STRUCTURAL ADJUSTMENT

a vulnerability index for Australian broadacre agriculture

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- **An indicator of the vulnerability of farm households to structural adjustment has been constructed using ABARE farm surveys data.**
- **Mapping the index has identified regions of Australia where farm households are likely to be most vulnerable to external influences that may force structural adjustment.**
- **The vulnerability index can assist in ensuring that government policies enhance the self reliant resilience of farm households in regions at risk.**

Structural adjustment is an ongoing focus of Australian agricultural and natural resource management policy (Fisher 2004). The term is used to express the ongoing shift in the distribution of activities and resources within and between individuals and firms in an attempt to improve efficiency, contribute to economic growth and raise living standards (Productivity Commission 1999). The development of an appropriate policy environment that facilitates self reliant adaptation within rural communities under structural adjustment pressure requires an understanding of both the external drivers and outcomes of change.

The external drivers of structural adjustment in Australian agriculture are well known and include declining terms of trade, technology induced productivity changes, and productivity changes associated with changes in the natural resource base including climate change.

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Applying this general knowledge to predict and facilitate structural adjustment requires a capability to measure the vulnerability of farm households to external pressures.

This analysis uses the rural livelihood framework of Ellis (2000) to create a simple and easily constructed indicator of the vulnerability to structural adjustment of Australian farm households that are dependent on broadacre agriculture. Its goal is to show how existing information provided by Australian farmers through ABARE's annual farm surveys can be used to identify regions most vulnerable to structural adjustment pressure.

Vulnerability to structural adjustment

The vulnerability of Australian farm households to structural adjustment can be defined as their relative exposure to external events, and their internal capability to cope with external events as they occur (Ellis 2000). According to Ellis, the ability of farm households to cope with external trends such as declining terms of trade and climate variability depends on the diversity of assets owned, controlled, claimed and accessed by households in their livelihood strategies.

This gives rise to the concept of resilience, defined as the ability of farm households to recover their livelihoods following stress or shocks. Greater diversity enables substitution between activities and assets in response to structural adjustment pressures, particularly if income sources less affected by structural adjustment are available. As Ellis (2000) states: 'The

most vulnerable households are those that are both highly prone to adverse external events and lacking in the assets or social support systems that could carry them through periods of adversity'.

Self reliance has been a key pillar of Australian agricultural policy for over a decade (Drought Policy Review Task Force 1990). This means that policy is directed toward enhancing the resilience of farm households to self manage change, rather than to mitigating the impacts of change. The impacts of structural adjustment can, in part, be mitigated through policy options such as income and price stabilisation schemes, production and income insurance, and income support to reduce the impact of external events. However, if sustained, these policies can diminish incentives to self manage risk, reducing the resilience of farm households to external pressures and perpetuating reliance on government support.

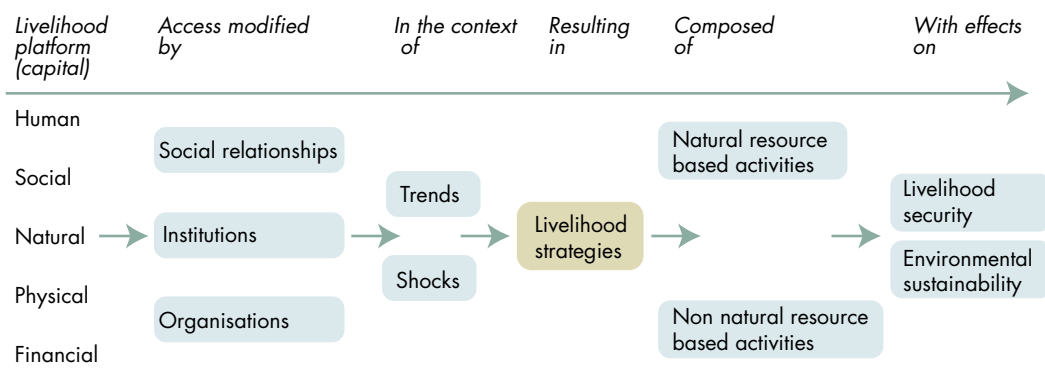
In contrast, international competitiveness and long term farm viability require policies that facilitate change to the predictable pressures of competition, enhancing the self reliant resilience of farm households to external shocks. The resilience of farm households can be enhanced through policies that increase the diversity of assets and activities available to form livelihood strategies (Ellis 2000). Policies of this kind include investment in production, transport and marketing infrastructure, education and training, regional development, and policies that affect the cost and availability of rural credit (Anderson 2003).

