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How stable are farmers' risk perceptions? A follow up study of one community in the Karoo

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Abstract:

The Karoo Farm Management Survey sampled risk perceptions in 2012 and 2016. Round 2 added fracking, uranium prospecting, weather weirding and political instability to the list of potential threats. This analysis compares farmers' assessments of these new threats to those analysed previously. New threats were rated riskier than the old ones and in four cases the original item scores increased significantly. Resurveying improved sampling adequacy as measured by Kaiser-Meyer-Olkin tests in the principal component analysis and allowed labour regulation to be identified as the key concern in the regulation risk component. Adding the four additional threats changed the structure of these refined risk perceptions. It identified as the main component of farmers' risk perceptions a component that was labelled "unsympathetic government". The seven items which substantially on this factor are increased predator and farm worker tenure regulations, falling and unstable commodity prices, the issue of fracking and prospecting licenses without consulting landholders and increased political instability. The other components of risk perception were more familiar. Frequently conducted representative surveys of farmers' risk perceptions could insure against the adverse effects of the governments' proposed land and labour market reform plans and could assist in formulating effective climate change messages.

Keywords: arid areas, agriculture, risk perceptions, principal components analysis

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Introduction

As the most arid part of South Africa, the Karoo is a difficult place to make a living from farming. Threats are many and severe (Conradie and Piesse, 2016), support is generally lacking (Conradie, 2016; Kirsten and Van Zyl, 1996) and the livelihood that can be made from sheep farming is quite precarious because of a weakening terms-of-trade and worsening environmental conditions (Conradie et al., 2009; Conradie and Landman, 2015; Nattrass and Conradie, 2015).

The main sources of risk for agriculture include financial risk, natural disasters or adverse climate, institutional risk and labour regulations (Barry et al., 1995; Martin, 1996; Baquet et al., 1997). Price and production risks often emerge as the most important concerns, although environmental regulations and contractual risk have also been raised (Musser and Patrick, 2002). Multiple dimensions of environmental risk are now routinely examined in climate change studies and is sometimes contrasted to price risk (Weber, 1997; Greiner et al., 2009; Barnes et al., 2013). In the Karoo farmers are most worried about environmental and price risk, and to a lesser degree about uncertain property rights, increases in regulation and a lack of rural safety (Conradie and Piesse, 2015). Profitability and experience mitigate risk perceptions. Individual circumstances matter. For example, the owners of large properties tend to be more concerned about rural safety than people who own small farms, farmers who expect their heirs to succeed them, are more concerned about tenure security than those have made peace with the idea of giving up the farm when they retire and part time farmers are less fearful of market risk.

Risk perceptions are important because they shape investment decisions which could have far reaching impacts on the rural economy and the health of the natural resource base. In extensive grazing systems land and livestock are more important than capital and labour inputs (Conradie, 2017). Stocking densities are under the control of the farmer and can be potentially devastating to rangeland condition (Archer, 2000, 2004; Todd and Hoffman, 1999; Hoffman, 2014). When farmers

give up hope of being able to make a long-term living on a Karoo farm there are still short term gains to be made by running the vegetation into the ground, and given the slow rates of recovery of these dwarf shrublands (Seymour et al., 2010) it is in the wider public interest not to let Karoo farmers get this desperate.

The aim of this analysis is to compare a second round of perception data to the 2012 findings (Conradie and Piesse, 2016). The questions posed are: 1) Did farmers assessment of any of the first found items increase or decrease significantly? 2) How are the new threats rated relative to those survey in both rounds? 3) Can more components be extracted with more observations? and 4) Does the additional of new threats affect the structure of this community's risk perceptions. This research is important because it demonstrates how helpful it can be to know what farmers think and how frequently such information ought to be updated.

