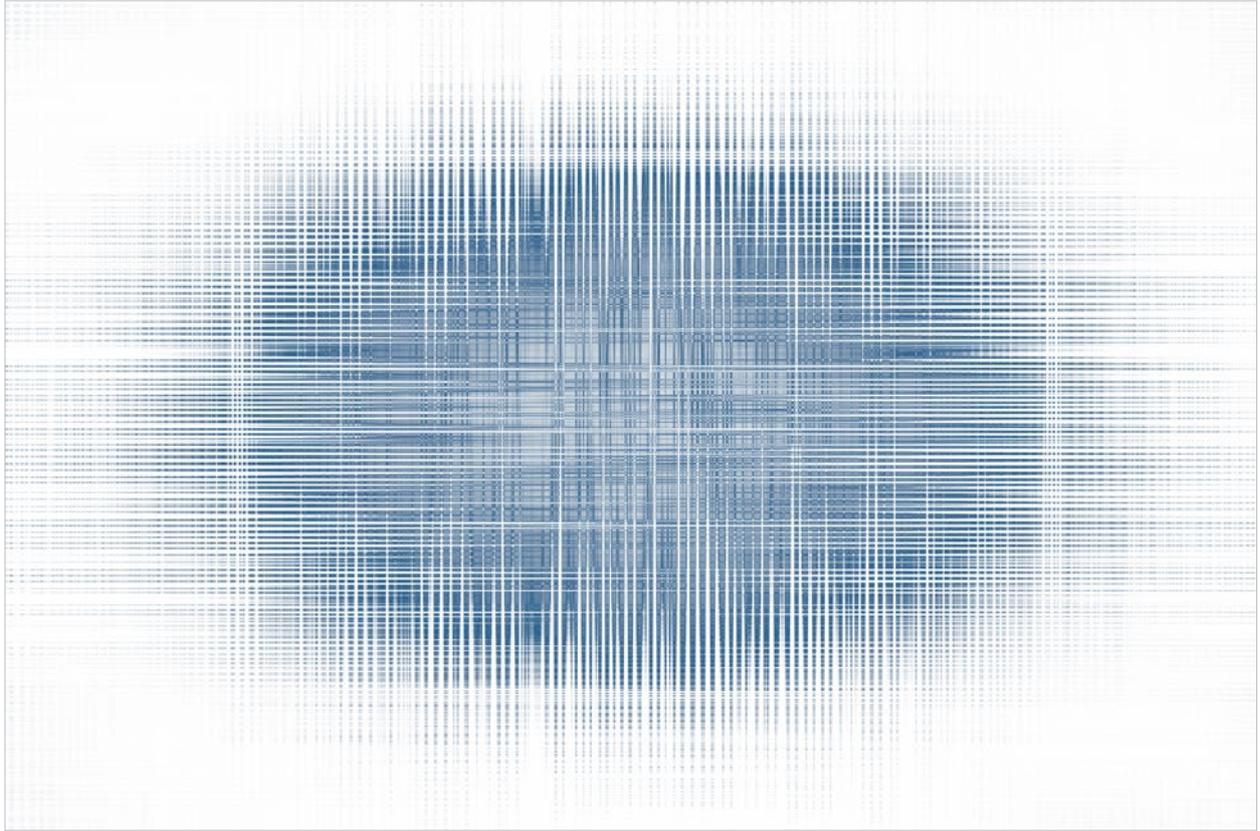




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The social and economic impacts of drought

B. Edwards, M. Gray and B. Hunter

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February 2018

The social and economic impacts of drought

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Abstract

Although the economic and environmental impacts of drought have been widely studied, few large-scale studies have examined the broader social impacts of drought. To fill this knowledge gap, the Australian Institute of Family Studies undertook the Regional and Rural Families Survey in 2007, when a significant part of Australia was experiencing a severe drought. This paper analyses that survey to measure the extent to which drought affects a range of economic, health and social outcomes. Drought is found to have a substantial negative economic

and health impact on farmers and others employed in the agricultural sector. There is some evidence that groups that are not employed in agriculture are adversely affected, with a widespread loss of services in drought-affected areas and some marginal labour market groups (e.g. carers) experiencing poor employment outcomes in a drought-affected local economy. Policy makers need to take these impacts into account in designing an effective response to future droughts.

