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The dynamics of rural poverty in a South African community: A spatial-temporal model

Summary – Rural poverty in South Africa remains a contentious issue and national statistics often conceal the complex nature of this dilemma at village and household level. The objective of the paper is to better understand the variables, dynamics and trends that influenced the socio economic position (SEP) of a rural community. The study examines asset and other socio-economic data from a rural community for the period 2001 to 2007. Contrary to other work in the region, descriptive statistics, simulation based Bayesian kriging and ordinal logistic regression models suggest a significant increase in asset status over time. The disaggregated results, however, indicate that high levels of income inequality exist and that former Mozambican refugee households continue to be disadvantaged. The results also examine a number of significant relationships between household SEP and a range of household predictor variables. In conclusion, these findings could have important implications for government policy regarding the targeting of a range of social grants.

Keywords - Africa, South Africa, rural poverty, asset status

1. INTRODUCTION

Rural poverty has worsened in recent decades as a result of globalization, the commercialization of agriculture, land use changes, degradation, climate variability, and increasing levels of urban migration (Bryceson, 2002a: 2002b; 2004; Mertz, Wadley &

Christensen, 2005). While rural poverty has decreased in Asia (Binswanger, 2004; Kydd, Dorward, Morrison & Cadisch, 2004; Sherbinin et al., 2008), poverty levels in Sub Saharan Africa have increased due to disease, low levels of education and limited access to energy, water and sanitation. Although many variables influence poverty, Binswanger (2004) suggests the failure of rural development programs is a primary factor influencing high levels of poverty in Africa.

South Africa's highly skewed bi-modal economy has exacerbated the plight of the rural poor as a result of a focus on urban industrial development at the expense of the rural economy (Bryceson, 2002a: 2002b). Historical legacies have also fundamentally skewed the wealth and population demographics of the country with 80% of the population located on 13% of the available land (Bryceson, 2002b). In this regard, 70% of South Africa's poor live in densely populated rural areas whose economic development is compromised by a lack of development and employment opportunities (Machethe, 2004; Kariuki, 2004). Many of the country's rural development interventions, moreover, appear to have aggravated high levels of income inequality because only more affluent rural households have benefited from land and business opportunities (Machethe, 2004; Kariuki, 2004; Business Day, 2008).

National poverty statistics are often misleading because the aggregated indicators do not account for the gains and losses at a local community or household level. Definitions of poverty also vary widely across nations and regions (Sen, 2003; Krishna, 2006; Howe, Hargreaves & Huttly, 2008) and various studies indicate growing poverty among the chronically poor despite improvements in national statistics (Sen, 2003; Krishna, 2006; Xing, Shenggen, Xiaopeng, & Zhang, 2008). Furthermore, the drivers of poverty are both complex and elusive because they are influenced by a wide range of exogenous and endogenous factors (Sen, 2003). The objective of

the paper is to better understand the variables, dynamics and trends that influence the socio economic position (SEP) of a rural community for the period 2001 to 2007. More specifically, the paper will explore these relationships at both household and village level for approximately 12000 households, located in 21 villages in rural Mpumalanga, South Africa. The importance of the study is underlined by the World Bank's increasing concern about the globalization of rural poverty, as well as the growing frustration of the marginalized in South Africa (Bryceson, 2004; Mertz, Wadley & Christensen, 2005). The study makes a contribution to the rural poverty literature as follows. Firstly, a combination of spatial-temporal modeling and mapping techniques is used to illustrate the complex nature of disaggregating SEP over time in a rural community. Secondly, the study illustrates the pervasive long term SEP effects that have confronted former refugees that have settled in South African rural communities.

In Section 2, we outline a conceptual framework that highlights the relationships between rural SEP and a range of socio-economic variables. The next section, namely Section 3, provides details about the dataset from which we drew the variables, and the methodological approaches we use to analyze the data. Section 4 introduces the results and discusses the changing asset status of households and villages over time, as well as the variables that influence these changes. Finally, Section 5 concludes the study and makes some policy recommendations , as well as suggestions for further research.

2. A CONCEPTUAL FRAMEWORK

The Agincourt Health and Socio-Demographic Surveillance Site (HDSS) constitutes a rural sub-district of the Bushbuckridge municipal area that is located in Mpumalanga Province in the northeast of South Africa. The site is bordered by a national park to the east that forms the

national border to Mozambique. In 2007 the site covered 400 square kilometres that included 21 villages with a combined population of 70 000 inhabitants living in over 12 167 households. A third of this population are of Mozambican origin, many of them arriving as refugees in the early to mid-1980s during the civil war (Schatz, 2009). The site has high levels of unemployment and poverty and, because of this, 60% of males and 30% of females engage in some form of migrant labour. It has also been estimated that 60% of households receive child support grants (Collinson, Tollman & Kahn, 2007). Furthermore, life expectancy between 1992 and 2003 decreased by 14 years for males and 12 years for females largely due to an increase in HIV/AIDS as shown by cause of death analysis from verbal autopsy data (Kahn, Garenne, Collinson & Tollman, 2007). Local households are highly dependent on social grants and the death of a breadwinner, in particular the household head, is a major shock that can negatively influence SEP (Hargraeves et al., 2004; Schatz & Ogunmefun, 2007; Hunter, Twine & Patterson, 2007; Goudge et al., 2009a; 2009b). Furthermore, the area is semi-arid scrubland and, thus, not suited to agriculture though adequate for game farming and low-density cattle-rearing (Tollman, Herbst & Garenne, 1995; Collinson et al., 2002). Finally, annual rainfall is generally low (550-700 mm), falling mostly during the summer months of November to March and thus insufficient for irrigation and domestic needs (Hunter, Twine & Patterson, 2007).

2.1. Rural socio economic position (SEP)

Household wealth or socio economic position (SEP) has been assumed to incorporate some measures of physical and social resources, as well as the household status in a local social hierarchy (Howe, Hargraeaves & Huttly, 2008). Whilst SEP is often described in terms of income per capita at the national level, local understandings might be very different. At household level, for instance, the poverty threshold could include a household's access to food,

the ability to do minor house repairs, the ability to pay off debt or to wear different clothing outside the family house (Sen, 2003; Krishna, 2006). Various studies have tested variables that influence SEP including access to infrastructure, services, facilities, institutions, household demographics, literacy issues, asset status and education. Further variables tested include access to water, electricity, health status, access to social grants, credit and a diverse range of economic and agro-ecological variables (Reardon et al., 2000; Barrett et al., 2000; Barrett, Reardon & Webb, 2001; Sen, 2003; Kydd et al., 2004; Machethe, 2004; Bryceson, 2004; Schwarze& Zeller, 2005; Anriquez & Valdes, 2006; Malmberg & Tegenu, 2007; Wouterse & Pieterse, 2008; Lay, Mahmoud & M'Mukaria, 2008; IIYama et al, 2008; Vermeulen, Nawir & Mayers, 2008; Xing et al., 2008; Kanagawa & Nakata, 2008; Goudge et al., 2009a:2009b). Natural disasters, health problems and social expenses have also been cited as having a major influence on rural SEP patterns. In particular, the death of household adults, especially the household head, has a negative impact on the SEP of the family (Urassa et al., 2001; Sen, 2003; Hosegood et al., 2004; Krishna, 2006). Finally, particular ethnic identification has been cited as associated with rural poverty as a result of group specific historical legacies that promote low levels of initial asset endowments (Krishna, 2006).

Chayanov (1986) explains that rural households are likely to experience different levels of wealth over time as the family producer/consumer ratio changes. Wealth status is an ongoing dynamic process that results in better access to resources that, in turn, accelerate asset acquisition rates (Krishna, 2006). In particular, family size and its related dependency ratio, influence asset accumulation and long term SEP although initial asset status has also been described as pivotal (Malberg & Tegenu, 2007; Sherbinin et al., 2008). High return activities, that promote faster rates of asset accumulation, normally require some barrier of entry like finances or skills.

Conversely, low return activities, like part-time local wage labor and petty trading, may be easier to access but have a more limited impact on asset accumulation rates (Sen, 2003; Elmquist & Olsson, 2006; Krishna, 2006; Mendola, 2008).

2.2. The dynamics of social economic position (SEP) at household level

Sen (2003) and Krishna (2006) question the standard interpretation of national poverty statistics by describing four possible categories of rural wealth status. These groups include "always poor" (poor then poor now) and "descending into poverty" (not poor, then poor now). These households have also been classified as highly vulnerable or vulnerable depending on their ability to cope with a crisis. The other two groups are "never poor" and "ascending out of poverty" (poor then, not poor now). In this regard, the change in SEP can be calculated by estimating the aggregated difference between the number of households that ascend out of poverty from those that descend into poverty during a given time period (Sen, 2003; Goudge et al., 2009a; 2009b). The changes in socio economic position (SEP), illustrated in Figure 1, are largely driven by the activities of the household which, in turn, are a function of household variables.

