



HAL
open science

Prepare for the unanticipated: Portfolios of coping strategies of rural households facing diverse shocks

Fiona Paumgarten, Bruno Locatelli, Ed T F Witkowski, Coleen Vogel

► To cite this version:

Fiona Paumgarten, Bruno Locatelli, Ed T F Witkowski, Coleen Vogel. Prepare for the unanticipated: Portfolios of coping strategies of rural households facing diverse shocks. *Journal of Rural Studies*, 2020, 80, pp.91 - 100. 10.1016/j.jrurstud.2020.05.013 . cirad-03920221

HAL Id: cirad-03920221

<https://hal.science/cirad-03920221>

Submitted on 3 Jan 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

Prepare for the unanticipated: Portfolios of coping strategies of rural households facing diverse shocks

Fiona Paumgarten (1), Bruno Locatelli (1,2,3), Ed T. F. Witkowski (1), Coleen Vogel (1,4)

(1) School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, Johannesburg, South Africa

(2) Forests and Societies, University of Montpellier and CIRAD, Montpellier, France

(3) Center for International Forestry Research, Lima, Peru

(4) Global Change Institute, University of the Witwatersrand, Johannesburg, South Africa

Accepted manuscript of the following paper: Paumgarten F., Locatelli B., Witkowski E.T.F., Vogel C., 2020. Prepare for the unanticipated: Portfolios of coping strategies of rural households facing diverse shocks. *Journal of Rural Studies*, [doi:10.1016/j.jrurstud.2020.05.013](https://doi.org/10.1016/j.jrurstud.2020.05.013).

Abstract

Rural households have established various informal strategies to cope with unanticipated shocks. These existing coping strategies are receiving renewed interest, particularly in the context of climate change and in terms of the role they do, and can play, in enhancing households' adaptive capacity. An improved understanding of these strategies, and the factors that influence their application, may support the design of locally relevant adaptation strategies. We explored the nature and prevalence of unanticipated shocks, including natural hazards, experienced by households in two villages in Venda, South Africa, with the villages selected, in part, because of notable differences in precipitation. We considered the influence of shock type, and household- and location-specific characteristics, on the use of various household-level coping strategies. We report on semi-structured interviews, administered to 170 randomly selected households, and a participatory rural appraisal. Almost 90% of households reported the experience of at least one unanticipated shock over a prescribed 5-year period, with natural hazards reported by 42%. The type of shock experienced and various household-level characteristics, such as households' access to human and financial capital, influences households' coping response. Households' access to natural and social capital allowed for the protection of ex-ante coping options. Overall, our findings indicate that when possible, households actively manage their coping strategy portfolio, both in response to the shock experienced and in anticipation of future shocks. Generally, households' informal, ex-post coping options appear to be insufficiently robust for the covariate nature of natural hazards, suggesting the need for interventions that support households' existing coping portfolio.

Keywords

Coping; Multiple shocks; Natural hazards; Non-timber forest products; Participatory rural appraisal; Rural households

1. Introduction

Rural households inhabit a state of often persistent and complex uncertainty, which undermines their efforts to secure a sustainable livelihood (DFID, 1999). This includes the experience of more unanticipated shocks, including climate-related shocks such as natural hazards. In general, more marginalized groups, including poorer, female-headed, and natural resource dependent households, tend to be more vulnerable to, and less able to cope with, these various shocks (Shackleton and Shackleton, 2004; Börner et al., 2015; Djoudi et al., 2016; Flatø et al., 2017). In developing countries, where public safety-nets are limited, and where poor, rural households have limited access to formal, private insurance, households have established various informal strategies to cope with shocks. These coping strategies consist of short-term responses to immediate threats, through which households, within the ambit of their available resources, aim to minimize the impact of the stress (Blaikie, 1994; Eriksen and Silva, 2009; Coulibaly et al., 2015; Mehar et al., 2016). Common strategies include the liquidation of assets (e.g. livestock); the reallocation of labour; changes in household spending and consumption; the use of formal and informal savings and loans and, the reliance on family- and community-support networks (kinship) and on external organizations (Corbett, 1988; Dekker, 2004; Heemskerk et al., 2004; Cooper et al., 2008; Eriksen and Silva, 2009; Adimassu and Kessler, 2016). More recently, attention has been drawn to the safety-net function of natural resources (including non-timber forest products (NTFPs)), including their role in smoothing consumption and income variations (McSweeney, 2005; Paumgarten and Shackleton, 2011; Mugido and Shackleton, 2017).

Households' coping strategies are often distinguished as either ex-post or ex-ante strategies, with the former described as reactive strategies and the latter, as more anticipatory, precautionary and active strategies (Adams et al., 1998; Cooper et al., 2008; McCarthy and Martello, 2010). Households' reliance on ex-post strategies is often framed within the context of limited control over their coping options and limited access to alternatives, although some suggest that even these ex-post strategies require some degree of anticipation (Cooper et al., 2008; Börner et al., 2015). For example, the liquidation of assets such as livestock requires their initial, anticipatory accumulation. Households may also purposefully turn to these ex-post options to manage their future insurance options, with Corbett (1988) arguing that households actively sequence and prioritize strategies. Despite the common bundle of responses, households' ultimate selection and application of coping strategies (whether ex-post or ex-ante), and their overall capacity to cope, has been argued to depend on multiple factors, including the nature and duration of the shock, individual household characteristics (e.g. the gender of the household head), as well as contextual factors such as access to public and financial services, natural resources, and markets (Osborne et al., 2008; Tran, 2015; Gautier et al., 2016; Van Aelst and Holvoet, 2016). Although these informal coping strategies may prove effective in the face of small to medium idiosyncratic shocks, concerns exist over their ability to insure against large, covariate shocks (e.g. natural hazards), which affect several households simultaneously (Skoufias, 2003; McSweeney, 2005; Günther and Harttgen, 2009; Wunder et al., 2014). Increasingly frequent and intense covariate, climate-related shocks, a possible outcome of climate change, may overburden households' existing coping portfolio and push households and communities beyond their capacity to cope (Smit and Wandel, 2006; Börner et al., 2015; Coulibaly et al., 2015).

Despite these concerns, households' existing coping strategies are receiving renewed interest, particularly within the context of climate change and in terms of the role they do, and can play, in enhancing households' adaptive capacity (Brockhaus et al., 2013; IPCC, 2014; Börner et al., 2015; Hänke and Barkmann, 2017). Eriksen and Silva (2009) argue, that in order to reduce households' overall vulnerability, there is the need to support both their ability to engage short-term coping strategies and to adapt to more long-term risks. Although distinctions between coping and adapting are generally framed on the timescale of response (Smit and Wandel, 2006; Osborne et al., 2008),

others suggest that this dichotomy may be misleading, with coping strategies either morphing into adaptation strategies, or with households using their coping strategies to adapt (Berkes and Jolly, 2001; Fabricius et al., 2007). Strengthening households' existing coping portfolio has therefore been described as a possible means of facilitating early forms of adaptation (Cooper et al., 2008; Castells-Quintana et al., 2018). Within this context, it has been argued that an improved understanding of households' past responses to shocks (including natural hazards), their existing coping options, the opportunities and constraints associated with these, as well as how households combine and protect their coping strategies, may provide useful insights into enhancing coping and facilitating adaptation (Smit and Wandel, 2006; Cooper et al., 2008; Börner et al., 2015; Mehar et al., 2016; Ofoegbu et al., 2016). This study sought to contribute towards this improved understanding. To do so we consider the nature and prevalence of multiple, unanticipated shocks, including natural hazards, experienced by rural households in Venda, South Africa. We explore the range and prevalence of coping strategies used in response to these shocks, and whether certain strategies are more often used to respond to particular shocks. In addition to exploring whether shock type influences the strategy used, we consider whether a range of household socio-demographic and -economic characteristics and location have an influence. Finally, we consider the respective coping strategies' limitations in buffering households against covariate natural hazards.

