

# Transformational Change in Climate Change Impacted Regions

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*We focus on the potential for policy action to assist optimal transformative change in agricultural districts affected by drought and climate change. The primary research issue acknowledges that current forms of agriculture no longer seem viable in some areas impacted by increasing water costs and/or drought resulting from climate change. Transformation of these areas is inevitable. Is there a role for policy intervention? In relation to this issue, the paper endeavours to address the question: what has been happening and what is likely to happen to the communities of drought and climate change affected areas where irrigation is a dominant part of the economy? Our initial focus will be on NSW where we will analyse the apparent impact of drought between the 2001 and 2006 censuses by regions with a view to identifying what has been happening to their economic base in terms of both levels and patterns of production and whether or not there is evidence of adapting to change. In particular we want to examine how the local labour market has been impacted and its response. The paper concludes by identifying the major questions remaining in order to answer what can or should be done for the communities involved to mitigate the effects of drought and climate change and the issues that further research needs to address to ascertain what elements of comparative or absolute advantage each region has, the communities understanding of challenges and opportunities confronting them and the assistance they need to take advantage of these opportunities.*

## **1. Introduction**

There is a growing concern that climate change is occurring and that drought can be expected to become an increasingly common phenomenon across all areas of regional Australia. Many with an interest in regional and rural communities want to believe that there is some direct policy intervention that can, and needs, to be taken if these regions are to remain sustainable in the face of climate change and its consequent impact on the agricultural activities of the regions.

## **2. Classifying regions by drought experience**

The Australian Standard Geographical Classification of the Australian Bureau of Statistics (ABS) divides the state of New South Wales into the twelve Statistical Divisions (SD) identified in Table 1. The NSW Department of Primary Industries (DPI) identifies 47 Rural Land Protection Boards (RLPB) and for each has reported the drought status of the RLPB on a monthly basis since 1998. The DPI uses a classification for each RLPB of “in drought” (D), “marginal” (M) and “satisfactory” (S). By overlaying the RLPB data on the SD data we can derive estimates of drought status for each SD for each month from June 1998 to the present.

In this paper we are concerned with the social and economic changes of SDs as reflected in Census data and the extent to which the changes might be attributed to drought. Apart from Murray and Far West, the SDs in NSW were relatively drought free in the two years leading up to the 2001 Census on the 7<sup>th</sup> August of that year. At the time of the Census only a small portion of North Western was in drought – but this was soon to change. In the period through to the 2006 Census of August 8 of that year, every SD in NSW was to experience drought. However, over this period, there was significant variation amongst SDs in their respective drought experience. Based on RLPB data we have constructed the classification of SDs provided in Table 1.

**Table 1: Drought Experience Classification of NSW Statistical Divisions 2001-2006.**

| <b>Statistical Division</b> | <b>Drought Classification</b> |
|-----------------------------|-------------------------------|
| North Western               | Chronic Drought (CD)          |
| Far West                    | Chronic Drought (CD)          |
| Murrumbidgee                | Drought Prone (DP)            |
| Murray                      | Drought Prone (DP)            |
| Richmond-Tweed              | DP Highly Variable (DPHV)     |
| South Eastern               | DP Highly Variable (DPHV)     |
| Northern                    | DP Highly Variable (DPHV)     |
| Central West                | DP Highly Variable (DPHV)     |
| Mid-North Coast             | Marginal Drought (MD)         |
| Sydney                      | Marginal Drought (MD)         |
| Hunter                      | Marginal Satisfactory (MS)    |
| Illawarra                   | Marginal Satisfactory (MS)    |

*Source: ABS (2006a) and NSWDI (various).*

Our methodology was as follows. An SD was classified as in drought if, for the month in question, 50 percent or more of the RLPB area within its boundaries was classified D. If less than 50 percent of RLPB area within the SD was D, but D + M equaled or exceeded 50 percent, the SD was classified marginal. Where more than 50 percent of the area was declared S, the SD was classified as satisfactory – notwithstanding the fact that some RLPB areas within it may be declared D and/or M. This exercise was undertaken for each month from August 2001 to August 2006. In arriving at the classifications presented in Table 1 we defined an SD as an area of chronic drought (CD) if it recorded greater than 50 months as D over the period. An SD was classified as drought prone (DP) if it recorded more than 30 months as D. However, where such an area also had in excess of 15 months satisfactory it was classified as drought prone but highly variable (DPHV). Areas that were not CD nor

DP but where C + D exceeded 45 months were classified a marginal drought (MD) and areas where M + S exceeded 45 months were classified as marginal satisfactory (MS).

### 3. Sectoral shifts in employment

Significant drought events can be expected to impact on regions affected in many ways. One important impact is the impact it has on the employment structure of the region and, in turn, the consequences of changes in employment structure on both aggregate employment levels in a region and on the region's share of state or national employment. The impact on aggregate employment determines whether the region is one of growing or shrinking employment – with shrinking employment indicative of the region's potential viability. The impact on the region's share of employment is indicative of the relative change in economic importance of the region and may also provide signals related to the future viability of that region.

