

Food Pricing, Extreme Weather and the Rural/Urban Divide: A Case Study of Northern NSW, Australia

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Abstract According to the Australian Government (2012:vi), 'a crucial question for the wellbeing of all Australian residents is the extent to which the food supply chain is resilient in the face of disruption'. The impact of extreme weather events and a changing climate on food production influences food prices across time and space. In this study food prices across the Northern Rivers region of New South Wales were surveyed one week after a disastrous flood and cyclone event. Six months later, a follow-up survey was initiated. The surveys provided data which allowed comparisons between food pricing in urban settlements and rural settlements in the region, both at the time of flooding, and six months after the floods. Results from the study indicate that the large chain supermarket prices actually decreased during the six-month period while, in contrast, food pricing in the small independent stores continued to increase after the flood event. We conclude that the smaller, regional stores are less resilient to the impact of the flooding event than are the larger, urban based stores. This raises significant concerns for regional communities that are dependent for food provision from small independent stores

Keywords: *food supply chain resilience, rural food security, food inequity, food basket surveys, climate change impacts*

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1. Introduction

Interruptions to food production and supply can result in rapid increases in food prices which, in turn, can contribute to food insecurity [1]. Such interruptions can arise from severe weather events (often linked to climate change – see [2]), environmental degradation – and subsequent yield decreases [3], bio-security hazards [4], and increasing fuel prices [5,6]. Individually and collectively, these factors compound existing market-based pressures on food production.

The length of the food supply chain can create additional vulnerability by increasing the number of potential impact points [7]. Australia relies heavily on long food supply chains that are controlled by the supermarkets [7]. Food is moved around the continent by fleets of refrigerated trucks which use the national roadway – a roadway that is often cut when flooding events occur. In the face of such threats, the Australian Government has acknowledged the importance of maintaining the strength and resilience of the food system, particularly its capacity quickly to return to normal after facing disruption [4, p19]. The Government similarly acknowledges that one of the emerging challenges to food supply chain resilience was that of scale. It questions

whether 'the food supply chain can adapt to disruption up to a certain population or geographic scale, with elements breaking down beyond that point' [4, p. ix].

In December 2010 – February 2011 most of Queensland's and Northern NSW's food system was affected by a devastating flood event, followed by tropical cyclone Yasi. The impact upon the food system (from production to food distribution) was enormous, revealing both the 'fragility' and 'resilience' of existing food supply chains [4, p.x]. These concurrent extreme weather events resulted in the closure of 155 roads and 14 highways. The main food distribution centre for the region, the Rocklea Markets in Brisbane, Queensland, was submerged by the floods.

In this paper, we explore food supply chain resilience via a case study of the Northern Rivers region in Northern New South Wales. We consider the implications for householders and residents in both urban and rural settings in the case study region through food pricing surveys following the significant flooding/cyclone events of 2010/2011. The method was to examine changes in the price of foods in selected towns within the region. One survey was completed in January 2011, a week after the devastating flood and cyclone; the other was completed in July 2011, at a time when local food production and food markets had regained some momentum.

The Northern Rivers region provided an opportunity to explore the relationship between food security and urbanisation following extreme weather events. The region is experiencing higher than average population growth along the coastline and within the urban fringe - consistent with peri-urban regions nationally and internationally [8]. Northern Rivers is also experiencing population decline in the inland, largely-rural regions [9]. As such, this study compares food prices across the region from the large growing coastal cities and swelling peri-urban areas to the declining towns beyond the urban boundary and beyond the major transport networks. It allows for an assessment of the relative abilities of urban-based regional, and small rural, communities to adapt to disruptions in their food supply chains.

To this end, this paper addresses the following research objectives:

- to identify whether residents in small rural towns pay more for food than urban-based regional residents, and
- to identify whether urban-based regional food retailers, and rural-based food retailers, were able to adapt to the impacts of 2010/2011 extreme weather events by stabilising food prices six months following these events.

2. Background

2.1. Food Security

Food security is essentially having ready access to food that is nutritionally adequate for a healthy and active life, is affordable, is safe and has cultural acceptability [10]. Factors like food affordability and food access directly determine food security and, in this context, food security is an issue for Australia [11]. Surveys have revealed that some 7% of the general population in South Australia [12] and 5% of people in New South Wales [13] have experienced food insecurity at some point within a specified 12 month period. In a more recent national survey of 1200 people conducted in 2011, some 16% worried often or sometimes that their food would run out before they had the funds to purchase more, and 8% admitted that they had run out of food and did not have the funds to buy more [14]. Food insecure Australians are disproportionately found among Indigenous, homeless, unemployed or older, single people [15,16,17]. The food insecure often live in economically disadvantaged suburbs in capital cities or in areas remote from urban centres [15].