Figure 1: The dynamics of socio economic position (SEP) (about here)

Push- led asset accumulation

Poorer (more vulnerable) households, including households that have recently descended into poverty, are often characterized by a large family size and unemployed dependents. These households are also often compromised by low initial asset status, as well as low levels of education, skills, social status and access to institutions. Poorer families also have less access to permanent employment and are more likely to engage in casual labor and low return migrant options (Sen, 2003, Krishna, 2006). Poorer households are also more vulnerable to natural

disasters like drought and flooding, the death of income generating adults and the effects of chronic illness (Sen, 2003; Hargraeves et al., 2004; Krishna, 2006; Schatz & Ogunmefun, 2007; Goudge et al., 2009a; 2009b).

Poorer rural households are often forced (pushed) into economic activities in order to survive and these type of strategies are normally associated by a lack of assets or a very slow pace of asset accumulation (Sen, 2003; Krishna, 2006). They simply do not have sufficient assets (savings-collateral) to offset the impact of their adverse conditions (Lay et al., 2008; Wouterse & Taylor, 2008; IIYama et al, 2008). The push to diversify could be influenced by the diminishing returns of family labor, a reaction to crises like the death of the household head, a reaction to climatic conditions and as a way to reduce high costs. In particular, families can be pushed into survival mode because of the increased number of dependents in the household that place a strain on the use of limited resources (Urassa et al., 2001; Hosegood et al., 2004; Elmquist & Olsson, 2006; Malmberg & Tegenu, 2007). Other push factors could include insecure property rights, limited labor availability and a lack of access to credit (Barrett et al., 2001 ; Kydd et al., 2004; Wouterse & Pieterse, 2008; Lay et al., 2008). Push led strategies are more likely to rely on complementary coping strategies, like the sale of limited household assets, that often result in a reduction of SEP (Giannechini et al., 2007). There is some debate as to whether the poor diversify less or more. On the one hand they may diversify less because they are unable to fund high return options whilst on the other hand they may diversify more because they are forced into other activities by a lack of land/assets in combination with high dependency rates (Barrett et al., 2001; Mertz, Wadley & Christensen, 2005; Wouterse & Taylor, 2008). Finally, poorer families are also more vulnerable to shocks like the death of a working adult or

the cost of chronic illness because of a reduced ability to access social networks (Goudge et al., 2009a; 2009b).

Pull- or opportunity-led asset accumulation

Wealthier or ascending rural households (secure) are generally faster accumulators of assets, better diversifiers and their income portfolio includes a strong investment in non farm activities. In this regard, more productive households are often characterized by smaller families with higher numbers of employed family members and a lower dependency ratio. In addition, wealthier families have better access to natural resources that are more likely to be exploited by adopting new technologies (Sen, 2003; Goudge et al., 2009a; 2009b). Krishna (2006) cites the ability to invest in non farm business opportunities as the most important reason for ascent out of poverty. More affluent households are also able to invest in more lucrative activities like migrant remittances, transport, construction, trading and shop keeping. Wealthier families, moreover, are also more likely to exploit high return migration opportunities as a basis to fund other household activities and investments. (Sen, 2003; Elmquist & Olsson, 2006; Mendola, 2008; Goudge et al., 2009a; 2009b).

The strategies of more affluent rural households, especially with respect to wealth creation opportunities, are different from poorer households. In this regard, the more affluent own assets that they can invest in other higher return activities. In a sense, the ownership of assets creates an incentive (pulls households) to invest in high return opportunities that involve a barrier of entry like financial resources, specific skills, access to credit, working capital and education (Sen, 2003; Krishna, 2006; Lay et al., 2008). Furthermore, wealthier families are more likely to rely on principal coping strategies, like a regular income, to fund high return investments (Giannecchini,Twine &Vogel , 2007). These households are also better able to

select high return migrant options because of being better educated, being able to afford considerable travel and set up expenses (Barrett et al., 2001; Kydd et al., 2004; Wouterse & Pieterse, 2008; Lay et al., 2008; IIYama et al, 2008) and because of better access to social networks, local institutions and credit (Goudge et al., 2009a; 2009b). Finally, it has been observed that opportunity or pull led diversification seems to exacerbate rural income inequality in the sense that the 'rich get richer' whilst the poor are excluded (Lay et al., 2008).

3. DATA

The data used in this study came from the Agincourt Health and Demographic Surveillance Site (HDSS) that was established in 1992. Household censuses and vital events updates are conducted each year. Household socio-economic position (SEP) has been determined by an asset survey conducted every two years between 2001 and 2007. A GIS system exists for all households within the site that is updated each year. We used a household level panel data structure for the years 2001, 2003, 2005 and 2007. The assets used to construct the wealth indices included a fridge, stove, TV, video machine, satellite dish, radio, phones (fixed or cellular), car, motorbike, bicycle, cart, and toilet facility type (modern, VIP or pit versus none). Further assets included water supply type (tap versus well, pond, river, dam or rainwater tank), main cooking power or fuel (electricity, gas, paraffin versus wood or other) and the main power for lighting (electricity, battery/generator, solar power or paraffin versus candles or other). Finally the assets surveyed included the number of household rooms, the modern components to house structure (floor, walls or roof), as well as the number of livestock (cattle, poultry, pigs and goats). In this regard, livestock have been regarded as an important asset in rural households in order to obtain credit, as a form of insurance, to raise cash and for food security purposes

(Jabbar, Ehui, & Von Kaufmann, 2002; Berzborn, 2007). No data were available on the presence of domestic servants and insufficient data were available regarding agricultural land ownership.

4. METHODS

This section outlines the method used to analyze the variables, dynamics and trends that influence the socio economic position (SEP) of a rural community. In particular, SEP was determined by using an absolute asset count (ACA), as well as a multiple correspondence (MCA) index. An ACA index was only used to develop the spatial temporal maps because this approach simplified the interpretation of the results. An MCA index was used for the remainder of issues examined because it was more appropriate for a measure of SEP using categorical data. Finally, a measure of absolute poverty was introduced to highlight SEP inequality over time.

4.1. Description of household demographics and asset status

Firstly, we calculated various summary statistics in order to describe and track household demographics for the period 2001 to 2007. These household level characteristics by panel year included mean age, structure (individual <18 and 18+), nationality, distance to various infrastructures and overall death rates per 10 000 person years. We then constructed a detailed breakdown of household assets per year to illustrate the type of assets owned, as well as the rate of change of asset accumulation. The detailed frequencies of household demographics, as well as assets owned not only provided us with a basis to calculated an asset based wealth index but also allowed us to provide a more intimate description of the socio economic position (SEP) of rural inhabitants.

4.2. Spatial-temporal trends in wealth status at village level

An absolute asset count (ACA) was used for the spatial maps as they are more comparable over time and the interpretation and comparison of MCA scores would have been more difficult. It should be noted, however, that the analysis using an MCA score produced very similar spatial-temporal distributions. An absolute asset count (ACA) was used to assess spatial temporal trends because it is considered a reliable proxy for SEP (Howe et al., 2008). We used Simulation Based Bayesian Kriging (Gelfand, Ravishanker & Ecker, 1999) to produce smoothed maps of the predicted asset counts at numerous prediction points (regular grid) within the site for each of the panel years (WinBUGS software). The advantage of using a Bayesian approach is that it allows one to predict at unsampled locations to generate estimates throughout the site. A baseline Poisson model was used that included no covariates except a constant and spatial (village level) random effect modeled as a parametric function of distance between pairs of village centroids (Diggle, Tawn & Moyeed, 1998).

4.3. Measuring the absolute poverty line

An absolute poverty line was used to estimate the number of households and households within villages falling below this critical threshold. We assessed the percentage of households below the absolute poverty line by village, as well as by nationality to ascertain if the changes were spatially orientated over the period 2001 to 2007. In particular, we did this to ascertain if there was an ethnicity factor influencing SEP because of the former Mozambican refugee status of a third of the households that have been disadvantaged relative to South African households. The absolute poverty line in our study was based on the assets selected in a study of poverty change in seven Sub-Saharan countries (Booysen et al., 2008). They defined the absolute poverty line as having a minimal set of assets or conditions required for an adequate standard of living.

These assets included ownership of a radio and bicycle, a cement floor in the house, as well as access to public water and a pit latrine.