Changes in the composition of employment, resulting from changes in industrial structure have been proceeding in many developed countries (Robson, 2006). The general pattern observed has been a decline in the proportion of employment in manufacturing and a rise in the proportion of workers employed in services. NSW has largely replicated this pattern. However, being a state with a significant proportion of its workforce in agriculture, it is important to note that this too, is an industry that has been in decline in terms of its share of employment, whilst construction – in addition to services – has been a sector of growth. Table 2, presents, for NSW, the broad industry groupings share of employment for each of the last three censuses.

**Table 2: NSW Employment Structure 1996, 2001 and 2006 (%)**

|               | 1996 | 2001 | 2006 |
|---------------|------|------|------|
| Agriculture   | 3.6  | 3.3  | 2.7  |
| Mining        | 0.8  | 0.6  | 0.7  |
| Manufacturing | 11.5 | 11.0 | 9.6  |
| Utilities     | 1.0  | 1.0  | 1.0  |
| Construction  | 6.4  | 6.8  | 7.5  |
| Services      | 73.8 | 75.2 | 76.1 |

*Source:* Calculated from ABS (2006b).

Table 3 illustrates that, in common with other countries (Robson, 2006), the regional distribution of these structural changes has been influenced by the traditional employment strengths of each region. Thus, in terms of our current interests, regions in which agriculture has been the largest

employer, have seen its contribution to employment decline significantly, a decline which was, in all cases more rapid between 2001 and 2006 than between 1996 and 2001 (Table 4). Thus we conclude that a long term downward trend in agricultural employment was evidently accelerated by drought. Robson (2009) notes that the causes of structural shifts has been widely debated. Various explanations have been put forward and include changes in the pattern of consumer demand as real incomes rise, industry responses to competition from “low wage” developing economies and the “crowding out” and more recently the “crowding in” of private sector activity as the public sector’s direct contribution to production waxes and wanes. To this we must now add the response to climate change for which the extended drought in the first part of the new century is often considered a manifestation.

In the UK, studies conducted several years apart have consistently found that changes in industry structure have resulted in regions becoming increasingly similar in terms of the industries in which the regions employment is concentrated (Wren and Taylor, 1999; Robson 2006; and Robson 2009). Robson (2009) states that “[i]n particular, employment in all regions is becoming increasingly concentrated in the service sector. Furthermore, within the service sector itself, an increasing share of the total number of jobs is located within a relatively small number of industries”.

#### 4. Measures of Regional Diversity and Specialisation in Employment

In order to provide a measure of the extent of convergence in regional employment structures, a number of authors have utilized the Coefficient of Regional Diversity (*CRD*)<sup>1</sup>. For our purposes *CRD* is calculated as

$$CRD = \frac{1}{2} \sum_i \left| \frac{e_{ij}}{E_j} - \frac{e_{ij}}{E} \right| \quad (1)$$

where  $e_{ij}$  is employment,  $i$  is industry of employment,  $j$  is a given region and  $NSW$  is state (NSW). Thus we are computing the *CRD* of a given region with respect to NSW as one half of the sum, over all industries, of the absolute difference between the proportion of employment in the industry in the region to total regional employment and the proportion of employment in the industry in NSW to total employment in NSW. At one extreme, if employment in the region was distributed across all

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<sup>1</sup> This measure is more commonly known as the Coefficient of Regional Specialisation (CRS) but for reasons explained in the text, and to assist with interpretation, we prefer *CRD*. Dixon and Freebairn (2009) provide an abridged listing of authors utilising the concept dating back to Hoover (1948).