Vulnerability to food insecurity has, to date, been investigated either through large-scale household surveys to determine food consumption patterns [16,17,18] or via static food-pricing surveys of retail stores which calculate the cost of a prescribed 'food basket' [18,19,20,21,22,23].

Although the Australian Bureau of Statistics has reported that the average family spends around 17% of its household income on food and non-alcoholic beverages [24], several studies have identified that this percentage of income is much less than that of an unemployed family dependent upon welfare payments. Australian research reveals that dual-couple and single-parent families where adults are unemployed need to spend around 30% - 40%

of their household income in order to secure a healthy diet for their families [18,19,20,21,22,23].

2.2. Geography and food prices

Research in Australia that relates food prices to geographical space, shows food prices in rural settings tend to be higher than those in urban settings – with food basket studies showing that the cost and availability of healthy food may be compromised in rural areas [19,22]. [25] revealed that, in the State of Queensland, food prices increased according to the extent of remoteness of communities. Similarly, [26] demonstrated that food prices have increased at a higher rate in remote and rural locations in Australia.

In other studies, the actual size of the supermarket, rather than the distance of the host town from urban areas, has been shown to be a determinant of food prices [22,27]. These studies report that rural communities are at a distinct disadvantage because large supermarkets are not present in those towns. The healthier food choices that are on offer in the large supermarkets are not generally available in the smaller general stores [28]. In any case, the healthier products tend to be more expensive than less healthy options and, as such, influence food choices in rural communities [27,28].

In a study undertaken in Adelaide, [29] found that urban dwellers were able to choose between a variety of food outlets – something which helped to create a situation of competitive pricing in the city. This was not the case in the rural regions. Also, in the urban areas, public transport was an expected and well-patronised component of the city infrastructure, which increased the opportunity for urban households to gain greater access to cheap food sources and to a greater variety of cheaper take-away foods. Other benefits afforded to urban dwellers included more assistance and facilities offered by local social or medical authorities. For example, taxi vouchers were one of the options available to pensioners for transport to local shops in urban centres but not available to those in rural settings [29].

There is, however, not as clear a relationship regarding food prices in urban versus regional settings in which this study is located. In peri-urban Victoria, [19] hypothesised that food prices would correlate with proximity to a town serviced by a major supermarket chain but found that there was no appreciable difference in food prices between food stores in urban Melbourne and those easily accessible in South West Victoria. Similarly, [22] found no relationship between remoteness and food prices in a study of 34 non metropolitan areas in South West Victoria.

3. Methods

3.1. The Northern Rivers Region – Case Study

The Northern Rivers region in New South Wales extends between Tweed Heads in the north, to Grafton in the south. The region is bordered to the east by the coast, and to the west by the Great Dividing Range. Within the Northern Rivers, each of the Local Government Areas (LGAs) has a lower Socio-Economic Indexes for Areas (SEIFA) score indicating disadvantage in comparison to

the average Australian LGA [30]. This measure of disadvantage is also observed in the percentage of unemployment and the median weekly family income reported by the Australian Bureau of Statistics [30]. For the latter, all of the LGAs in the Northern Rivers fall short of the Australian average. Furthermore, all of the Northern Rivers LGAs have a higher percentage of lone households and single parent families than the Australian average [30].

Another factor that may indicate significant levels of food insecurity in the region is the notable lack of public transport options. Regions that contain a significant number of households without a car and are located greater than 2.5km from the nearest supermarket are nominally referred to as 'food deserts' [29]. Normally this association is made within an urban setting. Yet, it is equally apt for regional areas where mobility and cost of food are known determinants of food insecurity [16]. Across the Northern Rivers region between 6% and 10% of households do not have access to a car and are not supported by public transport options [30]. The more vulnerable members of the community are therefore dependent upon local food stores where prices are higher and the variety and quality of fresh food is often limited.

Between 2005 and 2010 the Northern Rivers region experienced population growth which occurred, predominantly, in the larger coastal centres: population loss occurred in the most rural areas [9]. This trend is representative of global-scale urbanisation with over half of the world's population now living in urban centres. On the national scale, in 2009, almost 69% of Australians resided in the nation's capital, and other major cities [30].