Data

Perception data were collected during waves 1 and 4 of the Karoo Farm Management Survey, a panel study that covered 61% of the farmland on the plains of the Central Karoo. The study area's boundaries are the Swartberg Mountain range in the south, the Great Escarpment in the north, the Matjiesfontein-Sutherland tarred road in the west and the Beaufort West-Meiringspoort tarred road in the east. This area of 1.6 million hectares supports 161 thousand stock sheep and goats (StatsSA, 2011) on approximately 193 farms (StatsSA, 2006). A sample of 102 farmers yielded 59 unusable data points in round 1 (2012), which is a response rate of 58%. Risk perceptions were not surveyed during the next two waves of the panel study (2014, 2015). The second round (2016) produced 55 responses, a 54% response rate. A total 38 farmers participated in both rounds, giving a balanced panel of 78 observations on the initial twenty risk items. Grazing conditions vary considerably within the boundaries of the study site, but rainfall data for the towns of Laingsburg and Beaufort West the first round of perception data was gathered at the end of a relatively good year, while the second-round survey took place at the end of a much drier season.

In this community farm sizes vary between 1,500 and 36,000 hectares. In about half the cases farming is conducted on two or more, partly rented properties. The typical flock consists of 716 stock sheep or goats, mostly Dorper ewes. Some farmers keep woolled sheep or angora goats while the more aggressive boer goats are considered the best way to generate a quick profit when school fees are to be paid. In response to rising predator problems some farmers introduced a native fat tailed sheep line into their dorper flocks. The cross breed, referred to as *Meatmasters*, are believed to bring a reproductive edge and a flocking instinct that gives some protection against predation. Success in this farming system is enhanced by experience, a *Grootfontein* sheep management diploma, farm size, running woolled sheep and a large, flexible farm (Conradie, 2018). There is no statistically significant difference in the performance of fulltime and part time operations.

Methods

The analysis combines single variable analysis of variance tests with principal component factor analysis. Stata 15.0 was used to run all tests.

The first step was to conduct a single variable analysis of variance (ANOVA) test across rounds for each item. All items are scored on a five-point Likert scale with 1 = no threat to 5 = a major threat. Given the short interval between the first and second set of perception data and the relatively small sample sizes, few changes were expected. Changes could be the result of a change in sample composition or a change in the views held by the same people; to establish dominant factor the ANOVA tests were rerun for the balanced panel to establish the degree to which the same

individuals changed their minds. Were Bartlett's test indicated that the hypothesis of equal variance did not hold, ANOVA tests were replaced by non-parametric Kruskal Wallace tests of equality of means.

The second step revisited the principal component analysis conducted on round 1. Three versions were run, on the round 1 subsample factoring in the twenty original risk items, on the balanced panel, factoring in twenty original times and on the round 2 subsample factoring in the larger set of risk items. Missing item scores were inferred from other scores or in most cases assigned a value of one to indicate that the respondent had no opinion on the matter. Principal components were selected using a combinations of scree plots, Eigen values and information about Heywood cases. A series of Kaiser-Meyer-Olkin tests confirmed sampling adequacy. Orthogonal (Kaiser's varimax) rotation was then applied to distinguish between relevant items (with maximised loadings) and irrelevant items (of which the rotated loadings are minimised after rotation) for each of the retained factors. A cut-off of 0.600 was used in most cases but was dropped to 0.500 in cases where specific factors intuitively belonged to a particular element of risk perceptions.

Results

1. Changing risk perceptions between 2012 and 2016

Table 1 reveals a general increase in risk perceptions between rounds. In three quarters of cases item scores increased and in four cases this difference was statistically significant $p \leq 0.05$. The only threat to be rated as less of a risk in round 2 than in round 1 was commodity price weakness. The Cape Wools Merino price index opened the 2016/17 season 25% higher than the previous year (www.capewools.co.za) and mutton prices were 23% higher in 2016 than during 2014 (DAFF, 2017). Items rated as a higher risk in round 2 than before were increased environmental regulations, rising minimum wages, inadequate drought relief and climate change. Scores were practically unchanged for labour regulation, stock theft, farm attacks and commodity price stability.