The different dimensions of the vulnerability of farm households to structural adjustment can be defined using the rural livelihoods framework of Ellis (2000). Livelihood strategies comprise activities that are continuously invented, adapted and adopted in response to changing access to assets, as influenced by a range of processes. According to Ellis the five types of capital accessed by farm households to produce flows of outputs include:

- Human capital – factors that influence the productivity of labor, such as skills, health and management capacity including education;
- Social capital – claims on others by virtue of social relationships;
- Natural capital – land, water and biological resources;
- Physical capital – produced by economic activity including infrastructure, equipment and technology; and
- Financial capital – savings and credit.

The framework recognises that access to these five types of capital is affected by a range of processes that are outside the individual's control (figure A). These latter influences include the external drivers of structural adjustment, such as policy implementation and change, market trends and shocks as well as climate variation

A A framework for analysing rural livelihoods



Ellis (2000)

and change. These are often unpredictable, but can have a profound effect on the use of assets to generate livelihoods.

Other influences on the ability of a farm household to access resources include social relationships, institutions and organisations. Social relationships refer to the position of individuals within society, which is influenced by factors such as gender, ethnicity, age and religion. Institutions such as laws and less formal rules that help to make human interaction more predictable can also modify access to assets such as natural resources. Government agencies are one of many types of organisation that can influence access to resources, along with nongovernment organisations and industry associations.

Constructing the index

A number of different dimensions need to be taken into consideration in order to construct a robust measure of vulnerability. Carney (1998, cited in Ellis 2000) developed a cobweb framework that can be used to capture the multiple dimensions of the livelihood asset base that determine vulnerability (figure B). Each of the five dimensions — human, social, natural, physical and financial capital — can be individually ranked before being aggregated to an overall measure of vulnerability. One advantage of this approach is that it transparently presents the individual dimensions of vulnerability so that those interpreting the information can apply their own weighting to each component.

The rural livelihoods framework was used to select key indicators of the level of the five types of capital on which rural livelihoods depend. Farm surveys data collected between 1992-93 and 2001-02 were used to construct each indicator (table 1).

The education level of both the farm operator and their spouse was used to measure human capital. Lower levels of education were assumed to be associated with a higher vulnerability index.

The number of partners running the farm business, internet use and membership of a Landcare or similar group were used to create an indicator of social capital. Fewer partners as well as a lack of internet use or a lack of Landcare membership were assumed to be associated with a higher vulnerability index.

The extent of on-farm land degradation problem and the frequency of extreme pasture growth conditions were used to construct an indicator of natural capital. It was assumed that the vulnerability score increased with the proportion of degraded land and the proportion of extremely low pasture growth days.

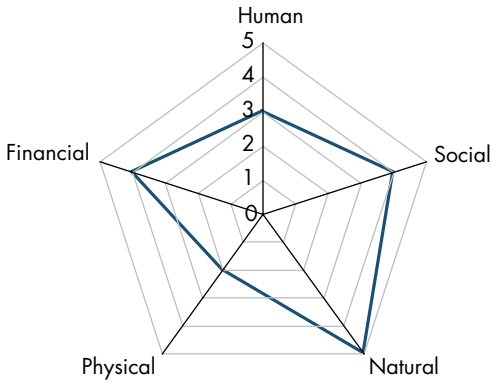
The indicator of physical capacity was represented by the area operated on the farm and the diversity of enterprises contributing to on-farm income. Smaller operating areas and fewer sources of income were assumed to be associated with higher levels of vulnerability.

Financial capital was represented by three measures of income: average on-farm income, variability in income and the availability of off-farm income sources. Higher levels of vulnerability were assumed to be associated with lower than average on-farm and off-farm incomes and higher levels of income variability.

These variables were selected following tests to ensure that no one indicator was highly correlated with any other indicator and that each of the twelve indicators represented a different aspect of overall vulnerability.

