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Exploring the Drivers of Irrigator Mental Health in the Murray–Darling Basin, Australia

Sahar Daghigh Yazd ^{*}, Sarah Ann Wheeler ^{*} and Alec Zuo ^{*}

Centre for Global Food and Resources; Faculty of Professions, University of Adelaide, Adelaide, SA 5000, Australia

^{*} Correspondence: sahar.daghighyazd@adelaide.edu.au (S.D.Y.); sarah.wheeler@adelaide.edu.au (S.A.W.); alec.zuo@adelaide.edu.au (A.Z.)

Received: 19 September 2019; Accepted: 29 October 2019; Published: 1 November 2019



Abstract: There has been little work conducted on how landholders' farm management approaches and financial capital (specifically (i) farm method such as organic farming and (ii) financial profitability) may impact mental health. In particular, there is emerging evidence that an increase in natural farm capital and environmental conditions may improve farmers' wellbeing. We used a 2015–2016 survey, which randomly sampled 1000 irrigators from the southern Murray–Darling Basin, to model the drivers of irrigators' psychological distress. Results highlight that worsening financial capital (namely, lower farmland value, higher farm debt, lower percentage of off-farm income, lower productivity change over the past five years, and lower net farm income) was the most statistically significant factor associated with increased irrigator distress. In addition, there was some evidence that being a certified organic irrigator was also associated with lower psychological distress; however, it was only weakly significant in our overall model, with the most significance within the horticultural industry model. Contrary to expectations, drought and water scarcity were not the main drivers of psychological distress in the time-period studied, with their influence seemingly through reducing financial capital as a whole.

Keywords: Murray–Darling Basin; irrigator; certified organic agriculture; wellbeing; psychological distress

1. Introduction

Studies have identified several occupational stressors that are unique to farming communities and that are potentially harmful to mental and wellbeing [1,2]. In Australia, prolonged drought in rural and remote regions is considered as one of the key factors influencing psychological distress and poor wellbeing [3]. Water scarcity has been particularly relevant for irrigators in the Murray–Darling Basin (MDB) in Australia who have experienced the Millennium Drought (the worst ever recorded drought since European settlement—with the commonly-assessed time-frame of 2002–2010) and ongoing low rainfall and low water allocations over the past decade [4,5]. As a result, uncertainty about the future expanded irrigators' traditional agricultural sources of worry [6,7]. In addition, changes in commodity prices and, arguably, unequitable processor contracts, have increasingly negatively impacted irrigators (e.g., dairy farmers and grape growers especially) in the MDB [8].

Farmers' mental health is an important factor contributing to their overall wellbeing [9]. The sustainable livelihood framework distinguishes five different types of capitals that influence wellbeing (namely: physical, social, financial, human, and natural). These capitals influence the capacity to help people survive shocks and stresses, as well as the quality of their lives [10]. Although there has been considerable literature focussing on factors such as social, human, and physical capital (e.g., [7]), there is emerging literature on the importance of natural capital in influencing mental health. Natural capital refers to both the natural land assets (and farm management practises) of the farm,

and to the natural resources of a region such as climate, rainfall, water quality, air quality, and the health of vegetation [9,11]. Schirmer et al. [9] identified natural resource management practices and the physical environment of the agricultural landscape as influences on farmers' wellbeing.

This paper seeks to test the link between natural, physical, social, financial, and human capital and irrigators' mental health. It uses certified organic farm management practise as a proxy of natural capital and controls for a wide variety of other farm and farmer variables to provide a comprehensive understanding of the drivers of 1000 irrigators' mental health in the southern MDB in 2015–2016.

2. Literature Review

2.1. Overall Influences on Farmer Mental Health

Farming is associated with a range of physical and mental health risks because of the hard work under challenging conditions [1]. A range of occupational stresses result in various symptoms for farmers, such as physical problems (e.g., headaches, sleep problems, weight change), mental health problems (e.g., anxiety, anger, depression), and cognitive issues (e.g., memory loss, inability to make decisions) [12]. Some studies have identified greater mental health issues and less life satisfaction amongst farmers than non-farmers [13]. The literature suggests that farmers' stress is attributable to pesticide exposure, financial difficulties, climate variability, injuries, regulations, uncertainty about the future, role conflict between work and home roles, and heavy workloads [13–15]. Most importantly, mental disorders have been recognised as one of the key risk factors for suicide and suicidal ideation in farmers [13,16].

A person's resilience is one reason explaining why some people do not suffer significant distress in the face of stress [17]. Stain et al. [18] argue that greater levels of personal resilience, personal hope, and optimism help people deal with, and recover from, difficult times such as drought. Also, many have studied various coping techniques for farmers that may increase their resilience and, therefore, decrease their probability of mental health issues in difficult times. For example Gunn et al. [3] identified the coping strategies used in the Australian farming population in a time of drought. The most commonly employed farming coping strategies were planning, acceptance, and active coping, whereas the least used were alcohol/drug use, denial, behavioural disengagement, and religion. Winkelman et al. [19] examined behaviours to cope with stress amongst Latino farmworkers and showed that higher wages, sleep, and family support helped. In addition, Zarafshani et al. [20] evaluated differences in drought perceptions and coping strategies among Iranian farmers and showed that farmers in drought-stricken areas used more emotion-focused coping strategies such as acceptance and praying.

