manifested by subtle, but important, alterations in task allocation and livelihood strategies, along with changes in related opportunity costs. Illustrative examples are presented in the following paragraphs.

In general, patterns of change in the selection, use, consumption and acquisition strategies of households experiencing an adult mortality are clearly related to the role of the deceased in the household economy. If the deceased was a resource collector, for example, but did not engage in income-generating work outside of the household, their resource collection duties were typically taken on by other household members. For example, George's household lost their primary resource collector, George's wife. As he explains, "*she used to collect fuelwood in the bush She was responsible for household duties like cleaning and other things.*" George now stays with his sister's daughter who "*performs those duties now.*"

Although the shifts in time allocation describe above are clearly important, the most significant changes in the household economy were felt when the deceased had contributed wages. But that said, impacts involving natural resource selection, use, consumption and collection strategies varied greatly. In some cases, the lost income had been used to purchase fuelwood and water, with household members subsequently being forced to collect wood and water on their own. As stated by Ntombi, the death of her self-employed household head "*brought a lot of changes. The first thing being changes on the diet and the second thing is that we are no longer able to buy fuelwood and water, so it requires us to do that by our own hands.*" Her household's longer-term social capital has also been compromised since "*eventually his son had to drop out of school to look for a job.*" As noted, these increases in collection time entail opportunity costs, including reduced time for schooling and, in some cases, for household chores such as tending gardens.

Further illustrating shifts due to lost wages, Trezia discusses the impacts on her household following the death of her father. He worked as a gate keeper at a local game reserve and contributed important income to the household. Trezia describes "*there are lot of changes like I did not have to collect fuelwood, and he used to buy groceries, but now I need to do that on my own.*" However Trezia has not been successful in her search for employment and the household's income had yet to be replaced at the time of the interview.

Another example of the potential impacts of lost wages is seen in the situation following the passing of Lucille's husband. Lucille's husband had been engaged in hard labour "*piece jobs like brick making and digging toilet holes.*" During his time of illness he was unable to work and was cared for by a traditional healer. Lucille thus had to take a job as a domestic worker. Since Lucille was then less available for household tasks, the children took primary

responsibility for resource collection “*because they also needed to do the things I used to do.*” Unfortunately, after her husband’s death, Lucille became ill and she too was no longer able to work and must now rely completely on her children for maintenance of household tasks and modest contributions of income. Overall, Lucille’s story reveals a complex array of task reassignments to manage daily living in the context of illness and uncertainty.

Also revealing of the complex changes in household natural resource use patterns is the reconfiguration of household tasks following the death of Asnara’s sister, who had been employed. The children in the household now have to collect fuelwood and, as she explains “*it is difficult to get fuelwood because there are no longer trees around.*” Asnara is looking for a job and, if she finds one, “*I would reduce the boy’s responsibilities since I will buy fuelwood. But with water, they would have to collect.*” She would prefer that “*these boys would collect sand for ... bricks.*”

Food security and dietary reliance on the local environment

The qualitative interviews revealed that the passing of an adult member also impacted on the household’s food security and reliance on wild foods and foods from their gardens. Although not dealt with in the quantitative models, these results are important, as they further reflect human – environment interactions as shaped by experience of an adult mortality. As suggested by Tsakani’s story, the strongest associations between mortality and shifts in household food security appear in cases where the lost income had been used specifically to purchase groceries. Tsakani’s employed adult son recently passed away. He “*was a very good person who related well with siblings. He could do anything for them when asked.*” He worked regularly and, as explained by Tsakani, “*would remember us every month end, buying groceries and a sac of maize meal [a local staple]*” Since his income has not been replaced, she explains that “*there is a serious gap now.*”

Our interviews suggested that edibles collected from the local environment often replaced previously purchased goods. As clearly articulated by one respondent whose household had lost its primary wage earner, “*locusts are now our beef.*” To further illustrate these associations, following are insights by Asnara, Zodwa, Triza, Elliott and Meslina, each offering brief descriptions of their household’s increased dependence on wild sustenance and their gardens following adult mortality experience.