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Acronyms

OECD	Organisation for Economic Co-operation and Development
RRFS	Rural and Regional Families Survey

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1 Introduction

Drought can have substantial negative economic impacts on farmers and the local economy. These impacts have been frequently documented (e.g. Diersen et al. 2002, Horridge et al. 2005, Edwards et al. 2009). However, the broader social effects of drought have received far less attention (Fritze et al. 2008). There are several mechanisms for social impacts of drought – for example, indirect effects of economic factors such as the hardship and stress of lost productivity; population decline; disruption of social connections as a consequence of the negative economic effects of drought; and the trauma of witnessing damage to livestock, crops, soil and native vegetation (Berry et al. 2008).

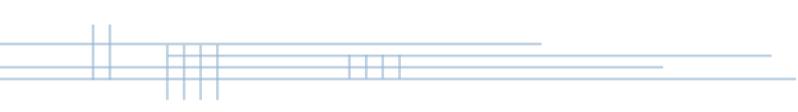
Many studies of drought have focused on farmers because they are most directly affected through lost agricultural productivity. Little evidence has been collected on the social implications for people who are not working in agriculture or related industries (e.g. Stain et al. 2011). The ability to estimate the impact of drought on social and economic outcomes is limited because studies have focused on a few communities, are based on small samples, and have not collected comparable data for people or areas not affected by drought (e.g. mental health studies of Alston & Kent 2004; Stehlik et al. 1999). Few studies have considered population-level consequences of drought in developed countries. Edwards et al. (2015) are an exception; they calculated that, if the population were not exposed to drought, the overall incidence of mental health problems in rural and regional areas would be 10.5% lower.

Very low rainfall is likely to precede drought, but lack of rain and drought are clearly different phenomena. A case needs to be made for using particular measures of drought to estimate the impacts of drought. Previous research by the authors considered several measures of drought – one based on rainfall deficiency and another based on a respondent's perception of drought – but argued that a measure of drought based on the perception of drought of other people living

in the same area provides a robust and unbiased measure of socioeconomic drought (Edwards et al. 2015). This is a measure of drought that uses disaggregated information available to individuals, but will not be correlated with respondents' reported outcomes. Among inhabited continents, Australia is the driest and has one of the most variable rainfall patterns. Australia is particularly vulnerable to the economic and social effects of drought because it has a relatively large agricultural sector (McMichael et al. 2006). Projections suggest that the frequency and severity of drought in Australia will increase as a result of climate change. Furthermore, Australia is particularly vulnerable to the potential effects of the types of climate changes that are expected in coming decades (Hennessy et al. 2008).

Given that the negative financial impacts and personal losses from drought are greatest for farmers, farm managers and farm workers (Edwards et al. 2009), we expect these groups to be the most severely affected by drought. Those in nonagricultural employment are expected to be less affected; effects on this group would largely be 'flow-on' effects of drought from people who are directly affected. We also examine farmers' reports of declines in agricultural productivity due to drought to further test whether the extent of drought has a particularly significant effect on the socioeconomic outcomes of farmers.

This paper addresses the lack of research into the socioeconomic impact of drought using data from the 2007 Rural and Regional Families Survey (RRFS). One of the main contributions of this analysis is to provide consistent estimates of the social effects of drought by employment status. Section 2 provides an overview of the data used in the analysis, some comments on how to best measure drought, and an introduction to both the socioeconomic outcomes analysed and the method for estimating the impact of drought. Section 3 presents the results and provides detailed analysis. Section 4 provides a conclusion that draws together some of the policy and research implications of the analysis.



2 Data and methods

2.1 Data

The effects of drought were estimated using data from the RRFS – a representative population-based survey of 8000 adults living in agricultural areas of Australia – conducted during September–December 2007. Farmers and agricultural workers were oversampled to ensure that valid inferences can be drawn for these subpopulations. The survey also includes nonagricultural workers and people who are not employed, to allow the broader effects of drought to be estimated.

The sample was stratified such that equal numbers of interviews were conducted in drought-affected areas, other areas with below-average rainfall and areas with above-average rainfall (using the Australian Bureau of Meteorology rainfall deficit definition of drought).¹ Computer-assisted telephone interviewing was used, and households were selected at random within each of the four strata by random-digit dialling into eligible postcodes.