Resilience relies on a variety of capitals: (a) social capital (e.g., memberships); (b) human (e.g., age, education), financial (e.g., debt, land value, income), and physical capital (e.g., infrastructure, water entitlement ownership); (c) natural capital (landholders' management approaches); and (d) governance [21]. It also relies on using natural resource management techniques [17], which may result in less significant distress during environmental changes. It is argued that having greater access to five capitals and having higher resilience allows farmers to better cope with adverse events such as drought and climate variability [7,22].

Berry et al. [13] argue that the major stress in a time of drought is socio-economic hardship, which is known to have a significant influence on farmers' wellbeing. Farmers can be more successful in finding some alternative agronomic options for adapting to drought than in adapting to financial burden. In general, there has been a lack of research on the role that financial conditions play in driving mental health, even though there have been a wealth of studies that have looked at the drivers of farmers' stresses. Specific drivers of farm's financial status, such as off-farm income, farmland value, farm debt, and net farm income are rarely studied (see Wheeler et al. [22] for further discussion), and only very broad consideration of finances and economic burdens have been considered [23,24].

Our study fills this gap by incorporating a wide range of measures of financial capital to understand what the key drivers of psychological distress are for southern MDB irrigators.

Natural farm capital (e.g., locational and 'place' factors, such as natural resource bases, including land, water, air, minerals, soils, fossil fuels, and landscapes) and farmers' landholder practises can influence farmers' wellbeing [25–27]. Emerging literature is considering the relationship between farmers who undertake certain activities (e.g., natural resource management techniques) and their overall mental health and wellbeing [17]. One proxy for natural capital and management of land is certified organic or alternative management (discussed later), as it has been consistently shown these practices have greater environmental benefits on and off farms [28]. There is an increasingly recognised link between farmers' mental health, climate variability, and events such as droughts [3,29]. However, as Stain et al. [18] point out, the existence of drought itself is not necessarily associated with high drought-related worry. The definition of drought, and its many different connotations, is discussed later.

Irrigators in particular face additional pressures in times of drought through falling seasonal water allocations. For example, South Australian irrigators, who commonly received 90% of the water from their high-security water entitlements, received only 32% in 2007–2008, and, in 2008–2009, only received 18% [11]. As at 2019, many general security irrigators in NSW have been on 0% allocation for the past couple of years. Partly as a result of water variability, Wheeler et al. [5] suggested that MDB irrigators in 2015–2016 recorded higher levels of psychological distress than other dryland farmers, or the general Australian population. They also found that irrigators' psychological distress varied by industry and location, with the highest levels of distress amongst horticulturists, followed by broadacre, dairy, and livestock producers.

2.2. Potential Influence of Organic Farming on Mental Health

One of the most researched aspects of farming and mental health is the link between the use of neurotoxic pesticides and neural systems (not used in certified organic farming) known to cause mental illness and depression [15]. Khan et al. [2] found that organic farmers have a significantly lower frequency of neurological symptoms and depression. Others have found that organic farmers are happier and have higher levels of life satisfaction [30,31]. However, the increased labour demands of organic agriculture, and the need to negotiate price premiums and markets, can cause additional stress [32]. There is also an argument that organic farmers' social-ecological systems approach to managing their farm (and also the greater environmental benefits derived from organic farming [28]) increases farmer wellbeing [33]. Schirmer and Brown [34] discuss the importance of defining farmer participation in alternative agricultural systems, on the basis of measuring their implementation of social-ecological systems-based farming principles. Their evidence shows that farmers practising alternative practices had significantly higher subjective wellbeing compared to those who only self-labelled as using alternative practices.

Australia leads the world in the amount of land devoted to certified organic agriculture (albeit it has a much lower percentage share of organic agriculture compared to other countries) [35]. Especially in areas such as horticulture, growers are increasingly converting to certified organic agriculture, and name water security, finance, and environmental issues as their main motivations for conversion [11]. Some other potential benefits and costs of organic agriculture include reduced input costs, poverty reduction, and improved soil conditions [36,37]; higher income (especially in dry years) [38,39]; and more diversified production and resilience [39,40]. In South Australia, it has been found that organic and biodynamic grape growers perceive less vulnerability to reduced water and greater resilience to water stress due to their higher soil water retention and carbon matter in soils [11]. Given that Brown and Schirmer [17] also found that farmers who undertake natural resource management techniques have improved overall mental health and wellbeing, in this current study, we seek to explore the following question: do certified organic southern MDB irrigators experience lower levels of psychological distress than conventional irrigators, holding all other factors constant?

