RESEARCH ARTICLE

Agrarian Change and Adaptive Capacity in Rural South Africa

Sam Schramski* and Grenville Barnes†

Abstract: This article explores how agrarian change and the current prevalence of non-agrarian livelihoods in rural South Africa might be assessed using the concept of adaptive capacity. Agrarian change is often characterised as "de-agrarianisation" or "de-peasantisation," which implies a wholesale change in the composition of agricultural areas. While some of the research on southern Africa regards these processes as linear, other studies argue that the dynamics are hybridised: large-scale agriculture is being increasingly abandoned, while smallholder agriculture remains intact or becomes even more robust. We argue that a complex non-linear deactivation process is taking place, leading to less agricultural activity and a reduction in the levels of agricultural production. Adaptive capacity and agrarian change are not necessarily related, and households' livelihoods and health status may continuously evolve without being adversely affected by an alteration in their use of resources, particularly natural resources. Using a mixed methodological framework, including social network analysis and qualitative interviews, the article highlights the importance of considering rural people's responses to global environmental change, and how their agrarian contexts may not align perfectly with discourses surrounding adaptive capacity.

Keywords: Climate change adaptation, rural livelihoods, South Africa, social network analysis.

Introduction

J. M. Coetzee, in his analysis of South African farm novels, raised the question, "What should the rural order be?" (Coetzee 1986) Given the continuous social-ecological changes taking place in South Africa, that question is even more relevant today. This is not an accidental association: much of the contemporary work exploring climate change and the human dimensions thereof uses the concept of adaptive

* Center for the Analysis of Social-Ecological Landscapes (CASEL), Indiana University, sschrams@indiana.edu
† Geomatics, School of Forest Resources and Conservation (SFRC), University of Florida, gbarnes@ufl.edu

capacity to understand agrarian change (Yohe and Tol 2002; Smit and Wandel 2006; Smith and Olesen 2010).

Research on agrarian change has also focused on forms of vulnerability and adaptation in the context of climate change (Ehlert 2012). The social dimensions of climate vulnerability have been a field of inquiry for many years (e.g. Bohle, Downing, and Watts 1994; Ribot 1995), and that of climate change adaptation even longer (e.g. Butzer 1980; Warrick and Riebsame 1983). As the United Nations Framework Convention on Climate Change (UNFCCC) defines the terms (2010), vulnerability is the "degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes," and adaptation is the "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities." Our research sits at the intersection of the literature on agrarian change and climate vulnerability, with a specific focus on communities in rural South Africa.

We measure adaptive capacity as a direct function of a household's diversity of livelihood activities and its health in terms of prevalence of disease. We then explore how households demonstrate adaptive capacity in relation to environmental change through varying reliance upon natural resources and linkages with other households. More specifically, we address the following questions:

1. What is the nature of agrarian change that has taken place?
2. Do households that are less reliant on natural resources have less adaptive capacity?
3. Do households that rely on more extensive external exchange networks exhibit less adaptive capacity?

The first question asks if the agrarian changes that have occurred in southern Africa are in line with de-agrarianising and de-peasantising trends. The second question addresses an essential theme in the literature on adaptive capacity, that is, whether households that demonstrate land-based livelihoods possess less adaptive capacity. The third question refers to households which may have to rely heavily on external support, and the implications of such external reliance for adaptation.

Climate change adaptation is now a central area of focus in development theory and praxis in the global South, but the way it has been interpreted and utilised has increasingly become a source of debate (Inderberg *et al.* 2015). An adaptive capacity approach has been applied to a number of fields, but most recently to a body of work on social-ecological resilience (SER) and climate change adaptation (CCA), or community-based adaptation (CBA), as it is often configured in the global South. These two areas of focus are adapted from the fields of social-ecological systems science and livelihoods analysis, respectively. Their lineages are very different and

as a result, upon first glance, they appear conceptually divergent. While their lineages differ, however, the word "adaptive" in this context derives from research on adaptation to global environmental change, which has been explored in the environmental social sciences since at least Butzer (1980), and before that in fields ranging from business to psychology (Bowden 1947; Heron and Hunter 1922). At its most basic level of definition, adaptive capacity is the capacity of a system to adapt if the original environment of the system changes. At this level it does not exclusively focus on vulnerabilities, as is the case in much of the research that highlights the intersection of climate and livelihood change (Bohle *et al.* 1994; N. Adger 1999; Füssel and Klein 2006). We investigate the relationship of adaptive capacity to agrarian change, which to our knowledge has not been undertaken, and analyse whether households differ in their adaptive capacities.

The Intergovernmental Panel on Climate Change (IPCC) refers to adaptive capacity as the

> ability or potential of a system to respond successfully to climate variability and change, and includes adjustments in both behaviour and in resources and technologies (Parry *et al.* 2007).

The authors of *Panarchy*, one of the foundational texts used in resilience thinking, regard adaptive capacity as

> the ability to confront uncertainty and develop an understanding of what contributes to loss . . . as well as development of actions that are structured for learning and allow for the generation of novelty (Holling *et al.* 2002).

Drawing on these definitions, we modify the definition of adaptive capacity to be the potential of households to respond to the uncertainty caused by climate change and variability. We examine whether households differ in their adaptive capacities and the extent of agrarian change in the rural Eastern Cape of South Africa. For this reason, and because of the large body of literature on livelihoods and natural resources in the area (Cousins 1999; Charlie M. Shackleton *et al.* 2001; Cocks and Wiersum 2003; C. M. Shackleton and Shackleton 2004), we focus on livelihood diversity, natural resource reliance, household health, social networks, and perceptions of environmental change in order to understand adaptive capacity and de-agrarianising trends.

De-agrarianisation in its simplest formulation describes the process of moving a social unit or community from an agrarian mode of existence towards a non-agrarian mode. This is explained in greater detail below.

Smallholder agriculture may be an important conduit for increasing adaptive capacity, but how can adaptive capacity be increased when agricultural livelihoods are minimally evident in many parts of rural South Africa? Do rural, superficially

"agrarian" households and communities that are dependent on social grants have lower adaptive capacity in the face of global environmental change? We argue that the majority of households in the study area have low household-level adaptive capacity, both in the systems and livelihood sense of the term, as demonstrated by an analysis of livelihood strategies and exchange networks, contextualised through oral histories and ethnographies.

Within the African context, adaptive capacity has been the subject of research and discussion at least since the publication of the Second Assessment Report of the IPCC in 1995. As Hulme (1994) noted,

> Whether technological innovation will enable the adaptive capacity of ecosystems and societies to develop at a rate commensurate with climate change and population growth is a key question for all world regions.

The project of assessing Africa's adaptive capacity is difficult, however, because the continent presents some of the most varied cultural and environmental features in the world, climate included. More recently, the adaptive capacity of Africa was linked to food security issues, water resources stress, and an increase in communicable diseases, especially in arid regions like southern Africa. In reference to vulnerability, Parry *et al.* (2007) also point out that the continent is vulnerable because of the interactions of multiple stressors, and that agricultural adaptations of African farmers may be insufficient to address future changes.

If South Africa represents the growth trajectory and level of development that many other African nations aspire to, as noted in polling and steady migration into the country (IOM 2009; Polzer Ngwato 2010; Statistics South Africa 2012), it is all the more important to explore South Africa's adaptive capacity. The country has taken steps that many in the government perceive as being adaptive, especially the creation of the 2008 National Sustainable Development Framework and a National Climate Change Response Policy (Joemat-Pettersson 2012). These policies emphasise innovations in what has been termed "climate smart" agriculture, and even the piloting of water markets (Callaway *et al.* 2009). Nevertheless, because the country has more developed infrastructure, higher rates of foreign direct investment, and a healthy participation in global trade, it may be concluded that South Africa does not suffer from the same types of environmental concerns as other nations. But this would be to ignore the inequality, levels of poverty, and ultimately climate vulnerability with which the majority in the country have to cope.

Our study areas were located in the poorest province in the Republic. Its rural areas have a socio-economic profile similar to other countries in sub-Saharan Africa (Makiwane and Chimere Dan 2011). The Willowvale villages, for instance, are located in a local municipality (Mbashe) that is widely considered to be South Africa's worst managed and poorly serviced (Municipal IQ 2013) municipality. The

communities of Willowvale district and Baviaanskloof of the Eastern Cape are both commonly regarded as agrarian, but we argue here that this characterisation is questionable. By investigating adaptive capacity we also call into question the nature of agrarian change and changes to agrarian livelihoods taking place throughout the region (Hebinck and Lent 2007).

Description of the Study Areas and Sampled Population

We selected two study areas in the rural Eastern Cape province, which is one of the country's most rural and also, by most measures, poorest regions. The areas of Willowvale (Muncu and Tokwe villages) and Baviaanskloof (Sewefontein and Zaaimanshoek villages) (Figure 1) are inhabited by the very poor of South Africa.

While our initial focus was on the amaXhosa villages in Willowvale, in the eastern part of the Eastern Cape, the study was extended to make it more representative by including study sites on the western side of the province. Both study areas are located in relatively isolated rural corners of the province, have villages of approximately the same area and number of households, are culturally and ethnically homogeneous within the villages, and are relatively close to concentrations of tourist activity. These are selection criteria and not control variables. To measure adaptive capacity, single villages or assemblages of

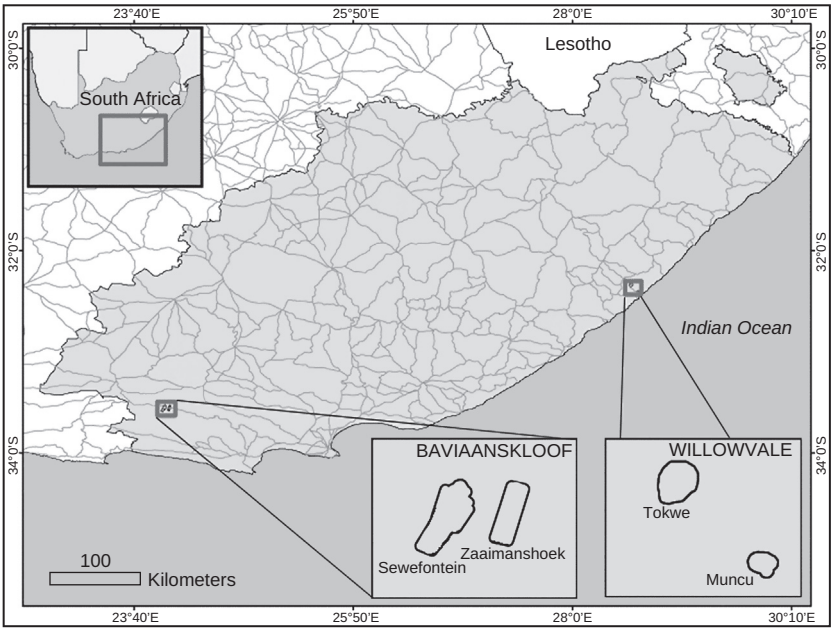

Figure 1 *Map of the study areas in the Eastern Cape province, South Africa*
Note: Data sources include ESRI and the Departments of Geography and Environmental Science at Rhodes University.

households were chosen randomly and both study areas were representative of social-ecological trends occurring across the province and the country.

We use the definition of a household adopted by the South African census bureau, although we recognise that the definition of "household" is a contested one (Bender 1967; Saradamoni 1992; Keilman 1995). Statistics South Africa (Stats SA) defines a household as a place where a person or persons eat together and share resources, and where they normally reside four nights a week at a specific visiting point (Stats SA 2012). Our census in the four villages showed that the number of households ranged from 25 to 42.

Like many rural parts of the former Transkei, Willowvale is uniformly inhabited by the amaXhosa. The two villages of Willowvale exemplify some of the lowest levels of development in the country (Stats SA 2007). Both villages are administratively located in the Mbashe local municipality which lies in Willowvale district, and are contained within the Maputaland–Pondoland–Albany subtropical thicket biome – an internationally recognised biodiversity hotspot (Conservation International 2013). South African conservationists have long identified this biome as key for the provision of ecosystem services and mitigation of the effects of climate change (Forest *et al.* 2007).

The residents of Muncu and Tokwe villages live under a traditional governance system composed of headmen and chiefs of various ranks. The two villages have different headmen but fall under the same *inkosana*, or paramount chief. Land tenure is also customary and, in keeping with traditional practice in many amaXhosa areas, is largely decided at the chief's discretion. Although rural in character, Willowvale today, like many rural districts in the Eastern Cape, is noticeably less agrarian than in the past (Hebinck and Lent 2007). In both village communities together, only 1.5 per cent of households cultivate one or a handful of subsistence or commercial crops (not a single household in Muncu cultivates land outside small home gardens), and the average household has three heads of cattle, a number that would have been much bigger up until the mid-1990s (Beinart 2003). This phenomenon of de-agrarianisation, which, as some have argued, is tied to forms of agrarian change (Bryceson and Jamal 1997) in South Africa, is often attributed to the existence of social grants and the accompanying wider availability of purchased food items since 1994 (Neves and Du Toit 2013). Many households still collect timber and non-timber forest produce (NTFP) from the veld, at the very least for firewood and thatching. In these communities, the household unemployment rate is high (75.4 per cent of households report no employment), and the median household income including government grants ($1,972) is about $9,000 and below South Africa's per capita GDP (World Bank 2015). Both Tokwe and Muncu are located more than 25 kilometres away from markets or other urbanised areas, the connection being via an extremely rugged road. The village communities have been receiving pumped water since 2006, but neither a sewage system nor an electrical grid is available.

