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**INTERNATIONAL PROGRAMME FOR RESEARCH ON THE INTERACTIONS
BETWEEN POPULATION, DEVELOPMENT AND THE ENVIRONMENT
(PRIPODE)**

APPLICATION FORM

**Application deadline: 11 April 2003
(electronic file)**

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Title of the project
**AIDS mortality and Household Characteristics
in Rural South Africa:
Implications for Natural Resource Use
and Development**

Name of the person in charge
Wayne Twine

Applicant Centre
**Centre for African Ecology,
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Country
South Africa

I - PROJECT SUMMARY

1. Project Title: AIDS mortality and Household Characteristics in Rural South Africa: Implications for Natural Resource Use and Development
2. Name of person in charge: Wayne Twine
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4. Centres or teams involved in the project: Centre for African Ecology (address above) University of the Witwatersrand SOUTH AFRICA Agincourt Health and Population Unit School of Public Health University of the Witwatersrand Private Bag 3 PO Wits, 2050 SOUTH AFRICA University of Colorado at Boulder Institute of Behavioral Sciences Program on Environment and Behavior Campus Box 468 Boulder, CO 80309 USA
5. Number of researchers involved in the project: 5
6. Disciplines concerned by the project: Ecology Demography Public Health Sociology
7. Area(s) of research: Agincourt field site, Bushbuckridge, Limpopo Province, South Africa
8. Key words describing the project (between 2 and 4 per heading) : <i>Population: AIDS mortality, household size ; household composition Development: rural communities ; coping strategies ; time allocation; ecological foundation Environment: natural resources ; ecological integrity ; fuelwood ; water Geographical field: South Africa Methods of analysis: quantitative modelling; qualitative analysis Sources of data: household survey; in-depth resident interviews</i>

9. Summary of the project (no more than one page):

There is a significant lack of research examining the relationship between AIDS mortality and the environment in the developing world. The environment is central to rural livelihoods in poor rural communities across Africa, where the use of natural resources serves as a buffer against poverty and household shocks. AIDS is a dramatic household shock, which impacts on important household characteristics such as size, composition and income. In Africa, where AIDS is most prevalent and rapidly increasing, the relationship between AIDS mortality and household use of natural resources is particularly relevant to sustainable livelihoods and planning for sustainable development. Environmental degradation in these areas compromises household options for use of natural resources, which has severe implications for rural livelihoods, especially in view of the pending AIDS crisis in Africa.

This project aims to address the following key questions within the context of a rural area in South Africa : 1) *How does AIDS mortality influence the way in which households use key natural resources?*, 2) *What are the associations between household size, composition and economic status, and resource use?*, and 3) *What are the implications of these associations for development in the context of rising AIDS mortality among poor rural communities?* The proposed project is based at the University the Witwatersrand (Wits) in South Africa, involving two research units : the Centre for African Ecology and the Agincourt Health and Population Unit. The proposed work is collaborative with colleagues from the University of Colorado at Boulder, USA, with the project designed to build capacity at Wits with regard to both research units. As a key comparative advantage of the project outlined here, we build upon a decade-long research program in the Agincourt subdistrict of the Bushbuckridge region the Limpopo Province of South Africa. Since 1992, the Agincourt Health and Population Unit's (AHPU) longitudinal demographic surveillance system has collected census data at 12-18 month intervals from over 11,000 households in the 21 villages within the Agincourt subdistrict. The resulting data are incredibly rich in demographic detail, allowing identification of age-specific mortality at the household level, as well as key socio-demographic characteristics (e.g., male/female headship, age composition, assets).

We propose to compare household use and per capita consumption of key natural resources between households which have recently experienced a death of a household member within the productive age group most vulnerable to AIDS mortality (15-49 years), and those which have not. Households within these two categories will be randomly sampled within strata based on household size class and ranked wealth class, yielding a total sample of 540 households. The survey data will allow 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. The development implications will be 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. 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. It is anticipated that this will provide insight into the mechanisms behind the relationship between AIDS mortality and household resource use patterns. In addition to the survey data, 25 in-depth, qualitative interviews will be undertaken, yielding rich qualitative insight to supplement empirical modelling.

The resulting insights will allow consideration of the effects of changes in household demographic and economic variables, due to AIDS, on household resource use. In addition, the resulting model will be useful for communicating findings and exploring future scenarios with community members, as well as policy- and decision-makers. Indeed, such a model will be incorporated within a research summary to local policymakers, as well as a component of community meetings during which summaries will be presented.¹

Key to the objectives of CICRED's PRIPODE, the proposed project pushes the frontier of research normally carried out by demographic centres through extension of Agincourt's ongoing demographic surveillance work to more centrally integrate environmental issues. The proposed work provides a foundation for more specific modelling of ecological and development implications of AIDS impacts on resource use. In addition, the proposed project provides the groundwork for future research specifically examining reciprocal aspect of the PED association. Such potential extensions represent the capacity-building nature of the proposed work, whereby the expansion of ecological and development considerations, using collaborative associations with U.S.-based colleagues, provides a substantial foundation for future endeavours.

II – DESCRIPTION OF THE PROJECT

There is a significant lack of research as to 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. The project proposed here 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 proposed project takes 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 integrate consideration of the impacts of HIV/AIDS upon household dynamics, resource use, and relevant development implications.

The proposed project offers new ways for population sciences to examine the PED equation through its extension beyond traditional analyses of population size and growth rates. The focus upon household size and composition builds upon recently published work exploring these key demographic dynamics as related to resource use, sustainability, and development outcomes. Our focus on the relationship between AIDS mortality and consumption of non-agricultural natural resources is novel.

