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# A Sunburnt Country: The Economic and Financial Impact of Drought on Rural and Regional Families in Australia in an Era of Climate Change

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## Abstract

*Australia is indeed a sunburnt country, and is arguably becoming increasingly sunburnt. If most climate predictions are correct, much of Australia will experience droughts even more often. This paper uses the Rural and Regional Families Survey to explore the economic and financial implications of drought in regional Australia. Drought has significant negative economic impacts, with large effects on the experience of financial hardship and deterioration in household financial position— especially for farmers and farm managers who reported that the current drought had reduced property output substantially. The study also identifies some heterogeneous patterns of mobility within many drought-affected households. It is important that policy makers understand the complex processes of adjustment that occur in times of drought in order to enable them to prepare for the changes that will take place if our worst fears about climate change are realised.*

I love a sunburnt country,  
A land of sweeping plains,  
Of ragged mountain ranges,  
Of droughts and flooding rains.  
I love her far horizons, I love her jewel-sea,  
Her beauty and her terror—  
The wide brown land for me!

*My Country, Dorothea Mackellar\**

## 1. Introduction

Despite the prevalence of drought in Australia over the years, there have been few studies that examine the impact of drought upon financial living standards and

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Acknowledgements: The views expressed in this paper are those of the authors and may not reflect those of AIFS or the Australian Government. The authors are grateful to the anonymous referees for comments on an earlier version of this paper. \*By arrangement with the licensor, The Estate of Dorothea Mackellar c/- Curtis Brown (Aust) Pty Ltd.

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employment for families or households in regional and rural Australia. The existing studies have generally produced estimates of the impact of drought at the regional or industry sector level. Some studies (e.g., Australian Bureau of Agricultural and Resource Economics [ABARE], 2008) have provided estimates of the economic impacts of drought on farmers, but have not considered the flow-on economic effects to those who are not farmers but live in rural and regional areas. Other studies that have estimated the economic impacts of drought on farmers have also often been restricted to a small number of communities in specific locations with relatively small sample sizes.<sup>1</sup> Moreover, most of these studies have been cross-sectional or have not collected information from similar communities that are not in drought, which makes identifying the effects of drought very difficult (Alston and Kent, 2004; Stehlik, Gray, and Lawrence, 1999).

It is projected that the frequency and severity of drought in Australia will increase as a result of climate change. A recent report from the Bureau of Meteorology (BOM) and CSIRO concluded that the extent and frequency of exceptionally hot years has increased and that this trend will continue (Hennessy *et al.*, 2008). This report also projected that exceptionally low rainfall years are likely to become more frequent in Victoria, Tasmania, the south west of Western Australia, and agricultural regions of South Australia.

The lack of large-scale survey data on families in regional and rural Australia that could be used to estimate the economic and social impacts of drought—such as information on financial hardship, income, labour market variables, health status, relationship issues, family wellbeing and community social capital—led to the Australian Institute of Family Studies conducting the Rural and Regional Families Survey. The survey conducted computer-assisted telephone interviews (CATI) with 8,000 people living in rural and regional areas of Australia in late 2007. An equal number of interviews were administered in each area that, according to rainfall data, was in severe drought, was in moderate drought, had below average rainfall or had above average rainfall.

At the time the interviews were conducted there was widespread drought, with much of Australia experiencing one of the worst and most prolonged droughts on record (National Climate Centre, 2007). The available evidence to date suggests that this drought has had significant economic impacts on farmers. ABARE estimated that on average farm incomes in 2006-07 were \$29,002 less than in 2005-06. Farms with negative cash income also increased from 24 per cent in 2005-06 to 42 per cent in 2006-07 (ABARE, 2008).

This paper uses data from the Rural and Regional Families Survey to estimate the impact of drought on financial wellbeing and paid employment. The estimates provided in this paper are the first estimates from this survey and aim to provide 'broad brush' estimates. More detailed analyses in the future will consider whether the economic effects on families differ between different types of families and whether the employment effects differ between males and females.

One of the challenges of estimating the impact of drought on the economic wellbeing of farmers is that the income of farmers can vary dramatically from year to year for reasons other than drought. There may be other natural disasters or adverse weather events, input prices can fluctuate and commodity prices can vary greatly.

<sup>1</sup> For instance, Alston and Kent (2004) interviewed around 100 people, while Stehlik, *et al.* (1999) interviewed 103 farmers.

Farming families can be asset-rich and income-poor (Botterill, 2002). In addition, farming families may receive significant amounts of in-kind consumption (e.g., consumption of farm outputs and also farm inputs that are consumed by the family and are attributed to the business, such as electricity, fuel and telecommunications). The tax system can also allow farming families to reduce their effective tax rates (Johnson, 1996; Productivity Commission, 2008). One way of addressing these issues is to examine non-income based measures of financial wellbeing, such as perceived prosperity and the experience of hardship as a consequence of a lack of money.

The effects of drought on four different groups are considered: farmers; those employed who are not farmers, farm managers or farm workers; and those who are not employed. We would expect farmers and farmer managers and workers to be the most severely affected by drought. Those employed outside of agriculture would be expected to be less affected by drought, as any economic effects of these groups would be a result of the 'flow-on' effects of drought. Those who are not employed would not be expected to be directly affected by drought.

The number of persons employed in agriculture in Australia has fallen from about 430,000 in 1966-67 to about 360,000 in 2007-08 (Productivity Commission, 2008). What is different about the current drought is that the fall in agricultural employment has been much greater than in previous droughts over the last 40 years.

One of the important issues that must be addressed when attempting to understand the impact of drought is how to define drought. This is not a straightforward issue. The Productivity Commission (2008) concluded that:

What constitutes a drought may seem readily apparent. But in fact it is difficult to disentangle a confluence of factors—for example: the quantity, location and timing of rainfall and runoff; temperature, evaporation and soil moisture; water storages and allocations; commodity prices and input costs; land values and equity levels; off-farm diversification and so on. (p. 1)

One definition of drought is the severity of the impact of low rainfall. Other more sophisticated definitions also make use of information on the timing of rainfall relative to growing seasons, soil moisture and plant growth. In this paper we use two alternative definitions of drought: the first is a rainfall-based measure and the second is as reported by respondents to the survey.

The remainder of this paper is structured as follows. The second section provides an overview of the Rural and Regional Families Survey and the third section discusses how to define and measure drought. In the fourth section, the measures of financial wellbeing examined in the paper and the estimation method used are described. The fifth section presents information on the impact of drought on farm property output and the sixth section the impact of drought on employment rates. In section seven the impacts of drought on financial hardship and the extent to which respondents said their households' financial position had worsened over the last three years are discussed. Given that one of the possible responses to drought is to move to 'greener pastures', in the eighth section we also provide estimates of residential mobility in response to drought that suggest that the estimates of the impact of drought on financial wellbeing are possibly an underestimate. The final section concludes.