We also seek to explore how access to the five capitals (physical, social, human, natural, and financial) affects Australian irrigators' mental health.

3. Methods

3.1. Location

The location of this study is the southern MDB in Australia, which is one of Australia's most productive agricultural regions, producing more than one-third of the nation's food. The southern MDB spans New South Wales (where mostly annual cotton and rice crops are grown); to Victoria (mostly dairy and livestock); and the south-eastern part of South Australia (citrus, wine grapes, fruits, and nuts) [5].

3.2. Data

After gaining ethics approval, a telephone survey was conducted in 2015–2016 ($n = 1000$), with irrigators, not dryland farmers, in the southern MDB. Participants were randomly sampled, with a final response rate of 51% (or 73% including those who agreed to be surveyed but were not because sample size was achieved). The random telephone survey subsequently collected information from 957 (95.7%) conventional and 43 (4.3%) certified organic irrigators. This is a reasonable sample, given that data from the 2015–2016 agricultural census by the Australian Bureau of Statistics suggests that the percentage of organic irrigating farms was 2.1%. The largest number of organic irrigators in our sample was in horticulture (8.3%). Overall, in our sample, organic irrigators, compared with conventional irrigators, were significantly younger (p -value = 0.09), had lower debt (p -value = 0.03), lower off-farm income (p -value = 0.09), and higher farm productivity change over the past five years (p -value 0.00).

Wheeler et al. [5] compared southern MDB irrigators stress to dryland farmers' stress, identifying stress across irrigation industries and factors broadly associated with high levels of psychological distress in the irrigator population. They found 58.5% of the irrigator population in the southern MDB had low distress (K10 scores of 10–15, explained later in Section 3.3.1), 24.1% medium distress (16–21), 12.1% high distress (22–29), and 5.3% very high distress (30+). This study expands on the simple methodology used in Wheeler et al. [5] by using more sophisticated regression methods to explore the influences on irrigators' stress, as well as exploring in detail the question about the role that farm management practice, location, and natural capital play. Statistical analysis was performed by STATA SE Version 16.

3.3. Regression Methodology

A variety of methods were tested, with an Ordered Probit model chosen to model irrigators distress levels given the nature of our dependent variable Y^* (low; moderate; high; and very high distress levels):

$$\begin{aligned} Y^* &= x\beta + \varepsilon, \\ Y &= 1 \text{ if } -\infty \leq Y^* < \mu_1, \\ Y &= 2 \text{ if } \mu_1 \leq Y^* < \mu_2, \\ Y &= 3 \text{ if } \mu_2 \leq Y^* < \mu_3, \\ Y &= 4 \text{ if } \mu_3 \leq Y^* < +\infty, \end{aligned}$$

where X_i is the vector of independent variables; β , μ_1 , μ_2 , and μ_3 are unknown parameters to be estimated by the maximum likelihood method using the log-likelihood function; and ε is the error term, which is assumed to be normally distributed with zero mean [41]

3.3.1. Dependent Variable—Mental Health

Our indicator of the mental health and wellbeing of the irrigator population was the Kessler Psychological Distress Scale (K10). Past research has found the K10 a valid and accurate screening and

assessment tool for mental disorders [42]. A 10-item self-report questionnaire in the survey assessed the frequency of psychological distress over the past four weeks, with higher scores denoting greater psychological distress. Respondents indicated how frequently they felt distressed on a five-point response format from one (none of the time) to five (all of the time) [43]. Although K10 scores are a continuous variable from 10 to 50, researchers usually group K10 into categories. For the purposes of this study, we used the Health and Wellbeing Survey (2000) and the National Health Survey (2001) cut-off scores: low (10–15), moderate (16–21), high (22–29), and very high (30–50) distress.

3.3.2. Independent Variables

Our regression methodology utilises a variety of the five capitals as independent variables to model irrigators' distress. Financial capital factors include the percentage of off-farm income, net farm income, farm debt, farm productivity, and farmland value. Note that earlier year financial capital values were used to avoid endogeneity issues with irrigators' mental health. Human capital variables included education (low educational qualifications; year 10 or below), age, marital status, gender, and number of children, whereas social capital variables included whether the irrigator is a member of a social group and had a successor in place (expecting a family member to take over the farm). Physical capital factors included the irrigated area, the farm's long-term average annual yield (LTAAY, the long-term annual average volume of water permitted to be taken for consumptive use under a water access entitlement. Currently all LTAAY figures are calculated using the long-term diversion limit equivalent (LTDLE) factors, with these factors to be accredited in finalised state water resource plans) of all water entitlements, and whether their farm's productivity has changed in the last five years. For natural capital factors, we included locational and place measures of drought, net evaporation, mean historical maximum temperature, water allocations, and certified organic status.

