

**PERSPECTIVE**

The weather as a determinant of farmer's mental health: A dependent, interacting, cumulative and escalating model (DICE) of the effects of extreme weather events

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Email: kylie.rice@une.edu.au**Abstract**

This perspective paper presents a conceptual, theoretical framework of the weather as a determinant of mental health for farmers. This model proposes that the effects of extreme weather events have interacting and cumulative effects for farmers, who are dependent on the land.

KEY WORDS

adaptation, climate change, extreme weather, farmer, mental health

INTRODUCTION

This perspective paper presents a conceptual, theoretical framework of the weather as a determinant of mental health for farmers. This model proposes that the effects of extreme weather events have interacting and cumulative effects for farmers, who are dependent on the land.

Extreme weather and natural disasters are no longer isolated incidents with an endpoint and recovery time, but may now represent a pervasive and ongoing threat (Longman et al., 2023). Australia is in the grip of another season of extreme weather events, with major climate indicators (e.g., El Nino and a negative Indian Ocean Dipole index) declared and converging. In Australia, these climate drivers are typically associated with higher rate of occurrence, longer duration and increased severity of compound drought and heatwaves, which have extensive impacts, including an increased risk of bushfires and significant environmental and socio-economic harm (Reddy et al., 2022). Drought is classified as a 'slow-moving disaster' (Yazd et al., 2019, p.10) and is related to stress on communities and individuals, particularly for farmers who are 'more vulnerable to environment-induced mental health risks carried by drought' (Cianconi et al., 2020, p. 7). Drought has devastating effects on farm eco-systems and production, with

crop and livestock losses and farmer psychological morbidity (Yazd et al., 2019). The effect of extreme weather events is considered to be inequitable and unjust and is experienced more acutely by vulnerable groups including farmers, who experience greater impacts on mental health (Gergis et al., 2023). Extreme weather events also disrupt the integral relationships between people and place, with farmers identifying profound emotional and psychological connections to their land (Ellis & Albrecht, 2017).

AUSTRALIAN FARMER MENTAL HEALTH

Elevations of mental health symptoms in farmers have been recognised in Australia (Austin et al., 2018) and internationally (Shoko Kori, 2023). Mental health issues in farmers are recognised as a key risk factor for suicide and high rates of suicide have been found in farming populations (Yazd et al., 2019). Farmers are often recognised as being stoic and reluctant to seek help, in addition to being isolated (Austin et al., 2018, 2020), increasing their risk for untreated mental health issues. In a systematic review, the most frequently reported risk factor for farmer mental health symptoms in Australian studies

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was weather uncertainty, including drought, followed by financial pressures (Yazd et al., 2019). Extreme weather events, including drought, are recognised to 'create a different kind of psychological and psychopathological distress compared to normal seasonal weather changes' (p. 3) and may include post-traumatic stress disorder, depression and anxiety; alongside elevations in suicide, substance use and aggression (Cianconi et al., 2020). There are also psychosocial changes related to drought (e.g., reduced time for family, loss of contact with friends, not going out as often), alongside farm effects such as financial stress, increased workload and business issues (Austin et al., 2018). Thus, farmers are a vulnerable group for mental health issues (Yazd et al., 2019) and are also vulnerable to the effects of extreme weather events (Cianconi et al., 2020). These composite vulnerabilities place farmers in an at-risk category.

This model proposes a conceptual framework to consider the effects of extreme weather events for farmers. Weather is a key determinant of mental health for farmers, with multi-level effects. The changing climate and the associated burden of extreme weather events has compound effects for the mental health of farmers, who are dependent on the land and these effects may be interactive, cumulative and escalating (Figure 1).

Dependent

Agricultural families are dependent on the land and may be among the most impacted by natural disasters, with detrimental impacts to farms, management, productivity, and commodity prices (Yazd et al., 2019). Thus,

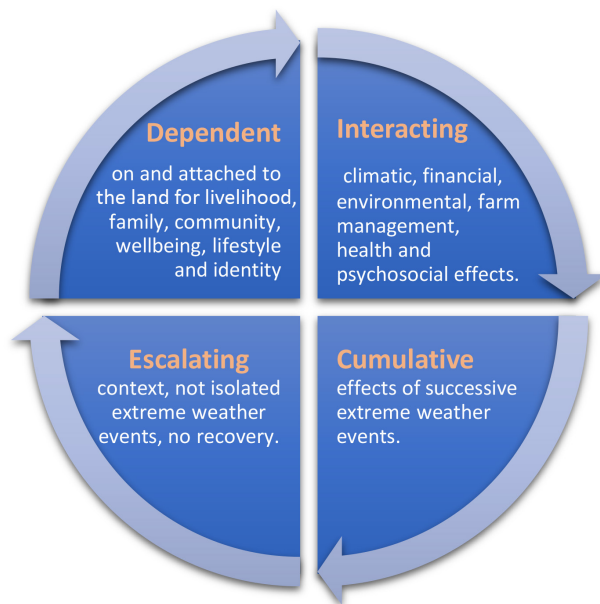


FIGURE 1 The DICE model: dependent, interacting, cumulative and escalating effects of extreme weather events on farmer mental health.