## 2. The Rural and Regional Families Survey

The Rural and Regional Families Survey is a population-based study of 8,000 people living in areas of Australia that had at least 10 per cent of the population employed in agriculture or a related service industry at the time of the 2001 Census. The 2001 Census was used because it was before the current period of drought.<sup>2</sup> The interviews were conducted over September to December 2007 with people living in over 400 postcodes.

The sample was stratified into four groups of 2,000, according to whether they were currently in drought and the severity of the drought. The groups were:

- severe drought (0 to 5th percentile of rainfall over the last three years compared to rainfall over the last 100 years);
- drought (6 to 10th percentile);
- below average rainfall (11 to 49th percentile); and
- above average rainfall (50 to 100th percentile).<sup>3</sup>

Interviews were conducted using computer-assisted telephone interviewing (CATI) and households were selected at random within each of the four 'drought strata' by random digit dialling into eligible postcodes. CATI methods generally over-sample older people and females (Gaziano, 2005); therefore, when selecting which person in the household to interview, the interviewer initially requested to speak with the youngest adult male in the household. If there were no resident males, then the request was for the youngest female. This methodology is a commonly used method of obtaining a random sample (see Gaziano, 2005).<sup>4</sup> The method worked well, with 47 per cent of the sample being male and 53 per cent female. We also collected information on the sex of the first adult to come to the phone to examine the effect of this within household selection technique. The first adult to come to the phone was female in 58 per cent of households.

Calculating response rates for random digit dialling telephone surveys is difficult. Perhaps the best measure is the 'cooperation rate', which is the proportion of interviews divided by the number of interviews plus the number of refusals. The cooperation rate for this survey was 27 per cent and varied little between the four

<sup>2</sup> Areas in the 'peri-urban' fringe (just outside the formal boundaries of cities) were excluded from the sampling frame because of their proximity to metropolitan labour markets and associated opportunities.

<sup>3</sup> The above average rainfall area group had, generally, not experienced very high levels of rainfall but rather above average rainfall. The median percentile for the above average rainfall was the 58th percentile and 90 per cent of the above average rainfall group were below the 65th percentile.

<sup>4</sup> The pilot test for the survey trialled a sample selection algorithm described by Rizzo, Brick and Park (2004). Under this method, selection of the respondent is based on the number of adults reported to be living in the household and is as follows:

- if one adult, that adult was selected;
- if two adults, either the screener respondent or the other adult was randomly selected, with probability equal to 0.5; or
- if three or more adults, the screener respondent was randomly selected with probability equal to one over the number of adults, or else the other adult with the most recent birthday was selected. If the screener respondent did not know the birthdays of other adults, the interviewer then enumerated the other adults, and one was randomly selected.

In theory, this method ensures that all eligible adults have an equal chance of selection. However, in our initial pilot of 50 interviews, this approach did not result in an even gender distribution among the sample (the male:female ratio was 36:64).

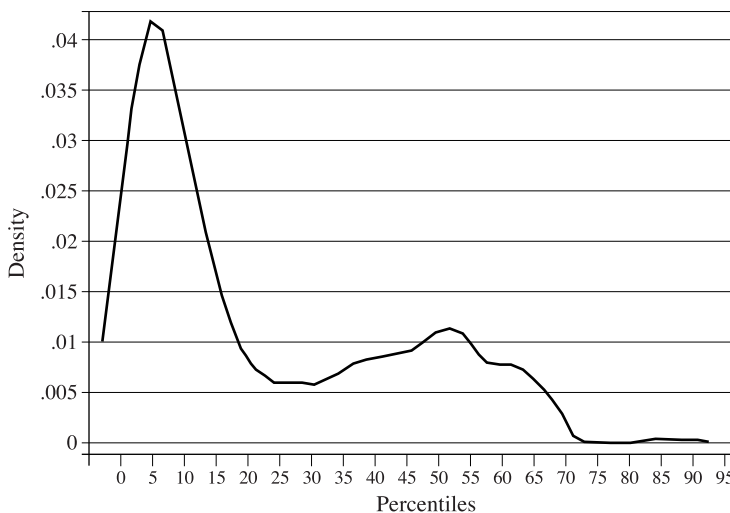
drought strata (26 per cent to 28 per cent). This cooperation rate is similar to that achieved by other CATI surveys that employ random digit dialling (e.g., 26-28 per cent for 2006 to 2008 for the Australian Unity Wellbeing Index).

### 3. Defining and Measuring Drought

As noted by the CSIRO and BOM, drought can be defined in many different ways (Hennessy *et al.*, 2008). There is no consensus about the appropriate definition of drought, and hence we use two definitions: one based on meteorological data and the other based on survey responses.

The *rainfall deficit* definition of drought is based upon rainfall deficits in the area in the last three years compared to the last 100 years. The rainfall deficits were obtained from the BOM and were updated to be exactly three years prior to the month of interview.<sup>5</sup> The kernel density plot in figure 1 shows the distribution of rainfall percentiles for each respondent in the sample. There are two points to note from figure 1. First, there was not 25 per cent of the sample in each of these four groups because of the time difference between the completion of the sampling design and interviewing. Forty-four per cent of respondents were located in drought-affected areas (24.7 per cent in severe drought and 19.7 per cent in drought), a further 39.1 per cent were in below average areas and 16.4 per cent in above average rainfall areas at the time of interview. Second, although we refer to above average rainfall areas, this category did not denote excessive rainfall. Eighty-nine per cent of respondents located in this category were living in areas that were between the 50-65th percentile. We used the same four-category definition of drought used in the sampling design.

Figure 1 - Density in Rainfall Percentiles for Respondents to the Rural and Regional Families Survey



Notes: Density is estimated using Kernel Density Smoothing with a bandwidth of .80.

<sup>5</sup> Estimates were based on 2001 Census of Population and Housing Statistical Local Area geographical boundaries.

Although the sampling for the survey involved equal numbers of respondents being interviewed from each drought strata, because these strata were defined according to rainfall in the three years prior to 31 March 2007, there are differences in the drought experience at the time of interview (September to December, 2007).

The *self-reported* definition of drought is based on people's perceptions of whether they were currently or had been in drought in recent periods. The categories of drought that were derived were:

- currently in drought;
- in drought in the last year but not currently in drought;
- in drought in the last three years but not in the last year; and
- not in drought in the last three years.

Using the self-reported definition of drought, 61.0 per cent of the respondents said they were currently in drought, a further 13.3 per cent had been in drought in the last year but were not currently in drought, 5.2 per cent had been in drought in the last three years but not in the last year and 20.5 per cent had not been in drought in the last three years.