Asnara's sister worked as a waitress at a local game reserve and made important financial contributions to their household. Now, the household survives on very low levels of income, with the only regular source being the government disability grant paid to her mother, who is the victim of a stroke. In addition to her disabled mother, Asnara takes care of her two children, her sister's child, and her elderly grandmother. The household makes use of a wide variety of natural resources including reeds for mats, marula nuts for jam, and indigenous wild fruits and herbs for nutrition. They also collect termites, although as Asnara explains *"we don't go out to look for them but catch those which are attracted by light in the evening."*

Zodwa collects wild vegetables from the communal rangelands for her 12-person household. She explains that the land *"is for everybody because when I plough it I can as well collect vegetables from it."* Her household has no regular income, but she buys maize meal, sugar, and soap with money from relatives. Her husband held a good job at a local game reserve, but once he became ill, he no longer worked. She explains that her household has experienced substantial changes in their diet since *"there is a big change now because we no longer have food, we just get assisted by the relatives and we depend more now on the field."*

Triza's deceased husband also worked long distance on a contract basis, regularly remitting *"some money which we used for groceries."* She has since found a job as a domestic worker, but explains that *"it used to be very hard because we had nothing to keep us surviving We relied [on wild vegetables] on a day-to-day basis because in the past we used to buy chicken, woks [sausage] and fish."*

Elliott explains that his wife passed away and he also recently lost his job. Elliott substantiates the fact that purchased food is often forgone once wages are lost *"yes, we stopped purchasing because you only do that when you have money ... sometimes we buy [food], but most of the time we rely on the garden."*

Finally, Meslina lost her sister who was a waitress at a local game reserve. Her sister's income was of great importance to their 7-person household and Meslina specifically noted the changes in diet in her description of household-level impacts. *"We used to buy groceries like beef and chicken but now we can only afford mixed portions no longer tinned stuff and other things. So you find that we rely on the field or borrow some money from neighbours."*

When asked which strategy they most often take, she explains that *“I may want to rely on asking money but when it comes to returning it, you find it is too difficult. I work on a budget that is why we rely on vegetable collection.”*

As seen from these examples, some households substituted bought foods with wild foods and crops from their gardens following the loss of a breadwinner. However, conversely, loss of household members who had done household chores forced other households to buy food which they had previously grown themselves, due to lack of household human resources. For example, Joseph used to tend his garden which provided important sustenance to the household, but since the deaths of both his parents, he no longer has the time. When asked if he now buys what he used to grow, Joseph agrees *“yes, I buy them now”* thereby resulting in decreased fiscal resources for other household needs. Similarly, both of Hope’s parents passed away, each of whom had previously assisted in their household’s resource collection. Hope explains that when her mother was alive, *“she used to do”* the cooking but now *“I do it myself.”* Hope also collects wood and water and, as she says, *“I have to do a lot of things by myself now.”* Because of necessity of taking on these new duties Hope no longer has time to tend the garden. *“I used to have a garden and I could go out to collect water to water my plants But I buy now [what I used to grow].”*

Another way in which our qualitative data suggested that morality has an impact on household diet is through resultant shifts in food storage. As an example, Rirhandzu’s husband used to work outside of the home and remit wages. After his death, the household’s diet was impacted as a result of the inability to purchase *“gas [with] which I operated a freezer where I would put meat, fish, chicken head and feet, but now I no longer have those things.”* Without this freezer, Rirhandzu contends they have *“more reliance on garden now.”* In fact, Rirhandzu has developed a larger garden precisely to meet her household’s sustenance requirements. *“By the time my husband was alive he used to give me some money to buy groceries,”* but she started a garden by *“digging down and put[ting] some manure on it.”* Her new garden is much larger than in the past, and as she explains, *“now it seems like I’m forced to do it for survival because as a woman you cannot just fold your arms.”*

Clearly, mortality is not the only cause of loss of income which impacts on household food provision. For example, in addition to losing his sister who had been employed, Thomas was also laid off from his job several months ago, and due to the lost income, they stopped

regularly purchasing food although “*sometimes we buy, but most of the time we rely on the garden.*”

3) What are the implications of these associations for development in the context of rising AIDS mortality among poor rural communities?