NATIONAL IMPORTANCE OF THE PROBLEM: South Africa has the largest number of people living with HIV/AIDS in Africa (UNAIDS 2002). Approximately 40% of mortality of South African males in the age group 15-49 in the year 2000 was attributed to AIDS, making it the single highest cause of mortality in the country. In 2000, 24.5% of pregnant mothers tested in antenatal clinics tested HIV positive (Dorrington *et al.* 2001). HIV seroprevalence in Limpopo Province is roughly 13%, although it may be as high as 18-20% in the densely populated region of Bushbuckridge (Pronyk & Collinson, Pers. Com. In Hansen 2002, Liskin 2003). The epidemic is rapidly increasing in South Africa and by 2000, mortality among females in the age group 25-29 years had increased by 3.5 times since 1985. AIDS is thus a phenomenon with which the South African government has to grapple, as it has far reaching implications for, among other things, health care services and the economy of the country. The South African government has taken the position that AIDS is a symptom of poverty, and that poverty relief is thus part of the solution to the problem. Given the dependence of poor rural households on natural resources, it is clear that the relationships between AIDS, poverty, and the environment in these areas are of national significance. However, as pointed out by Hansen (2002), the relationship between epidemics and the use or management of natural resources has not been explicitly dealt with in South Africa.

The South African government is currently tackling the problem of poverty and escalating unemployment through its inter-departmental Poverty Alleviation Programme. This laudable initiative focuses on job creation and infrastructure development, but pays little attention to sustainable livelihoods within rural communities. The relationship between human populations and the environment is, however, central to rural development in South Africa, as the vast majority of rural households depend heavily on natural resources as an integral part of their livelihoods (Cunningham 1988; Shackleton 1996; Shackleton & Shackleton 2000). Environmental degradation, therefore, has important implications for the residents' current livelihoods and the region's future development options.

The natural environment in rural South Africa has been significantly modified by the activities of humans and their livestock, and the local resource base continues to come under increasing pressure, highlighting the importance of the issue of sustainability. High human densities, sometimes in excess of 300 people/km² (Pollard *et al.* 1998), clearly have environmental consequences, but a range of other factors, such as economics, local institutions, and cultural belief systems influence the way in which households utilise natural resources (Hunter 2000; Twine & Moshe 2003). South Africa is currently undergoing rapid political and socio-economic change, which has significantly influenced resource use patterns in rural South Africa, with serious environmental and development consequences (Twine *et al.* In Press). Associated with these political and socio-economic changes are transitions in health and population. These, too, have environmental and development implications.

Two critical resources which have become focal in rural development in South Africa are water and energy. Water continues to be a critically limiting, and limited, resource in rural communities, and its procurement remains a daily challenge for most rural households (Perez de Mendiguren and Mabelane 2001). Similarly, significant household resources are expended on collecting fuelwood. Importantly, even in villages where electricity is readily available, over 90% of households use fuelwood as their primary energy source for cooking and heating due to the prohibitive costs of electricity and electrical appliances (Griffin *et al.* 1992; Twine *et al.* 2000; Twine & Moshe 2003). Degradation of these natural resources, as well as time and human resources spent on collecting them, have important development implications (including health) at the household and community level (additional detail below).

This project will provide new insights into key demographic and economic factors impacted by AIDS mortality, which in turn influence household use of water and fuelwood, all within the context of a rural population and society in transition. This information will be useful in answering questions relating to environmentally sustainable development within such rural communities in the face of rapidly rising AIDS mortality. The Bushbuckridge region of Limpopo Province, South Africa (our study area), is well situated as a research site for this project, and has national significance, for the following reasons: 1) the region is identified by the government as a nodal area for its *Integrated Rural Development Programme*; 2) the region lies within the UNESCO *Kruger to Canyons Biosphere Reserve*, an initiative focussed on sustainable development to the benefit of both human populations and the environment within the region ; 3) the region includes the Agincourt Health and Population Unit, a long-standing demographic surveillance site associated with the University of Witwatersrand School of Public Health (details below), and ; 4) the site is located in one of the poorest provinces in South Africa.

RELEVANCE TO POLICIES ON SUSTAINABLE DEVELOPMENT

The influential presence of HIV/AIDS: HIV/AIDS is increasingly becoming a critical development issue in Africa, with far-reaching implications. As Vogel (2002) states: “Alongside poverty, population and climate change, AIDS is one of the *great problems* of the late 20th and early 21st centuries, and primarily affects the developing world”. Nowhere is this more evident than in sub-Saharan Africa, where average life expectancy is reaching an all-time low due to AIDS (Pilgram & Kees 2002). Once a mainly urban phenomenon, AIDS has become a “formidable social problem” in rural sub-Saharan Africa, with major implications for rural development (Rugalema & Khanye 2002). The impacts of AIDS on development at the household level are primarily in the form of changing household size, composition, and income. AIDS morbidity and mortality has a significant impact on household domestic labor, with potentially severe implications for food security in rural communities reliant on small-scale agriculture for survival (Barnett & Blaikie 1992, Jackson 2002). Many rural households are also dependant on remittances from employed migrant family members, and illness and death of breadwinners thus has major impacts on rural households which have no other source of income (Rugalema & Khanye 2002). Morbidity or mortality of a household member may also result in coping strategies such as divesting family assets, spending savings, and withdrawing children from school (especially girls) to compensate for loss of income. It can also result in increased malnutrition in children, especially in the case of illness or death of a mother (Jackson 2002). This exacerbates the existing “spiral of poverty” which is so prevalent in rural African communities.