3.2. The Healthy Food Basket Survey

Similar to other healthy food basket surveys, the food baskets developed by [31], and used in this study, consider the nutritional needs of three different hypothetical households consisting of: (i) two unemployed adults and two children (ii) an unemployed single parent with two children and (iii) a single retiree. The food baskets for these three groups were developed from the *Australian Guide to Healthy Eating* with reference to a typical 'welfare budget' [32]. The *Australian Guide to Healthy Eating* is an educational tool which promotes and guides food choices in order to ensure a healthy diet consistent with the suggested daily nutritional requirements for adults under the age of 65, for the elderly, and for children.

Nineteen independent general stores and supermarkets were surveyed across the Northern Rivers region in January 2011, a week after the flooding event in Queensland (see Figure 1). The surveying was repeated in July 2011 at the same locations, for the same items.

At each location a large chain supermarket, a small locally-owned supermarket (franchised) and a collection of food speciality shops (butchers, green grocers, and a bakery) were expected to be surveyed. In the larger regional cities and coastal towns of Lismore, Casino, Ballina and Tweed Heads this was attainable. However, in the smaller towns of Geneva, Coraki and Tabulam there was only one small general store servicing the rural community. Often in these smaller independent stores, all of the food basket items were not available and so the median price of the nearest town's surveyed prices were substituted, in this instance, following the method

employed by [19]. The stores were classified as either a Large Chain Supermarket (ALDI, BiLo, Coles or Woolworths); a Specialty Food Retailer (butcher, baker, green grocer); or as an Independent (IGA, FoodWorks or small general stores).

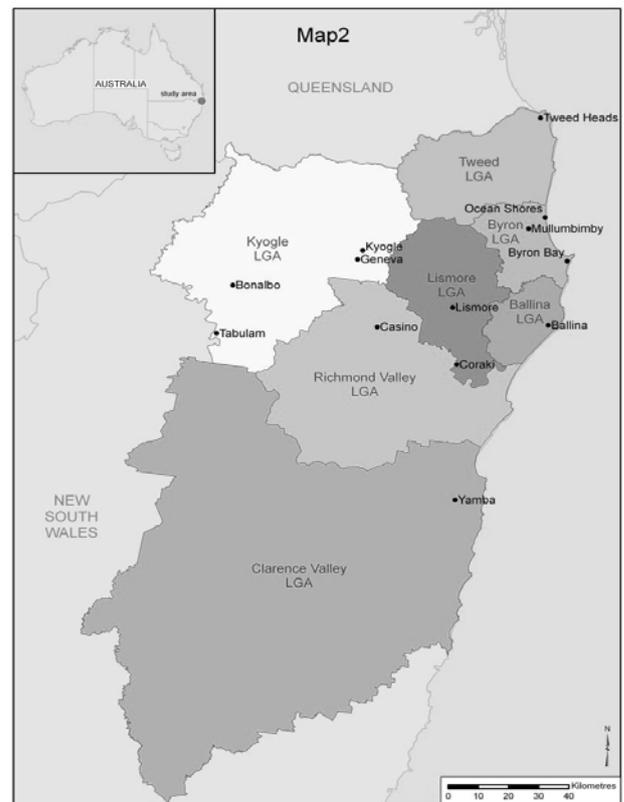


Figure 1. The location of towns surveyed within the Northern Rivers region of NSW

Each of the three food baskets were physically priced at each store/supermarket by two of the authors. Food basket items were chosen over other brands based on price and quantity. In the context of pricing a nutritional diet for a 'welfare budget', specials, canned and frozen items were chosen if they were cheaper than other options. If the required quantity of a specific product was not available, multiples of a smaller quantity or a larger quantity was priced as an alternative, and the cheapest option chosen.

A significant limitation to the healthy food basket surveys in general, are that they cannot account for people living in these areas that might grow their own fruit and vegetables, or access direct produce from local farms and markets.

3.3. Data Analysis

The percentage of household income of the three family groups required to purchase the healthy food basket is a useful indicator of food security. Households are considered 'food insecure' if more than 30% of income is required to purchase the food basket [23].