4.4. The construction of asset based wealth indexes

A number of asset based SEP indexes were initially developed in order to develop a suitable dependent variable that could be tested against a series of predictor variables influencing socio economic position for the period 2001 to 2007. The assets used to develop the index concurred with a number of other studies conducted by the World Bank in 2000 (Gwatkin et al., 2000; Howe et al in 2008). These assets included a balance of purchased household assets, housing quality, water and sanitation. We believe the additional data regarding livestock ownership contributes to the construction of a more reliable wealth index. The use of household assets (wealth indices) to determine socio economic position has been adopted by a number of studies (Gwatkin, et al., 2000; Sahn & Stifel, 2003). In this regard, household asset status is a reliable proxy for long term consumption expenditure (Booysen et al., 2008). Furthermore, measures of income and consumption expenditure are difficult and costly to obtain in a rural setting and measures of income can vary widely from season to season (Howe et al., 2008). SEP indices were constructed using an Absolute Asset Count (ACA), Principal Components Analysis (PCA) and Multiple Correspondence Analysis (MCA). The weights used for both the PCA and MCA indices were those from the first dimension. Previous studies in Agincourt HDSS have only used the ACA and PCA indices but we felt that an MCA index was more suited to the data because of its categorical nature.

4.5. Assessing the asset based wealth indices

Measurements of agreement are of great importance for assessing the acceptability of a new process. The three indices were compared with each other for misclassification of

households between quintiles of indices. Kappa statistics (measure of reliability based on the agreement expected on the basis of chance) were calculated to assess the agreement of classification between indices. Kappa is a preferred statistic to estimate agreement for nominal or ordinal scale data (in our case the variables are ordinal SEP indices). A Kappa statistic of one indicates perfect agreement and a value of zero indicates no agreement. In general, a Kappa statistic of less than 0.5 indicates poor agreement. Misclassification between quintiles was used as the measure of agreement since most epidemiological studies using a wealth index will use quintiles of the index in their analyses (Howe et al., 2008).

The relationship between the methods, illustrated in Tables 1, indicates a fairly robust Kappa of 0.699 between the MCA and PCA index and a less convincing relationship with an ACA index. In this regard, 73.50% of MCA index were in the same quintile as the PCA index while only 62.94% of MCA index were in the same quintile as the ACA index. For those where there was disagreement, virtually all were only one quintile shift (26.41% for MCA versus PCA and 35.23% for MCA versus ACA).

A decision must be made about which weights to assign to each indicator variable when constructing a wealth index. Using an equal weights approach (e.g. ACA), although simple, may be too arbitrary and simplistic, since different assets are unlikely to have equal meaning in terms of SEP. It is for this reason that the MCA quintile index was selected for use in the final univariate and multivariate analysis, since it is it more appropriate for the analysis of the categorical data commonly collected on most assets (Howe et al, 2008). Moreover, a PCA index was designed for use with continuous variables while MCA makes fewer assumptions about the underlying distributions of the indicator variables and is more suitable with categorical or discrete data like those in our study (Howe et al., 2008). The direction of poverty trends can also

sometimes be different when using a PCA versus an MCA based asset index (Booysen et al., 2008). The most important difference, however, is that PCA requires linear constraints (i.e. assumption that the distance between categories are the same and ordered) whereas MCA imposes fewer such constraints (Blasius and Greenacre, 2006). It should be noted that all the asset indicator variables tracked at the Agincourt field site are categorical which, as mentioned above, reinforces the use of MCA.

Table 1: Percentage of households in the same quintile and Kappa statistics of agreement between pairs of indices (about here)

4.6. Testing an MCA based wealth index for variables influencing SEP

This paper attempts to contribute to a better understanding of the factors influencing SEP and persistent poverty in the study site In order to achieve this objective, an MCA based wealth index was tested against a wide range of explanatory variables that influence SEP. Explanatory variables used in the univariate and multivariate analysis included year, household head demographics (age at panel year, gender, nationality, death), household factors (duration or years existed : number of individuals in household 18+ or <18, hospital admissions in a given panel year, the migrant ratio; in preceding year: number of working individuals, number of deaths; cumulative up to given panel year: total number of household deaths, education years of household occupants and household child grants received), ownership or access to and usage of farming land, elevation (rainfall proxy) and minimum distance of household to main road. The definition of migration discriminates between permanent and temporary to reflect a high dependency on temporary labour migration in this population (Collinson, Tollman and Kahn, 2007). We use temporary migration in the household migrant ratio because this has been shown in earlier studies to be the most crucial type for socio-economic status (Collinson, et al., 2006).

A preliminary univariate ordinal regression analysis (clustered on household level) was carried out using Stata to assess the relationship between the wealth quintile and each covariate. Covariates significant at the 10% level (and without substantial missing values) were then incorporated into the multivariate model. Common exposures may influence SEP similarly in households of the same geographical area, introducing spatial correlation in outcomes. Repeated data are also expected to be correlated in time. Standard statistical methods assume independence of outcome measures and ignoring this correlation introduces bias in the analysis (underestimation of the standard errors of the explanatory variables and thus overestimates their significance). Analyzing these data using Bayesian geostatistical models circumvents these problems. A multivariate multilevel random effects ordinal model (Hedeker & Gibbons, 1994) was fitted in WinBUGS to examine the association between the significant covariates and household SES category. The spatial random effect was at the village level to take into account spatial correlation. Temporal random effects were also used at yearly intervals to account for temporal correlation. Village specific random effects were modelled via a multivariate Gaussian process with covariance matrix expressed as a parametric function of distance between pairs of village centroid points (Diggle et al., 1998). A non-informative gamma prior for phi (ϕ) and a uniform prior distributed between ϕ_{min} and ϕ_{max} were tested for best fit (Gelfand & Vounatsou, 2003). A standard Bayesian autoregressive (AR[1]) approach defined by Schotman was used to model the temporal random effect that included an unstructured level random effect (Schotman, 1994). Finally, Markov chain Monte Carlo simulation was used to estimate the model parameters (Gelfand & Smith, 1990).

4.7. Data management and analysis software

A Stata macro for MCA was used (Econpapers, 2009). Data extraction and management was done using Microsoft SQL Server 2005. Finally, data analysis was carried out in STATA 10.0 and WinBUGS. MapInfo Professional 9.5 was used to display the risk maps.

5. RESULTS AND DISCUSSION

The results outline the change in household demographics and SEP for the period 2001 to 2007, as well as map the changes in SEP and absolute poverty levels at household and village level for the period. The univariate and multivariate models test the relationship between socio economic position (SEP) and a number of predictor variables showing how a wide range of endogenous and exogenous variables influence a rural community over time. Finally, the results provide a basis to quantify rural poverty at a community level, as well as precipitate a discussion on policy implications that could be considered.

5.1 Changes in household demographics and asset status

The household demographics for an average of 11 975 households, illustrated in Table 2, were evaluated between the period 2001 and 2007. The majority of households are male headed (~60%) and the average age of household heads increased by 9% to show a marginally higher age compared to other studies (Hunter et al., 2007). The percentage of settled, former Mozambican refugees has remained relatively constant at 30%. Despite a slight increase in the number of households, the average household size has declined by 8% due to a decrease in household members less than 18 years of age. In this regard, there has been a 50% increase in the death rate and a survey of 290 households by Twine and Hunter (2008) indicated that 37.5% of households had experienced an HIV/AIDS related death in the previous two years. Other studies confirm an HIV infection rate of 34.8% in Mpumalanga (Goudge et al., 2009a; 2009b).

Furthermore, the management of illness in the province has been compromised by poor health care service delivery, poor secondary roads, high transport costs and an inability by poorer households to access primary care facilities, as well as hospitals (DSP, 2006; Goudge et al, 2009a; 2009b).

Table 2: Household demographics (about here)

The results indicate the asset status (SEP) of a majority of households (villages) has improved significantly by between 35-50% in the period 2001 to 2007. The increase in overall asset status, illustrated in Table 3, is supported by a considerable increase in high cost items like fridges, stoves, TV sets, video machines and cell phones that are complimented by sizeable increases in the asset value of their houses. In this regard, the results indicate an increased household access to electricity for lighting (35%) and cooking (129%).

The results appear to be supported by a baseline study conducted by the Department of Social Development that indicates that the poverty status of the Bushbuckridge municipal area is the third best across 14 other similar rural municipalities across South Africa. This is principally due to comparatively lower levels of informal housing, functional illiteracy, over crowding and higher levels of electrification and regular income (DSP, 2006). Despite an increase in certain assets, the results indicate that the livestock holdings of the average household of cattle, poultry, pigs and goats has declined except for an increase in households owning more than 40 head of livestock. This is confirmed by other studies that show that livestock ownership (particularly cattle) declined sharply after periods of excessive drought. Furthermore, many households now hire oxen in order to plough their fields (Giannecchini et al., 2007; Hunter et al., 2007).