Although the importance of the relationship between AIDS and the use and management of natural resources in rural areas has been acknowledged (e.g. Barany *et al* 2001; Barnett and Whiteside 2002 ; Hansen 2002 ; Rugalema & Khanye 2002), most information is anecdotal and scant scientific data exist on these relationships. Most of the research exploring AIDS-environment relationships in rural areas has focussed on the impact of AIDS mortality on household resources important for cultivation and animal husbandry (see Barnett and Whiteside 2002). In the context of extraction of natural resources from indigenous forests in Africa, Barany *et al* (2001) lament that “to date there appears to have been little or no effort made to understand the role of forestry in mitigating the impact of HIV/AIDS”. Little has changed since then.

Household characteristics as associated with resource use: Much existing literature on population-environment dynamics has attempted to link population size and/or growth rates to levels of environmental change (e.g., Cincotta, Wisniewski & Engelman 2000; Dietz & Rosa 1994, 1997; Ehrlich 1975; Ehrlich and Ehrlich 1990). Although important, a focus solely on aggregate population size and/or growth neglects to consider other important demographic dynamics such as the number of households, as well as, household composition. Indeed, some have argued that the household is, in fact, the most appropriate level of analysis given the household’s primacy with regard to resource acquisition and consumption (e.g. Liu *et al.* 2002).

An important study recently published in *Nature* illustrates the centrality of household dynamics to environmental issues. Focusing upon demographic distinctions between regions characterised by levels of biological diversity, Liu and colleagues find that in hotspot countries, the annual rate of growth in the number of households (3.1%) was substantially higher than the growth rate (1.8%) between 1985 and 2000.² Through more detailed examination of 6 representative hotspot areas, the researchers find that reductions in average household size contributed approximately 30-73% to the growth in the number of households over the periods of 10 and 40 years. Household size reductions are a product of lower fertility rates, increases in per capita incomes, higher divorce rates, ageing populations, and the lowered likelihood of extended family living arrangements. As for environmental impacts, more households mean more housing units, thereby typically increasing the amount of land and materials required for housing construction. In addition, smaller households have lower efficiency in resource use per capita (Liu *et al.* 2002).³ The above is highly relevant in the Agincourt site, where a high incidence of migrant labour to urban centres across the country significantly influences household size and dynamics.

² Biological hotspots are defined as areas rich in endemic species and threatened by human activities (Cincotta et al. 2000; Liu et al. 2002).

³ A letter of encouragement from Professor Jianguo Liu is included with this application.

Other work also informs the use of household perspective with regard to resource issues (e.g., Awasthi et al. 2003; Cooke 1998; Masera and Navia 1997; Vermeulen, Campbell, and Matzke 1996; Whittington, Mu, and Roche 1990), and this literature will provide one dimension of the proposed project's academic foundation.

Development implications of resource use related to AIDS mortality and household dynamics: This project will consider at least two primary routes through which development prospects are related to AIDS mortality and household consumption of local resources: 1) through time and human resource allocation, and 2) through the buffering effect of access to natural resources. Each is briefly outlined below.

Allocation of time and human resources: A fascinating body of research is emerging with regard to household time allocation as related to resource scarcity, much of it also incorporating key gender dimensions (e.g., Cooke 1998; Giampietro, Bukkens, and Pimentel 1993; Ilahi and Grimard 2000). The results of this work have important policy implications related to development, particularly as associated with the opportunity costs of environmental scarcity. More specifically, this research generally suggests that poor access to necessary resources increases time allocated to resource collection (particularly by women), thereby reducing the opportunity for other forms of contribution to the household (including income-generating market activities). In our study region, these constraints with regard to time allocation are likely exacerbated by AIDS-related mortality.

For example, in rural Nepal, women spend over 4 hours daily collecting resources (i.e. fuelwood, leaf fodder, and cut grass), time that reduces the labour available for other vitally important household activities (Cooke 1998). The results of research in this area suggest that if environmental conditions deteriorate, women, in particular, "will pay a high price" (Cooke 1998). Similar patterns characterise rural Pakistan, where evidence suggests that poor water infrastructure induces women to reduce their market-oriented work, and thus, their contribution to household income (Ilahi and Grimard 2000).

The critical role that women play in alleviating poverty and promoting development is being increasingly recognised (e.g. World Bank 1995). As related to resource use, inequalities in the household division of labour typically imply that, in the face of resource scarcity, women spend increasing amounts of time doing unpaid work. It is argued by some that reduction of this gender gap would assist in alleviation of poverty through facilitation of women's participation in market-oriented activities, since this increase in household income as contributed by women, could lead to improved nutritional and educational status of their children (e.g., Ilahi and Grimard 2000).

With regard to AIDS impacts, the implications of loss of household domestic labour (particularly in prime working-age groups), for collection of natural resources will be considered. Loss of a household member in the productive age group, will influence how households apportion their time and human resources between procuring resources and engaging in other essential domestic and economic activities. Two possibilities exist: 1) less time and human resources spent on securing natural resources, necessitating buying or bartering for resources, or 2) more time and human resources spent on securing resources, as other commercial alternative become too costly because of loss of a breadwinner, resulting in an opportunity cost for other domestic and economic activities. Elderly household members will potentially be placed under greater pressure to harvest resources in households where younger productive members have died.