Although a large number of studies highlight the significance and importance of drought on farmers' and rural communities members' mental health [3,14], there is no agreed definition of drought. Various definitions include meteorological (problematic weather patterns), hydrological (lack of rain), agricultural (low commodity production), or socioeconomic (low incomes and related social consequences). In the Australian literature, it is common to define drought by a deficiency of rainfall over an extended period [18,44]. Given the finding that an extended length of drought seems to be most associated with mental health stress [45], we used a figure of 12 months of rainfall deficiency to signify drought, and used a 12 month rolling rainfall deficiency grid from November 2014 to October 2015 from the Australian Bureau of Meteorology (BOM). The rolling ASCII (American Standard Code for Information Interchange) format gridded data was converted to the raster format to create a projection in ArcMap, based on the Australian national grid. The measure of drought involved spatial analyses of the data in the ArcMap and creating a dummy variable based on the identifying the tenth percentile (or within the lowest 10% of rainfall records) rainfall deficiency for each specific area on the basis of the statistical local area (SLA). Drought data were then matched to the location of respondents on the basis of their available postcode. Detailed evaporation and maximum temperature data were also collected from the BOM and were geo-referenced to spatial levels based on the SLA and then were linked to irrigators' postcodes using a Geographic Information System (GIS). The definition of the full list of variables, as well as their summary statistics, are provided in Table 1.

Table 1. Summary Statistics.

<i>Dependent Variable</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>
K10 (psychological distress: 1 = low, 2 = moderate, 3 = high, 4 = very high)	1.64	0.88	1	4
<i>Independent Variables</i>				
Male (1 = male; 0 = otherwise)	0.86	0.34	0	1
Age (years)	58.66	11.41	24	90
Low education (1 = higher education level is year 10 or below; 0 = otherwise)	0.16	0.37	0	1
Marital status (1 = married; 0 = otherwise)	0.87	0.33	0	1
Children (number)	2.78	1.38	0	10
Succession (1 = family member successor in place; 0 = otherwise)	0.39	0.48	0	1
Social group (1 = member of a social group; 0 = otherwise)	0.57	0.49	0	1
Farm generations (number of generations of farming)	3.10	1.42	1	14
Irrigated area 2014/2015 (hectares)	242.95	523.09	0	8000
Certified organic (1 = certified organic grower; 0 = otherwise)	0.04	0.20	0	1
Productivity change (Likert scale of farm productivity change in last 5 years: 1 = strongly decreasing; 5 = strongly increasing)	3.22	1.21	1	5
Off-farm income (% of annual household income from off-farm work)	24.79	31.11	0	100
Net farm income 2014/2015 (AUD \$1000 annual net income (gross revenue take gross costs)) ^b	85.36	84.53	0	250
Farm debt 2014/2015 (AUD \$1000) ^b	419.07	482.35	0	1250
Farmland value 2014/2015 (AUD \$1000) ^b	1385.16	1010.10	125	3000
Drought ^a (1 = drought; 0 = otherwise)	0.24	0.43	0	1
Mean annual historical maximum temperature (C°) ^c	23.33	0.92	20.07	25.24
Net annual evaporation ^b (evaporation minus rainfall)	1581.55	296.17	812.81	2438
Average final water allocation percentage ^d	0.77	0.32	0	1
LTAAY of all surface-water entitlements (GL)	634.47	1405.94	0	30995

^a Drought is the 10th percentile rainfall deficiency for the statistical local area (SLA), based on 12 month rolling rainfall deficiency grids prior to Oct 2015. ^b Net farm income, debt and farmland value figures were semi-continuous variables converted from the middle point range value. Specifically, net farm income values were: 0, 25k, 62.5k, 87.5k, 112.5k, 137.5k, 200k and 250k; debt values were: 0, 25k, 75k, 125k, 200k, 375k, 625k, 875k, 1125k and 1250k; and farmland values were: 125k, 375k, 625k, 875k, 1125k, 1375k, 1750k, 2500k and 3000k. ^c Rainfall, evaporation, and temperature data over 30 year period (1986–2015). ^d Water allocations is the seasonal amount of water received by water entitlements based on security and location. LTAAY: long-term average annual yield as already defined.

4. Results

Table 2 provides the regression results on the psychological distress levels for all southern MDB irrigators and by industry in 2015/2016. Similar results were obtained from the reduced form of the ordered probit model (models available upon request). To interpret the effect of each variable as a probability on each mental health outcome, marginal effects were calculated for each level of the dependent variable (please see Appendix A).

Table 2. Ordered probit regression results on drivers of irrigator psychological distress.