The remainder of this paper is organized as follows: section two describes the study area, section three describes the data collection and analysis processes, section four describes and discusses the main findings, including i.) households' exposure to multiple shocks, ii.) households' use of, and preference for, specific coping strategies, iii.) the associations between the different shocks and coping strategies and, iv.) the determinants of the strategies used. Section five presents the main conclusions and recommendations.

2. Study area

The research was conducted in the villages of Bennde Mutale (31°1'48''E; 22°24'14''S) and Vondo (30°21'60''E; 22°56'5''S), in the Vhembe District Municipality of South Africa's Limpopo Province, one of the country's poorest provinces (Statistics South Africa (SSA), 2014; Paumgarten et al., 2018). Prior to South Africa's 1994 democratic transition, both villages fell within the Venda homeland. "Homelands" were territories set aside, under South Africa's apartheid policies, for the re-settlement of black South Africans (Thornton, 2002). These areas remain characterized by limited development, poor service provision, low education levels, high dependency ratios, and high unemployment rates, with state welfare grants and migrant remittances making an important contribution to households' income (SSA, 2014). To secure their livelihoods, households engage in diverse, land-based and off-farm livelihood strategies (Venter and Witkowski, 2013; Ofoegbu et al., 2016). Limited access to productive assets, a high incidence of HIV/Aids and food insecurity, and variable (and often extreme) weather conditions, including natural hazards such as floods and droughts, exacerbate household vulnerability (Neves and Du Toit, 2013; Venter and Witkowski, 2013; Shisana et al., 2014). Climate change, including increasing temperatures and decreasing rainfall, is likely to intensify households' overall vulnerability context (Turpie and Visser, 2013).

Bennde Mutale and Vondo consist of 327 and 340 households respectively (Table 1). Bennde Mutale is bordered by communal rangelands, conservation areas (e.g. the Kruger National Park) and a military corridor. Pine and tea plantations border Vondo. The dominant vegetation types include mixed Musina Mopane Bushveld and Makuleke Sandy Bushveld in Bennde Mutale and Soutpansberg Mountain Bushveld in Vondo (Mucina and Rutherford, 2011). In both sites, households continue to rely on natural resources, including NTFPs, however as Vondo falls within a more densely populated local municipality, households have less access to unconverted land. They do, however, have better access to the nearest, sizeable commercial centre (i.e. Thohoyandou). Although both sites receive summer rainfall, the difference in mean annual precipitation was one of the primary criteria for the site selection, with Bennde Mutale and Vondo receiving, respectively, 402 ± 141 mm and 1108 ± 371

mm for the period 1981–2014 (Funk et al., 2015). Bennde Mutale is warmer, with a mean annual temperature of 24.7 °C, versus 19.0 °C for Vondo. As such, Bennde Mutale is henceforth referred to as the “dry site”, and Vondo as the “wet site”. Natural hazards, including floods and droughts, are experienced in both sites.

Table 1. Summary profile of the two sites – socio-cultural attributes of the sampled households (n = 170) were compared - () indicates differences at p < 0.05*

	Dry Site	Wet Site
Av. number of people/household	5.3	4.7
Av. age of the household (years)	19.5	20.8
Av. age of the household members (years)	26.3	27.4
Av. education of the household members (years)	6.2	7.2
Female-headed households (%)	43.5	42.4
Electricity for lighting (%)	94.1	98.8
Firewood for cooking and heating (%)	100.0	95.1
Formal housing (%):		
~ brick walls	49.4	56.5
~ metal roofs	67.1*	100.0
Water sources (%):		
~ communal taps	97.6*	41.2
~ natural (rivers, springs, etc.)	28.2*	98.8
Households owning livestock (%)	61.2*	25.9
Households cultivating (%)	63.5*	95.3
Households using NTFPs (%)	100.0	96.5
Households receiving migrant remittances (%)	28.2	29.4
Households receiving government grants (%)	84.7	90.6
Households with formally employed members (%)	29.4*	16.5

3. Methods

3.1. Data collection

Quantitative and qualitative data were collected through a participatory rural appraisal (PRA), a semi-structured household survey, key informant interviews and personal observations.

Following a livelihoods approach, data were collected on households’ characteristics, their livelihood strategies, their access to different assets (i.e. natural, social, financial, human and physical capital, as described in the Sustainable Livelihoods Framework (DFID, 1999)), their vulnerability context (including their experience of various unanticipated shocks), and the coping strategies employed in response to unanticipated shocks.

The PRA, conducted during voluntary community workshops, consisted of exercises such as the construction of seasonal calendars; historical profiles; time trends; and impact chains, which all allowed for discussions on the community's overall vulnerability context (DFID, 1999; Dazé et al., 2009; Turnbull and Turvil, 2012). Respondents discussed the experience of common climate-related shocks, specifically floods and droughts, their impacts, as well as the measures households, and the community, have historically used to cope with these.

The household survey was administered to 170 randomly selected households, 85 per village, and included questions on households’ experience (over the preceding 5 years) of twelve common shocks identified during the PRA (Table 2). The focus was on unanticipated shocks, for example, unexpected crop losses rather than predictable, seasonal crop shortfalls. Similarly, the costs associated with unpredictable social events (e.g. funerals) were considered, not those associated

with more predictable, annual social events such as religious holidays. For each shock, households were asked to identify the coping strategies used, selecting from a list of twelve common strategies, also identified during the PRA.

Table 2. Percentage of households (HH) using a coping strategy (in rows, either external or internal) among the households reporting a shock (in columns).

Shocks	All shocks (152 or 89% of all HH)	Production shocks (127 or 75% of all HH)	Human shocks (100 or 59% of all HH)	Financial shocks (67 or 39% of all HH)	Natural hazards (71 or 42% of all HH)
Description of shocks (prior to clustering)		Crop and livestock losses; crop and livestock pests/diseases; loss of agricultural/grazing land; damage to HH infrastructure/assets	Increase in the number of dependents; death of a HH member; serious/chronic illness or injury	Loss of remittances and wages; failure of self-owned business; expenditure on social events	Floods, droughts, strong winds, etc.
External Strategies					
Kinship	80	66	58	73	53
External Assistance (from government or NGOs)	79	64	59	22	63
Loans	18	15	3	18	6
Internal Strategies					
Savings	80	79	54	72	69
Labor Reallocation (local employment or outmigration)	67	42	57	48	21
Spending Reductions (reducing cash expenses or quantity/quality of meals)	66	55	44	31	21
Natural Products (NTFPs)	41	33	25	19	1
Asset Depletion (of manufactured assets or livestock)	27	23	13	19	8

3.2. Data analysis

We grouped the pre-selected shocks into four overarching groups, namely production, financial and human shocks as well as natural hazards (Table 2). The selected responses were grouped into 8 categories and designated as either internal (e.g. adjustments to household savings or consumption) or external (e.g. assistance from outside the household) strategies.