Access to natural resources as a buffer against household economic shocks: The economic and social values of land-based strategies in rural livelihoods in South Africa, including natural resource harvesting, have not been fully appreciated by policy makers, especially with regard to "direct provisioning" and "as part of the rural safety net" (Shackleton *et al.* 2001). Shackleton and Shackleton (2000) have demonstrated that natural resources "represent a substantial value in terms of the amounts used in the homestead as well as traded" in the rural communities of Bushbuckridge. In this context, Cousins (1999) refers to these communal resources as *invisible capital*. The natural capital in these communal lands is vital for coping strategies in the event of a household shock, such as an AIDS mortality in a household. It is therefore imperative that the importance of the environment as a basis for development in rural communities be acknowledged and better understood. Shackleton *et al.* (2001) make the point well: "...building on land-based livelihoods that rural people currently practice, seeking ways to enhance their economic value, might be more appropriate than attempting to replace them with fully market-orientated or commercialised approaches."

Access to natural resources can act as a buffer against hardship, by providing free or cheap alternatives to commercial items or commodities. For example, firewood is cheaper than electricity for cooking, thatching grass is cheaper than corrugated iron roofing, and wild spinach's are cheaper than purchased vegetables. Use of these natural resources thus constitutes a financial savings. Using freely harvested natural resources, rural households could save between Euros 280 (Shackleton and Shackleton 2000) and Euros 480 (Twine *et al* 2000) per annum. These figures are significant in the context of severe poverty in these communities. Access to natural resources can also have a buffering effect against household economic shocks by providing opportunities for generating income. A wide range of resources, including fuelwood, carvings, traditional beer, fruit, and water are sold locally within rural communities of the Bushbuckridge region, and are an important source of income for many households (Hansen, B. 1998, Shackleton and Shackleton 2000, Twine *et al* 2000 ; Perez de Mendiguren and Mabelane 2001). These resources

can also be used, indirectly, for generating money through supporting other economic activities. Examples include: using fuelwood to cook or bake food which is then sold, using water in a home hairdressing salon, or using water and *marula* fruit to brew traditional beer to be sold.

The household economic shock of losing a breadwinner or household member who contributed to income generation in other ways, may be buffered by increasing the use of natural resources instead of commercial alternatives, and/or by engaging in the commercial trade of resources to compensate for loss of household income. However, such coping strategies may be compromised by the impact of a death on household time and human resources, as outlined above.

SCIENTIFIC OBJECTIVES: We aim to expand the insights garnered from the above-reviewed literature, through a focus upon mortality and household characteristics as related to environmental resource use, with specific consideration of the implications for rural economic development in an impoverished rural region of South Africa. The following key scientific objectives are as follows: 1) *Examine how AIDS mortality influences the way in which households use key natural resources*, 2) *Examine the associations between household size, composition and economic status, and resource use*, and 3) *Examine the implications of these associations for development in the context of rising aids mortality among poor rural communities*. The results of work guided by these research questions have clear policy implications as outlined in the project description's concluding section.

DATA: To meet the above research objectives, we will make use of 3 data sources, each reviewed in turn below. First, however, we provide a brief overview of the study context: the Agincourt subdistrict of the Bushbuckridge region the Limpopo Province of South Africa.

Study Context: The Agincourt subdistrict, named after one of the local villages, consists of 21 villages, comprising over 11 000 households and 67 000 people. The area is typical of rural communities across South Africa, and is characterised by poverty, high human densities, and a high reliance on both natural resources and on remittances from a large migrant population.

The mean household size in Agincourt ranges from 6.2 in the South African population to 6.5 in the Mozambican sector. There is a high degree of variation around these means, and many households have more than 10 members. Due to poor employment opportunities in the region, a large proportion of adults are migrant labourers, working on commercial farms and in the 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. Sero-prevalence of AIDS is around 18% in the region (Pronyk Pers Com..)

Data Source #1, Ongoing Demographic Surveillance System: Incidence of mortality in age groups most vulnerable to AIDS mortality, as well as other demographic characteristics of Agincourt households will be provided through the Agincourt Health and Population Unit's (AHPU) longitudinal demographic surveillance system (DSS). Since 1992, the AHPP has collected census data at 12-18 month intervals from all 11,000 households in the Agincourt subdistrict. The resulting data are incredibly rich in demographic detail, allowing identification of key household demographic characteristics (e.g., male/female headship, age composition). Of particular interest in the present project is household economic status, measured in the Agincourt DSS through an 'asset index' derived from an asset register including presence of a tap and toilet on the household stand, ownership of appliances (e.g. radio) and equipment (e.g. wheelbarrow), and income for a given census year.

Data Source #2, Natural Resource and Development Survey: Insight into the resource use patterns of Agincourt residents will be provided through a survey of a random, stratified sample of 540 households. Half of these (270) will be randomly selected from a pool of households which have had a mortality in the productive age group most vulnerable to AIDS (15-49 years) (Dorrington *et al.* 2001) during the last year. Gender and income-generating status of the deceased person will be recorded (from the DSS). The other 270 *control* households will be randomly sampled from households which have not had a mortality in the last year. The samples within the *treatment* and *control* will be stratified to ensure sufficient representation (30 households) within combination of the following two independent variables: 1 Household size (1-5, 6-10, >10) and 2) Economic status (low, medium, high, based upon the asset index noted above).

A face-to-face survey will be undertaken with the female household head, due to women's primacy in resource collection within this context. The survey will request information on the following as related to **both** water and fuelwood:

availability (proximity); method of acquisition; time required to acquire on a daily and weekly basis; individuals responsible for acquisition; assistance available for acquisition; difficulties encountered in acquisition; level of use on daily and weekly basis; types of use; perception of the condition of the local environment; the opportunity costs of resource collection; perception of key local needs.

In addition to this, all natural resources used by the household for a) domestic purposes and b) income generation, will be documented using an existing questionnaire instrument developed by the Centre for African Ecology.