Both the rainfall and self-reported definitions of drought have strengths and weaknesses. As indicated above, the rainfall definition of drought does not take into account potentially important aspects of the quantum and timing of water availability but may be considered 'objective', in some sense. The self-reported definition is potentially biased because of its subjectivity. For example, those who claim to be in drought are the most inclined to complain in any given set of circumstances. (i.e., complain about financial hardship). This is not an issue if responses about drought are reasonably consistent within an area. Locational consistency amongst those self-reporting drought status were checked using the intra-class correlation coefficient and 57 per cent of total variance can be explained by between group variance. That is, people in the same postal area tend to say they are experiencing similar levels of (subjective) drought. Given that some postal areas are rather large, this level of concordance is remarkable as water availability will not be consistent or homogenous within such areas. Hence we can largely discount the hypothesis that particular groups of residents are more likely to complain than other residents of drought affected areas. It is apparent that the proportion of the sample who said they were currently in drought (61.0 per cent) is much higher than the proportion who, according to rainfall data, are currently in drought (44.4 per cent).

Table 1 shows the relationship between rainfall as measured by the BOM and self-reported drought. The rainfall data is grouped according to percentiles: 0-5 (severe drought), 5.01-10.00 (drought), 10.01-15.00, 15.01-20.00, 20.01-30.00, 30.01-40.00, 40.00-50.00 (below average rainfall), 50.00-60.00 and 60+ (above average rainfall).

Table 1- Relationship between Rainfall Definition of Drought and Self-reported Drought

	<i>Self-reported Drought Status</i>				<i>Total</i>
	<i>Not in</i>	<i>Drought in</i>	<i>Drought in</i>	<i>Current</i>	
	<i>Drought in</i>	<i>last 3 years</i>	<i>last year</i>	<i>Drought</i>	
	<i>Per cent</i>				
<i>Rainfall (percentiles)</i>					
0.00-5.00 (severe drought)	12.2	4.1	19.9	63.9	1,977
5.01-10.00 (drought)	10.8	3.7	14.1	71.5	1,578
10.01-15.00 (below average)	20.4	4.7	10.0	64.9	911
15.01-20.00 (below average)	17.5	5.3	9.4	67.8	410
20.01-30.00 (below average)	18.4	8.1	11.5	62.0	461
30.01-40.00 (below average)	17.8	7.7	12.1	62.4	590
40.01-50.00 (below average)	22.8	6.1	13.7	57.4	759
50.01-60.00 (below average)	35.5	6.1	8.0	50.3	7
60+ (above average)	64.2	7.7	4.3	23.8	520

*Notes:* There were 172 respondents who had missing information on whether they were currently in drought.

A striking feature of the relationship between self-reported drought and the rainfall measure is that the majority of those who are living in areas that are in drought (according to the rainfall data) say that they are currently in drought, have been in drought in the last 12 months or have been in drought in the last three years (87.8 per cent of those in severe drought and 89.2 per cent of those in moderate drought). This three-year period is consistent the three-year period developed for the rainfall data.

Many respondents who are living in areas that are not in drought according to the rainfall deficit measure say that they are in drought or have been in drought in the last year. For example, in areas in which the average rainfall over the last three years was in the 40-50 percentile (that is, just below average), 13.7 per cent of respondents said that they had been in drought in the last year and 57.4 per cent said they were currently in drought.

Two-thirds of those in the 60+ percentile range reported not being in drought in the last three years.

Clearly these two measures of drought are quite different. The rainfall deficit measure does not capture factors such as the timing of rainfall relative to growing seasons or the availability of other water sources. The advantage of the self-reported definition of drought is that respondents potentially take into account these factors in deciding whether their area is currently in drought.

As alluded to in the introduction, the definition of drought is contested, not least because it is becoming apparent that the lack of adequate rainfall relative to some historical norm is theoretically an inadequate basis for a taxonomy in the era of climate change. It should not be assumed that the rainfall or soil moisture definitions



provide a superior basis for estimating the incidence of drought.<sup>6</sup> While the rainfall definition of drought (or the soil moisture definition) can be argued to be more objective than the self-reported definition, the rainfall deficit definition can not fully capture the impact on agricultural production ('agricultural drought') of low rainfall.<sup>7</sup>

## 4. Measures of Financial Wellbeing and the Estimation Method

### *Measures of Financial Wellbeing*

The effects of drought on two measures of economic wellbeing are analysed. The measures are: the experience of hardship as a result of a lack of money in the last 12 months and perceived change in prosperity over the last three years.

Hardship as a result of a shortage of money is based upon whether any of the following happened because of a shortage of money: could not pay electricity, gas or telephone bills on time; could not pay the mortgage or rent on time; pawned or sold something; went without meals; asked for financial help from friends or family; or asked for help from welfare/community organisations. Originally included in the ABS 1998-99 Household Expenditure Survey, these events have also been included in the Household, Income and Labour Dynamics in Australia (HILDA) survey. A household is said to have experienced financial hardship if the respondent reports experiencing one or more of these events because of a shortage of money.

Respondents were also asked whether they thought their household's financial position during the last three years had become worse, stayed the same or improved. In this paper, we focus on reports of the household financial position becoming worse or much worse in the last three years.

### *Estimation Method and Issues*

The basic method used to estimate the impact of drought on economic wellbeing is to compare people living in areas that are drought-affected with people living in areas that are not drought-affected.

While rainfall and drought are generally regarded as random events, it may be the case that people living in areas more prone to experiencing drought differ systematically from those living in areas not as prone to experiencing drought. To the extent to which these differences are related to economic wellbeing, the estimated effects of drought on economic wellbeing will be biased. These differences can be taken into account using regression modelling. In addition to drought severity, the

<sup>6</sup> Data for soil moisture level by geographic area is also available from the Bureau of Rural Sciences. This information can be used to generate definitions of drought in an analogous way to the use of rainfall data. However, the soil moisture data was generated by a computer simulation model that used information on actual rainfall and potential evaporation rates to estimate soil moisture levels (Hennessey *et al.*, 2008). This measure is not used in this paper for several reasons. First, there are a number of assumptions inherent in the computer simulation that may not hold over a 100-year period. Second, Hennessey *et al.* (2008) only report soil moisture for a 50-year period in their study and note that 'prior to 1957, potential evaporation data are considered unreliable ...' (p. 5).

<sup>7</sup> Direct measures of agricultural impacts may provide an alternative measure of drought, but these are likely to introduce intractable endogeneity issues involving the simultaneous interaction between the definition of drought and the effects of that drought.

regression models included information on the demographic characteristics of the respondent (gender, age, age-squared, Indigenous status, educational attainment), the household (at least one child is in the household) and the area (remoteness and state/territory). The inclusion of these explanatory variables in the following analysis is justified by the fact they are the basic socio-demographic and geographic factors identified in Human Capital Theory (Preston, 1997). The models were estimated using the entire sample, except for the models of employment and those involving interactions between drought status and employment, which were estimated using the working age population (18-64 years). This study attempts to scope the importance of drought rather than provide a detailed 'structural' analysis of the effect of drought on residents. Accordingly, the following are reduced form estimates that do not include explanatory variables that may themselves be impacted upon by drought.

The effects of drought on the binary dependent variables (employment, the experience of financial hardship and a decline in household financial position) are estimated using logistic regression. All of the regression models are estimated using robust standard errors that take account of any heteroscedasticity that is present. We present estimated predicted probabilities in the tables and figures in the body of the article. In appendix A we present details of the first regression presented (see table A.1) and then summary tables for the other regressions estimated (see tables A.2 and A.3).