The Baviaanskloof is both the name of an administrative local municipality and a physical geographic region (mountain range and canyon). Sewefontein, a land reform farm, and Zaaimanshoek, a village, are located between the Baviaanskloof and the Kouga Mountains, in a valley situated in the centre of a culturally and ecologically rich UNESCO Heritage Mega-Reserve of some 500,000 hectares (UNESCO 2013). Both villages are made up of Coloured (a South African term for persons of mixed race, but in this case predominantly Khoisan heritage; Adhikari 2009) residents, as is the majority of the valley's population. Most land in the area is owned privately by White commercial farmers (Crane 2006). The Coloured population is predominantly employed as seasonal farm workers on these farms (Cocks *et al.* 2007). Both unemployment and chronic poverty are ubiquitous in the Baviaanskloof.

The Baviaanskloof sits at the intersection of seven floristic biomes (Van Eck *et al.* 2010); the most prominent of these is the Cape Floristic Region subtropical thicket biome. Like the Willowvale villages, it too occupies the subtropical thicket biome. In recent years, residents of the Baviaanskloof Valley, urged by conservation scientists and the South African government, have attempted large-scale ecological (Hawn 2005) and potentially geomorphological (Bobbins 2012) restoration focused on the removal of alien invasive plant species and the reshaping of riparian systems. Many of the White farms have become the centrepiece of an ecotourism effort for the valley as a whole, but the majority of the Coloured population is only partially employed in these ventures.

Sewefontein and Zaaimanshoek have differing governance forms: Sewefontein functions as a land redistribution farm of over 25 families with a largely male farm committee administration; Zaaimanshoek, with 42 households, is under the dominion of the United Congregationalist Church (UCC) located in a town an hour-and-a-half away. The Baviaanskloof communities are also rural, but only Sewefontein demonstrates any agricultural output given its status as a redistribution farm. Three percent of the households in both communities cultivate land, and 45 per cent have some livestock. Most households have a garden where they grow some food and medicinal crops. As with Willowvale, de-agrarianisation (Bryceson 1996) may in part help to explain the low level of cultivation; but there is also less land available to cultivate in the Baviaanskloof, especially for Zaaimanshoek, given its dominion under the UCC (Crane 2006). But this has not dampened interest in home garden cultivation and livestock rearing, which have expanded in the Baviaanskloof. Although seasonal farm work is available, many working-age members of households are still unemployed. Sewefontein and Zaaimanshoek are also located far – more than 75 kilometres– from any market or other urbanised area, and connected via a very rugged road. In both communities water is pumped in, and access to electricity and telephones is periodically available; however, half of Sewefontein does not have access to water or electricity.

Over the course of approximately one year of fieldwork, the first author conducted oral interviews, livelihood surveys, and convened participatory workshops with community members from both the Willowvale district and the Baviaanskloof.[1]

What Agrarian Changes Have Occurred?

De-agrarianising Trends

Historically, inquiries into de-agrarianisation processes begin with research on agrarian change and invariably summon foundational writings in peasant studies, including those surrounding the "agrarian question." The agrarian question originated with Karl Kautsky's Marxist analysis of the dynamics of capitalist agriculture (Kautsky 1988). Kautsky's and Marx's are materialist perspectives. In Marx's formulation of agriculture, if small-scale peasant producers combined elements of petty capitalists and labourers, how could agrarian reform be enacted (Hammen 1972)? Kautsky believed that the peasantry would eventually cease to exist due to impoverishment, and as such would be enveloped in the ranks of the proletariat. This reasoning proved to be unsound in world history, but subsequent reappraisal of the agrarian question in rural sociology and geography has been nevertheless sympathetic and remains largely materialist in scope (Akram-Lodhi and Kay 2010a; Akram-Lodhi and Kay 2010b; Goodman and Watts 2013). Bernstein (1996) argues that in the South African context, the rural peasantry has become ever more tied to the whims of the global market, in large part through agreements between the State and global capital, and that the development agenda throughout the country is not always as uniform as is claimed in many cases. This point is consistent with findings in the context of rural livelihoods in southern Africa, precisely because both markets and livelihood options have increasingly become less localised (Scoones and Wolmer 2003).

Smallholder agriculture, from the cultivation of crops to cattle-rearing, is limited in all the study sites. Writing about the former Transkei, Andrew and Fox (2004) argue that much of the activity in Eastern Cape homesteads has taken the form of increased agricultural "extensification." Extensification, a term popularised perhaps most notably by Booth (1985), is a function of output divided by population. Households with large areas that remain fallow or unused altogether may demonstrate extensification if they utilise a greater mix of land-use types (Greiner and Grosskopf 1990). Andrew and Fox (2004) utilise this notion to combat claims of under-cultivation, which implies a lack of agricultural activity altogether. We argue that these observations do not hold for the communities we studied, both in terms of area cultivated and foods derived from these home gardens. Furthermore, agricultural land in the country since 1994 has been reconfigured by land reform,

[1] Written consent from participants was sought in the form of signed consent forms, but consent was obtained orally and recorded in the case of illiterate or functionally illiterate respondents. The University of Florida Institutional Review Board approved this study (IRB: #2011-U-719).

which is an ongoing and highly criticised series of policies given its unequal effects upon smallholders (Cousins 2013).

The processes presented in the study area demonstrate de-agrarianisation, a term Bryceson (1996) coined for the process of decreased income differentiation and decline in agricultural livelihoods combined with lack of self-sufficiency among agrarian households in rural Africa. This is accompanied by de-peasantisation or the diminishing importance of the family as a basis for livelihoods (Ellis and Freeman 2004). De-agrarianising processes can include de-peasantisation if households lose their economic capacity and social coherence, and thus shrink in size (Vanhaute 2012). In the African context, peasants and agrarian exports were necessary for the aims of colonial governments, which, while destructive to indigenous African economic and social life, also established a productive relationship in which Africans did not have full control over their modes of labour.

Sub-Saharan Africa has been a focal geographical region for the analysis of de-agrarianisation and de-peasantisation, including in the works of Deborah Bryceson (Bryceson 1996; Bryceson and Jamal 1997; Bryceson 1999; Bryceson 2002; Bryceson and Fonseca 2006) and Frank Ellis (Ellis 1993; Ellis 1998; Ellis 2000; Ellis and Freeman 2004). The classical view of African rural inhabitants as self-sufficient subsistence farmers still persists in agricultural policy and economics. Off-farm activities have tended to be viewed as secondary or as seasonally carried out by marginal groups such as female heads of households (Bryceson 1996). Interestingly, interventions in the agricultural sector still occupy a favoured position in developmental approaches focused on stimulating growth and alleviating poverty (Diao *et al.* 2007). Yet even as cash-earning activities increase, their role has largely been seen as supplementary rather than substitutive for farm activities in sub-Saharan and especially southern Africa (Bryceson 2009). Sub-Saharan Africa has for decades witnessed a patchy increase or decline – depending on the analysis – in agricultural production per capita; in either case it has not been the fêted success that the Green Revolution arguably brought to other parts of the developing world (Cullather 2004; Fuglie and Rada 2012).

These medial theories of de-agrarianisation and de-peasantisation—that are neither macro or micro—can be linked to studies of rural livelihood diversification which have devised general causal explanations for the lack of diversity observable in a given locality, based on empirical evidence in southern African fieldwork (Ellis 2000; Davis 2005). Researchers have proposed macro-level trends such as population growth, urbanisation, global climatic change, and structural adjustment as causal factors (Dercon and Krishnan 2000; Shackleton *et al.* 2001). Scholars have also pointed to micro-level factors, including the prevalence of HIV/AIDS in the household and the availability of historically exploited species in proximity to the household (Stringer *et al.* 2008; Slater and Wiggins 2009). Proponents of neoliberal economic practice, including the World Bank, do not always concur that diversity is

beneficial. When writing about livelihoods, researchers argue that development necessitates bringing people out of all informal and "meagre" arrangements for the purpose of integration into larger economies (Dani and Moser 2008).

Hebinck and Lent's (1997) study enumerates several reasons why agriculture is no longer widely practised, ranging from the price of hired labour to the lack of mechanisation. But their own conclusions point to a cultural shift influenced by intergenerational differences in aspiration, rather than in the availability of arable land, capital for farm investment, labour assistance, or mechanisation.

One form of rural South African livelihood strategies that may be considered is the acquisition of social grants. The Republic of South Africa operates a far-reaching system of state cash transfers that are targeted towards poverty reduction. Social grants are direct income transfers in the form of grants provided by the Government, and include disability grants, grants for older persons, war veterans' grants, foster-child grants, care dependency grants, child support grants, and grants-in-aid. They are regular and reliable, means-tested, non-contributory, and payable from the general fund (Bhorat *et al.* 2014). Most of these multifarious grants are unconditional, which has in part increased their expansion: roughly a third of all South Africans receive one or more of these benefits (Leibbrandt *et al.* 2016). During the apartheid era, Black and Coloured South Africans were heavily discriminated against in the disbursement of pensions and smaller grant schemes that dated back to 1928; the small amounts that these populations received, especially in rural areas, were a source of increased financial security. Only after 1994, however, was the system extended to include a variety of targeted groups (Bhorat *et al.* 2014), all of which were present in the study area: children under the age of 18, the disabled, and the elderly. While social grants have often been vilified as depressing the labour market in the country (e.g. Karriem and Hoskins 2016), most economists agree that social grants, while often vital to households, are not, at a national level at least, legitimate drivers of unemployment or of reduced interest in work (Leibbrandt *et al.* 2016).

According to conservative estimates, 32 per cent of the country's population relies upon social grants (16,566,948 individual beneficiaries) and an even larger proportion in the Eastern Cape (41 per cent of the population of that province). (Table 1 contains the country-wide and province-wide data). In the Baviaanskloof communities, 90 per cent of households rely on social grants for the majority of their cash income, while in Willowvale this proportion is 82 per cent. The most important form of state assistance is old age pensions (Table 2).

Natural Resources and Livelihoods

A breakdown of livelihoods in the four study villages, given in Table 3, demonstrates that on average, social grants are the predominant livelihood option, followed by

Table 1 *Recipients of social grants in the Republic of South Africa, by province, 2015* in number and per cent.

Province	Population in numbers (2015)	Population in per cent (2015)	Total no. of social grant recipients (2015)	Recipients of social grants as percentage of population (2015)
Gauteng	13,200,300	24	2,307,849	13.9
KwaZulu-Natal	10,919,100	19.9	3,873,371	23.4
Eastern Cape	6,916,200	12.6	2,707,626	16.3
Western Cape	6,200,100	11.3	1,427,270	8.6
Limpopo	5,726,800	10.4	2,304,095	13.9
Mpumalanga	4,283,900	7.8	1,381,849	8.3
North West	3,707,100	6.7	1,165,125	7.0
Free State	2,817,900	5.1	956,335	5.8
Northern Cape	1,185,600	2.2	443,428	2.7

Note: Estimates for 2015 have been arrived at based on actual population figures in the 2011 Census.
Source: Statistics South Africa (statssa.gov.za).

livestock-rearing, and then wild fruit and vegetable harvesting. Collection of non-timber forest produce (NTFP), primarily bush medicine, is the least prevalent. Some features of the livelihood options are determined by differing socio-economic and ecological profiles of the study areas. Muncu and Tokwe have more land and larger garden plots in which to plant and plough. Sewefontein and Zaaimanshoek have greater outside employment. The Baviaanskloof Valley is home to an assortment of White commercial farms that have employed Coloured labourers for more than a hundred years, historically in oppressive conditions.

Table 2 *Number of households that receive primary social grants in Willowvale and Baviaanskloof, Republic of South Africa, by type of grant*

Type of grant	Willowvale	Baviaanskloof
Old Age Grant (OAG)	42	40
War Veteran's Grant (WVG)	12	5
Disability Grant (DG)	19	32
Grant in Aid (GIA)	2	8
Child Support Grant (CSG)	31	27
Foster Child Grant (FCG)	7	2
Care Dependent Grant (CDG)	—	—

Note: N=65 households in Willowvale and 67 households in the Baviaanskloof. Each household can receive more than one type of grant (i.e., grant recipience is not mutually exclusive).