Data Source #3, Qualitative Interviews: In addition to the quantitative data available through the DSS and field surveys, we will undertake in-depth qualitative interviews with no fewer than 25 households which have experienced a death of a household member in the age group 15-49 during the last year. The in-depth interviews will also be undertaken primarily by experienced, local fieldworkers, although graduate student research assistants from both the University of Witwatersrand (South Africa) and the University of Colorado (USA) will also participate in the qualitative research with the assistance of local fieldworkers. The interviews will focus upon the use of natural resources as a coping strategy following a death in the household, while at the same time further exploring the constraints which a mortality places on the household's ability to acquire natural resources. We will also gather ethnographic detail on residents' perceptions of the condition of the local environment, as well as opportunities forgone as a result of time spent acquiring water and fuelwood.

METHODOLOGY : To describe our methodology, we return to the 3 stated research objectives. In each case, the survey data will allow for empirical modeling of the associations under examination, while the qualitative interviews will yield rich, detailed insight into household-resource-development dynamics.

1) Examine how AIDS mortality influences the way in which households use key natural resources.

This objective will be addressed by comparing resource use in households which have had a recent mortality with those which have not. By sampling evenly across household size and economic status for both groups, we will ensure that presence or absence of a death is the primary independent variable. To ensure sufficient sample size and flexibility in data collection, we will not restrict our selection of households with a mortality to those in which AIDS was the cause of death. Rather, we will focus on the productive age group shown to be most vulnerable to AIDS mortality (15-49 years). We will be able to determine what proportion of all deaths in these age and gender groups are due to AIDS based on the standard verbal autopsies conducted after the annual census in the Agincourt field site. This will allow an analysis of whether resources use strategies differ between households in which a member died recently of AIDS compared to those where a member died from some other cause.

The quantities of water and fuelwood consumed annually by each sampled household will be determined using existing resource survey instruments used by the Centre for African Ecology. Because household size (temporary & permanent) will be known, we will calculate per capita consumption of these resources. Similar to past studies (e.g., Cooke 1998; Ilahi and Grimard 2000; Kerkvliet and Nebesky 1997; Kohlin and Parks 2001), we will model resource use as a function of individual, household, and locational characteristics. These will be compared between the two groups of households using bi-variate statistics. Allocation of time and human resources will be quantified and analysed using accepted methods.

2) Examine associations between household size, composition and economic status, and resource use.

We will examine these associations from several perspectives. First, descriptive profiles will be created of resource use for all incorporated households and as varies by village. Research in other cultural contexts on fuel wood use has provided interesting descriptive profiles of variation in frequency of use, collection, wood types, transport used, and gender of collector according to the type of consumptive use (i.e., day-to-day, brewing, special occasion) (Vermeulen, Campbell, and Matzke 1996). Such profiles provide the foundation for a more sophisticated understanding of social dimensions of proximate resources. Second, bivariate associations will yield insight into resource availability and levels of use by household SES and age/gender composition, with consideration of variation in such composition resultant of HIV/AIDS mortality. Third, and most insightful, will be the multivariate models that allow simultaneous consideration of other factors related to the social dimensions of resource use.

Much of the data to be used in modelling variation in resource use are available, longitudinally, through the Agincourt DSS, thereby demonstrating a comparative advantage of the proposed project : the ability to draw from an existing social science data source as a foundation for the proposed PED project. Of course, within the modelling, we will carefully consider multicollinearity, as well as the appropriateness of the linear form, and pursue alternative models where necessary. Team member Sam Clark contributes valuable statistical expertise, while additional consulting is available through the University of Colorado's Institute of Behavioral Science's Center for Computing and Research Services (<http://www.colorado.edu/IBS/DAC/>).

Data from the in-depth interviews will yield qualitative evidence of issues related to resource use on daily, weekly, seasonal basis, resource availability, time required to acquire on a daily, weekly, seasonal basis, individuals responsible for acquisition, assistance available for acquisition, difficulties encountered in acquisition, and other social dimensions of resource use (e.g. types of use).

3) Examine the implications of these associations for development in the context of rising aids mortality among poor rural communities.

As outlined above, central to our third research objective are the issues of time and human resource allocation, and the role of access to natural resources as a buffer against household economic shocks. As for time allocation, our focus will be upon examination of the time spent on resource allocation as contrasted with market involvement. Here, the

empirical models will be similar to those presented above, although the model's conceptualisation will focus upon the *relative* allocation of time to various household tasks (e.g., Ilhai and Grimard 2000). This portion of the work will be informed by classic econometric research exploring such tradeoffs (e.g., Becker 1965; Gronau 1977), and, again, specific consideration of the implications of HIV/AIDS mortality on relative time allocation as related to resources will be considered. In addition to statistical representation, qualitative data garnered through the in-depth interviews will allow respondents to "speak for themselves" with regard to the tradeoffs required in the face of resource scarcity. In particular, we will incorporate rural residents' perception of the opportunity costs of resource collection, as well as their perception of key local needs with regard to resource and development issues. The economic and development implications of allocation of human resources will be examined in the context of burden placed on the elderly.

As for the buffering effect of access to natural resources, the benefits of access to resources as a coping strategy following a death of a productive household member will be explored. The consequences of the inability to realise these benefits due to loss of human resources and time opportunity costs will also be examined in relation to AIDS mortality. Development consequences of decline in the natural resource base, and thus the potential for buffering household shocks will also be assessed based upon past understanding of the resource-development association. The underlying assumption is that the environment provides a base for diverse development options, and that ecological degradation compromises these opportunities. The qualitative interviews will allow for description of residents' perception of local environmental conditions, especially as related to the social and economic development implications of shifts in the resource context.