Using the geographic location of each survey farm, each of the variables contributing to the measure of vulnerability was mapped to a surface of grid points across Australia (see

B Measuring the multiple dimensions of vulnerability



Carney (1998)

1 Farm survey variables used to construct vulnerability index

Capital	Indicator	Description
Human	Operator education (↓)	Level of education, ranked from one (no schooling) to six (completed a university or other tertiary qualification)
	Spouse education (↓)	
Social	Partnerships (↓)	Number of partners running the business including the operator
	Internet use (↓)	Used the internet (yes/no)
	Landcare membership (↓)	Member of a Landcare or similar group (yes/no)
Natural	Degradation (↑)	Proportion of farm area significantly degraded (%)
	PGI extreme (↑)	Average proportion of days that the pasture growth index is less than 0.05 over a ten year period
Physical	Diversity of income sources (↓)	Diversity measure of onfarm receipts from wool, beef, wheat, other winter crops and summer crops
	Area operated (↓)	Area of farm operated (ha)
Financial	Average income (↓)	Mean farm cash income ($
	Income risk (↑)	Interquartile range of farm cash income divided by mean farm cash income over a ten year period
	Off-farm income (↓)	Average ratio of off-farm income to total on- and off-farm income

(↓) Arrows show the relationship between each variable and vulnerability.

Cowling et al. 1993 for more detail on the kernel smoothing technique). The smoothed data for more than 4000 grid points were then ranked from highest to lowest such that values with a high rank logically imply greater vulnerability. For example, low values of average farm income received a high ranking in terms of vulnerability, whereas low values of income risk received a low ranking.

The main purpose of the ranking procedure was to derive a robust overall index where extreme values of any one of the input variables did not overly influence the index in any region to such an extent that its contribution greatly exceeded that of any other. The rank values were then standardised to values between zero and one to account for the fact that the datasets had a variable number of grid points of equal rank.

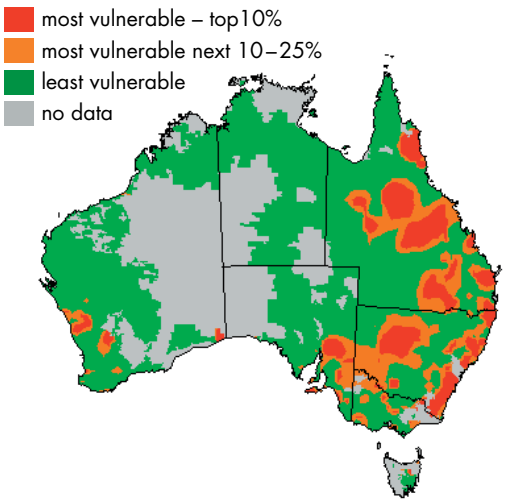
In order to construct one single measure of vulnerability, each of the twelve component indicators needed to be assigned a weight. In the absence of information on the relative importance of any one component over any other, each type of capital — human, social, natural, physical and financial — was given an equal weight in the final vulnerability index to account for the different number of indicators used to represent each type of capital. However, each component of the vulnerability index is presented in this paper to allow readers to make their own judgments about the relative importance of each indicator.

Mapping vulnerability

Mapping the final vulnerability index highlights the regions of Australia where broadacre farm households are likely to be most vulnerable to external influences such as structural adjustment (map 1). The red shaded areas show broadacre farming communities with a vulnerability index in the highest 10 per cent overall. The orange shaded areas identify regions with the next highest 10–25 per cent.

Many of the communities in eastern Australia with a vulnerability index in the highest 10 per cent occur in a band between the western margin of cropping areas in the wheat–sheep zone and the more extensive grazing areas to the west. In South Australia, New South Wales and southern Queensland, these farm households operate smaller than average properties relative to the

1 Vulnerability across Australian agricultural regions



rest of the pastoral zone and are mostly dependent on sheep for their livelihoods, with some opportunistic cropping along the eastern edge of these regions. Declining real wool prices and low productivity growth on wool specialist farms relative to cropping and beef specialists have contributed to the low average incomes across many of the broadacre farms in the region. A similar but less widespread trend can be seen in sheep dominated areas beyond the northern and eastern limits of cropping in the wheat belt of Western Australia. All of these areas tend also to have enterprises whose scale is below the average for the whole of the pastoral zone.

The relationship between areas with a high vulnerability index and the sheep industry is prominent. For example, even the relatively small sheep dominated area of the New England Tablelands is clearly distinguishable from the north west slopes and plains to the west, and higher rainfall beef dominated areas to the north west.

The presence of significant on-farm degradation problems and fewer business partners are also contributing to the high degree of vulnerability of farming communities across parts of the eastern states (maps 2 and 3). While farmers in isolated regions reported problems with erosion, water and soil quality, and salinity, the predominant reporting of degradation across the eastern states of Australia related to problems with weeds, including woody weed encroachment. Low levels of spouse education are contributing to the relatively high vulnerability score in north west New South Wales and in parts of central Queensland.