farmers are dependent on both the land and the weather. In addition to being dependent on the land for personal and familial livelihood, this dependency is also related to farmer mental health and well-being. There is a profound emotional and psychological connection for farmers to their land (Ellis & Albrecht, 2017), and, as such, extreme weather events may have deleterious impacts on the mental health of farmers affected by these disasters (Gergis et al., 2023). The connection between a farmer and their land represents a place-based attachment that relates to mental well-being, akin to Indigenous people's connection to country (Ellis & Albrecht, 2017). This attachment to the land relates to the interwoven relationships between people and place; and for farmers this place-based attachment recognises the personal significance of the farm as the place of personal identity, family and home (Ellis & Albrecht, 2017). As such, this connection is central to well-being and identity. Thus, farmers are deeply connected to and dependent on the land, for both livelihood and holistic well-being.

Interacting

The numerous effects of extreme weather interact for farmers. A systematic review on farmer mental health issues concluded that 'farmers' mental health issues are a result of a complex interplay between social, environmental and economic factors' (p. 14; Yazd et al., 2019). Extreme weather events have both direct effects (e.g. trauma) and indirect effects (e.g., social, economic), which interact in multidimensional pathways on mental health (Patrick et al., 2023). For example, drought experiences include financial issues, increased workload, farm management pressures, as well as psychosocial disruption and mental health symptoms (Austin et al., 2018), which all interact. Furthermore, mental health symptomology has been associated with negative impacts for farmers such as impaired performance, work-related injuries and reduced productivity (Rudolphi et al., 2019), further perpetuating an interactive cycle between types of effects. Thus, extreme weather events have complex social, economic and mental health impacts for farmers (Austin et al., 2020), that have both direct and indirect effects on mental health (Patrick et al., 2023) and these multidimensional pathways may interact systemically.

Cumulative

There may be an increasing risk of extreme weather events occurring in quick succession or simultaneously, which could result in compound impacts and minimal recovery time (Gergis et al., 2023). *Cumulative* in this model is intended to extend beyond the co-occurrence of weather events (e.g., cascading, concurrent, sequential, or interconnected; Niggli et al., 2022) and refers to



the compound *impacts* of exposure to multiple disasters. Although most of the literature on the experience of multiple disasters is more general and not necessarily related to extreme weather events, the emerging evidence suggests there may be an increased mental health and suicide risk with exposure to additional disasters (Gergis et al., 2023). As stated by Gergis et al. (2023) ‘when multiple extreme events occur together or in sequence, their impacts are compounded, resulting in greater cumulative stress on communities and the environment and less time to recover between disasters’, with ‘extreme impacts that are much greater than the impacts of individual extremes alone’ (p.32). Specific to farmers and extreme weather, Ellis and Albrecht (2017) reported ‘cumulative and compounding stresses associated with chronic climatic adversity’ and noted that ‘farmers’ emotional and psychological resilience erodes over the longer term’ (p.165). Thus, for farmers, consecutive exposure to extreme weather events can have cumulative and compound effects, such as psychological, environmental, financial and agricultural management pressures. Without time, recuperation and resources for systemic recovery from all effects of extreme weather events (e.g., environmental, financial, farm management, productivity, health and mental health etc), farmers are at considerable risk of psychiatric sequelae. Effects of each extreme weather event may be immediate, short term and/or long term and may range from acute to chronic (Cianconi et al., 2020); and each successive extreme weather exposure may reduce resilience, trigger new symptoms and/or worsen previous symptomology, and may have cumulative effects on farmer mental health and well-being.

Escalating

The duration, intensity, frequency and type of extreme weather events is increasing and recovery between adverse events is no longer possible (Longman et al., 2023). The notion of recovery here refers to environmental and systemic recuperation, and a return to a baseline level or homeostasis. In Australia, each year between 2013 and 2020 was in the 10 warmest years on record; with 2019 recording the hottest temperatures and lowest rainfall overall and the season culminated with the catastrophic ‘Black Summer’ bushfires which were of unprecedented magnitude and destruction (Niggli et al., 2022). As stated by Ellis and Albrecht (2017), ‘as climate conditions worsen, biophysical and economic limits to agricultural production are predicted to emerge, creating significant challenges for the long-term sustainability of current modes of family farming’ (p.166). This possible escalation in extreme weather events may present a real and holistic threat to farmers and farm management. Given that farmers’ capacity to recover from extreme weather events has been aligned with farm recovery and environmental return to homeostasis, including adequate rainfall, the