The National Environmental Management Act (act 107 of 1998) governs land use. This legislation has required environmental impact assessments for all significant land use changes for the last twenty years, although these were quite lightly enforced in the Karoo where it is unusual to develop more than hectares of virgin land at a time. With the rise in predation farmers the production of vegetable seeds, a high value commodity that makes the most of the Karoo's isolated growing conditions, has become more important. This crop's irrigation requirement and the emphasis placed on also monitoring water use from boreholes during the current Western Cape drought has meant that crop farming is now more closely monitored than in the past, which has created the impression amongst farmers that more environmental regulations now should be complied with that could explain why farmers are now more worried about environmental regulations than they were in the past. It is interesting to note that people were less anxious about unreasonable predator control regulations in 2016 than they were in 2012, although this decrease was not statistically significant.

A statutory minimum wage for South African agriculture was provided for in the Basic Conditions of Employment Act (act 75 of 1997, amended in act 11 of 2002), and came into effect as sectoral agreement 8 of 2003. This statutory wage rose at a few percentage points above inflation over the next decade but during late 2012 a wildfire strike erupted in the fruit growing districts of the Western Cape which awarded farm workers a 50% increase in the statutory minimum wage for agriculture in March 2013. A proposal for a national minimum wage of R20 per hour was recently accepted that will increase farm wages by a further 40% above the 2016 level of R14.25 per hour.

Despite the already quite low levels of employment in the Karoo, the policy change caused a 25% increase in the minimum wage item score.

Table 1: Single variable ANOVA tests for potential risk items that were surveyed in both years

Potential risk factor	Round 1	Round 2	F-test
	n = 58	n = 55	
Difficulty in sourcing reliable farm labour	3.475	3.255	0.76
Increasingly regulated labour markets	3.542	3.545	0.00
Predator damage to livestock	4.293	4.400	0.35
Unreasonable predation control regulations	4.034	3.764	1.39
Other environmental regulation	2.702	3.283	5.49 **
Extension of tenure security rights for workers	3.373	3.481	0.16
Rising statutory minimum wages for agriculture	2.746	3.436	7.81 ***
Stock theft	2.915	2.927	0.00
Drought	3.948	4.204	1.46
Lack of adequate state drought relief	2.966	3.818	15.84 ***
Co-operative gives inadequate support	1.644	1.500	0.64
Lack of market access	2.017	1.709	2.43
Rising costs	4.034	3.909	0.46
Falling commodity prices	3.328	2.818	5.85 **
Unstable commodity prices	3.069	3.018	0.05
Unstable currency	2.750	3.091	1.82
Land reform	3.069	3.291	0.63
Farm attacks	2.931	3.000	0.06
Unsustainable unemployment in economy	3.211	3.600	1.96
Climate change	3.172	3.655	4.53 **

*** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.10$

The remaining two items whose risk scores increased between rounds reflect farmers preoccupation with the drought. In the Beaufort West area 2012 was the last good grazing season. The next two years were normal and while conditions during 2015, 2016 and 2017 were substantially below average, which has made farmers take more note of climate change predictions for their area (Midgley et al., 2015). For the early part of this drought there was not drought relief made available from government, and when it finally came into effect during 2016, the rules had changed compared to what farmers were used to before 1994. A matching contribution was now required and all farmers received the same amount of aid regardless of the size of their flocks. The unhappiness with these new rules is reflected in the drought relief item whose score rose by 29% between rounds.

2. Are the same farmers changing their minds or drive changes in aggregate perceptions?

The ANOVA tests were rerun for the subsample of 37 farmers that answered the same risk perceptions questions in both rounds. Items whose scores differed in the second batch of tests appear in Table 2. The overlap with the previous section is substantial and in every case's growing concerns were muted by the change in group composition between rounds. For example, in the case of climate change, the whole group's scores went up by 15.2% between rounds, while the core group's scores on this item rose by 20%. The difference on the inadequacy of drought relief was

28.7% for the whole group and 35.3% for the core group. On the risk of rising minimum wages, the whole group awarded 25.1% higher score in round 2 while the core group's scores rose by 38.5%. Finally, on rising environmental regulations, the whole group's scores rose by 21.5% compared to an increase of 30.6% for the core group. The lower score on commodity price risk produced by the whole group was the result of sample size change as the change on this item was not statistically significant in the second batch of tests. Instead the core group assigned significantly higher risk to currency instability in the second than in the first.