**Table 3: Regional Employment Structure 1996, 2001 and 2006**

|                 | Chronic Drought |      | Drought Prone |      | Drought Prone Highly Variable |      |      |      | Marginal Drought |      | Marginal Satisfactory |      |
|-----------------|-----------------|------|---------------|------|-------------------------------|------|------|------|------------------|------|-----------------------|------|
|                 | FW              | NW   | Me            | My   | RT                            | SE   | N    | CW   | MN               | S    | H                     | I    |
| <b>1996 (%)</b> |                 |      |               |      |                               |      |      |      |                  |      |                       |      |
| Agriculture     | 9.2             | 19.4 | 17.2          | 18.8 | 8.7                           | 11.1 | 19.4 | 14.1 | 7.7              | 0.7  | 3.1                   | 1.8  |
| Mining          | 10.0            | 3.6  | 0.2           | 0.1  | 0.3                           | 0.5  | 0.7  | 3.1  | 0.2              | 0.2  | 4.4                   | 2.0  |
| Manufacturing   | 3.0             | 5.9  | 10.2          | 11.2 | 9.3                           | 7.0  | 6.7  | 11.7 | 9.9              | 12.0 | 12.5                  | 14.5 |
| Utilities       | 1.9             | 1.0  | 1.6           | 1.5  | 0.8                           | 1.5  | 1.1  | 1.7  | 1.1              | 0.8  | 1.7                   | 1.1  |
| Construction    | 6.6             | 5.2  | 4.9           | 4.7  | 7.2                           | 6.4  | 4.4  | 5.0  | 7.1              | 6.2  | 6.7                   | 7.7  |
| Services        | 69.2            | 64.9 | 66.0          | 63.6 | 73.8                          | 73.5 | 67.7 | 64.4 | 73.9             | 80.2 | 71.6                  | 72.8 |
| <b>2001 (%)</b> |                 |      |               |      |                               |      |      |      |                  |      |                       |      |
| Agriculture     | 9.9             | 19.2 | 16.8          | 17.3 | 7.5                           | 10.2 | 19.3 | 14.0 | 6.6              | 0.6  | 2.9                   | 1.5  |
| Mining          | 6.7             | 2.2  | 0.1           | 0.1  | 0.2                           | 0.3  | 0.4  | 2.6  | 0.1              | 0.1  | 3.1                   | 1.0  |
| Manufacturing   | 3.1             | 6.5  | 10.4          | 12.9 | 8.5                           | 7.2  | 6.6  | 11.3 | 8.4              | 11.4 | 11.3                  | 13.3 |
| Utilities       | 2.2             | 0.9  | 1.3           | 1.0  | 0.7                           | 1.3  | 0.7  | 1.5  | 1.2              | 0.8  | 1.6                   | 1.1  |
| Construction    | 4.7             | 5.1  | 5.2           | 5.4  | 7.2                           | 7.1  | 5.1  | 5.6  | 7.5              | 6.7  | 7.3                   | 8.0  |
| Services        | 73.4            | 66.1 | 66.2          | 63.3 | 76.0                          | 73.9 | 67.8 | 65.1 | 76.2             | 80.4 | 73.9                  | 75.0 |
| <b>2006 (%)</b> |                 |      |               |      |                               |      |      |      |                  |      |                       |      |
| Agriculture     | 7.5             | 16.4 | 13.2          | 14.4 | 5.6                           | 7.9  | 16.9 | 11.9 | 5.1              | 0.4  | 2.3                   | 1.2  |
| Mining          | 8.9             | 3.1  | 0.1           | 0.2  | 0.3                           | 0.3  | 0.5  | 3.4  | 0.2              | 0.2  | 3.5                   | 1.6  |
| Manufacturing   | 3.1             | 5.7  | 11.2          | 11.6 | 7.6                           | 6.5  | 7.0  | 9.7  | 7.7              | 9.7  | 10.5                  | 11.4 |
| Utilities       | 2.5             | 1.2  | 1.3           | 1.1  | 0.8                           | 1.4  | 0.9  | 1.6  | 1.5              | 0.8  | 1.6                   | 1.0  |
| Construction    | 4.8             | 6.0  | 6.1           | 7.2  | 9.3                           | 8.4  | 6.1  | 6.1  | 8.6              | 7.1  | 8.1                   | 8.6  |
| Services        | 73.1            | 67.6 | 68.1          | 65.4 | 76.5                          | 75.6 | 68.6 | 67.1 | 76.8             | 81.8 | 73.9                  | 76.3 |

Source: Calculated from ABS (2006b).

industries in the region exactly as employment in the state was distributed over all industries in the state, *CRD* would equal 0 and there would be no diversity of employment structure in the region relative to the structure of employment in the state. Higher values of *CRD* imply that the employment structure in the region is more diverse than the employment structure in the state. The higher the value, the greater the divergence of the regional employment structure from the employment structure of the state. For a *CRD* value of 1, the regional employment structure would be completely different to that of the state. Of course, we do not expect to find either extreme in reality. Rather, for each region, we expect to find a value between 0 and 1. The closer the value is to 0, the closer the distribution of regional employment across industries is to the distribution of state employment across industries. The higher the value, the greater the difference of regional employment across industries compared to the state. Further, if computed values for *CRD* for any region are falling (rising) over time, then for that region industry employment structure is becoming more (less) similar to state employment structure.

While *CRD* can be used as a measure of diversity in the structure of regional employment relative to the state, a different measure is required to capture changes in specialisation within the region alone (that is without reference to the state or other regions, but rather, with reference to the region itself between different points in time). With *CRD*, the measure can change because there has been a change in the structure of employment in the region, or in the state, or both – making the region more diversified relative to the state. Now, however, we are asking the question, regardless of any change with respect to the state has the employment in the region become more or less specialised relative to what the structure of employment in the region had previously been? To answer this question we can use the Coefficient Relative Regional Specialisation (*CRRS*) by:

$$\frac{\sigma}{\bar{e}} \quad (2)$$

Where  $\bar{e}$  is the mean employment level over all industries.

This measure was introduced originally by Robson (2006 and 2009)<sup>2</sup>. An increase in *CRRS* for a region over time indicates that the region has become more specialised in its employment structure as the

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<sup>2</sup> They referred to it as the Coefficient of Absolute Regional Specialisation (*CARS*), however, it should be noted that, technically, the measure is the coefficient of variation of employment in each industry and, as such, is a relative measure of variation which allows us to compare variations in the relative dispersion of employment amongst industries across both time and space for regions when mean levels of employment in industry may vary.