Table 3 *Basic livelihood activities of households in the study area* in per cent

Community/ Village	Cultivation	Wild fruit/ Vegetable harvesting	Livestock rearing	Bush medicine and other NTFPs	Self-employed	Social grants recipients	Employment outside the home
Muncu	23.33	26.67	10	3.33	6.67	80	13.33
Tokwe	14.29	34.29	14.29	2.86	2.86	82.86	5.71
Sewefontein	8	24	56	0	0	92	44
Zaaimanshoek	2.38	19.05	21.43	7.14	14.29	100	35.71

Note: The total number of households in the study area was as follows: Muncu=35, Tokwe=30, Sewefontein=25, Zaaimanshoek=42.

The pattern of livestock-rearing is worth noting: while the Willowvale households, like many amaXhosa households, have reared cattle, goats, and sheep (and to a lesser degree, pigs) for generations, the Baviaanskloof communities have only recently become engaged in livestock-rearing. In Sewefontein this started in 2001, and in Zaaimanshoek it has been carried on illegally for the last 15 years and in the open for the last six years. Finally, the other NTFP category is surprising in that it does not figure prominently in Sewefontein, although it is home to the leading medicine man in the valley. One possible explanation is that this livelihood is available to only one household in Sewefontein (that of the medicine man) and that other households do not participate in NTFP collection. The livelihood survey also revealed that no household in the former Transkei villages of Muncu and Tokwe cultivates land (see Table 6).

Only two (three per cent) households in the Baviaanskloof use both a garden and a field. The field in this case is a community field attached to the reform farm of Sewefontein. The field in the Zaaimanshoek case is a test plot of melons and was not productive at the time of our fieldwork. There is some evidence that households in the former Transkei have extensified their planting patterns by migrating to homestead gardens while abandoning their fields (McAllister 2000; Andrew and Fox 2004; Cousins 2013). If this is true, it is clear from the data that 37 to 40 per cent of households in Muncu

Table 4 *Mean and median size of home gardens in the study area* in sq. m.

Community	Village	Mean	Median
Willowvale	Tokwe	290.05	186
	Muncu	322.54	229
Baviaanskloof	Zaaimanshoek	13.67	11
	Sewefontein	38.14	22

Note: (i) Median and mean sizes are much larger in Willowvale, emphasising the longer history of permitted agriculture there.
(ii) Based on survey data for 132 households.

and Tokwe did not use their home gardens (the time period recalled was "in the last year"), and between 10 to 19 per cent of households did not have a home garden.

McAllister's premise that home gardens have increased in size and vegetation cover is supported by the size of home gardens in the Willowvale villages (McAllister 2000). (See Table 4).

The mean size of home gardens in Willowvale (Tokwe and Muncu combined) is 306 sq. m. By a conservative standard of 10,000 plants per hectare (as estimated by Grains SA 2012), each of these gardens can produce 307 maize cobs. On an average, there are 6.1 persons to a household in Muncu and Tokwe, so each member of a household would be able to consume approximately 50 cobs if split equally over the course of a year. Rarely are home gardens used exclusively for maize (most have large portions left fallow), however, and the methods used for cultivation and harvesting are different enough from commercial farming for even that conservative estimate to be very high.

The rates of livestock ownership are also low in comparison to historical precedents throughout the Eastern Cape and across South Africa (W. Beinart 2003; Feinstein 2005). In Willowvale, where cattle culture is strong, no household reported owning more than five heads of cattle. Even during the most restrictive period of Apartheid and homeland rule, cattle were tied to land and livelihood for the amaXhosa population in Willowvale in a way that never existed for the rural Coloured population in Baviaanskloof. As *plaasmans* (farm dwellers), most rural Coloureds were not permitted to own large numbers of livestock. Nevertheless, within the Baviaanskloof, donkeys and goats are present even if other animals are not. As an elderly man in Zaaimanshoek observed,

> There are more donkeys than people who know how to take care of them. They'll probably take over the Baviaans and fight with the rhino when they enter the reserve! (Interview with household Z16).

Towards an Assessment of Agrarian Change

In an attempt to answer this question, we made use of oral histories, livelihood and focus group data, to investigate de-agrarianisation in the Eastern Cape. For oral histories, we conducted a series of scoping interviews in the larger geographic area of both these sites before the final selection of the four communities mentioned above. Subsequently, we conducted 15 oral history interviews in the Willowvale villages (nine with women, six with men) and 14 in the Baviaanskloof (six women, eight men); all those interviewed were recipients of old age pension, and most were over the age of 65. We then carried out a narrative analysis of these oral histories to examine agrarian change in the study area. Observer impressions and Computer Assisted Qualitative Data Analysis (CAQDA), coding for themes of "agrarian

strategies in transition," "alternative agricultural strategies," "natural resource reliance," and lastly, "a changing climate" as a contextual variable (or code), were noted. Overall, 132 household livelihood surveys were conducted across all four communities. The adults interviewed were randomly selected to reduce the possibility of gender bias, a procedure advanced by Kish (1949).

Perceptions of De-agrarianisation

Our qualitative and quantitative data indicate that agrarian livelihoods and identities have undergone extensive changes throughout the study area. Furthermore, the oral histories reveal the change in agrarian identities across these communities. An example of agricultural strategies in transition was provided by a female interviewee who commented on how the cultivation of African maize (known as *mielies* in South Africa) had transformed since she was a child in the 1950s:

> They were ploughing their gardens and their fields, not like they do now. When they sold the surplus, that's how they would buy the things they couldn't grow or couldn't make themselves. Just as I came from the garden, a man, too, could come from the field. We were all eating *mielies* – all of us, all the time. But now they grow *mielies* and eat all of them in one month! . . . [T]hey grow so little. (ZM)

This excerpt emphasises the perceived importance of *mielies* and the practice of cultivation, albeit in a garden, while at the same time illustrating what was observed and recorded numerous times – a decreased extensification of agricultural activity in all the communities. The oral history of a man in his sixties who has been living on-and-off in Zaaimanshoek since the 1950s referred to both climate change and agricultural strategies in transition:

> When I was young we used to grow *mielies* and sweet potatoes. Back then the soil was bad. But now the soil is much healthier and much more productive. If you are planting vegetables you receive more from your investment than you would before. Much more… honestly, there is less water though… they don't need as much water… and us? We just grow small things in our gardens and on the farmers' land. We are small. (Z11)

While this man pointed out that agricultural strategies were changing, which could in part be a response to political and economic factors, he highlighted soil as an aspect that has improved since his younger years. In other words, not all the responses referred to negative trends.

Responses from Willowvale and Baviaanskloof study areas differ partly because residents of Muncu and Tokwe have engaged in smallholder agriculture for hundreds of years, while in the Baviaanskloof, households only very recently obtained nominal control over their mode of labour. Sewefontein's status as a recent redistribution farm, and the increased presence of donkeys and goats in all Coloured communities in the Baviaanskloof indicate that some agricultural assets are on the rise. Nevertheless, both communities cited fewer agricultural practices in general.

And in some cases their responses were similar despite differing historical contexts, as evidenced by these two examples from Sewefontein and Muncu.

> I am just growing the little things, the little foods, in my garden. I don't care about what's in the veld. I got everything I need here and then we must go to the shops. (S14)

> We just have the garden. We have *mielies*, onions, and cabbage. But we need money, man! We must go to the shops to get everything else. (VT)

They described a phenomenon that exists in all communities, no matter how isolated and technically rural: minimal cultivation and expanded reliance on outside markets, often small grocery shops. Many items purchased at shops cannot be grown by the smallholder farm or home garden. Nevertheless, many of the calories that were consumed from maize and livestock less than a generation ago in rural areas are now concentrated in processed foods bought from these businesses (D'Haese and Van Huylenbroeck 2005; Baiphethi and Jacobs 2009).

The increase and greater ease with which households acquire food and other material goods, and the impact of social grants were also revealed in several oral histories across both Willowvale and Baviaanskloof, most explicitly in the village of Zaaimanshoek (Z22):

> Life is much easier. The days are shorter for the workers and they get paid better by the Whites; they eat better. Our lives were harder before the darkies [Black South Africans] took over; we didn't have such fast and big machines... [B]ut also there are fewer Coloureds working, so their habits are those from the lazy types. All the *krone* [grant money] have made the families too lazy. They don't work hard, and you can see what happens even as I speak to you now. They do nothing…they grow nothing! (Z22)

This interviewee may appear at first glance to be repeating a charge much maligned by supporters of cash transfers in the developing world and South Africa especially: that recipients are indolent and too content with their social grants (Neves *et al.* 2009; Marais 2011). Many report that grants have made life easier and stopped the constant need to work as short-term or contract labour. The interviewee's comment about social grants also evokes the experience of large-scale unemployment. Finally, he gives voice to the discordance in relations between Coloureds and Blacks – a persistent feature of South African social life. The Baviaanskloof is roughly eight per cent Black and 80 per cent Coloured currently, the former having migrated to the municipality in large numbers only in the last decade (Stats SA 2012).

Historical Dimensions of Agrarian Change

We explored and expanded upon the question of historical perceptions of agrarian and environmental change, including in terms of natural resource use, through a series of perception questions going back to 1999 when Thabo Mbeki took over the presidency of the Republic from Nelson Mandela.

Household respondents across all four villages had widely differing perceptions on whether there was more, less, or the same amount of bush medicine, firewood, or good agricultural land in their communities (Table 5). Bush medicine appeared to be more widely available in all the villages than it was in 1999. However, many households in Zaaimanshoek reported that they did not have a strong sense of the availability of bush medicine in their community because they purchased their medicine primarily from a medicine man in Sewefontein. In Tokwe, the responses were stark: the overwhelming majority stated that bush medicine, a leading NTFP in rural Eastern Cape, is more available now than before (Cocks and Wiersum 2003). It is possible that Sewefontein's reports were based on the fact that households were no longer restricted in their collection and extraction, as they were now full-fledged residents of the community rather than merely farm dwellers or labourers, unlike in the recent past. The medicine man only moved to the community five years ago, which had possibly raised awareness about the biota. As for the Willowvale villages, and especially given Tokwe's disproportionately positive responses, the presence of encroaching secondary vegetation (primarily woody acacia) as a result of decreased cultivation and livestock grazing may have provided a habitat for species that would otherwise have been transformed for productive purposes (Chalmers and Fabricius 2007).

The climate data from our survey provide some explanations for the environmental perceptions in the community (Figure 2).

Both Muncu and Tokwe, as well as Sewefontein, highlight the fact that conditions of drought have become better – presumably shorter and less pronounced – than in the past. Willowvale's responses support other data indicating that much of the north-eastern coast of the Eastern Cape has become progressively wetter. Reports concerning storms are contradictory in all the villages, with almost an equal number of respondents indicating "worse" as those who selected "better." In spite of this, climate predictions project increased climate variability and overall greater precipitation for much of the study area (Archer *et al.* 2010). Interestingly, in Muncu, Tokwe, and Zaaimanshoek, floods are not regarded as "worse" despite the actual occurrence of storms in the recent past. This would seem to countervail the

Table 5 *Household perceptions of changing environmental conditions over the last ten years*

	Wood			Bush medicine			Agricultural land		
	Less	Same	More	Less	Same	More	Less	Same	More
Muncu	18	10	2	0	8	22	21	1	8
Tokwe	0	34	1	5	9	26	27	7	1
Sewefontein	13	3	10	0	5	21	7	9	10
Zaaimanshoek	19	10	13	0	9	33	13	11	18

Note: This table is based on data from 132 households.

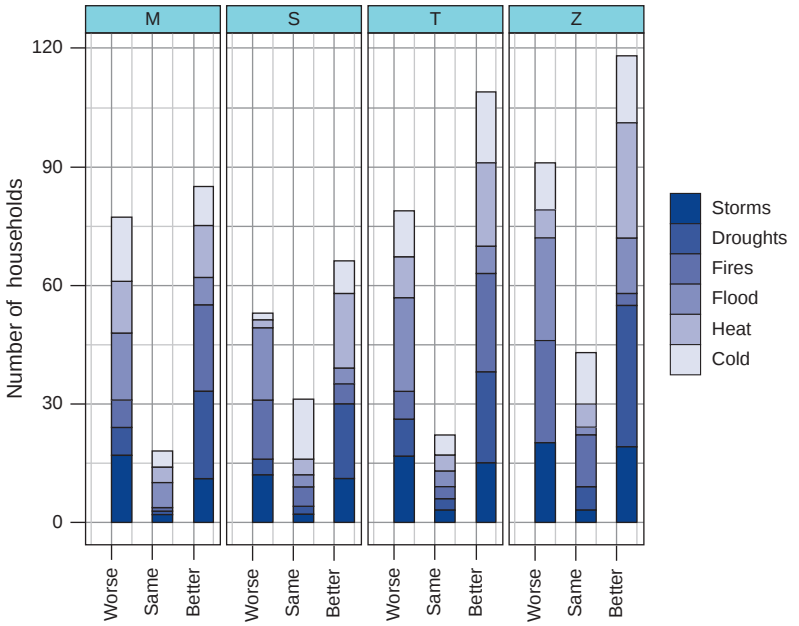

Figure 2 *Frequency chart illustrating household perceptions of changing environmental conditions over the last decade.*
Note: M=Muncu, S=Sewefontein, T=Tokwe, Z=Zaaimanshoek.

previous assertion, especially given the presence of significant erosion in all the study areas. But at least in Baviaanskloof, where respondents reported massive floods that isolated the communities over the years, the ongoing efforts of erosion control are well known, especially via a programme known as Working for Water (Turpie, Marais, and Blignaut 2008). This programme is tasked with employing the poor and ensuring the provision of ecosystem services in the catchments where they concentrate their efforts. Zaaimanshoek and Sewefontein both reported that overall, veld fires (often a driver of wild fires in thicket) have become worse in the Baviaanskloof, but no household surveyed in Zaaimanshoek reported that droughts had become worse.