### **Descriptive Statistics**

Descriptive statistics for the explanatory variables by drought status are provided in table 2. With few exceptions, there is little variation in the explanatory variables by drought status.

Table 2 - Descriptive Statistics by Drought Status (Rainfall Deficit and Self-reported Definitions)

<i>Rainfall deficit Definition</i>	<i>Drought Status</i>				<i>Total</i>
	<i>Severe Drought</i>	<i>Drought</i>	<i>Below Average</i>	<i>Above Average</i>	
Gender (percentage female)	54.02	52.60	54.04	52.13	53.44
Age-mean (SD)	50.85 (14.85)	50.72 (14.84)	50.41 (14.82)	49.68 (15.07)	50.46 (14.87)
Indigenous status	2.07	2.73	2.75	3.43	2.69
Education					
Less than secondary school	38.19	37.07	35.58	36.99	36.75
Secondary school only	16.19	14.96	15.43	15.37	15.51
Trade or apprenticeship, certificate, diploma	28.02	27.06	29.13	28.08	28.28
University	16.44	20.03	18.62	18.11	18.28
Other education, refused or don't know	1.16	0.89	1.25	1.45	1.19
Child present in household	31.97	33.08	33.18	33.33	32.89

Table 2 - Descriptive Statistics by Drought Status (Rainfall Deficit and Self-reported Definitions) (continued)

<i>Self-reported Definition</i>	<i>Drought Status</i>				<i>Total</i>
	<i>Current Drought</i>	<i>Drought in last year</i>	<i>Drought in last 3 years</i>	<i>No Drought in last 3 years</i>	
Gender (percentage female)	54.63	50.19	50.49	51.18	53.12
Age-mean ( <i>SD</i> )	50.51 (15.50)	50.80 (14.18)	51.46 (14.78)	50.32 (14.64)	50.53 (14.82)
Indigenous status	2.68	1.93	2.68	3.05	2.66
Education					
Less than secondary school	38.08	37.28	34.63	33.83	36.92
Secondary school only	15.38	14.16	18.05	16.23	15.53
Trade or apprenticeship, certificate, diploma	28.14	30.25	26.59	28.17	28.35
University	17.33	17.15	19.27	20.40	18.04
Other education, refused or don't know	1.07	1.16	1.46	1.37	1.16
Child present in household	33.11	32.66	36.34	31.28	32.84

*Notes:* This table provides information from the complete sample, not the working age sample. A table with the working age sample is available on request.

## 5. The Impact of Drought on Farm Property Output

Farmers and farm managers who said that they were currently in drought were asked about the effect of drought on their property's output.<sup>8</sup> The current drought has had a large impact on agricultural production. Almost 40 per cent of farmers and farm managers reported that drought had reduced property output to its lowest point ever (33.1 per cent) or eliminated it completely (3.4 per cent). A further 32.1 per cent said it had reduced property output substantially. Only 7.8 per cent of farmers said that their properties' output had not been or only been a little affected by the drought they were currently experiencing. Similar patterns to these were identified when the rainfall deficit definition of drought was used.

## 6. The Impact of Drought on Employment Rates

To the extent that drought reduces farm output, it will have a negative effect on farmers' incomes and can also result in job losses among those employed to work on farms. There can be direct effects of drought on agriculture-dependent businesses, such as farm machinery suppliers, fertiliser suppliers, seed suppliers, stock agents, fuel suppliers

<sup>8</sup> Property owners were asked directly whether drought had affected their property's output. This question was only asked of property owners who considered their area to be in drought, so farmers who said they were not in drought were excluded from the analysis. It was therefore difficult to accurately estimate the impact of drought as defined by rainfall deficits and any consequent estimates of the impact of drought would be biased. For those who had also experienced another natural disaster like a bushfire, we asked what the combined effect of drought and the natural disasters had been on their property's output. As the impact of drought and natural disaster on farm productivity were similar, we do not report these results in this paper. These results are available from the authors on request.

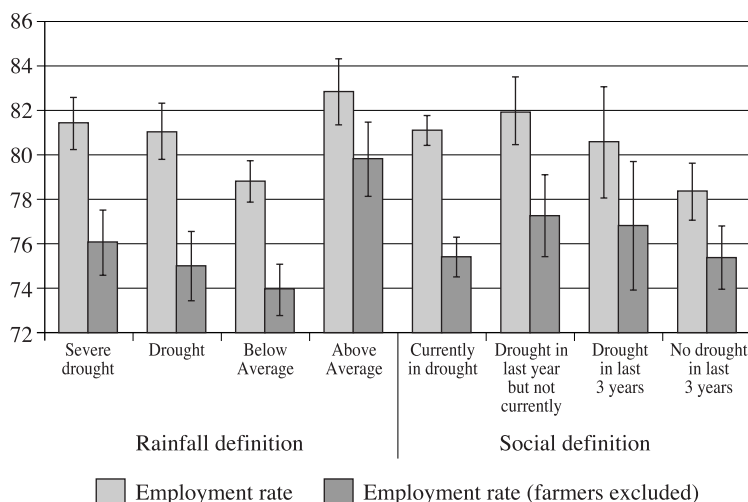
and contract harvesters. Drought can also have an indirect effect on local economies via the effects of drought on income that then reduces consumption expenditure in the local economy.

The impact of drought on regional economies will depend upon a range of factors including:

- the extent to which off-farm employment is available;
- the relative importance of agricultural production to the regional economy;
- the extent to which consumption expenditure is in the local economy;
- the extent to which people move away from a drought-affected area; and
- the extent to which there are additional government payments made to farmers and others living in drought-affected areas (such as Centrelink payments and Exceptional Circumstances (EC) payments).

The analysis of the effects of drought on employment is restricted to the working-age population. The estimated impact of drought on overall employment rates was relatively small. Using the rainfall deficit definition of drought, the employment rate in areas that had received above average rainfall over the last three years was 83 per cent, compared to 81 per cent in areas that were in severe drought or drought (figure 2). This difference was not statistically significant at the 5 per cent level. The largest and only statistically significant difference (4 per cent) in employment rates was between below average rainfall areas (79 per cent) and above average rainfall areas (83 per cent).

Figure 2 - Overall Employment Rates and Employment Rates Excluding Farmers, by Drought Definition



*Note:* Estimates derived from logistic regression with 95 per cent confidence intervals. *Source:* Rural and Regional Families Survey.

One of the limitations of the analysis above is that farmers are much less likely to lose their jobs. They may go deeper in debt and cut the operating costs of running their farm, but unless they are forced to sell their property, they will not become jobless. As such, evaluating the impact of drought on the overall rates of employment may be relatively insensitive. To address this limitation, we conducted the same analysis excluding farmers.