**Table 4: Changes in Regional Employment Structure 1996, 2001 and 2006**

|                       | Chronic Drought |      | Drought Prone |      | Drought Prone Highly Variable |      |      |      | Marginal Drought |      | Marginal Satisfactory |      |
|-----------------------|-----------------|------|---------------|------|-------------------------------|------|------|------|------------------|------|-----------------------|------|
|                       | FW              | NW   | Me            | My   | RT                            | SE   | N    | CW   | MN               | S    | H                     | I    |
| <b>% Point Change</b> |                 |      |               |      |                               |      |      |      |                  |      |                       |      |
| <b>1996-2001</b>      |                 |      |               |      |                               |      |      |      |                  |      |                       |      |
| Agriculture           | 0.7             | -0.2 | -0.4          | -1.5 | -1.2                          | -0.9 | 0.0  | -0.1 | -1.1             | -0.1 | -0.2                  | -0.2 |
| Mining                | -3.3            | -1.4 | -0.1          | 0.0  | -0.1                          | -0.2 | -0.2 | -0.5 | -0.1             | -0.1 | -1.3                  | -1.0 |
| Manufacturing         | 0.0             | 0.6  | 0.2           | 1.7  | -0.8                          | 0.2  | -0.1 | -0.4 | -1.5             | -0.6 | -1.2                  | -1.2 |
| Utilities             | 0.3             | -0.1 | -0.3          | -0.5 | -0.1                          | -0.2 | -0.4 | -0.2 | 0.1              | 0.0  | -0.1                  | -0.1 |
| Construction          | -1.9            | 0.0  | 0.3           | 0.7  | 0.0                           | 0.8  | 0.7  | 0.6  | 0.4              | 0.5  | 0.6                   | 0.3  |
| Services              | 4.1             | 1.1  | 0.3           | -0.3 | 2.2                           | 0.4  | 0.1  | 0.6  | 2.2              | 0.2  | 2.3                   | 2.2  |
| <b>2001-2006</b>      |                 |      |               |      |                               |      |      |      |                  |      |                       |      |
| Agriculture           | -2.4            | -2.8 | -3.7          | -2.9 | -1.9                          | -2.3 | -2.5 | -2.0 | -1.4             | -0.1 | -0.6                  | -0.3 |
| Mining                | 2.2             | 1.0  | 0.0           | 0.1  | 0.1                           | 0.0  | 0.1  | 0.8  | 0.1              | 0.0  | 0.4                   | 0.5  |
| Manufacturing         | 0.1             | -0.8 | 0.8           | -1.3 | -0.9                          | -0.7 | 0.4  | -1.5 | -0.7             | -1.7 | -0.8                  | -2.0 |
| Utilities             | 0.3             | 0.3  | 0.1           | 0.1  | 0.1                           | 0.1  | 0.2  | 0.1  | 0.3              | 0.0  | 0.1                   | 0.0  |
| Construction          | 0.1             | 0.9  | 0.9           | 1.8  | 2.1                           | 1.3  | 1.0  | 0.5  | 1.1              | 0.4  | 0.8                   | 0.6  |
| Services              | -0.2            | 1.5  | 1.9           | 2.1  | 0.5                           | 1.7  | 0.8  | 2.1  | 0.7              | 1.4  | 0.0                   | 1.3  |
| <b>1996-2006</b>      |                 |      |               |      |                               |      |      |      |                  |      |                       |      |
| Agriculture           | -1.7            | -3.0 | -4.1          | -4.4 | -3.1                          | -3.3 | -2.5 | -2.1 | -2.6             | -0.2 | -0.8                  | -0.6 |
| Mining                | -1.2            | -0.4 | 0.0           | 0.1  | 0.0                           | -0.3 | -0.1 | 0.3  | 0.0              | 0.0  | -0.9                  | -0.5 |
| Manufacturing         | 0.1             | -0.3 | 1.0           | 0.4  | -1.7                          | -0.5 | 0.3  | -2.0 | -2.3             | -2.2 | -1.9                  | -3.2 |
| Utilities             | 0.6             | 0.2  | -0.2          | -0.4 | 0.0                           | -0.1 | -0.2 | -0.1 | 0.4              | 0.0  | -0.1                  | -0.1 |
| Construction          | -1.8            | 0.9  | 1.2           | 2.5  | 2.1                           | 2.1  | 1.6  | 1.1  | 1.6              | 0.9  | 1.4                   | 0.8  |
| Services              | 3.9             | 2.7  | 2.1           | 1.8  | 2.8                           | 2.1  | 0.9  | 2.7  | 2.9              | 1.6  | 2.3                   | 3.5  |

Source: Calculated from Table 3.

standard deviation of employment across industries, the numerator in equation (2), relative to the mean level of employment for all industries, the denominator in equation (2), has increased. This can only occur as employment in some industries becomes relatively more important and as employment in other industries becomes relatively less important. That is, as employment in the region becomes relatively more specialised over time. Similarly, a higher value for *CRRS* in region A than in region B, at a given point in time, implies that the employment structure in region A is relatively more specialised than in region B at that point in time.

## **5. Findings on Regional Differences in Specialisation: Evidence of Transition?**

The data in Tables 5 and 6 is based on the classification of industry into 19 separate industry divisions for data provided in the 1996, 2001 and 2006 Censuses<sup>3</sup>. Table 5 indicates that the structure of employment in the regions of NSW differs from that in NSW in total. The calculation of *CRRS* for NSW as a whole provides values of 0.596 (1996), 0.655 (2001) and 0.726 (2006). Table 6 indicates that all of the regions are more specialised than NSW as a whole. Only Sydney comes close to replicating the state structure. Dixon and Freebairn (2009) observed that 'CR[D] appears to be inversely related to the size of the region's population.' Our findings are not entirely consistent with this, but the general pattern, as observed in Table 5, does tend to support the general proposition. The regions in NSW that were most diverse from the employment structure of NSW as a whole were also the regions that were most severely impacted by drought conditions between 2001 and 2006.