Table 3: Asset Status-Number (percent) of households in possession of item (about here)

The results contradict the opinions of numerous other studies in the same area that have assumed high, unchanged levels of poverty and unemployment in the Agincourt site (Schatz & Ogunmefun, 2007; Goudge et al., 2009a; 2009b). However, certain studies of the site concede that they may not have captured increased levels of household participation in the informal sector (Hargreaves et al., 2004; Bhorat & Kanbur, 2006; Giannecchini et al., 2007; Schatz & Ogunmefun, 2007; Goudge et al, 2009a; 2009b). In conclusion, it was noted that many households continue to lack electricity, water and toilet facilities. These households, at best, have access to water at a single outlet situated in their street or even village. Many households, moreover, indicated they used the surrounding bush for their toilet facilities. Clearly, for this category of rural inhabitant measures of GDP per capita mean very little in terms of their assessment of poverty status. Their definition of poverty is much more likely to regard the poverty threshold as access to the most basic of facilities confirming the local definitions of poverty adopted by other studies (Sen, 2003; Krishna, 2006; Schatz & Ogunmefun, 2007; Goudge et al., 2009a; 2009b).

5.2 The changing nature of SEP: A spatial-temporal analysis

A smoothed map of the mean predicted number of assets (SEP), illustrated in Figure 2, was developed for each asset survey conducted between 2001 and 2007. These maps for the AHDSS site were based on a baseline model without covariates using the Absolute Asset Count (ACA). The spatial temporal maps clearly indicate significantly different levels of asset ownership across the 21 villages (especially between 2001 and 2005).

The sequence of maps clearly also illustrates an increase in SEP of between 30% and 50% for a majority of the 21 villages. In this regard, the mean number of assets increased from

6.613 in 2001 to 8.23 in 2007 and the range from the baseline models (distance at which spatial correlation ceases) was estimated to be approximately 2642.5 meters (95% CI: 1782-5310.5).

The changing nature of SEP is illustrated by a reduction in the number of very poor villages (lighter colored areas). Furthermore, villages with a higher proportion of former Mozambicans are situated in the eastern part of the site bordering the Kruger National Park. In particular, the maps indicate a cluster of six very poor former refugee based Mozambican based villages in 2001 (largely located in the South East) that reduce to two in 2007 with a further two marginal villages. The maps suggest significant and differential changes in SEP, as well as illustrate the dynamic patterns of household and village wealth over time (Chayanov, 1986; Krishna, 2006).

Figure 2: The mean predicted number of assets: 2001-2007 (about here)

5.3 Absolute poverty levels by village and ethnic make-up

Further analysis of the data indicates six villages had absolute poverty levels of more than 50% in 2001 and only two in 2007. All but one of these six villages had a concentration of Mozambican inhabitants of over 90% illustrating the disadvantaged status of this ethnic group and the pervasive long-term implications of disadvantaged initial asset status (Williamson, 2000; Malberg & Tegenu, 2007; Sherbinin et al., 2008). It is interesting to note the villages with a very high Mozambican content (>50%) also indicated a lag factor that was maintained throughout the period 2001 to 2007 supporting claims of the disadvantaged status of these households. Despite an overall improvement in SEP, Mozambican former refugee households are twice as likely to fall under the absolute poverty line, than South African households. Villages 18 and 19, in particular, retain chronically high levels of poverty in 2007.

Table 4: Households below the absolute poverty line by village (about here)

Additional evidence, illustrated in Table 5, suggests that former refugee Mozambican based households retained twice the level of poverty of their South African counterparts further confirming the disadvantaged status of Mozambican households in general (Hargreaves et al., 2004; Goudge et al., 2009a; 2009b).

Table 5: Households below the absolute poverty line by nationality and village (about here)

5.4 Variables influencing social economic position (SEP)

The univariate results, illustrated in Table 6, indicated a number of highly significant relationships between SEP, based on an MCA index, and a range of predictor variables that were then included for further analysis in the multivariate analysis.

Table 6: Variables influencing SEP (about here)

The univariate results indicate a significant positive relationship between SEP and time, the gender of the household head, the duration of the household, the number of family members over 18 years of age, the number of hospital admissions and the migrant ratio. Conversely, the results indicate a significant negative relationship with the ethnicity of the household head, as well as the number of child grants received and the death of the household head. Other significant relationships included the age of the household head, the elevation of the household, the number of family members less than 18 years, household deaths, the level of education and the distance to the main road. Interestingly, the number of household deaths in the preceding (or given year) did not appear to influence SEP, indicating perhaps, that the family member concerned had not contributed to household income for some time. To some degree these results contradict the fact that ill health and/or the cost funerals are often cited as a major cause of household shocks (Urassa et al., 2001; Sen, 2003; Hosegood et al., 2004; Krishna, 2006).

Interestingly, a highly significant positive relationship emerged between access to land and SEP illustrating the importance of agricultural based strategies and household wealth in a rural society (Kydd et al., 2004). These findings disagree with the assumptions of other studies that indicate the diminishing importance of farmland as a basis to improve SEP (Bryceson, 2002a; Giannecchini et al., 2007), however, our ability to interpret the results was compromised because of the limited data in this regard.

The univariate results also indicated that the receipt of childhood grants had a significant negative relationship with socio-economic position (SEP). In this regard, it is estimated that 66.67% of all grants received were for child support possibly suggesting that mostly poorer households access child grants and that there are higher levels of dependent family members that do not contribute to household income and aggravate household dependency ratios (DSP, 2006; Gainnecchine et al., 2007; Hunter et al., 2007; Malberg & Tegenu, 2007; Sherbinin et al., 2008). Finally, child support grants in South Africa are very small in comparison to other government grants (pensions) and probably have a limited ability to stimulate asset acquisition.

The multivariate results, illustrated in Table 7, indicate a significant positive relationship between SEP and time that has been demonstrated in the increase in asset status between 2001 and 2007, as well as a reduction in households below the absolute poverty line. The province's electrification program, in particular appears to have promoted the acquisition of appliances, as well as the asset value of homes confirming the progress claimed in a government scorecard (DSP, 2006). A highly positive significant relationship also was demonstrated between male headed households and SEP illustrating the improved status of male headed households in a traditional rural African society that is characterized by patriarchal structures. These advantages often include elevated social status and better access to communal resources and social networks.

The status of the household head also appears to improve with age further underling the characteristics of many collectivist African societies (Thomas & Bendixen, 2000; Hofstede, 2001; Dimba & K'Obonyo, 2007; Luiz 2007).

The results also indicate a highly positive significant ratio between the number of temporary migrants per family (the migrant ratio) and SEP, which supports the findings of other studies. In this regard, other research in the site indicates that 60% of males and 30% of females attempt to secure income by way of migrant activities. The importance of remittances is especially enhanced if local employment opportunities are limited and unemployment rates are high (Schatz & Ogunmefun, 2007; Goudge et al., 2009a; 2009b). The results also support the importance of migrant remittances in many Africa countries (Barrett et al., 2001; Kydd et al., 2004; Wouterse & Pieterse, 2008; Lay et al., 2008; IIYama et al, 2008). The duration (age) of the household from initiation also has a significant positive effect on SEP indicating that older households have higher levels of status and had better access to resources. In this regard, older households are likely to have had better access to natural resources confirming the importance of initial asset status, as well as more established networks in local communities (Sen, 2003; Krishna, 2006; Goudge et al., 2009a; 2009b). Furthermore, a significant positive relationship between SEP and the number of family members over 18 suggests family members in this age group are more likely to contribute towards the generation of household income and, therefore, reduce the dependency ratio (Sen, 2003; Malberg & Tegenu, 2007; Sherbinin et al., 2008). A lesser positive effect is also reported for family members less than 18 years who are, therefore, also presumed to be engaged in household activities at an early age. These results contradict the findings of Sen (2003) which indicate wealthier rural households tend to have smaller families. However, this assertion is based on an assumption that larger families are compromised by more

wholly dependent family members including infants and the very elderly. In South Africa, the elderly often contribute positively to household SEP as a result of the receipt of a government pension (Goudge et al., 2009a; 2009b).