In order to determine the percentage of household income required to purchase the healthy food baskets, household incomes were calculated as benefits provided by the Australian Government for non-working families (referred to hereafter as Centrelink payments). For the four person family (2 adults and 2 children), household income was calculated as a combination of Newstart,

Parenting Payment and Tax Benefits A and B. This totalled \$704.71/week. For the single parent family household income comprised a combination of Single Parenting Payment, Family Tax A and B a total of \$588.93. For a single pensioner (Family 3) total income was that provided by the Pension and Seniors Supplement - some \$351.15 per week [33]. This method has been employed in numerous other studies to determine household food affordability or food security [22,23].

In regard to the first research objective of this study which is to identify whether rural-based residents pay more for food than urban residents located in the Northern Rivers region. An index of geography in reference to urban/rural scales has been developed by the Australian Bureau of Statistics. For each LGA surveyed, the Australian Bureau of Statistics' ASGC-RA classification system of remoteness zone categories was identified to statistically determine if rural food prices were higher than urban food prices. To do this, the ratio of the LGA residing in the inner regional RA2 zone / outer regional RA3 zone was correlated with the median food basket cost for a family of four (2 adults and 2 children) determined from the July survey (six months after the extreme weather events). Spearman's rank order correlation coefficient for tiered ranks was employed using Microsoft Excel to determine the relationship between remoteness and food prices as in [22].

The second research objective was to identify whether urban and rural-based regional food retailers were able to adapt to the impacts of 2010/2011 extreme weather events by stabilising food prices six months following these events. As such a comparison of food prices between the two survey events for each location was calculated. A paired t-test analysis was undertaken using Microsoft Excel data analysis tools for each location to identify if there was a statistically relevant difference in food prices.

4. Results

The food prices compiled for each store and the associated percentage of household income required to purchase the basket is presented in Table 1. There is great variation in the cost of the healthy food baskets with a price range of \$172 - \$322 to acquire the same items for the traditional family of two adults and two children. Accordingly, the percentage of household income required to purchase this basket will range from 24 - 46% of their household income indicating severe disadvantage to some families based upon their residential location. Similar comparisons exist for the other two family types: an unemployed single parent with two children and an elderly pensioner living alone.

Table 1. Food basket prices determined from the January pricing survey for each of the three family groups and the resulting % of household income (based upon a welfare dependent household) for Family One.

Local Government Area	Urban / Rural	Towns	Shop \$ Family 1	% Income Family 1	Shop\$ Family 2	Shop \$ Family 3
Ballina Shire Council	Urban	Ballina (Chain)	172	24.41	134	81
Byron Shire Council	Urban	Mullumbimby (Ind)	285	40.44	216	119
		Ocean Shores (Chain)	225	31.93	183	100
		Byron Bay (Ind)	204	28.95	174	92
		Byron Bay (Chain)	200	28.38	161	95
Lismore City Council	Urban	Lismore (Chain)	172	24.41	134	81
		Lismore (Ind)	230	32.64	166	107
Kyogle Council	Rural	Bonalbo (Ind)	255	36.19	212	113
		Tabulum (Ind)	305	43.28	263	152
		Geneva (Ind)	322	45.69	272	138
		Kyogle 1 (Ind)	224	31.79	178	100
		Kyogle 2 (Spec)	210	29.80	164	96
Richmond Valley Council	Rural	Casino (Chain)	200	28.38	161	92
		Casino 2 (Ind)	213	30.23	183	95
		Casino 3 (Spec)	202	28.66	163	99
		Coraki (Ind)	242	34.34	242	121
Tweed Shire Council	Urban	Tweed Heads (Spec)	201	28.52	164	94
		Tweed Heads (Chain)	224	31.79	178	101
		Tweed Heads (Ind)	259	36.75	229	119
Median			223.50	31.72	178.35	100.02

Where Ind = Independent, Spec = Specialty Food Store and 'Chain' = Large Chain Supermarket

The results presented in Figure 2 indicate that the median percentage of household income required to purchase the food basket for the three family groups varied from 28 - 32% of household income. A comparison between urban centres located within Byron, Tweed, Lismore and Ballina LGAs with the more remote rural

locations in the Kyogle and Richmond Valley local government areas reveals that the median percentage of household income required to purchase the food baskets, for all three family groups, is greater in the rural locations than in the urban areas within the Northern Rivers region. This is depicted in Figure 2.