	<i>All Irrigators</i>	<i>Horticultural</i>	<i>Broadacre</i>	<i>Dairy/Livestock</i>
Male	−0.25 ** (0.12)	−0.63 ** (0.24)	−0.04 (0.28)	−0.19 (0.16)
Age	−0.01 *** (0.003)	−0.005 (0.007)	−0.02 ** (0.007)	−0.01 ** (0.006)
Education < Year 10	0.13 (0.11)	0.32 (0.22)	0.07 (0.23)	0.09 (0.18)
Marital status	−0.10 (0.12)	0.18 (0.25)	−0.40 (0.25)	−0.16 (0.19)
Number of children	0.03 (0.03)	−0.03 (0.06)	0.07 (0.06)	0.06 (0.04)
Succession	−0.08 (0.08)	0.13 (0.17)	−0.22 (0.16)	−0.12 (0.13)
Social group	−0.06 (0.08)	0.05 (0.15)	−0.24 (0.16)	−0.08 (0.12)
Farm generations	−0.007 (0.02)	0.05 (0.05)	0.005 (0.51)	−0.07 (0.04)
Irrigated area	−0.000 (0.000)	−0.000 (0.001)	−0.000 (0.000)	0.000 (0.000)
Certified organic	−0.34 * (0.20)	−0.57 * (0.29)	−0.11 (0.46)	0.09 (0.30)
Productivity change	−0.12 *** (0.03)	−0.10 (0.06)	−0.19 *** (0.06)	−0.17 *** (0.06)
Off-farm income (%)	−0.003 * (0.001)	−0.002 (0.02)	0.001 (0.003)	−0.006 *** (0.000)
Net farm income	−0.001 ** (0.000)	−0.001 (0.001)	−0.001 (0.001)	−0.001 (0.000)
Farm debt	0.0001 *** (0.000)	0.0004 (0.000)	−0.0001 (0.000)	0.001 *** (0.00)
Farmland value	−0.0002 *** (0.000)	−0.0001 (0.00)	−0.0001 (0.000)	−0.0002 *** (0.000)
Drought condition	0.008 (0.10)	−0.58 (0.39)	0.16 (0.22)	0.06 (0.15)
Mean annual temperature	0.02 (0.06)	−0.009 (0.10)	0.15 (0.14)	0.11 (0.09)
Net annual evaporation	0.0001 (0.000)	0.0001 (0.000)	−0.0004 (0.000)	0.0002 (0.000)
Average allocation	−0.07 (0.14)	−0.19 (0.22)	0.27 (0.28)	−0.12 (0.24)
LTAAY of all entitlements	0.0001 (0.000)	−0.0001 (0.00)	0.0001 *** (0.000)	−0.0002 (0.000)
Horticulture	0.02 (0.13)			
Broadacre	0.09 (0.10)			
Constant cut 1	−0.81 (1.40)	−1.10 (2.61)	1.06 (3.25)	1.13 (2.27)
Constant cut 2	−0.05 (1.40)	−0.50 (2.61)	1.82 (3.25)	2.10 (2.27)
Constant cut 3	0.64 (1.40)	0.10 (2.61)	2.74 (3.25)	2.84 (2.27)
Observations	910	281	253	376
McKelvey and Zavoina R²	0.11	0.15	0.23	0.20
Pseudo R²	0.04	0.05	0.08	0.08
Cox-Snell R²	0.08	0.11	0.16	0.15
% correctly predicted	0.58	0.60	0.58	0.61

Note: Standard error in parentheses. Due to missing covariate answers, a total of 910 surveys were available. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The models were estimated with robust standard errors. Checks on correlation analysis and variance inflation factor (VIF) results showed that serious multicollinearity was not present (mean VIF = 1.50). In ordered probit models, the McKelvey and Zavoina's R^2 is the closest measurement to R^2 in OLS (Ordinary Least Squares) models [46], which ranged from 0.11 to 0.20. In addition, the percentage of correct prediction ranged from 0.58 to 0.61.

4.1. Natural Capital

After controlling for a variety of influences on irrigator mental health, results suggest that certified organic southern MDB irrigators are slightly more likely to experience lower levels of psychological distress than conventional irrigators ($p < 0.08$). Specifically, the results indicate that certified organic irrigators are 4% less likely to be in the high level of psychological distress band and 2% less likely to be in the very high level of psychological distress stratum. In the horticultural industry-only regression, these probabilities increased to 7% (high) and 5% (very high), and were significant at the $p < 0.05$ level. This supports Khan et al. [2], who demonstrated a significantly lower frequency of depression problems among organic compared to conventional farmers. The small sample sizes of certified organic irrigators in broadacre and livestock/dairy meant that no robust results were obtained.

On the other hand, perhaps somewhat surprisingly, we found no significance for the impact of locational natural capital (drought, mean historical temperature, net-evaporation, and last year's average allocation factor) on irrigators' psychological distress. However, it is worth noting that only 24% of our sample were classified as in drought conditions using our definition. Drought started to increase in severity from 2016–2017, especially for New South Wales. Similarly, Stain et al. [18] reported that existence of drought was not necessarily the main driver of psychological distress for rural and remote Australian communities. Hanigan et al. [47] also found a more complex story associated with drought, where drought duration was associated with higher distress in younger rural women but not older rural women or men. The relationship between drought and financial capital is explored in more detail in the next section.