With the exception of Tokwe, the average household reported that firewood was less available in their community than it was a decade ago. Firewood is perhaps the most important collected natural resource given that it is harvested virtually every day by most households, and because water (a similar natural resource in terms of its daily collection historically) is now piped or accessible from various boreholes. The rationale for this is clear in the Baviaanskloof: much of the best areas remaining for firewood harvesting are in a protected reserve that has restrictions on extraction. In the Willowvale villages it is possible that the succession of *Acacia karoo* and associated species do not supply the best wood for combustion.

Table 6 *Possession and use of fields and gardens in the study area*

		Has a field	Uses the field	Has a garden	Uses the garden
Willowvale	Tokwe	11	1	25	25
	Muncu	6	0	21	18
Baviaanskloof	Zaaimanshoek	1	1	29	26
	Sewefontein	2	1	15	13

Finally, we return to the primary agricultural question in this study relating to the availability of agricultural land. In Sewefontein, it is understandable that agricultural land is more widely available than a decade ago, since the community was allocated land through a land restitution programme in 2001. Zaaimanshoek's findings are also understandable, given that the land available for cultivation has not changed tremendously, although the grazing area has increased to accommodate the dramatic growth in the donkey population. Perhaps slightly less intuitively, people in Tokwe and Muncu – both villages in the former Transkei where respondents repeatedly cited that they do not cultivate their fields and yet still have large homestead gardens (see below) – reported compellingly that such land was less available. This is confusing, especially in light of fallow fields and often fallow home gardens (Table 6). One supposition is in relation to cattle; while far fewer in number than in previous times, the cattle were repeatedly reported to be less healthy and not able to graze healthy graminoids.

Summary

Results indicate that agricultural livelihoods have changed notably in the Eastern Cape, which may be both a long-term historical shift dating back to well before the democratic transition in 1994, and perhaps also dating to when respondents perceived social grants to have commenced. In most of the rural Eastern Cape, smallholder farmers are engaged in less agricultural activity than before, with perhaps the exception of Sewefontein, the restitution farm. Data on environmental perceptions are indicative of only some of the climate trends for both parts of the province. Droughts are reported to be less dramatic than they used to be, which at least in the Willowvale area is consistent with reports about wetter conditions across the province. Counter-intuitively, agricultural land would appear to be widely available in Muncu and Tokwe, but households overwhelmingly reported that suitable agricultural land was in short supply. This appears to be conflated with the lack of perceived means to cultivate, rear livestock, and collect NTFPs – all activities that are reported to require labour and capital inputs unavailable to the average household. Finally, the NTFP of bush medicine is considered widely available, at least in general terms, thus indicating at least a perception that local ecosystems are productive enough for certain species.

Do Households That Rely on More Extensive External Exchange Networks Exhibit Less Adaptive Capacity?

External Connectivity and Adaptive Capacity

Throughout this paper we attempt to answer whether households demonstrate adaptive capacity in the face of environmental change through reliance upon another household external to the community. This may be in the form of financial exchange, gifts, or information about disease, which we measure using social network analysis. We use network centrality measurements, namely in-degree and out-degree, to gauge this (Freeman 1976). In rural South Africa, remittances prop up otherwise deeply cash-poor households, and provide opportunities for education, health care, and employment (Klasen and Woolard 2009). Nevertheless, as important as out-migration, circular migration and return migration appear in the literature on household livelihoods in a country like South Africa (Gupta *et al.* 2009), and our own research in the Eastern Cape demonstrates that remittances pale in comparison to the amount of cash income a household receives from the State. The absence of remittance monies may in fact be an artefact of the global recession beginning in 2007, the effects of which are still felt in South Africa (Padayachee 2011).

Social network analysis is used to demonstrate our arguments about remittance reliance and exchange, but it is used in concert with other methods to assess agrarian change more widely, in recognition that agency and action should be considered together. Survey data and qualitative interviews also provide insight into the dynamics of the household. Finally, the ecological validity of the work may be limited, but the phenomena should not be discounted given similar community characteristics throughout South Africa.

Agrarian change, like its climate analogue, is not purely a function of smaller-scale changes in the political economy or the biophysical conditions of the research area. This is a theme echoed in works by scholars like Taylor (2014), who argue that climate change adaptation is not something "out there" and exogenous, and is adapted to, but is endogenous to our daily environments, and therefore actively produced through tethered social and biophysical forces. Flows of internal migration between the rural and urban have defined the experience of South Africans of colour for generations (Reed 2013). The history of labour migration in the former Bantustans resulting from Apartheid segregationist policies and the profitability of the country's mines has been dealt with substantively by historians and social scientists (Posel 2001; Kok *et al.* 2003; William Beinart 2012). Other more complicated perspectives on labour trends in a neoliberal global economy, and particularly circular migration in South Africa, have also been advanced, many of which have adopted a networks approach (or related transnational approach, which incorporates some theories of network connectivity) (Samers 2009). Networks have provided migration with a "migration systems paradigm;" ultimately, a way of

looking at migration through historically rooted cultural, economic, political, and social linkages (Massey and Espana 1987; Gurak and Caces 1992). "Migrant networks" or "network-mediated migration" might include kin and friendship ties through villages, or other networks based around a perception of common cultures or shared ethnicity (Massey and Espana 1987; Wilson 1993). Social networks for individuals ordinarily provide financial resources to the host communities from which they emanate (Boyd 1989).

A formal transfer of financial resources such as that found in the social grants system in South Africa may lead to decreasing livelihood diversification, including in agricultural activity, and negligible interaction with formal markets. This is consistent with the findings of Hebinck and Lent (2007), whose work on de-agrarianisation in the Eastern Cape province is based upon national and regional observations over decades. Because of the particular interconnections between disease and rural resource-dependent peoples in South Africa (Reid and Vogel 2006; McGarry and Shackleton 2009; Kaschula *et al.* 2012), we address this through ideas of exchanges of information about disease. This variable is expressed as the count number of the interactions between households who share information about their health conditions.

Our enquiry into households and their connections to external domains includes an assessment of state grant recipients and questions about outside support. Additionally, we made use of network surveys composed of two parts: a whole and a personal network of household exchanges. Whole networks refer to social networks where the sampling frame is known (Kadushin 2012), and in our case, where a roster was obtainable. Personal networks focus on social relations and are often elicited through name generators from respondents who are often unrelated (McCarty 2002). Data collected from households for the personal network survey in this study were sampled from the initial whole network roster based on a household's structural position. They were determined via graph visualisation and summary statistics (Schramski, McCarty, and Barnes, forthcoming). Households may play roles as brokers or bonding actors within a social network, may be isolated or disconnected in the network, or may be deeply embedded. In the two Willowvale communities we conducted a personal network survey with 26 households (Tokwe=16, Muncu=10) and in the Baviaanskloof with 33 households (Zaaimanshoek=18, Sewefontein=15). Using a personal network instrument, we asked questions about exchanges outside a household's respective community on a monthly basis, specifically in the form of food, wood and water, money, labour, and information about disease. Food exchanges included both meals and prepared food; wood and water were networks of highly utilised (and labour-intensive) resources; money included exchanges that were not related to transactions for goods or services. The respondents were asked to report whether they exchanged nothing, exchanged equally, gave more to household B than household B gave to them, or gave less to household B than household B gave to them (0, 1, 2, −2). Each

respondent was asked to list 10 households for the personal network design. We also collected ethnographic information on the surveyed household to contextualise the results. This paper uses the number of ties coming into (in-degree) a node or household in the study from other households for exchange networks (in frequency) related to gifts, remittance money, and disease information (Borgatti 1994). Gifts in this study are non-monetary and non-food-related exchange, and remittance money is the sum of money transferred from one household to the other. Disease information refers to information about disease of any kind shared between households in the study area.

Adaptive Capacity as Derived from Outside Communities

As noted above, households in the study area have undergone a series of transformations including a greater connectivity to outside households and markets. One way to understand this phenomenon is through the most prevalent livelihood strategy, namely social grants. We contrast this with a more commonly cited poverty alleviation strategy, namely remittance transfers. Many households are also connected to commercial markets to a much greater degree than before, although most likely as consumers and not as vendors. As discussed in the next section, agricultural activity is virtually absent in all the communities under review, except perhaps for Sewefontein. What is also notable, at least in these increasingly non-agrarian rural landscapes, is the limited importance of remittances. This, too, reflects contemporary trends for South African household economies, insofar as remittances appear to play a smaller role in relation to social grants (Jensen 2004; Leibbrandt *et al.* 2010). The percentage of households that regularly receives remittance money or gifts in the entire study area is a mere 6 percent. These remittances do not appear to approach the importance of government grants in all its forms: 91 per cent of all households in all communities received an old age pension grant independent of other social grants. Grants are ascendant, and as Neves and du Toit (2013) note:

> Cash transfers therefore potentially enable recipients to overcome liquidity constraints, transcend the need to engage in precautionary low-risk activities (or crops) and keep savings in liquid but low-yield forms.

Networks and Social Capital

Social grants are prominent in one of the scores we use for livelihood diversity, a dimension of adaptive capacity. Livelihood diversity in this study is a measure that captures various sources of income including gross financial income, employment status, agrarian activities, non-timber forest product (NTFP) collection, and social grant acquisition, in an effort to capture the "hidden harvest" present in diverse rural livelihoods (Luckert and Campbell 2002). The exact definition used is shown in Appendix 1.

Social capital, although often in abstract terms, is another dimension of adaptive capacity often discussed in research on livelihoods, social ecological resilience (SER), and climate change adaptation research. It is commonly referred to in modern social and interdisciplinary science, including network analysis (Lin 2001; Adger *et al.* 2005; Burt 2005; Walker *et al.* 2006; van Aalst *et al.* 2008; Ebi and Semenza 2008; Cassidy and Barnes 2013). We use the centrality of the household's position in a network of reliance, a form of social capital (Freeman 1976), as a predictor of adaptive capacity. In-degree centrality is the number of ties received by an actor from other actors (in this case the actors are households), and out-degree is the number of ties given by that household to another household. We assess both whole networks of the communities in question (that is, where the sample is the entire community) and a personal network of some of the household's ties outside of their respective community (a so-called personal network) (Barnett 2011). By looking at networks of external agents that a household relies on for contributions of health information, natural resources, or money in the form of centrality measurements, we are then able to identify the relative reliance of a household on such contributions.

Livelihood diversity is a linear function of a household's income-producing and non-income-producing activities; natural resource reliance is a composite of variables gauging natural resource use, from bush medicine collection to field cultivation; and household health is based on a measure of morbidity and mortality within the household (Appendix 1). The items for the household health score include: numbers of death and cases of serious illnesses over the last year, current prevalence of disease in the household, and effects of disease on the household. Principal component analyses (PCA) were used to convert a set of observations of possibly correlated variables into a set of uncorrelated linear variables. PCA was utilised in this analysis because it provided a means of grouping together similar network measurements of often very disparate criteria. We also utilised a combination of linear and robust linear regression models to analyse the relationship between livelihood diversity and household health scores and extent of reliance on external households. The results of this analysis are shown in Tables 7 and 8.

Table 7 *Results of robust linear regression model for personal networks of disease information on livelihood diversity in the study area*

	Livelihood diversity	Standard Error	T	P>|t|	Adjusted R-Squared
Disease information	Constant	22.4721	8.4081	0.0333	—
	Baviaanskloof	10.3697	7.6293	0.0386*	0.844
	Constant	0.13549	1.076	0.286	—
	Willowvale	0.1188	0.711	0.479	0.0078

*$=p<.05$

Note: In the Baviaanskloof, personal network exchanges of disease information positively predict livelihood diversity.

Table 8 *Results of linear regression model for the effect of a gift sharing network on household health*

	Gift sharing	Standard Error	T	P>|t|	Adjusted R-Squared
Household health	Constant	188.6	0.7699	0.0667	–
	Baviaanskloof	79.23	−0.47	0.026*	0.0824
	Constant	0.1409	0.524	0.602	–
	Willowvale	0.1237	−1.212	0.23	0.0073

*=p<.05

Note: In the Baviaanskloof, networks of gift exchanges negatively predict household health.