Table 2: Single variable ANOVA tests for risk scores obtained from the same respondents (n = 38 pairs of observations)

Potential risk factor	Round 1	Round 2	F-test
Other environmental regulation	2.730	3.566	8.48 ***
Rising statutory minimum wages for agriculture	2.595	3.595	12.83 ***
Lack of adequate state drought relief	2.956	4.000	17.23 ***
Unstable currency	2.788	3.324	3.03 *
Climate change	3.054	3.649	4.15 **

3. How did the new threats rank in round 2?

In round 1 only two items were scored more than 4/5, namely the risk of predation and the threat of rising input costs. Unreasonable predator control regulations were ranked third, followed by drought and labour laws. In round 2 predation was still ranked as the top threat, with general political instability second, drought third and rising input costs fourth. In fifth place was shale gas exploitation by means of hydraulic fracking, followed by inadequate drought relief in sixth, unreasonable predator control regulations in seventh place and uranium mining in eighth place.

Neither fracking nor uranium mining were entirely new issues in 2016, but both had received substantial additional publicity in the period between 2012 and 2016. Since the passing of the Mineral and Petroleum Resources Development Act (act 28 of 2002) landowners have had no say over minerals exploration on their land. The threat of fracking first broke during a series of public hearings in the Karoo in 2013 and the regulations to govern it came out in 2015 (Government Gazette 38855 of 20 June 2015). The Karoo Action Group has since lobbied vociferously against fracking on the grounds that it poses unacceptable risks of pollution to the Karoo's scarce groundwater resources. Uranium was discovered in the Karoo during the late 1960s but plans for its extraction were shelved following the Three Mile Island nuclear disaster of 1979. When president Zuma announced plans to substantially expand South Africa's nuclear power generation capacity during his State of the National speech in early 2016 uranium mining was put back on the agenda and was debated especially heatedly in the Beaufort West community where the processing plant will be installed.

It is hard to judge from this data whether farmers tend to rank new risks more highly than familiar threats just because they are new or because the new threats are objectively more serious. Since fracking and uranium mining were not on the list in round 1 it is impossible to say how these factors would have been rated then, although it is worth noting that fracking was ranked more seriously than uranium mining which has received less attention locally. The item weather weirding was put on the round 2 list as a result of respondents' struggles to think through the threat of climate change which was on the round 1 list. Farmers did not quite understand what climate change is or what the prediction for their area was (these were only published in 2015) but reported in round 1 that they

have noticed changes in familiar weather patterns. In reference to winter rainfall patterns in the Roggeveld, some people claim that these changes have started as early as the 1970s after which cereal crops have never been entirely viable again. If new items were ranked highly just because they were new, weather weirding ought to have placed higher than the eleventh place it attained in round 2. In the run-up to the ANC leadership election in December 2017 there was more political turmoil in South Africa which explains why politics was ranked so seriously in round 2 and there is similar objective evidence to explain why drought was more prominent in round 2 than in round 1.

4. The main components of risk perception in round 2.

In round 1 the main elements of Karoo farmers' risk perceptions were institutional, market, rural safety and environmental risk (Conradie and Piesse, 2016). Table 3 reports Eigen values, cumulative variance explained, factors associated with each element and the individual covariances for this principal component analysis and the two others there were also conducted. The rotated factor loadings for this and the two other principal component analyses appear in appendix 1-3. In the original analysis the regulation component combined labour laws with environmental laws under the heading of regulation. When rerun on the larger sample size compiled from both rounds, the order of importance of the underlying risk components changed and the general regulation element was reduced to a more focused concern over labour regulation only. The Kaiser-Meyer-Olkin test result of 0.6482 compared to the previous value of 0.5765 indicates that the larger sample size makes it possible to extract the main elements of risk perceptions more confidently than before.