The first analysis examined whether the type of shock experienced influences the coping strategies used. We represented the frequency of reported shocks and coping strategies in mosaic plots and used simple tests (independence test using Pearson residuals) to identify the strategies that were significantly more or less frequently associated with the different shocks (Fig. 1). For the second analysis, we used a multivariate analysis to explore whether the adoption of a coping strategy was influenced by explanatory variables related to site and/or household characteristics (Table Annex 1). These variables fell into 5 categories, namely: 1.) basic household descriptors related to location and the demography of the household, 2.) households' available savings and assets (capital stocks), 3.) households' access to kinship and community-support networks, 4.) households' existing livelihood strategies and income sources, and 5.) households' existing human capital. Some skewed explanatory variables were log-transformed before the analysis. We used a logit linear model to

explain the use of a strategy. In the version 3.3.2 of the R software (R Core Team, 2016), the “step” function was used to select variables for the model. The function started from a full model and successively dropped or added variables to minimize the AIC score. We reported the significant variables ($p < 0.05$) of the final model and described whether they had a positive or negative effect on the strategy used.

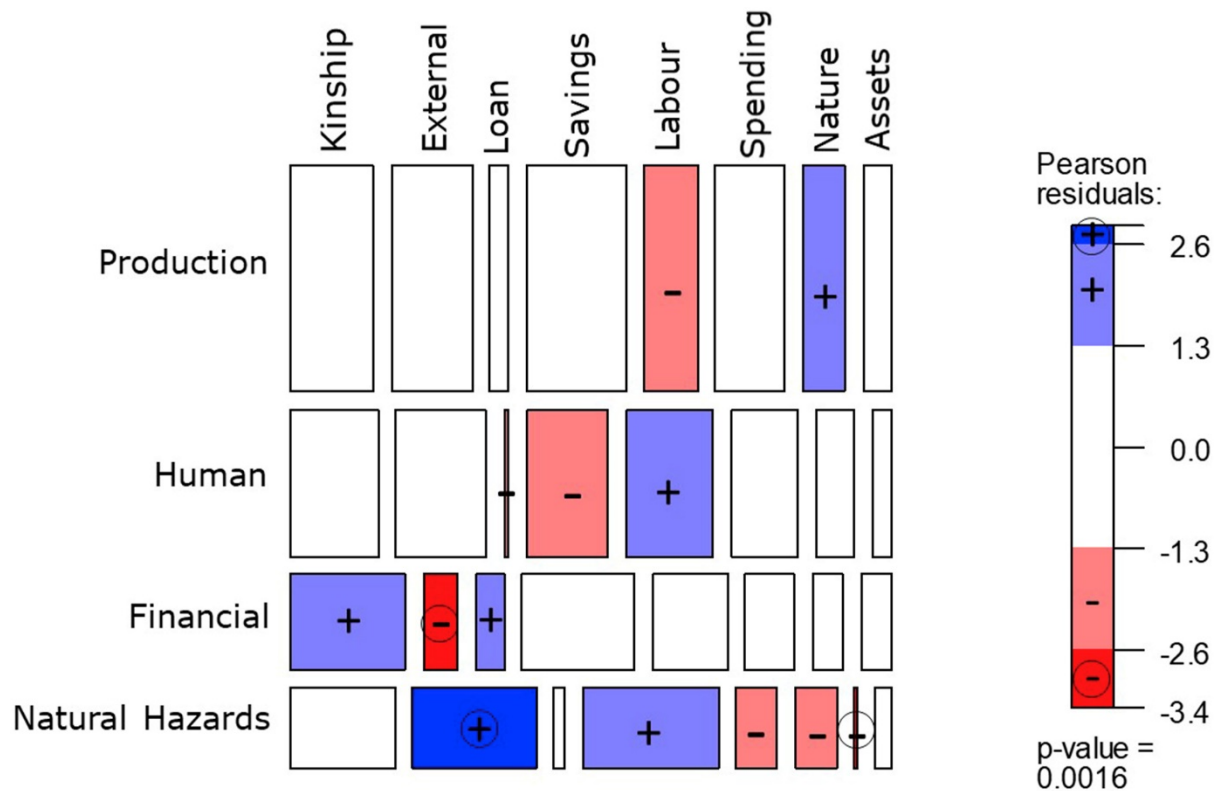


Fig. 1. Mosaic plot of the frequency of reported shocks and coping strategies, indicating positive and negative associations between each shock and strategy. Each box is associated with a shock (left list) and a strategy (top list). The height of a box is proportional to the number of reports of the corresponding shock, while the width is proportional to the number of times a strategy was reported for this shock. Box colours show the outcome of an independence test using Pearson residuals to highlight associations between the shocks and strategies. Blue boxes or plus signs indicate positive residuals (i.e. this strategy was used more for this shock than expected, if the shock and strategy were independent variables) and red boxes or minus signs indicate negative residuals. Bright blue (or bright red) boxes (with circled plus or minus signs) indicate residuals with absolute values exceeding a critical value (95% percentile in the distribution of absolute Pearson residuals). For the sake of simplicity, boxes with absolute residuals below 50% of this critical value are white. The plot was drawn with the vcd package in R and the distribution of absolute Pearson residuals was calculated with the function `coinddep.test` of this package (Meyer et al., 2016). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

4. Results and discussion

4.1. Households' experience of multiple shocks

Production shocks were the most commonly reported (Table 2). Multiple factors caused unanticipated crop and livestock losses (workshops). For example, in the wet site, respondents noted crop losses from pest outbreaks while in the dry site cross-border cattle rustling occurs, driven by neighbouring Zimbabwe's economic crisis (Thornycroft, 2017) and livestock is occasionally killed by wildlife escaping the neighbouring conservation areas. Crop and livestock losses were also associated with extreme temperatures and unpredictable rainfall. Production shocks included the loss of, or damage to, household infrastructure and assets, including, for example, termite damage to food/seed storage facilities.

Human shocks were the second most commonly reported. Although primarily associated with an increase in dependents, these shocks included the death of household members and serious illnesses/injuries which resulted in either reduced labour availability (of the patient or the primary caretaker) and/or expensive medical treatment. For example, respondents in both sites reported an increase in HIV/Aids and diabetes, with one elder explaining that historically, it was unusual for young adults to die, with this no longer being the case. In South Africa, an increase in dependents is a complex shock, resulting in increased pressure on the household's existing resources, while simultaneously (potentially) increasing the household's access to government social grants.

The experience of impacts associated with natural hazards, was reported by 42% of households. Both sites experienced floods in 2013, the year preceding the fieldwork, with the dry site worst affected, receiving more rainfall in one week, than its annual average (Du Preez and Seale, 2013; Pringle et al., 2013). These floods, caused by a tropical low-pressure system, were associated with multiple, simultaneous impacts, including production, human and financial shocks (workshops), which may have, therefore, been more commonly reported than usual. For example, crops, livestock, irrigation pumps, agricultural and grazing land, and NTFPs were washed away; community infrastructure was damaged; and houses collapsed, damaging assets and food/seed stores. In the dry site, temporary job losses occurred when a nearby tourist camp was closed due to flood damage. Incidences of malaria and cholera increased. Other natural hazards, and their associated impacts, were also reported, including hail and strong winds. A tornado was experienced in the dry site. In the wet site, landslides destroyed several orchards.

Financial shocks were the least commonly reported, and included the loss of income from wages, remittances, government grants, and money earned through self-employment. For example, in the dry site, the closure of a nearby mine resulted in job losses. Respondents also noted the failure of locally owned businesses, with one household having to close their tuck-shop when a bigger store opened in the village, while another claimed that their business, raising and selling chickens, failed because households in the village preferred, and had access to, bushmeat. Financial shocks were also associated with expensive social events such as weddings and funerals.

Over the selected 5-year period, only 11% of households reported no experience of the selected shocks, while 71% reported the experience of two or more shocks.