*CRD* will fall in a region when either — has fallen in industries better represented in the region or when — has risen in industries that are not as well represented in the region as in the state. We would expect drought to bring with it a fall in the importance of employment in agriculture and this is certainly reflected in Tables 3 and 4. Indeed, for NSW as a whole agricultural employment fell by nearly 14,000 between the 2001 and 2006 and each of the regions experienced absolute falls. The biggest relative falls, however, occurred in the regions most severely impacted by drought.

Because employment in agriculture in the regions experiencing drought represents a greater proportion of total employment in these regions than for the state in general, drought, through its adverse impact on agriculture, an industry of significant specialisation for these regions, can be

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<sup>3</sup> We note that the use of such data is of concern to Dixon and Freebairn (2009) because it does not allow for the economy being at different stage of the business cycle.

**Table 5: Coefficient of Regional Diversity (CRD)**

|            | Chronic Drought |        | Drought Prone |        | Drought Prone Highly Variable |        |        |        | Marginal Drought |         | Marginal Satisfactory |        |
|------------|-----------------|--------|---------------|--------|-------------------------------|--------|--------|--------|------------------|---------|-----------------------|--------|
|            | FW              | NW     | Me            | My     | RT                            | SE     | N      | CW     | MNC              | S       | H                     | I      |
| 1996       | 0.246           | 0.207  | 0.172         | 0.181  | 0.152                         | 0.159  | 0.195  | 0.161  | 0.141            | 0.059   | 0.092                 | 0.099  |
| 2001       | 0.254           | 0.193  | 0.169         | 0.176  | 0.146                         | 0.158  | 0.188  | 0.156  | 0.144            | 0.058   | 0.098                 | 0.099  |
| 2006       | 0.252           | 0.193  | 0.157         | 0.157  | 0.142                         | 0.162  | 0.171  | 0.153  | 0.141            | 0.058   | 0.093                 | 0.096  |
| Changes    |                 |        |               |        |                               |        |        |        |                  |         |                       |        |
| 1996-2001  | 0.007           | -0.014 | -0.002        | -0.005 | -0.006                        | -0.001 | -0.007 | -0.005 | 0.003            | -0.001  | 0.006                 | 0.000  |
| 2001-2006  | -0.002          | 0.000  | -0.012        | -0.019 | -0.004                        | 0.004  | -0.017 | -0.003 | -0.004           | 0.000   | -0.005                | -0.003 |
| 1996-2006  | 0.005           | -0.014 | -0.014        | -0.024 | -0.009                        | 0.003  | -0.024 | -0.008 | 0.000            | -0.001  | 0.001                 | -0.003 |
| Population |                 |        |               |        |                               |        |        |        |                  |         |                       |        |
| 1996       | 22031           | 111230 | 147294        | 110524 | 219329                        | 197943 | 172395 | 170899 | 284676           | 4119190 | 589239                | 394211 |

Source: ABS (2006b)

**Table 6: Coefficient of Relative Regional Specialisation (CRRS)**

|           | Chronic Drought |        | Drought Prone |       | Drought Prone Highly Variable |       |        |       | Marginal Drought |       | Marginal Satisfactory |       |
|-----------|-----------------|--------|---------------|-------|-------------------------------|-------|--------|-------|------------------|-------|-----------------------|-------|
|           | FW              | NW     | Me            | My    | RT                            | SE    | N      | CW    | MNC              | S     | H                     | I     |
| 1996      | 0.754           | 0.875  | 0.842         | 0.909 | 0.726                         | 0.676 | 0.903  | 0.764 | 0.732            | 0.641 | 0.655                 | 0.729 |
| 2001      | 0.703           | 0.896  | 0.874         | 0.921 | 0.809                         | 0.752 | 0.921  | 0.780 | 0.815            | 0.704 | 0.716                 | 0.820 |
| 2006      | 0.768           | 0.859  | 0.872         | 0.928 | 1.035                         | 0.946 | 0.904  | 0.785 | 1.008            | 0.746 | 0.842                 | 0.896 |
| Changes   |                 |        |               |       |                               |       |        |       |                  |       |                       |       |
| 1996-2001 | -0.050          | 0.021  | 0.032         | 0.013 | 0.083                         | 0.076 | 0.018  | 0.016 | 0.083            | 0.063 | 0.061                 | 0.091 |
| 2001-2006 | 0.064           | -0.038 | -0.002        | 0.006 | 0.226                         | 0.195 | -0.017 | 0.005 | 0.193            | 0.042 | 0.126                 | 0.076 |
| 1996-2006 | 0.014           | -0.017 | 0.030         | 0.019 | 0.309                         | 0.271 | 0.001  | 0.021 | 0.276            | 0.105 | 0.187                 | 0.003 |

Source: ABS (2006b)

expected to result in a decrease in the region’s diversity from the employment structure of NSW as a whole, a reduction in regional specialisation (as agriculture accounts for such a large proportion of the region’s employment) and poorer employment outcomes for the regions – as indicated by changes in the share of NSW employment accounted for by the region (Table 7). This measure is used as, without exception, all regions experienced an absolute increase in employment over the period.

However, within the data, these outcomes are not consistently found.