Robust regressions are designed to circumvent the limitations of traditional statistical methods, and are designed to not be overly affected by violations of assumptions in the same way as ordinary least square regressions (Hampel *et al.* 1986). A robust linear regression model indicates that the reliance measurements of a personal network of information about disease is a positive predictor of livelihood diversity in the Baviaanskloof (Table 7), but probably this is not the case in the villages of Willowvale. This is illustrated below in the case of Baviaanskloof by plotting the household-level reliance of disease information against livelihood diversity (Figure 3).

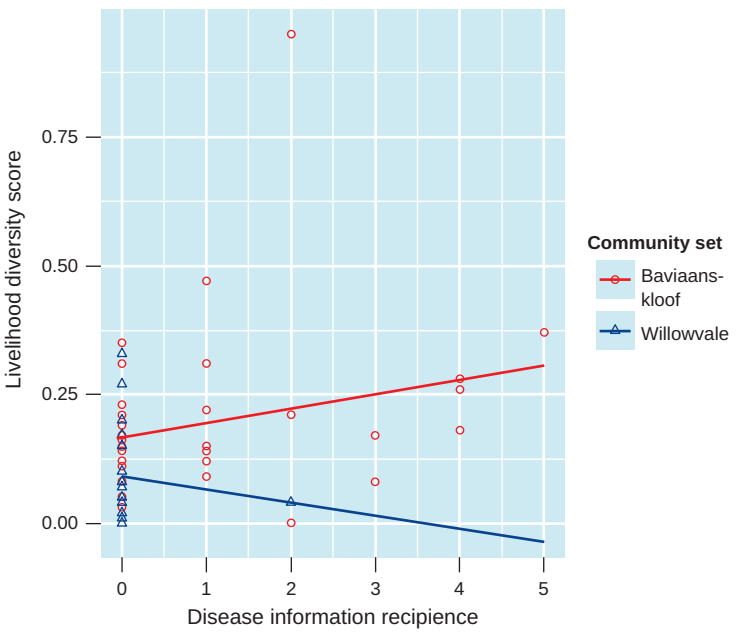

Figure 3 *Scatter plot of recipience of disease information against livelihood diversity*
Note: The y-axis represents livelihood diversity score and the x-axis, recipience (number of incoming ties). The regression was significant only in the Baviaanskloof.

Further robust linear regressions reveal that recipience of gifts appears to somewhat negatively predict household health in the Baviaanskloof. The model outputs are observable in Table 8. It is clear that many households in the regression actually exhibit no recipience whatsoever.

Figure 4 is a visualisation of the combined personal networks for Zaaimanshoek and Sewefontein. As it demonstrates, livelihood-diverse households (lighter coloured nodes) are also largely the most reliant (they receive more than they give; based on larger node size) in the disease information personal network. An example would be to compare "Z29," both more reliant and more livelihood-diverse, with "Z27," which is clearly the opposite. In addition to the statistical significance between livelihood diversity and reliance in this network, there is a breakdown by village. Zaaimanshoek is more prominent in this personal network in terms of the predicted relationship than Sewefontein (most of the households in Figure 3 centred around "1" on the x axis are located in Sewefontein). This could be explained by the fact that many in Sewefontein work on the redistributed farm and not off-farm, unlike those in Zaaimanshoek. They therefore exhibit less diversity.

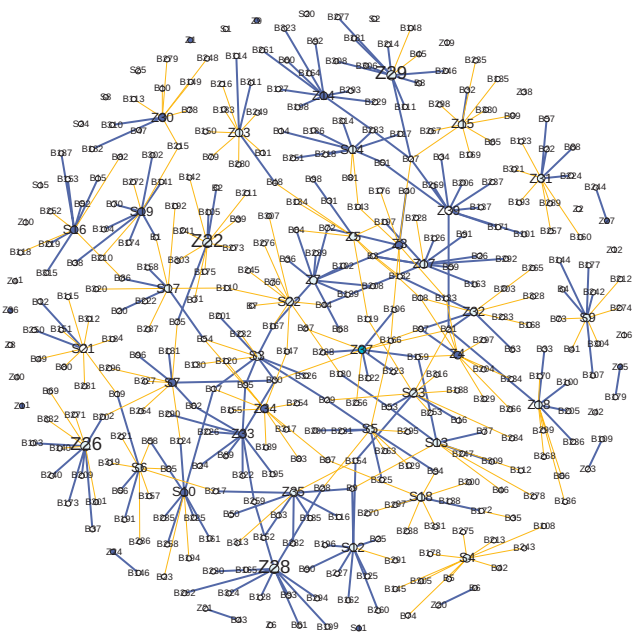

Figure 4 *Graph visualisation of the personal network exchanges for disease information in the Baviaanskloof communities.*
Note: Nodes sized by reliance (more reliant=larger node and text label) and coloured by livelihood diversity (greater diversity=lighter colour). Nodes beginning with S=Sewefontein, Z=Zaaimanshoek, B=outside Baviaanskloof households.

We also conjecture that because households in Zaaimanshoek have greater livelihood diversity – and therefore work in a greater diversity of locations – their external community networks are also more expansive, and therefore they are more able to call upon resources when sick or in need of treatment information. This bridging capital has been highlighted in previous studies of adaptive capacity (Pelling and High 2005). Zaaimanshoek is also home to a clinic, which is likely to have a multiplier effect on the sharing of disease information with external households, depending on the effectiveness of the healthcare staff (Valente 2010). To illustrate, B21, a reserve official and long-time forestry employee, has long been thought of as a patron in the local community given his wealth and political standing. He shows up in at least five personal networks related to the question of disease information dissemination (Figure 4).

The prominence of the Baviaanskloof communities is demonstrated by another measurement: the relationship between adaptive capacity and social capital in the form of gift recipience (food or material goods) and household health. The relationship is weak, and therefore definitive conclusions are not possible. The indication is that a household receiving gifts generally has a lower household health score. This could be a sign that needier households are even more vulnerable, in this case in respect of health. Increasing work in social network analysis is confirming the link between social capital, poverty, and health (Cattell 2001; Valente 2010).

The variability in the livelihood diversity measurements for Willowvale's households may explain why adaptive capacity is not significantly predicted by either of these networks. We observed that throughout the survey process, personal networks for disease information were sparse, even more so in Muncu, where we suspect much health information is disseminated by a nearby clinic. In both Tokwe and Muncu it was often remarked that "I do not ask anyone about information about disease; that's for doctors to decide," or some variation thereof. The visualisation in Figure 5 demonstrates the lack of connectivity as well as variability in the livelihood diversity measurement for Muncu and Tokwe. Neither the nodes labelled "CM" nor "WB," as an example, demonstrates this in any robust way.

As for the second regression, it is clear from the scatter plot (Figure 3) that there is clustering around both the household health score and the gift reliance measurement, which demonstrates skewedness, affecting the statistical model. There are a large number of non-exchanges on the gift–reliance axis. This, too, demonstrates that the Willowvale area is somewhat more autochthonous than the Baviaans set. This could be partly explained by its closer proximity to an urban area (Willowvale town is a 45 minutes to one hour drive from Muncu and Tokwe, and a one-and-a-half to two hours' drive from Sewefontein and Zaaimanshoek). The density of human settlements is also greater in Willowvale; it is replete with a large number of traditional medicine practitioners, shamans, and nurses, and has ease of access to material goods.

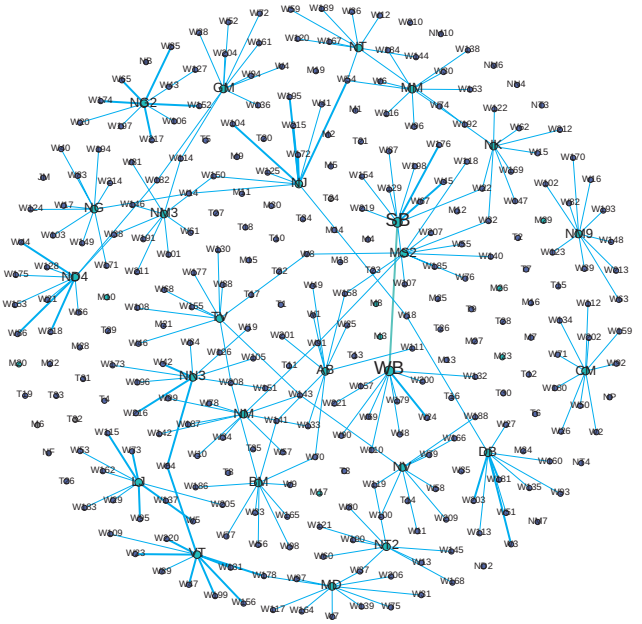

Figure 5 *Visualisation of personal network exchanges for disease information in the Willowvale communities.*
Note: Nodes (households) sized by disease information recipience (larger node and text label=greater disease information recipience). Livelihood diversity score (lighter colour=greater diversity). Nodes beginning with M=Muncu, T=Tokwe, W=outside Willowvale households.

Summary

This section reaffirms the argument posed at the beginning of the manuscript: households are more reliant on social grants than they are on any other livelihood strategy across the study area. Remittances, which in sub-Saharan Africa are often argued to be the stop-gap between rural households and severe poverty, did not emerge as significant. For the clearest sign of connectivity to communities outside the study area, the example of the Baviaanskloof is instructive (Willowvale less so). Two personal network exchange measurements of centrality are significant predictors of adaptive capacity in Sewefontein and Zaaimanshoek in aggregate: gifts and disease information reliance. These appear to provide contradictory evidence given our argument that a low score on any one of the individual measurements of adaptive capacity indicates low adaptive capacity. There is a positive relationship between disease information reliance and livelihood diversity, and a negative relationship between gift reliance and household health. We believe that this is because these networks do not follow the same pattern vis-à-vis more reliance, implying greater vulnerability. Gifts include hard assets and, much like money, they follow the trajectory of the financially poorer sections having less access to good

healthcare and information. Greater livelihood diversity, which we surmise is a proxy for greater social interaction, leads to greater exchanges of health information, including information about diseases such as tuberculosis, perhaps the most serious public health concern in the Baviaanskloof.

Do Households Less Reliant on Natural Resources Have Lower Adaptive Capacity?

Natural Resource Reliance: A Portfolio

A great deal of research links natural resource reliance with adaptive capacity, and the empirical literature suggests that household poverty is positively associated with reliance on natural resources (Fraser *et al.* 2003; Shackleton and Shackleton 2004; Adger and Vincent 2005; Paumgarten 2005; Engle 2011). This is especially true of non-timber forest produce (NTFP) in rural South Africa. In this section we test the claim that poorer, less adaptive households are more reliant on natural resources. Although a linkage between reduced smallholder agricultural activity and the social grant system has been proposed by some authors (Neves *et al.* 2009), it has also been criticised as not being empirically grounded and as a false characterisation of dependence (Marais 2011). Conservatively, 32 per cent of the country's population relies on social grants and even more so in the Eastern Cape (41 per cent of the province). In the Baviaanskloof communities, 90 per cent of households rely on social grants for the majority of their cash income, while in Willowvale the proportion is 82 per cent. The grant system combined with remittances is linked to processes of de-agrarianisation in South Africa, but in all four communities together or parsed out, grant recipience does not seem to predict a household's natural resource reliance. Nor does it apparently correlate with any of our variables for natural resource dependence, including the natural resource reliance score used in this study.

Our livelihood survey gauged five asset categories (financial, natural, social, human, and physical capital) of the sustainable livelihoods framework (Scoones 1998). The survey also asked questions about land in possession or used by a household; the historic and current number of livestock (other than fowl) owned; the presence or absence of home gardens, and their average size.

Adaptive capacity measures were derived from a livelihood diversity score and a household health score (see Appendix 1). It is, in fact, the average between these two scores. In addition, natural resource reliance was tested against both these scores to investigate its relationship with adaptive capacity. Natural resource reliance is a composite of natural resources acquired by the household. These include items related to timber products and NTFPs, water, fields, home gardens, and livestock.

As discussed above, existing research in the area shows a link between natural resource reliance and poverty. This has implications for studies on the question of agrarian change, although we hypothesise that the same link exists between natural resource reliance and adaptive capacity. This relationship is shown in Figure 6.

Descriptively, Zaaimanshoek represents the upper bounds and Tokwe the lower bounds for *both* measurements of adaptive capacity and natural resource reliance. Sewefontein and Muncu are comparable in the average measurements of both scores. By these measures, therefore, Zaaimanshoek has the greatest adaptive capacity and is most natural resource-reliant; Muncu and Sewefontein represent the median for both measures; and Tokwe represents the lowest quartile (again, for both scores).

Initial correlations were not revealing, but because of the hypothesis about the relationship between vulnerability (often posed as a foil to adaptive capacity) and natural resource reliance, specifically in rural South Africa, we persisted with linear regressions under assumptions of independence, linearity, homoscedasticity, as well as the normality of natural resource (explanatory) and adaptive capacity (response) variables (Smit and Wandel 2006). None of the assumptions was violated. However, the results were not significant and we failed to reject the hypothesis (two-tailed). This would indicate that there is a very minimal relationship between natural resource reliance and adaptive capacity.