4.2. External and internal household coping strategies

4.2.1. External coping strategies

Kinship was the most commonly reported external, and overall, coping strategy, with households seeking assistance from family and community-support networks (e.g. religious groups and informal savings clubs) (Table 2). Seeking external assistance from government and non-government organizations (NGOs) was also common and included both seeking support through the existing agricultural extension, food aid, and healthcare programmes and post-disaster assistance related to

the 2013 floods. The remaining external strategy was seeking loans, with this being the least commonly used strategy overall. Some households received loans from formal money-lending institutions or their employers, but most sought loans from local loan sharks or informal, community-based savings groups. Some local shops sold goods on credit.

4.2.2. Internal coping strategies

Drawing from household savings was the most common internal coping strategy, with households drawing from investments in formal institutions (e.g. banks) or informal community-based savings groups and burial societies. Labour reallocation and household spending reductions were reported by similar proportions of households. Labour reallocation included migration in search of work and casual, community-based work in exchange for money or goods. For example, some flood-affected farmers employed people to repair their fences and replant. Household spending reductions included reductions in the quantity and/or quality of meals consumed. According to respondents, wealthier households were able to cut spending on “luxury” items while poorer households were forced to cut “essentials”.

Forty-one percent of households relied on the safety-net function of natural products (e.g. NTFPs) from non-cultivated ecosystems. For example, in the dry site, one woman started selling mopane worms after her husband was retrenched, while fencing poles were harvested to replace flood-damaged fences. In both sites, people relied on medicinal plants to treat human/livestock diseases. Although not the most common strategy, relying on NTFPs was more common than the sale of assets (internal strategy) and loan seeking (external strategy). Livestock was the most commonly sold asset, sold both within the community and externally. Respondents indicated that selling small stock, particularly goats, was easier. Assets such as televisions and radios were also sold. The limited reliance on asset depletion, suggests households are reluctant to decapitalize (i.e. it is a “last-resort” strategy), have limited disposable assets, or that market barriers exist.

4.3. Associations between shocks and strategies

Households' coping response is influenced by the type of shock experienced. Although all the coping strategies were reported for all the shocks, certain strategies were either positively or negatively associated with certain shocks. This suggests that households prioritize certain strategies in response to certain shocks (Table 2; Fig. 1). Other studies have also noted the influence of shock type on households' coping response, suggesting the need for either a few effective strategies or a diverse coping portfolio (Takasaki et al., 2004; Wunder et al., 2014; Börner et al., 2015; Mugido and Shackleton, 2017). Asset depletion was the only strategy neither positively nor negatively associated with any of the selected shocks.

Although widely used, kinship was only significantly, positively associated with financial shocks, with households possibly relying on their social capital to tide them over until other livelihood and coping options come into play. Loan-seeking, also an external strategy, was also positively associated with financial shocks. Labour reallocation was positively associated with human shocks, but negatively associated with production shocks and natural hazards. Given the risks associated with migration, households may resort to labour reallocation to cope with the long-term challenge of an increase in dependents (human shock) but prefer to retain their labour locally to recover from the more short-term disturbances associated with production shocks and natural hazards (Davies and Hossain, 2000; Osbahr et al., 2008; Gao and Mills, 2018). Ofoegbu et al. (2016) found migration to be an uncommon response to drought in Venda, however, others have found migration to be a prevalent response to climate-related shocks, raising concerns of increasing climate change refugees (Börner et al., 2015). Natural products appear to be more useful for coping with production shocks that temporarily affect food supplies and infrastructure, rather than natural hazards. Other studies indicate a greater contribution of NTFPs towards coping with natural hazards (Takasaki et al., 2004; Liswanti et al., 2011; Wunder et al., 2014).

Relying on external assistance was logically, positively associated with natural hazards (e.g. floods) and negatively associated with more idiosyncratic, financial shocks. Drawing from household savings was the only internal coping strategy that was positively associated with natural hazards. Poor households, with limited savings, are therefore more likely to resort to less optimal alternatives (Kazianga and Udry, 2006; Mugido and Shackleton, 2017). Increasingly frequent and intense natural hazards may undermine households' ability to save and their capacity to cope with other shocks and day-to-day expenses (Adimassu and Kessler, 2016). Access to weather insurance may help reduce this risk (Castells-Quintana et al., 2018). Households used savings despite government's post-disaster assistance, with respondents indicating limitations to this support, including limited capacity and funds, corruption, and poor infrastructure. Similar challenges were noted by Twomlow et al. (2008). Government support services may become increasingly strained in the face of climate change, increasing pressure on households' internal, coping options (Dercon, 2002; Gao and Mills, 2018). Given that household-level strategies may be insufficient in buffering against natural hazards, strengthening external social safety-nets is essential for maintaining household welfare (Gao and Mills, 2018).

Households' informal, ex-post coping options may be insufficiently robust for the covariate nature of natural hazards, with households therefore relying on external assistance and ex-ante options (i.e. drawing from household savings). Internal coping strategies, including the reliance on natural products, labour reallocation, and household spending reductions, were all negatively associated with natural hazards, suggesting limitations to their safety-net function. For example, respondents associated floods and droughts with reduced NTFP availability, increased competition for scarce resources, and the need to travel further to harvest and market, challenges also noted by Boafo et al. (2016) and Ofoegbu et al. (2016). Although households may store NTFPs, recent floods damaged households' storage facilities while these available stores may be insufficient in the face of prolonged droughts. Furthermore, in the immediate aftermath of natural hazards, households may be unable to reallocate labour to the collection and sale of NTFPs. Households possibly choose strategies that provide more immediate relief (e.g. drawing from savings), turning to NTFPs later (e.g. to rebuild houses), with this delayed use not captured in our survey. Labour reallocation, by means of outmigration, is only beneficial if the migrant finds work, undermining the usefulness of this strategy for coping with the immediate impacts of natural hazards (Gao and Mills, 2018). Given the costs of migrating, this strategy may also be unavailable to more vulnerable households (Castells-Quintana et al., 2018). The option to reallocate labour may be undermined by decreased health (and therefore human capital) associated with flood-related incidences of malaria and cholera and drought-related hunger and weakness. Households may also need to retain their labour to recover locally. Respondents identified some local job opportunities related to the recent floods, with households and government employing people to assist with repairs.

Although kinship, loans and asset depletion were neither positively nor negatively associated with natural hazards, these strategies also have limitations in the face of covariate shocks. Kinship networks and informal, community-based savings clubs may become strained if several members require support simultaneously (Ligon et al., 2002; Gao and Mills, 2018). Informal money lenders (operating in the absence of formal credit facilities) may be unable to provide sufficiently large loans to numerous afflicted households. Where loans are relied on, increasingly frequent and intense natural hazards may result in repeat borrowing, leading to greater indebtedness (Castells-Quintana et al., 2018). The option to sell assets may be limited when several households try to offload assets simultaneously (Kazianga and Udry, 2006; Börner et al., 2015). Households may be unable to sell their assets quickly enough, or for a reasonable price, if supply outweighs demand. This coping option is also undermined by asset losses associated with these natural hazards (Ngigi et al., 2015; Mehar et al., 2016; Hänke and Barkmann, 2017). For example, respondents in both sites reported livestock losses resulting from floods and droughts, with one respondent noting that these losses are "a problem because we lose our insurance for other things". Finally, asset depletion undermines

households' future production and coping options (Del Ninno et al., 2016). Other studies also highlight the limitations of these local, informal insurance options for coping with covariate shocks, with poor households, with limited alternatives being hardest hit (Andrade Pérez et al., 2010; Börner et al., 2015).