When farmers were excluded from the analysis, there was a statistically significant impact on employment rates of drought as defined by rainfall deficits. The employment rate was four or five percentage points lower in drought-affected areas than in above average rainfall areas. Rates of employment were similar in below average rainfall areas and drought-affected areas.

For the self-reported definition, the employment rate in areas that respondents said were currently in drought was three per cent higher than for those who had not been in drought in the last three years. However, this effect seems to be entirely due to the higher propensity of farmers (who cannot, by definition, *not* be employed) to report being currently in drought. When farmers were excluded from the analysis the average employment rate was almost identical in areas currently in drought and those that had not been in drought in the last three years. There were no other statistically significant differences between the average employment rate (excluding farmers) and drought areas when the self-reported definition of drought was used.

## 7. The Impact of Drought on Financial Wellbeing

This section presents the results of estimating the effects of drought on the experience of financial hardship and perceived prosperity.

### *Financial Hardship*

Households in drought-affected areas were experiencing more financial hardship than in non-drought affected areas, regardless of the drought definition (figure 3). Households in severely drought-affected and drought-affected areas, as defined by rainfall, had rates of financial hardship that were four to five per cent higher than in below average or above average rainfall areas.

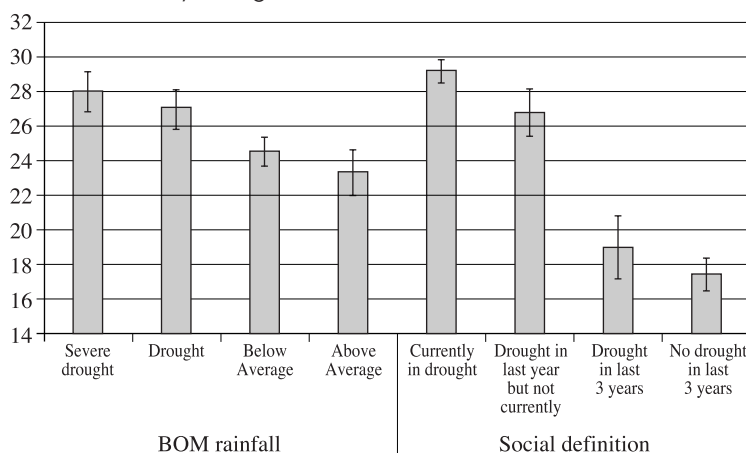
Differences between drought-affected and non-drought affected areas were most pronounced for the self-reported definition of drought. Those who were currently in drought had rates of financial hardship 12 percentage points higher than those who had not been in drought in the last three years. The difference between those who had been in drought in the last year but not currently and those who had not been in drought in the last three years was also substantial (nine percentage points).

In order to further explore this issue, the impact of drought on financial hardship according to drought status and sector of employment is presented in table 3. Irrespective of the level of drought and definition used, farmers had a much higher probability of being in financial hardship than those who were employed but not in agriculture (about double the rate, irrespective of level of drought):

- Almost half of the farmers in drought-affected areas were experiencing financial hardship compared to one in three in areas of above average rainfall. Although large, this difference was not statistically significant (at the five per cent level).

- The difference in the probability of financial hardship between farmers currently in drought and those who had not been in drought in the last three years is even greater, and is statistically significant (47 per cent compared to 25 per cent).

Figure 3 -Probability of Household having experienced a Financial Hardship in the Last 12 Months, by Drought Definition



*Note:* Predicted probabilities and 95 per cent confidence intervals derived from logistic regression. *Source:* Rural and Regional Families Survey.

Drought also impacts on the financial hardship experienced by farm workers. For example:

- Farm workers in areas of severe drought had a higher probability of being in financial hardship than those in areas of above average rainfall. However, this difference was not statistically significant.
- Farm workers who indicated they were currently in drought also had much higher levels of financial hardship than those who said they had not been in drought in the last three years. This difference was statistically significant at the five per cent level.

There was mixed evidence of the impact of drought on the experience of financial hardship for those employed but not in agriculture. According to the rainfall deficit definition, there was no clear link between drought and financial hardship for this group. However, when the self-reported definition was used, those employed but not in agriculture who said they were currently in drought had higher levels of financial hardship than those who had not been in drought in the last three years (this difference was statistically significant at the 5 per cent level, but was significant at the 10 per cent level).

The impact of drought on the financial hardship of the not-employed was similar to those employed but not in agriculture. There were little differences between

the rates of financial hardship when drought was defined by rainfall; however there were some statistically significant differences when the self-reported definition was used. The not-employed who reported they were currently in drought had rates of financial hardship that were 13 percentage points higher than those who had not been in drought in the last three years. Perhaps drought limited the amount of cash-in-hand work (such as fruit picking) that could be found in rural areas.

Table 3 - Probability of Financial Hardship and 95 Per cent Confidence Intervals, by Drought Definition and Type of Employment

	<i>Drought Experience</i>			
	<i>Severe Drought</i>	<i>Drought</i>	<i>Below average</i>	<i>Above average</i>
<i>Rainfall deficit Definition</i>	<i>Per cent</i>			
Farmer	45.0 (39.2–50.9)	44.4 (38.1–50.8)	41.1 (36.1–46.4)	35.4 (27.3–44.5)
Farm worker	35.0 (29.0–41.4)	24.9 (19.1–31.9)	27.3 (23.0–32.091)	23.2 (17.5–30.0)
Employed but not in agriculture	22.8 (19.7–26.2)	24.0 (20.5–27.7)	21.7 (19.3–24.3)	21.8 (18.2–25.7)
Not employed	38.3 (32.9–43.9)	37.0 (31.4–43.1)	34.5 (30.4–38.8)	37.0 (30.4–44.2)
	<i>Current Drought</i>	<i>Drought in last year</i>	<i>Drought in last 3 years</i>	<i>No Drought in last 3 years</i>
<i>Self-reported Definition</i>	<i>Per cent</i>			
Farmer	46.9 (43.2–50.6)	37.6 (29.8–46.1)	27.8 (16.5–42.8)	25.0 (17.0–35.2)
Farm worker	31.7 (28.1–35.5)	25.9 (19.0–34.1)	24.1 (14.1–38.2)	17.1 (12.1–23.5)
Employed but not in agriculture	24.6 (22.5–26.8)	25.2 (20.9–29.9)	16.4 (11.7–22.6)	17.7 (15.1–20.7)
Not employed	40.4 (36.8–44.0)	38.4 (31.1–46.3)	31.7 (21.4–44.2)	26.5 (21.9–31.7)

*Note:* Predicted probabilities and 95 per cent confidence intervals derived from logistic regression.

*Source:* Rural and Regional Families Survey.