Of course, regardless of socio-economic context, the death of a productive adult household member has important impacts on those remaining. Still, in poverty-stricken households, impacts may be especially severe given ongoing struggles to meet day-to-day needs. Importantly, however, adult mortality is just one of the multiple vulnerabilities faced by these households. Although one limitation of the current study is indeed its inability to compare the impacts of mortality to those resulting from other forms of transition, such as migration and job loss, this study nonetheless provides information highly relevant to the formulation of HIV/AIDS mitigation policies.

The survey data and personal stories revealed above provide evidence in support of earlier work on various household impacts of adult mortality. As suggested by prior research, adult mortality was indeed found to impact households’ human, social, financial, physical – and especially relevant given the aim of the current project – natural capital. The interview results suggest that households are often impacted through the loss of income from employed family members. In addition, lost human capital often results in lowered household productivity, while individual household members’ time allocation often shifts as the labour of healthy individuals is diverted to different household chores. As related to dietary needs, additional household responsibilities sometimes yield decreased time to tend gardens and fields. In other cases, however, households respond to an adult mortality with an increased reliance on gardens and fields, as these sources of sustenance must replace previously purchased goods.

In all, both the survey and interview results suggest natural resource use strategies and levels of consumption vary little in this context given the near universality of fuelwood and water use for cooking and high levels of use of electricity for lighting. Although universally used, the level of consumption is extremely low given the difficulties inherent in collecting these resources. The survey results suggest that village resource context and household SES are the primary forces shaping household fuelwood and water strategies.

With regard to mortality, both quantitative and qualitative data reveal that adult mortality experience influences natural resource selection and collection strategies. Specifically, interview data suggest that wages lost due to the death of an adult member further reduce the likelihood that a household will be in a position to afford electricity for cooking, and hence climb the “energy ladder”. In this case, mortality exacerbates poverty, with poverty being the primary factor shaping natural resource use strategies. Regarding natural resource collection, the analyses reveal shifts in time allocation of the remaining household members to cover the collection tasks previously undertaken by the deceased, especially with regard to the participation of the male household head in collection duties.

What emerges from our data is a picture of the role that natural resources play in buffering households against some of the economic shocks associated with the loss of a productive adult. First, by using natural resources such as fuelwood and wild foods, households are able to save much needed financial resources. Similarly, harvesting resources such as fuelwood instead of buying them, or paying for costlier alternatives, enables financial savings. Importantly though, resource collection entails opportunity costs, and loss of household human capital to mortality may render harvesting of resources impractical, further stressing the household financially as it is forced to purchase resources. Second, the qualitative data suggest that increased dietary use of wild foods in response to the loss of a breadwinner, and thus the inability to buy food, may make a positive contribution to food security in such households. Unfortunately, our data do not allow for an assessment of the adequacy of the substitution of bought foods with wild and garden foods, and this will be the focus of future studies in the study site.

Policy implications

Analyses of the effect of adult mortality on household natural resource strategies yield policy implications in several arenas. The first is in regard to *natural resource conservation policy*. Although local populations depend greatly on indigenous natural resources, these resources are coming under increasing pressure due to poverty, as evidenced here, high human population densities, as well as the weakening of the traditional authority structures historically responsible for access and control (Twine *et al.* 2003). In addition, extraction rates appear unsustainable (Banks *et al.* 1996). As such, the increasing risk of adult mortality due to HIV/AIDS adds insult to injury when it comes to marginal households dealing with