4.4. Determinants of the coping strategies used

4.4.1. Kinship and external assistance – informal and formal social safety-nets

Kinship was not used exclusively by households with limited coping alternatives. Households with formal savings and livestock were more likely to rely on kinship to cope, suggesting that households with ex-ante coping options avoid depleting their resources and future coping potential, relying instead on essentially free, ex-post strategies such as kinship (Table 3). Households with labour occupied in NTFP collection, possibly more vulnerable households with fewer livelihood and coping options, were also more likely to rely on kinship. Households with self-employed members were, however, less likely to do so, possibly being more self-sufficient. The nature of households' kinship networks influenced their coping choices. Households with family-support networks avoided spending reductions but still applied for loans and depleted assets (possibly within their networks). Households with only non-family kinship networks were more dependent on their savings. These results suggest the need for nuanced considerations of the nature of kinship networks; i.e. although kinship is an ex-post strategy, it is influenced by the nature of households' existing social capital. Others also suggest that households with better social capital, cope better (Adimassu and Kessler, 2016; Ofoegbu et al., 2016). Overall, kinship was a common strategy, used irrespective of location and demography, and as part of a suite of strategies (Paumgarten and Shackleton, 2011; Bofo et al., 2016; Mugido and Shackleton, 2017).

	Kinship	External assistance	Loans	Savings	Labor reallocation	Spending reductions	Natural products	Asset depletion
Location...HH is located in the dry site						+		-
Demography...HH is:								
Older				+		-		+
Larger		-	-			+		+
Female-headed							-	-
Has a high proportion of children		-	-		-	+		
Capital stocks...HH has/owns:								
Formal savings	+	+	-				+	
Informal savings				-			-	
Livestock	+					-		
Equipment of high value (total)		-				-		
Kinship networks...HH has:								
Family kinship networks			+			-		+
Non-family kinship networks				+				
Off-farm livelihoods...HH has a high number of members who are:								
Formally employed				+				
Self-employed	-				+			
Remitting migrants			+		+	+		
Non-remitting migrants								+
Land-based livelihoods...HH sells:								
NTFPs				-		+	+	-
Crops								-
Livestock				+			+	+
Labor availability...HH spends more time collecting:								
NTFPs	+		+		-			
Water						+		-

Table 3. Summary of the effect of location and household characteristics on the use of coping strategies. Only variables with a significant positive (+) or negative (-) effect are described ($p < 0.05$).

With respect to external assistance, from government or NGOs, larger households and those with a high proportion of children were less likely to rely on this option. Assuming these households are more vulnerable, this raises a concern that the available external assistance is not accessible to those most in need. Households with formal savings were more likely to rely on external assistance, supporting the argument that this assistance may not be reaching those most in need. However, households with a high equipment value (i.e. asset rich households) were also less likely to rely on external assistance.

4.4.2. Household savings and loans

Although drawing from household savings was the most common internal coping strategy, households endeavour to protect their financial capital by engaging alternatives. Households with formal savings still relied on ex-post coping strategies, including kinship, external assistance and natural products. It is also possible that households' savings are insufficient, with a portfolio of strategies therefore required. Households who have had the time (i.e. older households) and income (i.e. through formally employed members and livestock sales) to accumulate savings were more likely to draw from their savings to cope. Households' ability to save is, however, undermined by limited sources and amounts of income (Mugido and Shackleton, 2017). Households with only non-family kinship networks were also more likely to rely on their savings. Households selling NTFPs were less likely to rely on savings, which may reflect the safety-net function of NTFPs, or that households selling NTFPs have limited savings. As with kinship, there is the need for a more nuanced understanding of the insurance function of household savings, including savings type. For example, households with informal savings were less likely to draw from these for unanticipated shocks. Informal, community-based savings clubs often have conditions to use, making them better suited to more anticipated periods of hardship (Paumgarten and Shackleton, 2011).

Generally, ex-post loan-seeking was limited to households with remitting migrants, a possible indicator of better access to, and awareness of, loan facilities. Ofoegbu et al. (2016) found poor access to credit to be a major challenge for households in Venda. This lack of access to financial products, including credit facilities, hinders households' ability to both cope and adapt (Börner et al., 2015; Castells-Quintana et al., 2018). Households with family kinship networks also relied on loans, possibly receiving these from within their networks. Larger households and those with a high proportion of children were less likely to seek loans. Assuming these are more vulnerable households, they may lack the resources to access and repay loans. However, households with labour engaged in NTFP collection, also possibly more vulnerable households, relied on loans, which may reflect limited alternatives. Households with formal savings avoided loan-seeking.

4.4.3. Reallocation of labour

Households' access to, and ability to reallocate, labour has an important effect on their coping choices. Overall, ex-post labour reallocation was the third most commonly reported coping strategy, however households with human capital constraints were unlikely to consider this option. This included households with a high proportion of children and those with labour committed to NTFP collection. Households who have successfully traded labour in the past, including those with remitting migrants and self-employed members, continue to rely on their human capital. Migration involves "start-up" costs, which may be reduced when there is an existing migrant able to support new arrivals. Therefore, although labour reallocation is an ex-post option, it is affected by households' existing human and social capital. Similarly, Hänke and Barkmann (2017) identified labour reallocation as a common strategy, practiced more by households already engaged in waged labour, although they found households resorted waged farm labour rather than outmigration.

4.4.4. Household spending reductions

Reductions in household spending and consumption were less common in households with high physical, natural and social capital. Although two thirds of households reported this ex-post strategy,

older households, those with a high equipment value (physical capital), with livestock (natural capital), and with family-support networks (social capital), were less likely to reduce spending, suggesting access to alternative coping options (Tran, 2015). Similarly, Mehar et al. (2016) found that livestock-owning households were less likely to reduce food intake. Households with remitting migrants reduced spending, suggesting limits to migrants' capacity to provide support, including delayed support, requiring households to make temporary cuts. Larger households, those with a high proportion of children, and those with labour occupied in collecting water, were also more likely to reduce spending and consumption. Although households may choose to reduce consumption to preserve their assets and future options, poorer households are likely to be worse affected, having to cut essential items while their wealthy counterparts cut luxuries (Eriksen and Silva, 2009; Börner et al., 2015; Castells-Quintana et al., 2018). These consumption decreases have been associated with increased NTFP extraction, which may explain why households in the dry site, with better access to, and already engaged in the sale of, NTFPs, were more likely to reduce spending (McGarry and Shackleton, 2009; Mugido and Shackleton, 2017; Paumgarten et al., 2018).

4.4.5. Natural products

The safety-net function of NTFPs was limited for female-headed households, suggesting gender-specific limitations to this coping option. This differs to other South African studies which found households relied on the safety-net function of NTFPs irrespective of the gender of the household head (Paumgarten and Shackleton, 2011; Mugido and Shackleton, 2017). Although NTFPs are argued to be of greater benefit to poor, rural women and female-headed households, others suggest that women may have limited access to, and control over, these resources (Posel, 2001; Takasaki et al., 2004; Mehar et al., 2016). The notable difference in the proportion of households reporting the daily-net (98%) versus safety-net (41%) function of NTFPs emphasizes the possible limitations to this safety-net function. Börner et al. (2015) also noted a lower than expected reliance on natural resources. Mugido and Shackleton (2017) identified NTFPs as a common coping strategy, especially in low-potential agro-ecological zones, although only 35.6% of their sample reported this safety-net function. We found that households already selling NTFPs, and those with livestock, were more likely to rely on NTFPs to cope, suggesting an existing knowledge of these resources, their harvesting areas, and their markets (Boafo et al., 2016; Ofoegbu et al., 2016). Households with formal (rather than informal) savings were also more likely to rely on NTFPs to cope suggesting that households purposely rely on NTFPs to protect their alternative and future coping options.