USE AND VALORIZATION OF RESULTS: This project will highlight the important role of natural resources in rural livelihoods, particularly in coping strategies following a death in the family, and thus the development implications of environmental degradation. Although the natural environment is central to sustainable development in any context, its role is more immediate in less developed rural communities which depend directly on the natural resource base. This project should therefore initiate debate and reflection on the effects of public health and rural development policy and intervention programs which pay inadequate attention to the relationship between households and the local natural environment.

The proposed project will provide innovative contributions within both academic and applied contexts in at least three key ways. First, a central output from this project will be a model of household resource use that includes mortality, household size, composition and economic status as parameters – an important extension to work focused solely on the environment and development impacts of population size and growth rates. The resulting insights will allow consideration of the effects of changes in household demographic and economic variables due to development interventions and/or shifts in HIV/AIDS patterns/trends) on household resource use. Second, an additional value of this model will be the ability to aggregate household insights to assess village-level demand for natural resources, and environmental impacts. Such potential highlights the value of the detailed household data which exists for all households in the Agincourt field site. Third, the resulting model will be useful for communicating findings and exploring future scenarios with community members, as well as policymakers. Indeed, such a model will be incorporated within a research summary to local decision-makers, as well as a component of the community meetings (one in each study village) during which summaries will be presented.⁴

Key to the objectives of CICRED's PRIPODE, the proposed project pushes the frontier of research normally carried out by demographic centres through extension of the ongoing demographic surveillance work to more centrally integrate environmental and development issues, with AIDS as an integrating them. Using a new and innovative approach to assessing the relationship between AIDS mortality and the environment, this work will make a significant contribution to this new and under-developed field of research. In addition, the proposed project provides the groundwork for future research examining reciprocal aspects of the PED association, allowing the relation of resource availability (as function of use patterns) to development capacity to demographic trends. The proposed work also provides a foundation for more specific modelling of ecological implications of resource use. Such potential extensions represent the capacity building nature of the proposed work, whereby the expansion of ecological and development considerations, using collaborative associations with U.S.-based colleagues, provides a substantial foundation for future endeavours. Finally, the project team is seeking additional resources to enhance research capacities related to PED in rural South Africa through additional proposals (e.g., to the University of Colorado's Population Aging Center, April 2003).

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⁴ The AHPU has a successful history of engaging community members through such meetings.

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III - THE TEAM

1. Person in charge

Name: **Twine** First name: Wayne

Sex: **Male** Date of birth: **28 September 1971**

Nationality: **South African**

Current position: **Research Officer, Centre for African Ecology**
.....

2. The Centre

(the Centre is the institution which will receive the funds if the project is selected)

Name: **Centre for African Ecology, School of Animal, Plant & Environmental Sciences, University of the Witwatersrand**

Acronym: **CAE**

Postal address: **School of AP&ES, University of the Witwatersrand, Private Bag 3, PO WITS, 2050, SOUTH AFRICA**

Telephone: +27-11-717-6454 Fax: +27-11-403-1429

E-mail: Norman@gecko.biol.wits.ac.za

Give the complete name and position of the person representing the organisation:

Name: **Norman Owen-Smith**

Position: **Director, Centre for African Ecology**

3. Table of the members of the team

Name	First name	Parent organisation	Proportion (a)
Twine	Wayne	Centre for African Ecology University of the Witwatersrand	40%
Hunter	Lori	Institute of Behavioral Science, Research Program on Environment And Behavior, University of Colorado	20%
Collinson	Mark	Agincourt Health & Population Programme, University of the Witwatersrand	10%
Clark	Sam	University of Colorado Agincourt Health & Population Programme	5%
Owen-Smith	Norman	Centre for African Ecology, University of the Witwatersrand	5%

(a): proportion (in %) of working time dedicated to the project

4. Individual forms

Individual forms are included for both Twine and Hunter, since they will work closely to develop and implement the project proposed here.

INDIVIDUAL FORM

Name: Twine..... First name: Wayne.....
Sex: Male..... Date of birth: 28 September 1971.....
Nationality: South African.....

Organisation: Centre for African Ecology, School of Animal, Plant & Environmental Sciences,
University of the Witwatersrand
Complete address: Wits Rural Facility, Private Bag X420.....
City: Acornhoek, 1360..... Country: South Africa.....
Telephone: +27 (0)15 793 3991..... Fax: +27 (0)15 793 3992
E-mail address: rcrd@global.co.za

Current position: Research Officer (grant-funded contractual post), Centre for African Ecology, School of Animal, Plant & Environmental Sciences, University of the Witwatersrand

Main degrees (title, University, year):

BSc Hon University of the Witwatersrand, 1993

MSc University of the Witwatersrand (Conservation Biology), 1995

PhD University of Natal (Resource Ecology) In Progress

Discipline(s) specialised in: Resource ecology, ethnobotany

Professional experience, notably in research:

- ◆ Five years experience in managing a research programme of the Centre for African Ecology, focusing on the relationships between humans and the environment in a rural region of South Africa (Bushbuckridge). Research projects, including those of supervised students, have covered topics ranging from ecological impacts of human activities to the role of natural resources in rural livelihoods.
- ◆ Other positions include Research Co-ordinator at the Wits Rural Facility and Head of Research of the Kruger to Canyons Biosphere Reserve (voluntary position).