Another band of communities with a vulnerability index in the highest 10 per cent stretches along eastern New South Wales and into south east Queensland. Many of these areas contain beef or sheep producers operating small properties characterised by few business partners and a number of land degradation problems. Farm households in these regions are typically earning lower than average on-farm incomes and are facing continual pressure from rising land values caused by urban encroachment.

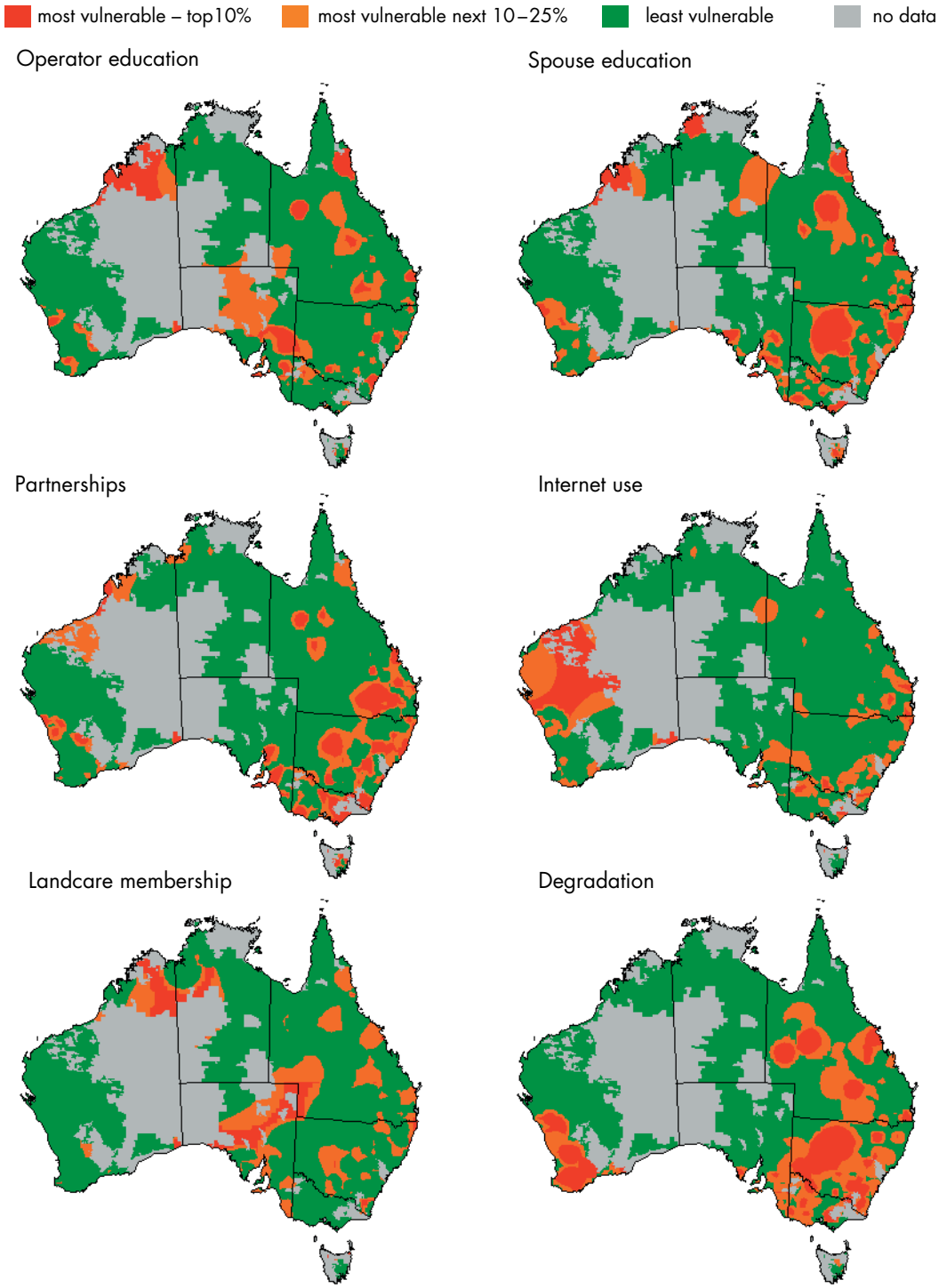
Beef dominated farming communities around the major population centres of Rockhampton and Cairns also have a vulnerability index in the highest 10 per cent. Factors contributing to the vulnerability of these regions include a lack of diverse sources of farm income, which in turn contributes to higher variability in income over time, some problems with land degradation, relatively low levels of eduction, and in some cases a lack of membership in Landcare or similar groups.