In both communities there was clustering around the second and third quartiles (the median) of the natural resource reliance score, but the values were much more

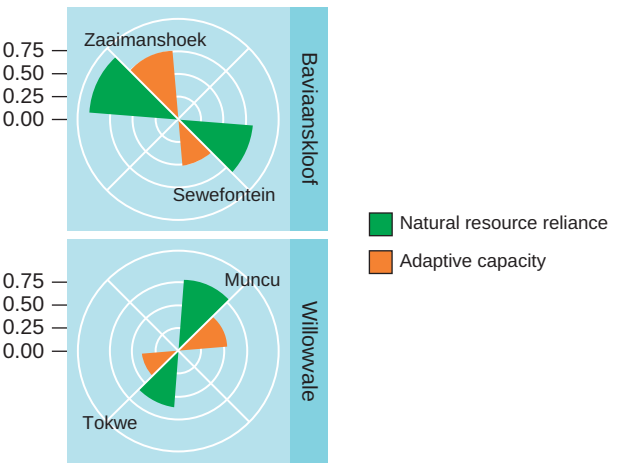

Figure 6 *Wind rose plot of average adaptive capacity and natural resource reliance scores in the study area, split up by community.*
Note: Score measurements are on the y-axis; the x-axis starts from the pole (centre).

dispersed in the measurement of adaptive capacity. The outliers in the analysis proved problematic for the model (a household in Zaaimanshoek rates extremely high in natural resource reliance and a household in Tokwe is near the upper limit for adaptive capacity). Aside from these outliers, and the predictable result that the adaptive capacity scores between both sets of communities did not correlate, uniformity of distribution of natural resource reliance was discernible. It appears that the natural resource reliance scores have a greater central tendency and therefore might be more reliable. This is in part because this score is a genuine measure of both natural resource activity and reliance, and these scores were first reported as qualitative changes and then formalised by an analysis of survey data. Households were, on an average, moderately natural resource-reliant, and much of this was proportionate to the collection of firewood (given its daily necessity and the large quantities required). This score would be much lower if natural resource reliance was based solely upon NTFPs or even the occasional trip for water when government-maintained taps malfunction.

Summary

The livelihood portfolios for these rural geographies in the Eastern Cape demonstrate: (i) the primacy of social grants; (ii) the limited nature of agrarian livelihoods; (iii) a surprisingly high reported number of wild fruits, vegetables, and related non-timber forest produce collection; and (iv) differential off-farm (or outside the homestead) employment opportunities. Additionally, the results indicate that the households in Willowvale did not cultivate the fields they had totally unrestricted access to, and to some extent this prevailed in Baviaanskloof as well. To combat what some view as the under-cultivation hypothesis in South Africa, studies have demonstrated the importance of home gardens for households. Nevertheless, while home gardens are large by any estimation, especially in Muncu and Tokwe, they are not necessarily cultivated at the rate necessary to compensate for lack of field cultivation. Moreover, even if they were extensively utilised, production would not be sufficient for the average-sized household in the study area for any prolonged period of time. Finally, there does not appear to be a statistically significant relationship between adaptive capacity and natural resource reliance, even though many scholars highlight the importance of natural resources for extremely poor households in rural South Africa. While our measure of livelihood diversity is not a pure marker of income, and therefore does not directly dispute much of the previous work that derives a safety net linkage between natural resources and poverty, it is a close relative and therefore important.

Conclusion

Adaptive capacity, as measured by household health and livelihood diversity, is not dependent upon natural resource reliance. This conclusion runs counter to much of what is to be found in the literature. Recall that the livelihood diversity score includes

an income variable. Nevertheless, the results should not be overly surprising as we have shown that households in the study areas have undergone important transformations. The agrarian change observed in the historical accounts, the not altogether affirmative role of remittances, and the visible sight (and number) of abandoned fields, all demonstrate that these communities may at first appear agrarian in composition but are less so in their functioning. This is a key part of work in community based adaptation (CBA) and social ecological resistance (SER), linked as they are by adaptive capacity. As the literature on resilience discusses using "basins of attraction" and changing identity (Carpenter *et al.* 2001; Folke *et al.* 2002), these communities demonstrate adaptive capacity as a function of the diversity of their households outside of social grants recipience, and in spite of the destructive properties of diseases like HIV/AIDS and tuberculosis. But they could well have shifted to a different social-ecological state, one perhaps where the communities maintain little adaptive capacity while the household is in flux. What, after all, are the markers of an agrarian community if not agricultural and natural resource reliance? The latter is salient to community-based adaptation as well, as adaptation efforts in sustainable development programmes are often predicated on a consideration of the human–land interface, and a proper accounting for sustainable livelihoods that may be affected by climate change and variability (Magee 2013).

The rural Eastern Cape has significant arable land, judging by former agricultural plots that have lain fallow for two decades. Similarly, we can conclude there is very little ambition to cultivate large swathes of land, even in the community with the least amount of land to cultivate (Zaaimanshoek), unless government and outside parties provide financial incentives.

South Africa's social grant system has been both lauded and derided since its inception as the continent's first wide-scale welfare programme (Ferguson 2007). This system is predominantly means-tested, not conditional like programmes in Mexico or Brazil (Fiszbein *et al.* 2009). In the context of this research area, however, even if South African social grants were conditional, it would be difficult to imagine a solution based on grants directly tied to agricultural production. It is also doubtful that welfare on condition of work (so-called "work-fare") as seen in some Western countries would emerge. It is perhaps even less likely that an agriculturally focused version, a so-called "agri-fare" would emerge, given the already weak agricultural extension operations in much of the country (Hall 2007).

Given the lack of employment opportunities in the rural Eastern Cape as a whole and especially in the communities within which we worked, old age pensions, childcare grants, care dependency, disability, and foster-care grants appear to be long-lasting to the recipients, even if the national government has begun to express concern about future spending on social grants (Gordhan 2013). Should the effects of financial bust cycles and climate-induced changes emerge at any point in the future,

it is possible that the South African state may no longer be inclined to provide social grants to such a large segment of society. This would catalyse a chain of events with very ambiguous consequences.

Where migration and remittances emerge, the oral histories indicate that changing labour patterns are resonant. Traditional circular migration patterns that existed during the Apartheid and even after the democratic transition show up, but references to remittance money derived from those extra-community endeavours do not. Clearly, there are a number of research households' kin who live in larger urban areas. Many in the study area pointed out that while kinship and friendship networks in communities geographically external to theirs are important sources of assistance in the form of personal exchanges of gifts, these are overshadowed by social grants from the state. If one accepts that most of these gifts do not act as sufficient substitutes for cash, this is significant. And even if one were to value household assets exclusively in terms of the material goods present in a home, asserting that all such goods are gifts would be incorrect.

Rural identity is complex and rich in South Africa, and this study has sought to answer questions about agrarian change and adaptive capacity. First, as the data demonstrate, agrarian livelihoods are not the defining feature of the rural Eastern Cape. They may very well not be the defining feature of all of South Africa, unless the home garden and woody encroachment proximate to one's homestead become the new locus of agrarian activity. These households are de-agrarianised. If this is the case, policy efforts at building adaptive capacity in rural communities like the ones studied here will need to contribute to programmes premised on climate-smart agriculture, good governance, and technological innovation (World Bank 2013).

The second question is neither reassuring to the present conditions of the most vulnerable in these communities and other communities like it, nor is it particularly reassuring to the State. There are exchanges of goods and information within and outside of Willowvale and the Baviaanskloof. For those exchanges which are sparser within the communities in question, some assistance appears to exist from outside. The data demonstrate some reliance on external people on the part of Baviaanskloof, but not so for Willowvale.

While agrarian livelihoods with some exceptions are also sparse, the collection of available resources in even degraded ecosystems might very well be what is left of a denotation of rurality, not the raising of Nguni cattle or planting of *mielies*. The global economic recession of 2007–9, which nominally ended two years before our fieldwork commenced, has undoubtedly affected labour patterns and remittance money transfers to rural areas throughout the country. However, this was not raised in either the oral histories or the historical questions in the livelihood survey. Social grants have buffered both communities, and register both in the interviews and the scenario planning data as the means by which households have survived.

Households in this study demonstrate adaptive capacity in their current form, and have altered their social, economic, and ecological make-up as a result. Given that most climate change projections are for increased variability across a wide spectrum of the country (the Baviaanskloof and Willowvale are projected to receive dramatically different climatic results; Archer *et al.* 2010), adaptive capacity will be configured through a combination of State policy, market forces, bio-geochemistry, and perhaps decreasingly, the field and livestock pen.

Acknowledgements: We would like to acknowledge the logistical support and help we received in South Africa, particularly from the Department of Environmental Science at Rhodes University and the Living Lands NGO. We would like to thank the reviewers of this manuscript for their thoughtful comments. We would also like to acknowledge the National Science Foundation's Interdisciplinary Graduate and Education Traineeship programme (IGERT) no. 0504422.

References

Adger, Neil (1999), "Social Vulnerability to Climate Change and Extremes in Coastal Vietnam," *World Development*, vol. 27, pp. 249–69.

Adger, W. Neil, and Vincent, Katharine (2005), "Uncertainty in Adaptive Capacity," *Comptes Rendus Geoscience*, vol. 337, pp. 399–410, available at doi:10.1016/j.crte.2004.11.004, viewed on October 6, 2016.

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., and Rockström, J. (2005), "Social-Ecological Resilience to Coastal Disasters," *Science*, vol. 309, pp. 1036–9.

Akram-Lodhi, A. Haroon, and Kay, Cristobal (2010a), "Surveying the Agrarian Question (Part 2): Current Debates and Beyond," *The Journal of Peasant Studies*, vol. 37, pp. 255–84.

Akram-Lodhi, A. Haroon, and Kay, Cristobal (2010b), "Surveying the Agrarian Question (Part 1): Unearthing Foundations, Exploring Diversity," *Journal of Peasant Studies*, vol. 37, pp. 177–202, available at doi:10.1080/03066150903498838, viewed on October 6, 2016.

Andrew, Maura, and Fox, Roddy C. (2004), "'Undercultivation' and Intensification in the Transkei: A Case Study of Historical Changes in the Use of Arable Land in Nompa, Shixini," *Development South Africa*, vol. 21, pp. 687–706.

Archer, E., Engelbrecht, F., Landman, W., Le Roux, A., Van Huyssteen, E., Fatti, C., Vogel, C., Akoon, I., Maserumule, R., and Colvin, C. (2010), "South African Risk and Vulnerability Atlas," Department of Science and Technology, Johannesburg, South Africa.

Baiphethi, M. N., and Jacobs, P. T. (2009), "The Contribution of Subsistence Farming to Food Security in South Africa," *Agrekon*, vol. 48, pp. 459–82.

Barnett, G. A. (ed.) (2011), *Encyclopedia of Social Networks*, Sage Publications, Thousand Oaks, CA.

Beinart, William (2003), *The Rise of Conservation in South Africa: Settlers, Livestock, and the Environment 1770–1950*, Oxford University Press, Oxford.

Beinart, William (2012), "Beyond 'Homelands': Some Ideas About the History of African Rural Areas in South Africa," *South African Historical Journal*, vol. 64, pp. 5–21.

Bender, Donald R. (1967), "A Refinement of the Concept of Household: Families, Co-residence, and Domestic Functions," *American Anthropologist*, vol. 69, pp. 493–504.

Bernstein, H. (ed.) (1996), *The Agrarian Question in South Africa*, Frank Cass, London.

Bhorat, H., Hirsch, A., Kanbur, R., Ncube, M. (eds.) (2014), *The Oxford Companion to the Economics of South Africa*, Oxford University Press, Oxford.

Bobbins, K. L. (2012), "Developing a Form-Process Framework to Describe the Functioning of Semi-Arid Alluvial Fans in the Baviaanskloof Valley," Masters of Science Thesis, Rhodes University, Grahamstown.

Bohle, Hans G., Downing, Thomas E., and Watts, Michael J. (1994), "Climate Change and Social Vulnerability: Toward a Sociology and Geography of Food Insecurity," *Global Environmental Change*, vol. 4, pp. 37–48.

Booth, A. (1985), "Accommodating a Growing Population in Javanese Agriculture," *Bulletin of Indonesian Economic Studies*, vol. 21, pp. 115–45.

Borgatti, S. P. (1994), "A Quorum of Graph Theoretic Concepts," *Connections*, vol. 17, pp. 47–9.

Bowden, Gordon T. (1947), "The Adaptive Capacity of Workers," *Harvard Business Review*, vol. 25, pp. 527–42.

Boyd, M. (1989), "Family and Personal Networks in International Migration: Recent Developments and New Agendas," *International Migration Review*, vol. 23, pp. 638–70.