Five main publications during the last five years relating to PRIPODE:

- ◆ Twine, W. (2002) The fuelwood problem: Are we reaching crisis point? *Environment Today*, 2:20-21.
- ◆ Twine, W. (In Press) Medicinal bark harvesting and yields in woodlands: A case study from southern Maputaland. In: M. Lawes, H. Eeley, C. Shackleton, and B. Geach (Editors). *The use and socio-economic value of indigenous forest and woodland resources in South Africa*. University of Natal Press.
- ◆ Twine, W. (In Press) Socio-economic threats to woodland resources on communal lands. In: M. Lawes, H. Eeley, C. Shackleton, and B. Geach (Editors). *The use and socio-economic value of indigenous forest and woodland resources in South Africa*. University of Natal Press.
- ◆ Twine, W., Siphugu, V. & Moshe, D. (In press) Harvesting of natural resources by “outsiders” in rural South Africa: A case of xenophobia or a real threat to sustainability? *International Journal of Sustainable Development and World Ecology*.
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INDIVIDUAL FORM

Name: Hunter..... First name: Lori M.....
Sex: Female..... Date of birth: Oct. 12, 1963.....
Nationality: USA.....

Organisation: University of Colorado.....
Complete address: University of Colorado, Institute of Behavioral Science, Program on Environment and Behavior,
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City: Boulder, CO..... Country: USA.....
Telephone: +01-303-492-1006 (USA)..... Fax: +01-303-492-1231 (USA).....
E-mail address: Lori.Hunter@colorado.edu.....

Current position: Assistant Professor of Sociology; Faculty Research Associate, Institute of Behavioral Science,
Program on Environment and Behavior.....

Main degrees (title, University, year):
Ph.D., Brown University (Sociology), 1997;
M.S., Brown University (Sociology), 1994;
B.A., University of Washington (Sociology, Communications), 1986

Discipline(s) specialised in: Sociology (Demography, Environmental Sociology)

Professional experience, notably in research:

- ◆ Areas of expertise include demography (particularly as related to population-environment associations, population distribution and migration, land-use change, ecological studies), environmental sociology (particularly as related to public perception of environmental issues, environmental equity, human-environment interactions).
- ◆ External research funds garnered from the U.S. Environmental Protection Agency (Population and Development in the California Mojave) ; the National Science Foundation (Household Valuation of Curbside Recycling) ; the American Association for the Advancement of Science (Population and Biodiversity in the Fragile Ecosystems of Utah) ; the U.S. Department of Agriculture (The Demographic Implications of Hazardous Facility Development in Rural America) ; the City of Boulder Open Space and Mountain Parks Department (An Examination of Boulder Residents' Attitudes Towards Biodiversity and Threatened and Endangered Species in City Open Space and Mountain Parks) ; the American Sociological Association (Assessment of Recycling Options and Household Trash Reduction in Cache County, Utah).

Five main publications during the last five years (*or more recently forthcoming*) relating to PRIPODE:

- ◆ Hunter, Lori M. 2000. *The Environmental Implications of Population Dynamics*. A monograph prepared for the RAND Corporation's *Population Matters* Series. Policy Brief based on report translated into French and German.
- ◆ Hunter, Lori M., Manuel de J. Gonzalez G., Matt Stevenson, Richard Toth, Thomas C. Edwards, Jr., Robert J. Lillieholm. (*in press*). "Population and Development in the California Mojave: Natural Habitat Implications of Alternative Futures." *Population Research and Policy Review*.
- ◆ Hunter, Lori M., and Michael B. Toney. (*in press*). "A Test of the Continued Distinctiveness of the Mormon Culture Region: Variation in Environmental Attitudes." *Social Science Journal*.
- ◆ Hunter, Lori M. and Joan Brehm. (2003, *in press*) "Qualitative Insight into Public Knowledge of, and Concern with, Biological Diversity." *Human Ecology Review*.
- ◆ Hunter, Lori M., John Beal, and Tom Dickinson. (2003, *in press*) "Integrating Demographic and GAP Analysis Biodiversity Data: Useful Insight?" *Human Dimensions of Wildlife*.

5. Presentation of the team (no more than 2 pages)

Origin, and Affiliated Institutions, of the Team: The research team presented within this proposal represents a combination of both pre-existing and new collaborative partners. In parallel, the data to be used to meet the scientific objectives represents information gathered as a product of a long-standing research presence within the demographic surveillance region, as well as new data collection as represented by the natural resource and development surveys and in-depth interviews.

As mentioned above, the Agincourt Health and Population Unit has been underway since 1992, with co-PI Collinson centrally involved in the demographic surveillance system through most of its years. PI Twine is relatively new to the AHPU collaboration, but represents the ecological perspective in the Agincourt area, a key component heretofore not emphasized within the DSS. Co-PI Owen-Smith further represents the ecological perspective and, although not previously affiliated with AHPU, is a renowned scholar of African ecology. Co-PI Clark has been active in the AHPU for the past year, particularly with regard to data management and modeling. In all, Collinson, Twine, and Clark represent 3 of the many Witwatersrand researchers primarily affiliated with AHPU. Co-PI Hunter is new to the AHPU, having joined the ongoing research efforts following a recent workshop at Witwatersrand aiming to build capacity and collaborative relationships among Witwatersrand scholars and others from Brown University and the University of Colorado (March 2003). All members of the research team are affiliated with public institutions.