Large parts of Australia were experiencing a severe and extended period of low rainfall at the time of the survey, with substantial rainfall deficiencies across much of southern Australia and southeast Queensland (BOM 2007). The amount of water available for irrigation was reduced, particularly in the Murray–Darling Basin, an area that is heavily dependent on irrigation and grows more than one-third of Australia’s total food production (Productivity Commission 2009). It is estimated that farm incomes in 2006–07 were, on average, \$29 002 less than in the previous year (see ABARE 2008). There were large effects on the experience of financial hardship and deterioration in household financial position, especially for farmers and farm managers, who also reported that the current drought had reduced property output substantially (Edwards et al. 2009). By the end of the 2002–07 drought, the owners of around 70% of agricultural land were in receipt of

some level of drought-related government financial support (Nicholson et al. 2011).

We now turn our attention to how best to measure drought.

2.2 Measuring drought

Although the term ‘drought’ is widely used, it is surprisingly hard to define and measure. There are at least four types of drought: meteorological drought (a period of low rainfall), agricultural drought (short-term dryness of soil layers at a critical time in the growing season), hydrological drought (prolonged moisture deficits that affect surface or subsurface water supply, thereby reducing stream flow, groundwater, and dam and lake levels) and socioeconomic drought (when human activities are affected by meteorological, agricultural or hydrological drought) (Hennessy et al. 2008).

Despite the complexity of defining drought, the mostly commonly used measure is rainfall deficit in an area compared with the long-term average. Rainfall deficit does not take into account factors such as the timing of water availability, temperature and wind speeds (which affect evaporation), and the availability of water from other sources, and therefore cannot fully capture the impact of low rainfall on agricultural production. For example, good irrigation flows or adoption of more advanced agricultural water usage may partly offset the economic impact of low rainfall. Given that good measures of agricultural drought are not available in Australia, this paper uses the assessment of respondents to a question about whether the area in which they live is experiencing drought. This measure has the advantage of capturing all the different aspects of the climatic conditions and the availability of water from other sources that will affect agricultural production. Self-reported drought has been validated as a reliable measure of drought

(Hunter et al. 2013). However, when analysing the socioeconomic impact of drought, it is important to guard against the possibility of reverse causation, whereby people who are anxious or unhappy may be more likely to say that they are experiencing drought than other residents. This possibility can be eliminated by excluding the individual's own assessment of whether they are experiencing drought from the measure of whether their area is experiencing drought (Edwards et al. 2015).

This drought measure requires several respondents from the same geographic area. Accordingly, the measure is effectively restricted to postcodes in which there were three or more respondents. A postcode was considered to be in drought if more than 66% of survey respondents said that their area was currently in drought (i.e. discounting the respondent's assessment of drought). Edwards et al. (2015) showed that this measure was highly correlated with rainfall deficit and conducted a sensitivity analysis; the key conclusions remained unchanged for drought measures with different cut-offs (e.g. 50% or 75% of respondents thought they lived in a drought area).

Although the area-based self-report drought measure does not capture differences in the severity of drought, the RRFS includes questions to farmers who said that they were experiencing drought about the impact of drought on the production from their farm. Farmers were asked if the drought had eliminated farm production or reduced it to the lowest point ever, reduced farm production substantially, reduced farm production to below average, or had little or no effect on production.

2.3 Measures of outcomes analysed

The main contribution of this paper is to provide an estimate of the impact of drought on a range of health, social and economic outcomes using a measure of drought that is exogenous to an individual's reported outcomes. The health outcomes examined are mental health problems, use of prescription medications such as antidepressants and hazardous drinking. The economic outcomes examined are equalised

household income and financial stress. The social capital measures examined are neighbourhood social cohesion, active membership of community groups and loss of services from the local area. The impact of drought on mental health using the RRFS 2007 has been estimated in Edwards et al. (2015), and this paper uses a similar methodology to consider the impact of drought on a much wider range of outcomes. The following provides consistent and arguably unbiased estimates of the effects of drought on a range of outcomes.

The first outcome analysed is whether a respondent was identified as having a mental health problem.² Use of prescription medication is measured using the question: 'In the last 12 months, have you been prescribed drugs by a doctor, such as anti-depressants, to help you cope?' This is similar to questions used in the National Survey of American Life and the National Comorbidity Survey Replication (González et al. 2008).³

Some people self-medicate in stressful situations by drinking excessive amounts of alcohol. At the time the RRFS was conducted, National Health and Medical Research Council guidelines (NHMRC 2001) defined hazardous or 'risky' drinking in terms of thresholds that were differentiated by gender: five or more standard drinks for women and seven or more standard drinks for men. A person was classified as having engaged in hazardous drinking if they had exceeded these thresholds at least once in the past month.