Table 7: Multivariate multilevel random effects ordinal regression analysis (about here)

The multivariate results also suggest that households headed by a Mozambican and/or that have a high Mozambican content have had the impact of significantly reducing wealth. In this regard, ethnicity has been cited as a reason for a rural poverty as a result of group specific historical legacies that promote low levels of initial asset endowments (Krishna, 2006). Their disadvantaged situation has been attributed to their refugee status and lack of assets on arrival in South Africa (Malmberg & Tegenu, 2007; Sherbinin et al., 2008) that has been further compromised by being located in poorer agro-ecological conditions, as well as by problems of accessing the necessary documentation to access facilities like state based grants, education, medical care and formal employment. Mozambican based households, moreover, are further away from health services and have poorer access to water and sanitation, labor markets, legal rights and government services (Hargreaves et al., 2004; Kahn 2006; Twine, Collinson & Polzer, 2007; Schatz, 2009). Finally, Mozambican émigrés were also allocated less land than local residents and arrived with no cattle, two key variables thought to influence rural household livelihood strategies (Twine et al., 2007; Giannecchini et al., 2007; Millar & Photakoun, 2008).

The results underline the negative significance of the death of the household head. In particular, the effect of HIV/AIDS has had a devastating effect on the relevant households underlining the important linkages between disease and a reduction in SEP (Urassa et al., 2001; Sen, 2003; Hosegood et al., 2004; Krishna, 2006; DSP, 2006; Hunter et al., 2007). In this regard, the Bushbuckridge municipality scored poorly with respect to the provision of health services

emphasizing the close relationship between poverty and health status (DSP, 2006; Goudge et al., 2009a; 2009b). Conversely, the univariate results indicate a strong positive relationship between the number of admissions and SEP possibly indicating that only wealthier households with higher levels of education and awareness have the resources to pay for healthcare services (DSP, 2006).

6. CONCLUSION AND RECOMMENDATIONS

The results of the study provide an interesting study of the rate of change of socio economic position (SEP) over an extended time period, as well as illustrate the complex nature of poverty at a local level where households can move in and out of poverty compared to the aggregated trends that are prepared at a national level. In particular, the results contradict the (implicit) assumptions of a number of other studies in the same site that suggest a static level of SEP has been maintained due to high levels of population density and unemployment. In this regard, the results suggest SEP can be accelerated by the provision of services like electricity that appear to have contributed towards the acquisition of high cost household appliances. Further studies in the same site are needed, however, to assess exactly how these assets were funded and the reasons behind their purchase at a particular time.

The results illustrate how the dynamic nature of SEP can be reflected with the use of spatial temporal modeling techniques. We used an ACA approach in this regards for ease of interpretation, however, there are limitations associated with this approach as no relative weighting is applied to various assets as was mentioned earlier. However comparing this ACA analysis with an MCA based asset index yielded similar spatial patterns. The predicted socio economic position of households at 21 village centroids starkly underlines differential rates of

asset acquisition over the period. The use of longitudinal/panel datasets, moreover, illustrates how the effects of government policy can be evaluated. In particular, the use of simulation based Bayesian Kriging is advocated for illustrating the temporal and spatial elements of rural poverty and this technique can be usefully employed by government planning offices to pinpoint rural intervention programs. The disparate nature of local poverty at household level was highlighted by the pervasive long term effect of historical legacies. In particular, the disadvantaged situation of Mozambican households is illustrated by the fact that they are still twice as likely to fall below the absolute poverty line despite having settled in the area as far back as the 1980s and many of these households continue to have no toilet facilities or access to water.

The results underline the multiplicity of variables influencing social economic position (SEP). In particular, the results indicate how a modified multiple correspondence analysis (MCA) index can be a useful indicator of SEP/ consumption expenditure in a rural context. We believe, that the important status of cattle in rural Africa, moreover, justifies its inclusion in the MCA wealth index The results also highlight the realities of rural life in Sub Saharan Africa by reporting significant relationships between SEP and the gender/death of the household head, as well as the reliance of households on remittances.

In particular, the strong positive relationship between SEP and male headed households could be used to augment policy to target the development of female headed households.

The realities of rural life are further emphasized by the highly negative relationship between SEP and former refugee Mozambican household heads. The usefulness of the results is that they quantify the reality of their disadvantaged status and this data can be used as a basis to develop more suitable policy for this category of household. Further policy amendment could also considered with respect to the efficacy of child support grants. Currently, the receipt of child

support grants appears to be accessed by poorer families that are not able to use this resource for wealth creation purposes. Somewhat disappointingly, the relationship between access to land and SEP was not developed in the multivariate model due to insufficient observations. This relationship needs to be studied further as the univariate results indicated a highly positive relationship that contradicts the assumption that agriculture led development will play an increasingly insignificant role in rural development programs.

The results underline the critical role of government to address issues like education, improved healthcare services and nutrition in order to alleviate poverty. In addition, the need for government to facilitate the provision of roads, energy, social protection measures and employment schemes, is emphasized (Sen, 2003; Xing et al., 2008). In particular, the development of roads is a key requisite for successful electrification and water provision. Furthermore, the capital costs of electricity-water provision at household level may need to be supported by government in order to assist rural populations overcome the initial investment costs (Kanagawa & Nakata, 2008). Finally, it is evident that multiple routes need to be explored to alleviate poverty and different groups of households need different exit plans (Sen, 2003; Krishna, 2006; Xing et al., 2008)

Much further research is needed in rural South Africa and the SADC region. This should include additional asset surveys in rural South Africa, as well as its neighboring countries in order to better understand the variables influencing poverty.

References

Anriquez, G. & Valdes, A. (2006). Determinants of farm revenue in Pakistan, *Pakistan Development Review*, 45(2): 281-301.

Barrett, C.B., Bezuneh, M., Clay, D.C. & Reardon, T. (2000). Heterogenous constraints, incentives and income diversification strategies in rural Africa.

Barrett, C.B., Reardon, T. & Webb, P. (2001). Non-farm income diversification and household livelihood strategies in rural Africa: Concepts, dynamics and policy implications. *Food Policy,* 26(4): 315-331.

Berzborn, S. (2007). The household economy of pastoralists and wage laborers in the Richtersveld, South Africa. *Journal of Arid Development*, 70(4): 672-685.

Bhorat, H. & Khanbur, S.M.R. (2006). Poverty and policy in post apartheid South Africa, HSRC Press, Cape Town, South Africa.

Binswanger, H. (2004). Empowering rural people for their own development, Farewell lecture from the World Bank, November 30.

Blasius, J., & Greenacre, M. (2006). Correspondence analysis and related methods in practice. In M. Greenacre, & J. Blasius (Eds.), Multiple correspondence analysis and related methods (pp. 3–40). London: Chapman & Hall.

Booysen, F., Van Der Berg, S., Burger, R., Von Maltitz, M. & Du Rand, G. (2008). Using an asset index to assess trends in poverty in seven Sub-Saharan African countries. *World Development*, 36(6): 1113-1130.

Bryceson, D. F. (2002a) Multiplex of livelihoods in rural Africa: Recasting the terms and conditions of gainful employment, *Journal of Modern African Economics,* 40 (1): 1-28.

Bryceson, D. F. (2002b) The scramble in Africa: re-orientating rural livelihoods. *World Development* 30(5): 725-739.

Bryceson, D. F. (2004). Agrarian vista or vortex: African rural livelihood policies, *Review of African Political Economy,* 31(102): 617-629.

Business Day. (2008). Land reform failure rate may be 50%. www.businessday.co.za/aerticles posted on 19 February 2008.

Chayanov, A.V. (1986). *On the theory of peasant economy*. Madison: The University of Wisconsin Press.

Collinson, M.A., Mokoena, O., Mgiba, N., Kahn, K., Tollman, S.M., Garenne, M., Shackleton, S. 2002. Agincourt Demographic Surveillance System (Agincourt DSS).in: Sankoh et al (eds). "Population and Health in Developing Countries. Volume 1: Population Health and Survival at INDEPTH sites". INDEPTH Series Volume 1, Part C. IDRC, Ottawa, Canada. Pp.197 – 206. ISBN: 0-88936-948-8

Collinson, M.A., Tollman, S.M., Kahn, K., Clark, S.J., Garenne, M. 2006. Highly prevalent circular migration: households, mobility and economic status in rural South Africa. In: Tienda, M., Findley S.E., Tollman, S.M., Preston-Whyte, E. (eds) 'African on the Move: Migration in Comparative Perspective'. Wits University Press, Johannesburg. Pp. 194 – 216. ISBN 1-86814-432-1.

Collinson, M.A., Tollman, S.M. & Kahn, K. (2007). Migration, settlement change and health in post apartheid South Africa: triangulating health and demographic surveillance with national census data. *Scandinavian Journal of Public Health*, 35 (Suppl. 69): 77-84.