### ***Change in Financial Position in the Last Three Years***

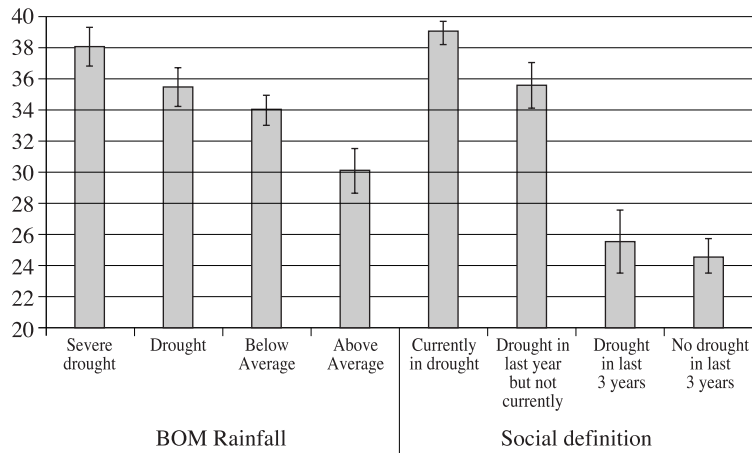
The Rural and Regional Families Survey contained a question that asked respondents whether they thought their household's financial position during the last three years had become worse, stayed the same or improved.

Overall, respondents who were living in drought-affected areas were more likely to say that their household's financial position had become worse or much worse in the last three years than respondents in non-drought affected areas.

The size of the difference in worsening financial position between severely drought-affected areas and below average rainfall areas was three percentage points. The difference in financial position between those who were currently in drought and

those who had not experienced drought in the last three years was even greater when using the self-reported definition (16 percentage points, see figure 4).

Figure 4 - Worsening Financial Position in the Last Three Years, by Drought Definition



Note: Predicted probabilities and 95 per cent confidence intervals derived from logistic regression. Source: Rural and Regional Families Survey.

The effects of drought on the household’s financial position were substantially greater for farmers than the other three groups (table 4). Overall, more than 50 per cent of farmers said that their financial position had become worse or much worse over the last three years.

Table 4 - Probability of Worse Household Financial Position in the Last Three Years and 95 Per cent Confidence Intervals, by Drought Definition and Type of Employment

Rainfall deficit Definition	Drought status			
	Severe Drought	Drought	Below average	Above average
	Per cent			
Farmer	66.9 (61.3–72.1)	60.4 (54.2–66.4)	56.2 (51.2–61.1)	50.8 (42.2–59.3)
Farm worker	36.5 (30.4–43.0)	35.0 (28.2–42.5)	35.3 (30.6–40.3)	31.2 (24.5–38.7)
Employed but not in agriculture	30.3 (26.7–34.1)	27.6 (23.9–31.7)	29.7 (27.0–32.6)	24.4 (20.6–28.7)
Not employed	40.0 (34.7–45.6)	35.3 (29.8–41.2)	35.5 (31.5–39.7)	34.8 (28.5–41.6)



Table 4 - Probability of Worse Household Financial Position in the Last Three Years and 95 Per cent Confidence Intervals, by Drought Definition and Type of Employment (continued)

	<i>Current Drought</i>	<i>Drought in last year</i>	<i>Drought in last 3 years</i>	<i>No Drought in last 3 years</i>
<i>Self-reported Definition</i>	<i>Per cent</i>			
Farmer	65.6 (62.1–68.9)	55.4 (47.2–63.4)	36.5 (24.3–50.8)	35.1 (26.6–44.6)
Farm worker	39.6 (35.8–43.5)	30.7 (23.3–39.3)	31.0 (19.7–45.3)	20.9 (15.1–28.2)
Employed but not in agriculture	31.6 (29.3–34.0)	30.3 (25.7–35.3)	22.4 (16.6–29.4)	22.4 (19.4–25.7)
Not employed	38.9 (35.5–42.4)	37.1 (30.0–44.8)	37.0 (26.7–48.6)	29.6 (24.9–34.8)

*Note:* Predicted probabilities derived from logistic regression.

*Source:* Rural and Regional Families Survey.

Two-thirds of farmers in severe drought as defined by rainfall deficits said that their financial position had become worse or much worse over the last three years, compared to 51 per cent of those in areas that had experienced above average rainfall. Although not statistically significant, differences existed between drought-affected farmers and those in above average rainfall areas.

The effects of drought were much stronger when the self-reported definition was used. Farmers who were currently in drought had almost twice the rate of worsening financial position than farmers who had not experienced drought in the last three years (66 per cent and 35 per cent of farmers in the respective areas). Statistically significant differences were also evident between farmers currently in drought and those who had been in drought in the last three years (66 per cent and 37 per cent).

Drought as defined by rainfall deficit had little impact on farm workers' financial positions in the last three years. However, using the self-reported definition, farm workers who said they were currently in drought had almost double the rates of worsening financial position than those who said they had not experienced drought in the last three years (40 per cent and 21 per cent respectively). There were statistically significant differences in the probability of being in a worse household financial position in the last three years between those farm workers currently in drought and those who had not been in drought in the last three years and those who had been in drought in the last three years (but were not currently in drought).

For people who were employed but not in agriculture, their household's financial position was affected by drought regardless of the definition, although not to the same degree as farmers and farm workers. When the rainfall deficit measure was used, 30 per cent of those employed but not in agriculture who were in severe drought said that their financial position had become worse or much worse over the last three years, compared to 24 per cent of those in an above average rainfall area (this finding was not statistically significant at the 5 per cent level). Using the self-reported definition

of drought, 32 per cent of those employed but not in agriculture who were experiencing current drought said that their financial position had become worse or much worse over the last three years, compared to 22 per cent of those who had not experienced drought in the last three years.

Surprisingly, there was a small impact of drought on the household financial position of people who were not employed, using the self-reported definition. Thirty-nine per cent of those who were not employed who were currently in drought said that their financial position had become worse or much worse over the last three years, compared to 30 per cent of those who had not experienced drought in the last three years. For the rainfall deficit definition, there were no statistically significant differences.

## 8. Geographic Mobility

One of the potential impacts of drought is that it may result in increased rates of people moving away from the area. This could be because of the financial effects of drought, loss of services or perhaps because of the social effects and impact upon the general 'mood' of the community.

One of the difficulties in collecting information on the impacts of drought on residential mobility using a cross-sectional survey is that only those still living in the area at the time of the survey can be interviewed. This will tend to bias the sample towards those with a lower propensity to move.

The Rural and Regional Families Survey asked respondents whether anyone who had lived in their household had permanently moved out of the area (defined by a respondent's postcode) in the last three years. Respondents were also asked how many times they personally had moved between areas in the last three years (moves within a particular area were excluded). We present the raw unadjusted percentages in this section of the results.

Drought was associated with a higher likelihood of having had a household member move out of the area in the last three years.

Using the rainfall deficit definition, rates of mobility out of an area were two to three percentage points higher over a three-year period in drought-affected areas (12 per cent in severe drought and 13 per cent in drought) than in below or above average rainfall areas (9.9 per cent and 9.6 per cent respectively). Rates of mobility out of the area using the self-reported definition were highest for those respondents who said they had been in drought in the last year but were not currently in drought (13 per cent). Those who said they were currently in drought did not report household members moving out of the area at higher rates (11.3 per cent) than those who had been in drought in the last three years but not in the last year or currently (11.2 per cent). The lowest rate was evident for respondents who were not in drought in the last three years (8.6 per cent).