**Table 7: Share of NSW Employment**

| <b>Statistical Division</b> | <b>1996</b> | <b>2001</b> | <b>2006</b> |
|-----------------------------|-------------|-------------|-------------|
| Far West                    | 0.003       | 0.003       | 0.003       |
| North West                  | 0.018       | 0.017       | 0.016       |
| Murrumbidgee                | 0.024       | 0.023       | 0.023       |
| Murray                      | 0.018       | 0.017       | 0.017       |
| Richmond-Tweed              | 0.027       | 0.027       | 0.030       |
| South Eastern               | 0.028       | 0.028       | 0.030       |
| Northern                    | 0.027       | 0.026       | 0.025       |
| Central West                | 0.027       | 0.026       | 0.025       |
| Mid North Coast             | 0.033       | 0.033       | 0.035       |
| Sydney                      | 0.657       | 0.666       | 0.654       |
| Hunter                      | 0.082       | 0.081       | 0.085       |
| Illawarra                   | 0.054       | 0.054       | 0.055       |

*Source:* Calculated from ABS (2006b).

In the following we examine the outcomes for each region in turn before providing a general summing up. Our main focus is on the period of drought (2001-2006) with the earlier period being referred to when appropriate.

#### *Far West*

The Far West accounts for a very small fraction of NSW employment. Over the period studied, this proportion hardly changed notwithstanding the fall in agricultural employment. The data in table 3 indicates that there was very little change in the diversity of employment in the Far West compared with the state as a whole, although during the period of drought, there were minor signs of a convergence. However, Table 6 indicates that *CRRS* grew strongly over this period. Interestingly, employment in the Far West is not particularly specialised (only Sydney was less specialised in 2006) although the Far West remains the most diverse region in the state emphasizing the fact that our two measures really are telling us a different things about the structure of the region.

For the Far West, the substantial fall in agricultural employment was offset by the very rapid growth in mining employment (Table 4) which had previously been in decline. Both are industries in which employment is more important in the region than it is in the state. In addition although employment in manufacturing across the state was in decline, manufacturing employment in the Far West held up. Changes in other industries were less important. Total employment grew for the region and its share of NSW employment remained relatively constant. The Far West has clearly benefited from the mining boom and the performance of manufacturing is likely to be closely associated with this. The growth of mining, closely associated with booming exports to China (and latterly India) seems to have largely offset the impact of drought and removed, at least for the time-being, any pressure on the sustainability of the Far West. Evidence from other research suggests that the resources boom will continue well into the foreseeable future ensuring the sustainability of the Far West even in the absence of an end to drought conditions.

Of course, drought conditions have now had some significant relief and should this change be prolonged, it will be interesting to see if employment in agriculture rebounds. The potential for the rebound in agricultural employment will be the subject of future research.

#### *North Western*

Agriculture is a more important employer of workers in North Western than it is for any other region in NSW. It is therefore reasonable to assume that the impact of drought on regions will be well represented in the changes in the employment structure of this region. The findings are not encouraging. The overall share of NSW employment accounted for by employment in North Western fell between the two Censuses and total employment hardly changed – although the small change that did occur was an increase. Clearly these outcomes were driven by the decline in agricultural employment (of over 1,000). The decline in agriculture had, as might be expected, an impact on other areas. For North Western, the impact appears to have prevented services from growing at the rate services grew in the rest of NSW as the degree of under-representation of services in North Western, when compared to the rest of NSW, increased sharply and was largely the explanation for our measure of the degree of diversity in the region compared to the rest of NSW remaining unchanged. Changes in other industries had only marginal impact. The degree of specialisation in this region is higher than for the Far West, the Central West and Sydney, but it is lower than every other region and it fell considerably during the drought when all others apart from Northern and

Murrumbidgee actually increased. Following this survey of the regions, we will present our argument for regions increasing their level of specialisation if they are to remain sustainable communities.

### *Murrumbidgee*

The number of people employed in Murrumbidgee increased but there was a fall in the proportion of NSW employment accounted for by employment in Murrumbidgee. The drop in employment in agriculture between 2001 and 2006 was substantial, both in absolute terms and in relation to what was happening in the rest of the state and resulted in employment in Murrumbidgee being less diverse compared with NSW in 2006 than it was in 2001. What was important for Murrumbidgee, was that manufacturing employment, which had been more important in the region than in the state, continued to increase its importance to the region with absolute growth defying the overall state trend. Both construction and services both became of increasing importance to the region presumably on the back of the growth in manufacturing. These changes were not sufficient during the 2001-2006 period to prevent a minor fall in the degree of specialisation in Murrumbidgee, but over the longer period, there was an increasing trend towards specialisation notwithstanding the fact that diversity, when compared with the state as a whole was declining.

### *Murray*

In terms of our interest in the transition of regional economies to meet the challenges of climate change, Murray appears to be one of the success stories. Between 2001 and 2006, Murray had one of the strongest employment growth experiences – notwithstanding the impact of drought on agriculture and was able to maintain its share of NSW employment. Murray's employment structure became more similar to that of NSW as a whole although the level of specialisation increased only slightly. The industry offsetting the impact of the decline in agriculture for Murray was construction which moved from a situation in which employment in construction in Murray was less important than it was in NSW to a situation in which it was just as important. Although manufacturing employment in Murray declined (slightly) it fell, in relative terms, by more than in the state. Manufacturing has always been more important in Murray than it has been in the state in general and Murray's ability to maintain its manufacturing base as agriculture fell (and construction rose) clearly contributed to better employment outcomes in Murray. Although the change was not large, services in Murray also improved their employment position relative to the state. Again, we would argue, this was due to the maintenance of manufacturing and the growth of construction.

