Salinity control, water reform and structural adjustment: The Tragowei Plains Irrigation District

by

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Abstract

The Tragowel Plains Irrigation District lies in the lower Loddon catchment of northern Victoria. Since the 1890s progressive development of the irrigation infrastructure of the Tragowel Plains has been accompanied by the development of irrigation induced soil salinity. In 1988 the State Government of Victoria supported the development of a community managed salinity management plan. At the same time, the water supply industry was significantly deregulated. Full cost recovery principles were applied to irrigation water pricing. Water entitlements were transformed into tradable commodities.

The Tragowel Plains Salinity Plan was subsequently promoted by the Victorian government and the Loddon irrigation community as a model for encouraging structural change in a Commonwealth government facilitated regional development plan for the whole of the Loddon-Murray irrigation region. The process of developing this regional development plan revealed difference in the objectives of the various actors in this new planning process. The objective of community planners was the survival of the irrigation district. One of the objectives of Commonwealth was the transfer of water from low value use to high value use. These higher value uses were potentially elsewhere in the Murray Darling Basin. Further, these actors in the planning process used differing implicit models of the process of structural change in irrigation areas. The Commonwealth representatives had an implicit model of structural change in which farm consolidation was driven by the rate of exit from farming. They were also sceptical of the capacity of the Tragowel Plains salinity plan model to facilitate significant change in water use. The community proposal argued that farm consolidation was driven by the capacity of existing businesses to fund farm expansion, and that the Tragowel Plains model was capable of facilitating significant structural change and achieving real environmental benefits..

This thesis examines the outcomes of five years of Salinity Plan implementation and assesses these outcomes against the objectives of government, the community and the environmental movement, and assesses the implicit models of structural change used by the various actors.

The study found that the accuracy of farmer appraisal of soil salinity has been greatly improved by the provision of soil salinity surveys. This supports one of the components of the implicit adjustment model used by the community planners – that without information from
electro-magnetic surveying, farmers were often unable to accurately judge the salinity of farm soils.

Greater certainty provided by soils salinity surveys has catalysed significant structural change on farms. Almost half of the saline land irrigated in 1989 has since been retired from irrigation. Two thirds of the water retired from saline soils had been reallocated to higher value perennial pastures. The adoption of professional whole farm planning has increased significantly since the implementation of the Salinity Plan. The rate of land relayout has not increased, but the participation rate has increased.

The pattern of structural adjustment varied across the study area. Successful consolidation of enterprises was underway within dairy farm areas of the Tragowel Plains during the period of this study. The process was driven by the relative prosperity of dairy industry which enabled the operators of those businesses to fund farm expansion. The Salinity Plan had little direct impact upon decisions to purchase land. In contrast, in mixed farming areas in the north of the study area the number of small farm businesses increased during the period of study. This was counter to the objectives of the salinity management plan. The major processes causing this structural adjustment on the Tragowel Plains can be summarised as follows:

- Low returns to existing mixed farming industries encouraged many farmers in these industries to exit.
- A high exit rate due to financial pressure was being accelerated by non-financial issues such as the family and lifestyle dissatisfaction of women on farms.
- A high concentration of mixed farms in the north created a geographic shortage of strong businesses able to fund expansion in that district.
- A high demand for small farms in the north from new entrants appeared to be based upon unrealistic expectations of the limitations of small farms and local off-farm work opportunities.
- When the existing agricultural industries of a region are all in a weak financial position, they will be at a competitive disadvantage when bidding against new entrants for whom the housing and other farm infrastructure is not a sunk cost.
These results call into question the implicit model of “exit-driven” structural change which has been the basis of agricultural structural adjustment policy for the past 30 years. This thesis concludes that policy tools to enhance structural change in agriculture need to be targeted to entry to agriculture and the competition between farm build-up and farm entry, rather than focusing upon changing the rate of exit from agriculture.
Preface

As I reflect upon my professional career, it is clear that structural adjustment of agricultural communities and salinity control have been the consistent themes of my research. My first research position, which I entered soon after graduating, was set in the midst of a period of aggressive restructuring of the Australian dairy industry during the late 1970s. This theme continued in studies of part time farming, adjustment decision making and changes in the composition of the farm workforce. With hindsight borne of a career based upon the changing priorities of research funding bodies, I can see now that a change in research career was inevitable.

In 1983 I commenced a new research direction... a study of farmers’ perceptions of the extent of irrigation salinity and the barriers to salinity control. The intention was to assess the accuracy of farmers’ appraisal of hazard using remote sensed estimates of the extent of soil salinity. As the project developed it became apparent that the utility of remote sensed salinity detection had been over marketed by those developing the technology. The objective of measuring accuracy of salinity appraisal was abandoned. Now, fifteen years late, this thesis represents the belated delivery of research which fulfils my 1983 intention.

Despite the methodological limitations of my first study of salinity, it was still the first significant Australian study of the social issues which are enmeshed in the salinity control. It lead to my decade long involvement in social research within the Victorian Salinity Program and positioned my career firmly in the commencement of the ongoing infatuation of research organisations with the goal of a sustainable agriculture. And for many years I believed that the ‘structural adjustment’ chapter of my research career had closed. This was not the case. By the mid 1990s there was a growing realisation by research funds that the objective of sustaining agriculture was closely liked with the direction of structural adjustment within agricultural industries. And thus, with the research described in this thesis, the two main strands of my research career are finally entwined in a single thread.

Clearly, this thesis represents both the outcome of research undertaken during the period of my formal enrolment for the degree of Doctor of Philosophy and research undertaken prior to this period. Parts of chapter 1 have been previously published as chapter 12 of *Greening a
Brown Land (Barr and Cary, 1992). Some sections of chapter 2 were previously published in Community Involvement in Catchment Management (Wilkinson and Barr, 1993). I certify that this thesis comprises my original work and that due acknowledgement has been made in the text of the thesis to all other material used. This thesis is less than 100,000 words in length, exclusive of tables, bibliography and appendices.
Acknowledgements

A number of people have played a pivotal role at key points in my life, shifting the points and sending my carriage on the journey to this study of structural adjustment in the rural sector. My parents experienced their share of the pressure for adjustment within the rural sector, and from this I learnt a little of the personal struggle behind the words. Glenn Ronan, an early advocate of the need for rural counselling, first set me on this research path in 1977. John Cary inducted me into the world of salinity research in 1984.

I believe it will indeed be many years before another researcher is placed in the fortunate position of having available such a rich and extensive longitudinal data set for study. To be given the opportunity to explore such a data set is an honour of fortune for which I must express my gratitude to the Murray Darling Basin Commission and the Department of Natural Resources and Environment, who shared funding of this research.

I have benefited from wise council and advice during the preparation of this thesis. Ken McDougall shared similar experiences to my parents. His local knowledge of the Tragowel Plains was a valuable assistance, as was that of Drew English, Lester Haw and Craig Dyson. I am indebted to a number of colleagues whose ideas and insights have been of enormous assistance. Foremost is my supervisor, Professor John Cary. Likewise, Roger Wilkinson of Landcare Research, New Zealand and Ian Reeve of the University of New England.

The completion of this research would not have been possible without the assistance of Sally McInnes who undertook more than her share of the 1995 interview load, George Wyatt who organised the 1987 interviews, the officers of the Pyramid Hill office of Goulburn Murray Water and Andy McAllister of Tatura. Andy is the only person whose knowledge of the arcane minutiae of water and land records in irrigation districts exceeds that which I have been required to acquire.

I am indebted to the generations of farmers and ex-farmers of the Tragowel Plains who co-operated in the studies described in this thesis. They gave their time with generosity, and I was enriched by each story I was privileged to hear.
Finally, I must express my heartfelt thanks to my partner Julie Flynn, who endured the experience of being married to a PhD candidate with good humour and forbearance. I acknowledge to her that a PhD more than outweighs the sacrifices I made during her short period as a political candidate. I promise not to undertake another doctoral candidature.
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Introduction

Problem Statement

The Tragowel Plains is one of a number of irrigation settlements in northern Victoria. Extensive irrigation-induced soil salting has developed on the Plains over the past 100 years. Within this environment farm managers had developed a culture of conservative farm management. The predominant production system was the irrigation of annual pasture. On many farms irrigation took little account of the salinity status of soils. This was in part due to the desire to maintain a leaching fraction to ameliorate the salinity impacts of high watertables, and in part due to an inability to identify the less obviously damaged saline soils.

In the late 1980s the State government sponsored the development of a Salinity Plan by a Tragowel Plains community group. The Salinity Plan advocated a new farming strategy of explicitly living with salt. Using new technology, identification of saline soils was made the focus of farm management recommendations. Farmers were recommended to cease irrigation of saline soils and to find a use for the saved water which would provide a higher return to the irrigator. Higher value uses would included re-allocation to perennial pasture on the farm, or the sale of the water to other landholders in the newly created water entitlement market.

Soon after the commencement of the implementation of the Tragowel Plains Salinity Plan a serious structural weakness was detected in the Torrumbarry Weir on the Murray River. This weir supplied irrigation water to the Torrumbarry irrigation settlement adjoining the northern boundary of the Tragowel Plains. Both the State and Federal Governments were obliged to contribute to the rebuilding of the Weir by the Murray Darling Basin Agreement. However, the Commonwealth expressed considerable concern at prospect of investing considerable resources into the rebuilding of a weir which might be used to support the continued existence of an inefficient irrigation industry based on the irrigation of annual pastures and saline soils. The Commonwealth attempted to make their contribution to the rebuilding of the weir contingent upon a commitment by the State and the local community to a restructuring of irrigated agriculture in the region.
The response of Victorian Government representatives was that the structural adjustment measures contained or implied in the Tragowel Plains Salinity Management Plan would facilitate structural adjustment by moving water from high salinity soil to low salinity soil within the Tragowel Plains or further afield. The application of similar measures over the rest of the lower Loddon irrigation region would achieve the adjustment sought by the Commonwealth. This argument was received with some scepticism by representatives of the Commonwealth. They had correctly identified that a major objective of the community group developing the Tragowel Plains Salinity Management Plan was the social sustainability of their community. This objective was not necessarily congruent with the Commonwealth objective of structural change. These differences were compounded by differing implicit models of structural change used by the actors in this planning process. The Commonwealth representatives assumed that encouraging exits from agriculture was the main lever available to influence the rate of farm amalgamation. Community representatives believed that improving farm business performance was the most effective tool to influence the rate of consolidation.

The differences between the Commonwealth and the State were essentially unresolvable due to the absence of reliable data on the extent of structural adjustment on the Tragowel Plains and the relationship between this adjustment and the activities promoted under the Tragowel Plains Salinity Management Plan.

Aim

It is the intention of this author to determine the extent and nature of structural adjustment amongst irrigation farms on the Tragowel Plains and the contribution of the Salinity Management Plan to this adjustment, to test this against the objectives of the actors in the planning process, and to test the implicit models of structural change used by those actors.

Research Approach

To determine the extent and nature of structural change on the Tragowel Plains, this study utilises a uniquely rich data set of archival data and a longitudinal panel study of farm families. The archival data includes extensive soil salinity measurements conducted across much of the Tragowel Plains, remote sensed crop data, archival water-use data and records of land and water ownership spanning an eight year period. The longitudinal panel data is based upon two
personal interview studies conducted in 1997 and 1995. The availability of this longitudinal data is a key resource in allowing an exploration of the relationship between salinity control strategies and structural adjustment. The data set is potentially unique in its scope, allowing an exploration of structural change impossible in most other farming districts across Australia.

The first section of this thesis describes the background. Chapter two provides a history of the development of irrigated agriculture on the Tragowel Plains and how this led to ongoing extensive irrigation of saline land. Chapter three describes significant recent changes in the institutional and policy context, and how these have led to public concern at the inefficiency of irrigation practice on the Tragowel Plains and Torrumbarry irrigation districts. The fourth chapter outlines the research questions which arise from a review of the changing policy and institutional framework.

The second section describes the research work undertaken by the candidate. Chapter five describes the data sources and their inter-relationship within a relational database. Chapters six to twelve each report on the results of the research, dealing with each of the seven research issues in turn.

The third section is the synthesis of the research results. In chapter thirteen I discuss the results and their implications. In chapter fourteen I draw my final conclusions.
A history of the Tragowel Plains

In 1836, Major Thomas Mitchell stood atop a small pyramid shaped granite hill at a place close to the centre of the Murray River basin. He surveyed a remarkably flat plain which extended in all directions. To the south the foothills of the Great Dividing Range would have been visible in the far distance. The creek at the foot of the hill snaked its way north towards the Murray River. Like other inland explorers, Mitchell dreamed of discovering a rich, productive heart of Australia. Maybe this was that heartland? The mostly treeless plain with its lush grass cover greatly impressed the explorer. He envisaged how the land might be transformed by men, animals and irrigation.

I ascended a rocky pyramidal hill . . . Its apex consisted of a single block of granite and the view was exceedingly beautiful over the surrounding plains, shining fresh and green in the light of a fine morning. The scene was different from anything I had ever before witnessed, either in New South Wales or elsewhere. A land so inviting, and still without inhabitants! As I stood, the first European intruder on the sublime solitude of these verdant plains, as yet untouched by flocks or herds; I felt conscious of being the harbinger of mighty changes; and that our steps would soon be followed by the men and the animals for which it seemed to have been prepared . . . This seemed to me a country where canals could answer, the better distribution of water over the fertile plains. (Mitchell, 1838. pp. 271-2)

Today the town of Pyramid Hill sits at the base of its namesake hill in the middle of the Tragowel Plains Irrigation District. The sign at the town’s southern entrance proclaims ‘Pyramid Hill: The Major’s Vision’. Yet if you drive through the town and continue north or west on a wet winter’s day the land smells of the sea, although the sea is more than 200 kilometres distant. Another underground sea is only a metre or two away. The Tragowel Plains watertable is very salty and in mid-winter after heavy rain may rise in some parts to within centimetres of the soil.
A history of the Tragowel Plains  5

surface (Pratt et al., 1988). The surrounding land bears the salty scars of the watertable. How did the Mitchell’s vision turn to salt?

Figure 1 Location of the Tragowel Plains

Mitchell did not know he had surveyed the plain at its best. He was travelling, during the winter, in a good season when rain was sufficient to grow impressive stands of native grass. The squatters who followed Mitchell in the 1840s soon learned what was not obvious to a visitor passing quickly during a good season. The drover Hawdon, one of the first Europeans after Mitchell to cross the plains, recorded in February 1838 that he could scarcely find sufficient grass for stock, having to rely on reeds in depressions. It was clear to those who followed Mitchell that the average summer in these plains was long and dry. Water was short and grass for stock soon dried off (Thompson, 1969; Hawdon, 1952).

George Hepburn, one of the first overlanding squatters to travel from the north, followed Mitchell’s dray tracks. Mitchell’s drays had travelled over moist ground leaving deep ruts. Hepburn’s dray left no mark in the dry ground beside Mitchell’s ruts.

We reached the Murray River in about fourteen days. When the Major crossed the country it had been very wet, but many places where we encamped had been destitute of water when we passed, although the lapse of time was short; the tracks of the
drays were deeply cut, and ours, which was moderately loaded, did not make a mark.

(Hepburn, 1969. p. 60)

Taddy Thompson followed the overlanding trail behind Hepburn. He was even less impressed with Mitchell’s discovery. In February 1841 he observed that a series of dry seasons had altered the country over which Mitchell had travelled and ‘the fertile region which had presented itself to his [Mitchell’s] delighted view had been converted into an arid waste, destitute of either grass or water’ (Hepburn, 1969). Hepburn and the other early overlanders hurried through the central Victoria plains and continued southward to the moister country of the Western District and the Great Dividing Range. When the better runs to the south were taken up, the later squatters filled the gaps around Pyramid Hill (Powell, 1996).

The squatters on the Plains had drawn the short straw. In dry seasons the grass disappeared and the waterholes receded. In 1851 the only place stock could drink was in waterholes in the Loddon or at Lake Boga, many miles to the north west (Kent, 1974). Land beyond the fringes of the river was useless. When wet years did come they brought forth grass, but also floods. Water flowing north from the Great Dividing Range slowed as it reached the plains and spread out over the runs. The plains became a shallow inland sea.

Presaging future problems, the Tragowel Plains and the land on the Loddon Valley plains had a high level of natural salinity. To the west of Pyramid Hill, on the Terrick Plains, the natural vegetation until about 1860 was salt tolerant pigface (Dysphyma sp.) Edward Curr, one of the earliest squatters in the area, described a trip he made from Tongala to Mount Hope Station (north of Pyramid Hill):

The pigs’ faces were covered with ripe fruit, so, naturally, as we had been living on mutton and damper for months, we indulged in them more than we should have done . . The plain, for the thirty miles we followed it from the Campaspe to Mount Hope, was one bed of ripe fruit (Curr, 1965. p. 169).

Curr also described stands of saltbush on these plains, with some standing ‘ten feet high’. These saltbush pastures were common across the lower riverine plains until destroyed by the sheep of the squatters. Curr’s widespread rambles across the Loddon plains were curtailed by the introduction of the later Selection Acts. By the time the plains were released for selection,
most of the loopholes exploited by Western District squatters had been removed. Despite attempts at subterfuge and trickery, the squatters could not stem the invasion of the selectors (Priestly, 1984). Perhaps, instead of trickery the squatters should have relied on the truth: the land was harsh and would break many a selector’s heart.

In the 1870s small settlements sprang up along the intermittent watercourses which crossed the plains: Macorna, Mologa, Tragowel, Mincha, Terrick and Durham Ox. The settlers around these towns tried to make a living growing wheat. The seasons seemed to conspire against them. The droughts and floods which bedevilled the squatters bedevilled the selectors as well. In drought the wheat withered and settlers had to make the long trek to the Loddon River to water their horses. By 1880 the district was in a sorry state. The land along the railway line between Bendigo and Echuca was described by a contemporary correspondent as *grain sick*—depleted of nitrogen by constant cropping (Dingle, 1984). The settlers who survived the decade were mostly destitute. A few *boss cockies* had accumulated large properties despite the intentions of the Selection Acts. The lot of the remaining settlers was hardship and poverty (Davidson, 1981). Under pressure of debt they were farming their land under a continuous cropping system which replaced neither nitrogen nor phosphorus (Barr and Cary, 1992).

Like the squatters before, the selectors had found Mitchell’s vision of a grass covered plain to be misleading. On one point there was strong agreement with the Mitchell. What the land needed was irrigation and a better distribution of water. It was water shortage which was depicted as the reason selections were unprofitable and life a misery. Local Minister of religion, E.C. De Garis of Durham Ox, had taken the role of social activist in defence of his parishioners. Inspired by Benjamin Dod’s proposal to irrigate the northern plains of Victoria, he organised a campaign to bring stock and irrigation water to the plains, hoping irrigation would alleviate the hardship his parishioners suffered (Barr and Cary, 1992). When legislation was passed allowing groups of farmers to form Waterworks Trusts for commandeering and distributing water, De Garis chaired the Tragowel Plains Trust (Kent, 1974).

The Trust planned to build a small dam on the Loddon and divert water to Tragowel Plains farms. From the beginning it was clear there was not enough water to go around. The Loddon River stopped flowing in dry years when the need for water was greatest. De Garis and others continued their lobbying, this time for a dam on the upper Loddon River to ensure a flow
of water through summer. In 1891 the Victorian government opened the Laanecoorie reservoir on the upper Loddon. The reservoir was to release water into the Loddon in summer with local irrigation trusts diverting and distributing the water.

The increased water supply did little to improve the situation on the Loddon Plains. The dam increased the demand for water. Other Trusts sprang up along the Loddon. The existing Tragowel, Twelve Mile, Meering, Leaghur, Swan Hill, Boort East, Boort North and Pyramid Hill Trusts were joined by the Mincha, Calivil and Pompapiel Trusts. These private irrigation trusts attempted to share a very limited resource in the Loddon River, but descended into bickering and intrigue. Downstream Trusts considered there was not enough water to supply all the needs of households and farm animals. Upstream Trusts saw water flowing down the river and argued that it was time to make water available for irrigation (Sharland, 1971).

The Trusts achieved little in the way of irrigation, but achieved much in their approaches to the Banks. Most Trusts borrowed heavily. With the financial crash of 1893, they faced insolvency and a legacy of debt. With the severe depression the banks closed and loan funds dried up. Successive governments sought to impose some degree of financial discipline on trusts, buying co-operation with the incentive of relief from some debts. The situation was beyond redemption. In 1899 the Turner Government passed the Water Supply Advance Relief Act which was an admission that the Trusts could not be made solvent (McCoy, 1988).

After the failure of the Waterworks Trusts the newly formed State Rivers and Water Supply Commission took over the responsibilities and financial commitments of the Trusts. The State Rivers and Water Supply was charged with building a more profitable irrigation industry. The lessons of the early Trust failures had been partly learnt. The chairman of the new Commission, the American Elwood Mead, decided that farmers in the areas serviced by his dams would have no choice but to use the water supply. There would be no option of using water only in a dry year. All properties in irrigation areas were to be rated to receive a fixed amount of water each year. This fixed water right was allocated according to a formula based upon supply capacity and area of land. Payment for this water right was compulsory whether or not the water was used. Additional water could be purchased on a seasonal basis according to availability. This optional purchase was to be called sales water. In later years water rights were increased as
further water became available from storage construction. This structure of water survived until the 1980s era of water market reform discussed in a following chapter.

State investment in irrigation infrastructure gradually increased the water available to Tragowel Plains farmers. In 1912 a channel from the Waranga Basin in the Goulburn catchment reached the Loddon River. The Loddon farmers no longer had to rely on the limited water from the Loddon River. Water from the more prolific Goulburn River could be channelled across the plains and diverted into the Loddon River. The channel placed increased demands on the storages on the Goulburn River. Within two years a drought exposed the over-commitment of the available water. In 1927 the State Rivers and Water Supply Commission built another dam at Eildon on the upper Goulburn River. It also built a new channel supply from the Waranga Mallee Channel into the middle of the Plains. This provided a gravity supply across much of the plain. Irrigators no longer had to lift water out of the Loddon, merely open a gate on the channel and the water flowed across their land (Kent, 1974).

The Tragowel Plains were different from irrigation districts to the east of the Riverine Plain. In the Goulburn Valley the Water Commission was creating new communities to use the new irrigation water. It was buying land, subdividing, supplying water and finding new settlers to farm the land. Each block was allocated a legal right to sufficient water to irrigate the whole of the block. This was about one acre foot of water per one acre (equivalent to 30 centimetres of rainfall per year). On the Tragowel Plains the Commission supplied water to the existing settlers. This difference had profound implications for the way farming developed on the Tragowel Plains.

Farm size on the Tragowel Plains had been set by the minimum subdivision size allowed for in the Selection Acts. The Water Commission could not supply enough water to the Tragowel Plains to water all the land on any given farm. Rather than supplying a few farms with all the water they needed, as in the Goulburn Valley to the east, the Commission shared the available water between all the farms with access to its channels. The Commission granted water rights at the rate of one acre foot for every five acres. This was insufficient water to irrigate the whole of a farm. The channel system distributing the water to the larger Tragowel Plains farms was longer and more complex than channel systems in the Goulburn Valley. It was harder to
manage and the water delivered to the Tragowel farms arrived more irregularly than in the Goulburn Valley (Bartels, 1963; Aird, 1944; Hanslow, 1943; Bartels, 1938).

The Tragowel Plains were flat, so farmers could start irrigating with very little preparatory work; a supply channel and branches were all that were needed. When the farmer dug a series of holes in the branch channel, water flowed out over the plain. This practice came to be known as *wild flood irrigation*. Once the water left the branch channel, it was uncontrolled. Although the land was generally flat it was riddled with ‘crabholes’, small circular depressions between five and fifty metres across. With wild flood irrigation, water collected in the crabholes leaving the higher areas of the paddock dry (Bartels, 1932; Bartels, 1928).

The State Rivers and Water Supply Commission encouraged irrigation farmers to grow lucerne on their irrigated paddocks. In the mid 1920s the Department of Agriculture established a demonstration lucerne plot in the nearby Goulburn Valley (Bartels, 1930). But farmers who tried to grow irrigated lucerne on the Plains were often unsuccessful. Lucerne did not grow well under wild irrigation methods and it did not grow well in the wet crabholes. The roots succumbed to waterlogging and the leaves were scalded as the ponded water warmed in the summer sun. Irrigation crusted the surface of the heavy Tragowel clay soils and the delicate lucerne seedlings often could not break through the crusted surface (Bartels, 1938).

The Tragowel farmers developed their own style of irrigation farming. In spring they used their irrigation water to irrigate wheat. In summer and autumn the wheat did not need water. If water arrived in the channel, to produce a ‘green pick’ of native pasture, it was directed into crabhole depressions and dry swamps, where it often remained until it percolated away or evaporated. The more adventurous farmers used their summer water to irrigate sorghum, amercane or millet, crops which could cope with waterlogging. Farmers applied as much as possible of the irregularly delivered water to ensure the crop was tided over until the next watering. Water ponded in the sorghum paddocks for days (Garland, 1952).

When government advisers changed their emphasis from lucerne to perennial white clover pasture in the 1930s, the Tragowel Plains farmers did not change their traditional practices. White clover was better able to stand waterlogging, but it needed to be watered regularly through summer otherwise it would not survive. White clover pasture was unreliable because of the irregular Tragowel Plains water supply. Consequently, Tragowel farmers
followed the example of the dryland farmers farther south who were planting Wimmera rye-grass and subterranean clover. This *annual pasture* grew in autumn, winter and spring, dying off in summer each year and re-establishing itself in autumn when the rains fell. By irrigating in autumn, the Tragowel Plains farmers could grow subterranean clover by creating an artificial break to the season. Within 15 years Tragowel Plains farmers had planted 6 000 hectares of subterranean clover pasture, converting land from barley, lucerne and native pasture (Aird, 1944).