Financial stress was measured using a question that asks whether the respondent had experienced any financial stress due to a shortage of money in the past 12 months (see Edwards et al. 2009 for details). The measure of household income is annual gross (pre-tax) income from all sources. Household income is adjusted for differences in family size and composition, which affect the costs of living, using the 'OECD-modified' equivalence scale.⁴

Neighbourhood social cohesion is defined by the average extent to which the RRFS respondent agreed with statements about whether they live in a cohesive neighbourhood (e.g. 'This is a close-knit community'; 'People in this community can be trusted'; see Sampson et al. [1997] for full details

of all component questions). Active membership of community organisations is defined by whether a respondent frequently attends activities of such groups (e.g. Landcare, farmers' association, service club, church, sporting club). Loss of services is measured as the number of services lost in the local community in the past 3 years.

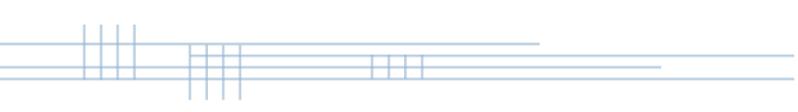
2.4 Analytic techniques

The basic empirical strategy for estimating the impact of drought is to compare the health, economic and social outcomes of residents of drought-affected areas with those of people living in other areas. Although drought is generally regarded as a 'random event', it may be that people living in drought areas differ systematically from those living in nondrought areas. To take into account any differences in observable individual characteristics, regression models are estimated that control for demographic characteristics of the respondent: gender, age, age-squared, Indigenous status, educational attainment, presence of children in the household of the respondent, and geographic area.

The effect of drought is captured using an indicator variable (based on the area-level report) to determine whether or not the area was experiencing drought at the time of the interview. Given that drought has, on average, the most direct and largest economic impact on farmers and other people employed in agriculture, it is important to allow the estimated impact of drought to differ between farmers, people employed in agriculture, people in nonagricultural employment and people who are not employed. The regression models include a set of dummy variables for employment status: farmer, employed in agriculture (farm worker), nonagricultural employment and not employed. Interaction terms between the drought measure and employment status are included in the regression models. The models were estimated using the working-age population (18–64 years).

The effects of drought on binary outcomes are estimated using logistic regression, and the results are reported in terms of odds ratios. The binary outcomes analysed are mental health problems, use of prescription medication, hazardous drinking, financial stress and active membership of community organisations. The effects of drought on other outcomes are estimated using ordinary least squares. All estimated models use robust standard errors that take account of any clustering of survey respondents at the postcode level.

A second set of regression models estimates the impact of severity of drought on the socioeconomic outcomes of farmers. As discussed in Section 2.2, severity of drought is measured using farmers' reports of the impact of drought on the production from their farm. In addition to the set of dummy variables capturing severity of drought, the same set of sociodemographic control variables used in the first set of models is included for these models.



3 Results

The first set of regressions estimates the effect of drought on social and economic outcomes by employment/farmer status (Table 1). Drought is estimated to increase mental health problems significantly. A negative impact of drought on mental health is found for farmers and farm workers, but significant effects are not found for those employed outside agriculture and those who are not employed. The effect of drought on the use of prescription medication or hazardous drinking is not significant for any of the subpopulations in Table 1.⁵

One plausible mechanism for drought affecting social outcomes is through the effect on economic outcomes. Drought only significantly affects financial stress and (equivalised) household income for farmers – the group most likely to be directly affected (whose households are 1.4 times more likely to report financial stress and have \$12 640 less income than similar households in nondrought areas).

The economic stress from drought is not reflected in lower neighbourhood social cohesion or active membership for any of the subpopulations in Table 1. However, one interesting finding is that all groups except farmers seemed to experience lower services in drought-affected areas than in nondrought areas. This may reflect that policy makers are sensitive to farmers' need for services during drought, or that the service needs of farmers are different from those of the rest of the population.

Table 1 conditions on employment status, and hence one summary economic impact of drought is not captured. However, the overall employment impact of drought can be estimated for the whole population. A regression that controls for the same set of sociodemographic control variables revealed that there is no significant effect of drought on overall employment (odds ratio of 1.1 with a 95% confidence interval of 0.9 to 1.3).