Table 3: Main components of Karoo farmers' risk perceptions

Factor label	Eigen value (cumulative variance)	Items summarised	Factor loadings
<i>n = 59, round 1, summarising 20 items, KMO test = 0.5765</i>			
Regulation	4.532	Labour laws	0.793
	(0.227)	Environmental laws	0.710
		Tenure law	0.687
		Minimum wages	0.862
Commodity prices	2.396	Falling prices	0.847
	(0.346)	Unstable prices	0.816
Rural safety	1.973	Land reform	0.848
	(0.445)	Farm attacks	0.713
Climate	1.715	Drought	0.816
	(0.531)	Climate change	0.519
<i>n = 76, balanced subpanel, summarising 20 items, KMO test = 0.6482</i>			
Commodity prices	4.560	Falling prices	0.910
	(0.240)	Unstable prices	0.841
Rural safety	2.144	Land reform	0.675
	(0.353)	Farm attacks	0.875
		Unemployment	0.673

Climate	1.661	Drought	0.814
	(0.440)	Climate change	0.758
		Inadequate drought relief	0.561
Farm labour markets	1.641	Reliable labour in short supply	0.816
	(0.527)	Labour laws	0.700
<i>n = 55, balanced subpanel, summarising 24 items, KMO test = 0.6190</i>			
Unsympathetic govt.	5.847	Predator control regulations	0.688
	(0.244)	Tenure regulations (workers)	0.674
		Falling prices	0.710
		Unstable prices	0.652
		Fracking for natural gas	0.762
		Uranium prospecting	0.788
		Unstable political climate	0.704
Climate	2.576	Drought	0.718
	(0.351)	Climate change	0.849
		Weather weirding	0.852
Rural safety	2.378	Land reform	0.807
	(0.450)	Farm attacks	0.888
		Unemployment	0.666
Farm labour markets	1.696	Reliable labour in short supply	0.654
	(0.521)	Labour laws	0.811
		Rising minimum wages	0.599

In this second principal component analysis, commodity price risk accounted for 24% of sample variance and carried an Eigen value of 5.46. Farmers are equally concerned with falling as with unstable commodity prices. The second element of risk, the lack of rural safety, accounted for a further 9.3% of sample variance. Its Eigen value was 2.144, and although it was strictly a boundary case, it was retained because the fourth component was fully extractable. Whereas the smaller sample size had only land reform and farm attacks loading on the rural safety element, the larger sample also revealed a link to unemployment. The common threat arises from poor unemployed people who see farmland as a source of wealth to be expropriated without compensation and the occupants of remote farms as soft target. An under-resourced and inefficient police force seems incapable of providing acceptable levels of rural safety. The third element of farmers' risk perceptions, climate risk, accounted for a further 8.7% of the sample covariance. Its Eigen value was 1.661 and it was also a Heywood case. The three individual risk factors that loaded on the climate risk component were drought, climate change and inadequate drought relief, with the latter correlated the least well with the factor. This is understandable as the lack of drought relief was not of much concern during 2012 when grazing conditions were between 30-40% better than in round 2. The fourth component of risk, labelled farm labour markets, had an Eigen value of 1.641 and accounted for 8.7% of sample covariance. The two factors loading strongly on this element were the availability of reliable farm labour and labour laws.

The principal component analysis conducted on the round 2 subsample confirmed labour, climate and rural safety as stable components of this community's risk perceptions. Instead of showing up on its own as before, concerns about unstable and falling commodity prices now forms part of a much larger main component of risk. This new component whose Eigen value was 5.847, explained 24.36% of sample covariance. It was associated with fracking, uranium mining, political instability and unreasonable predator control regulations and escalation tenure regulations for farm workers. Because of the diversity of factors associated with this risk component, it was difficult to come up with a simple label for it. The community believes that the government is anti-agriculture, does not listen to the sector's concerns and is not prepared to offer relief in tough times. Some people may even believe that it is actively trying to expropriate white land rights without compensation, but we have settled for the less sinister interpretation, but labelling this component of risk perceptions as a government that is unsympathetic to agriculture.