**Salinity: the unexpected visitation**

The local activists who conceived the scheme for irrigating the Tragowel Plains made the mistake of Thomas Mitchell, seeing what they wanted to see in the landscape. The landscape held warnings of the likely impact of irrigation schemes. The squatter Curr’s wanderlust and observations of saltbush and pigface have already been recounted (Curr, 1965). When the drover Hawdon crossed the plain in 1838, he found little grass, but much ‘salsuginous pigsface’. He crossed level plains of saltbush (*Atriplex* spp.) and pigface (*Dysphyma* sp.) between the Campaspe and Loddon Rivers (Hawdon, 1952). These were signs of salt quite close to the soil surface. At that time oldman saltbush and cottonbush (*Kochia aphylla*), with sparse grass, extended from the middle reaches of the Loddon River to beyond the Murray River (Williams, 1962). With hindsight we can surmise that irrigating this country was bound to cause salinity problems.

The Tragowel Plains are a natural flood plain. In places the slope of the land is less than a metre in every two kilometres. The plains are drained by many ill defined small creeks and anabranches of both the Loddon River and of Bullock Creek. Originally, when the heavy rains came, every five years or so, the floodwaters were very slow to clear. Settlement brought roads, levee banks and, eventually, irrigation channels. All interrupted the tenuous natural drainage lines, exacerbating the winter flooding of the plains. Irrigation further worsened the drainage. Summer irrigation water flowed into the normally intermittent creeks. This radically changed the ecosystem of the creeks. Dense cumbungi weed does not survive in intermittent streams, but its dense thickets quickly dominated the now perennially wet shallow creeks. They slowed the drainage, spreading the area of permanent inundation, spreading the cumbungi habitat, and further exacerbating the winter flooding. Despite the summer shortage of water, the winter
flooding was unwelcome, waterlogging the soils and hindering access to paddocks for long periods. Crop and pasture production was reduced and prolonged flooding increased the amount of water reaching the watertable.

Irrigation itself exacerbated the watertable problems. Irrigation ensured large areas of the plain had wet subsoil before the natural autumn break. The use of annual rather than perennial pastures increased the area of artificially wet subsoil. When the winter rains came there was no water storage capacity in the soil and winter rain penetrated the soil directly to the watertable. Farmers irrigated natural pasture by wild flooding of undrained depressions. Water ponded in crabholes, causing water to percolate into the watertable. The existence of an unseen deep lead system below the plains further exacerbated the impact of irrigation (Macumber, 1991).

In the 1880s the watertable in parts of the northern Plains was eight to ten metres below the surface. In 1890 the water table depth was four metres; by the turn of the century it was only two or three metres. By the 1920s the first visible salt appeared on either side of the Macorna channel in the north of the Plains, where the drainage was almost totally cut-off. The salt proceeded to spread north and south from the channel. The plains were flat and the salt spread widely, unhindered by local topography. There was little elevated land above the influence of the watertable (Garland, 1952).

A salinity reclamation culture

By the early 1930s salinity was a serious problem not just on the Tragowel Plains, but on much of the irrigation country around Kerang. The Water Commission started a belated program of drainage for the Kerang East area, progressively extending the drains upstream and promising that the drains would reach the Tragowel plains. The State Department of Agriculture placed an agricultural scientist, Alan Morgan, in Kerang with the task of discovering how farmers could reclaim their saline land (Russ, 1995; Jones et al., 1989).

Morgan hoped to reclaim salt affected land by regular watering throughout the irrigation season. He argued that regular watering would leach salt from the soil surface down below the root zone of pasture grasses. To do this he had to grow white clover pasture which needed to be watered throughout summer. There was no sense in irrigating subterranean clover in the middle of summer when it was dormant. This approach required a dramatic improvement in the
inefficient irrigation methods. Wild flooding, which oversaturated some ground and left higher ground dry, was not compatible with salt reclamation. The high unwatered ground was not leached and so stayed salty despite irrigation. The low ground was waterlogged and did not grow healthy white clover. Better water control was to be achieved with border check layout with the farm divided into rectangular watering bays. The supply channel was at the top of the bay and the drainage channel at the bottom. The sides of each bay were raised mounds of earth called checkbanks. The checkbanks stopped water flowing sideways out of the bay, forcing it to flow down the bay to the drain. The surface of each bay was levelled using horse drawn implements like the buckboard and the scraper. This levelling could fill in small crab hole depressions and level small rises. Removing cross slopes on bays was beyond the capacity of the buckboard. This meant bays had to be built to fit with the slopes of the farm. The government advisers recommended bays no wider than 15 metres to ensure water covered the whole of the land in the bay (Morgan, 1942).

Irrigators had in the past been unconvinced of the need to layout their farm with border check. The narrow bays and limitations of farm topography meant a farm was covered with many small bays, often pointing in differing directions. Laying out the farm was time consuming and expensive and irrigating it was time consuming. Farmers had to water each bay in turn by digging and then filling a hole in the supply channel. The State Rivers and Water Supply Commission first demonstrated the system before the First World War on two demonstration farms in the Goulburn Valley. The farms were closed within a few years because irrigation farmers did not believe they could achieve the same results with private resources (Bartels, 1963). Farmers chose instead to persist with wild irrigation, or to layout their farms with much longer and wider bays. Farmers overcame the difficulties of cross slopes on the wider bays by raising small banks across the bay at intervals of about twenty metres. These transformed the bays into a series of shallow basins. At watering each filled in turn, watering all the way across the bay, before overflowing into the next small basin. The Department of Agriculture advised against this style of watering with the observation ‘under this system there can be no pretence of uniform watering, since there can be a foot of water near the bank and an inch at the further reaches’ (Bartels, 1932).

Farmers in the Tragowel Plains were particularly reluctant to lay out their farms according to the recommended border check style (Bartels, 1938). They used most of their
irrigation water in a couple of waterings in the autumn over a much larger area of pasture than irrigation farms elsewhere in the state. Where they did layout to border check, their bays were wide and long, sometimes over a kilometre long, taking over a full day to water (Hanslow, 1943). The large farms and subterranean clover pastures made small border check bays specially unattractive.

Morgan set up demonstration plots on farms to show the importance of improved layout if a farmer wished to reclaim salty land. Pasture sown on a saline property at Kerang East soon established as regular watering washed the salt down below the root zone. After three years paddocks of lucerne and pasture were growing where before there was nothing but salt bush and salt, though the productivity was below what was achieved elsewhere (Morgan, 1942). Later attempts to grow crops and subterranean clover on neighbouring paddocks were less than successful. Regular watering of the first paddock had raised the watertable in neighbouring paddocks. The only crops which could be grown next to the successfully reclaimed pasture were those which the farmer watered throughout the summer (Morgan, 1943). Subterranean clover, which died off in summer, could not survive next to the reclaimed land. While the subterranean clover was dead and unwatered in summer, evaporation drew salt to the soil surface.

At another demonstration paddock at Tragowel, whenever the new pasture germinated it was quickly eaten by rabbits which had a natural habitat in the Dillon bush and lignum on the adjacent salty land. In summer the perennial pasture was a magnet to the rabbits. After one poisoning around the demonstration block Morgan and the block owner found 3 000 rabbit carcases. Many local farmers regarded the rabbits as a bigger problem than the salt (Garland, 1953).

The war brought Morgan’s official, but not unofficial, experimental work to an end. He managed to continue to supervise the reclamation until 1943 by working in his own time on weekends (Russ, 1995; Jones et al., 1989). In 1947, Morgan summed up the results of the experiment:

The Department has advocated for many years, from the standpoint of efficient utilisation of irrigation water, the fullest application of the principles of:- (a) effective grading; (b) short, narrow bays; (c) sowing of permanent crops and pastures; (d) maintenance of fertility by adequate topdressing with superphosphate; (e) scientific
grazing management. These principles apply even more forcibly to areas affected by salt. The reason is obvious—the aim of reclamation by irrigation is to leach the harmful mineral salts to a depth at which they no longer affect the plants to be grown, and this is most satisfactorily accomplished where the irrigation water is evenly applied and the amount not sufficient to cause any appreciable rise in the watertable of any adjoining unirrigated area. (Morgan, 1947. p. 111)

But the message was not as clear as it seemed. Agricultural advisers lamented the low use of superphosphate in the Kerang area. For most farmers there was no point in fertilising the land until the salt had been washed away (Morgan, 1943). The experiments had shown the importance of maintaining cover on land with high watertables to slow the rate of salting, and yet the first step in relayout was to remove all vegetative cover to grade the land. The experiments had not demonstrated that careful watering would eliminate the risk to neighbouring paddocks. On the experimental plots watering one paddock brought up salt on a neighbouring paddock. It was impossible to predict where this seepage would occur, so the farmer had to water the whole farm at once (Morgan, 1943). But Tragowel farmers did not have enough water to irrigate all their land. Better layout was not the answer to this dilemma. Measurements on the plots showed layout did not lower watertables. The only contribution of layout was to improve leaching. To leach salt to the lower soil depths it was necessary to irrigate consistently with sufficient water to wash the salt through the soil. The water had to go somewhere. If it did not raise the watertable then it increased the drainage flow of salty water. The greatest contradiction was the observation that ‘irrigation is required to undo the damage done by irrigation’, when it was clear that irrigation was the cause of the problem. Morgan noted that where farmers were reclaiming their salted land ‘the point has been reached where more irrigation water is required than can be guaranteed by the existing storages’ (Morgan, 1947). It was difficult to see how farmers on the Tragowel Plains could reclaim more than a quarter of their land (Garland, 1952). Yet increased water supplies raised watertables and caused more salting.

The gospel of efficient irrigation

With all these contradictions, Tragowel farmers were slow to respond with effective land layout. Advisers complained that it was the exception to find a farm with good layout. Tragowel farmers had developed a reputation for conservatism, for ‘sticking to poor layout’, ‘eschewing
perennial pasture for summer crops’ and being ‘sparing with superphosphate’ (Aird, 1944; Bartels, 1938; Bartels, 1931).

The prescription for efficient irrigation and perennial pasture did offer Tragowel farmers the opportunity to decrease waterlogging on their irrigated pastures and eliminate unproductive weeds like rush and sedges. Improved irrigation efficiency also offered the chance to reduce the amount of fresh water flowing into the local creeks and nourishing the cumbungi menace, thus easing the State Rivers and Water Supply Commission’s difficulties in distributing water across the plains and, in turn, increasing the area of pasture which farmers could sow (Morgan, 1931).

In 1940 the Pyramid Hill farm competition was supplemented by a water efficiency competition in which the prize was free water from the Water Commission. Harold Hanslow judged a number of the competitions. He advised:

*Continued watering in excess will spoil the land, and areas subjected to it will soon become artificial swamps. Rushes and yellow weed will replace the better vegetation. Excess water implies waste of water and aggravation of drainage troubles. All Pyramid farmers should fall into line and adopt the border system of layout for irrigation. (Hanslow, 1943, p 295)*

The response was less than overwhelming. During the war there were about ten entries a year in the farm competition (Aird, 1944; Hanslow, 1943). Superphosphate was rationed and labour was short. Tragowel farmers had a reputation for sparing use of superphosphate before the war and rationing during the war was based on pre-war use. After the war the number of competition entries dropped to three (Rayner, 1947).

The reluctance to accept the prescription lay in the unavoidable risks for Tragowel farmers. If a saline paddock was reclaimed by relayout there was a strong risk that the surrounding land would become more saline. On the experimental blocks Morgan had been forced to water the whole of the block to prevent differential seepage. On the plains where there was not enough water to water all of each of the farms; the closest alternative was to continue with annual pasture irrigation over the widest possible area. We have already seen that relayout of annual pasture was less financially attractive than relayout of perennial pasture. Harold Hanslow, an irrigation farmer himself, diagnosed the cause of the Tragowel Plains conservatism...
as due to the practicality of partial irrigation in the Pyramid Hill district. Inadequate water rights and the extended water distribution meant that supply at frequent intervals was impracticable (Hanslow, 1943).

The conservatism of the Tragowel farmers was in part an outcome of the decision of the early irrigation planners to share water widely in the interests of ‘social justice’. If the Plains had been transformed by closer settlement into more, smaller, concentrated settlements, it would have been easier to establish border check irrigation; but the cost was the social dislocation of remaining settlers without water who would have been forced off their ‘uneconomic’ farms.

Looking to relayout irrigation land on farms to reduce accessions to the watertable overlooked the huge problem of the leaking water delivery systems. During the Second World War concrete and iron were almost unobtainable. The Water Commission could not effectively maintain its already leaky supply structures. In the Torrumbarry system to the north only a quarter of the water which left the Torrumbarry Weir arrived on farms. The other three quarters either evaporated, leaked or seeped into the watertable before it reached the farms. The long supply system in the Tragowel area probably leaked at a similar rate. It is no coincidence that the worst salting developed first along the Macorna channel in the north of the district (Garland, 1952). The channel probably contributed its share of this leakage.

In 1950 Alan Morgan was still lamenting the prevalence of wild irrigation methods, wide and long bays, inadequate fertiliser applications and inefficient water use in the Kerang region (Morgan, 1950). Only twenty per cent of irrigable land was laid out to the recommended standards of the day. There was optimism that this would change (Morgan, 1947). Tragowel farmers were abandoning the old summer crops. Rising wool prices meant there would be more spare cash for farm investment. The rubber tyred tractor promised to revolutionise the business of paddock relayout from the rough and ready methods of horse drawn implements.

While the focus of agricultural advisers was on salt reclamation and relayout, the interest of the irrigation community was on increasing the water supply. Tragowel Plains farmers played their part in lobbying the government for both the enlargement of the Eildon Reservoir and the enlargement of the Waranga Mallee channel which brought the water to their district. The Government acceded on the first request, but not the second. The enlargement of Eildon Reservoir dramatically increased the amount of water available to Tragowel farmers, though they
still had insufficient water to irrigate all their land. The prospect of this extra water on the plains raised concern in a few quarters (Morgan, 1947). In 1952 one scientist estimated that twenty per cent of the land around Tragowel and Macorna was so salinised it grew no vegetation (Garland, 1952). A further ten per cent of land grew only poor medic and rye-grass. Perhaps up to half of the district was suffering salt damage. In the mid 1950s soil surveyors laboriously tramped over the plains taking soil and sub-soil samples. They found large areas of the plains soils lay over extremely salty sub-soils. They predicted any rise in the watertables would mobilise vast quantities of salt, bringing extensive salting to the surface (Skene, 1971).

The mobilisation of this salt was hurried by a cruel coincidence. The early 1950s were very wet years. On the Tragowel Plains the rains flooded the plains season after season. As watertables rose, the salt spread. The extra Eildon water arrived in time to further stress the watertable balance. By 1954 Alan Morgan appears to have become concerned at the sustainability of salinity reclamation work. In reporting ‘satisfactory’ reclamation in Tyntynder (north of the Tragowel Plains) he observed that there was no change in soil salinity below the top six inches and that the height of the watertable remained unchanged (Morgan and Garland, 1954). In a report to an inter-departmental meeting he was even more direct.

_The summer watered perennials appear to be the crops which grown under irrigation in modern conditions of layout, lead to waterlogging and high watertables as surely as the primitive layouts and methods associated with summer crops in the early days. The fact is that modern layouts and improved pastures merely delay the process._

(Morgan, 1954).

Despite these misgivings, Morgan and staff of the Department of Agriculture continued to promote the reclamation saline land (Morgan, 1956; Morgan and Garland, 1954). By the early 1960s the salt problems in the Kerang area prompted a new round of investigations. The Water Commission appointed an engineer, Alan Coad, to assess the area of salted land and find economic solutions to the problem. He mapped the area of salt and warned that large areas were at risk of imminent salting (Coad, 1963). Alan Coad worked with the local Shire to create a drainage trust to help control the spread of salt. The work of this trust building shallow drains continued for the next 30 years.
A little to the north of the Tragowel Plains two agricultural scientists took the work of the drainage trust a step further. They adapted a technique used by the Municipality of Kerang which had been forced to pump groundwater to control watertables on construction sites. The researchers irrigated the soil from above while pumping out the salty groundwater from below. The salty groundwater poured down the drain. The pumping was successful. Pastures grew on land which had not borne crops for 30 years. The scheme was successfully repeated on the Kerang Irrigation Research Farm. Today it is hard to believe that the lush pastures on the community farm were once saline, windswept land (Jones, 1962; Garland, 1961).

But the pumping solution was no solution at all. What was physically possible was neither responsible nor politically acceptable. The groundwater of the Tragowel Plains is extremely salty, sometimes saltier than sea water. The real problem was not the pumping but the disposal of this saline effluent. The salty groundwater from just these two experimental bores had little effect downstream. But if every farmer with a salty farm was to follow this example the repercussions would be felt all the way to Adelaide. The Murray River would become a saline drain. The pumping was stopped by the State Rivers and Water Supply Commission within a few years.

The extension of the Kerang East drainage system on the northern borders of the Tragowel Plains was also stopped because of concern at the downstream impact of salty groundwater. The deep drains which had snaked through the Kerang East district flowed salty throughout the summer. Extending the drains into the Tragowel Plains would have increased the salt flow. Only shallow drains which would not intersect the watertable would in future be allowed. The Tragowel Plains had an improved water supply, but was left with rising watertables, poor drainage and little hope for a solution. The few tree crops grown in the area vanished from land. The last peach trees around Pyramid Hill disappeared about 1960 (Coad, 1991).

**Learning to live with soil salinity**

There was not a lot that farmers in the north of the Tragowel Plains could do to reduce the salting on their properties. They had to learn to live with salinity. Tragowel farmers developed a strategy borne out of their experience of salinity. The first part of the strategy was to
be very conservative when investing in improving the farm. Old fences were repaired rather than being replaced with new ones; water reticulation was rarely upgraded. Fertilisers were used sparingly; and new equipment was purchased rarely (Nicholson and Heslop, 1990). There have been good reasons for following this conservative investment strategy. Salt affected land does not produce the profits of unaffected land and cannot support as many overhead costs. Farm debt levels need to be lower to forestall the cyclic downturns in commodity prices or the more recent experience of volatile and high interest rates. Investing in farm improvements on salt affected land has a greater than average risk of investment failure (Standen, 1996).

The second part of the strategy was to spread irrigation water over all the farm. Because there is insufficient water to irrigate all the land through summer, the majority of Tragowel Plains farmers irrigated most of their properties in the spring and in the autumn only. Financial analysis showed clearly that higher gross margins could be generated by concentrating water on only part of the farm thus maintaining a continuous perennial pasture (Ferguson et al., 1979) But concentrating water on perennial pasture requires investment in fertilisers and relayout, breaking the security strategy of not investing in development. There is also the risk that large parts of the farm will become more saline once that land does not have irrigation water flushing salt from the surface several times each season. This irrigation strategy received scientific blessing from some sections of the agricultural research community who argued for a shift from summer irrigation of perennial pastures to more widespread irrigation of annual pastures (Myers, 1974).

The third part of the strategy was to invest in extra land, particularly when commodity prices are low. History showed improved profitability was more likely to come from buying extra land rather than improving existing land. Not everyone was able to follow this strategy. A minority able to save cash for the right time built up very large undeveloped properties irrigating extensive annual pastures.

By the early 1980s the results of these strategies were easily visible. The Tragowel Plains did not look like a prosperous farming area. The deterioration of farm equipment and low investment levels was obvious. Fences, sheds and houses were often dilapidated. Farm productivity was obviously low. The farmers of the Tragowel Plains had regularly been exhorted to pull themselves up by their boot straps. In one study of cropping management in the Pyramid Hill Area agricultural extension officers concluded that ‘disappointing yields are a result of a
number of management inadequacies’ (Noble, 1981). In other studies extension officers observed that low rates of investment were a reaction to poor responses to previous investment (Standen, 1996).

It was even argued that the salting of the Tragowel area had in some ways shaped the nature of the community as a whole. Because of the reputation of land in this area, potential outside buyers were thought to be more often repelled than attracted to the area. It was argued there had been comparatively few outsiders buying into the area. Innovative farmers have often either left willingly or paid the ultimate price of innovation in a saline area—they have forfeited their farming investment. Sharman Stone, a sociologist with family roots in the area (and now the Federal parliamentary representative), was in a unique position to study the impact of salt on the Tragowel Plains community. She concluded that the local community had not maintained the skills and innovativeness of other local communities (Stone, 1977). It had not been able to protect, maintain or develop resources in competition with other towns. Boort, in the same Shire as the town of Pyramid Hill, provided a contrast to the Pyramid Hill and Tragowel Plains area. The farming land around Boort town was responsive to innovative farming practices. The soil is better, there is little salt. Farmers in Boort have produced Australian record sunflower crops. They have a history of quick adoption of new ideas and techniques on their farms (Ewers, 1988). Stone argued that this innovativeness spilt over into community activity. The people of Boort had at that stage done well in attracting facilities to their end of the Shire. Pyramid Hill at the other end was clearly lagging.

The gospel of laser levelling and land relayout

In the 1940s Morgan had developed a recipe for salinity reclamation in the Kerang area. This recipe included effective grading, shorter, narrow bays, permanent crops and pastures, top dressing and grazing management to maintain cover during periods of high evaporation (Morgan, 1947). Despite the inconclusive results and misgivings of Alan Morgan, the message of improved layout and correct grading as necessary to assist with salt reclamation was still being promoted in the 1960s (Jones, 1962). But this message held limited appeal in the Tragowel area. Having less water per area of land than the irrigation properties closer to Kerang, the typical Tragowel Plains farmer was unable to irrigate large areas surrounding land reclamation to
prevent salinity outbreaks surrounding reclamation work. Neither was the Tragowel Plains farmer interested in sowing perennial pastures.

By the 1970s much of the Tragowel Plains was either not layed out or remained under very poor layout. Drainage was often unreliable or even non-existent. The large number of irregular irrigation bays on most farms made irrigation a time consuming task. As property sizes increased with farm amalgamations, irrigation workload increased. The uneven slope of irrigation bays reduced production and inadequate drainage often meant the lower ends of paddocks were constantly under water.

New technology was to change the opportunities for relayout. The introduction of more powerful tractors in the 1970s allowed larger volumes of soil to be shifted. Where properties were regraded the irrigation bays were made much larger and there were fewer of them on a farm. Watering became a less arduous task. With fewer, longer bays it was easier to achieve an effective drainage system.

There still remained the problem of getting an even slope in the bay. The results of manual grading were not always reliable and farmers were reluctant to embark on a significant alteration to the existing topography. This difficulty was solved with the introduction of laser beam controlled landforming equipment in 1977 by a local earth moving consultant, Stan Archard (Ewers, 1988). The new technology allowed grading to be simply controlled to produce a very even slope. This technology provided the key to radical relayout of irrigation farms. A farm of many small bays could be transformed into a farm with a small number of wide and long bays with no cross slope. The labour efficiency of large bays could be captured without sacrificing irrigation effectiveness.

Laser grading is expensive. Land which is laser graded is taken out of production for at least a year. Despite this, the innovation was rapidly adopted. In the ten years after the first laser grading in the area in 1977, nearly 60 per cent of irrigation farmers on irrigation properties around Kerang laser graded some of their property (Ewers, 1988). A laser graded relayout of pastures greatly eased the burden of watering for irrigation farmers. Farmers also seemed to gain increased production from relayed out paddocks because of improved drainage. Dry high spots and waterlogged low spots in the paddock were eliminated. Irrigation was easier, so irrigation was often more timely.
The arrival of laser controlled graders heralded a new enthusiasm in the promotion of improved land relayout by extension workers and researchers (Dingle, 1984). At times this enthusiasm reached an almost evangelical fervour (Russ, 1995). There were clear and unequivocal benefits from laser guided relayout. The results of laser grading on the nearby Cohuna irrigation district were impressive. To the clear benefits of labour efficiency and improved productivity other benefits were soon ascribed. The belief in the role of laser relayout to aid salinity reclamation spread through the farming community. By 1982 sixty per cent of farmers in the irrigation areas of northern Victoria believed laser grading would prevent the encroachment of salinity. A third of farmers believed existing salt damage could be controlled by laser landforming and relayout (Barr, 1984). It is surprising to look back on such a pervasive belief and realise there was little scientific evidence to support it (Patto, 1988). The Victorian Government offered ‘salinity loans’ which were used by some Tragowel Plains farmers to finance investment in land relayout specifically for the purpose of salinity reclamation.

Government support for laser grading dovetailed neatly with another recommendation to Tragowel Plains farmers to grow more permanent pasture. In the 1960s additional irrigation water storages allowed the government to more than quadruple the amount of water allocated to the Tragowel Plains. The capacity of the Waranga Mallee supply channel which was to carry the water was not increased. This caused a problem for the Tragowel Plains farmers who watered mainly annual pastures, using most of their water allocation in the autumn. Each autumn the majority of Tragowel Plains farmers required large proportions of their water allocation within a short period when the delivery system could not cope with the demand. Water was rationed by allowing each farm a fixed proportion of the farm’s water right within a certain number of days. In dry autumns there was a long period between waterings of annual pasture which often begins to die between autumn waterings, resulting in lost production. The minority of farmers with large areas of perennial pasture did not suffer from this rationing. They used their water allocation gradually throughout the summer irrigation season. They grew a much smaller area of annually irrigated pasture, and when autumn came they needed a smaller proportion of their water right to maintain the pasture.

The drought of 1982-83 led to particularly severe water rationing on the Tragowel Plains. Despite the hopes of some that upgrading the channels could solve the rationing, the only economically justifiable solution lay in changing farming practices. The local agriculture and
water supply departmental authorities recommended irrigators increase the area of perennial pasture and decrease the area of annual pasture, thus lessening the impact of rationing. This became a formal campaign sponsored by the unimaginatively named Cultural Practices Review Committee (Cultural Practices Review Committee, 1986; Cultural Practices Review Committee, 1984).