Households engaged in the sale of NTFPs were less likely to deplete assets or rely on savings to cope. However, they were more likely to reduce spending and turn to NTFPs, suggesting that they may be poorer, with a more limited portfolio of coping options. It is also possible that their existing traditional ecological knowledge allows them to rely on NTFPs as a gap-filler. By using NTFPs for minor crises, these households are able to maintain their cash and assets, and thereby their future welfare (Skoufias, 2003; Boafo et al., 2016). Paumgarten and Shackleton (2011) found households relied on the safety-net function of NTFPs irrespective of household wealth, while Hänke and Barkmann (2017) found almost all households, irrespective of their primary economic activity, relied on the gap-filling function of wild foods in response to crop failure. McSweeney (2005) argues that access to these natural resources should be maintained, particularly if alternatives are limited.

4.4.6. Asset depletion

Asset depletion by households engaged in livestock sales, by older and larger households, and by those with a high number of non-remitting migrants, suggests that existing market experience, accumulated assets, greater need, and limited alternatives may all influence households' decision to decapitalize. Households with family-support networks were also more likely to deplete assets, possibly selling assets within their networks. Female-headed households and those with labour constraints (i.e. labour engaged in water collection) were less likely to deplete assets, suggesting gender- and labour-related barriers to asset accumulation and sales (Tran, 2015). Asset depletion

may also be a strategy of last resort. Börner et al. (2015) also noted that the female-headed households in their African subsample were less likely to sell assets. Surprisingly, households in the dry site, where livestock ownership is more prevalent, were also less likely to deplete assets. Limited and variable market demand, veterinary controls on the movement of animals, and the multiple functions of livestock, may all discourage sales (Ofoegbu et al., 2016). Hänke and Barkmann (2017) suggest that where cattle fulfil an important socio-cultural role, households may choose to rather sell less culturally important small stock. Other studies have considered asset accumulation as an ex-ante risk management strategy and an ex-post coping strategy, with mixed views on this strategy's robustness (Dercon, 2002; Kazianga and Udry, 2006; Deressa et al., 2009). Households selling NTFPs and crops were also less likely to deplete assets.

5. Conclusion and recommendations

Rural households in Venda, South Africa, experience a mix of unanticipated production, human, and financial shocks, as well as natural hazards. Although a range of informal coping strategies was identified, our findings suggest that households' response to these shocks is influenced by the type of shock experienced. This suggests that households choose specific coping strategies based either on the effectiveness of the strategy in buffering against the shock, or on households' active intent to manage their broader coping portfolio in anticipation of future shocks.

With respect to natural hazards, households' informal, ex-post, household coping strategies appear to be limited, with households relying on external assistance from government or NGOs, and ex-ante household savings. The reliance on external assistance is expected however, our findings suggest that more vulnerable households are less likely to rely on this option. Further investigation into whether there are barriers to accessing these formal, external social safety-nets is advised. Given the possibility of increasingly intense and frequent natural hazards, associated with climate change, this assistance, and the institutions that provide it, will need to be increasingly robust, appropriately targeted, and accessible to the most vulnerable. The key role of household savings in helping households cope with natural hazards is also concerning if these events occur with increasing frequency and intensity. Without alternative options, households' ability to accumulate savings will be hindered, undermining their efforts to secure a sustainable livelihood, reducing their overall coping capacity, and limiting their ability to make the necessary investments in adaptation. How to increase households' access to alternative financial services, including credit and climate insurance, needs further exploration.

In addition to exploring whether shock type influences households' coping choices, we explored whether a range of household characteristics and location have an influence. Generally, households' access to human and financial capital influenced the coping strategies used. Our findings also suggest that female-headed households have fewer coping options, being less likely to deplete assets or rely on NTFPs. Female-headed households may face barriers to accumulating and/or disposing of assets, and to accessing NTFPs, which need to be explored to address existing gender-based inequalities. This includes understanding why female-headed households were less likely to rely on NTFPs, particularly given that these are often considered an important safety-net for those with limited alternatives. Larger households, and those with a high proportion of children, also appear to have more limited coping options, relying on negative strategies such as spending and consumption reductions, which may negatively affect their human capital. The influence of location on households' willingness to deplete assets to cope provides insights into the insurance role of livestock and suggests that although households may accumulate livestock as an ex-ante insurance strategy, this is not their primary reason for doing so, with livestock fulfilling multiple functions. It also suggests barriers to selling livestock. It would be useful to better understand at what point households are prepared to discount the benefits of retaining their livestock, versus selling it to cope, as well as what support services could be put in place to enhance the insurance value of livestock.

Natural products were not often used to cope with natural hazards, suggesting limitations to their safety-net function for covariate, climate-related shocks. However, access to natural capital, as well as social capital, allows for the protection of households' assets and savings, and the avoidance of spending and consumption reductions, thereby contributing towards households' overall resilience. Households' reliance on natural and social capital is, therefore, not necessarily an indicator of vulnerability, but may be a considered means of managing their future insurance options. By relying on natural products to buffer against other shocks, households may be better able to retain their savings for natural hazards.

Funding

This work was supported by South Africa's National Research Foundation (NRF 92241), the Global Change Institute (through the Carnegie Corporation of New York (B874.R01)), the Centre of Excellence in Tree Health Biotechnology, the University of the Witwatersrand and the Center for International Forestry Research.

Compliance with ethical standards

The Research Office of the University of the Witwatersrand granted the ethical clearance to conduct the research (H120803). All ethical standards were adhered to. The relevant local authorities granted permission to conduct the research and formal, free, prior and informed consent was obtained from all participants. Anonymity was assured.

Declaration of competing interest

None.

Acknowledgement

We extend our thanks to the communities of Bennde Mutale and Vondo for welcoming the research team and for participating in the research. Thanks also to the translators and enumerators for their invaluable contribution. The research was made possible with funding provided by South Africa's National Research Foundation (NRF), the Global Change Institute (with funding from the Carnegie Foundation of New York), the NRF Centre of Excellence in Tree Health Biotechnology, the University of the Witwatersrand and the Centre for International Forestry Research.

References

- Adams, A.M., Cekan, J. and Sauerborn, R., 1998. Towards a conceptual framework of household coping: Reflections from Rural West Africa. *Africa* 68(2), pp. 263–283.
- Adimassu, Z. and Kessler, A., 2016. Farmers' strategies to perceived trends of rainfall and crop productivity in the Central Rift Valley of Ethiopia. *Environmental Systems Research* 5(13), pp. 123–140.
- Andrade Pérez, A., Herrera Fernández, B. and Cazzolla Gatti, R., 2010. Building resilience to climate change: Ecosystem-based adaptation and lessons from the field. International Union for Conservation of Nature (IUCN), Gland.
- Berkes, F. and Jolly, D., 2001. Adapting to climate change: Social-ecological resilience in a Canadian western Arctic community. *Conservation Ecology* 5(2), pp. 18.
- Blaikie, P., 1994. Population change and environmental management: Coping and adaptation at the domestic level. In: Zaba, B. and Clarke, J., Editors, 1994. *Environment and Population Change*. Liege: Derouaux Ordina Editions, France.
- Boafo, Y.A., Saito, O., Jasaw, G.S., Otsuki, K. and Takeuchi, K., 2016. Provisioning ecosystem services-sharing as a coping and adaptation strategy among rural communities in Ghana's semi-arid ecosystem. *Ecosystem Services* 19, pp. 92–102.