decline in the local stock of natural resources essential for day-to-day needs. The additive effects of rising levels of dependence on natural resources in the face of increasing adult mortality due to AIDS and other factors, could further erode a resource base already under pressure, thus compromising the sustainability of such livelihood strategies in the longer term. Therefore, although use of natural resources may buffer households against certain effects of an adult mortality in the short term, increasing resource scarcity may expose such households to greater levels of risk in the future. Loss of social capital associated with rising adult mortality, such as the weakening of local institutions responsible for resource management, will further exacerbate the situation (Haddad & Gillespie 2001). Greater government support for local resource stewardship is thus desperately needed, including strengthening local institutions involved in resource management. More specific interventions focusing on resources themselves might include the establishment of homestead fuelwood plots, use of fuel-efficient stoves, and cultivation of wild indigenous food products for meeting dietary needs. Our data show that biomass energy will remain central to rural livelihoods in the short to medium term, especially for those impacted by HIV/AIDS. This means that a comprehensive and integrated response to the AIDS pandemic in rural South Africa needs to include policy and practical support for local communities and institutions to sustainably use and manage their common property woodland and forest resources.

The second policy arena is that of *rural development*. In relation to rural energy policy, governments need to look beyond rural electrification on its own, and must consider mechanisms which lower or remove the economic barriers to the use of electricity, especially for cooking. Despite the dramatic increase in the pace of rural electrification in South Africa in recent years, our data show that this alone will not solve the problem in the short to medium term, because of the economic obstacles facing the rural poor, including those impacted by adult mortality. Rising adult mortality due to AIDS, with the associated economic impacts on households, can be expected to keep electricity effectively inaccessible to the majority of households, despite improved physical accessibility. Possible government interventions include increasing the free basic household electricity allowance in South Africa, currently 50 kWh per household per month. Another aspect of rural development policy relates to small scale agriculture. In contrast to the trend of “deagrarianisation” observed across Africa in recent decades (Bryceson 1999), our qualitative data suggest a possible increased reliance on subsistence farming for household food security by some households in the face of rising adult mortality, especially following the loss of a

breadwinner. This is provided that the household has sufficient remaining human resources to do so. Although increased reliance on homestead gardens for food may buffer the household against shorter-term impacts of adult mortality on food security, longer-term livelihood vulnerability may actually be raised due to factors such as inadequate access to seeds and equipment, land shortage, and global climate change. Reliance of food gardens may be a short-term coping strategy, abandoned when households “get on their feet” again, but it nevertheless suggests that access to land, and technical and even financial support for small scale farmers will need to be an important component of an integrated AIDS response strategy in rural Africa.

Finally, *public health* is another arena of policy import. Although HIV/AIDS is an obvious public health priority, from an environmental perspective, increasing financial and time costs of household dependence on declining stocks of locally available natural resources may also have health consequences. Specifically in regions where little wood is available, it is argued that those unable to afford alternate forms of energy will be forced to reduce their requirements, possibly such that heating food or boiling water “become luxuries.” (Griffin et al. 1993) Such association further testifies to the importance of focusing on the environmental dimensions of HIV/AIDS since households turn increasingly to local stocks in the face of declining alternatives.

CONCLUSION

The evidence from this study suggests that adult mortality and environmental scarcity are indeed colliding to shape and re-shape household strategies with regard to natural resource use and collection strategies. Importantly, the survey data reveal associations between SES and village resource context reflecting the interaction between poverty and location in determining household coping strategies. Combined with the interview data, the results reveal subtle and complex shifts at the household level. Based on this work, we argue that better understanding the role of natural resources in coping strategies is central to the design of effective policy aimed at supporting impoverished, adult mortality-impacted rural households.

In closing, we must revisit an important limitation of this study. The methodology used within this project did not allow for identification *a priori* households experiencing only

HIV/AIDS mortality. Rather, our focus has been on households experiencing the loss of an adult household member in the prime working years with past scholarship suggesting that at least half of these mortality experiences are likely due to HIV/AIDS. The lack of integration of environmental dimensions within AIDS scholarship necessitates these broad analyses as a first step, with our ongoing efforts designed to distinguish specifically across causes of death in order to reveal a more nuanced story with regard to the environmental dimensions of AIDS. Our ability to undertake micro-level analyses knowing even age of death is an important advance, and our next work will make use of the now-available cause of death data to further explore the association between HIV/AIDS and the environment more explicitly.

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APPENDIX

Field site map

Figure 1: Study Area, Agincourt sub-district, Limpopo Province, South Africa