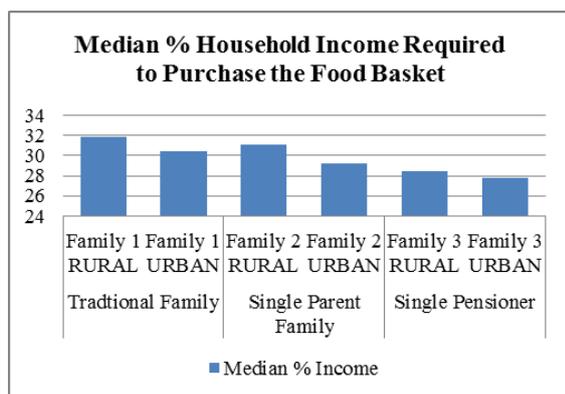


Figure 2. The percentage of household income required for Centrelink dependent families to purchase the food basket for regional and urban locations.

Comparison between January and July Surveys

As noted earlier, the flood event in Brisbane closed the Rocklea market, which is a central fresh-food distribution centre for local businesses and large chain supermarkets operating in the Northern Rivers. Our initial food pricing survey was undertaken in January, a week after the floods when roads to Rocklea were still closed. An analysis of food prices in January was compared to food prices

recorded in July 2011 (see Table 2). A paired t-test analysis was undertaken using Microsoft Excel data analysis tools with results indicating that paired $t(18) = -0.39$, $p = 0.70$ with $t(-0.39) < 2.1$. Therefore, the t-test reveals that there is significant difference between the January and July food basket costs. On the whole, the mean cost of the food basket for the nineteen retailers increased marginally from \$231 (S.D \$43) to \$233 (S.D \$43). There is, however, significant variance between locations with food basket costs ranging from \$172 - \$322 in the January survey and between \$192 and \$354 in the July survey.

A t-test analysis of the January food basket survey prices for retailers in the rural locations of Kyogle and Richmond Valley local government areas in comparison to the urban locations revealed that the difference in means was significant (t paired (8) = 2.11, $p=0.07$ with $t(2.11) < 2.31$). The mean food basket price for the rural locations increased from \$248 (S.D \$47) to \$256 (S.D \$52) between January and July. In comparison, the mean food basket price remained relatively stable for the urban locations with a mean price increase of only \$0.54 from \$211.30 (S.D \$33.59) to \$211.84 (S.D \$20.30) for the same period.

Table 2. A comparison of the cost of Family 1's food basket from the initial survey undertaken in January 2011 to July 2011.

Local Government Area	Towns	Family One \$Cost Shop	Family One \$Cost Shop
		Jan-11	Jul-11
Ballina Shire Council	Ballina (Chain)	171.95	191.62
	Byron Bay (Ind)	213.26	232.66
Byron Shire Council	Byron Bay (Chain)	199.86	192.31
	Ocean Shores (Chain)	224.34	195.81
	Mullumbimby (Ind)	259.40	*219.91
Kyogle Council	Kyogle (Ind)	229.77	228.83
	Kyogle (Spec)	203.73	223.5
	Bonalbo (Ind)	254.85	256.26
	Tabulum (Ind)	322.31	321.67
	Geneva (Ind)	305.37	353.9
Lismore City Council	Lismore (Ind)	210.13	223.5
	Lismore (Chain)	171.95	191.62
Richmond Valley Council	Casino (Ind)	201.19	201.14
	Casino (Spec)	200.01	234.42
	Casino (Chain)	225.43	208.72
	Coraki (Ind)	288.51	276.77
Tweed Shire Council	Tweed Heads (Spec)	202.00	207.31
	Tweed Heads (Ind)	284.72	242.9
	Tweed Heads (Chain)	223.50	228.83

*a large chain supermarket opened in the town between the two survey periods which will significantly impact on the price comparison.

Relationship between food prices and the size of retailers

Another t-test analysis was applied to compare the large Chain supermarket's price for the food basket in comparison to the Independent and Specialty Store food basket prices across the Northern Rivers sample sites. The analysis revealed that the difference in price was significant between January to July and that the mean cost of the food basket for the six large chain supermarkets actually decreased during this period from a mean price of \$202.84 (S.D \$26) to \$201.49 (S.D \$15). In contrast, the mean food basket price for the independent and speciality stores increased from \$242.99 (S.D \$45.82) to \$250.24 (S.D \$46.07).

Relationship between food prices and remoteness

Table 3 presents information relating to each of the LGAs in the study area in regard to disadvantage (SEIFA) and remoteness (RA1-3). It can be determined from this table that significant disadvantage can be related to the rural LGAs of Kyogle and Richmond Valley which were

identified, respectively, as the twelfth and ninth most disadvantage LGAs in NSW.