In round 2 climate was the second most important component of risk perceptions. Its Eigen value was 2.576 and its marginal contribution to explaining sample covariance was 10.7%. The underlying factors summarised by this component of risk were as before drought and climate change, but in round 2 the item weather weirding replaced inadequate drought relief, whose rotated factor loading was only 0.428. The rural safety component whose Eigen value and marginal contributions were 2.378 and 9.9% of sample covariance again summarised perceptions of the risk of farm attacks, land reform and unemployment in the wider economy. The fourth component of risk perceptions, farm labour markets, identified in addition to the short supply of reliable farm labour and increasingly tedious and potentially costly farm labour regulations, also the specific issue of rising minimum wages. The Eigen value on the labour market component of risk was 1.696 and its marginal contribution to explaining sample covariance was 7.1%

Discussion and conclusion

With its in-depth analysis of agricultural risk perceptions of one community in the Karoo, this study makes an important contribution to the policy debate in South Africa. Ideally agriculture should contribute food security, rural development and jobs, and should take good care of a country's natural resources. The sector will become more vulnerable as the negative effects of climate change unfolds, but timely investment into research and development combined with a strong extension system ought to help farmers cope with these new difficulties (Prokopy et al., 2015; Salim and Islam, 2010; Hoag, 2005). The good news in this study is that climate does feature which means that messages on how to adapt to and mitigate climate change will probably fall on fertile ground. Unfortunately, however, the policy environment in which South African farmers operate is extremely cluttered with farmers responding to many threats from many origins, including government. This will make them likely to resist important climate change messages and other policies introduced by government. Under these conditions investment decisions will be made that will not be socially optimal and might in certain cases even be irreversible. The big risks in the Karoo are overgrazing and the mismanagement of predator control.

We have learnt from this study that there is value in surveying risk perceptions as widely as possible because it allows the best possible fix on how farmers are likely to respond to new policies. The list should be as inclusive as possible, and as long as it is populated with familiar threats, even those with not very much education seems to cope easily with the ranking exercise. We also learnt that risk perceptions are updated rapidly as new threats emerge. If this kind of survey is conducted regularly on a representative sample of South African farmers it would provide the government and organised agriculture with the information needed to anticipate responses to new threats.

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Appendix 1: Varimax rotated factor loadings for principal component analysis of round 1 data

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
Lack of reliable farm labour	0.446	0.051	0.120	-0.116	-0.077	0.711
Labour laws	0.793	0.160	0.116	-0.095	0.012	0.117
Predators	-0.041	0.010	-0.093	0.200	0.014	-0.027
Unreasonable predator control regulations	0.165	0.125	0.248	-0.060	0.016	-0.686
Other	0.710	0.297	-0.070	0.110	0.240	-0.099
Tenure Act (worker protection)	0.687	0.290	0.422	-0.121	-0.051	0.033
Rising minimum wages for farm labour	0.862	-0.013	-0.005	0.160	0.174	0.087
Stock theft	0.267	-0.375	0.329	-0.080	0.430	0.332
Drought	0.012	-0.036	-0.014	0.816	-0.103	-0.089
Inadequate drought relief	0.259	0.392	-0.088	0.499	-0.189	0.056
Inadequate support from cooperative	0.022	0.433	0.066	0.004	0.346	0.469
Inadequate market access	0.008	0.490	0.317	-0.285	0.284	0.051
Rising input costs	0.073	0.511	0.464	0.292	-0.116	0.278
Falling commodity prices	0.114	0.847	0.029	-0.219	0.051	-0.016
Unstable commodity prices	0.310	0.816	-0.014	0.189	0.068	-0.049
Unstable currency	0.301	0.227	0.079	-0.145	0.767	-0.061
Land reform	0.195	0.136	0.848	0.001	0.000	-0.034
Farm attacks	-0.079	-0.168	0.713	-0.007	0.362	-0.040
Unemployment	0.019	-0.075	0.432	0.357	0.480	-0.027
Climate change	0.016	-0.126	0.272	0.519	0.342	0.149
Eigen values	4.532	2.396	1.973	1.715	1.334	1.112
Cumulative sample covariance explained	0.227	0.346	0.445	0.531	0.597	0.653
Heywood case	No	No	No	No	Yes	Yes