Bryceson, Deborah Fahy (1996), "De-agrarianisation and Rural Employment in Sub-Saharan Africa: A Sectoral Perspective," *World Development*, vol. 24, pp. 97–111.

Bryceson, Deborah Fahy (1999), "African Rural Labour, Income Diversification and Livelihood Approaches: A Long-Term Development Perspective," *Review of African Political Economy*, vol. 26, pp. 171–89.

Bryceson, Deborah Fahy (2002), "The Scramble in Africa: Reorienting Rural Livelihoods," *World Development*, vol. 30, pp. 725–39, available at DOI: 10.1016/S0305-750X(02)00006-2, viewed on October 6, 2016.

Bryceson, Deborah Fahy (2009), "Sub-Saharan Africa's Vanishing Peasantries and the Spectre of a Global Food Crisis," *Monthly Review*, vol. 61, pp. 48–62.

Bryceson, Deborah Fahy, and Fonseca, Jodie (2006), "An Enduring or Dying Peasantry? Interactive Impact of Famine and HIV/AIDS in Rural Malawi," *AIDS, Poverty, and Hunger: Challenges and Responses*, p. 97.

Bryceson, Deborah Fahy, and Jamal, Vali (1997), *Farewell to Farms: De-agrarianisation and Employment in Africa*, Ashgate Publishing Limited, Farnham.

Burt, Ronald S. (2005), *Brokerage and Closure: An Introduction to Social Capital*, Oxford University Press, Oxford.

Butzer, Karl W. (1980), "Adaptation to Global Environmental Change," *The Professional Geographer*, vol. 32, pp. 269–78.

Callaway, John, Louw, Daniel, and Hellmuth, Molly (2009), *Benefits and Costs of Measures for Coping With Water and Climate Change: Berg River Basin, South Africa*, Routledge, London.

Carpenter, Steve, Walker, Brian, Anderies, Marty J., and Abel, Nick (2001), "From Metaphor to Measurement: Resilience of What to What?" *Ecosystems*, vol. 4, pp. 765–81.

Cassidy, Lin, and Barnes, Grenville D. (2013), "Understanding Household Connectivity and Resilience in Marginal Rural Communities through Social Network Analysis in the Village of Habu, Botswana," *Ecology and Society*, vol. 17, p. 11.

Cattell, Vicky (2001), "Poor People, Poor Places, and Poor Health: The Mediating Role of Social Networks and Social Capital," *Social Science and Medicine*, vol. 52, pp. 1501–16.

Chalmers, Nigel, and Fabricius, Christo (2007), "Expert and Generalist Local Knowledge About Land-Cover Change on South Africa's Wild Coast: Can Local Ecological Knowledge Add Value to Science?" *Ecology and Society*, vol. 12, p. 10.

Cocks, Michelle L., and Wiersum, K. Freerks (2003), "The Significance of Plant Diversity to Rural Households in Eastern Cape Province of South Africa," *Forests, Trees, and Livelihoods*, vol. 13, pp. 39–58.

Cocks, M., Dold, T., Kingwill, R., and Andrew, M. (2007), "Baviaanskloof Mega-Reserve Project Study Area," Research Report, Baviaanskloof Mega-Reserve Project Management Unit.

Coetzee, J. M. (1986), "Farm Novel and '*Plaasroman*' in South Africa," *English in Africa*, vol. 13, pp. 1–19, available at doi:10.2307/40238587, viewed on October 6, 2016.

Cousins, Ben (1999), "Invisible Capital: The Contribution of Communal Rangelands to Rural Livelihoods in South Africa," *Development Southern Africa*, vol. 16, pp. 299–318.

Cousins, Ben (2013), "Smallholder Irrigation Schemes, Agrarian Reform and 'Accumulation From Above and From Below' in South Africa," *Journal of Agrarian Change*, vol. 13, pp. 116–39, available at doi:10.1111/joac.12000, viewed on October 6, 2016.

Crane, W. (2006), "Biodiversity Conservation and Land Rights in South Africa: Whither the Farm Dwellers?" *Geoforum*, vol. 37, no. 6, pp. 1035–45.

Cullather, Nick (2004), "Miracles of Modernisation," *Diplomatic History*, vol. 28, pp. 227–54, available at doi:10.1111/j.1467-7709.2004.00407.x, viewed on October 6, 2016.

Dani, Anis, and Moser, Caroline (2008), "Asset-Based Social Policy and Public Action in a Polycentric World," *Assets, Livelihoods, and Social Policy*, World Bank Publications, New York, pp. 3–42.

Davis, Junior (2005), "The Rural Non-Farm Economy, Livelihoods, and Their Diversification: Issues and Options," Working Paper, Natural Resources Institute, Chatham, U. K.

Dercon, Stefan, and Krishnan, Pramila (2000), "Vulnerability, Seasonality, and Poverty in Ethiopia," *The Journal of Development Studies*, vol. 36, pp. 25–53.

D'Haese, M., and van Huylenbroeck, G. (2005), "The Rise of Supermarkets and Changing Expenditure Patterns of Poor Rural Households: Case Study in the Transkei Area, South Africa," *Food Policy*, vol. 30, pp. 97–113.

Diao, Xinshen, Hazell, Peter, Resnick, Danielle, and Thurlow, James (2007), "The Role of Agriculture in Development: Implications for Sub-Saharan Africa," *Research Report 153*, International Food Policy Research Institute, Washington D. C.

Ebi, K. L., and Semenza, J. C. (2008), "Community-Based Adaptation to the Health Impacts of Climate Change," *American Journal of Preventive Medicine*, vol. 35, pp. 501–7.

Ehlert, J. (2012), *Beautiful Floods: Environmental Knowledge and Agrarian Change in the Mekong Delta, Vietnam*, LIT Verlag Münster, Berlin.

Ellis, F. (1993), *Peasant Economics: Farm Households in Agrarian Development*, Cambridge University Press, Cambridge.

Ellis, F. (2000), *Rural Livelihoods and Diversity in Developing Countries*, Oxford University Press, Oxford.

Ellis, F., and Freeman, H. A. (2004), *Rural Livelihoods and Poverty Reduction Policies*, Routledge, New York.

Ellis, Frank (1998), "Household Strategies and Rural Livelihood Diversification," *The Journal of Development Studies*, vol. 35, pp. 1–38.

Engle, Nathan L. (2011), "Adaptive Capacity and its Assessment," *Global Environmental Change*, vol. 21, pp. 647–56.

Feinstein, C. (2005), *An Economic History of South Africa: Conquest, Discrimination, and Development*, Cambridge University Press, New York.

Ferguson, James (2007), "Formalities of Poverty: Thinking About Social Assistance in Neoliberal South Africa," *African Studies Review*, vol. 50, pp. 71–86.

Fiszbein, A., Schady, N. R., and Ferreira, F. H. G. (2009), *Conditional Cash Transfers: Reducing Present and Future Poverty*, World Bank Publications, New York.

Forest, F., Grenyer, R., Rouget, M., Davies, T. J. (2007), "Preserving the Evolutionary Potential of Floras in Biodiversity Hotspots," *Nature* (445)7129, pp. 757–60.

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C. S., and Walker, B. (2002), "Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations," *Ambio*, vol. 31, pp. 437–40.

Fraser, Evan D. G., Mabee, Warren, and Slaymaker, Olav (2003), "Mutual Vulnerability, Mutual Dependence: The Reflexive Relation Between Human Society and the Environment," *Global Environmental Change*, vol. 13, pp. 137–44, available at doi:10.1016/S0959-3780(03)00022-0, viewed on October 6, 2016.

Freeman, Linton C. (1976), *A Bibliography of Social Networks*, Council of Planning Librarians, Monticello.

Fuglie, Keith O., and Rada, Nicholas E. (2012), "Constraints to Raising Agricultural Productivity in Sub-Saharan Africa," in K. O. Fuglie (ed.), *Productivity Growth in Agriculture: An International Perspective*, pp. 237–68, CAB International, Wallingford.

Füssel, Hans-Martin, and Klein, Richard J. T. (2006), "Climate Change Vulnerability Assessments: An Evolution of Conceptual Thinking," *Climatic Change*, vol. 75, pp. 301–29.

Goodman, D., and Watts, M. (eds.) (2013), *Globalising Food: Agrarian Questions and Global Restructuring*, Routledge, New York.

Gordhan, Pravin (2013), "Minister of Finance Pravin Gordhan Presents the 2013 Budget Speech," presented at the 2013 Annual Budget Speech to the Parliament of the Republic of South Africa, March 1, available at http://www.gov.za/minister-finance-pravin-gordhan-presents-2013-budget-speech, viewed on October 6, 2016.

Greiner, R., and Grosskopf, W. (1990), "Extensification of Agricultural Land-Use," *Berichte über Landwirtschaft* (*Reports on Agriculture*), vol. 68, pp. 523–41.

Gupta, Sanjeev, Pattillo, Catherine A., and Wagh, Smita (2009), "Effect of Remittances on Poverty and Financial Development in Sub-Saharan Africa," *World Development*, vol. 37, pp. 104–15, available at doi:10.1016/j.worlddev.2008.05.007, viewed on October 6, 2016.

Gurak, Douglas T., and Caces, Fee (1992), "Migration Networks and the Shaping of Migration Systems," in Mary M. Kritz, Lin Lean Lim, and Hania Zlotnik (eds.), *International Migration Systems: A Global Approach*, Oxford University Press, Oxford, pp. 150–76.

Hall, Ruth (2007), "Transforming Rural South Africa: Taking Stock of Land Reform," in L. Ntsebeza, and R. Hall, (eds.), *The Land Question in South Africa: The Challenge of Transformation and Redistribution*, Human Sciences Research Council, Cape Town, pp. 87–106.

Hammen, Oscar J. (1972), "Marx and the Agrarian Question," *The American Historical Review*, vol. 77, pp. 679–704, available at doi:10.2307/1870346, viewed on October 6, 2016.

Hampel, F. R., Ronchetti, E. M., Rousseeuw, P. J., and Stahel, W. A. (1986), *Robust Statistics: The Approach Based on Influence Functions*, John Wiley and Sons, New York.

Hawn, A. (2005), "South Africa Puts the Unemployed to Work, Restoring Land and Water," *The New York Times*, July 26.

Hebinck, Paulus, and Lent, Peter C. (2007), *Livelihoods and Landscapes: The People of Guquka and Koloni and Their Resources*, Brill, Leiden.

Heron, William Thomas, and Hunter, Walter Samuel (1922), *Studies of the Reliability of the Problem Box and the Maze With Human and Animal Subjects*, vol. 1, Williams and Wilkins, Baltimore.

Holling, C. S., Carpenter, S. R., Brock, W. A., and Gunderson, L. H. (2002) "Discoveries for Sustainable Futures," in L. H. Gunderson, and C. S. Holling (eds.), *Panarchy Synopsis: Understanding Transformations in Human and Natural Systems*, Island Press, Washington D. C.

Hulme, Mike (1994), "Regional Climate Change Scenarios Based on IPCC Emissions Projections With Some Illustrations for Africa," *Area*, vol. 26, pp. 33–44.

Inderberg, T. H. S., Eriksen, S., O'Brien, K., and Sygna, L. (eds.) (2015), *Climate Change Adaptation and Development: Transforming Paradigms and Practices*, Taylor and Francis, Abingdon.

International Organization for Migration (IOM) (2009), "In Pursuit of the Southern Dream: Victims of Necessity," *IOM*, Geneva.

Jensen, Robert T. (2004), "Do Private Transfers 'Displace' the Benefits of Public Transfers? Evidence From South Africa," *Journal of Public Economics*, vol. 88, pp. 89–112, available at doi:10.1016/S0047-2727(02)00085-3, viewed on October 6, 2016.

Joemat-Pettersson, Tina (2012), "Climate; Minister Joemat-Pettersson's Message," presented at the 2nd Conference on Agriculture, Food Security and Climate Change, Pretoria, South Africa, available at http://www.gov.za/minister-joemat-pettersson%E2%80%99s-message-2nd-conference-agriculture-food-security-and-climate-change, viewed on October 6, 2016.

Kadushin, C. (2012), *Understanding Social Networks: Theories, Concepts, and Findings*, Oxford University Press, New York.

Karriem, A. and Hoskins, M. (2016), "From the RDP to the NDP: A Critical Appraisal of the Developmental State, Land Reform, and Rural Development in South Africa," *Politikon*, vol. 43, no. 3, pp. 1–19.

Kaschula, Sarah A., and Shackleton, Charles M. (2012), "How Do HIV and AIDS Impact the Use of Natural Resources by Poor Rural Populations? The Case of Wild Animal Products," *South African Journal of Science*, vol. 108.

Kautsky, K. (1988), *The Agrarian Question*, Zwan Publications, London.

Keilman, N. (1995), "Household Concepts and Household Definitions in Western Europe: Different Levels but Similar Trends in Household Developments," in E. van Imhoff, A. Kuijsten, P. Hooimeijer, and L. van Wissen (eds.), *Household Demography and Household Modelling*, Springer, New York.