For respondents, residential mobility out of the area was not associated with drought. In fact, rates of mobility out of the area were highest for non-drought affected areas.

Among respondents, rates of mobility out of the area were two to three percentage points higher for above average rainfall than for drought areas as defined by rainfall deficits (15.0 per cent for above average areas and between 12.0 per cent to 12.5 per cent for the other areas). When the self-reported definition was used,

respondents who indicated that they had not been in drought in the last three years had rates of mobility out of their area that were three percentage points higher than those who said they were currently in drought or had reported having been in drought the last three years.

Taken together, these findings on residential mobility seem to indicate that households were adjusting to adverse circumstances in drought-affected areas, with some members of households probably moving (temporarily or otherwise) towards areas with greater economic opportunity. The lower level of respondent mobility, according to the self-reported definition of drought, may be associated with members of the household with greater responsibilities (for the property for instance) having lower mobility and therefore staying behind. This interpretation is consistent with the above findings, but it may change when, as is planned, more geographic mobility data is added to the analysis.

## 9. Concluding Comments

The Rural and Regional Families Survey is unique in that it provides a representative and reasonably large sample of people who are often omitted in extant analyses (e.g., Botterill, 2007).<sup>9</sup> Using data from this survey, we have been able to estimate the economic impact of drought on families in regional and rural areas. Defining drought is difficult and sometimes contested, and so we used two definitions of drought: a rainfall deficit definition and a self-reported definition. Generally, the results of these two measures were consistent, but the effects of drought were much more pronounced when the self-reported definition was used.

Overall, drought has significant negative economic impacts, with large effects on the experience of financial hardship and deterioration in household financial position—especially for farmers and farm managers who reported that the current drought had reduced property output substantially. Overall, 42.4 per cent of farmers and farm managers said that if the weather conditions of the last three years continued their property was not viable in the short term and a further 13.5 per cent said their property was not viable in the longer term. However, 47.0 per cent of farmers and farm managers who were experiencing drought said that their property was not viable even under normal weather conditions. This is remarkable for two reasons. First, it implies that such people may be reliant on off-farm income to make a living, which has implications for both the demand on government services and welfare. There are also possible flow-on effects for the regional economy especially if skilled farmers and farm managers are displacing other potential labour market participants. Second, it confirms that the subjective definition of drought is not causally (directly) tied to the experience of hardship. In a sense this confirms that one should not overemphasise the possibility of reverse causality between hardship and subjective drought as the group most likely to blame their poor prospects on the drought will be those whose livelihood depends on agricultural productivity.<sup>10</sup>

As could be expected, drought had a larger negative impact upon farmers than

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<sup>9</sup> Compared to the 2006 Census, the Rural and Regional Families Survey slightly over-represents older people and those with a post-secondary qualification.

<sup>10</sup> Causality and simultaneity issues are unlikely to be completely resolved using available data sources. However, there might be some advantage in future research pursuing focus group discussions or semi-structured interviews on such matters to supplement the evidence base.

others living in rural and regional areas. Importantly, there was also evidence that drought had a negative impact upon farm workers and on people who were employed in rural areas but not in agriculture. There was some evidence of an increased rate of financial hardship for those who were employed but not in agriculture, but this depended upon whether the rainfall deficit or self-reported definition of drought was used.

Historically, the standard measures of individual welfare have largely focused on head count measures of poverty and poverty gaps measured relative to a poverty line.<sup>11</sup> Botterill (2007, p. 38) noted that 'no large-scale attempts have been made to measure farm poverty systematically since the two small regional surveys undertaken for the Henderson Inquiry'. It is difficult to measure welfare for asset-rich and income-poor groups, such as farmers, largely because wealth and asset data are generally not collected in the surveys where poverty could be measured for such groups (Botterill, 2007, pp. 38–9). One of the potential contributions of research conducted on the Rural and Regional Families Survey could be to provide estimates of tentative 'poverty lines' for farmers based on the relationship between household income and levels of financial hardship. While the survey is extremely useful in documenting the general social and economic impacts of drought, it must be noted that it does not include direct information on wealth and assets, as this would require an instrument specifically designed to identify the complex issues involved.<sup>12</sup> However, future 'poverty' research using this survey, can tease out some of the processes involved and clearly there is a need to collect specific detailed wealth and asset data for farmers to address this gap in the literature.

The long-term decline in regional areas is clearly an analytically separate issue from the effects of recent drought; however, one should consider the interaction between the two issues. Economic and social decline in regional Australia is not simply a result of declining contributions of certain sectors—either because of drought or falling prices for produce. Rather, it also includes a demographic decline that feeds back into a lack of regional infrastructure and local amenity (Barr, 2004). In the long run, if drought conditions become more prevalent, one should expect populations to move away from less productive areas and this will reinforce the processes of regional decline. However, in the short run, our research seems to indicate there are incentives for some household members to move away from the drought-affected areas while other household members remain more attached to the local area. The long-term fragmentation of families who send some of their number out to find work is unlikely to be sustainable in the long run and eventually may lead to the breakdown of community structures. The recent public debate about social exclusion and social inclusion, which emphasises the dynamic social processes that perpetuate the lack of social participation in the workings of society, is particularly relevant for rural and regional Australia (Finer and Smyth, 2004; Hayes, Gray, and Edwards, 2008). Future research using data from the Rural and Regional Families Survey should identify the social processes associated with social exclusion and social inclusion.

A preliminary version of this paper formed the basis of a written submission to the Productivity Commission's Inquiry into Government Drought Support, titled *Social and Economic Impacts of Drought on Farm Families and Rural Communities* (Submission #92). The findings can and already have informed the design of policies designed to build self-reliance and preparedness to manage drought—our submission

<sup>11</sup> Creedy (1998) also emphasises the inequality among the individuals classified as poor.

<sup>12</sup> Note there is a question in the survey on the percentage equity held in the farm.

is quoted extensively in chapter 4 of the report released by the Productivity Commission on 30 October 2008, *Government Drought Support*. It is important that data such as that provided in the Rural and Regional Families Survey be used to extend our understanding of the complex processes of adjustment that occur in times of drought in order to enable policy makers to prepare for the changes that will take place if our worst fears about climate change are realised.