Spearman's rank order co-efficient for tiered ranks was applied to the RA2/RA3 data and the median cost of the food basket. The correlation between the remoteness indicator of RA2/RA3 and the cost of the food basket surveyed in January was calculated as a correlation of -0.7 suggesting that there is a reasonable correlation between remoteness and food price in the sample. However, when Spearman's rank order co-efficient for tiered ranks was calculated for the July survey, a correlation of -0.89 emerged; indicating a very strong relationship between remoteness and food costs as defined within the study methodology. This finding indicates that the association between remoteness and food prices increased during the study period in line with earlier observations that rural retailers were not able to stabilise the cost of food following the flood event, unlike many urban retailers in the Northern Rivers region.

Table 3. Localised socio-economic data specific to each LGA in the study region

Local Government Area	Ballina Shire Council	Byron Shire Council	Kyogle Council	Lismore City Council	Richmond Valley Council	Tweed Shire Council
Population per LGA	42708	32378	9877	45917	23115	90090
Median \$cost (Family One)	172	215	255	191	208	224
Median \$cost (Family One) July	191	208	256	208	222	229
Percentage of families of this composition in the LGA	14	14.5	12	15	13	12
% Income of Median Shop	24%	31%	36%	27%	30%	32%
SEIFA score (Ranking in NSW as most disadvantaged)	992 (98)	987 (95)	919 (12)	964 (63)	911(9)	966 (66)
Proportion of population in remote area zones RAI/RA2/RA3	0/100/0	0/100/0	0/78.3/21.7	0/100/0	0/99.3/0.7	75.5/24.5/0

5. Discussion and Conclusion

An analysis of nineteen retail outlets across northern NSW reveals that families living in the rural study locations at Kyogle and in the Richmond Valley LGA were paying more for their groceries than were their urban counterparts living along major transport routes in the coastal cities of Tweed, Ballina and Byron Bay and in the regional centre of Lismore. However, our study also reveals large variance in food prices across the region from \$172 to \$322 for the same shopping basket. The highest prices were recorded in the smallest rural towns of Tabulum, Coraki and Geneva which supported only one small general store. None of these towns are on the major transport route and, as such, would be increasingly impacted by rising fuel prices, reflected in food prices.

It is also interesting to note that the hypothetical low income families in our study were required to pay between 28 – 32% of their income on food in both urban and regional locations. This is broadly in line with the findings of other food basket studies. However, in the most remote rural locations, our study found that families could pay up to 46% of their household income in order to purchase the healthy food basket. Overall, the study confirmed the relationship between remoteness and food prices across the peri-urban/regional divide in Northern NSW. Food prices were significantly more expensive in rural locations that had only one general store and were distant from major transport routes.

The surveys undertaken in January were repeated in July in order to assess the difference in food prices following the Queensland flood and cyclone events in 2010/2011. Although our results indicate a significant difference in the food prices surveyed at nineteen locations for the two survey periods, it is likely that the impact of the flood/cyclone on the farming regions supplying food was one of the significant variables impacting at this time. Fuel prices also increased during this period.

A key finding of this research relates to the difference in retailers' ability to stabilise food prices following the extreme weather events of 2010/2011. Our study found that the larger supermarkets were able to absorb the additional costs of supplying food following the flood/cyclone events and prices actually fell in the

following six month period. In contrast, the independent and speciality stores were not able to stabilise food price increases and their food prices were higher six months after the severe flooding and cyclonic weather events. In reference to food prices, a strong relationship between disadvantage and remoteness has been detected. The results of the study indicate that low income families located in rural areas - especially those areas distant from major transport networks - are particularly susceptible to food insecurity.

Positioned against the Australian Governments' report on the resilience of Australia's food systems, our study responds to the question of 'whether the food supply chain can adapt to disruption up to a certain population or geographic scale' [4, p ix]. Based on our case study, we suggest that rural locations, particularly those with one small general store, are vulnerable to food insecurity resulting from the impacts of severe weather events. If, as anticipated, climate change in Australia will be accompanied by more intense and unpredictable weather conditions such as flooding and cyclonic activity [34], it will be important for governments at local, State and Federal levels to seek ways of financially supporting the most vulnerable people in small inland rural communities to access food in times of crisis.

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