Department of Social Development (DSP). (2006). A nodal baseline survey:

Bushbuckridge results. www.sarpn.org.za/documents.
Diggle P, Tawn J, Moyeed R. (1998). Model-based geostatistics. *Appl Stat.* 47: 299-350.
Dimba, B. & K'Obongo, P. (2007). Influence of culture on strategic human resource management (SHRM) practices in multinational companies (MNC) in Kenya: A critical literature review, A working paper, College of Humanities and Social Sciences, University of Nairobi, Kenya, 19 pages.
Elmquist, B. & Olsson, L. (2006). Livelihood diversification: continuity and change in the Sahel, *GeoJournal,* 67: 167-180.
Gelfand A. & Vounatsou, P. (2003). Proper multivariate conditional autoregressive models for spatial data analysis. *Biostat*., 4:11-25.
Gelfand A. & Smith, A. (1990). Sampling-based approaches to calculating marginal densities, *J Am Stat Association*, 85: 398-409
Gelfand, A. & Ravishanker, N & Ecker, M. (1999). Modeling and inference for point-referenced binary spatial data, In: Generalized Linear Models: A Bayesian Perspective, Dey D., Ghosh S., Mallick B., eds. Marcel Dekker Inc. 373–386.
Giannecchini, M. Twine, W. & Vogel, C. (2007). Land-cover change and human environment interactions in a rural cultural landscape in South Africa. *The Geographical Journal*, 173(1): 26-42.
Goudge, J., Russell, S., Gilson, L., Molyneaux, C. & Hanson, K. (2009a). Household experiences of ill health and risk protection mechanisms, *Journal of International Development*, 21(2): 159-168.
Goudge J., Gilson, L., Russell, S., Gumede, T. & Mills, A. (2009b). The household costs of health care in rural South Africa with free primary care and hospital exemptions for the poor, *Tropical Medicine and International Health*, 14(4): 458-467.
Gwatkin D, Rutstein S, Johnson K, Suliman E, Wagstaff A, & Amouzou A. (2000). Socio-economic differences in health, nutrition and population: Malawi 1992, 2000. HNP/Poverty Thematic Group of the World Bank.
Hargraeves, J., Collinson, M.A., Kahn, K., Clark, S.J. & Tollman, S. (2004). Childhood mortality among former Mozambican refugees and their hosts in rural South Africa, *International Journal of Epidemiology,* 33: 1271-1278.
Hedeker, D. & Gibbons, D. (1994). A random-effects ordinal regression model for multilevel analysis. *Biometrics*, 50: 933-944.
Hofstede, G. 2001. Culture's consequences: Comparing values, behaviors, institutions, and aspirations across nations (2nd edition), Sage, Thousand Oaks.
Hosegood, V., McGrath, N., Herbst, K. & Timaeus, I.M. (2004). The impact of adult mortality on household dissolution and migration in rural South Africa. *Aids,* 18(11): 1585-90.
Howe, L. Hargreaves, J. & Huttly, S. (2008). Issues in the construction of wealth indices for the measurement of socio-economic position in low-income countries. *Emerging Themes in Epidemiology*, 5:3.
Hunter, L.M., Twine, W. & Patterson, L. (2007). "locusts are now our beef": Adult mortality and household dietary use of local environmental resources in rural South Africa. *Scandinavian Journal of Public Health,* 35(suppl. 69): 165-174.
IIYama, M., Kariuki, P., Kristjansen, P., Kaitibie, S. & Maitima, J. (2008). Livelihood diversification strategies and soil management strategies: A case study from Kerio Valley, Kenya, *Journal of International Development,* 20: 380-397.

Jabbar, M.A., Ehui, S.K. & Von Kaufmann, R. (2002). Supply and demand for livestock credit in Sub-Saharan Africa: Lessons for designing new credit schemes. *World Development*, 30(6): 1029-1042.

Kahn K. (2006). *Dying to make a fresh start: mortality and health transition in a new South Africa* [dissertation]. Umeå University, Faculty of Medicine, Public Health and Clinical Medicine.

Kanagawa, M. & Nakata, T. (2008). *Energy Policy,* 36: 2016-2029.

Kariuki, S.M. (2004). Creating the black commercial farmers in South Africa, ASC Working Paper 56/2004, Department of Sociology, School of Social Sciences, University of the Witwatersrand, Johannesburg, South Africa.

Krishna, A. (2006). Pathways out of and into poverty in 36 villages of Andhra Pradesh, India, *World Development*, 34(2): 271-288.

Kydd, J., Dorward, A., Morrison, J. & Cadisch, G. (2004). Agricultural development and pro-poor economic growth in sub-Saharan Africa, *Oxford Development Studies,*32(1): 37-57.

Lay, J., Mahmoud, T.O. & M'Mukaria, G.M. (2008). Few opportunities, much desperation: The dichotomy of non-agricultural activities and inequality in Western Kenya, *World Development,* 36(12): 2713-2732.

Luiz, J. 2007. *Challenges and Prospects for economic and business development in Africa*, in Managing Business in Africa, editor J. Luiz, Oxford University Press, ISBN 0 19 576276 2.

Machethe, C.L. (2004). Agriculture and poverty in South Africa: Can agriculture reduce poverty. Paper presented at the Overcoming Underdevelopment Conference held in Pretoria, 28-29 October 2004.

Malmberg, B. & Tegenu, T. (2007). Population pressure and dynamics of household livelihoods in an Ethiopian Village: an elaboration of the Boserup-Chayanovian framework, *Population Environment,* 29: 39-67.

Mendola, M. (2008). Migration and technological change in rural households: complements or substitutes?, *Journal of Development Economics,* 85: 150-175.

Mertz, O., Wadley, R.L. & Christensen, A.E. (2005). Local land use strategies in a globalizing world: Subsistence farming, cash crops and income diversification, *Agricultural Systems,* 85(3): 209-215.

Millar, J. & Photakoun V. (2008). Livestock development and poverty alleviation: revolution or evolution for upland livelihoods in Lao PDR? *International Journal of Economic Sustainability*, 6(1): 89-102.

Reardon, T., Taylor, J.E., Stamoulis, K., Lanjouw, P. & Balisacan, A. (2000). Effects of non farm employment on rural inequality in developing countries: An investment perspective. *Journal of Agricultural Economics*, 51: 266-288.

Sahn, D. & Stifel., D. (2003). Exploring alternative measures of welfare in the absence of expenditure data, *Review of Income and Wealth*, 49(4): 463-489.

Schatz, E. & Ogunmefun, C. (2007). Caring and contributing: The role of older women in multi generational households in the HIV/Aids era, *World Development,* 35(8): 1390-1403.

Schatz, E. (2009). Reframing vulnerability: Mozambican refugees access to state funded pensions in rural South Africa, *Journal of Cross Cultural Gerontology*, 24(3): 241-258.

Schotman P. (1994). Priors for the AR (1) model: parameterization issues and time series considerations. *Econometric Theory*, 10: 579-595.

Schwarze, S. & Zeller, M. (2005). Income diversification of rural households in Central Sulawesi, Indonesia, *Quarterly Journal of International Agriculture,* 44(1): 61-73.
Sen, B. (2003). Drivers of escape and descent: Changing household fortunes in rural Bangladesh, *World Development*, 31(3):513-534.
Sherbinin, A., Van Wey, L.K., McSweeny, K., Aggarwal, R., Barbieri, A., Henry, S., Hunter, L.M., Twine, W. & Walker, R. (2008). Rural household demographics, livelihoods and the environment, *Global Environmental Change,* 18: 38-53.
Thomas, A., & Bendixen, M. (2000), 'The management implications of ethnicity in South Africa', *Journal of International Business Studies*, 31(3): 507-519.
Tollman, S.M., Herbst K, Garenne M. (1995). The Agincourt Demographic and Health Study: Phase 1. Johannesburg: Health Systems Development Unit, Department of Community Health, University of the Witwatersrand.
Twine R., Collinson, M, & Polzer, T. (2007). Evaluating access to a child-oriented poverty alleviation intervention in rural South Africa. Scand J Public Health. 69: 118-27.
Urassa, M., Boerma, J.T., Isingo, R., Ngalulu, J., Ng'weshemi, J., Mwaluko, G. & Zaba, B. (2001). The impact of HIV/AIDS on mortality and household mobility in rural Tanzania. *Aids,* 15(15): 2017-2023.
Williamson, O.E. 2000. The new institutional economics: taking stock, looking ahead. *Journal of Economic Literature*. Vol XXXVII (September 2000): 595-613.
Wouterse, F. & Pieterse, J.E. (2008). Migration and income diversification: Evidence from Burkina Faso. *World Development,* 36(4): 625-640.
Vermeulen, S., Nawir, A.A. & Mayers, J. (2008). Rural poverty reduction through business partnerships? Examples of experience from the forestry sector, *Environ Dev Sustain,* 10: 1-18.
Xing, L., Shenggen, F., Xiaopeng, L. & Zhang, X. (2008), Community poverty and inequality in Western China: A tale of three villages in Guizhou Province, *China Economic Review* (2008), doi: 10/1016/j.chieco.2008.10.006.