## Appendix A. Descriptive Statistics and Regression Estimates

Table A.1 - Employment Rate by Drought, Logistic Regression with Robust Standard Errors

<i>Variables</i>	<i>Coefficient</i>	<i>Robust SE</i>
<i>Rainfall deficit Definition</i>		
Severe drought	-0.098	0.120
Drought	-0.122	0.126
Below average	-0.262 **	0.111
Above average (reference)		
<i>Demographic Covariates</i>		
Age	0.299 ***	0.019
Age-squared	-0.004 ***	0.000
Aboriginal or Torres Strait Islander	-0.582 ***	0.162
Education		
Less than secondary school	-0.373 ***	0.096
Secondary school only (reference)		
Trade or apprenticeship, certificate, diploma	0.119	0.101
University	0.300 ***	0.112
Other education, refused or don't know	-0.120	0.344
Gender (female = 1)	-0.959 ***	0.068
One or more children live in the household	-0.453 ***	0.080
<i>State-by-remoteness Dummy Variables</i>		
Victoria—Inner region	-0.097	0.145
Victoria—Outer region (reference)		
Victoria—Remote region	-0.437	0.250
NSW—Inner region	-0.100	0.360
NSW—Outer region	0.243 *	0.126
NSW—Remote region	0.797 **	0.342
Queensland—Inner region	-0.090	0.222
Queensland—Outer region	-0.156	0.135
Queensland—Remote region	1.211 ***	0.322
South Australia—Inner region	0.336	0.220
South Australia—Outer region	-0.207	0.146
South Australia—Remote region	1.015 ***	0.334
Western Australia—Inner region	-0.099	0.305
Western Australia—Outer region	-0.210	0.187
Western Australia—Remote region	0.818 **	0.352
Tasmania—Outer region	-0.230	0.252
Tasmania—Remote region	0.053	0.373
Intercept	-2.673 ***	0.391

Notes: N = 6519. \* p < .10; \*\* p < .05; \*\*\* p < .01

Table A.2 - Summary of Logistic Regression Models for Employment Rate, Employment Rate (farmers excluded), Financial Hardship and Financial Position by Drought

<i>Rainfall deficit Definition</i>	<i>Employed</i>		<i>Employed (farmers excluded)</i>		<i>Financial Hardship</i>		<i>Change in Financial Position</i>	
	<i>Coefficient</i>	<i>Robust SE</i>	<i>Coefficient</i>	<i>Robust SE</i>	<i>Coefficient</i>	<i>Robust SE</i>	<i>Coefficient</i>	<i>Robust SE</i>
Severe drought	-0.098	0.120	-0.216 *	0.125	0.246 **	0.097	0.357 ***	0.091
Drought	-0.122	0.126	-0.273 **	0.130	0.195 **	0.100	0.245 **	0.095
Below average	-0.262 **	0.111	-0.329 ***	0.116	0.067	0.091	0.182 **	0.085
Above average (reference)								
<i>Self-reported Definition</i>								
No drought in the last three years (reference)								
Drought in the last three years, but not in the last year or currently	0.139	0.158	0.079	0.164	0.104	0.142	0.049	0.128
Drought in the last year but not currently	0.227 *	0.120	0.105	0.124	0.549 ***	0.100	0.526 ***	0.091
Currently in drought	0.168 *	0.086	0.002	0.089	0.667 ***	0.079	0.672 ***	0.071

Notes:  $N = 6519$ . When farmers are excluded,  $n = 5393$ . \*  $p < .10$ ; \*\*  $p < .05$ ; \*\*\*  $p < .01$

Table A.3 - Summary of Regression Models Financial Hardship and Financial Position by Drought and Employment Status

<i>Rainfall deficit Definition</i>	<i>Financial Hardship</i>		<i>Change in Financial Position</i>	
	<i>Coefficient</i>	<i>SE</i>	<i>Coefficient</i>	<i>SE</i>
Employed but not in agriculture—Severe drought	0.059	0.148	0.297 *	0.145
Employed but not in agriculture—Drought	0.125	0.153	0.165	0.153
Employed but not in agriculture—Below average	-0.005	0.136	0.269 *	0.133
Farmer—Above average	0.679 **	0.217	1.161	0.201
Farm worker—Above average	0.082	0.204	0.338	0.195
Not employed—Above average	0.750 **	0.182	0.501	0.177
Farmer—Severe drought	0.343	0.264	0.377	0.251
Farmer—Drought	0.250	0.271	0.227	0.257
Farmer—Below average	0.247	0.252	-0.051	0.233
Farm worker—Severe drought	0.518 *	0.262	-0.060	0.253
Farm worker—Drought	-0.033	0.282	0.008	0.269
Farm worker—Below average	0.225	0.243	-0.083	0.231
Not employed—Severe drought	-0.007	0.232	-0.072	0.225
Not employed—Drought	-0.125	0.240	-0.142	0.236
Not employed—Below average	-0.106	0.214	-0.238	0.206
<b>Intercept</b>	<b>-1.244</b>	<b>0.388</b>	<b>-2.835</b>	<b>0.407</b>
<i>Self-reported Definition</i>				
Employed but not in agriculture—Drought in the last three years, but not in the last year or currently	-0.090	0.223	-0.002	0.207
Employed but not in agriculture—Drought in the last year, but not currently	0.446 **	0.156	0.409 **	0.149
Employed but not in agriculture—Currently in drought	0.415 **	0.115	0.470 **	0.109
Farmer—Not in drought in the last three years	0.438	0.264	0.627 **	0.221

Table A.3 - Summary of Regression Models Financial Hardship and Financial Position by Drought and Employment Status (continued)

<i>Rainfall deficit Definition</i>	<i>Financial Hardship</i>		<i>Change in Financial Position</i>	
	<i>Coefficient</i>	<i>SE</i>	<i>Coefficient</i>	<i>SE</i>
Farm worker—Not in drought in the last three years	-0.046	0.223	-0.088	0.218
Not employed—Not in drought in the last three years	0.518 **	0.158	0.377 *	0.148
Farmer—Currently in drought	0.558 *	0.279	0.790 **	0.239
Farmer—Drought in the last year, but not currently	0.144	0.340	0.426	0.300
Farmer—Drought in the last three years, but not in the last year or currently	0.233	0.475	0.065	0.414
Farm worker—Currently in drought	0.399	0.245	0.438	0.239
Farm worker—Drought in the last year, but not currently	0.083	0.324	0.107	0.313
Farm worker—Drought in the last three years, but not in the last year or currently	0.527	0.451	0.534	0.423
Not employed—Currently in drought	0.213	0.181	-0.055	0.172
Not employed—Drought in the last year, but not currently	0.101	0.257	-0.070	0.246
Not employed—Drought in the last three years, but not in the last year or currently	0.342	0.373	0.335	0.340
<b>Intercept</b>	<b>-1.479</b>	<b>0.380</b>	<b>-2.929</b>	<b>0.401</b>

*Notes:* All estimates are from logistic regressions for financial hardship and change in financial position. In addition to drought definition, the following covariates were included in regressions: age, age-squared, ATSI status, education (four dummy variables: less than Year 12; trade, apprenticeship, certificate or diploma; university; other education, refused to report education, don't know education), gender, at least one child in the household and state-by-remoteness dummy variables. For the rainfall deficit regressions, the reference category is 'Employed but not in agriculture—Above average'. For the self-reported definition of drought regressions, the reference category is 'Employed but not in agriculture—Not in drought in the last three years'. \* p < .05; \*\* p < .01

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