In the years following this campaign, the area of perennial pasture actually increased only slightly. Few farmers believed that switching to perennial pasture would solve rationing problems. There was a fear that, if rationing still occurred, perennial pastures would be much more vulnerable. Changing to perennial pasture required major changes in farm enterprises and the use of laser grading. Perennial pasture required slopes steeper than the Tragowel Plains natural gradient. On many properties concentrating water on perennial pasture required radical laser landforming.

The genesis of the salinity management plan

In the first few years after its introduction, farmers on the Tragowel Plains were as enthusiastic about laser grading as farmers in neighbouring districts (Ewers, 1988). Government assistance was offered for laser relayout as part of a salinity reclamation objective. But the initial enthusiasm for laser relayout in a saline environment was soon replaced by caution. The results of relayout of some saline land appeared quite successful. On other land the agronomic results were disappointing. In the disappointing cases pasture regrowth after laser landforming of saline land was much slower than expected. Sometimes pasture did not re-establish at all. The salt-line did not often retreat down the paddock as expected; sometimes it advanced up the paddock once vegetative cover had been removed by the grader. For some these agronomic difficulties were compounded by historically high interest rates. Laser grading seemed a safe investment with a 12 per cent interest rate and with an assumed single year loss of production after landforming. The investment turned sour when interest rates rose to 22 per cent in the early years of financial deregulation and the unproductive period after laser landforming over high watertables stretched to two or three years (Sayer, 1986). Local investigation revealed widespread financial hardship (O'Farrell, 1986). A financial counsellor mediating between banks and financially pressed farmers passed a damning judgement on laser grading on the Tragowel Plains.
Reclamation of land within 1.2 metres of the watertable has become a rich man’s hobby and a poor man’s demise. The cost of various initiatives to alleviate the problem is usually considered too high. (Naughton, 1986)

The most vocal proponents of relayout could always point to successful examples of reclamation. They also noticed that many farmers relaying out land were not putting in the necessary inputs of gypsum, nitrogen and superphosphate. How could they expect the paddocks to recover as quickly as on the properties of those who applied these inputs? The disappointed investors pointed out that it made no sense continuing to apply superphosphate when there was no response. In a contemporary survey, conducted by the author, the Tragowel Plains farmers were found to have had very mixed success with laser landforming. Landforming had not been a burden for a minority who had few debts, but the majority who had recently undertaken laser grading were suffering acute financial stress (Barr, 1988). This study segmented Tragowel Plains businesses according to their experience of and attitude towards farm relayout. This segmentation showed that there was an interest in moving away from the traditional conservative investment strategy of the Tragowel Plains, but that the experiences of land relayout had dampened that initial enthusiasm.

The traditional Tragowel Plains management strategies were associated with two groups. The Land Purchasers had large properties, made little farm investment and had few debts. They made up less than 5 per cent of the population. The Low Input managers were the oldest farmers. They also had few farm debts, and were sceptical of investment in land relayout. Their survival strategy was to pull in the belt when times were bad and to save when times were good. Whilst having the lowest mean farm profit, these farmers also had the lowest stress levels. Between 10 and 15 per cent of farmers were members of this group.

Recent investors in land relayout were classified into two groups. The smallest, 5 per cent of the population, were called Successful Developers. They had relayed out a large proportion of their farms, but without going into significant debt. They had high farm profits. The larger investment group was those who had relayed out using debt finance. Twenty per cent of farmers were members of what was called the Developers at Risk group. This group had high gross farm incomes, yet had the second lowest profit of any of the segments. Only one quarter of the group made any profit. Personal stress levels were high.
The last two groups were those who were considering investing in land relayout. Thirty-three per cent of farmers were Discouraged Developers. Most of these farmers had whole farm plans and had considered relayout as a serious investment possibility. However they considered they could not justify the financial risk. The final group was the Intending Developers. These farmers believed their current farm layout and drainage were problematic. They intended to invest in farm relayout in the future. They believed they could manage the financial risk. Interestingly, the members of this group were in a similar financial position to that of the Discouraged Developers. However, unlike the Discouraged Developers, they mostly had no Whole Farm Plan and were comparatively new to the district. Twenty-five per cent of farmers were classified into this segment. It was argued that these farmers were less equipped by experience and planning to undertake an investment in land relayout than those who had rejected this option.

For most Tragowel Plains farmers land relayout had came to be seen as a risky proposition, a risk many with salt affected land were not able to afford. For a minority of farmers it had come to be seen as a threat to their farming future. By 1987 community leaders decided the development of a Salinity Management Plan for the Tragowel Plains was the best answer to these challenges (Wilkinson and Barr, 1996; Russ, 1995).

**Developing a salinity management plan**

On the weekend of May 31-June 1 1986, the Natural Resources Conservation League of Victoria convened a Salinity Update public forum in Kerang. Joan Kirner, then Minister for Conservation, Forests and Lands, spoke about the government’s salinity projects in the Kerang region and other parts of Victoria. Some Tragowel Plains farmers who had experienced failed land layout projects attended.

There was conflict at the forum as to the value of laser grading. Don Naunton, a local farm consultant with a wide knowledge of the Tragowel Plains, was one speaker. He said many farm development projects on areas with high water tables ‘have not generated sufficient income to come anywhere near servicing the commitments on the salinity loan, even under the concessional terms available’ (Branson, 1992). The Tragowel Plains area was not included among
government salinity projects. A motion was moved to support the establishment of a Land Protection Group on the Tragowel Plains. The resolution was passed.

Some weeks later a second public meeting was held on the Tragowel Plains. This meeting resolved ‘that an interim Tragowel Plains Land Protection Group be formed with the following objectives:

- To alleviate salinity related hardship in the Tragowel Plains.
- To identify salinity control strategies.
- To have these strategies implemented’ (O'Farrell, 1986).

These group objectives were submitted to a Cabinet Task Force on 4 August 1986. The Cabinet Task Force accepted the sub-committee’s proposals and agreed that Department of Agriculture should establish and convene a Tragowel Plains Sub Regional Working Group with wide community representation. The role of the Working Group was to:

- identify salinity related issues requiring resolution.
- liaise with and involve the local community.
- produce a sub-regional management plan supported by the community for submission to the Cabinet Task Force.

The Department of Agriculture was also instructed to report to the Cabinet Task Force on salinity related hardship in the Tragowel Plains area. Money was also allocated to employ a person to organise and assist community involvement in the development of the management plan.

The Tragowel Plains Plan group was to be part of the State Government’s ‘Salinity Program’. Community participation in the program was based around the work of community based regional or catchment working groups. In various irrigation and drainage districts and river catchments around Victoria small community working groups composed of community representatives were brought together to develop salinity management plans. There were no definitive guidelines about the composition and formation of working groups or the size of a
planning area. Salinity control sub regions were to be ‘areas in which salinity problems have a common cause, effect or downstream consequence and within which planned salinity control measures are likely to be effective’ (Government of Victoria, 1988). Membership was often dominated by farmers, but often also included representatives of broader interests: local shires, local environmentalists, urban water users and representatives of government departments.

The task of each of these groups was to develop a salinity management plan for presentation to government. This plan was expected to have the support of the catchment community. It was obviously unrealistic to expect the community working groups to achieve this unaided. The Government provided the groups with technical support groups composed of government scientists, planners and policy advisers. In theory these groups had no power to make decisions about the content of salinity plans, they were merely to advise the community working group. Again, there were no definitive guidelines on membership of these groups. Membership was predominantly drawn from four government departments and instrumentalities: the Rural Water Commission, Department of Agriculture, Department of Conservation and Environment and the Department of Water Resources. The major skills represented were those of water engineers, agricultural scientists, hydro-geologists, environmental scientists, economists and in some cases, social scientists.

The Government’s invitation for the community to be involved in salinity planning was not an invitation without constraints. In 1988 the Government released planning guidelines for the working groups (Government of Victoria, 1988). These guidelines set out a format for salinity plans to follow. The guidelines required planners to evaluate proposals from economic, environmental and social perspectives.

Two of the most crucial aspects of the guidelines were those relating to ‘cost sharing’ and to ‘community support’. Government expected salinity plans would involve local and regional communities taking responsibility for their problems and would have community support. The cost sharing guidelines were based upon the ‘beneficiary pays’ principle, and to a lesser extent the ‘polluter pays’ principle (Government of Victoria, 1988).
‘While the State has an important role to play in providing resource for salinity control, regional and local communities must be prepared to help themselves . . .. Contributions by communities at local and regional levels should reflect both the extent to which these communities derive benefit from salinity control and the relative inputs of local farming, water management and disposal systems to the worsening of the salinity problem (Government of Victoria, 1988. p.2).

Those who were to benefit from the salinity control work would pay the cost of the necessary investments. This was a major departure from the long established precedent of farmers paying the operation and maintenance costs and government paying capital costs of irrigation infrastructure investment. The interaction between these two major guidelines was to prove a crucial feature of the new participative planning process.

Community working groups were given deadlines within which to present their plans to the government. On presentation the plans would be assessed by government according to whether the plan was compatible with guidelines, technically feasible, supported by wider public comment and compatible with the salt disposal guidelines of the Murray Darling Basin Ministerial Council’s Salinity and Drainage Strategy (1987).

The new rules for cost sharing were balanced against a new commitment to community involvement in planning for salinity control. This latter commitment was promoted under the title Salt Action: Joint Action. Salt Action: Joint Action was written on the basic assumption that community participation in salinity management is essential to achieving a successful solution to the problem. Salt Action: Joint Action was based on local “ownership” of problems and local involvement in developing management strategies. Government and planners hoped the new process would “take the heat” out of catchment salinity planning. The community now had responsibility for difficult local decisions. No unwanted solutions would be imposed upon the community. There was also hope that community involvement would stimulate community “ownership” of salinity problems and lead to increased adoption of farming methods which prevented further increases in salinity.
With a history of constant agitation for drainage and the problems of the farmers who had redeveloped their farms, there were several people in the Tragowel Plains eager to become involved with the new Working Group. The farming areas within the sub region were all well represented. The group consisted almost entirely of farmers, with a reasonable balance of dairy farmers and graziers. Local government was also represented.

On 30 October 1986 the first meeting of the Working Group was held in Pyramid Hill. The Working Group met in 44 meetings over the following four years. The first 13 meetings were occupied by initial formalities and a series of seminars presented by technical advisers from government departments on technical aspects of salinity on the Tragowel Plains. Seven seminars were held in the Pyramid Hill Hall. The Working Group tried to hold the seminars every two to four weeks, meeting after each seminar to discuss the material presented in the previous seminar. The seminars were presented by local and Melbourne departmental officers. A range of topics was covered, including regional ground water flows, surface drainage, farm productivity improvement and social issues (O'Farrell, 1987).

Between meetings 15 and 27 the Working Group received eleven formal reports from members of the technical support group and from consultants. These reports covered the following topics in order: social impact of salinity, soil salinity surveys, hydrogeology, subsurface drainage, environmental conditions, stream management, surface drainage, flood management, farm situation, water supply and salt loads and drainage. These reports provided a comprehensive coverage of the complex suite of interrelating processes behind the salinity problem (Wilkinson and Barr, 1993).

After receiving eleven reports at the rate of almost one per meeting, the next task was to integrate these into a coherent set of recommendations to form the basis for a plan. What followed was essentially a process of exploration and negotiation within and between the planning support group and the community Working Group. As a first step, the Working Group again considered all the recommendations of the reports it had received. Only those recommendations which were accepted by the Working Group would be used in the final plan. The Working Group then considered each of the recommendations made by the planning support
group, consultants and members of the community Working Group. The outcome was the skeleton of a coherent plan.

**New technology gives a new perspective**

Producing a salinity management plan for the Tragowel Plains was initially believed to be a difficult task. The Tragowel Plains is arguably the most salt affected farming area in Victoria. It had few options for salinity control. There were no obvious methods of recovering salted land. The community itself had a reputation for conservatism in their approach to new agricultural technologies. The prevailing expectation of the supporting research and extension officers was a re-statement of the earlier departmental recommendation to concentrate irrigation water on perennial pasture. New technology allowed a refinement of this recommendation which previously had been received with some deserved ambivalence by Tragowel Plains farmers. The recently introduced EM-38 meters enabled cheap mapping of salt levels on properties based upon electromagnetic flux measurement. More precise local measurement of soil salinity provided a new way to look at farms on the Tragowel Plains. The EM-38 meter was used to make a comparison between the extent of soil salting on farms and farm productivity on a small sample of 28 farms (Norman *et al.*, 1988).

The extent of salt damage revealed was greater than many had anticipated. The existence of a small farm ‘problem’ on the Plains was clear from the available land and water ownership records. These showed that a significant number of farms lacked sufficient water to be classified as financially viable. The EM-38 results placed a new twist upon this observation. For a number of the surveyed farms, the limiting factor to improved production appeared to be not shortage of water, as had previously been assumed, but a shortage of non-salinised land. Extrapolating the survey results suggested that in the north there appeared to be many farms with too little water or too little non-salinised land. These farms lacked the resources to offer any prospect of long term viability under current patterns of agriculture. A number of farmers on these farms appeared to be watering large areas of land from which they could hope to make little income (Naunton and Rendell, 1988).
The use of the EM-38 meter also appeared to demonstrate the inability of both the sample of farmers and also advisers to perceive accurately the extent of salting in a paddock by visual examination (Norman et al., 1988). Land which had not been fertilised in many years looked remarkably similar to land with moderate salinity, both being covered by rushes and unproductive grasses and growing no clover. This explained why some people claimed success at reclaiming salt land and others claimed reclamation was financially untenable. Laser grading and fertilising the non-salinised and unfertilised land produced quick results. This was claimed as successful reclamation. The same treatment of ground of similar appearance, but with moderate soil salinity levels, was less successful. By the time the salted land responded, the debt and interest to be paid made the investment problematic. The EM-38 meter provided a cheap method of identifying appropriate land for development, land inappropriate for reclamation and farms which were unviable due to a combination of soil salinity and farm size.

The integration of these two research results provided the foundation on which the Tragowel Plains Salinity Working Group developed its Salinity Plan. The focus of the plan was to learn to live with salinity. It accepted that for the Tragowel Plains to survive as an irrigation district, its farmers needed to improve their productivity. To do so they needed to gain a greater financial return on their irrigation water by applying it to non-saline soils. Further, they needed to improve productivity on non-saline soils by improving irrigation management and drainage. The benefits of these activities could be increased by facilitating structural adjustment to reduce the number of small holdings with insufficient water or low salinity land. It was assumed that the major limitation to each of these practices being adopted was the inability to identify saline soils from which irrigation water should be removed and non-saline soils which would justify investment in improved farm layout (Tragowel Plains Salinity Working Group, 1988).

However, this simple farm management prescription was for some members of the Working Group quite a radical proposal. For decades the community had been educated in the merits of salinity reclamation. This new proposal was essentially advocating the abandonment of saline land. Discussion of this proposal was to dominate two meetings of the Working Group. There was concern that the abandonment of saline land would allow that land to further degenerate with the withdrawal of irrigation, leading to the expansion of unsightly salinity
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wastelands across the plains. This concern was eventually resolved by the inclusion of a low cost salinity reclamation strategy based upon the sowing of halophytes rather than clovers. Such a strategy no longer held the promise of productivity inherent in earlier visions of reclamation, but was aimed solely at limiting the visual and aesthetic losses associated with abandonment (Barr and Cary, 1992; Tragowel Plains Salinity Working Group, 1988). At a later stage this aim was gradually amended as methods were sought to gain advantage from the existence of halophyte species which may provide strategic grazing opportunities.

The components of the plan

The Tragowel Plains Salinity Plan proposed a stepwise series of management decisions for farmers to undertake for both saline land and non-saline land. The key to these choices was the undertaking of a soil salinity survey of the farm using the EM-38 meter. This service was provided under the plan in a manner which ensured there were no out of pocket expenses for participating farmers (Norman and Stevens, 1995). Land was classified in this survey into four classes. Class A was non-salinised land capable of growing white clover. Class B land was land with moderate salinity which was capable of growing rye grass and sub-clover, the components of a conventional annual pasture. B class soils were estimated to reduce annual pasture productivity to between 90 and 70 per cent of potential (Norman et al., 1988). C and D class land were high salinity classifications unsuitable for conventional agriculture.

For land identified as saline (class C and D), a series of new management steps were advocated:

- Cessation of irrigation with water being reallocated to other higher value uses.
- Control grazing by fencing off. This was supported by government grants to share the cost of fencing. This grant was only available to farms which had been surveyed for salinity.
- Sowing halophytes. The main halophyte recommended was tall wheat grass. The plan provided for a grant to cover part of the cost of seed. This grant was only available to farms which had been surveyed for salinity.
For land identified as A and B class land there was a different set of recommended practices. It was envisaged that the removal of uncertainty over land status would remove a major disincentive to land redevelopment.

- This land would be available for greater applications of water transferred from C and D class land. Any significant increase in the intensity of irrigation on this land would require improved layout and possibly a change to perennial pastures.

- Any future development such as land relayout would be on this land, based upon a whole farm plan. This plan would ensure co-ordinated drainage in the catchment. The plan provided for a subsidy to share the cost of a whole farm plan, but this subsidy would only be available for land which had been surveyed for salinity.

The final component of the plan was a modest restructuring package. Inclusion of a structural adjustment component in a community Salinity Plan was a brave step by the Community Working Group. Such proposals were firmly resisted in other salinity management plans (Tragowel Plains Salinity Plan Implementation Group, 1996). The Tragowel Plains proposal was essentially a strategic step to influence inevitable adjustment in a direction most favourable to the existing community. A survey of the financial performance of Tragowel Plains farms undertaken for the group estimated that fewer than 10 per cent of mixed farms in the district could be considered viable in the long term (ACIL Australia Pty. Ltd. 1988). This pessimistic assessment was an outcome of high salinity levels, poor returns but most importantly, large numbers of small mixed farms.

One vision of the adjustment that might occur caused great concern to the group—that ultimately much of the district’s irrigation water would leave the region through transfer of water entitlement as the imminent deregulation of the water industry was implemented. The community group believed that their community would benefit far more from adjustment, which shifted irrigation water from saline to non-saline soils within the Tragowel Plains. To achieve this they needed to encourage the amalgamation of Tragowel Plains properties. Here the consultant report offered a further cause for caution. It argued that the only successful strategy for businesses in the past decade had been to invest cash surpluses from above average years in
the purchase of additional land rather than invest in irrigation improvement on existing land (ACIL Australia Pty.Ltd. 1988). This was the historically successful strategy for farm management. A major reason hypothesised for the success of this strategy was the inability to control the salinity risk associated with irrigation development due to the inability to correctly identify saline land. The group realised that this latter strategy was unlikely to remain effective in the new water policy environment to which the irrigation industries would soon be moving. Returns to mixed farming, particularly grazing enterprises, were unlikely to be sufficient to ensure the continued success of the strategy of land purchase with minimal improvement.

Thus the Tragowel Plains Salinity Working Group had two potentially competing objectives… to increase the likelihood of farm amalgamation to increase the number of viable sized units on the Tragowel Plains, and to increase the incidence of farm investment in water management as a component of farm improvement. Two tools were proposed to increase the likelihood of farm amalgamation which it was hoped would not unduly favour the continuation of the low-input expansion business strategy. The major tool to achieve this objective was the provision of specific property soil salinity information to farm managers. The provision of the EM-38 survey was to be the catalyst to activate these changes by initiating a number of matters for decision (outlined in the following decision tree diagram).
Will water be released from saline land?

Yes

Is there suitable A and B class land to absorb released water?

No

Yes

Are there opportunities for intensification?

Yes

Can I fund the relayout?

No change

No

Will I remain viable if I sell water?

Can I fund the purchase of land?

Can I fund relayout to intensify irrigation?

No

For those farmers who were able to identify water to be removed from use on saline land, the immediate question they needed to ask was whether there was sufficient low salinity land on their existing farm to allow water reallocation under their existing irrigation culture. For those who found the answer to this question was ‘No’, three potential management options needed to be considered: water sale, land purchase, or relayout and irrigation intensification. Any decision to sell water would necessarily lead to a consideration of how such a sale would affect business viability. Any decision to purchase land or invest in relayout would need to be based on an assessment of the business’s viability and capacity to fund further investment. Where none of these options were compatible with the continued viability of the farm business, it was assumed the inevitable result would be a greater likelihood of exiting farming.

For those farmers who had no saline land, or had sufficient saline land to allow internal reallocation of water released from retired land, the clear identification of soil salinity status allowed the consideration of opportunities for irrigation relayout and intensification without the risk of salinity retarding recovery from relayout. The Tragowel Plains community group clearly envisaged farmers on these properties as the preferred purchasers of water or land sold from
properties with insufficient A and B class soils to utilise their water allocation. Where water was sold together with land, the group proposed a mechanism to favour purchasers on the Tragowel Plains over new entrants and external purchasers intending to later separate and export the water to other irrigation districts. The mechanism was the provision of a stamp duty rebate which was available to existing businesses which purchased additional land. This rebate was only available where additional irrigation would be on A and B class soils and would be within specified intensity limits. Arguments for this proposal were based on the desire to slow the perceived trend of expansion of large low-input farms and to encourage build-up of mid-range farms from the existing large number of small farms, and to protect the irrigation district from ‘cannibalisation’ by neighbouring irrigation districts.

A more subtle impact on structural adjustment was expected from the provision of detailed soil resource information which would ultimately influence the land market. It has been observed in other research into salinity control that the land market does not always reflect the salinity status of farm properties (Wilson, 1995; Bartels, 1932). Widespread adoption of EM-38 surveys would create a unique situation where a potential purchaser would be able to expect a vendor to supply accurate information of the resource status of a property. This unique situation was expected to lead to a better informed land market which would see land values settle at levels which would more accurately reflect the potential of the soil. In effect it was hoped this would act as an unofficial ‘pink slip’ policy proposed by other groups in the Murray-Darling Basin to ensure that land degradation is taken account in the purchase decisions of new entrants (Thomas, 1997). This would reduce the risk of uninformed bidding, particularly by new entrants to the land market.

The members of the Tragowel Plains Salinity Management Working Group had, in agreeing on their plan, agreed on a vision of the Tragowel Plains farming community they would prefer to see in the coming decade. The community wealth still was produced predominantly through irrigated agriculture. There were fewer agricultural establishments, but these were larger and more profitable. Irrigation water was applied to low salinity soils with appropriately developed water delivery structures. Saline land was managed to control off-site impacts. Most
importantly, there were sufficient financially viable farm businesses to ensure the continued maintenance of the district irrigation infrastructure.

Community reaction to the Salinity Plan

With the completion of a draft plan, the Working Group decided to manage an intensive formal consultation to clearly show the government that the community had been consulted. The chosen method of consultation was through LAAGs (Local Action and Advisory Groups). There were some public meetings, but these were mostly for information and to launch the LAAGs. The area was divided into 51 LAAGs. On average a LAAG contained 10 landholders. A landholder leader was appointed for each LAAG, with responsibility for calling a meeting of the group, explaining the plan and collating the group’s comments.

The LAAG leaders were invited to the launch of the draft plan in the Pyramid Hill Hall in August 1989. Almost all attended. After the launch the project team leader explained their role to the LAAG leaders. Two information sessions over four hours were then held to explain the plan to the LAAG leaders. At these meetings the LAAG leaders were given copies of the consultation booklet to distribute personally to the members of their LAAG before the meeting. They were also given copies of a special LAAG response sheet to fill in and return to the Working Group. To ensure the plan was explained adequately in the LAAG meetings, a Working Group member attended each meeting. Each Working Group member attended between two and six LAAG meetings. LAAG meetings were held in local homes, community halls, fire sheds, church halls, on banks of creeks and in sporting clubrooms throughout the region.

Every farmer was supposed to be invited to a LAAG meeting. According to the Working Group, 69 percent of resident landholders attended a LAAG meeting, 93 percent of resident landholders contributed comments, 43 percent of non-resident landholders commented and, overall, 75 percent of all landholders contributed comment. A survey conducted to evaluate the consultation process found 90 per cent of the local community were aware of the Salinity Plan. Although respondents expressed some concerns about the plan, there were no widely held
concerns. This indicated that there was strong acceptance of the plan. Recognition of good aspects in the plan was much stronger than concern about poor aspects (Wilkinson and Barr, 1993). After four years’ work the members had created a plan which had the enthusiastic support of most local farmers and the government. The reasons for this support were easy to determine. The plan addressed a salient issue. Salinity in the Tragowel Plains was a serious problem for landholders, not an incipient or possible future problem as in many other catchment planning processes across the basin. Second, the plan advocated voluntary solutions rather than compulsory infrastructure options. Third, it proposed government support for the adoption of best management practices (Wilkinson and Barr, 1991b).

The combined arguments of salinity related hardship, strong community support for a proposed Salinity Plan and the inclusion in the plan of strong technical data and an attempt to deal with restructuring were sufficient to win support for the plan from both the State and, eventually, the Murray Darling Basin Commission (Government of Victoria, 1990; Murray Darling Basin Ministerial Council, 1989). In 1990 the plan commenced operation with funding for all the proposed initiatives promised for a five year period, together with funds for a core team of extension support and the purchase of a property to act as a demonstration farm to develop and show-case the management strategies of the plan (Nicholson, 1988).
The changing commodity, policy and institutional environments

The Tragowel Plains Salinity Management Plan was a tool to change the way in which farmers managed their saline land, their irrigation water and their low salinity land in a manner to benefit both themselves and the wider community. Whilst the salinity planning and implementation process was occurring, other external factors were shaping the destiny of the Tragowel Plains. The impact of these exogenous influences on the behaviour of Tragowel Plains farmers was likely to be far greater than the Salinity Plan.