4.2. Financial Capital

Compared to the natural capital results, there is strong evidence suggesting an association between financial capital and irrigators' level of psychological distress. As Table 2 (all irrigation industry results) illustrates, financial capital variables are the ones most associated with irrigators' mental distress. Irrigators with a lower percentage of off-farm income, lower farmland value, higher farm debt, lower farm productivity, and lower net farm income were significantly more likely to experience higher distress. Specifically, the results indicate that an increase in net farm income by AUD \$100,000 decreases the likelihood of being in the high level of psychological distress category by 2 percentage points and the very high level of psychological distress by 1 percentage point. Also, an increase in farm debt of AUD \$1,000,000 increases the likelihood of being in the high level of psychological distress by 5 percentage points and the very high level of distress by 3 percentage points. Our results are consistent with other studies, which found financial problems as the most common issue associated with farming stress [1,5,48].

Considering different industries, the impact of lower off-farm income, lower farmland values, and higher farm debt were more likely to worsen mental health issues for dairy and livestock irrigators, whereas lower net farm income was identified as one of the key financial worries for broadacre irrigators.

4.3. Other Socio-Demographic Influences

Other significant influences on southern MDB irrigators' psychological distress are being female and younger. Our results indicated that male irrigators were 3% less likely to be in the high level of psychological distress category and 2% less likely to be in the very high level of psychological distress. This does not differ substantially from the existing literature, which suggests females report more psychological distress than men in surveys (e.g., [12]), though male farmers have higher suicide rates.

Male farmers embody a particular form of masculinity, which makes it difficult for them to seek help (or reveal distress, including in surveys), and thus this can increase their suicide risk [49]. Much of the literature has found that younger farmers experience higher levels of stress-related symptoms [12], which is probably because they are more likely to have higher debt levels.

5. Discussion

The results of the modelling in this paper suggest that drought and water scarcity are not necessarily the main drivers of irrigators' psychological distress, or at least, they were not in 2015–2016. Resilience, defined as the ability to successfully adapt to adversity and to capitalise on opportunities and to maintain family livelihood, is one reason why some farmers do not suffer significant distress, whereas others do [17]. The capacity of farm families to maintain a source of livelihood is also important. Resilience, as well as adaptive capacity to change, are often described as relying on the five capitals: (a) social, (b) human, (c) financial, (d) physical capital, and (e) natural capital. If all these capitals are not controlled for, then it is difficult to suggest the most significant drivers of mental health distress. Our results highlight that, in particular, financial capital plays a very important role as an alleviator of psychological distress, and that farm management practice (natural capital) may also be important. Correspondingly, it is not the actual industry or drought situation that necessarily drives mental distress, but the different capitals held by irrigators.

Despite the large body of research and literature that exists on farmer mental health, there has been little comparison between psychological levels of organic and conventional irrigators. The results in this paper suggest that certified organic farmers experience less mental distress. Our result adds to the other literature emerging on the link between natural capital and farm management practices, on the one hand, with farmer wellbeing on the other (e.g., [17,39]). It is important to note that our research was limited by its small sample of alternative growers (with the exception of the horticultural industry), but the results do suggest the need for increased research in this area with a bigger sample size, plus the need to follow and track irrigator mental health over time, such as looking at how farmer mental health changes as they convert to organic farming (e.g., namely the need to create a cross-sectional panel longitudinal dataset over time). Other limitations with our current methodology include the fact that in an ordered probit model it is difficult to set the ranking if the distribution is biased. Usually, K10 has more 10–15 points compared to 30–50 points.

Wheeler et al. [22] suggest that in order to reduce the psychological distress of Australian farmers, there needs to be a combination of four main policy mitigates: (1) drought policy for farms (e.g., farm household assistance, farm management deposit schemes, insurance, better decision-making, exit packages, and reducing subsidies for inputs and outputs); (2) mental health policy (e.g., health promotion, early intervention); (3) natural resource management/extension policy (e.g., climate change policy, land and water policy, soil carbon markets, payments for ecosystem services, land clearing regulations, public extension support); and (4) rural economic and social development policy (e.g., basic health and education services, communications and transport infrastructure, tourism policy, structural adjustment).

Building up the five areas of capital through the above policy mitigants will help move rural policy from a "crisis response" approach towards a preventive approach. Numerous commentators have suggested that current Australian assistance programs may not be equitable. For example, Botterill et al., [50] argue that current attitudes to drought assistance do not provide adequate protection to farmers from insolvency risks, and suggest other insurance schemes such as revenue contingent loans. O'Connor [51] also recommended crop insurance to allow farmers to become more resilient to extreme weather conditions. From a water and environmental management perspective, as argued by Wheeler and Marning [11], policy-makers should encourage the adoption of more agro-ecological methods which have often historically been ignored. Given the findings of the importance of financial capital on mental distress, further consideration must be given to how farmers can have a livelihood and receive money, even in the middle of a drought. Most farmers do not want handouts, however,