Dimensions of vulnerability

The twelve dimensions of the vulnerability index are presented in maps 2 and 3, sorted by type of capital. To the west of the cropping areas in eastern Australia, a high value of the vulnerability index is contributed to by low human capital, particularly spouse education. Low education of both operator and spouse also contributes to a high vulnerability index for the eastern communities of New South Wales and Queensland, and in the north east wheat belt of Western Australia.

With some contribution from a low diversity of income sources, low human and social capital are also the main contributor to high values of the vulnerability index for an area around Cairns in far north Queensland.

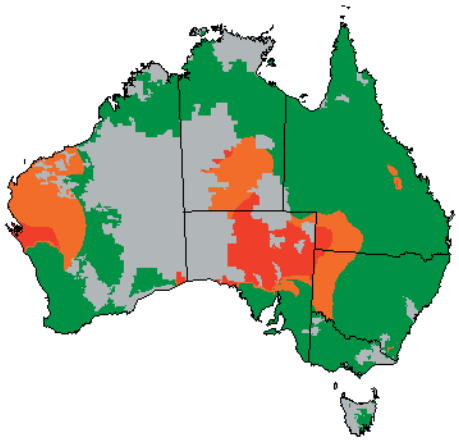
2 Factors contributing to the vulnerability of broadacre regions



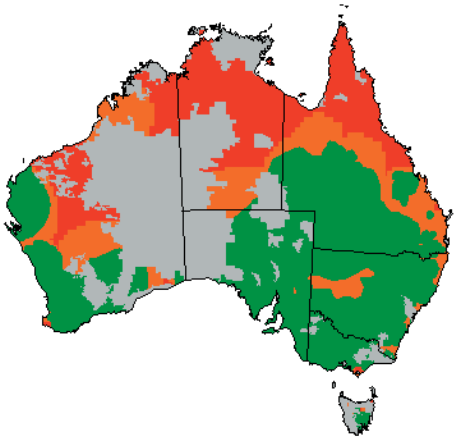
3 Factors contributing to the vulnerability of broadacre regions

most vulnerable – top10% | most vulnerable next 10–25% | least vulnerable | no data