Agricultural commodity prices

One of these factors was the ever present pressure on agricultural terms of trade. Despite recent theories which have been used to propose the present pressure on agriculture as a crisis borne of a radical restructuring of the global food economy (Gray et al., 1996; Musgrave, 1990; Friedmann and McMichael, 1989; Martin, 1989), the historical evidence is that terms of trade pressures are far from new. Australia’s rural sector has faced these pressures from its first days, an inevitable outcome of exporting produce into a global market. The general trend of downwards terms of trade is to a degree masked by international price fluctuations caused by seasonal and political factors. During the late 1980s and early 1990s the prices of the four major commodities of the Tragowel Plains, prime lambs, milk, wool and wheat followed different, but mostly volatile paths.

The most stable commodity prices for the region were received by dairy farmers (Figure 3). Over the decade of the 1980s there was an upward trend in dairy farm incomes due to increasing productivity and stable and favourable dairy prices (Martin, 1995a).

During the years of 1987 and 1995 when the field work for this study was conducted, the official outlook for milk prices was positive with real increases in prices expected (Gleeson and Abdalla, 1995). This generally positive outlook for the dairy industry was reflected in
the position of Tragowel Plains dairy farms. In 1993-94 a special ABARE survey estimated that the average profit for dairy farms in the Kerang region was $25,000 (after accounting for imputed operator labour), and that 72 per cent of dairy farms made a profit (Tran and Scoccimarro, 1995).

The decade of the 1980s was characterised by stable nominal prices for sheep meat, ensuring a steady decline in terms of trade for these producers, such that by the turn of the decade sheep meat producers were experiencing significant financial pressure. Lamb producers experienced a prolonged period when prime lamb prices were lower than the cost of production as estimated by local extension officers. But by 1995 prime lambs were fetching record prices in local saleyards (Wright, 1997). During the period of the study economic forecasts predicted a small rise in the price of sheep meats in the short term, but a long term outlook of falling prices (Gray and Walshaw, 1997).

The wool market has undergone a prolonged downturn through the period of implementation of the Tragowel Plains Salinity Management Plan. Wool prices reached a high point in 1987-88, while the plan was being developed. The consequent oversupply, followed by the removal of the Reserve Price Scheme, ushered in a prolonged period of low

![Indexed real prices received for milk, sheep meat, wheat and wool 1975-95 (Wright, 1997)](image-url)
wool prices. At the time of implementation of the field work for this study in 1995, the longer term outlook was for further modest rises in wool prices (Goesch et al., 1997). Despite this optimism on prices, the Australian Bureau of Agricultural and Resource Economics concluded in 1995 that farm cash incomes for sheep properties in eastern States remained at historically low levels, reflecting low levels of productivity improvement in the industry (Anon, 1996; Costin and Martin, 1995). Subsequent to the study, wool prices have fallen further.

Wheat prices have been perhaps the most volatile of the major Tragowel Plains commodities. Low prices in 1986, 1991 and 1994, while there were relatively high prices in 1989, 1993 and 1995-96 (Martin, 1995b).

The policy shift towards internationalisation of the Australian economy had a major impact on the terms of trade of some Tragowel Plains farmers during the 1980s—those with significant levels of debt (Anon, 1997). The deregulation of the financial sector in the 1980s resulted in an increase in interest rates to levels with no recent historic precedent. The rise was initially an outcome of government policy to maintain high interest rate levels to attract foreign capital (Lawrence, 1987). High rates were later continued as banks sought to maintain high margins to off-set bad debts accumulated during the recession which inevitably followed upon the peak in interest rates.

The combined effect of this price and cost volatility on mixed farms has been profoundly less positive than the experience of dairy farmers. Tragowel Plains mixed farms produce a mix of prime lamb, wool and cereal crops. In the period 1988-92 Department of Agriculture economists estimated that mixed farmers experienced a 40 per cent fall in their gross margin per megalitre of water (Branson, 1992). Two years later in 1993-94 the Australian Bureau of Agricultural and Resource Economics surveyed mixed irrigation farmers across the Kerang region. Despite a significant rise in prime lamb prices they found that the average farm business profit amongst these farms was -$16,800, and that only 32 per cent of mixed farms made a profit in that year (Tran and Scoccimarro, 1995).

This low profitability was due not just to commodity prices, but to the structure of Tragowell Plains farms. The generally observed industry reaction to continued historic pressure on terms of trade on farm businesses has been to increase the scale of farm
businesses as smaller farms adjust out of agriculture. Recent evidence suggests that this adjustment has not been as obvious in extensive grazing industries as in dairying, cropping and horticulture (Longmire, 1995). The structure of the mixed farm sector of the Tragowel Plains was typical of the general Australian trends. Loddon Valley mixed irrigation farms were smaller and less profitable than their NSW irrigated mixed farming counterparts (Tran and Scocimarro, 1995; Barr, 1992).

**Urbanisation and the decline rural influence**

The decades of the 1980s and 1990s have seen the provision of rural services by major commercial interests such as banks and pastoral houses gradually scaled down and centralised in regional centres, leading to a decline in the availability of private sector employment in smaller rural towns (O'Toole, 1993; Bureau of Industry Economics, 1983). Governments have followed the same trend in their service provision with a rejection of past policies of decentralisation of rural services towards a centralisation of services in regional centres as hospitals, schools and government service centres have been progressively closed (Shiel, 1997; Tonts, 1996; Jones and Tonts, 1993; Rolley and Humphries, 1993; Smith, 1993; Henshall Hansen Associates, 1988). At the same time there has been a gradual and bipartisan support for a shift in government policy away from industry support towards promotion of self-reliance for agriculture (Anderson, Minister for Primary Industries and Energy, 1997; McColl et al., 1997; Prime Minister’s land management Task Force, 1995; Drought Policy Review Task Force, 1990).

There are a number of ways of interpreting this shift in government policy. It could be interpreted as a strategy to comply with a free trade regime for agriculture which will enhance the ability of Australia to promote similar policies through the GATT agreements, thus improving market access for our primary produce exporters. An alternative view is that agricultural policy re-structure is designed to better meet the need of the corporate sector rather than the family farm sector (Gray et al., 1996). A third view is that this is a world wide trend in developed countries, reflecting the loss of competitiveness of the small farm sector and the declining political importance of rural constituency in nation politics (Cary, 1998; Vernon et al., 1997; Gebremedhin and Christy, 1996; Hinson, 1996). The significance of farming in the Australian economy has declined markedly over a period of
forty years (Kennedy, 1972; Davidson, 1968). The agricultural contribution to GDP has fallen from 18 per cent to less than 3 per cent. Contribution to exports has fallen from 75 per cent to 20 per cent in the same period (Barr and Brown., 1996).

In Victoria this change in policy has been manifest in a reduction in support for extension services and research support (Cary, 1998). This trend has been somewhat ameliorated by increased support for rural environmental programs, programs which are more in tune with the interests of a predominantly urban electorate. It was this aspect which provided impetus for Labor government support for the Victorian Salinity Program (Russ, 1995), a move which could have been seen as a policy Trojan Horse by rural interests to maintain industry support (Barr, 1994). Other manifestations have been the deregulation of the water industry, to be discussed in the next section, deregulation of statutory marketing arrangements, winding back of drought support mechanisms and the recently announced abolition of the Rural Adjustment Scheme and its replacement with a less expensive new program. The fall from policy grace of the statutory marketing authorities has been swift. In the early 1980s the authorities were seen as struggling to meet conflicting, but legitimate responsibilities to government and growers (Australian Government, 1986). By the late 1980s statutory marketing authorities were seen by the Federal Government as inefficient and an impediment to market reform (Prime Minister’s Science Council, 1991; Department of Primary Industries and Energy, 1989). The process of their decommissioning has been under way ever since. The removal of the Reserve Price Scheme for wool was seen as inevitable by economists, but it was a significant symbolic loss for many wool producers. The identification of the environmental disbenefits of drought support arrangements in the 1980s likewise has ensured the gradual winding back of this program over the last decade (Gray et al., 1997; Drought Policy Review Task Force, 1990).

The impact on the Tragowel Plains of some of these changes has been mixed. Some measures such as the winding back of drought support measures, have had little impact. Other impacts, such as the loss of non-farm job opportunities with the regionalisation of businesses and government bodies, has been obvious. And some impacts have been more subtle. The deregulation of statutory marketing authorities is an example of the latter influence. There has been an increased complexity of skills required for marketing
traditional bulk products as the powers of Statutory Marketing Authorities have been wound back. For lamb producers the increasing complexity of marketing requirements can be seen in the move away from bulk commodity products to niche market production to meet the demands of prime lamb production according to carcass targets. There is some speculation that the increasing complexity of production and marketing requirements is leading to a polarisation between those who are skilled in this new environment and those who are unable to compete in the new environment (Barratt, 1997; Lawrence and Vanclay, 1992a).

By far the greatest impact of the increasingly urban-driven public policy upon the primary producers of the Tragowel Plains was the reshaping of the water supply industry regulatory structure.

**Water industry reform**

The development of Victorian irrigation industries between 1890 and 1970 was driven by the social objective of closer settlement of the countryside. The motivations for this objective varied between social justice for selectors or returned soldiers, incentives for army recruitment or xenophobia over the insecurity of the white races in proximity to Asia (Barr and Cary, 1992). Initial hopes that irrigators would be able to pay for the full cost of irrigation development were shown to be ill-founded and abandoned in favour a State-sponsored irrigation industry where irrigators bore a share of the financial burden of operation and maintenance and the State bore the remaining cost, including all major capital works. Irrigation was essentially a State sponsored industry (Barr and Cary, 1992).

As additional storages were added to the supply system by successive governments, the allocation of additional water was guided by formulae constructed to maintain equity within each irrigation district. The construction of the ‘Big Eildon’ project in 1955 was the most significant storage augmentation for the Tragowel Plains region. The new water made available by this dam was allocated according to a formula based upon property size. The water right and sales tariff structure and the permanent linking of water to land remained the core structure of this allocation system (Dovers, 1992).

Changes in social perceptions of the value of natural environments, of the need for closer settlement and the maturing of the water economy were all factors which led to the
eventual question of the financial relationship between irrigators and the State. A turning point in the urban elite’s’ perception of irrigation was the publication of Bruce Davidson’s work ‘Australia Wet or Dry’ in 1969. In this book Davidson exposed the myth of benefits of further irrigation development which had underlain the building of the Ord River Scheme.

Discussion of the limits to the resource available from the Murray increased as the basin supplies were gradually exploited towards full capacity. The building of further reservoirs became increasingly less attractive. Additional schemes to augment supply such as cloud seeding and conversion of forested catchment areas to grasslands were even canvassed, though with some scepticism. The observation that when ‘irrigation enterprise is not profitable in a water demanding area, it would be reasonable to suggest the deployment of water to more economical areas’ (Holmes, 1974) was a problem to which the basin managers had no solution under their existing legal and administrative framework. The solution was obvious to the economics profession. ‘When engineers and administrators talk about the system being overtaxed or in a state where demand exceeds supply, the economist tends to shrug his shoulders’ (Paterson, 1974).

**Transferable water entitlements**

The development of public irrigation schemes in Victoria had been based upon the establishment of a legal bond between irrigation entitlements and land. Early experience with irrigation development at the turn of the century taught the government a lesson on the foolishness of providing irrigation infrastructure to farmers who had no legal obligation to utilise that infrastructure. Water was used only to supplement pre-existing dry land farming patterns when these were threatened by years of low rainfall. Such a pattern of irrigation was unable to produce any return on the State’s investment. After 1901 all irrigation schemes were based upon the distribution of water rights. A fixed water right was attached to each land parcel in an irrigation area. Farmers were required to pay for the water right each season, irrespective of whether the water was consumed (Barr and Cary, 1992). This new policy was based upon objectives of both improved economic efficiency, and equity between producers. The compulsory payment provided a powerful incentive for the development of irrigation dependent farm cultures. The permanent linking of land and water
provided a guarantee against the accumulation of water by a few ‘boss-cocky’ farmers, and prevented infrastructure complications for the supply authority.

In Victoria the first policy recommendations to seriously question the historical relationship between irrigators and the Government appeared in two reports by a Parliamentary Committee. In its 1982 report the Public Bodies Review Committee recommended a breaking of the link between land title and water right to allow the transfer of water from low value to high value uses, an outcome promoted as a solution to the poor economic performance of many irrigation schemes (Rose, 1997). In the same year the Parliamentary Joint Select Committee on Salinity reported on the allocation of additional water in Northern Victoria which had been made available by the building of the Dartmouth Dam. This committee recommended the freezing of all permanent district allocations at their current levels. Instead the Committee recommended a review of the Water Act to allow the allocation of water to highest value uses by means of transferable entitlements and sales by the State. These recommendations ran counter to the policy of the previous 90 years which was based upon a system of equitable distribution between irrigators, but which paid little heed to the equitable treatment of taxpayers. It is important to note that the recommendations received bipartisan political support.

A limited form of temporary Transferable Water Rights was introduced to the Goulburn Murray Irrigation District (of which the Tragowel Plains is part) in 1987-88. Permanent transfers were made possible by the enactment of the 1989 Water Act and the introduction of a management framework for those transfers in the 1991-92 season. After a slow start, the rate of permanent transfer accelerated in the 1994-95 season, spurred on by drought and strong demand for water from the dairy industry (see Table 1).

It was clear from the introduction of transferable water entitlements that there was an expectation that water would be transferred from the Tragowel Plains region in significant quantities (Collins, 1992; Toohey, 1992). The supply limitations of the Waranga Mallee channel and the obvious low value obtained from annual pasture irrigation were the basis of this expectation. There was obviously concern that the extent of sales from the district would lead to management difficulties and a cap on annual permanent sales to users outside the plains was set at two per cent.
Table 1: Transfer of Water Entitlements in the Goulburn-Murray Irrigation District

<table>
<thead>
<tr>
<th>Season</th>
<th>Temporary Transfer</th>
<th>Permanent Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of trades</td>
<td>Volume (ML)</td>
</tr>
<tr>
<td>1989-90</td>
<td>430</td>
<td>21,927</td>
</tr>
<tr>
<td>1990-91</td>
<td>400</td>
<td>31,955</td>
</tr>
<tr>
<td>1991-92</td>
<td>406</td>
<td>32,148</td>
</tr>
<tr>
<td>1992-93</td>
<td>258</td>
<td>22,829</td>
</tr>
<tr>
<td>1993-94</td>
<td>375</td>
<td>29,961</td>
</tr>
<tr>
<td>1994-95</td>
<td>2,268</td>
<td>192,493</td>
</tr>
</tbody>
</table>

Source: Office of Water Sector Reform

Water pricing for full cost recovery

The new Labor government in Victoria acted quickly in the spirit of the recommendations of the Parliamentary Committees. It abolished the State Rivers and Water Supply Commission and formed two new bodies. One, the Rural Water Commission, was responsible for the delivery of rural water. The other, the Department of Water Resources, had responsibility for water policy. The clear aim of this new administrative arrangement was to separate the responsibility for policy advice from the responsibility for water delivery.

The new government broke a long established tradition in appointing an economist instead of an engineer as head of water policy. The economist, John Paterson, had introduced a user pays philosophy to the Hunter River Water Board, cutting water demand and delaying the need to commence building a controversial new storage. His charter was clear; Victorian irrigators would have to learn to live with irrigation charges based upon the user pays principle.

These policies were implemented in a five year plan for the Rural Water Commission. In this plan government contribution to headworks maintenance was reduced. Irrigators were to pay the full cost of the service. This full cost was deemed to include an annual depreciation charge based upon the modern cost of replacing the current water infrastructure rather than the historically incurred cost. This was quite a contentious method of calculation. This policy of current cost accounting lead to significantly greater
depreciation costs than historical cost accounting (Watson, 1995). Finally, the government imposed a requirement that all government assets earn a real four per cent rate of return for the government. This meant the cost of irrigation water was bound to increase considerably. The government announced that water charges would rise by two per cent in real terms every year until the new accounting objectives had been achieved.

These policies met with spirited opposition. Not only was the choice of current cost accounting opposed, but the combination of a fixed rate of return and the monopoly position of the water supply authority was perceived as an unfair imposition on irrigators. In response to this opposition, the government initiated a review of the management arrangements of the Rural Water Commission. In 1992 the McDonald Review recommended regionalisation of the Rural Water Commission, but supported the proposed rise in water charges (Gutteridge, Haskin and Davey, 1992).

Further support for full cost recovery in the water sector was to come from the Federal sphere. The Industry Commission’s 1992 report into Water Resources and Waste Water Disposal rejected the arguments of the National Farmers’ Federation that the wider flow-on benefits of irrigation should be included in the calculation of water prices. It firmly recommended the adoption of full cost recovery including a return on capital invested in water infrastructure. The Commission also recommended the introduction of competition into the water sector. It argued for the regionalisation of water authorities with a view to privatisation. No major refurbishment of assets should occur until a transfer of ownership was achieved. Many of these arguments were reinforced by reports from the newly formed Victorian Office of State Owned Enterprises (Office of State Owned Enterprises, 1992) and the Hilmer report on National Competition Policy. Hilmer recommended the extension of the Trade Practices Act to organisations such as water supply authorities.

These reports set the agenda for the 1994 meeting of the Council of Australian Governments. It resolved that its member governments set costs and charges to comply with the principle of full cost recovery by 2001, introduce transferable water entitlements between states as well as within states where consistent with supply capacity, and ensure any future investments in water infrastructure be the subject of rigorous economic and environmental appraisal (Council of Australian Governments, 1994).
Victoria was already implementing much of this COAG agenda. However, there were still two areas where the implications of these reforms were unclear. The first is the legal status of sales water and how this would be legally tradable in the future. The expectation of irrigators that they own a right to this water was by no means clear. At the time of writing, trading in sales water has been halted, and those who sell water right have had their own access to sales water limited. The second unclear issue is how National Competition Policy will be applied to the irrigation water suppliers.

In New South Wales the COAG agenda has been implemented with different criteria to those used in Victoria. Unlike Victoria, the State has assumed responsibility for some community obligations. The result will be lower than expected increases in water supply charges. This difference is a cause of some friction between the States, with Victoria claiming distortions in inter-state trade will result (Eigenraam et al., 1998).

Despite disagreements over the details of full cost recovery (Watson, 1995), both states are moving quickly to establish a framework for inter-state trade in water. In July 1997 a pilot project commenced which will allow the trade of water across the Murray by private diverters downstream of Swan Hill. There is an expectation that by the turn of the century this project will be extended to include water users in settlement districts in the Murrumbidgee Irrigation Area.

**Catchment reform in the Murray Darling Basin**

The Murray Darling is Australia’s largest river system. Together with its tributaries, this system drains about one seventh of the land area of Australia. The mouth of the Murray is the only outlet to the sea for the surface and underground drainage water from a vast area of agricultural land. Before European settlement the Murray and Darling flowed strongly after seasonal rain. During drought both rivers stopped flowing, leaving water in deep pools. When freshwater flows were low, the river became salty from the seepage of naturally saline groundwater. In his diary the explorer Sturt described the discovery of the lower reaches of the Darling River. His men rushed to the river to quench their thirst, only to find it too salty to drink (Sturt, 1883).
To meet the demands firstly of river navigation, and later for irrigation and urban water supplies, the river system has been progressively regulated. The river no longer flows as low or as salty as in previous droughts, or as often in flood. Today, eighty per cent of the water used for irrigation in Australia is applied to land in the catchment of the Murray (Peck et al., 1983). The river also forms the major water supply for many of the urban centres in its lower reaches. It provides about one third of the water used by the one million inhabitants of the city of Adelaide (Blackmore, 1989).

In the 1980s there was a very marked increase in community concern for the environment throughout Australia and the western world (Papadakis, 1998; Barr and Cary, 1994; Lothian, 1994; Dunlap, 1992; Roy Morgan, 1992; Macken, 1991). Rural environments and river catchments were a particular focus for this concern (Barr and Cary, 1994; Reeve and Black, 1993). The reason for that concern in South Australia is starkly evident. It has a water supply that, at times, approaches brackishness. In its upper reaches the tributaries of the Murray are fed by rainfall in the highlands and river salinity is low. The River’s salinity increases markedly in its middle reaches around Barham and Swan Hill, largely as a result of saline drainage associated with irrigated agriculture as well as salinity in dryland catchments. Between Mildura and Morgan, the salinity doubles as a result of natural inflows of saline ground water along this reach of the river. The river salinity at Morgan has been increasing by at least two per cent per year since 1970 (McKay et al., 1988; Cunningham, 1985). More ominously, because of time delays in the aquifer responses, even if the saline inflows from the irrigation areas could be held constant, it is expected that saline groundwater inflows from the Mallee lands, cleared of their former vegetation in the last 75 years, will continue to increase for the next fifty years (Alison et al., 1990).

Increasing concern at the quality of Adelaide’s water supply has complicated attempts to control salinity by digging drains. Drainage of saline irrigation areas will increase the salinity of Adelaide’s water supply in two different ways. First, if drains are dug deeply enough to intercept the watertable, they will fill with saline groundwater. Second, even where drains are shallow enough to avoid direct contact with the watertable, they can still cause downstream problems. The first autumn rains falling on saline irrigated land
dissolve salt which has accumulated on the soil surface through summer. Where this water can drain away downstream, it carries with it a ‘slug’ of salt.

Salinity control required a means of disposing of salty groundwater. Victoria wanted to dispose of groundwater into the Murray River but South Australia would not support this. The Victorian Department of Water Resources was able to find a solution. On the basis of a linear programming model, all parties were convinced that everyone could benefit by a scheme which allowed the upstream states to dispose of salt into the Murray River in return for paying for schemes to stop salt entering the Murray downstream (Salinity and Drainage Strategy Working Group, 1987). The major source of salt in the Murray is groundwater flowing into the downstream reaches of the river. The cheapest method of attempting to reduce the salinity of the river was to remove this groundwater before it reached the river and dispose of it in evaporation basins. The interstate agreement on salt disposal gave the Victorian government an opportunity to do something about drainage and salinity control despite increasing concerns for the state of the Murray River (Murray Darling Basin Ministerial Council, 1987; Kellow, 1952).

However, the greater impact of increasing community concern for the state of the river may well come from the impact not of salinity, but blue-green algae. In the summer of 1989-90, soon after the release of the Salinity and Drainage strategy, a major outbreak of blue-green algae occurred in the Darling system. Dramatic images of mile upon mile of green and dead river precipitated a major review of the environmental state of the river. Blue-green algal blooms occur in warm, still water which has high levels of phosphorus and nitrogen. A report to the Murray Darling Basin Commission identified three reasons for an increased prevalence of algal blooms in the system. These were pollution of waterways, reduced flows and degradation of the streamside environment (Murray Darling Basin Ministerial Council, 1994; Gutteridge et al., 1992; Sturt, 1883). Major point sources of pollution were sewerage treatment in towns such as Albury and Shepparton, irrigation drains and reclaimed swamps in South Australia.

The three most effective management actions to reduce the frequency of these blooms were identified as improving sewerage treatment facilities in major towns, reducing nutrient flows from irrigation farms and increasing the environmental flow allocation to rivers. The
initial government response to blue-green algae was to fund improved sewerage treatment facilities in major inland towns, promote the adoption of Best Management Practices on farms, particularly effluent management around dairy sheds, and to support further research (State Government of Victoria, 1995; Murray Darling Basin Ministerial Council, 1994). But in 1996 the Murray Darling Basin Ministerial Council took a major step by agreeing to cap the harvesting of water from the Murray Darling system at 1993-94 levels in response to the outcomes of an audit of water usage in the Basin (Murray Darling Basin Commission, 1998; Lovering, 1997).

The impact of the cap on the irrigators of the Loddon Murray system will be three-fold. First, any developing industry must purchase water from existing users. Secondly, the capacity to sell sales allocations will be severely restricted. Finally, any permanent water trades will be subjected to a water tax to provide for environmental allocations (Murray Water Entitlement Committee, 1997).

A cap on extractions was only the starting point for providing water for river environments. Low environmental flows had become a potent political issue in NSW with the over commitment of water to environmental purposes being blamed for the decline of a number of significant environmental sites such as the Macquarie marshes (McPhail and Young, 1991; Pigram and Hooper, 1991b). The outcome was a review of the environmental requirements for maintenance of river ecosystems in New South Wales. Requirements for increased environmental flows were politically inevitable (Anon, 1997a). NSW allocations will be reduced by at least 5 per cent, though scenarios through to 20 per cent have been proposed for some of the northern NSW systems. A separate study of environmental flow requirements for the Snowy system was undertaken as part of the path towards corporatisation of the Snowy River Scheme (Snowy Mountains Council, 1995). The results of this inquiry are expected to have an impact upon irrigation flows available to the Murray system. Whilst the flow of water to the Goulburn system are expected to be lessened by only approximately one per cent in normal years, in years of drought the impact may be much greater (Scoccimarro et al., 1997). The economic impacts in dry years may be quite considerable given the high prices paid for water in the most recent year of water shortage in irrigation areas (Samaranayaka et al., 1998; Dent, 1997).
Victoria has undertaken its own path towards environmental flows (Ryan, 1992). Historically a reduction in irrigation allocations would have been achieved through a management imposed reduction of water allocations across all irrigation areas. Econometric modelling shows that requiring environmental flows to be purchased on the open market will achieve a more efficient economic outcome, as well as solving issues of compensation (Rose, 1997; Jones and Fagan, 1996). Whichever method is used, it is clear that the expectation is that water for environmental flows will come from the lowest value uses in the system (Doolan and Fitzpatrick, 1995). These are seen as a relatively cheap source of environmental flows and inter-state trade is the method of facilitating this transfer.