### *Richmond Tweed.*

Like most regions, the diversity index for Richmond-Tweed is declining. However, contrary to the movement in CRD, the measure of CRRS grew strongly. The region has a greater proportion of workers in agriculture than NSW as a whole so the downturn in agriculture has contributed to the fall in the CRD. However, agriculture is not the mainstay of this region with a number of other industries accounting for a greater share of the region's employment. Overall, there was strong employment growth in the region and it substantially increased its share of NSW employment between 2002 and 2006. A major area of growth was construction. But this in turn seems to be related to growth in services, a sector in which the region had lagged behind the rest of NSW but in which the importance was growing largely due to significant increases in retail and accommodation. No doubt efforts to grow the region's tourism have largely been responsible for this outcome. That services could grow from being less important in the region than in the state to being more important indicates that the nature of what is a basic industry for the region (to be discussed below) is not fixed in stone and, given the right circumstances new 'basic' industries can be established in regions to assist their transition and maintenance of sustainability.

### *South Eastern*

This region has, in recent years, increased its diversity slightly and its specialisation significantly. At the same time as it has seen employment in agriculture fall. For many years, agriculture had accounted for more than 10 percent of employment in the region, but it has now fallen below this figure with nearly 1,000 leaving agricultural employment between 2001 and 2006. Notwithstanding this, employment in the region has grown and the region has increased its share of NSW employment. The cause of this derives from the services sector. Although the services sector in total has always been under-represented in the region, this has not been true of public administration, which has always been over-represented. And it is growth in this one area which has been responsible for the employment performance of South Eastern over the period and swamped the decline in employment in agriculture. This one region does demonstrate the importance of government decisions with respect to the location of government activities. There is a question, however, regarding the extent to which government decisions aid sustainability, since a change in government can bring different decisions which may have a less salubrious impact.

### *Northern*

Employment in Northern has grown between 2001 and 2006, but its share of NSW employment has declined. This was largely due to the drop in agricultural employment and, as a consequence.

Northern's level of diversity has declined. Importantly, however, its level of specialisation has also declined. This outcome is indicative of the fact that no other industry has arisen to replace the employment opportunities that had been provided by agriculture in the past. The decline would have been greater if it had not been for the performance of manufacturing. Although manufacturing was under-represented in the region, employment in manufacturing held up over the period as that in the rest of NSW declined. The question that therefore arises is whether or not manufacturing can be an industry in the region that might eventually become a replacement for agriculture in terms of contributing to employment levels that would keep this area sustainable.

### *Central West*

The Central West has become less diverse and this is largely a result of the decline in agriculture modified by a growth in mining (but not to the same extent as the Far West). Changes in other areas have not been highly significant and there was little change in the level of specialisation over the period 2001-2006. The Central West is not highly specialised. Employment did increase between 2001 and 2006, but not by enough to prevent the Central West's share of NSW employment from declining. Services appear to be becoming more important in the Central West, but this does not seem to have contributed greatly to an enhanced viability for the region.

### *Others*

When compared with Sydney, the Mid North Coast has seen little change in diversity (from NSW) but quite a large change in specialisation. The growth in specialisation has been in the services area. Similar changes are taking place in Sydney, but not to the same extent and in different service industries. The extent of specialisation in Hunter and Illawarra has grown. This, also, has largely been the result of the growth of services. For all except Sydney, the changes have enabled the regions to grow their labour force faster than Sydney as a whole.

### *Summary*

Across all regions the impact of drought appears to provide an explanation for an accelerated decline in agricultural employment. Generally speaking, those regions in which drought has been most severe have been the regions in which the negative agricultural employment impact of drought has been greatest. To the extent that the recent drought is the outcome of climate change and provides any useful guidance with respect to the climatic future of the regions concerned there will be a need for transition of the economic base of the region which provides for less dependence on agriculture. There is evidence that such transition may be occurring in some regions in NSW. The

resurgence of mining in the Far West is dependent on the continuation of the resources boom to China and current data suggests that this is likely to continue. Thus a region that started as highly specialised continues to be highly specialised with mining employment substituting for agricultural employment. However, there is no evidence of convergence to an economic base similar to the rest of NSW and the region is moving against the trend with respect to services. Both Murray and Murrumbidgee also appear to be economies in transition. However, the changes in both regions appear to be more widely based than in the Far West. Although they are both highly specialised in terms of their employment structure, that structure is less diverse from the rest of NSW and the level of diversity is narrowing – reflecting a maintenance of their manufacturing base and a growth in the importance of services which, in turn has seen a growth in the importance of construction, particularly in Murray. North West, on the other hand, is becoming less specialised and less diverse as a result of the decline of agriculture with growth in other industries being insufficient to provide an assurance of sustainability into the future. Northern's predicament is similar and of the other DPHV group appears to be the region in greatest difficulty. Of the others, Richmond-Tweed is enjoying a boom in tourism (reflected in services and construction) which more than replaces the employment losses emanating from agriculture. South Eastern is in a similar position, but there it is not the private sector that is the driver but rather the benevolence of government. The Central West is somewhat more diverse than many of the seriously drought impacted areas and it is this diversity that for the time being, has provided it with some protection. However, apart from some growth in services, the Central West does not seem to be building a specialised industry structure that could underpin its sustainability. As previously mentioned, the remaining regions are not heavily dependent on agriculture and their economies do seem to be moving forward in terms of employment growth. Climate change does not seem to hold significant risk for their viability.