Kish, Leslie (1949), "A Procedure for Objective Respondent Selection Within the Household," *Journal of the American Statistical Association*, vol. 44, pp. 380–7.

Klasen, Stephan, and Woolard, Ingrid (2009), "Surviving Unemployment Without State Support: Unemployment and Household Formation in South Africa," *Journal of African Economies*, vol. 18, pp. 1–51.

Kok, P. C., O'Donovan, M., and Bouare, O. (2003), *Post Apartheid Patterns of Internal Migration in South Africa*, HSRC Publishers, Cape Town.

Leibbrandt, Murray, Levinsohn, James A., and McCrary, Justin (2010), "Incomes in South Africa After the Fall of Apartheid," *Journal of Globalisation and Development*, vol. 1, available at doi:10.2202/1948-1837.1023, viewed on October 6, 2016.

Lin, Nan (2001), *Social Capital: A Theory of Social Structure and Action*, Cambridge University Press, Cambridge and New York.

Luckert, M. K., and Campbell, B. M. (eds.) (2002), *Uncovering the Hidden Harvest: Valuation Methods for Woodland and Forest Resources*, Taylor & Francis, London.

Magee, T. (2013), *A Field Guide to Community Based Adaptation*, Routledge, New York.

Stats SA (2012), "Maize Emergence Under Conservation Agriculture," *Grains SA*, October.

Makiwane, Monde, and Chimere-Dan, O. D. (2011), *The State of the Population in the Eastern Cape*, Human Sciences Research Council, Pretoria.

Marais, H. (2011), *South Africa Pushed to the Limit: The Political Economy of Change*, Zed Books, London.

Massey, Douglas S., and Espana, Felipe Garcia (1987), "The Social Process of International Migration," *Science*, vol. 237, pp. 733–8.

McAllister, P. (2000), "Maize Yields in the Transkei: How Productive is Subsistence Cultivation? Land Reform and Agrarian Change in Southern Africa," *Land Reform and Agrarian Change in Southern Africa*, vol. 14, University of Western Cape, Cape Town.

McCarty, C. (2002), "Structure in Personal Networks," *Journal of Social Structure*, vol. 3, available at https://www.cmu.edu/joss/content/articles/volume3/McCarty.html, viewed on October 6, 2016.

McGarry, Dylan K., and Shackleton, Charlie M. (2009), "Children Navigating Rural Poverty: Rural Children's Use of Wild Resources to Counteract Food Insecurity in the Eastern Cape, South Africa," *Journal of Children and Poverty*, vol. 15, pp. 19–37; available at doi:10.1080/10796120802677594, viewed on October 6, 2016.

Municipal IQ (2013), *Municipal Productivity Index: Best/Worst Performing Municipalities*.

Neves, David, Samson, Michael, van Niekerk, Ingrid, Hlatshwayo, Sandile, and du Toit, Andries (2009), *The Use and Effectiveness of Social Grants in South Africa*, Finmark Trust, Johannesburg.

Neves, David, and du Toit, Andries (2013), "Rural Livelihoods in South Africa: Complexity, Vulnerability, and Differentiation," *Journal of Agrarian Change*, vol. 13, pp. 93–115, available at doi:10.1111/joac.12009, viewed on October 6, 2016.

Padayachee, Vishnu (2011), "Global Economic Recession: Effects and Implications for South Africa at a Time of Political Challenges," in *Selected Papers and Presentations From ID20 Academic Workshops*, London School of Economics, London.

Parry, Martin Lewis, Canziani, Osvaldo F., Palutikof, Jean P., van der Linden, Paul J., and Hanson, Clair E. (2007), *Climate Change 2007: Impacts, Adaptation, and Vulnerability*, Intergovernmental Panel on Climate Change, Cambridge.

Paumgarten, F. (2005), "The Role of Non-Timber Forest Products as Safety-Nets: A Review of Evidence With a Focus on South Africa," *GeoJournal*, vol. 64, pp. 189–97.

Pelling, M., and High, C. (2005), "Understanding Adaptation: What Can Social Capital Offer Assessments of Adaptive Capacity?" *Global Environmental Change Part A*, vol. 15, pp. 308–19.

Polzer Ngwato, T. (2010), "Population Movements in and to South Africa," *Issue Brief 491*, Forced Migration Studies Programme, Johannesburg.

Posel, Dorrit (2001), "How Do Households Work? Migration, the Household, and Remittance Behaviour in South Africa," *Social Dynamics*, vol. 27, pp. 165–89.

Reed, Holly E. (2013), "Moving Across Boundaries: Migration in South Africa, 1950–2000," *Demography*, vol. 50, pp. 71–95.

Reid, Paul, and Vogel, Coleen (2006), "Living and Responding to Multiple Stressors in South Africa: Glimpses From KwaZulu-Natal," *Global Environmental Change*, vol. 16, pp. 195–206.

Ribot, Jesse C. (1995), "The Causal Structure of Vulnerability: Its Application to Climate Impact Analysis," *GeoJournal*, vol. 35, no. 2, pp. 119–22.

Samers, M. (2009), *Migration*, Routledge, New York.

Saradamoni, Kunjulekshmi (1992), *Finding the Household*, SAGE Publications, Thousand Oaks, CA.

Scoones, Ian (1998), *Sustainable Rural Livelihoods: A Framework for Analysis*, vol. 72, Institute of Development Studies, Brighton.

Scoones, Ian, and Wolmer, William (2003), "1. Introduction: Livelihoods in Crisis: Challenges for Rural Development in Southern Africa," *IDS Bulletin*, vol. 34, pp. 1–14.

Shackleton, Charlie M., Shackleton, Sheona E., and Cousins, Ben (2001), "The Role of Land-Based Strategies in Rural Livelihoods: The Contribution of Arable Production, Animal Husbandry and Natural Resource Harvesting in Communal Areas in South Africa," *Development Southern Africa*, vol. 18, pp. 581–604.

Shackleton, Charlie M., and Shackleton, Sheona E. (2004), "The Importance of Non-Timber Forest Products in Rural Livelihood Security and as Safety Nets: A Review of Evidence From South Africa," *South African Journal of Science*, vol. 100, pp. 658–64.

Slater, Rachel, and Wiggins, Steve (2009), *Responding to HIV/AIDS in Agriculture and Related Activities*, ODI Natural Resource Perspectives.

Smit, B., and Wandel, J. (2006), "Adaptation, Adaptive Capacity, and Vulnerability," *Global Environmental Change*, vol. 16, pp. 282–92, available at doi:10.1016/j.gloenvcha.2006.03.008, viewed on October 6, 2016.

Smith, P., and Olesen, Jørgen E. (2010), "Synergies Between the Mitigation of, and Adaptation to, Climate Change in Agriculture," *Journal of Agricultural Science*, vol. 148, pp. 543–52.

Statistics South Africa (2012), *Census 2011: Statistical Release P0301.4*, Statistics South Africa, Pretoria.

Stringer, Lindsay C., Twyman, Chasca, and Gibbs, Leah M. (2008), "Learning From the South: Common Challenges and Solutions for Small-Scale Farming," *The Geographical Journal*, vol. 174, pp. 235–50.

Taylor, M. (2014), *The Political Ecology of Climate Change Adaptation: Livelihoods, Agrarian Change, and the Conflicts of Development*, Routledge, New York.

Turpie, J. K., Marais, C., and Blignaut, J. N. (2008), "The Working for Water Programme: Evolution of a Payments for Ecosystem Services Mechanism that Addresses Both Poverty and Ecosystem Service Delivery in South Africa," *Ecological Economics*, vol. 65, no. 4, pp. 788–98.

UNESCO (2013), "Cape Floral Region Protected Areas," available at http://whc.unesco.org/en/list/1007/multiple=1&unique_number=1177, viewed on December 14, 2016.

Valente, T. W. (2010), *Social Networks and Health: Models, Methods, and Applications*, Oxford University Press, Oxford.

Van Aalst, Maarten K., Cannon, Terry, and Burton, Ian (2008), "Community Level Adaptation to Climate Change: The Potential Role of Participatory Community Risk Assessment," *Global Environmental Change*, vol. 18, pp. 165–79.

Van Eck, B., Selomane, O., Broeck, D., and Zijlstra, M. (2010), "Cultivating the 'PRESENCE' Learning Network to Restore Living Landscapes: Adapting to Climate Change in the Baviaanskloof Catchment, South Africa," Gland, Switzerland.

Vanhaute, Eric (2012),"Peasants, Peasantries and (De) Peasantisation in the Capitalist World-System," in Salvatore J. Babones, and Christopher Chase-Dunn (eds.), Routledge Handbook of World-Systems Analysis, Routledge, New York, pp. 313–21.

Walker, B. H., Anderies, J. M., Kinzig, A. P., and Ryan, P. (2006), "Exploring Resilience in Social-Ecological Systems Through Comparative Studies and Theory Development: Introduction to the Special Issue," *Ecology and Society*, vol. 11, p. 12.

Warrick, R. A., and Riebsame, W. E. (1983), "Societal Response to CO2-Induced Climate Change: Opportunities for Research," in R. S. Chen (ed.), *Social Science Research and Climate Change: An Interdisciplinary Appraisal*, Kluwer, Dordrecht, pp. 387–428.

Wilson, Tamar Diana (1993), "Theoretical Approaches to Mexican Wage Labour Migration," *Latin American Perspectives*, vol. 20, pp. 98–129.

World Bank (2013), "World Databank," available at http://databank.worldbank.org/ddp/home.do?Step=12&id=4&CNO=2, viewed on December 14, 2016.

World Bank (2016), "GDP (Current USD)," available at http://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=ZA, viewed on December 14, 2016.

Yohe, Gary, and Tol, Richard S. J. (2002), "Indicators for Social and Economic Coping Capacity: Moving Toward a Working Definition of Adaptive Capacity," *Global Environmental Change*, vol. 12, pp. 25–40.

Appendix 1

Livelihood Diversity (L) is a linear function of several parameters, and so may be presented in matrix form:

$$L = c_L^T P_L$$

Where c_L is the vector of numerical constants and P_L are independent variables given below

$$c_L = \begin{pmatrix} 22.574/3 \\ 22.574/3 \\ 22.574/3 \\ 8.7465 \\ 8.724 \\ 8.724 \end{pmatrix}, P_L = \begin{pmatrix} H2 \\ \mathcal{J}2 \\ BV2 \\ BG2 \\ BX2 \\ L2 \\ BK2 \end{pmatrix}$$

$H2$ – how much money does the households receive (Rand), $\mathcal{J}2$ – household has own business (yes/no), $BV2$ – household collects wild fruits or vegetables, $BG2$ – household has field currently in cultivation or fallow (yes/no), $BX2$ – household collects veldt products, $L2$ – household has livestock (yes/no), $BK2$ – household receives social grants, including pension (yes/no)

Natural Resource Reliance (*NRR*) is a linear function of several parameters, and so may be presented in matrix form:

$$NRR = c_{NRR}^{T} P_{NRR}$$

Where c_{NRR} is the vector of numerical constants and P_{NRR} are independent variables given below

$$c_{NRR} = \begin{pmatrix} 28.543/3 \\ 28.543/3 \\ 28.543/3 \\ 10.086 \\ 10.086 \\ 1 \\ 17.457 \end{pmatrix}, P_{NRR} = \begin{pmatrix} BT2 \\ BW2 \\ BU2 \\ BX2 \\ BY2 \\ CB2 \\ 1 \end{pmatrix}$$

*BT*2 – household collects water from river or borehole (yes/no), *BW*2 – household collects medicinal plants not in cultivation (yes/no), *BU*2 – collects firewood (yes/no), *BX*2 – household hunts or fishes (yes/no), *BY*2 – household collects other products from non-cultivated land (yes/no), *CB*2 – household uses more, less, or same amount of cultivated land as 10 years ago (1,0,-1)

Household Health (*HH*) is a linear function of several parameters, and so may be presented in matrix form:

$$HH = c_{HH}^{T} P_{HH}$$

Where c_{HH} is the vector of numerical constants and P_{HH} are independent variables given below

$$c_{HH} = \begin{pmatrix} 13.1845 \\ 13.1845 \\ 12.4955 \\ 12.4955 \\ 9.198 \\ 9.198 \end{pmatrix}, P_{HH} = \begin{pmatrix} BP2 \\ BQ2 \\ Q2 \\ CR2 \\ CZ2 \\ DO2 \end{pmatrix}$$

*BP*2 – household believes that disease has an effect on labour to undertake normal activities (yes/no), *BQ*2 – household believes that disease affects need to immigrate (yes/no), *Q*2 – household receives disability grants (yes/no), *CR*2 – somebody is currently ill in the household (yes/no), *CZ*2 – did somebody in the household die in the last year? (yes/no), *DO*2 – household believes that disease affects trust in the community (yes/no)