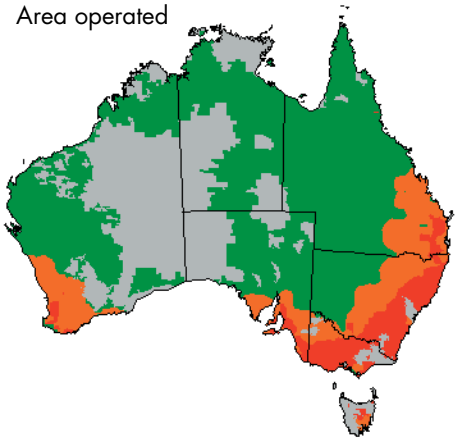
Extreme pasture growth



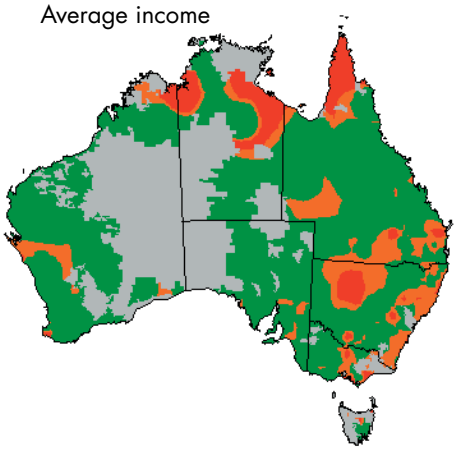
Diversity of income



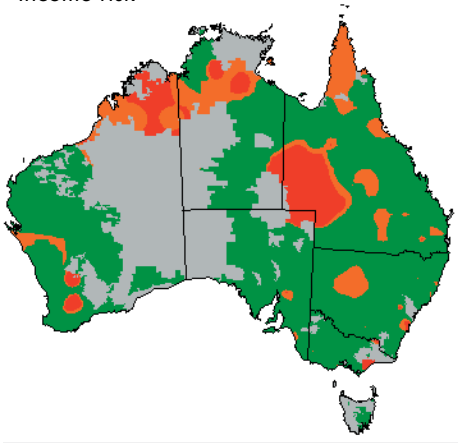
Area operated



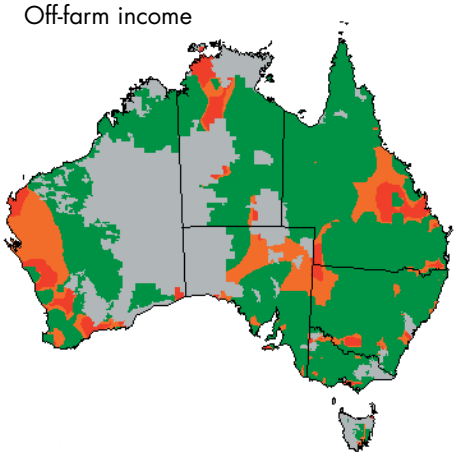
Average income



Income risk



Off-farm income



A low number of partnerships are one of the most significant contributors to a high value of the vulnerability index in areas dominated by the sheep industry in eastern Australia and in the north east wheat belt of Western Australia. Many of the eastern areas of New South Wales and Queensland with a high vulnerability index also have some of the lowest numbers of partnerships. In eastern Australia especially, moderately low Landcare membership and internet use also contributes to high values of the vulnerability index, as measured.

The relationship between areas with a high value of the vulnerability index and areas in which pasture growth is often extremely low is poor. In contrast, the area of reported degradation is one of the most important contributors to a high value of the vulnerability index in eastern Australia and right across the wheat–sheep zone of Western Australia.

Physical capital measured as area operated and the diversity of on-farm income generating activities contribute strongly to a high value of the vulnerability index along eastern New South Wales and Queensland, and in far north Queensland respectively. Area operated also makes an intermediate contribution to a high vulnerability index in central New South Wales, southern Queensland and the north east wheat belt of Western Australia. A low diversity of on-farm income generating activities also contributes to a high value of the vulnerability index in central western New South Wales.

Physical indicators such as area operated tend to categorise regions according to rainfall. Even the measure of diversity of on-farm activities tends to identify regions in northern Australia restricted by climate to beef production. Neither physical indicator contributed strongly to identifying regions with similar climate that have different vulnerability to external pressures that may force structural adjustment.

Low average farm incomes contribute to a high value of the vulnerability index in central west New South Wales and southern Queensland, and to a lesser extent along eastern New South Wales.

High income variability is an intermediate contributor to the high value of the vulnerability index in central west New South Wales and parts of central west Queensland.

A low reliance on off-farm income sources contributes to a high value of the vulnerability index in the central highlands of Queensland inland from Rockhampton, and inland from Geraldton in Western Australia.

Implications for agricultural policies

The resilience of farm households has been highlighted by Fisher (2004) as an important concept in Australian agricultural policy, but until now has been poorly defined. The rural livelihoods framework developed by Ellis (2000) provides some insights into the different types of capital that can increase the resilience of farm households to a range of factors creating structural adjustment pressures. Each regional community is likely to face different pressures depending on the industries that they are reliant on and to respond differently to these pressures depending on their endowments of human, social, natural, physical and financial capital.

The most contentious aspect of developing a single index of vulnerability is the selection and weighting of each indicator of capital. Presenting each component map enables the reader to come to his or her own interpretation independently although further research into variable selection and weighting methods is warranted.

An intermediate finding of this research is that farming in a harsh environment does not necessarily lead to a high score on the vulnerability index. Grazing based operations in central Australia with a high frequency of extreme pasture growth conditions do not tend to rate highly on the vulnerability index. This indicates that appropriate farming systems can effectively manage the risks associated with a highly variable, low rainfall climate so long as they have adequate scale. It also means that biophysical indicators of vulnerability such as rainfall and soil type are poor indicators of the vulnerability of farm households.

The most important finding of this research is that many Australian farm households dependent on broadacre agriculture lack elements of the human, social, natural, physical and financial

capital necessary to readily adapt to structural adjustment pressures. This is particularly true in areas of inland South Australia, New South Wales and Queensland that rely on the sheep industry for their livelihoods. A similar trend is emerging in areas dominated by the sheep industry in the north east wheat belt of Western Australia.

There are a number of areas for further research. One is to develop a region specific measure of farm size rather than using the current absolute measure. A second is to explore the sensitivity of the overall index to alternative measures of human, social and natural capital. A third area for further research involves designing the weights associated with each type of capital to help target specific policy objectives such as improved land stewardship or to facilitate adjustment through enhanced educational opportunities.

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