## **6. Securing employment growth and regional employment multipliers**

A number of writers have presented ideas and arguments with respect to encouraging the development of industry within regions (Bycroft et al., 2007, for example). Some have argued that this process will involve a diversifying of the economic base of the region (Eversole, 2003). However, our work suggests that, in fact, the best employment results are achieved by a region becoming more, not less, specialised and that if a decline in an industry in which the region is specialised is creating employment difficulties for the region, then a solution is to encourage growth in another industry in which that region can specialise.

The foregoing has suggested that changes in employment in some industries will be more important than changes in employment in others. This is because employment multipliers will be more significant for some industries in some regions than they will be in other industries for the same region or in the same industry for other regions. One way of analyzing this is to calculate employment multipliers via the basic/non-basic approach. This method recognizes that regions are open and stresses the relationship of the region to the outside world (Heilbrun, 1981). To begin, we assume that the region's export industries are its 'basic' economic foundation and are represented by those industries in which the share of employment is greater in the region than for the state. The remaining industries are assumed to exist in order to support the export industries and are termed 'non-basic'. Given that the ratio of non-basic to basic employment is stable, expected changes in total employment can be estimated from expected changes in basic employment by the use of the formula:

$$(3)$$

where  $\Delta E_i$  is the change in the associated variable and  $M_i$  is the employment multiplier for the region.

In calculating  $M_i$  we make use of the location quotient. The location quotient (LQ) for the  $i^{\text{th}}$  industry in the  $r^{\text{th}}$  region is given by:

$$LQ_i = \frac{E_{ir}}{E_r} \div \frac{E_i}{E} \quad (4)$$

For any industry in any region when  $LQ_i$  equals one, then for that industry, excluding international trade and assuming patterns of consumption and labour productivity do not vary spatially and that each industry produces a single, perfectly homogeneous good, local demand for the product (or service) can be met by local production. When  $LQ_i$  exceeds unity, the industry in the region will be exporting and the amount of export (basic) employment in the industry in the region ( $E_{ir}$ ) is given by:

$$E_{ir} = E_r \cdot LQ_i \quad (5)$$

Total basic employment in the region ( ) is therefore:

(6)

and

— (7)

Table 8 reports the estimated values of the employment multipliers for each statistical division in NSW for 2006. The estimates have been calculated using the 107 subdivision data from the ABS Census rather than the much more aggregated employment division data used for our previous calculations. When considering this table the assumptions on which it has been based should be noted. Where they do not hold, the values are likely to have an upward bias.

**Table 8: Regional Employment Multipliers (2006)**

| <b>Statistical Division</b> | <b>Employment Multiplier</b> |
|-----------------------------|------------------------------|
| North Western               | 4                            |
| Far West                    | 3.5                          |
| Murrumbidgee                | 4.5                          |
| Murray                      | 4.9                          |
| Richmond-Tweed              | 5.9                          |
| South Eastern               | 5.4                          |
| Northern                    | 4.4                          |
| Central West                | 4.9                          |
| Mid-North Coast             | 5.6                          |
| Sydney                      | 14.1                         |
| Hunter                      | 8.2                          |
| Illawarra                   | 7.9                          |

*Source: ABS (2006a)*

Our results are not encouraging for the regions on which we are primarily focused. In general the value of the employment multipliers in the major agricultural and drought impacted areas are lower than in the rest of NSW. Thus, in addition to the challenges of attracting industry into the region to create industries than can be, or can grow to be, 'basic' success in providing sustainable levels of

employment through a transition process will be hampered by the apparent lower values of employment multipliers in those regions.

The results also suggest that it is the larger regions whose employment structure is closer to the NSW's employment structure that have the larger multipliers – even those these regions are continuing to specialise.

## **7. Conclusions**

Regions in NSW that are seriously drought impacted areas and where, given that climate change will result in more severe and frequent drought experiences, need to transition the employment structure of their economies to a more sustainable basis. Our analysis suggests that some have been doing just this (although the transition, in some cases, appears to have begun before drought got under way). In these regions employment share has largely been sustained and often improved. The causes of this transition appear to vary from regions taking advantage of their comparative advantages with respect to alternative industry to direct government support for the change in the region's employment structure. However, in others there has been no change suggesting a need for policy intervention. In the first instance, policy should be directed at the establishment of industry that can produce a sustainable export base and this will certainly result in the region endeavouring to grow industry in which it can specialise. Unfortunately, in smaller communities, with a smaller range of industry, the employment multipliers for the industries developed are likely to be much smaller than in regions with a greater range of industry classified as basic. However, this disadvantage cannot be overcome by immediately attempting to increase the range of industry in a region as it is only through increased specialisation that basic industries, with significant employment multipliers, can be developed and on which the sustainability of the region can be based.

The question is, for the regions that have, to date, not moved to transition the employment and industry structure of their economic base (Northern and North West) what are the industries in which they have a comparative advantage and what policy changes would be successful in getting this change started.

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