Appendix 2: Varimax rotated factor loadings for principal component analysis of data from both rounds

Variable	Factor1	Factor2	Factor3	Factor4	Factor5
Lack of reliable farm labour	0.075	-0.029	0.015	0.816	0.125
Labour laws	-0.022	0.084	-0.057	0.700	0.427
Predators	-0.044	-0.019	0.424	0.330	-0.460
Unreasonable predator control regulations	0.370	0.198	-0.198	0.260	0.108
Other	0.274	-0.018	0.150	0.141	0.682
Tenure Act (worker protection)	0.449	0.298	-0.015	0.439	0.425
Rising minimum wages for farm labour	0.012	0.174	0.149	0.273	0.758
Stock theft	0.019	-0.122	0.814	-0.092	0.008
Drought	0.183	0.029	0.561	0.133	0.349
Inadequate drought relief	0.073	0.043	0.056	0.105	-0.074
Inadequate support from cooperative	0.332	0.224	-0.251	0.408	-0.021
Inadequate market access	0.469	0.117	0.371	0.463	-0.239
Rising input costs	0.910	0.021	-0.152	-0.030	0.009
Falling commodity prices	0.841	0.051	0.321	0.108	0.188
Unstable commodity prices	0.323	0.535	0.049	0.215	0.188
Unstable currency	0.203	0.675	-0.186	0.134	0.300
Land reform	-0.090	0.875	0.074	-0.046	-0.004
Farm attacks	0.159	0.673	0.144	0.063	-0.013
Unemployment	0.039	0.259	0.758	0.014	0.135
Climate change					
Eigen values	4.560	2.144	1.661	1.641	1.449
Cumulative sample covariance explained	0.240	0.353	0.44	0.527	0.603
Heywood case	No	Yes	Yes	No	Yes

Appendix 3: Varimax rotated factor loadings for principal component analysis of round 2 data

Variable	Factor1	Factor2	Factor3	Factor4	Factor5
Lack of reliable farm labour	-0.061	0.036	0.189	0.654	0.449
Labour laws	0.040	-0.035	0.239	0.811	0.107
Predators	0.086	0.448	-0.026	0.459	-0.119
Unreasonable predator control regulations	0.688	-0.038	0.001	0.258	-0.017
Other	0.178	0.148	0.095	0.131	-0.051
Tenure Act (worker protection)	0.674	0.020	0.106	0.464	0.167
Rising minimum wages for farm labour	0.355	-0.002	-0.037	0.599	-0.268
Stock theft	0.318	0.087	0.220	0.057	-0.531
Drought	0.063	0.718	-0.080	0.176	-0.182
Inadequate drought relief	0.174	0.428	0.100	0.158	-0.175
Inadequate support from cooperative	-0.202	-0.042	-0.022	-0.126	0.204
Inadequate market access	0.109	-0.187	0.089	0.101	0.793
Rising input costs	0.001	0.401	0.067	0.137	0.627
Falling commodity prices	0.710	-0.062	0.181	-0.183	-0.012
Unstable commodity prices	0.652	0.397	0.029	0.006	0.216
Unstable currency	0.254	0.152	0.269	0.037	0.559
Land reform	0.221	-0.082	0.807	0.276	-0.002
Farm attacks	0.027	0.110	0.888	0.002	0.068
Unemployment	0.209	0.116	0.666	0.128	0.143
Climate change	0.097	0.849	0.172	-0.046	0.114
Weather weirding	0.125	0.852	-0.008	-0.079	-0.010
Fracking	0.762	0.133	0.229	-0.015	-0.073
Uranium mining	0.788	0.166	0.166	-0.017	-0.002
Political instability	0.704	0.133	-0.040	0.177	0.013
Eigen values	5.847	2.576	2.378	1.696	1.597
Cumulative sample covariance explained	0.244	0.351	0.45	0.521	0.587
Heywood case	No	No	No	No	Yes