- Börner, J., Shively, G., Wunder, S. and Wyman, M., 2015. How do rural households cope with economic shocks? Insights from global data using hierarchical analysis. *Journal of Agricultural Economics* 66(2), pp. 392–414.
- Brockhaus, M., Djoudi, H. and Locatelli, B., 2013. Envisioning the future and learning from the past: Adapting to a changing environment in northern Mali. *Environmental Science and Policy* 25, pp. 95-106.
- Castells-Quitana, D., Del Pilar Lopez-Urbe, M. and McDermott, T.K.J., 2018. Adaptation to climate change: A review through a development economic lens. *World Development* 104, pp. 183-196.
- Cooper, P.J.M., Dimes, J., Rao, K.P.C., Shapiro, B., Shiferaw, B. and Twomlow, S., 2008. Coping better with current climatic variability in the rain-fed farming systems of sub-Saharan Africa: An essential first step in adapting to future climate change? *Agriculture, Ecosystems and Environment* 126(1–2), pp. 24–35.
- Corbett, J., 1988. Famine and household coping strategies. *World Development* 16, pp. 1099–1112.
- Coulibaly, J.Y., Gbetibouo, G.A., Kundhlande, G., Sileshi, G.W., Tracy, L. and Beedy, T.L., 2015. Responding to crop failure: Understanding farmers' coping strategies in Southern Malawi. *Sustainability* 7, pp. 1620–1636.
- Davies, S. and Hossain, N., 2000. Livelihood adaptation, public action and civil society: A review of the literature. IDS Working Paper No. 57, University of Sussex, Brighton.
- Dazé, A., Ambrose, K. and Ehrhart, C., 2009. *Climate Vulnerability and Capacity Analysis Handbook*. CARE International, Atlanta.
- Dekker, M., 2004. Sustainability and resourcefulness: Support networks during periods of stress. *World Development* 32(10), pp. 1735–1751.
- Del Ninno, C., Coll-Black, S. and Fallavier, P., 2016. Social protection: Building resilience among the poor and protecting the most vulnerable. In: Cervigni, R. and Morris, M., Editors, 2016. *Confronting Drought in Africa's Drylands: Opportunities for Enhancing Resilience*, World Bank, Washington, D.C.
- Department for International Development (DFID), 1999. *Sustainable Livelihoods Guidance Sheets*. Available at: http://livelihoods.org/info/info_guidancesheets.html, (17 March, 2018).
- Dercon, S., 2002. Income risk, coping strategies, and safety nets. *The World Bank Research Observer* 17(2), pp. 141–166.
- Deressa, T.T., Hassan, R.M., Ringler, C., Alemu, T. and Yesuf, M., 2009. Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environmental Change* 19, pp. 248-255.
- Djoudi, H., Locatelli, B., Vaast, C., Asher, K., Brockhaus, M. and Basnett, B., 2016. Beyond dichotomies: Gender and intersecting inequalities in climate change studies. *Ambio* 45(S3), pp. 248-262.
- Du Preez, Y. and Seale, L., 2013. Baby born in back of bakkie during floods. IOL. Available at: <https://www.iol.co.za/news/south-africa/limpopo/baby-born-in-back-of-bakkie-during-floods-1456832>, (17 March, 2018).
- Eriksen, S. and Silva, J.A., 2009. The vulnerability context of a savanna area in Mozambique: Household drought coping strategies and responses to economic change. *Environmental Science and Policy* 12, pp. 33–52.
- Fabricius, C., Folke, C., Cundill, G. and Schultz, L., 2007. Powerless spectators, coping actors, and adaptive co-managers: A synthesis of the role of communities in ecosystem management. *Ecology and Society* 12(1), 29.
- Fisher, M., Chaudhury, M. and McCusker, B., 2010. Do forests help rural households adapt to climate variability? Evidence from Southern Malawi. *World Development* 38, pp. 1241–1250.
- Flato, M., Muttarak, R. and Pelsler, A., 2017. Women, weather and woes: The triangular dynamics of female-headed households, economic vulnerability, and climate variability in South Africa. *World Development* 90, pp. 41-62.
- Funk, C., Peterson, P., Landsfeld, M., Pedreros, D., Verdin, J., Shukla, S., Husak, G., Rowland, J., Harrison, L., Hoell, A. and Michaelsen, J., 2015. The climate hazards infrared precipitation with stations - a new environmental record for monitoring extremes. *Scientific Data* 2:150066.
- Gao, J. and Mills, B.F., 2018. Weather shocks, coping strategies, and consumption dynamics in rural Ethiopia. *World Development* 101, pp. 268-283.

- Gautier, D., Locatelli, B., Corniaux, C. and Alary, V., 2016. Global changes, livestock and vulnerability: The social construction of markets as an adaptive strategy. *Geographical Journal* 182(2), pp. 153-164.
- Günther, I. and Harttgen, K., 2009. Estimating households vulnerability to idiosyncratic and covariate shocks: A novel method applied in Madagascar. *World Development* 37, pp. 1222–1234.
- Hänke, H. and Barkmann, J., 2017. Insurance function of livestock: Farmer's coping capacity with regional droughts in south-western Madagascar. *World Development* 96, pp. 264–275.
- Heemskerk, M., Norton, A. and De Dehn, L., 2004. Does public welfare crowd out informal safety nets? Ethnographic evidence from rural Latin America. *World Development* 32(6), pp. 941–955.
- IPCC., 2014. Annex II: Glossary [Mach, K.J., S. Planton and C. von Stechow (eds.)]. In: *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva.
- Kazianga, H. and Udry, C., 2006. Consumption smoothing? Livestock, insurance and drought in rural Burkina Faso. *Journal of Development Economics* 79(2), pp. 413–446.
- Ligon, E., Thomas, J. and Worrall, T., 2002. Informal insurance arrangements with limited commitment: Theory and evidence from village economies. *Review of Economic Studies* 69(1), pp. 209–244.
- Liswanti, N., Sheil, D., Basuki, I., Padmanaba, M. and Mulcahy, G., 2011. Falling back on forests: How forest-dwelling people cope with catastrophe in a changing landscape. *International Forestry Review* 13, pp. 442-455.
- McCarthy, J.J. and Martello, M.L., 2010. Identifying coping and adaptation strategies to climate change in the Arctic. In: *Arctic Climate Impact Assessment*, ed. International Arctic Science Committee.
- McGarry, D.K. and Shackleton, C.M., 2009. Is HIV/AIDS jeopardizing biodiversity? *Environmental Conservation* 36(1), pp. 5-7.
- McSweeney, K., 2005. Natural insurance, forest access, and compounded misfortune: Forest resources in smallholder coping strategies before and after Hurricane Mitch, Northeastern Honduras. *World Development* 33(9), pp. 1453–1471.
- Mehar, M., Mittal, S. and Prasad, N., 2016. Farmers coping strategies for climate shock: Is it differentiated by gender? *Journal of Rural Studies* 44, pp. 123–131.
- Meyer, D., Zeileis, A. and Hornik, K., 2016. *VCD: Visualizing Categorical Data*. R package version 1, pp.4-3.
- Mucina, L. and Rutherford, M.C. (eds). 2011. *The Vegetation of South Africa, Lesotho and Swaziland*. SANBI, Pretoria.
- Mugido, W. and Shackleton, C.M., 2017. The safety net function of NTFPs in different agro-ecological zones of South Africa. *Population and Environment* 39, pp. 107-125.
- Neves, D. and Du Toit, A., 2013. Rural livelihoods in South Africa. Complexity, vulnerability and differentiation. *Journal of Agrarian Change* 13(1), pp. 93-115.
- Ngigi, M.W., Muller, U. and Birner, R., 2015. The role of livestock portfolios and group-based approaches for building resilience in the face of accelerating climate change: An asset-based panel data analysis from rural Kenya. Center for Development Research, Bonn. Available at: <http://ssrn.com/abstract=2676574>, (17 March, 2018).
- Ofoegbu, C., Chirwa P.W., Francis, J. and Babalola, F.D., 2016. Assessing forest-based rural communities' adaptive capacity and coping strategies for climate variability and change: The case of Vhembe district in South Africa. *Environmental Development* 18, pp. 36-51.
- Osbahr, H., Twyman, C., Adger, W.N. and Thomas, D.S.G., 2008. Effective livelihood adaptation to climate change disturbance: Scale dimensions of practice in Mozambique. *Geoforum* 39, pp. 1951–1964.
- Pattanayak, S.K. and Sills, E.O., 2001. Do tropical forests provide natural insurance? The microeconomics of non-timber forest product collection in the Brazilian Amazon. *Land Economics* 77(4), pp. 595–612.
- Paumgarten, F. and Shackleton, C.M., 2011. The role of non-timber forest products in household coping strategies in South Africa: The influence of household wealth and gender. *Population and Environment* 33(1), pp. 108–131.