possible escalating context of increased frequency, severity and duration of extreme weather likely poses a threat to farmer coping thresholds (Ellis & Albrecht, 2017). This may have escalating personal impacts for farmers and their communities and both direct and indirect effects on mental health and livelihood (Shoko Kori, 2023). As stated by Ellis and Albrecht (2017), ‘farmers, when exposed to constant climate stress, may eventually reach limits in their ability to cope, resulting in the emergence of clinically defined forms of psychopathology such as depression and even suicidal ideation’ (p.166). Recognised mental health symptoms (such as post-traumatic stress disorder, anxiety and depression), have been combined into an extreme weather event exposure composite score of *psychological impairment* (Chique et al., 2021). In addition to this psychological impairment and morbidity (Chique et al., 2021), the escalating extreme weather context may also be associated with high levels of anxiety about anticipated future ecological adversity and grief for ecological loss (Comtesse et al., 2021). Given that extreme weather events can be acute, variable and pervasive for farmers, with short-term and/or long-term impacts on mental health (Cianconi et al., 2020), this context may represent both an escalating and enduring threat for farmers and their mental health.

ADAPTATION

Farmers depend on the land for livelihood and existence; and society depends on farmers for their food and survival. Extreme weather events impact farm practices (Shoko Kori, 2023) and reduce farm production (Yazd et al., 2019), having disastrous effects on the supply chains, commodity prices and food supply. Farmers are recognised to be a vulnerable group who experience disproportionate impacts from extreme weather on their mental health (Gergis et al., 2023) and on their livelihood (Shoko Kori, 2023). As such, effective agricultural adaptation practices need to be developed and implemented (Austin et al., 2020), for both farm sustainability and holistic well-being. Farmers need assistance and resources to create resilient farms and practices that are able to adapt to effectively maintain essential function and production in the variable climate and extreme weather (Cianconi et al., 2020). These resources need to be adequate, equitable and readily accessible, even for farmers who are required to have an off-farm income. On a community and societal level, facilitating farmers to adapt and maintain essential production in weather extremes is crucial for the sustainability of farming, the security of food supply, and survival (Cianconi et al., 2020). In addition to farm adaptation, mental health systems need to reform (Gergis et al., 2023), toward building adaptive capacity (Longman et al., 2023).

While the term ‘recovery’ is used above to refer to environmental recovery and ‘adaptation’ refers to adapting



farm practices, both terms are also applied in mental health spheres. In mental health, Anthony's (1993) long-established recovery definition of 'a way of living a satisfying, hopeful and contributing life even with the limitations caused by illness' (p. 13) has evolved through practice and research. Whitley and Drake (2010) later extended these psychological aspects of mental health recovery to a more systemic framework, that incorporated five broader domains of clinical (e.g., symptom improvement), physical (e.g., health and lifestyle), functional (e.g., roles and responsibilities including employment, housing, education), existential (e.g., hope, empowerment and spiritual well-being) and social (connection with significant other people and their community). This framework appears to offer a broader and more holistic conceptualisation of the notion of mental health personal recovery, and this may be valuable in building adaptive individual capacity, within environmental adaptation.

CONCLUSION

With extreme weather now ongoing and no longer limited to isolated events, recovery is not possible (Longman et al., 2023). There is no period of stability and 'normal', with resources to enable a return to homeostasis. Farmers are a vulnerable group with disproportionate risk (Gergis et al., 2023) and are on the frontline of extreme weather events and the changing climate. Farmers are essential for the survival of our planet and humanity, they are caretakers of the land from which we all depend and the providers of the world's food supply. As such, farmers are essential to societal existence, survival and well-being. Australia has launched into another season of extreme weather events and for our vulnerable farmers who are dependent on the land, this may have interacting, cumulative and escalating mental health impacts and holistic effects.

CLINICAL IMPLICATIONS

The proposed DICE model, presented above, provides an integrated, theoretical conceptualisation of possible compound effects of extreme weather exposure for farmers. While this model is suppositional and needs to be validated in future research, this model highlights some possible pathways for understanding the impacts of extreme weather events on farmer mental health.

Broadly, this model emphasises the importance of conceptualising farmer well-being holistically and within their multi-dimensional context, and particularly with consideration for their experiences of extreme weather events and farming stressors. This is consistent with a One Health conceptualisation, that emphasises the connection between people, the environment, plants and animals (Usher et al., 2024). Specifically, the DICE model

may have utility as a framework for practitioners to consider a farmer's experiences of extreme weather events, by prompting assessment of: (a) the level of dependence on the land, (b) the impacts of extreme weather events experienced and the interaction between these impacts, (c) the level of possible cumulative effects from multiple events and (d) the frequency and duration of each event.

Urgent support and resources are needed to help farmers to adapt in the current context. Models of farm support and psychological assistance need to focus on adaptation (Longman et al., 2023) and ensure that farmers have the systemic resources they need to effectively adapt. There is a crucial need to identify effective adaptive practices, to facilitate mental health promotion and prevent psychological morbidity (Charlson et al., 2022). The weather is a key determinant of farmer mental health and in this threatening context of escalating extreme weather events, systemic resources incorporating both farm adaptation and psychological adaptation are urgently needed.

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ETHICS STATEMENT

Ethics was not required for this article as no data was collected.

PATIENT CONSENT

Patient consent was not required for this article as no data were collected from human participants.

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