However, the introduction of water markets is often portrayed as having significant social costs for some rural communities. There are few jurisdiction within which a full market for water has been implemented. Research in the south-west of the United States has reported the impacts of social decline upon communities where there has bee a net loss of water (Howe et al., 1990; Nunn, 1990; Maass and Anderson, 1978). This research has limited utility in exploring the implications of the water reform agenda for the communities of the Loddon catchment.

**Econometric predictions of the impact of water sector reform**

The rapidly changing administrative and political climate for irrigation industries has obvious implications for Tragowel Plains farmers. The move towards higher prices for irrigation water over the past ten years will have greatest impact upon irrigators of annual pastures. Annual pasture is the major water use on the Tragowel Plains. This is a low value use for irrigation water and water charges form a proportionately larger component of farm costs (Bartels, 1938). Recent econometric modelling has suggested the marginal value of irrigation water on irrigated sheep properties in the Loddon region is already less than the cost of water (Collins et al., 1998; Samaranayaka et al., 1998). Given trends in commodity prices, it is unlikely this situation will improve in the long term.

There is an administrative prohibition of the purchase of water into the Tragowel Plains. This prohibition is a result of the supply limitations of the Waranga-Mallee Channel. The new rigorous regime for evaluation of infrastructure investment means there is no
The changing commodity, policy and institutional environments

The likelihood of an upgrading of the Waranga-Mallee channel. Water can only transfer out of the Tragowel Plains in the foreseeable future.

On the other side of the ledger, there are a number of major sources of demand for water in the foreseeable future. Foremost among these is the requirement for environmental flows. The dairy and wine industries have each been through a relatively buoyant period. The wine industry is seen as the impetus for major development of irrigated horticulture in the Victorian Sunraysia and South Australian Riverland (Duff, 1998; Fitzpatrick, 1992). Though there is now some evidence that the rate of horticultural expansion may be slowed for a period due to a shortage of grape processing facilities (Meredith, 1998). The dairy industry may be forced into purchases as a result of the implementation of the cap. There has been significant consolidation of dairy enterprises over the last decade (Lindsay and Gleeson, 1997). Many larger farms have been structured on the expectation of continued high availability of sales water. The reduction in sales availability through the implementation of the cap leaves some of these businesses in a tenuous financial position and under some pressure to purchase additional water to maintain production (Baker, 1998; Barlow, 1997). However, econometric modelling of the irrigation systems of Victoria under intra-state trading rules has suggested that the rate of outflow of irrigation water from the Tragowel and Torrumbarry regions may not be nearly as great as many have expected (Branson and Eigenraam, 1996; Eigenraam et al., 1996). This is in part due to the conservative nature of Victoria’s water supply management and the comparative high availability of water.

The introduction of inter-state trade in water is inevitable (Freeman, 1998; Parliament of Victoria, 1997). New South Wales has for many years allocated its water resources far less conservatively than Victoria, although it has been slower to tread the path of creating water markets (Delforce et al., 1990). New South Wales irrigators experience a far less secure supply. The cap on further extraction and the imposition of environmental flow requirements will have a far greater impact on NSW irrigators than Victorian irrigators. Further, the irrigation industries of New South Wales are generally achieving higher returns per megalitre than Victorian mixed irrigation farmers. In New South Wales the rice industry is experiencing a period of high prices. Expansion is limited by water availability. Early
results of econometric modelling funded by the Murray Darling Basin Commission suggested that 25 per cent of water in the Goulburn irrigation system would eventually transfer to the New South Wales Murray system if current commodity prices remained unchanged (Collins et al., 1998; Economic Services Unit NSW Agriculture, 1998). None of this water would transfer from the dairy industry. It would come from the mixed farms of the Goulburn and the Tragowel Plains districts (Read and Sturgess, 1991). This suggests that many mixed farms in these areas would disappear. Such an extensive transfer of water would be expected to create a ‘stranded asset’ problem for managers of the Tragowel irrigation water supply infrastructure. A “stranded asset” would be one or two viable farms remaining dependent upon an irrigation supply channel after the majority of businesses along the channel had sold their water to users elsewhere in the irrigation system. The water supply authority would be unable to raise sufficient revenue from the remaining businesses to pay for the cost of channel maintenance, yet be under a legal obligation to supply water to the remaining farms.

If these modelling results are to be believed, they suggest that investment in the Tragowel Plains Salinity Management Plan is an investment with little hope of paying a return. Many of the farming businesses it is designed to assist would be expected under this scenario to have transferred their water resources to higher value uses elsewhere in the southern Murray-Darling Basin. If viewed from this perspective, investment in the plan is seen as investment to impede the inevitable path of structural adjustment in the region and would therefore be viewed with strong suspicion. Investment in the plan would be seen as investment in a future ‘stranded asset’.

The stranded asset scenario is where the sale of permanent water from a number of properties along a supply channel leaves a small number of viable properties at the end of a supply channel. The asset is stranded if insufficient rate payers remain along the channel to meet the cost of channel maintenance. Depending on the level of disaggregation in maintenance charging, the costs of channel maintenance must be met then by either the remaining farms on the channel or by subsidies from all irrigators within the system. If the costs are met by the remaining irrigators on the channel, there is the possibility that increased
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costs will force further sales of water from these farms, further raising the costs for those that remain.

The stranded asset scenario was of significant concern to Tragowel Plains community members. The Tragowel Plains Salinity Management Plan came to be seen an alternative and more desirable vehicle for promoting a preferred structural adjustment. This desirable adjustment was the movement of water from irrigated grazing to higher value uses within the Tragowel Plains. Dairying and irrigated cropping were prominent in this scenario (Barlow, 1997).

Perspectives of ‘appropriate’ structural adjustment

Structural adjustment in agricultural industries is nearly always a contentious subject in rural politics. In adjustment there are nearly always losers, and the individual impact of individual losses is generally significantly greater than the individual impact of more widespread individual benefits. The Tragowel Plains Salinity Management Plan is a reflection of the Tragowel Plains Salinity Working Group’s acceptance of the inevitability of restructuring of farming on the Tragowel Plains. The plan was an attempt to influence the nature of restructuring in a manner which would maximise the benefits for the Tragowel Plains community. Given the requirement for the plan to have widespread local community support as a condition for State government funding, the inclusion of any overt commitment to enhance structural adjustment was adventurous. However, by setting an objective of encouraging certain forms of adjustment, the community planners made clear where they differed from other perspectives of ‘desirable’ adjustment. The debate over the desirable form and rate of structural adjustment in agriculture has until recently been dominated by two major positions. I will label as economic and social. In the last decade a third perspective based upon environmental considerations has become apparent.

Economic objectives in adjustment policy

The conventional economic view of the characteristics of desirable structural adjustment is well documented in numerous reports by the Productivity Commission and its predecessor the Industry Commission. Twenty years ago the position of these bodies was stated thus:
Pressure for structural change in Australian industry arises as a consequence of changes which are occurring continuously in the environment. How we adapt to structural change has an important bearing on everyone’s standard of living, because it affects the rate at which the nation’s wealth increases or decreases . . . The evidence suggest that resistance to change in the past has retarded economic growth and inhibited improvements in the standard of living. The increasing assistance being demanded by industries in an attempt to resist certain structural changes imposes increasing costs on, and entails massive re-distributions of income within, the community (Industries Assistance Commission, 1977. p. 3).

From this perspective, government intervention in adjustment is justified if ‘the market is not operating efficiently’. In a recent published debate on rural structural adjustment, Gow simply summarises how this position has been traditionally argued in the debate over government intervention in rural adjustment.

The primary justification for provision of agricultural adjustment assistance is market failure. The market failure observed in this instance is the supposed less than optimal rate of adjustment or transfer of resources from agriculture. The evidence for the view that farm resources are relatively immobile is the persistence of low farm incomes for a significant number of farmers and the lack of decline of farm numbers in the recent past (Australian Bureau of Statistics, 1992). Resources which could obtain higher returns in other sectors of the economy are retained in agriculture. This results in a loss of economic welfare as resources are not being used in the most efficient manner. (Gow, 1997. p. 11)

These arguments have been given greater emphasis by recent research which has shown that in Australia’s broadacre agricultural industries, larger farms have achieved far greater productivity gains over the past two decades. Smaller farms have achieved very little productivity improvement (Australasian Agribusiness Services, 1997; Knopke et al., 1995).

In short, the yardstick of adjustment achievement is movement towards a more efficient use of resources, land, water and labour. The assumptions of this position are that
labour employed in agriculture will be re-absorbed elsewhere in the economy, and that the choice to remain in agriculture in the face of negative incomes and a poor outlook is an outcome of lack of information of the alternatives. Those farm businesses which remain in agriculture will absorb the land and assets of exiting businesses, thus increasing both their scale and profitability.

**Social and equity objectives in adjustment policy**

The debate over structural adjustment in agriculture during the last 30 years has hinged on a tension between the objectives of increased efficiency and intervention in the name of equity, the protection of ‘those without adequate market strength’ (Industries Assistance Commission, 1977). The difficulty in resolving what are true matters of equity is shown in the tendency of those advocating efficiency objectives to portray equity arguments as being based upon self-interest. This debating point is often unresolvable. It may indeed be also self-serving. However, these two characteristics are not mutually exclusive.

One current issue on the question of equity revolves around the debate as to whether the ‘fixity of human resources and capital within agriculture when those resources might be more profitably utilised elsewhere’, is indeed a market failure. An alternate view is that the fixity of these resources is a reflection of different values or utility held by farmers. The high value placed upon the farming way of life by farmers and the non-economic values of farming achievement have been well documented (Walter, 1997; Glyde and Vanclay, 1996; Mesiti and Vanclay, 1996; Hawkins and Watson, 1972; Gasson, 1969). This preference for a certain lifestyle cannot in itself be regarded as a market failure. It is instead a choice of values which differ to the values inherent in an economic analysis of agriculture. The argument of ‘market failure’ might only be invoked if the decision to remain in agriculture is undertaken in ignorance of alternatives which might be attractive within the chosen value orientation of the farmer.

Support for this view comes from one school of rural sociology, and in particular, Geoff Lawrence. He claims that the Rural Adjustment Scheme, and particularly the ‘self-reliance’ policy, is not a supportable policy as it is facilitating a form of adjustment based upon corrupted market signals, hence producing a corrupted agricultural structure.
At the basis of Lawrence’s concern is a belief that the State has no right to expect that farmers performing at low levels of economic efficiency should leave farming for the good of the wider economy. It is ironic that in taking this view Lawrence has much in common with the extreme right of the neo-classical economic profession who would be suspicious of any proposal for government intervention in individual freedom of choice (Lawrence, 1997). In a vigorous debate conducted in the pages of Rural Society, Lawrence said:

‘Not only do farmers have no choice [but to respond to corrupted price signals], but if they don’t succeed in agriculture they are expected to bow out without fuss, leaving the nation’s resources to those who have proven themselves to be more efficient and productive. This survival-of-the-fittest accords nicely with social Darwinism which was, not surprisingly, an ideology in vogue during the time in which most of the neo-classical theorists were busy perfecting their models of atomistic competition’ (Lawrence, 1994, p. 11)

In making his argument against the prevailing orthodoxy of structural adjustment policy, Lawrence makes much of the inability of current economic theories to predict the patterns of structural adjustment in Australian agriculture as these theories ignore much of the social complexity of family goals and social preferences. Lawrence’s solution is to advocate a move from what he describes as a ‘productionist orientation’ in national agriculture policy towards a ‘resource limited orientation’. In this vision, government would support the adoption of environmentally sensitive forms of production through extension and incentives. Lawrence contends that if farmers can ‘develop new ways to enhance productivity in the context of sustainable resource use, this, more than anything else, may help them to remain in agriculture.’ (Lawrence, 1994). The author of this thesis feels that, however emotionally attractive this proposal may be, there is a degree of naive optimism in seeing this path as any solution to the adjustment pressures being currently experienced in Australian agriculture.

The predominant export orientation of agricultural industries means that protection barriers will be of limited impact upon prices received by Australian farmers. Lawrence’s proposal for an essentially production limiting solution is dependent upon similar production
limiting responses from international competitors, or upon significant transfer payments from the rest of the economy. Here the Australian farmer is in an unfortunate strategic position, with Australian agriculture being a major component of export income, but providing a small and decreasing share of the voting population (Barr and Cary, 1994).

Despite these misgivings of the Lawrence proposal, it must be acknowledged that the Tragowel Plains Salinity Management Plan does bear some of the hallmarks of his concept. There has been significant government support for the development of a more sustainable agriculture on the Plains. Almost $2,000,000 was spent in 1995-96 for a community of 500 farms. It is questionable whether any government would have the will or the capability to spend at this rate to promote sustainable farming across all farms in Australia. By comparison, the spending on the National Heritage Trust is equivalent to one quarter of this rate, assuming all moneys are directed to farms, a plainly unsupportable political position.

Further, although there is a strong emphasis upon improving the financial performance of Tragowel Plains farms, this runs counter to the general expectations of the water industry that the most efficient outcome from a State view point would be for the water from the Tragowel Plains mixed farms to transfer out of the district to higher value uses. At the least one must concede that the Tragowel Plains Salinity Management Plan has had a foot in both camps of this argument, seeking to enhance production, yet seeking to temper the effects of structural adjustment seen as detrimental by its own community.

Environmental objectives in adjustment policy

The consideration of environmental objectives in adjustment policy is a relatively new phenomena which has not yet entered the mainstream of the policy debate over structural adjustment (Price, 1997). In the case of the Tragowel Plains there are two aspects of adjustment which might be considered to be of environmental significance. The first is the assumption that structural adjustment consisting of property amalgamation and the exit of farmers will create more profitable farms which have a greater ability to invest in environmental protection (McFarlane, 1997). The second is the link between adjustment of
resources out of agriculture giving greater flexibility in the provision of environmental stream flows.

Will the creation of more profitable farms on the Tragowel Plains lead to more sustainable farming practices being adopted? The recommendations of the Tragowel Plains Salinity Management Plan could be defined as the Best Environmental Management Practices for the region from the point of view of local industry sustainability. Although these practices were chosen for their clear potential to achieve environmental benefit at minimum cost (Wilkinson and Barr, 1993), most are clearly not cost free. As is often the case with agricultural Best Management Environmental Practices, the potential costs are implied in the next management step after adoption of the recommended practice (Barr, 1996). Whilst it is cost free to cease irrigation of saline soils, the application of that water effectively elsewhere on the farm may imply investment in layout, or improved management skills. Management of the saline land will require fencing and possibly sowing with halophytes. Whilst there are subsidies within the plan to support these activities, they cover only a component of the full cost (Tragowel Plains Sub-Regional Working Group, 1988).

Many of the exogenous influences on the Tragowel Plains mentioned in the previous chapter can be expected to increase cost pressures faced by Tragowel Plains farm businesses. This is clearly likely to reduce the likelihood of the adoption of those Best Environmental Management Practices which incur cost. This possibility was raised by Bryant (1989) in her small scale study of agricultural exits. There is concern in the Murray-Darling Basin Commission that pressures for adjustment will limit the adoption of Best Environmental Management Practices in dryland catchments through the impact of the cost price squeeze. In an earlier study of the Tragowel Plains, Hooper (1995) found that farmers did indeed mention cost as the major factor limiting adoption of salinity control practices. This position has been reiterated at a recent local landcare conference (Brown, 1996).

The assumption that more profitable farms will lead to greater adoption of environmentally friendly farming has been questioned by the environmental movement. The Australian Conservation Foundation believes ‘It is a dubious proposition that high farm income relates to improved natural resource management outcomes’ (Alexandra and Curmi, 1997). Limited evidence against the link between financial pressure and adoption of soil
conservation measures has been presented by ABARE (1992). The ACF has argued that assistance to farmers should be based upon contractual obligations to achieve natural resource goals, and that adjustment policies should be managed in tandem with natural resource strategies. The Australian Conservation Foundation clearly has a concern that the pattern of adjustment in agriculture may be a factor mitigating against the achievement of environmental goals in agriculture.

The Murray-Darling Basin Commission Community Advisory Council expressed similar concerns to the ACF in their submission to the review of the Rural Adjustment Scheme (Murray Darling Basin Community Advisory Council, 1997). A different slant has been placed upon this relationship by Ian Thomas, chairman of the Murray-Darling Basin Commission Community Advisory Council who has expressed his concern at anecdotal evidence that ‘pluriactivity’ and diversification may lead to a lessening of the adoption of Best Environmental Management Practices (Thomas, 1997).

The second concern of the environmental movement relates specifically to adjustment within irrigation industries. Adjustment in irrigated agriculture is seen as necessary to release water for allocation to environmental flows (Alexandra, 1994). The tool for this release is either purchase of transferable water rights or an administrative restriction on legal entitlements. Any adjustment which increases the cost or difficulty of achieving this objective would presumably be viewed as undesirable. One outcome which has been discussed unofficially between governments is the possibility that the introduction of transferable water entitlements will provide an opportunity for the purchase of water for environmental purposes at market prices and provide a dignified exit from mixed farming. In part the Tragowel Plains Salinity Management Plan has objectives which run counter to this in that it seeks to limit the sale or transfer of irrigation water away from the Tragowel Plains. The creation of fewer, larger more profitable farms on the plains would further limit the potential for purchase of water rights.

**Human capital issues in adjustment policy**

The environmental issues discussed above are closely related to some of the human capital issues which have been recently debated in the literature on structural adjustment in
Australian agriculture. Stayner (1997a) raised the question of adjustment trends in Australia leading to the disproportionate export of human capital from agriculture through both the recruitment process and through the tendency of younger farmers being more likely to take the exit option when under financial stress. This tendency is explained in part by the nature of events which lead certain types of farmers into financial difficulty, the opportunities facing younger and older farmers outside agriculture and by the relative value orientations held by younger and older farmers (Runge, 1986). Research in the United States (Salamon, 1989; Bultena et al., 1986; Salamon and Davis-Brown, 1986) in the mid-west corn belt identified two differing strategies to cope with financial pressure. The ‘yeoman’ farmer limited expansion, took off-farm work, cut back on family expenditure and basically worked harder. The ‘entrepreneurial’ farmer expanded to gain efficiencies of scale, often through increasing debt. Salaman and Davis-Brown coined the phrase ‘the disappearing middle’ to describe their finding that it was the entrepreneurial farmers who were more likely to be forced to exit farming. While there is evidence that this trend towards ‘dualism’ in agricultural adjustment peaked in the 1970s and has passed in North America (Albrecht, 1997; Munton and Marsden, 1991; Albrecht and Murdock, 1990; Harper et al., 1980), it has been hypothesised that the disappearing middle phenomena is occurring in Australian agriculture (Davidson, in press; Vanclay, 1994). Certainly the trend towards off-farm work on smaller farms is well documented (Dyson, 1997; Fairweather, 1996; Stayner and Lees, 1995; Peterson and Moon, 1994; Peterson et al., 1991; Le Heron, 1988; Males et al., 1987; Paul, 1982; Core, 1974).

Recent research in Australia suggests that those farm managers who have become clients of financial counsellors have experienced a serious decline in their financial position because of debt taken on as part of a major investment decision, whether for land purchase or equipment investment (Madden, 1996; Edwards, 1994; Stayner, 1994; Ginnivan et al., 1991; Murdock and Leistritz, 1988; Paul, 1976). It is clear from studies of farm family life cycles that decisions to increase farm size are more likely to be taken at certain stages in the family life cycle—whilst there are dependent children or when another generation is seeking to join the family business (Gasson et al., 1996; Barr et al., 1979). Older farmers with less need to take these risks are less likely to be forced out of agriculture by financial pressure (Leistritz et al., 1989; Rathge et al., 1988; Bultena et al., 1986). Younger farmers and those
with debt based expansion strategies and a more entrepreneurial approach are more likely to be forced out in times of economic stress (Stayner, 1997; Reeve and Kaine, 1996).

Although the research is now somewhat dated, both Gasson (1973) in England and Kerridge in Western Australia (1978) found that farmers on smaller farms and older farmers were more likely to hold intrinsic values about their role in farming. More recently, research into ‘farming styles’ has shown the importance of intrinsic values in the decision to stay in farming (Glyde and Vanclay, 1996; Mesiti and Vanclay, 1996). Similarly, Stayner (1994) has shown the importance of intrinsic values to the decision to enter agriculture. Intrinsic values are expressed in beliefs about the values of farming as a way of life and are less influenced by financial considerations. Holders of these values are therefore less likely to be convinced to leave agriculture because of poor financial returns. They are less likely to experience individual stress when the farm business suffers financial stress. It is the experience of stress that is likely to motivate the decision to move out of farming (Ginnivan and Lees, 1991). Numerous studies have confirmed that there is indeed often little relationship between the farm financial situation and individual stress (Heffernan and Heffernan, 1996; Weston, 1988; Weston and Cary, 1979; Cary and Weston, 1978), indicating that individual stress is not a direct outcome of financial situation, but is mediated by personal values (Molnar, 1985).

The previous two paragraphs have discussed mediating influences upon factors which might push a farm family out of agriculture. There are also factors which might pull a family out of agriculture (Fox, 1973). These are predominantly the existence of a perceived better life beyond farming. It is well established in the literature that lack of perceived employment options beyond agriculture is often a major barrier to making a decision to leave farming (Kennedy, 1996; Cook and Ronan, 1994; Ginnevan and Lees, 1991; Bryant, 1989; Graham and Brake, 1986; Woods and Chamala, 1977). Recent research in North America suggests this apprehension may be well founded (Albrecht, 1998). Those dairy farmers most likely to perceive that they have options outside agriculture are more likely to be young and to be more highly skilled (Ginnevan and Lees, 1991; Nankinvell, 1979). Current Commonwealth rural adjustment policy appears to be directed strongly toward training support to encourage exiting farming (Stephens and McGuckian, 1995; McGuckian, 1994;
McGuckian and Stephens, 1993). Given that training is clearly a more favourable option for younger rather than older farmers (Paul, 1976; Bell and Nalson, 1974; Core, 1974; Core, 1973), any further change in policy in this direction may further enhance the differential impact of the adjustment process across age groups and managerial styles.

To be added to these push and pull factors are a third group of factors which act to keep a family in agriculture. One of the most important is the availability and propensity to take off-farm work. Off-farm employment was seen some decades ago as a transitional step to exiting farming (Bell and Nalson, 1974). Since the 1970s it is clear that off-farm employment has become a permanent feature of agriculture in Europe, Australia and North America. In the decade immediately prior to the commencement of the Tragowel Plains Salinity Plan, Peterson et al (1994) estimated that the contribution of off-farm income to Australian gross farm income had risen from 10 per cent to 23 per cent. In some regions off-farm income was a permanent feature of agricultural structure (Barr and Brown, 1996, 1998; Olfert et al., 1998; Garnaut and Lim-Applegate, 1998; Garnaut and Lewis, 1997; Gooday, 1995). Given the pervasive nature of off-farm income, any understanding of adjustment must consider the availability of off-farm employment and the skills held by farmers which give them improved opportunities in the off-farm labour market (Stayner and Gow, 1992). Off-farm work in Australia, and in the United States is clearly related to farms of smaller economic size, which would often be considered unviable without the availability of the off-farm income (Rathge et al., 1988; Males et al., 1987; Paul, 1982; Robinson et al., 1982). Off-farm work may be acting as a barrier to adjustment rather than a stepping stone to adjustment.

How does one integrate these apparently competing explanations of the pressures for adjustment, the lessons of history that businesses leave agriculture as they become left behind by the pressures of the cost price squeeze, and the observations of these research studies which suggest that it is not necessarily the owners of smaller businesses which are forced out of agriculture, but those which have overstepped some investment mark? One possible explanation is that exit adjustment may be delayed in farm businesses until the time of inter-generational transfer. The major adjustment decision may be whether another generation takes over or the farm is sold. There is strong evidence that this is the case in the
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dryland areas of the Loddon catchment (Barr and Ridges, 1998b). If this is the case, then demographic structures will mediate the rate of adjustment. However, in times of financial instability, volatile commodity prices, interest rates and environmental conditions, the greatest adjustment pressures will be focussed upon those businesses with higher debt levels. These businesses are held by the younger and probably more entrepreneurial farmers identified as more likely to exit in much of the research cited above. And it is in time of instability and greater adjustment pressure that such research is commissioned! This emphasises the need for studies of the process of adjustment to be based upon longitudinal research designs to allow for the observation of factors which operate over a considerable period of time (Stayner and Gow, 1992).

As we have already discussed, the Tragowel Plains mixed farming community was experiencing a period of instability during the late 1980s and early 1990s. Mixed farmers on the Tragowel Plains are predominantly sheep producers, mainly producing prime lambs, but also producing wool. Sheep farmers as a group have achieved the lowest level of productivity improvement over the last three decades of any farming group (Wool Industry Taskforce, 1996). This low productivity is postulated by some to be an outcome of a farming social culture which supports low risk financial and grazing management strategies (Marks and O’Keefe, 1996; O’Keefe, 1993). In the light of the factors highlighted in the preceding paragraphs, one could speculate that the current structure of the wool industry is the result of an evolutionary cycle which has eliminated many businesses which have taken on debt in making investment decisions and selected for those businesses which have followed a conservative strategy of debt and risk minimisation.

Evidence for this interpretation may be found in research conducted over the last 30 years. Core (1974; 1973) found that few wool producers in economic difficulties left the wool industry. The Bureau of Agricultural Economics (1975) found that most applicants for debt reconstruction who were rejected as unviable remained in agriculture. Those that follow these conservative investment strategies generally have low rates of adoption of Best Environmental Management Practices recommended for the sheep industries in dryland catchments (Barr, 1996; Condon et al., 1995; Shaw, 1994). The risk averse strategies adopted by these farmers are preferred as they minimise the probability of being forced to
leave agriculture. As a result, sheep farms in Victoria are seen as being composed of too many small farms which are unable to fund investment in some Best Management Environmental Practices. (Wool Industry Taskforce, 1996).