Figure 1: The dynamics of socio economic position (SEP)

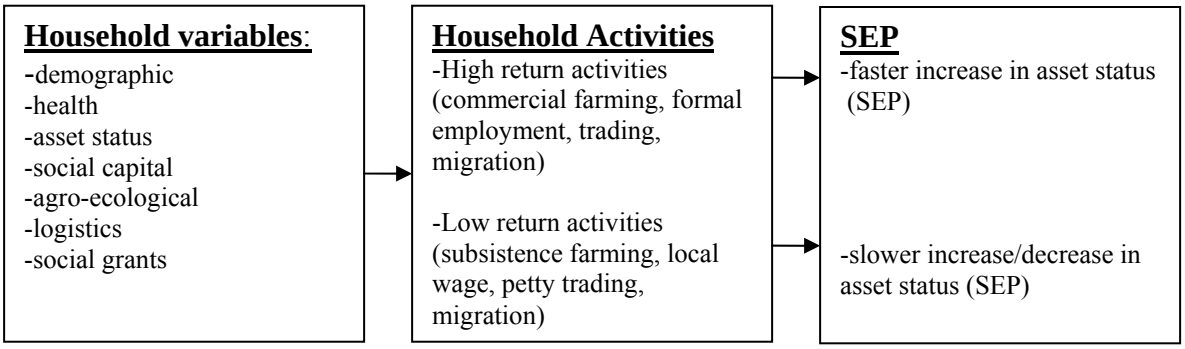

Figure 2: The mean predicted number of assets: 2001-2007 (Note: village centroids depicted by circles)

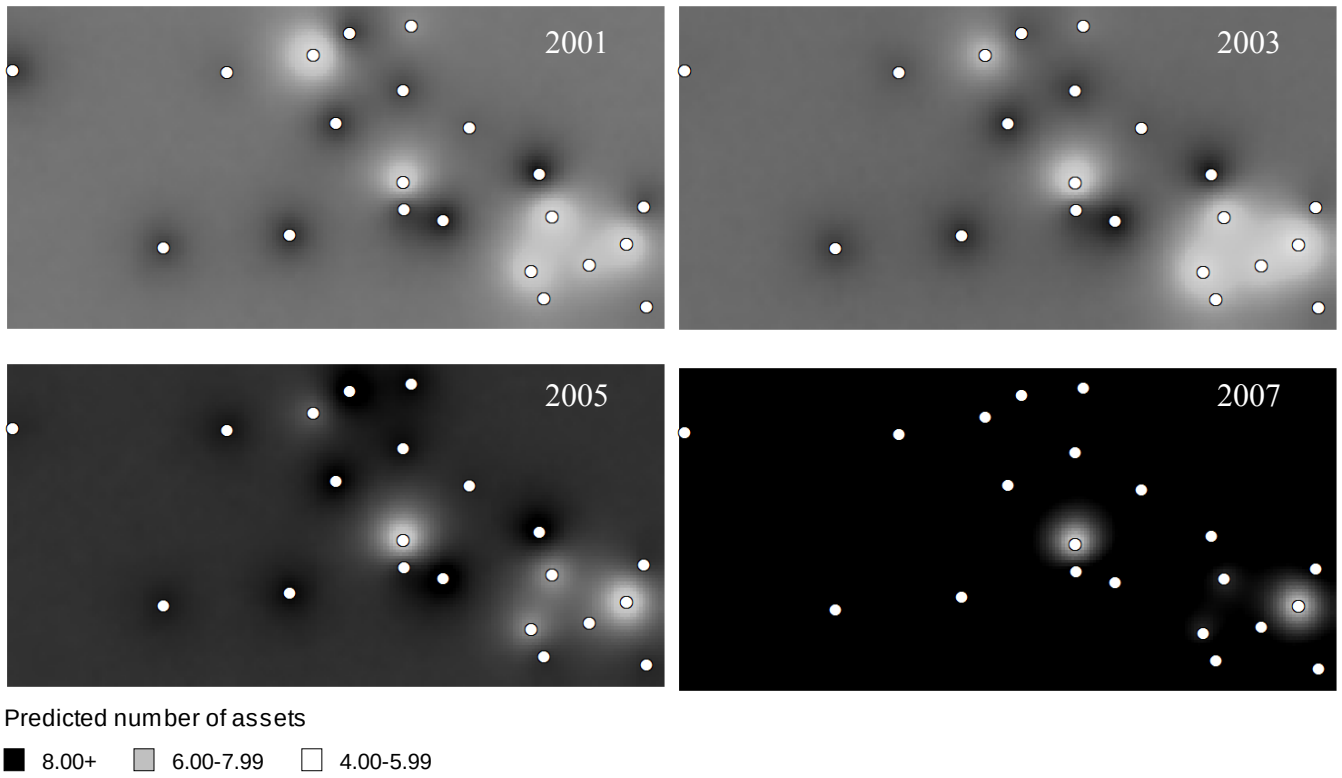

Table 1: Percentage of households in the same quintile and Kappa statistics of agreement between pairs of indices

Wealth Index	Absolute asset count	PCA	MCA
Absolute asset count	---	---	---
PCA	62.61%; κ=0.533*	---	---
MCA	62.94%; κ=0.537*	73.50%; κ=0.669*	---

*p < 0.001

Table 2: Household demographics

Factor	**2001**	**2003**	**2005**	**2007**	**Overall**
Households	11,822	11,727	12,183	12,167	47,899
Average age (std. dev.)	46.94 (15.27)	48.24 (15.28)	49.50 (15.39)	51.07 (15.48)	48.96 (15.43)
Male household head (%)	7270 (61.51)	7199 (61.44)	7425 (61.11)	7389 (60.98)	29283 (61.26)
Mozambican origin (%)	3521 (29.79)	3497 (29.85)	3645 (30.00)	3652 (30.14)	14315 (29.95)
Distance to local clinic#	3.06 (2.23)	3.03 (2.23)	3.03 (2.24)	3.04 (2.23)	3.04 (2.23)
Distance to hospital#	22.66 (5.57)	22.64 (5.63)	22.59 (5.65)	22.61 (5.65)	22.62 (5.63)
Distance to main road*	12.59 (4.11)	12.54 (4.08)	12.50 (4.07)	12.51 (4.08)	12.53 (4.09)
Average household size (std. dev.)[i]	6.61 (4.25)	6.47 (4.14)	6.32 (3.94)	6.08 (3.72)	6.37 (4.02)
Avg. household size <18	3.22	3.07	2.92	2.68	2.97
Avg. household size 18+	3.39	3.40	3.41	3.39	3.40
Deaths (rate per 10,000 person years)[ii]	493 (70.3)	791 (112.6)	815 (115.4)	816 (115.2)	2915 (103.4)

i Significant decreasing trend in household count (β = -0.006, p<0.001) between 1992-2007
ii Significant increasing trend for deaths (β = 0.087, p<0.001) between 1992-2007
*Euclidian distance # network estimate