there is a need for society to create markets and conditions where farmers are rewarded for undertaking activities that society values (e.g., protecting (and creating) environmental services, increasing soil carbon for sequestration purposes). For water policy in particular, Wheeler et al. [5] recommended the buy-back of water entitlements, the use of exit packages, and the need to eliminate on-farm irrigation infrastructure subsidies. They argue that the flexible nature of the water buy-back policy allows for compensated farm exit, and the ability to spend the proceeds on the farm or in whatever way is seen fit (e.g., decreasing debt that is not possible through irrigation infrastructure subsidies). Helping farmers leave in a dignified manner (which includes exit packages) is preferable to many other worst case scenarios. The other issue is that subsidising infrastructure decreases capital costs and increases incentives to convert to more permanent cropping, increasing the probability of these irrigators' experiencing severe water scarcity in the next drought and losing years of investment.

6. Conclusions

Maintaining the physical and mental health of farmers is important not only for their own personal wellbeing but also for society. Our results indicate that financial capital seems to play the most significant role in influencing southern MDB irrigators' psychological distress, with net farm income, debt, productivity changes, and land capital value being the most important influences, respectively. This research also provides some evidence that landholder governance and natural resource management (such as certified organic status) statistically positively influence irrigators' mental health and potentially their wellbeing, especially in the horticultural industry (where larger sample sizes were available). Being female and younger were the other significant factors associated with higher levels of distress, whereas, perhaps surprisingly, no significant relationship was found between drought, water allocations, weather patterns, and psychological distress in our study year of 2015–2016. On the one hand, this reinforces findings from other literature that it is not drought that directly causes psychological distress, but that it happens indirectly through reduced yields, increased costs, and debt, along with reduced farm returns overall. Our results suggest that those farmers who have strong financial and natural capital, adequate productivity, and good land management are far better able to deal with, and are more resilient to, weather uncertainty. This paper has argued that to better build natural farming and financial capital and encourage greater risk-management strategies to withstand a hotter and drier future in Australia (and around the world), the focus must be to integrate (1) natural resource management/extension policy, (2) drought/climate change policy, (3) mental health policy, and (4) rural economic and social development policy.

Author Contributions: All authors discussed the research questions. S.D.Y. conducted the literature review and preliminary analysis, along with A.Z. and S.A.W., S.D.Y. and S.A.W. drafted the paper, and all participated in revisions. We are also grateful to Adam Loch and Juliane Haensch for their support in collecting the irrigator surveys.

Funding: This work was supported by the Australian Research Council [DP140103946 and FT140100773], and a University of Adelaide International Postgraduate Scholarship.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A Ordered Probit Marginal Effects Results

Table A1. Ordered probit marginal effects, low level psychological distress.

	<i>All Irrigators (dy/dx)</i>	<i>Horticultural (dy/dx)</i>	<i>Broadacre (dy/dx)</i>	<i>Dairy/Livestock (dy/dx)</i>
Male	0.10 **	0.24 ***	0.01	0.07
Age	0.004 ***	0.001	0.007 **	0.004 **
Education < Year 10	-0.05	-0.12	-0.03	-0.03
Marital status	0.03	-0.06	0.16	0.06
Number of children	-0.01	0.01	-0.03	-0.02
Succession	0.03	-0.05	0.08	0.05
Social group	0.02	-0.02	0.09	0.03
Farm generations	0.002	-0.01	-0.002	0.02
Irrigated area	0.00007	0.00003	0.0001	-0.00006
Certified organic	0.12 *	0.20 **	0.04	-0.03
Productivity change	0.05 ***	0.03	0.07 ***	0.06 ***
Off-farm income (%)	0.0009 *	0.0007	-0.0004	0.002 ***
Net farm income	0.0005 **	0.0005	0.0004	0.0003
Farm debt	-0.0001 ***	-0.0001	0.00001	-0.0002 ***
Farmland value	0.00006 ***	0.00004	0.00003	0.00009 ***
Drought	-0.003	0.20 *	-0.06	-0.02
Mean annual temperature	-0.01	0.003	-0.06	-0.04
Net annual evaporation	-0.00002	-0.00003	0.0001	-0.00009
Average allocation	0.03	0.07	-0.10	0.04
LTAAY of all entitlements	-0.00002	0.00005	-0.0003 ***	0.00007
Horticultural	-0.008			
Broadcare	-0.03			
Observations	910	281	253	376

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A2. Ordered probit marginal effects, moderate level psychological distress.