One response to economic distress caused by agricultural drought would be for farmers and people affected by lower productivity in the agricultural sector to look for jobs elsewhere in the regional economy. Increases in the amount of job search in the economy, as a result of many people in the agricultural sector looking for work, may displace marginal jobseekers from finding work. Edwards et al. (2011) used rainfall deficiency data from the Bureau of Meteorology and the associated measures of meteorological drought, together with 2006 Census data, to show that employment was significantly lower for some groups in drought-affected areas.⁶ Carers were significantly less likely to be employed than noncarers in drought-affected areas (more than 14 percentage points difference in drought areas, compared with around 4 percentage points difference in nondrought areas). Carers may have been in a worse condition to compete for jobs with people displaced from agriculture (or to compete for other work to supplement their falling income). Although there is no significant effect of drought on overall employment, this finding is noteworthy because carers are not associated with agriculture; it suggests that drought has a significant spillover effect on other residents.

Another response to drought may be that some local residents move in search of economic opportunities. In the RRFS, one measure of mobility was whether a householder moved out of the area in the past 3 years. Hunter and Biddle (2011) used this to show that the mobility of respondents is significantly lower in areas experiencing current drought than in areas that have not experienced drought in the past 3 years. In contrast, mobility of nonrespondents is significantly higher in households in drought areas. This may be important if some household members are maintaining contact with the 'local area', while other household members are looking for economic or other opportunities during presumably temporary climatic conditions.

Table 1 Effect of drought on selected social and economic outcomes, by employment/farmer status

Social and economic outcome	Nonagricultural employment	Farmer	Farm worker	Not employed	Total
Mental health problems	1.1	1.4*	2.2***	1.1	1.3***
Prescription medication	0.9	1.2	1.0	1.2	1
Hazardous drinking	0.9	1.2	1.1	0.9	0.98
Financial stress	1.1	1.4**	1.1	1.1	1.2**
Equivalised household income (\$) ^a	-2 111	-12 643***	-57	-1 413	-3 280***
Neighbourhood social cohesion ^a	0.1	0.0	0.0	0.1	0.05
Active member	1.0	1.2	0.9	1.1	1.07
Loss of services ^a	0.12***	0.07	0.13***	1.11***	0.11***

a Effect of drought for this outcome is reported as the coefficient estimated using an ordinary least squares regression.

Notes:

1. Unless otherwise indicated, the reported results are the odds ratio for drought areas relative to nondrought areas.
2. All statistical tests are pairwise, comparing differences in outcomes between drought areas and those not in drought areas.
3. Bolded statistics are significant at the conventional levels (i.e. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$).
4. Full regression models are available on request.

Source: 2007 Rural and Regional Families Survey

Table 1 demonstrates that the effect of drought is particularly pronounced on farmers. Table 2 explores whether the intensity of the effect of drought on farm productivity has a pronounced effect on selected socioeconomic outcomes for farmers. The first finding is that droughts that have a relatively small effect on farm productivity are not significantly correlated with worse social and economic outcomes. However, the effect of drought was significant and particularly pronounced when farm productivity had been reduced to the lowest point ever. The exception to this observation was that hazardous drinking was not significantly higher for any group in Table 2, even when the effect of drought on productivity was most extreme.

As the effect of drought on productivity increases, so too does the impact of drought on social and economic outcomes. For example, the effect of drought was higher among farmers for whom the effect on productivity was most extreme, compared

with farmers who were not affected by the local drought. The odds of having a mental health problem were 8.5 times higher where productivity had been reduced to the lowest point ever, but were 4 times higher among farmers where productivity was only substantially reduced by drought. Prescription medication was commensurately higher where productivity was extremely adversely affected or substantially affected by drought (odds ratios of 7.6 and 4.4, respectively).

Severity of drought was also significantly associated with financial stress (odds ratios of 3.2 and 2.2). Farmers whose productivity had been reduced to the lowest point ever had equivalised household income that was \$21 360 lower than farmers whose productivity was not affected by drought. Therefore, the impact of drought on agricultural output is a major factor in the social and economic impacts of drought.