Table 3: Asset Status-Number (percent) of households in possession of item

Factor	2001	2003	2005	2007	Overall
Ave number of assets (std. dev.)[iii]	7.19 (2.85)	7.13 (2.79)	7.80 (2.63)	8.55 (2.66)	7.67 (2.79)
Asset totals (%)					
Fridge	4,454 (41.46)	5,115 (46.07)	6,498 (58.24)	7,768 (67.85)	23,835 (53.62)
Stove	4,312 (40.14)	4,556 (41.04)	5,869 (52.62)	7,544 (65.89)	22,281 (50.13)
TV	5,834 (54.31)	6,164 (55.54)	6,711 (60.17)	7,334 (64.09)	26,043 (58.60)
Video machine	647 (6.03)	819 (7.38)	1,340 (12.02)	4,441 (38.84)	7,247 (16.32)
Satellite dish	27 (0.25)	29 (0.26)	59 (0.53)	203 (1.78)	318 (0.72)
Radio	4,482 (41.73)	2,828 (25.50)	2,714 (24.36)	2,643 (23.12)	12,667 (28.52)
Fixed phone	362 (3.37)	231 (2.08)	186 (1.67)	290 (2.54)	1,069 (2.41)
Cellular phone	4,002 (37.26)	5,788 (52.18)	8,439 (75.69)	9,687 (84.57)	27,916 (62.82)
Car	1,578 (14.70)	1,517 (13.66)	1,669 (14.96)	1,779 (15.53)	6,543 (14.72)
Motorbike	72 (0.67)	36 (0.32)	41 (0.37)	76 (0.66)	225 (0.51)
Bicycle	1,458 (13.58)	1,163 (10.48)	1,144 (10.26)	972 (8.49)	4,737 (10.66)
Cart	363 (3.38)	272 (2.45)	219 (1.96)	223 (1.95)	1,077 (2.42)
Ave number of rooms (std. dev.)	2.77 (1.58)	2.65 (1.33)	2.75 (1.37)	2.71 (1.42)	2.72 (1.43)
Power (lighting)					
Electricity	7623 (70.96)	8434 (75.95)	9952 (89.18)	10272 (87.56)	36281 (81.09)
Battery/Generator	8 (0.07)	11 (0.1)	17 (0.15)	15 (0.13)	51 (0.11)
Solar Power	7 (0.07)	9 (0.08)	3 (0.03)	121 (1.03)	140 (0.31)
Paraffin	1071 (9.97)	744 (6.7)	286 (2.56)	265 (2.26)	2366 (5.29)
Power (cooking)					
Electricity	1591 (14.81)	2064 (18.59)	2292 (20.54)	3650 (31.11)	9597 (21.45)
Gas Bottle	253 (2.36)	206 (1.86)	250 (2.24)	169 (1.44)	878 (1.96)
Paraffin	605 (5.63)	536 (4.83)	472 (4.23)	184 (1.57)	1797 (4.02)
Toilet facility type					
Modern	22 (0.2)	18 (0.16)	28 (0.25)	32 (0.27)	100 (0.22)
VIP	100 (0.93)	56 (0.5)	254 (2.28)	424 (3.61)	834 (1.86)
Pit Toilet	6564 (61.1)	6779 (61.05)	7326 (65.65)	8042 (68.55)	28711 (64.17)
Water availability					
Always	1077 (10.03)	1205 (10.85)	1596 (14.3)	1262 (10.76)	5140 (11.49)
Most of the time	4603 (42.85)	2428 (21.87)	3472 (31.11)	3735 (31.84)	14238 (31.82)
Few hours a day	490 (4.56)	369 (3.32)	801 (7.18)	911 (7.77)	2571 (5.75)
Water supply					
Tap in house	82 (0.76)	58 (0.52)	67 (0.6)	69 (0.59)	276 (0.62)
Tap in yard	1770 (16.48)	980 (8.83)	1719 (15.4)	2462 (20.99)	6931 (15.49)
Tap in street	7121 (66.29)	8494 (76.49)	9005 (80.69)	8699 (74.15)	33319 (74.47)
Livestock					
Cattle	1677 (15.6)	1443 (13.0)	1427 (12.8)	1393 (12.1)	5940 (13.4)
Poultry	6892 (64.2)	6200 (55.9)	4568 (41.0)	4543 (39.6)	22203 (50.0)
Pigs	472 (4.4)	300 (2.7)	299 (2.7)	262 (2.3)	1333 (3.0)
Goats	1396 (13.0)	1153 (10.4)	1134 (10.2)	1089 (9.5)	4772 (10.7)
Main dwelling still under construction	1665 (15.5)	1963 (17.68)	2340 (20.97)	2068 (17.63)	8036 (17.96)
Plans to extend main dwelling	340 (3.16)	165 (1.49)	159 (1.42)	727 (6.2)	1391 (3.11)

iii Significant increasing trend for number of assets ($\beta = 0.03$, $p<0.001$) between 2001-2007

Table 4: Households below the absolute poverty line by village

Village	Number of Households [i]	Mozambican (%) [i]	2001 (%)	2003 (%)	2005 (%)	2007 (%)
1	1347	16.3%	33.9	32.7	25.1	17.6
2	605	20.0%	35.8	29.2	21.1	21.7
3	1172	15.9%	40.4	28.8	27.3	17.7
4	684	8.9%	38.3	25.7	26.4	17.8
5	622	28.0%	31.5	37.2	31.2	21.3
6	723	25.3%	30.7	32.4	22.9	23.6
7	438	40.2%	42.5	39.8	32.0	28.0
8	1138	47.7%	28.8	31.0	31.6	25.3
9	933	12.0%	28.4	23.7	21.2	17.6
10	896	48.5%	30.5	27.8	27.2	17.9
11	1253	31.5%	21.7	25.9	15.5	15.0
12	463	77.1%	57.2	60.7	32.0	25.1
13	658	10.9%	33.8	30.3	23.0	19.4
14	404	4.0%	42.9	35.5	27.2	21.4
15	608	38.8%	39.3	52.1	33.4	21.7
16	857	5.5%	38.4	35.7	30.2	25.7
17	468	97.6%	65.0	68.7	41.8	37.7
18	242	95.0%	88.6	80.0	82.9	81.4
19	262	96.6%	55.2	66.0	74.1	76.4
20	218	81.7%	56.0	63.3	50.4	35.7
21	703	7.3%	74.6	52.1	39.4	28.9

i: based on estimates for 2001-2007

Table 5: Households below the absolute poverty line by nationality and village

Factor	Category	2001	2003	2005	2007
Mozambican	poor HH	1,481	1,704	1,343	1,260
	total HH	3,041	3,240	3,208	3,520
	% HHs	48.70%	52.59%	41.86%	35.80%
	95% CI	46.92 – 50.48%	50.87 – 54.31%	40.16 - 43.57%	34.21 - 37.38%
South African	poor HH	2,470	2,201	1,807	1,404
	total HH	7,694	7,851	7,928	8,153
	% HHs	32.10%	28.03%	22.79%	17.22%
	95% CI	31.06 – 33.15%	27.04 - 29.03%	21.87 - 23.72%	16.40 - 18.04%

Table 6: Variables influencing SEP

Factor	Odds ratio	P value	95% CI
Year			
2001	Reference		
2003	1.05	<0.001	1.02 - 1.08
2005	1.15	<0.001	1.12 - 1.19
2007	1.27	<0.001	1.22 - 1.31
Household head age	1.01	<0.001	1.003-1.007
Male household head	1.52	<0.001	1.44-1.60
Mozambican head	0.26	<0.001	0.25-0.28
In migrated post 1993 (small sample, n=38)	0.58	0.210	0.25-1.36
In migrated pre 1993	0.26	<0.001	0.25-0.28
% Mozambican content of household	0.24	<0.001	0.22-0.25
Duration of existence of household (years)	1.12	<0.001	1.11-1.13
Elevation of household (m) – rainfall proxy	1.002	<0.001	1.002-1.003
Elevation of household (m) – rainfall proxy (controlling Mozambican status of household head)	0.998	<0.001	0.998-0.999
Number of individuals in household 18+	1.23	<0.001	1.22-1.25
Number of individuals in household <18	1.07	<0.001	1.06-1.09
Number of working individuals in preceding year	1.48	<0.001	1.44-1.52
Proportion of household that are migrants	1.76	<0.001	1.56-1.99
Household head death in given year	0.63	<0.001	0.50-0.80
Household deaths in given year	1.01	0.856	0.94-1.08
Household deaths in preceding year	1.02	0.493	0.96-1.10
Cumulative household deaths to given year	1.02	0.177	0.99-1.06
Number of household hospital admissions	1.11	0.001	1.04-1.18
Number of education years in household	1.01	<0.001	1.006-1.011
Min. network distance to main road	1.04	<0.001	1.03-1.04
Ownership or access to and usage of farming land	2.07	<0.001	1.89-2.26
Number of child grants received	0.83	<0.001	0.76-0.90
Number of child grants received in previous year	0.87	0.004	0.80-0.96

i: Poisson regression of absolute number of assets (ACA) versus a household death in a given year yields a significant result (IRR=0.97; p=0.002).

Table 7: Multivariate multilevel random effects (household, village and yearly level) ordinal (MCA quintile) regression analysis using WinBUGS

Factor	Odds ratio	95% CI	Significant [i]
Year	1.55	1.45-1.65	*
Household head age	0.99	0.983 - 0.989	*
Male household head	2.38	2.17 - 2.61	*
Mozambican head	0.12	0.10 - 0.13	*
Duration of household	1.16	1.15 - 1.18	*
Household head death in given year	0.72	0.52 - 0.99	*
Number of individuals in household 18+	1.21	1.19 - 1.24	*
Number of individuals in household <18	1.09	1.08 - 1.11	*
Proportion of household that are migrants	1.53	1.34-1.75	*

* at 5% level