There are a significant number of farm managers on the Tragowel Plains who fit the profile of the low-input risk averse manager (Barr et al, 1988). It is possible that the pressures for adjustment over the last decade have not forced risk-averse farmers to exit agriculture, but have instead caused the exits of farmers who had invested in Best Environmental Management Practices such as land relayout. The inevitable questions which arise from a consideration of these issues are whether adjustment patterns select against human capital in the form of skills and knowledge, and if they do, whether this is an issue worthy of government policy attention.

The evolution of Federal rural adjustment policy

The interplay of competing economic and social objectives, and more recently environmental objectives, is apparent in the development and transformations of Australia’s Rural Adjustment Policy. The Rural Adjustment Scheme was formed in the 1960s and has undergone a number of policy transformations which have dramatically changed the focus of the scheme. Recent changes to the scheme appear to have been accepted with a degree of bipartisanship. As such, the scheme may be taken as a barometer of Federal departmental views on the appropriate form of government intervention in the process of structural adjustment in the farm sector. Its evolution demonstrates the relative strength of arguments in favour of efficiency, equity and environmental objectives.

The Marginal Dairy Farms Reconstruction Scheme

The dairy industry was the cornerstone of closer settlement policies in southern Australia after the Second World War. Soldier settlers were established on dairy blocks in locations across the irrigated and high rainfall areas of south eastern Australia. The industry was supported by quotas, tariff protection and preferential access to the British market. Institutional memory is often short, and though soldiers were being gratefully settled on blocks in the early 1950s, within ten years proposals to remove subsidies and support for the dairy industry were being made. The removal of subsidies and protection would improve the
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overall economic welfare of the community, but would clearly entail significant hardship for sectors of the dairy industry. In recognition of this transitional pain, those advocating removal of support for the industry recommended gradual implementation of their plan and assistance by providing funds to ‘rehabilitate the efficiency of dairy farmers who can … expect profitability to continue in dairying with reduced protection, provide departure assistance by capital grants or loans to compensate for capital losses, and a limited system of income support for those remaining’ (Downing and Karmel, 1960). Both the content of the proposal, and the implied trade-off with lower protection were themes which were to continue to reappear in adjustment policy over the next four decades.

These proposals were clearly unacceptable politically as they assumed that the State had a role to remove farmers from the land, a position untenable to the Country Party whose constituency was strongest in closer settlement areas. However, the Country Party would be unable to hold the line against such heresy. The dairy industry was dependent upon exports of surplus to Britain. But a combination of EEC subsidised exports and loss of access to British markets with Britain joining the EEC created a continued slide in butter prices from the mid 1960s to mid 1970s (Hefford, 1985). Widespread financial pressure was being felt in the dairy and beef industries by mid-60s, but was particularly strong on North Coast of NSW (Bureau of Agricultural Economics, 1966). This area was identified by the Minister for Primary Industry as a region of particular problem with low agricultural incomes (Bell and Nalson, 1974).

Tension between the Country Party and Liberal party over rural policy saw Liberal members of the government release their own rural policy, arguing this area of government should no longer be the reserve of the Country Party. The policy made it clear that there was a role for government to assist farmers out of agriculture, rather than just to support them to remain in farming.

Producers must be given the opportunity to either obtain sufficient resources to become viable, or to leave that industry. It is clear that if some producers leave an industry, additional resources will become available to others… providing those that remain with at least a chance of attaining economic viability.(Liberal Party, 1970)
This policy was adopted by the government and in the same year the government passed a Bill through parliament called the ‘Marginal Dairy Farms Reconstruction Act’ (Parliament of Australia, 1970). This Bill had the stated objectives of enabling dairy farmers to voluntarily leave the industry, receiving fair compensation for their land and assets, including redundant assets (Anthony, 1970). In the guidelines for the administration of the scheme, buyers were to receive full market price for their property, while purchasers were to be able to purchase land at a price which discounted the value of fixed redundant assets (Bureau of Agricultural Economics, 1966). Essentially, the Commonwealth was offering to bear the cost of redundant assets such as houses and dairy sheds.

The scheme was given only a small level of funding, sufficient to fund the exit of only 1.4 per cent of holdings (Bureau of Agricultural Economics, 1966). A criticism made at the time was that the scheme made no provision for retraining of farmers for other occupations (Bell and Nalson, 1974). The implicit assumption behind the scheme seems to have been that the small number of farmers to be assisted out would be retiring, or already able to take up employment in other occupations. The justification for the scheme was the resolution of the problem of redundant assets as a barrier to adjustment and was limited to the dairy industry.

**The Rural Reconstruction Scheme**

If the government saw their passing of the Dairy Reconstruction Act as a solution to a passing problem, they were informed otherwise in a paper by the head of the Bureau of Agricultural Economics. In this paper Harris explained that the situation facing dairy farmers was not a short term phenomena, but a manifestation of the long term processes of economic growth (Harris, 1970). He identified a long term structural problem of large numbers of producers with long term incomes insufficient to fund the improvement of farm productivity necessary to remain viable. Harris saw the key to the problem as the unwillingness or inability of farmers to leave agriculture. He explained the factors which lead to a reticence to leave agriculture during times of low commodity prices as a combination of the ability to produce a significant subsistence income, the lack of attractive employment alternatives, the desire to remain in the farming lifestyle and the probability of
low land prices due to the high number of properties for sale in areas suffering generally low farm incomes.

Harris assumed that alternative employment did exist for farmers and that vacated land would be purchased for farm build up and concluded that ‘a case exists for government policies to deal with the low income question because the economy would benefit from using the resources elsewhere’ (Harris, 1970). Harris proposed government purchase of small holdings for amalgamation and resale at a price which discounted the value of redundant assets, the provision of finance for farmers to purchase additional land or otherwise improve productivity, debt reconstruction, retraining and relocation assistance for removal costs and the cost of finding alternative accommodation. Harris finally argued that these provisions should be available to all farmers, not just dairy farmers. The problem of inefficient resource use in agriculture was seen quite clearly as the large number of small farms, particularly in the grazing and sugar industries rather than just in dairying (McKay, 1967).

By the early 1970s low commodity prices in a number of farm industries had led to widespread indebtedness in the farm sector. The response of the government was to introduce the State Grants (Rural reconstruction) Act in 1971 (Parliament of Australia, 1971). The objective of the Act was to extend assistance to the wool and wheat industries. The Act adopted many of the proposals of Harris.

The Act contained provisions for debt reconstruction, farm build up and rehabilitation. The majority of funds were targeted to farm build up, to supplement the normal process of small unviable properties being consolidated with adjoining larger properties. Rehabilitation assistance was in the form of a loan. The major justification for government assistance was to overcome the problem of redundant assets and to give encouragement for farmers to leave agriculture. However, the majority of applications were for debt reconstruction… assistance for businesses which ‘have sound prospects of long term viability… but who can’t meet their financial commitments’. There was little demand for rehabilitation assistance which was made available in the form of loans rather than grants or for farm build up.
The scheme went through a number of changes over the following two years. A Rural Reconstruction Retraining Scheme was introduced. This subsidised the wage costs of employers who employed and retrained exiting farmers. The Rehabilitation maximum loan was increased and was made convertible into a grant at the discretion of the administering body. The new Labor government in Canberra had decided to reduce public support for agricultural subsidies and in compensation decided to make further funds available for the scheme in response to the already high demand for the schemes funds (Hefford, 1985).

This commitment to adjusting farmers out of agriculture was strengthened with the passing of an additional act targeted specifically at the fruit growing industry, which was judged to be incapable of responding to the incentives in the Rural Reconstruction Act (Parliament of Australia, 1972). However, political pressures for short term support to keep farmers in agriculture came to the fore with the collapse of the beef industry in the mid-1970s (Johnson and White, 1977). Federal and State governments responded with the Beef Carry-on Loans Scheme which was designed to provide financial support to beef producers experiencing economic pressures (Parliament of Australia, 1975). The objective of this scheme was clearly designed to maintain resources in the beef industry in a time of reduced incomes (Industries Assistance Commission, 1983). The tension between the competing objectives of these two Acts was to bedevil all subsequent adjustment policy.

**The Rural Adjustment Scheme**

Applications for assistance under the Rural Reconstruction Act were driven by the need to survive in business in the short term. By far the major interest was in debt reconstruction. There was far lower interest in actually increasing debt by increasing property size, or in leaving agriculture. Almost eight per cent of Australian farmers applied for support, and three per cent of farmers actually received assistance (Bureau of Agricultural Economics, 1974). Many applicants for debt reconstruction were rejected on the grounds of lack of long term viability. Most of these would have been eligible for resettlement assistance. However, only three per cent of this group actually applied for this form of assistance. The majority of these farmers instead found means of remaining in farming (Australian Bureau of Agricultural Economics, 1975; Bureau of Agricultural
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Economics, 1975). Likewise, few farmers took up the retraining option offered by the Rural Reconstruction Scheme (Fitzgerald, 1997; Prime Minister's Science Council, 1974).

This fixity of farmers in poorly performing industries led to research on the extent of poverty in agriculture. The most definitive evidence was produced for the Henderson Commission of Inquiry into Poverty (Vincent et al., 1975). The results highlighted the tension in dealing with policy objectives in welfare and efficiency caused by this behaviour. Welfare and efficiency were two objectives of government policy outlined in the 1974 ‘Green paper on agriculture’.

Government action to assist adjustment in the rural industries has a social and an economic base. The social base for adjustment is to avoid or mitigate the severe welfare problems which can arise as a result of the unimpeded action of market forces. The economic basis for adjustment assistance is that the market does not ensure an efficient adjustment in the allocation of resources in response to changes in economic conditions. (Prime Minister's Science Council, 1974. p. 32)

Those concerned about the existence of a low income problem sought solutions which were seen as counter-productive to the objective of increasing industry efficiency by reducing the incentive for adjustment (Bureau of Agricultural Economics, 1966).

Seeking a compromise to this conundrum, Chisholm put forward a proposal of a time limited income support for low income farmers which would allow them time to assess the option of leaving farming. He recommended that those with significant realisable assets should be required to contribute to their own support (Chisholm, 1972). Chisholm specifically stated that he was not intending to answer questions about whether such special assistance to low income farmers was equitable when it was not available to other industries. One response to this latter concern was a recommendation that rehabilitation assistance be made available to all workers in depressed rural areas who could gain employment by moving to areas where greater job opportunities existed (Interdepartmental Manpower Mission, 1974).
However, the authors of the Henderson Inquiry rural poverty report were cautious in their assessment of their own findings of widespread poverty, finding this at odds with the at times high wealth levels of these same farm households (Vincent et al., 1975). As a solution they recommended a farm annuity scheme for older farm operators to overcome the unattractiveness of the rehabilitation option of the Rural Reconstruction Scheme (Watson and Vincent, 1973). Under this proposal farmers would not be required to leave and set up a new abode, but instead be required to sell their farm to the Reconstruction Authority for farm build-up on their death, in return for an annuity payment. Rather than give up their own farming lifestyle, they would have been required to forgo the option of passing on the business to a succeeding generation.

Meanwhile, most adjustment funding was being allocated to debt reconstruction. Concerns at the equity of the debt reconstruction assistance were being put to government. The Green paper argued that ‘an emergency measure which started out virtually as a rescue operation turned out to be an extremely profitable exercise for some people who received assistance’ (Prime Minister's Science Council, 1974).

In response to these concerns, a review of the Rural Reconstruction Scheme was released by the Industries Commission in 1976. It recommended that greater attention be paid to those rejected as ineligible for debt reconstruction by providing a single year of household support assistance at a level commensurate with unemployment benefits, as originally proposed by Chisholm, though with a less generous period of support. The annuity scheme suggested by Vincent et al was not supported.

The review also recommended that all existing rural adjustment schemes be amalgamated into a single program, a Rural Adjustment Scheme, and that in future government policy be that this scheme become an integral and permanent part of Australian agricultural policy. Under this proposed scheme the provisions for farm build up were recommended to be extended for activities other than land purchase, and that carry-on finance be made available on a short term basis for industries facing severe and sharp downturns in commodity prices.
The recommendations of the Industries Assistance Commission were accepted by the government, and in 1976 the government introduced a bill to enact a new Rural Adjustment Scheme (Parliament of Australia, 1976). In its evolution to this form, the Rural Adjustment Scheme appeared to have taken considerable steps away from the original justification for intervention. The main argument for intervention in farm build-up had been clearly for government to provide ‘social assistance to write down the value of redundant fixed farm assets where necessary . . . To expedite voluntary farm mergers’ (Mauldon and Schapper, 1974). The extension of farm build up assistance to encompass pasture improvement and water infrastructure development indicated a new direction based more upon rural politics than economic efficiency objectives, though it was justified on the grounds of the failure of the private finance sector to meet rural needs due to regulation of the finance sector. Likewise, the introduction of carry-on finance rather than welfare measures suggested a similar rural political motive rather than a concern for universal welfare issues. Despite the brave announcement that the Rural Adjustment Scheme was to be a permanent feature of government rural policy, in this form the Scheme carried with it from its beginnings the seeds of its own downfall.

Since its inception the Rural Adjustment Scheme has been subject to regular reviews. Of major importance to expenditure in the fund was the increasing amount of funds being allocated to what was called ‘Part B’ of the Rural Adjustment Scheme, the categories of ‘Exceptional Circumstances’ and ‘drought assistance’. The role of each of these components was to provide carry-on finance for farm businesses facing sudden and extreme commodity price collapses or facing drought. An Industries Assistance Commission review (1984) found that the scheme was acting as an assistance to commercial lenders by reducing default risk, had been capitalised into land values and had not provided real additional welfare support. The resulting revised scheme introduced in 1985 reduced the period of interest rate subsidy to seven years and capped the level of assistance at 50 per cent.

The next review in 1988 came to a number of similar conclusions. It was argued that the objectives of the scheme contained in the Act, ‘to assist rural industry structural adjustment and to ease adjustment pressure’, were imprecise and confusing, resulting in the intentions of the Rural Adjustment Scheme being widely perceived as ‘to keep farmers on
the land and to subsidise interest rates without reference to adjustment effects’ (Coopers and Lybrand WD Scott, 1988). The scheme was described as having little if any impact on adjustment, perhaps even delaying departure. Drought funding in particular was the subject of intense public scrutiny, being placed under attack from both the economics profession who argued that it encouraged managers to not take adequate account of drought in their business management, and the conservation movement who argued that drought funding encouraged over use of range lands leading to a loss of the resource (Cameron and Elix, 1994). The 1988 version of Rural Adjustment Scheme continued funding for drought assistance pending the outcome of a review of national drought policy. It introduced funding for skills improvement as a component of the scheme.

The National Review of Drought Policy made a series of recommendations aimed at bringing stricter criteria into the declaration of drought. The basic arguments were that drought assistance discouraged management planning for drought and penalised good managers (Drought Policy Review Task Force, 1990). This was soon followed by the next review of the Rural Adjustment Scheme (Synapse Agricultural Consulting, 1992) which made many conclusions in common with previous reviews. The scheme was not contributing significantly to adjustment. The scheme’s components were not aligned with its objectives. The scheme placed too much emphasis upon Exceptional Circumstances assistance. The resulting revised scheme was somewhat at odds with this assessment. Interest assistance for farm productivity was reduced to a 3 year period. Greater emphasis was placed upon training. Funds were made available for skills enhancement, though the application of this component was rather patchy across States. However, the new direction indicated by this component was a strong indication of what was in store in the near future. Exceptional Circumstances criteria were tightened, but assistance under these Exceptional Circumstances was still significant with full interest rate subsidies, additional re-establishment grants double that normally available and generous waiving of assets tests for both unemployment benefits and Austudy assistance.

‘Agriculture - Advancing Australia’

In reviewing the changes to the Rural Adjustment Scheme which occurred over the 21 years of its life, it is apparent that the original objective of the scheme, to compensate for
the loss of sunk costs arising from property amalgamation, was quickly lost in the morass of rural politics and the debate over welfare and efficiency objectives. The emphasis had been in providing funds where the demand has been greatest . . . in interest rate subsidies for exceptional circumstances and drought. For the period 1992-96, skill enhancement comprised only two per cent of the budget, 26 per cent of applications and involved nine per cent of farmers. Re-establishment accounted for only eight per cent of the budget, three per cent of applications and one per cent of farmers accessing funds (McColl et al., 1997).

In the context of the declining political power of the farm lobby and the increasing policy emphasis upon ‘self-reliance’, the Rural Adjustment Scheme was clearly in line for major surgery. The surgery form was indicated in a mid-term report (McColl et al., 1997). The abolition of interest rate subsidies was announced in the following week (Anderson, Minister for Primary Industries and Energy, 1997; Australian Department of Primary Industry and Energy, 1997). The review based its arguments upon the limited justifications for government involvement in private markets. The faith in markets was clearly stated . . . “Competitive markets are the preferred means of dealing with the range of competing alternatives that characterise most human transactions”.

Market failure was identified as occurring where markets reduce the efficiency of resource use within an economy. Equity was noted as a lesser reason for intervening. The position makes an interesting comparison with the sentiments of the Prime Minister's Science Council in 1974.

*No government is likely to give unqualified approval to the implications of the market mechanism as the means by which resources are allocated and incomes distributed in the economy. This is particularly true of the farming sector where, because of the inherent difficulties of adjustment to continual changes, the response to market prices often leads to undesirable results which require some action on the part of government.* (Prime Minister's Science Council, 1974, p. 32)

This overt raising of the relative importance of efficiency over equity was to be expected, reflecting long term trends in policy ideology within government and the public
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service (Pusey, 1991) and the declining importance of agriculture in the economy. However, the report heralded a far greater interest in issues of human capital in agriculture and to a lesser degree environmental concerns. Intervention of government was recommended as a means of addressing market failure. No market failure was detected in the provision of farm finance. From this position it was clear that no justification would be found for the maintenance of interest rate subsidies. The older arguments advanced by Harris regarding compensation for fixed assets were cursorily rejected by observing that although these fixed assets may act as a barrier to amalgamation, the fact that they have value to the current user indicates there might not necessarily be efficiency losses (Kingma et al., 1977).

Three main areas of market failure were identified. These were difficulties in accessing training for improved management skills, barriers to exit from farming and welfare problems. The new combination of policy tool focussed upon these three market failures (Agriculture, Fisheries and Forestry Australia, 1998).

Skills weaknesses were addressed through Property Management Planning, FarmBis and a rural strategic planning initiative. The existing Property Management Planning initiative was extended into a second phase, where the emphasis was firmly placed on subsidised access to introductory strategic planning workshops. Further support for training was provided in the FarmBis program. Support for training needs of farmers was made available through a contestable process involving public and private suppliers. A new program to support regional strategic planning replaced the Rural Partnership Program. Unlike the RPP, funds were only available for planning, networking and facilitation. Funding for these various strategic planning programs indicated continuing belief in the principles which lead to the creation of the initial Property Management Planning Program: that involvement in strategic planning would lever a major change in the attitudes and skills of Australian farmers (Prime Minister's Land Management Task Force, 1995).

Welfare problems were recommended to be dealt with in future through an “Exceptional Circumstances” Program and the mainstreaming of farm welfare programs. The Exceptional Circumstances program recognised exceptional farming conditions beyond the previous specific drought definition. However, definitions of exceptional were significantly tightened. Applications needed to demonstrate that the exceptional event was
rare and severe, that the subsequent downturn in farm income was a one in twenty year event, that the impact was regional, lasted for more than 12 months, and was not predictable or part of a structural adjustment process. Support for farm families under Exceptional Circumstances included an interest rate subsidy and family income support. The interest rate subsidy was phased to decline over 50% until a review in 2002 when the subsidy is to be reviewed. The objective of the phase down is to increase farmer self-reliance and encourage the use of the new Farm Management Deposit Scheme which was designed to be more attractive than the previous Income Equalisation Deposit Scheme.

The phase down allows farmers to achieve greater financial self-sufficiency as they take up opportunities under Agriculture – Advancing Australia to strengthen business management skills and use the new Farm Management Deposit Scheme which has been designed as an enhanced risk management tool. (Agriculture, Fisheries and Forestry Australia, 1998).

A related review of the social security system was undertaken to mainstream the payment of income support. (Special Rural Task Force, 1997). In its report, the Special Rural Task Force recommended that support for farm families facing financial difficulty be improved by a relaxation of the activity test and the liquid assets test (Special Rural Task Force, 1997). Under unemployment support arrangements current in 1997, farmers had to pass a number of steps to receive assistance. Demonstration of an active search for work and assets below $264,000 were sufficient to qualify for assistance. As most farmers would have difficulty in passing this assets test, meeting three further criteria enabled farmers to qualify under ‘hardship’ provisions:

- A demonstration of inability to use assets to borrow
- Placing the farm on the market at a genuine price
- Liquid assets below $10,000 for couples or $6,000 for singles.

Under the mainstream arrangements, payment support was made equivalent to that available to the general population under the Newstart allowance. Payment was made subject to the same income and assets tests with the exception that under Exceptional
Circumstances declaration, and for 12 months afterwards, farm assets were exempted from the assets test. Farm families were also made eligible for a Health Care card.

The solution to the perceived problem of low exit rates from farming was recommended as counselling through skills audits, career counselling and retraining to encourage a consideration of this option and the provision of two programs to financially support farm exit (Alston et al., 1997). The Farm Family Restart Scheme was made available to low income farmers who are experiencing financial hardship and are unable to borrow against their assets. Eligible farm families are assisted with the Newstart allowance for a period of up to a year. This assistance is provided without the need to pass a work test. A further grant of up to $45,000 is available for those who decide to leave farming within this 12 month period. Further support for business assessment and exit planning is available. The total support offered cannot exceed $45,000, and the scheme phases out by 2001. The purpose of the Farm Family Restart Scheme is to provide a period within which decisions about the family’s future on the farm can be made without extreme financial pressure cutting short the decision process.

The complementary exit package is the Retirement Assistance for Farmers Scheme. This scheme encourages older farmers to exit agriculture by allowing them to gift up to $500,000 of assets to their children and still qualify for the pension (Aubin, 1997, Agriculture, Fisheries and Forestry, 1997). However, strict eligibility criteria were later attached to this relaxation of the assets test. This led to claims in the media that fewer than 600 farmers across Australia may qualify (Duff, 1997). Currently the package is available to farmers who have owned that farm for 15 years, or who have farmed it for at least 20 years. Average income in the preceding three years must have been less than the pension. The younger generation must have been actively involved in the farm for at least three years. Again, the package closes after 3 years of operation.

**Perspectives on the ‘need for adjustment’**

While the Rural Adjustment Scheme Review gave a strong indication of Federal policy makers’ expectations of the process of structural adjustment at a national level, expectations of adjustment within the Loddon irrigation systems were made clear through
entirely different circumstances. One of the features of water sector reform in Victoria has been the corporatisation of water supply bodies. This corporatisation places a pressure on irrigation supply bodies to achieve full cost recovery and generate a return on capital. This objective, shared by both the corporations and government, creates a strong interest at government level in the acceleration of the transfer of water from low value to high value uses (Barson et al., 1990). Government is actively involved in planning to accelerate horticultural development using water made available through the creation of a water right market (Duff, 1998).

The Loddon catchment irrigation districts have been the subject of a series of studies which have attempted to identify appropriate regional rural adjustment measures which would accelerate this ‘appropriate’ adjustment. These have included a Department of Primary Industry funded study to identify ‘opportunities for regional rural adjustment’ (Barson et al., 1990), a Murray-Darling Basin Commission funded Irrigation Management Strategy (Department of Agriculture, 1996) and a ‘behind the scenes’ investigation by the State-based Office of Water Sector Reform (Office of Water Sector Reform, 1993). The latter investigation had a clear focus on identifying and closing down unprofitable supply channels to enhance the financial performance of the water supply body. Inherent in this objective is the encouragement of farmers on poorly performing farms to leave the district. The Australian Conservation Foundation has taken an even stronger position in advocating structural adjustment in the Tragowel Plains to benefit the environment.

In some areas such as the Tragowel Plains and the Kerang region it seems that it will be simply a matter of time before salinisation ensures the almost complete demise of the agricultural economy. Surely it would be kinder and more prudent to adopt a policy which supports the rapid phase out of irrigation farming in these regions and the return of water allocations to the river system. Of course, this would need to be done with due respect for the social implications through the adoption of strategies which ensure minimal disruption. (Alexandra, 1991).

This political interest in Loddon adjustment was strengthened when an unexpected hole appeared in the skirt of the Torrumbarry Weir in the early 1990s. This emergency
required an immediate commitment to repair or to build a replacement weir. Engineering advice was that building a replacement was the only reasonable option.

Under the Murray Darling Basin Agreement, the cost of the replacement weir had to be borne by the four participating governments - the State governments of Victoria, New South Wales, South Australia and the federal government. This agreement dates from the time when weirs along the Murray were necessary to maintain trade and commerce. This situation provided an early test of the COAG agreements on water sector investment. The Australian Government representatives took a strong view that the replacement of the weir needed to be economically evaluated and that it should only be built if there was a commensurate commitment to accelerated structural adjustment of the broadacre irrigation industries in the Loddon Valley. The Commonwealth did not have the powers to enforce such a stand. Rebuilding the weir was an inevitability under the Murray Darling Basin Act. However, Victoria agreed to join a partnership program with the Commonwealth and the Loddon community to facilitate regional development in this district.