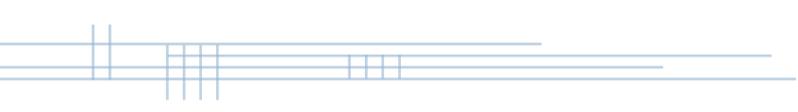
Table 2 Effect of the extent of drought (measured by farm productivity)

Social and economic outcomes	Farm productivity eliminated or reduced to lowest point ever	Farm productivity reduced substantially	Farm productivity below average
Mental health problems	8.5***	3.9**	2.4
Prescription medication	7.6***	4.4**	3.1
Hazardous drinking	0.9	0.89	0.9
Financial stress	3.2***	2.2***	1.3
Equivalised household income (\$) ^a	-21 360***	-9 680	-6 170

Notes:

1. Effect of drought is reported as the coefficient estimated using an ordinary least squares regression.
2. Unless otherwise indicated, the reported results are the odds ratio for drought areas relative to nondrought areas.
3. All statistical tests are pairwise, comparing differences in outcomes between drought areas and those not in drought areas.
4. The number of observations for the regression analysis based on farm productivity ranges from 929 to 1126.
5. The significance of the effect of the extent of drought is measured relative to the omitted category, which is whether the farm had little or no effect from drought, or was not in drought.
6. Bolded statistics are significant at the conventional levels (i.e. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$).
7. Full regression models are available on request.

Source: 2007 Rural and Regional Families Survey



4 Discussion

This paper has, for the first time, provided consistent estimates of the impact of drought on a range of health, social and economic outcomes using a large-scale, nationally representative sample and an exogenous instrument to measure drought. The main finding is that drought directly affects people working in the agricultural sector. However, there are substantial spillover effects on other groups as economic stress spreads across the local economy. Employment appears to be affected for certain groups (e.g. carers) who are not in a good position to compete in a labour market with more potential workers. Furthermore, the more severe the drought, as measured by the impact on farm productivity, the larger the effect of drought on the social and economic outcomes of farmers. One of the broader social effects of drought seems to be a loss of services in the local community. Taken as a whole, the empirical evidence suggests that the primary mechanism by which drought affects social outcomes is economic.

The findings about farm productivity are consistent with the direction of drought policy management in Australia; following the 2008 review of drought policy by the Australian Government, this has shifted from a crisis response to a risk management approach, with a focus on sustaining productivity even during sustained dry periods (Productivity Commission 2009, Gray et al. 2011). However, it is important that policy makers recognise that drought also affects people outside the agricultural sector, particularly those who are already more likely to experience involuntary joblessness and economic hardship, such as carers. There is also evidence that people who are not working in agriculture are particularly affected by a widespread loss of services in drought-affected areas.

This paper has implications for the health system and for health professionals in regional areas affected by drought, in that policy needs to address farm workers as well as farmers. Our analysis also suggests that governments have a role in ensuring that adequate services are available to all residents of drought-affected areas. In a sense, the analysis could be interpreted as optimistic with respect to the prospect of effective policy intervention. Farmers are the main focus of drought policy, and this seems to have ensured that drought does not adversely affect their access to local services.

Overall, drought is tough for those in the agricultural sector (financially and mentally), but rural communities are resilient, at least in terms of social cohesion. In part, this is likely to be due to a high level of engagement in community organisations, whereby residents pull together in a time of a crisis. However, it is important to ensure that basic services are not neglected or lost permanently during a prolonged, but temporary, climatic event.



Notes

1. For the purposes of survey design, drought status is based on historical rainfall deficiency in the 3 years before April 2007. Severe drought is areas with rainfall in the lowest 0–5th percentile compared with the long-term average, drought is areas in the lowest 6–10th percentile of rainfall, below-average rainfall is areas in the 11–49th percentile, and above-average rainfall is areas in the 50–100th percentile. Further details about the design and conduct of the RRFs are provided in Edwards et al. (2009).
2. Edwards et al. (2015) used the 5-Item Mental Health Inventory from the Medical Outcomes Study 36-Item Short-Form Health Survey to assess the mental health status in the previous 4 weeks. Scores ranged from 0 to 100. People who score less than 52 have been found to satisfy the clinical diagnostic criteria for depression and related disorders.
3. In these surveys, the question was: ‘Did you take any type of prescription medicine in the past year for problems with your emotions, substance use, energy, concentration, sleep, or ability to cope with stress?’
4. This OECD-modified scale, which was adopted by the Statistical Office of the European Union (EUROSTAT) in the late 1990s, takes the value of 1 for the first adult and adds 0.5 for the second and each subsequent adult, and 0.3 for each child.
5. The importance of using a measure of drought that excludes own response is illustrated by the fact that, when the individual self-report measure of drought is used, the effect of drought on both mental health and prescription medication appears to be statistically significant for the non-employed, but, when the exogenous drought instrument is used, it is no longer statistically significant.
6. The reliance on meteorological data was necessitated by the focus on census data on employment for a relatively small subpopulation, whose representation in the survey was too small to conduct meaningful tests (i.e. carers).

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