- Paumgarten, F., Locatelli, B. and Witkowski, E.T.F., 2018. Wild foods: Safety net or poverty trap? A South African case study. *Human Ecology*. Available at: <https://doi.org/10.1007/s10745-018-9984-z>, (17 March, 2018).
- Posel, D.R., 2001. Who are the heads of household, what do they do, and is the concept of headship useful? An analysis of headship in South Africa. *Development Southern Africa* 18(5), pp. 651–671.
- Pringle, C., Maseko, B., Roesli, H. and Kerkmann, J., 2013. Tropical low over southern Africa (6-21 January 2013). Available at: http://oiswww.eumetsat.org/WEBOPS/iotm/iotm/20130117_troplow/20130117_troplow.html, (17 March, 2018).
- R Core Team (2016), R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Version 3.3.2, 2016-10-31, <http://www.R-project.org/>.
- Shackleton, C. and Shackleton, S., 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* 100, pp. 658–665.
- Shisana, O., Rehle, T., Simbayi, L.C., Zuma, K., Jooste, S., Zungu, N., Labadarios, D. and Onoya, D., 2014. South African national HIV prevalence, incidence and behaviour survey, 2012. HSRC Press, Cape Town.
- Skoufias, E., 2003. Economic crises and natural disasters: Coping strategies and policy implications. *World Development* 31(7), pp. 1087–1102.
- Smit, B. and Wandel, J., 2006. Adaptation, adaptive capacity and vulnerability. *Global Environmental Change* 16, pp. 282–292.
- Statistics South Africa., 2014. Census 2011_Provincial profile: Limpopo. Report No. 03-01-78 (2011). Statistics South Africa, Pretoria.
- Takasaki, Y., Barham, B.L. and Coomes, O.T., 2004. Risk coping strategies in tropical forests: Floods, illnesses, and resource extraction. *Environment and Development Economics* 9(2), pp. 203–224.
- Thornton, R., 2002. Environment and Land in Bushbuckridge, South Africa. In: Zarsky, L. Editor, 2002. *Human Rights and the Environment: Conflicts and Norms in a Globalizing World*. Earthscan Publications, London.
- Thornycroft, P., 2017. Zimbabwe financial crisis deepens, inflation ‘on the march again’. IOL. Available at: <https://www.iol.co.za/news/africa/zimbabwe-financial-crisis-deepens-inflation-on-the-march-again-11310266>, (17 March, 2018).
- Tran, V.Q., 2015. Household’s coping strategies and recoveries from shocks in Vietnam. *The Quarterly Review of Economics and Finance* 56, pp. 15-29.
- Turnbull, M. and Turvil, E., 2012. *Participatory Capacity and Vulnerability Analysis: A Practitioner’s Guide*. Oxfam International, Cowley.
- Turpie, J. and Visser, M., 2013. The impact of climate change on South Africa’s rural areas. In: F.A. Commission, Submission for the 2013/14 Division of Revenue, Financial and Fiscal Commission, Cape Town.
- Twomlow, S., Mugabe, F.T., Mwale, M., Delve, R., Nanja, D., Carberry, P. and Howden, M., 2008. Building adaptive capacity to cope with increasing vulnerability due to climate change in Africa – A new approach. *Physics and Chemistry of the Earth* 33, pp. 780-787.
- Van Aelst, K. and Holvoet, N., 2016. Intersections of gender and marital status in accessing climate change adaptation: Evidence from rural Tanzania. *World Development* 79, pp. 40-50.
- Venter, S.M. and Witkowski, E.T.F., 2013. Fruits of our labour: Contribution of commercial baobab (*Adansonia digitata* L.) fruit harvesting to the livelihoods of marginalised people in northern Venda, South Africa. *Agroforestry Systems* 87, pp. 159-172.
- Wunder, S., Börner, J., Shively, G. and Wyman, M., 2014. Safety nets, gap filling and forests: A global-comparative perspective. *World Development* 64, pp. S29-S42.

Appendix A.

Explanatory variables used in the logit linear model to explain the use of a selected coping strategy. Those variables dropped by the model are indicated by N/A.

Category	Description	Code (Table 3)
<i>1: Basic Household Descriptors</i>		
Location	Dry site (Bennde Mutale) vs. wet site (Vondo)	<i>Location (dry site)</i>
Age	Age of the household (years since established)	<i>Older</i>
Composition of household members	Female- vs. male-headed households	<i>Female-headed</i>
	Percentage of female vs. male household members	<i>N/A</i>
	Number of household members (excluding migrants)	<i>Larger</i>
	Percentage of children vs. adult household members	<i>High proportion of children</i>
Migrant household members	Number of migrants	<i>N/A</i>
<i>2: Savings and Household Assets</i>		
Savings	Household has formal savings	<i>Formal savings</i>
	Household has informal savings (e.g. burial society, stokvel, weather insurance, other)	<i>Informal savings</i>
Equipment	The value of equipment owned by the household (calculated in ZAR)	<i>Equipment of high value</i>
<i>3: Kinship</i>		
Kinship	Household has family in the village they can rely on	<i>Family kinship networks</i>
	Household doesn't have family but can rely on other groups (i.e. churches, burial societies, stokvels (informal savings groups) and cooperatives)	<i>Non-family kinship networks</i>
<i>4: Livelihood Strategies & Income Sources</i>		
Off-farm strategies	Number of formally employed household members	<i>Formally employed</i>
	Number of informally employed household members	<i>N/A</i>
	Number of self-employed household members	<i>Self-employed</i>
	Value of government grants received (ZAR) including old age pensions, child care grants and disability grants	<i>N/A</i>
	Whether the migrant sends remittances	<i>Remitting vs. non-remitting migrants</i>
<i>Land-based strategies:</i>		
~ Arable agriculture	Household cultivates (field and/or homegarden)	<i>N/A</i>
	Household sells crops	<i>Sells crops</i>
~ Animal husbandry	Household owns livestock	<i>Livestock</i>
	Household sells livestock	<i>Sells livestock</i>
~ NTFPs	Household stores NTFPs	<i>N/A</i>
	Household sells NTFPs	<i>Sells NTFPs</i>
<i>5: Labor availability</i>		
	Time spent collecting NTFPs	<i>More time collecting NTFPs</i>
	Time spent collecting water	<i>More time collecting water</i>