Technical qualifications:

- ◆ Wayne Twine: MSc in conservation biology (University of the Witwatersrand 1995), with a focus on the ecology of human-impacted ecosystems ; five years experience in field-based research in the Bushbuckridge region, investigating various aspects of the interactions between humans and the natural environment (individual information form attached) ;
- ◆ Lori Hunter: Ph.D. in Sociology (Brown University, 1997) with expertise in Demography and Environmental Sociology (individual information form also attached) ;
- ◆ Mark Collinson: BSc Hons in statistics and MSc in population studies ; Extensive experience in project management, statistical analysis, and database management, especially as related to the Agincourt Health and Population Unit ; particular substantive interest in migration as related to health and development ;
- ◆ Sam Clark: Ph.D. in Demography (University of Pennsylvania, 2001) with expertise in African Demography, demographic methods, mathematical modeling of population processes, modeling and studying processes involving temporal and spatial components, Information Technology, and topics at the interface of Biology, Ecology, and Demography;
- ◆ Norman Owen-Smith: Ph.D. (Wisconsin, 1973) in animal ecology. Research professor in African Ecology, University of the Witwatersrand, and head of the Centre for African Ecology ; particular experience and expertise in modelling animal populations ; Accredited as an ‘A rated scientist’ by the National Research Foundation (South Africa).

The team has been purposively developed to include the expertise deemed necessary for the project, thereby not necessitating additional technical support other than regularly available through the support mechanisms of either Witwatersrand or Colorado. As noted in the attached letters of support, senior scholars at both the University of the Witwatersrand (i.e., Tollman) and the University of Colorado (i.e., Menken) are also available for guidance and support where needed.

Comparative Advantages (and means available): One of the key comparative advantages of the proposed project, and the research team, is the foundation provided by ongoing work in the Agincourt field site. The initial motivation of the DSS was to provide detailed data for examination of the social dimensions of health issues in an impoverished rural region of South Africa. We aim to build upon the decade-long research agenda focused on health and population, with specific extensions related to environment and development. Given a decade of data collection related to health and demographic issues, the data offer a unique opportunity for expansion into these critically related areas.

We also see this comparative advantage as a key example of the ‘means available’ to the proposed work. The support of the leaders of AHPU is essential to the efforts proposed here.

Capacity Building: The proposed project would substantially contribute to capacity building in South Africa, at the University of the Witwatersrand, as well as more specifically within the Agincourt Health and Population Unit and its affiliated programs. We aim to enhance current research capacities through facilitation of the incorporation of issues

related to natural resources and development within the existing longitudinal dataset. In addition, the proposed project incorporates requests for support for the ongoing demographic surveillance research, particularly as related to the proposed PED extensions. As such, the proposed project would both contribute to, and expand, existing research capacities in the rural site of Agincourt.

Also related to capacity building, requested funds would be used for recruitment and training of local fieldworkers, thereby providing economic opportunity within the rural study site. In addition, support is requested for 2 graduate students, one at Witwatersrand and one at Colorado, thereby providing unique collaborative and applied research experience for each. Finally, the proposed project also takes important steps toward fostering collaborative relationships between North/South institutions and researchers. In particular, the project specifically links scholars from the University of the Witwatersrand with two from the University of Colorado at Boulder, with mutual visits entailing research presentations, student meetings, and other opportunities for intellectual 'sharing' across borders, thereby potentially yielding a foundation for future efforts. At the Agincourt Health and Population Unit, social scientists with an environmental focus have not previously been central to the research agenda. As such, scholars from the University of Colorado can assist in the incorporation of the human dimensions of environmental change and development prospects. At the University of Colorado, the Institute of Behavioral Science's Program on Environment and Behavior offers a unique community in which scholars across several social science disciplines engage in research related to human-environment-development interactions. Still, the Environment and Behavior Program would greatly benefit from contributions by Witwatersrand colleagues, particularly as related to the cultural nuances and ecological setting of rural Southern Africa. In each case, the reciprocal relationship will yield new capacities allowing broadening of research agendas and enhancing expertise as related to population/environment/development relationships.

Organizations with which the Team is Working: The team's key relationships with other partners come primarily from past work at the AHPU. In particular, co-PI Collinson is chairman of the INDEPTH Network's Migration and Urbanization Working Group. INDEPTH represents the International Network for the Demographic Evaluation of Populations and Their Health in developing countries. This organizational contact is key in that inclusion of environment and development issues within the Agincourt Health and Population Unit will receive international attention through meetings of the INDEPTH network. Ideally, the AHPU can provide a model whereby other demographic surveillances systems can incorporate PED issues.

In addition, AHPU has held a 'Franco-South Africa' research grant for several years now (with M Garenne who was first at CEPED - the French Center for Population and Development - and is currently at the Pasteur Institute). This is but one of several strong collaborative partnerships between AHPU and other internationally recognised research centres for the northern hemisphere. These partnerships contribute to the strengthening of local expertise in health and population research.

Both the AHPU and Centre for African Ecology have contact with a local development organisation, the Association for Water and Rural Development (AWARD), which was responsible for a national pilot project in integrated catchment management, and which focuses on supporting local government and communities in managing their water resources. Research findings relating to water will be useful and relevant to AWARD's development work in this field, and will be presented to them in a workshop.

As a final organizational affiliation, Co-PI Hunter is a member of the International Advisory Board of the "Population-Environment Research Network" (PERN). PERN's mission is to to advance academic research on population and the environment by promoting scientific exchange among researchers from social and natural science disciplines worldwide and by providing relevant and timely materials. Through this contact, information on PED extensions to the Agincourt Health and Population Unit (e.g., reports, working papers, publications) can be readily disseminated to the international academic community engaged in these issues.

Dissemination and Outreach : The AHPU has a community feedback programme in which research findings are communicated back to local communities and institutional structures, in a meaningful and appropriate way. Throughout the program, village-level health and demographic data has been communicated to each village (leadership and general community) after each round of the annual AHPU census. Skilled fieldworkers from the local community are responsible for this, and we will also use this method as a vehicle for disseminating findings from this research project.

IV - WORK SCHEDULE

Household Characteristics in Rural South Africa: Implications for Natural Resources and Development