The plan was to be part of the Rural Partnerships Program. This was a Commonwealth co-ordinated project which aimed to co-ordinate funding from a range of Commonwealth and State sources to achieve adjustment objectives in areas selected as suffering significant regional adjustment problems. The program was based on the notion of a partnership between local communities and State and Federal governments to co-ordinate funding within existing programs to target the key problems in targeted regional areas. Rarely is government use of such inclusive ‘community’ rhetoric unaccompanied by a government perception of an unequal power relationship between the partners (Fitzgerald, 1997; G. Gorrie, 1997). The growth of the Rural Partnerships program was driven by political imperative. The first projects were in areas receiving significant drought exceptional circumstance funding or adjustment funding in response to pressures in the tobacco industry caused by the removal of tariffs and price supports. These areas were South West Queensland (Australia and New Zealand Environment and Conservation Council, 1996; Hoey, 1994), the Western Division of NSW (West 2000 Management Board, 1997; Wood, 1997), the Gascoyne-Murchison the Eyre Peninsula, the Atherton Tablelands and north east Victoria. The motivation of the Commonwealth was clear in each case . . . to
reduce the dependence of these areas on industry support. As such, the Rural Partnerships program is, from the Commonwealth perspective, a continuation of the withdrawal of government services from rural areas outlined in chapter three. The clear focus of a number of the early partnership programs was the encouragement of rangeland farmers to leave agriculture. The Rural Partnerships Programs in these areas were seen by the Department of Primary Industries and Energy as ‘getting the region’s farmers off the government payroll’ (DPIE, pers. comm.). The payroll in those cases was drought assistance. Subsequent additions to the Rural Partnerships Program portfolio confirm this analysis. The Sunraysia, Riverland (Kerby et al., 1994) and Riverina joined the program in response to the implementation of the Council of Australian Governments water reform agenda. The lower Loddon irrigation districts became a partner as part of the negotiations between State and Commonwealth over the shared funding to replace the damaged Torrumbarry weir. The newest partner is the South Coast of Western Australia (Goss, 1997).

The success of a partnership must be based upon common objectives between all partners. The experience on the Loddon is an indication that perhaps there is a fundamental difference of objectives between the partners. The representatives of the irrigation community defined their mission as being to ‘achieve prosperity for the Loddon-Murray region through strong and sustainable economic growth’ (Rendell, 1996). The key to this prosperity was identified as adjustment which transferred water to higher value uses within the region, mirroring the objectives of the Tragowel Plains community planners. This was to be achieved by a number of strategies including expanding horticulture and improving regional infrastructure. Nowhere was a proposal for structural adjustment of low performing farms explicitly targeted in the group’s strategic plan (Rendell McGuckian and Associates, 1996). In explaining this decision, the authors made it clear that they were adopting a ‘solution focussed rather than problem solving approach’.

There are too many non-viable farmers with low value enterprises in the region.

There is currently a system in place (transferable water entitlements) for water to leave low value agriculture which generally caters well for the sellers.

Concentrating all efforts on the non-viable farmers is not considered efficient within the Loddon-Murray 2000 plus strategy. The Loddon Murray region
needs more high value agriculture and the strategy needs to identify and facilitate high value agricultural opportunities. The development of these opportunities will increase the transfer of water and cause substantial structural adjustment. (Rendell McGuckian and Associates, 1996).

Very little provision was made in the plan for this activity beyond proposed funding for the facilitation of family goal planning for ‘trapped’ families. This activity was seen as encouraging these families to ‘see a way to a more positive future’. The development of high value enterprises and the work of informing the market of resource status undertaken in salinity plans was proposed as the major activity to catalyse significant structural adjustment (Department of Natural Resources and Environment Victoria, 1997).

To the Commonwealth the proposed partnership program as outlined in the Loddon Murray 2000 plan was not acceptable in the way it approached the issue of structural adjustment. To them ‘regional development’ meant at least in part a restructuring of the irrigation industry which would see irrigation water moving to higher value uses elsewhere in the basin as predicted in econometric modelling of the water market, or to environmental uses. The representatives of the Commonwealth Department of Primary Industry and Energy expected that a regional development plan for the lower Loddon would include specific proposals for enhancing structural adjustment. The response of Victorian Government representatives was that the structural adjustment measures contained or implied in the Loddon Murray 2000+ plan and the Tragowel Plains Salinity Management Plan would facilitate structural adjustment by moving water from high salinity soil to low salinity soil within the Tragowel Plains or further afield. The application of similar measures over the rest of the lower Loddon irrigation region would achieve the adjustment sought by the Commonwealth.

One means of conceptualising these differences in opinion between the policy actors in the development of the Loddon-Murray 2000+ plan is to construct both the implicit theories upon which each actor is basing his or her judgement of appropriate structural adjustment tools for the region. While the differences between the actors were in part due to differences in social goals, some differences were due to differences in implicit models of
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The representatives of the Loddon-Murray community shared a common social objective of ensuring the social sustainability of irrigation communities upon the Loddon Plains. The means to this objective was seen to be through facilitating the transfer of irrigation water from low value uses to high value uses within the Loddon-Murray region. The implicit theory underlying the Tragowel Plains Salinity Plan and the discussions over the Loddon-Murray 2000+ plan could be encapsulated as follows:

- Irrigation water is being applied to saline soils due to an inability of farm managers to accurately distinguish between saline soils and soils with a history of low fertiliser and management input and a lack of opportunities to apply water to higher value uses due to a shortage of non-saline soils on properties, and a lack of a market mechanism to enable the transfer of water between properties.

- Investment in the development of low salinity land has been slowed by the inability to differentiate between saline soils and soils with a history of low fertiliser and management input, leading to a risk-averse management style.

- Provision of detailed soil salinity survey data in a context of a water market will lead to the retirement of saline soils from irrigation, the re-allocation of irrigation water from saline soils to higher value uses on non-saline soils, and investment in the development of non saline soils suitable for irrigation.

- The preponderance of small farms in the region is best addressed by facilitating the opportunities for businesses to grow by reducing the risk associated with inaccurate appraisal of land salinity status. These farms will in many cases be able to fund the purchase of land and water resources currently employed in small farms. This will reduce the number of small farms in the region.

The representatives of the Department of the Department of Primary Industry and Energy placed a differing emphasis on the goals of sustainability. Water use efficiency and environmental sustainability objectives were not necessarily compatible with the social sustainability objective of the Loddon-Murray community. However, in questioning the
Victorian position that proposals to facilitate structural change towards more efficient water use and a reduction in small number of small irrigation farms, they were also questioning the validity of the implicit theory I have inferred above. They were presented with no evidence to support the implicit theory of the local community.

On strategies to reduce the number of small farms, it is possible to recognise two opposing theories of structural adjustment. While Loddon-Murray 2000+ representatives made a clear statement in their strategic plan that there was little to be gained in committing resources to encourage the owners of small farms to leave agriculture, Commonwealth representatives clearly believed otherwise. They were adhering to an implicit model of structural change in agriculture which has recently been placed under question by researchers in the North America and Europe. Jackson-Smith (1999) described this implicit model thus:

> Over time most analysts have adopted an implicit model of structural change that is driven by the relative economic viability of different types of farms. A focus on competition in the market place as a key mechanism for structural change has led to the common, but largely untested, belief that most change occurs via the involuntary exit of farmers who could not compete, and the (inevitable) adaptations of those who remain in business.

In the United States studies of micro adjustment in agriculture have shown that the rate of entry to and exit from agriculture have been generally higher than has been assumed on the basis of net declines in farm numbers (Gale 1994, 1996). These higher than expected rates of entry and exit are consistent with research in Canada, where longitudinally matched census data allow tracking of farm ownership trajectories (Steeves, 1979; Ehrensaft and Bollman, 1984). In a panel data study of Wisconsin farmers, Jackson-Smith (1999) concluded that small changes in entry and exit rates can have significant impact upon the observed net change in farmer numbers.

These results suggest that structural adjustment policy should be focussed upon both exits and entry to agriculture. In the case of the Loddon-Murray region, the local community was explicitly arguing that too great an emphasis was being placed upon encouraging exits from
agriculture. This position is taken even further by Gale (1996), who argued that in the United States exit rates appear to have been relatively constant over time, and that variations in the rate at which farm numbers fall are driven by changing rates of entry into agriculture.

The differences in the implicit theories of the actors developing the Loddon-Murray 2000+ plan were essentially unresolvable due to the absence of reliable data on the extent of structural adjustment on the Tragowel Plains, the relationship between this adjustment and either the activities promoted under the Tragowel Plains Salinity Management Plan or the alternative adjustment policy tools utilised with the Rural Adjustment Scheme or in other partnership programs. It is the intention of this author test the implicit theories of the actors in this policy debate.
To recap the discussion in the previous chapters, the Tragowel Plains Salinity Management Plan was a catchment plan which has been developed with possibly as high a level of community support as any in Australia. By 1995 the plan had been under implementation for six years with significant financial support from State and Federal governments. The plan promoted Best Environmental Management Practices which are in many cases potentially advantageous to the farm business. When viewed from a catchment planning perspective the plan should have resulted in significant adoption of the farm management practices it advocates. Further, the plan attempted to promote structural adjustment within the region in a form acceptable to the local community.

However, the plan had been implemented during a time of significant change in the commodity and administrative environment in which Tragowel Plains farm businesses operated. There was also debate over the extent to which the plan would promote structural adjustment and whether the adjustment it promoted was of a ‘preferred’ form. The measures in the Tragowel Plains Salinity Management Plan had been portrayed, in tandem with the proposed regional development plan, as an effective tool to restructure agriculture in the Loddon-Torrumbarry irrigation districts. From one perspective the plan could have been interpreted as a correction of a market failure caused by a lack of information about the state of the natural resource.

There was no consensus as to whether the plan was likely to contribute to an appropriate restructuring of the district. This was in part due to a lack of consensus on what form a more appropriately structured agriculture may take, but also in part due to difference in implicit theories of structural change which were used by the policy actors in the debate.

The object of this thesis is to examine the validity of the implicit theories of the policy actors by examining the effectiveness of the Tragowel Plains Salinity Management Plan in achieving its stated objectives in changing farm management behaviour, and its wider influence on the path of structural adjustment in the region.
Informing salinity appraisal

The whole structure of the Tragowel Plains Salinity Management Plan is built upon the assumption that farm managers were unable to accurately perceive the extent of salting on their farms. This inability to accurately assess the extent of soil salting was seen as the reason for misguided attempts to reclaim saline land, for the application of water to unproductive saline land and for the reticence of many farmers to invest in water management technology (Tragowel Plains Salinity Working Group, 1988). Any impact of the plan upon farm management behaviour and structural adjustment in the region is assumed to be an outcome of better informing farm managers of the resource condition of their farm.

The assumption of poor appraisal of soil salinity was based upon slender foundations. The evidence comes from the results of a survey of 29 farms conducted in 1989. These farms were selected randomly. The survey found that farmers generally underestimated the extent of salinity on their farms (Norman et al., 1988). This finding was somewhat at odds with the results of Barr and Cary (1984) who concluded that irrigation farmers in two localities in the nearby Campaspe West and Girgarre irrigation settlements were reasonably accurate in their assessments of soil salinity on their farms.

The results of comprehensive soil salinity surveying of the Tragowel Plains clearly show that the farms in the initial sample of 29 were significantly more salted than other Tragowel Plains farms (Tragowel Plains Salinity Plan Implementation Group, 1995). Any interaction between the extent of salinity on a farm and the accuracy of farmer perception would render the findings from the small sample invalid. A major question to be addressed by this thesis must therefore be a review of the accuracy of farmers’ assessments of soil salinity on their farms prior to the commencement of the Tragowel Plains Salinity Management Plan. A related question is whether farm managers changed their estimation of salinity in response to the soil salinity survey results they have received. This latter question could be rephrased as ‘Do farm managers believe the results of soil salinity surveys using EM-38 meters?’. Answers to both these questions will enable us to address the first major research question:

Research issue 1: Have the soil salinity surveys improved farmers’ appraisal of soil salinity?
• How accurate were farm managers’ appraisals of soil salinity prior to the commencement of the Tragowel Plains Salinity Management Plan?

• Have farmers’ appraisals of soil salinity on their farms changed in response to the results of soil salinity surveys?

Retiring saline soils

The second major assumption of the Tragowel Plains Salinity Management Plan was that provision of accurate soil salinity information would lead to a change in the management of water and soils. Specifically, it was assumed that farm managers would reallocate water from high salinity soil to low salinity soil and manage saline soils according to soil capabilities. Again, the survey which formed the basis of the Tragowel Plains Salinity Management Plan found that on the 29 farms in its sample a significant number were applying irrigation water to saline soils, an activity which produced little or no financial return (ACIL, 1988). Given the unrepresentative high levels of salinity on these sample farms, it is possible that the applications of irrigation water to saline soils in this group were also unrepresentative. With large areas of saline soil on these farms, there may have been little option but to apply irrigation water to these soils. (Transferable water entitlements were not available at the time of the initial survey.)

It was also assumed that the application of irrigation water to this saline soil was as a result of the lack of knowledge of salinity status, and that improving this knowledge of the salinity status would be sufficient to persuade farm managers to cease irrigation of this land and manage it with strategies appropriate for saline soils. However, an alternative explanation of the irrigation of saline land may well lie in beliefs about the need to maintain a leaching fraction over as much land as possible to prevent land becoming salty, or even in the belief in reclamation of already saline soil. These beliefs might be called Morgan’s legacy (Morgan, 1947). If these beliefs are indeed an explanation for the application of irrigation water to saline soils, then the provision of soil salinity data may well have no influence on decisions about the application of irrigation water and may even reinforce the practice of irrigating saline soils.

The inclusion of halophyte sowing as a supported activity in the Tragowel Plains Salinity Management Plan was intended to provide an alternative strategy to irrigation which farmers could use as a means of protecting saline soils. Whilst there is little economic return
from this management recommendation, it was seen as necessary to make the land retirement option more attractive. The management steps from land retirement through to sowing of halophytes are promoted as part of the suite of Best Environmental Management Practices for this area. It was assumed that these practices would be adopted in preference to continued irrigation of saline land.

**Research issue 2: Has the provision of soil salinity survey information led to the changes in the management of saline soils?**

- How extensive was the irrigation of saline soils?
- Has there been a reduction in the irrigation of saline soils since the availability of soil salinity survey results?
- Are saline soils being managed with the Best Environmental Management Practices recommended in the Tragowel Plains Salinity Management Plan?

**Reallocating irrigation water**

The success of measures to transfer water from applications to saline soils is in part judged by the value of the alternative use to which that water is applied. It must be remembered that the justification for the Salinity Plan recommendation to withdraw water from application to saline soils is based less on environmental grounds than on the grounds of maximising the return to the community from a scarce resource.

The simplest re-allocation option is to apply the released water over the rest of the farm. There are three methods this could be achieved. Whether one sees any of these alternatives as the Best Environmental Management Practices for the area depends to an extent on how one defines one’s community of concern.

The first option for re-allocation of water is greater applications of water to existing areas of annual pasture. This is generally seen as undesirable from a State economic viewpoint. Gross margins for annual pasture products are seen as low value uses for irrigation water. There is a general consensus amongst both environmental and economic oriented observers that this is a poor outcome for re-allocated water. However, some local agricultural advisers believe there is scope for this to make significant improvements to the productivity of annual pastures and that
these improvements would be the least risk alternative for many farm managers whose businesses lack the ability to fund investment in water management. A survey in 1990 revealed widespread poor irrigation management of annual pastures (Nicholson and Heslop, 1990). Work at the Tragowel Plains Demonstration Block has sought to demonstrate the improved productivity to be gained by concentrating water on better annual pastures and watering more often to meet the needs of the pasture, rather than according to a calendar schedule (Hammett, 1994).

A second option is the re-allocation of water to the irrigation of perennial pasture. The Tragowel Plains Salinity Management Planning documents argue that accurate soils salinity maps will reduce the risk of investment in improved land relayout. If this were the case, then we would expect that some of the water withdrawn from saline soils would be reallocated to improved shaftal or perennial pastures which require higher standards of layout than sub clover based annual pastures. Perennial pasture is seen as a desirable outcome from the viewpoint of economic return for water. There were a number of attempts to promote the increased sowing or perennial pastures in the 1980s, but no observable change was achieved.

A third option is to increase water security and reduce consumption charges merely by reducing the use of sales water. This outcome would be seen as undesirable by the Tragowel Plains Salinity Management Working Group as it would lead to no increase in production for the region. However, from an environmental viewpoint, it could be argued this would reduce the pressure of recharge to the watertable.

Water no longer applied to saline soils could be reallocated beyond the boundaries of the farm by another three options. It may be reallocated to other properties within the Tragowel Plains by transfer of water entitlement on a temporary or permanent basis. It could also be reallocated indirectly by property amalgamation and subsequent internal transfer across previous property boundaries. Finally, it could be transferred beyond the boundaries of the Tragowel Plains through permanent or temporary transfer of water entitlement.

Research Issue 3: Has water released by the retirement of saline soils been reallocated to higher value uses?

- What volume of water has been made available for re-allocation by through reduced irrigation of C and D class soils?
The research issues

- To what purposes has this water released from C and D class irrigation been re-allocated?

**Investment in water management on low salinity land**

A major catalyst for the development of the Tragowel Plains Salinity Management Plan was the poor financial outcomes experienced by the farmers who invested in salinity control and water management infrastructure in the mid-1980s. An assumption of the plan was that an inability to identify non-saline land appropriate for development was a major contributor to these failures and, as such, was a potent disincentive to further investment in water management. By providing accurate information on salinity status, the plan was intended to remove this barrier to investment in whole farm planning, farm drainage and land relayout.

One indication of the success of the Salinity Plan as a catalyst for adjustment would be an increase in the adoption of these measures, particularly as an integrated package with a whole farm plan directing the extent of investment in drainage and relayout. A more particular test of the effectiveness of the Salinity Plan would be a change in behaviour of two particular segments of the farming population in 1987. The Deterred Developers were not inclined to invest in relayout, despite having undertaken a whole farm plan. They were generally apprehensive of the risks involved. Renewed investment in land relayout by members of this group would be consistent with the aim of the Salinity Plan to remove uncertainty. The Intending Developers group had no whole farm plan, yet intended to invest in land relayout. Adoption of whole farm planning by members of this group could reasonably be attributed to the soil salinity survey cross-compliance mechanisms used in the Salinity Plan.

**Research Issue 4: Has there been an increase in the adoption of land whole farm planning and relayout as part of an integrated farm management package.**

- Has the adoption of whole farm planning increased in general, and in particular by the group of farmers previously identified as Intending Developers.
- Has the adoption of laser grading increased in general, and in particular amongst that group of farmers previously identified as Deterred Developers.
Farm consolidation and the “small farm problem”

At the centre of the previously recounted debate over the inclusion of a structural adjustment component in the Loddon-Murray 2000 Regional Development Plan was the question of whether the strategies in the Tragowel Plains plan have encouraged a significant degree of ‘desirable’ structural adjustment. The resolution of this debate was limited by a lack of any definitive information on the extent and nature of adjustment which was occurring and by differing beliefs as to the most appropriate form of structural adjustment.

The nature of ‘appropriate’ structural adjustment as desired by different parties has been discussed in greater detail elsewhere. To simplify the debate I have concentrated upon three positions which I have labelled as social, economic and environmental. The social perspective on structural adjustment encompasses many views. If the view of Lawrence (1987), based upon community self-determination, is adopted, then the desirable form of adjustment is that acceptable to the Tragowel Plains community. These are the recommendations contained in both the Tragowel Plains Salinity Management Plan and the Loddon-Murray 2000+ regional development plan. The Tragowel Plains Salinity Management Plan aimed for modest influence on structural adjustment through the provision of soil salinity information at the paddock level to farm managers and by the provision of a stamp duty rebate to assist with the amalgamation of sub-economic sized farm units. In providing these forms of assistance, the objectives were for there to be a transfer of water from saline soils to non-saline soils, but also an increase in the number of viable properties through amalgamation of resources, and a reversal of the trend towards expansion by land acquisition associated with low input management strategies.

The economic view of desirable structural adjustment is quite clear. Water would be transferred to higher value activities, whether on or off the Tragowel Plains. There would also be a net exit of farmers from the mixed farming sector in particular and property amalgamation to create larger farm businesses.

The environmental position on desirable structural adjustment is less clearly articulated, but two aspects of structural adjustment merit consideration as indicators of environmental desirability. The first is the question of whether exits from farming enhance or reduce the probability of the adoption of environmental Best Management Practices. The second is whether
The research issues

The form of structural adjustment encouraged by the Tragowel Plains Salinity Management Plan provides opportunities for the transfer of water resources to environmental purposes.

A major difference in the theoretical model of the actors in the debate was the implicit position of the Commonwealth representatives that a low rate of aggregation of properties on the Tragowel Plains was caused by a low rate of exit from farming, and that the most appropriate policy tool to respond to this was to facilitate an increased rate of exit from farming. The community representatives did not accept this implicit model of the problem, arguing that the existence of a greater number of financially successful farm businesses in the region would facilitate greater farm consolidation. Since the implicit Commonwealth model of farm consolidation underlies much of national structural adjustment policy over the past three decades, any lessons for structural adjustment policy gained from this study may have application elsewhere in rural Australia. Any questioning of the validity of the “exit enhancement” model of agricultural adjustment has potentially significant implications for national structural adjustment policy.

Research Issue 5: What patterns of structural adjustment have been followed by the farm businesses of the Tragowel Plains?

- To what extent are low exit rates from farming contributing to the continued existence of a small farm sector on the Tragowel Plains?

- To what extent are high entry rates to farming contributing to the continued existence of a small farm sector on the Tragowel Plains?

Research issue 6: Are the processes of adjustment observed on the Tragowel Plains consistent with adjustment elsewhere in Australian agriculture?

- Are the observed rates of exit and entry to agriculture on the Tragowel Plains consistent with those observed elsewhere in Australia?

- Are the patterns of consolidation, fragmentation and polarisation observed on the Tragowel Plains consistent with those observed elsewhere in south east Australia?

Having measured the extent to which the agriculture sector has adjusted towards more efficient water use and greater farm consolidation, we need to assess the contribution of the
Tragowel Plains Salinity Management Plan to these changes. Have the outcomes of structural
adjustment been consistent with the objectives of the Salinity Management Plan? Has the
Tragowel Plains Salinity Management Plan been a significant factor in facilitating restructuring?
Has the nature of structural adjustment acted as a barrier to the implementation of the Best
Management Practices recommended in the plan?

Research Issue 7: What has been the relationship between the Tragowel Plains Salinity
Management Plan and structural adjustment on the Tragowel Plains?

• Has the Tragowel Plains Salinity Management Plan influenced the rate of structural
  change and farm consolidation amongst Tragowel Plains farms?

• Has structural change influenced the rate of adoption of Best Environmental
  Management Practices advocated in the Tragowel Plains Salinity Management Plan?

An assessment of the outcomes of the plan

In the final chapters I discuss the adjustment outcomes on the Tragowel Plains during
the period of the implementation of the salinity management plan. These outcomes are reviewed
from the perspective of the social, economic and environmental positions outlined in the early
chapters of this report. The implicit models used by the actors in the policy debate are assessed.
Where the observed outcomes of adjustment are judged to be inconsistent with the objectives of
either the community or governments, I consider the potential impact of alternative adjustment
policy tools. Alternative policy tools to be considered will include those used in past
incarnations of the Rural Adjustment Scheme, in the Rural Reconstruction Scheme, the Loddon-
Murray 2000+ regional development plan and the recently released Integrated Rural Policy
Package.
Research methods

The study area

The Tragowel Plains study area is situated between the regional centres of Bendigo and Kerang, on the northern riverine plain of northern Victoria. The nearest towns are Pyramid Hill and Boort. Goulburn Murray Water supplies irrigation water to farms in this region as part of the Pyramid Hill Irrigation District (PHID). Water is supplied from the Goulburn River system and is transported into the district in the Waranga Channel. Adjacent to the PHID is the East Loddon Water Supply District (ELWSD). This is made up of farms surrounding the southern part of the irrigation district. Farms in ELWSD are supplied water for stock and domestic purposes by Goulburn Murray Water.

For the purposes of this study, the farms in the district have been divided into five distinct districts. These are shown in Figure 4.

- The Pyramid Hill district situated south of the Macorna channel, north of the Durham Ox-Mitiamo Road and west of Pyramid Creek. This is a predominantly mixed farming district. Farms in this district are within both the Pyramid Hill Irrigation District and the Tragowel Plains Salinity Management Region.

- The Calivil-Dingee district, situated south of the Durham Ox-Mitiamo Road. The majority of irrigation farms in this district are dairy businesses. These farms are also part of both the Pyramid Hill Irrigation District and the Tragowel Plains Salinity Management region.

- Mincha-Patho district. Many farms in this district are owned by dairy farmers whose base of operations is in the nearby Cohuna district. The Tragowel Plains blocks owned by these dairy farmers are operated as winter ‘run-off’ blocks and used to agist dry dairy cattle. These farms are also part of both the Pyramid Hill Irrigation District and the Tragowel Plains Salinity Management region.
• Macorna North. This small number of irrigation properties are situated north of the Macorna Channel and are part of the Torrumbarry irrigation district. These properties were originally not part of the Tragowel Plains Salinity Management region. They were added to Tragowel Plains Salinity Region after the commencement of plan implementation.

• East Loddon Water Supply District. These farms are not part of the Pyramid Hill irrigation district, but are supplied stock and domestic water by the same supply system. With the introduction of transferable water rights many of these properties are in a position to purchase water from more saline properties and increase irrigation intensity.

The focus of this study is upon farms operating in the Pyramid Hill region bounded by the Macorna Channel in the north, the Durham Ox-Mitiamo Road in the south, the Loddon River to the west and Pyramid-Bullock Creeks to the east. It is in this district that salinity levels are highest, that adjustment pressures are strongest and the availability of data is highest. Information from the Calivil-Dingee area and the Mincha-Patho area are used where available to assist in understanding the adjustment and adoption processes occurring in the Pyramid Hill district.