	<i>All Irrigators (dy/dx)</i>	<i>Horticultural (dy/dx)</i>	<i>Broadacre (dy/dx)</i>	<i>Dairy/Livestock (dy/dx)</i>
Male	-0.03 *	-0.04 ***	-0.005	-0.03
Age	-0.001 ***	-0.0005	-0.002 **	-0.002 *
Education < Year 10	0.01	0.02 *	0.01	0.01
Marital status	-0.01	0.02	-0.04 **	-0.03
Number of children	0.004	-0.004	0.01	0.01
Succession	-0.01	0.01	-0.03	-0.02
Social group	-0.009	0.006	-0.03	-0.01
Farm generations	-0.001	0.005	0.0007	-0.01
Irrigated area	-0.00002	-0.00001	-0.00003	0.00003
Certified organic	-0.05	-0.07 *	-0.01	0.01
Productivity change	-0.01 ***	-0.01	-0.02 **	-0.03 **
Off-farm income (%)	-0.0003 *	-0.0002	0.0001	-0.001 ***
Net farm income	-0.0001 **	-0.0001	-0.0001	-0.0001
Farm debt	0.00005 ***	0.00004	-0.00005	0.0001 ***
Farmland value	-0.00002 ***	-0.00001	-0.00001	-0.00005 ***
Drought	0.001	-0.07	0.02	0.01
Mean annual temperature	0.003	-0.0009	0.02	0.02
Net annual evaporation	0.000006	0.00001	-0.00004	0.00004
Average allocation	-0.01	-0.02	0.03	-0.02
LTAAY of all entitlements	0.00001	-0.00002	0.00001 **	-0.00004
Horticultural	0.003			
Broadcare	0.01			
Observations	910	281	253	376

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A3. Ordered probit marginal effects, high level psychological distress.

	<i>All Irrigators</i> (dy/dx)	<i>Horticultural</i> (dy/dx)	<i>Broadacre</i> (dy/dx)	<i>Dairy/Livestock</i> (dy/dx)
Male	−0.03 **	−0.08 ***	−0.007	−0.02
Age	−0.001 ***	−0.0007	−0.003 **	−0.001 *
Education < Year 10	0.02	0.04	0.01	0.01
Marital status	−0.01	0.02	−0.07	−0.02
Number of children	0.004	−0.005	0.01	0.008
Succession	−0.01	0.01	−0.04	−0.01
Social group	−0.01	0.007	−0.04	−0.01
Farm generations	−0.001	0.006	0.0009	−0.009
Irrigated area	−0.00002	−0.00001	−0.00004	0.00002
Certified organic	−0.04 *	−0.07 **	−0.01	0.01
Productivity change	−0.01 ***	−0.01	−0.03 ***	−0.02 ***
Off-farm income (%)	−0.0003 *	−0.0002	0.0001	−0.0008 ***
Net farm income	−0.0002 **	−0.0002	−0.0002	−0.0001
Farm debt	0.00005 ***	0.00005	−0.00007	0.0001 ***
Farmland value	−0.00002 ***	−0.00001	−0.00001	−0.00003 **
Drought	0.001	−0.07	0.02	0.008
Mean temperature	0.003	−0.001	0.02	0.01
Net evaporation	0.000017	0.00001	−0.00006	0.00003
Average allocation	−0.01	−0.02	0.05	−0.01
LTAAY of all entitlements	0.00001	−0.00002	0.00002 ***	−0.00003
Horticultural	0.003			
Broadacre	0.01			
Observations	910	281	253	376

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.**Table A4.** Ordered probit marginal effects, very high level psychological distress.

	<i>All Irrigators</i> (dy/dx)	<i>Horticultural</i> (dy/dx)	<i>Broadacre</i> (dy/dx)	<i>Dairy/Livestock</i> (dy/dx)
Male	−0.02 *	−0.12 *	−0.002	−0.01
Age	−0.001 ***	−0.0006	−0.001 **	−0.0007 *
Education < Year 10	0.01	0.05	0.005	0.006
Marital status	−0.01	0.02	−0.03	−0.01
Number of children	0.002	−0.005	0.005	0.004
Succession	−0.008	0.01	−0.01	−0.007
Social group	−0.006	0.007	−0.01	−0.004
Farm generations	−0.0007	0.006	0.0003	−0.004
Irrigated area	−0.00002	−0.00001	−0.00002	0.00001
Certified organic	−0.02 **	−0.05 ***	−0.006	0.005
Productivity change	−0.01 ***	−0.01	−0.01 **	−0.01 **
Off-farm income (%)	−0.0002 *	−0.0002	6.92×10^{-5}	−0.0003 **
Net farm income	−0.0001 **	−0.0001	-8.18×10^{-5}	-5.20×10^{-5}
Farm debt	0.00003 ***	0.00005	−0.00002	0.00004 ***
Farmland value	−0.00001 ***	−0.00001	−0.00005	−0.00001 **
Drought	0.0007	−0.05 **	0.01	0.003
Mean temperature	0.002	−0.001	0.01	0.006
Net evaporation	0.00001	0.00001	−0.00002	0.00001
Average allocation	−0.007	−0.02	0.01	−0.007
LTAAY of all entitlements	0.00001	−0.00002	0.00001 **	−0.00001
Horticultural	0.002			
Broadacre	0.009			
Observations	910	281	253	376

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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