The data sources

The Tragowel Plains provides an opportunity to study the adoption of Best Environmental Management Practices (BEMPs) and structural adjustment with a uniquely rich data set. The existence of this data set is in part due to the choice of the Tragowel Plains as one of the earliest attempts at salinity planning in Victoria and its status as an irrigation district. This research program is based upon a combination of quantitative data derived from personal interviews, soil salinity measurements, remote sensing and archival water-use data. The study is also longitudinal with various data sets available for the period between 1987 and 1996. The availability of this longitudinal data is a key resource in allowing an exploration of the relationship between salinity control strategies and structural adjustment. In the following sections each component of the project database is described in detail. The geographical coverage of all database components is summarised in Table 5.
Figure 4  Sub-regions of the Tragowel Plains
Personal interview data

1987 ‘Sociological study’

In late 1985 a ‘sociological’ study of the Tragowel Plains was proposed by extension officers of the Department of Agriculture. This was at a time when concern over the negative social impacts of laser relayout was at its peak. The purpose of the survey was to test the hypothesis of some extension officers that personal stress was preventing farm managers from making sensible decisions about investment in laser relayout and management of recently lased land. A committee composed of farmers and representatives of the Department of Agriculture, Institute of Family Studies, Department of Water Resources and the Bendigo College of Advanced Education worked through 1986 to design the study (Barr, 1988).

The population of the study was defined as families living on farms in the Tragowel Plains Irrigation Area south of the Macorna channel and north of the Mitiamo-Jarklin Road. This corresponds with the Pyramid Hill sub-region described earlier in this chapter. Within this region it was estimated there were 185 farming families. This sample frame excluded properties in the Patho and Mincha parishes in the far north east of the irrigation area as most of these properties were owned by Cohuna domiciled families and were operated as run-off blocks. A sample of approximately 106 families was selected. Members of these families were interviewed in the first half of 1987. The main survey instrument was answered by the person undertaking greatest responsibility for farm management. Additional survey instruments were answered by other adult family members.

The interview schedule for this study was designed to collect information for three different entities. For farms information was collected on household structure, farm enterprises, financial performance, investment in laser grading and salinity control and salinity status. For families information was collected on family structure, income sources (farm and off-farm) and future expectations. Adult individuals within families were asked to provide information on basic demographic characteristics, education, workforce status and a significant amount of data on psychological satisfaction, well-being and stress. This psychological data was used to construct scales for sense of mastery, goal orientation, fatalism, sense of competence, optimism, distress and satisfaction.
The results of this study were reported in an unpublished report and later used as a significant contribution to the development of the Tragowel Plains Salinity Management Plan (Barr, 1988). The author of this thesis was the major author of this report and acted as custodian of the data key and the data over the intervening decade.

1995 Adoption and Adjustment interview study

In 1995 another personal interview study was conducted amongst the farming families of the Tragowel Plains. This study was designed to measure the performance of the Tragowel Plains Salinity Management Plan by determining changes in farm management and structure. The interview schedule collected data at four entity levels: farm business, household, individual and cadastral unit of land (individual title).

For the farm business data was collected on farm structure, household structure, financial performance, investment in salinity control, adjustment expectations and adoption of salinity control management strategies. These latter strategies included laser relayout, farm drainage, tree planting, improved annual pasture management and whole farm planning.

At the family data level data was collected on family structure and income. At the individual level basic demographic, education and training details were collected. In comparison to the 1987 instrument, there was far greater detail of farm structure and performance and adoption of salinity control management strategies. There was no collection of data on psychological indicators of sense of mastery, goal orientation, fatalism, sense of competence, optimism, distress and satisfaction. The survey instrument was answered by the person taking greatest responsibility for farm management decision making.

Table 2  Sampling strategy for 1987 interview survey

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population of farms 1986-87</td>
<td>252</td>
</tr>
<tr>
<td>Number of farms approached for interview</td>
<td>115</td>
</tr>
<tr>
<td>Number of interviews</td>
<td>106</td>
</tr>
<tr>
<td>Refusals or inability to make contact</td>
<td>9</td>
</tr>
<tr>
<td>Response rate to sample</td>
<td>92%</td>
</tr>
<tr>
<td>Effective sample rate (Interviews as a % of population)</td>
<td>38.5%</td>
</tr>
</tbody>
</table>
At the paddock level detailed data was collected on the management of saline land. This included identification of saline land, changes in irrigation of saline land, fencing, grazing control and sowing of halophytes. Preparation for interview included the printing of maps of the interviewee’s farm using a cadastral database available on the Department of Agriculture’s GIS. These maps showed title boundaries, roads, drainage lines and title identification. These maps were used extensively in the interview process, allowing firm identification of land owned by the farm business. Farmers were asked to draw in areas of C and D class saline land. They were then questioned on the changes in management of each area of saline land identified. Thus areas of saline land became another data entity, with one cadastral unit containing possibly many different areas of saline land.

![Figure 5 Examples of paddock records used in 1995 interview survey](image)

It was the intention of this study to use a repeated measures design to improve the power of longitudinal statistical testing. In an unchanging agricultural environment the sample frame would thus have been those farm businesses which were previously interviewed in 1987.
However, in the years since the 1987 survey it was expected there would have been significant change in the structure of the agricultural businesses of the plains. Some farm businesses would have been sold to new owners. Some existing operators would have acquired extra land. Others would have sold some land whilst remaining in the district. New farm managers would have entered the district. In this dynamic environment, the sample frame for a longitudinal study differs according to the data entity being studied.

For a longitudinal study of farm businesses, the sample frame must include both the owners of farm businesses who were included in the 1987 sample and have remained in the district since, as well as those new farmers in the district who have entered by purchasing businesses or parts of businesses which were in the 1987 sample. It will not include farm businesses which were present in 1987 but excluded from the 1987 sample, even though those businesses have since purchased all or part of a farm which was included in the 1987 sample. Inclusion of these businesses would bias the repeat sample towards larger farms.

By using property records of Goulburn Murray Water and accessing local knowledge of informants it was possible to identify 26 new farm owners who had purchased land sold by members of the 1987 survey sample and who still owned and farmed this land at the time of the 1995 survey. A further 7 new operators had purchased farms from the 1987 sample but had since sold their business in turn. Only 8 farms sold by the 1987 sample had been purchased in full or part by existing property owners. In addition to the 27 new farm operators, a further 12 new farm managers had commenced their career through purchase or some other transfer mechanism from parents. The 12 transfers from parents were from 6 original farm businesses.

At the request of the Tragowel Plains Salinity Plan Implementation Group, an addition to the sample was made to include farms in the Calivil and Dingee districts in the south of the planning area. These areas had been excluded from the original survey as there was at that stage little concern over the deleterious impact of investment in laser grading and the lower levels of soil salinity. The sampling rate for this additional area was based upon the effective rate of sampling undertaken in the northern part of the planning area.
Land and water ownership Data

Historically tenure of land and water have been legally linked in Victorian State sponsored irrigation schemes. The State Rivers and Water Supply Commission and its successors have maintained integrated records of land and water tenure reflecting this link. The key data entity in these records has been the Register Entry Number (REN), more recently renamed the Supply Point Group. The REN is an aggregation of crown allotments (the base unit of land ownership records) which have in common a single owner. Associated with each REN is a Water Right. Farm businesses may consist of one or more RENs. In most cases a REN consists of contiguous crown allotments.

The REN is not a stable entity over time. The ownership of crown allotments of which it is composed may change to reflect land transfers between properties or administrative changes.

Table 3  Sampling strategy for Pyramid Hill region farms in 1995

<table>
<thead>
<tr>
<th></th>
<th>Surviving Businesses</th>
<th>New businesses which purchased land of exiting businesses</th>
<th>Businesses which have transferred from previous generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number in 1995</td>
<td>64</td>
<td>26</td>
<td>12</td>
</tr>
<tr>
<td>Number approached</td>
<td>64</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td>Number interviewed</td>
<td>60</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>Response rate to sample</td>
<td>93 %</td>
<td>78 %</td>
<td>100 %</td>
</tr>
<tr>
<td>Estimate of effective sample rate (interviews as a % of population)</td>
<td>39 %</td>
<td>29 %</td>
<td>42 %</td>
</tr>
<tr>
<td>Weighting</td>
<td>1.07</td>
<td>1.44</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4  Sampling strategy for Calivil-Dingee farms in 1995

<table>
<thead>
<tr>
<th></th>
<th>Population 1995</th>
<th>Number of subjects approached for interview</th>
<th>Number of subjects interviewed</th>
<th>Response Rate to Sample</th>
<th>Effective Response Rate (Interviews as a % of population)</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population 1995</td>
<td>125</td>
<td>43</td>
<td>37</td>
<td>86 %</td>
<td>30 %</td>
<td>1.40</td>
</tr>
</tbody>
</table>

Land and water ownership Data

Historically tenure of land and water have been legally linked in Victorian State sponsored irrigation schemes. The State Rivers and Water Supply Commission and its successors have maintained integrated records of land and water tenure reflecting this link. The key data entity in these records has been the Register Entry Number (REN), more recently renamed the Supply Point Group. The REN is an aggregation of crown allotments (the base unit of land ownership records) which have in common a single owner. Associated with each REN is a Water Right. Farm businesses may consist of one or more RENs. In most cases a REN consists of contiguous crown allotments.

The REN is not a stable entity over time. The ownership of crown allotments of which it is composed may change to reflect land transfers between properties or administrative changes.
made by GMW. Where the crown allotments which compose a REN have been sold to a single new owner, the water authority has generally maintained the REN comprised of the same crown allotments and merely changed the record of ownership. However, where a REN has been purchased by the owner of an adjoining REN, the water authority has sometimes amalgamated the crown allotments of both RENs into a single REN. Where the Crown Allotments which comprise a single REN have been sold to a number of different owners, the water authority has generally used a combination of REN amalgamation and creation of new RENs to reflect the new tenure arrangements.

1986-87 land and water tenure

REN tenure for 1986-87 was recorded by the State Rivers and Water Supply Commission in an internal publication called the ‘Register of Lands’. No copy of this book could be obtained. It was administrative policy at the time to discard the previous year’s register on the arrival of the succeeding volume. However, privately archived copies of both culture sheets and water use records for the 1986-87 season were held by the author. No direct link between crown allotments and RENs could be obtained from this data. However, the 1987 REN archival material did report the size of land included in an REN aggregation. By comparing the size of REN bundles of crown allotments in 1987 and 1989-90 it was possible to determine which RENs had remained unchanged, and thus infer which 1987 RENs had the same structure as 1989-90 RENs. Using this method it was possible to recreate a majority of 1987 REN structures for businesses in the Pyramid Hill, Calivil-Dingee and Patho sub-districts. Further reconstruction was possible by using farm size provided in the 1987 social survey. The painstaking reconstruction resulted in an accurate allocation of 1305 (76 per cent) of crown allotments to Register Entry Numbers and owners.

1989-90 land and water tenure

A privately archived copy of the 1989-90 Register of Lands was available to the research team. This volume listed each REN and its associated ownership status, size, water right and the crown allotments from which it was comprised. This allowed the creation of a database table which detailed the one-to-many relationship between REN and crown allotments for this season and linked this to ownership. Because of the historic policy of allocating a fixed right to water to each crown allotment within an irrigation area, the Register of Lands provided a comprehensive
archive of ownership of all irrigated Crown allotments within the Pyramid Hill, Calivil-Dingee, East Loddon and Patho sub-regions of the irrigation area.

1990-91 land and water tenure

At the commencement of the implementation of the Tragowel Plains Salinity Management Plan the responsible implementation team created a GIS database to assist with the implementation of grants schemes. This database was built around the cadastral data obtained from the State Office of Geographic Data Co-ordination. For each crown allotment ownership was linked to the associated REN data from the water authority. This database was made available for this study. This database provided ownership information for all five sub-areas of the irrigation region.

1993-94 land and water tenure

In 1993-94 the newly formed Goulburn Murray Water ceased producing a Register of Lands. Instead it produced a database form called the Customer Information Base (CIB). This was a flat form database which detailed all the information in the previous Register of Lands, as well as details of water use. Unfortunately, the CIB is based upon REN as its key field and only held a single field for crown allotments, and in this text field all crown allotments for an REN were listed. Conversion into a relational one-to-many database was again a very time consuming exercise. This process provided water and land ownership data for all but the Macorna North sub-area.

1995-96 land and water tenure

1995-96 Customer Information Base of Goulburn Murray Water provided accurate information on the ownership of REN aggregations. However, the GMW land allotments records are based upon the 1993-94 cadastral data set which did not reflect recent subdivisions of crown allotments. This resulted in the creation of apparent inconsistencies where more than one REN was linked to a Crown allotment. These inconsistencies were resolved by the use of spatially referenced data describing GMW assets such as water supply wheels and a recent geographically defined cadastral data set. The new cadastre allowed the identification of changes in crown allotment structure. The link between supply wheels and billing allowed a geographical query to allocate ownership to new crown allotments.
The increasing commercial focus of Goulburn Murray Water and the removal of the permanent link between land and water right has focussed the data maintenance of this body on asset and water ownership rather than on land. The permanent sale of water from some properties has left crown allotments with no water allocation attached to them. It appears from the data that GMW no longer maintains records of these allotments within their Customer Information Base. Thus there is no longer an accessible record of ownership of this land. The link to these now unirrigated Crown allotments was created by using where possible information collected from survey respondents who identified the properties they owned on the cadastral maps provided by interviewers. Some remaining allotments were linked to owners using geographically located water authority asset descriptions as described in the previous paragraph. However, the process of linking was not complete, as wheels supply allotments other than that on which they are located. Data was reconstructed for the Pyramid Hill, Patho and Calivil-Dingee sub-regions.

**Water transaction data**

The Pyramid Hill office of Goulburn Murray Water has maintained a record of all permanent water transfers which have occurred since the introduction of permanent water transfers. This database identifies the nature of the transfer, the purchaser and the vendor. This database was made available for this research project.

**Water usage**

Although each property holds a fixed water right for any season, this water right does not reflect actual usage. In some cases, farmers will use less than their water right, particularly in wet seasons. Far more common is the extensive use of sales water in addition to the water right. Water usage is recorded by the water authority against REN, not crown allotment.

1986-87 water usage was available for many properties from privately archived copies of the bailiffs’ records for this season. This data provided water usage on a monthly basis.

The next available water usage data was for each season from 1991-92 through to season 1995-96. This data was available only aggregated as yearly consumption. Data was obtained from the 1993-94 and 1995-96 Customer Information Base of Goulburn Murray Water. The quality of this data varies according to the year. The structure of the CIB is, as mentioned before,
a flat form database. The 1993-94 CIB is based upon the REN as of 1993-94. Water consumption figures supplied for this year will reflect the land and water tenure structure of that year. However, the same table also provides water consumption figures for the two preceding years. It is unclear how any change in REN structure is reflected in these figures. Fortunately, most changes in ownership do not require any change in REN structure, but merely a change in ownership entity linked to the REN, so any discrepancy will be minor, relating to only a few RENs. The same structural problem is evident in the 1995-96 CIB which includes water consumption figures for both that year and the two preceding years. Water consumption data was not available for the Macorna North sub-region.

**Land culture data**

**1987 RWC Culture Census**

Land culture data refers to the form of agricultural and irrigation culture which the land is managed by in any particular season. Until the early 1980s water bailiffs maintained annual records of the water and irrigation culture used on each REN aggregation of crown allotments. This data was exhaustive, covering each allotment of irrigated land. However, there was some doubt as to the validity of the data. It was believed that there was insufficient incentive for water bailiffs to maintain high standards of data integrity. Nevertheless, this was the most extensive data source for land and water management available at the time and produced credible results when used to monitor the adoption of laser grading in the Goulburn Murray region (Ewers, 1988).

Culture sheet data collection was ceased in 1989-90. Like the Registers of Lands, culture sheet data has not been intentionally maintained as an archive. The data was intended for use in making water supply management decisions. However, as the data was not digitally coded, the extent to which the data was actually used has been questioned. With the break up of the State Rivers and Water Supply Commission and the increasing commercial focus of the succeeding water supply bodies, much culture sheet data has been destroyed. The author maintained a personal archive of 1986-87 culture sheet data for the Pyramid Hill, Patho and Calivil Dingee sub-regions. After coding, this data was able to be linked by REN fields into the project database. This data was not able to be linked at the crown allotment level.
In an effort to obtain new culture information at minimal cost, Goulburn Murray Water undertook a customer census in 1993. The census instrument was administered by mail. It covered a subset of questions included in the original culture sheet database, with some additional questions on salinity control included. Customers were offered an incentive of entry into a lottery for a prize of free water. Despite the incentive and the simple survey instrument, the census achieved a response rate of only 50 per cent. This level of response makes the data of only limited interest to this study. The data was obtained in electronic form from Goulburn Murray Water and integrated into the database at REN level for all sub-regions of this study area.

Remote sensed irrigation culture data.

In theory irrigated broad acre agriculture in the Tragowel Plains lends itself to identification by remote sensing. The key to remote sensing is the variation in vegetation growth through the year. Pastures and crops on unirrigated land will be inactive through summer and autumn. Annual pastures will be inactive in summer and active in autumn. Perennial pastures will be active in both summer and autumn. Summer crops will be active in summer and inactive in autumn. Pasture and growth activity can be remotely sensed using the near infra-red region of the spectrum based upon comparisons of imagery taken in mid-summer and autumn. The methodology for this remote sensing was developed by Howell and McAllister.

Unfortunately, there are a number of factors which may render this remote sensing ineffective. Rainfall can be a major disturbing factor, promoting plant activity in unirrigated pastures. An early seasonal break in autumn can prevent any reasonable use of remote sensed culture data in that season. Likewise, cloud cover during the time of the satellite pass can prevent images being obtained.

As part of this project imagery from the LandSat 5 satellite was used to secure remote sensed land cultural data. To gain useable satellite imagery for a year one needed images in mid-summer and mid-autumn which were taken on cloudless days and which had been preceded by a significant rain free period. The timing of images is critical. Late December or early January is considered an ideal time for a summer image. Any earlier than this and there is a chance that the image may detect growth in unirrigated crops and miss growth in summer crops which have not
Research methods

sufficiently matured. Any later and there is an increasing probability of detecting annual pastures composed of shaftal clover which are normally irrigated much earlier than sub-clover. Late April or early May is considered a good time for the autumn imagery if there has not been a preceding break in the weather. There is a significant variation in the time at which farmers irrigate first irrigate annual pasture. Any earlier than mid-autumn and there is a good chance that later first irrigations will not be detected.

As LandSat 5 passes each point on the earth’s surface once every 16 days, the above criteria are not easily met. For this project useable imagery was obtainable only for 1989-90, 1982-83 and 1995-96. In each of the other years in this sequence early autumn rainfall or cloud cover made imagery unacceptable. Two seasons, 1989-90 and 1995-96, were chosen for analysis. The first of these seasons corresponded to the commencement of the Tragowel Plains salinity program. The second of the chosen seasons provided the greatest period of time for comparison with plan commencement. Even these seasons contained significant compromises. In both seasons imagery was taken in early December due to later cloud cover and rain. This means there is a possibility of the images classifying late active annual pasture as summer crops. Both autumn images were also earlier than desirable due to rainfall in mid-April in both seasons. This compromise means there is a probability of the imagery not detecting later watered annual pastures and classifying these instead as unirrigated pastures (Abuzar et al., 1996).

Despite these difficulties, the imagery was still able to be relied upon to detect changes in area of perennial pastures and for this reason the data set was included in the project. The imagery was geographically linked to crown allotments, allowing a data table to be constructed with crown allotment as the key and with details of the percentage of the crown allotment growing perennial pasture. This data covered all sub-regions except for the East Loddon Water Supply District.

Salinity data

Soil salinity surveys using EM-38 meters has been the cornerstone of the Tragowel Plains Salinity Management Plan. For farmers these surveys have been required for access to any of the other incentives or programs contained in the Tragowel Plains Salinity Management Plan. For the planners the availability to farmers of reliable soil salinity data has been the intellectual justification for the plan. At the time of analysis soil salinity surveys had been completed for
103,065 hectares of the Tragowel Plains, 81 per cent of the total area (Tragowel Plains Salinity Plan Implementation Group, 1996).

The data from this survey was geographically linked and maintained in a database at the Institute for Sustainable Irrigated Agriculture in Tatura, consisting of 250,000 records. This was made available to the project. A GIS interrogation routine was used to calculate the area of class A, B, C and D soils for each crown allotment which had been surveyed. This allowed soil salinity data to be linked into the project database using the crown allotment as the key.

Subsequent monitoring of soil salinity on selected properties has revealed the probability of variation between years for salinity measurements. This variation seems to be due to differences in summer seasons. However, it appears that this variation is rarely greater than 10 per cent. This degree of variation is unlikely in most cases to be detectable in the growth of pastures and crops without sophisticated measurement methodologies (Terry, 1997; Terry et al., 1996).

**Incentives database**

The Salinity Plan Implementation Team has maintained a database of incentives use by farmers. Incentives on this database include soil salinity surveys, whole farm planning, surface drainage, planting of salt tolerant vegetation, fencing of saline land and planting of trees. Only those activities which have been supported by Salinity Plan grants are included in the database. Hence, whilst the coverage of soil salinity surveys and whole farm planning may be expected to be comprehensive, it is probable that the tree planting recorded is only a small proportion of the total activity taking place.

The database indicates which year the incentive was used between 1989-90 and 1995-96. Some entities (such as farm planning and soil surveying) are geographically located to crown allotments, allowing linking into this research projects database by this key. Other entities are not geographically linked to crown allotments, but are instead based upon REN as a key. To further complicate matters, the database takes no account of the dynamic relationship between ownership and land.
Structuring the data

Data obtained for this project was structured around a number of data keys. To understand the final structuring of the project database it is important to appreciate the features of each of these keys.
• Farm business: The major unit of analysis for the project. Data from both interview surveys was predominantly collected in this aggregation. The farm business is composed of one or more farm households.

• Farm Household: The Tragowel Plains is predominantly a family farming community. Farm businesses are composed typically of one or more households. Both interview surveys collected data on the household composition of farm businesses.

• Individual: Farm Households are composed of a number of individuals. Both interview surveys collected data on the education and labour status of individuals in farm households. The 1987 survey collected data on the psychological state of individuals in farm households.

At any one point in time these first three keys are related in the simple relational form shown below.

![Diagram showing database structure for business, household and person entities]

*Figure 6 Database structure for business, household and person entities*

The relationship between farm business and household is not stable over time. Household composition of businesses changes as new family members join the business or family businesses split up. Likewise, the composition of families changes over time as family members leave for jobs elsewhere, or new members are born. Probably the family composition change which has the most impact upon the operation of businesses is change in marital status. To reflect these dynamics in data obtained from the two interview studies in 1987 and 1995, two data structures may be used, depending upon the unit of analysis. For the more common analysis of business units, the structure is as follows:
Although this structure contains significant redundancy, with appropriate queries it does simplify the analysis of changes in business structure in flat form statistical packages such as SPSS.

An alternate means of structuring the data is according to person. This provides a structure as shown below. This form allows analysis according to the person rather than the business if the appropriate queries are in place.

In addition to these three familial and business structures, there are five significant cadastral based keys.

- **Crown Allotment**: The basic legal unit of land tenure is the Crown allotment. This is the minimum unit of land which can be traded. Crown allotments used for agricultural production are typically sized between 20 and 200 hectares in the Tragowel Plains district. Small allotments of residential size were not included in the project database. Land ownership status is recorded at this level.

- **Land parcel**: The Crown allotment may be composed of more than one parcels of land. The parcels are often separated by road or channel reserves. In some cases the parcels composing a single crown allotment are not geographically contiguous. Remote
sensed data on irrigation culture and EM38 measurements of soil salinity were included in the project database at the land parcel level of aggregation.

- **Salinity spot**: Detailed data was collected on the management of each area of salinity on the farm. Within one land parcel there was often more than one area of salinity. Further, where a fence-line intersected an area of soil salinity, there were situations where management differed across the fence line. Soil salinity spots were incorporated into the database in a one-to-many relationship with land parcels.

- **Register Entry Number**: The Register Entry Number is an aggregation of normally contiguous crown allotments which are owned by the one farm business. A farm business may own a number of RENs. The Register Entry Number is the major data entity used by GMW for recording water supply. All water use data used in this study was aggregated at the REN level. Use of a number of the Salinity Plan incentives have been recorded at the REN level. The REN is now called the Supply Point Group by Goulburn Murray Water.

- **Property Number**: Goulburn Murray Water aggregates its Register Entry Numbers into Property Numbers. Businesses composed of non-contiguous allotments will normally be allocated more than one REN. The Property Number is the basis of billing for GMW. Despite what one would expect, Property Number is not synonymous with farm business. Farm businesses which are composed of more than one family will often maintain separate ownership of different titles within the business. This is often a strategy to ease inter-generational farm transfer of assets or to assist taxation strategies. GMW property numbers reflect this division of asset ownership within a farm business. Farm culture surveys by Goulburn Murray Water report at the Property Number level and have been integrated into the database at this level.

At any point in time the relationship between these five cadastral keys is a simple series of one-to-many relationships as shown below.

The relationship between REN and Crown allotments is not stable over time. If a landowner sells one Crown allotment from within a Register Entry number aggregation, the GMW will continue to use the same Register Entry Number. The sold allotment may become a
new REN, or it may be aggregated into another existing REN. This instability requires the use of REN to allotment keys for each year in a time series. Unfortunately, data to create this key for every year is not available. However sufficient data is available to allow the tracking of property size (in megalitres) by following the data associated with the REN. This leads to a quite complex database structure. This complexity has been reduced only a little by collapsing the detail in the GMW Property Number entity into the more useful family business entity.

![Database Relationship Structure](image)

**Figure 9** Full database relationship structure for a single year

The table below contains significant redundant information, but allows the easiest interrogation of the database to allow comparison between years. The example below demonstrates a query constructed to provide a flat form output for the year 1987.
The above example shows a query to extract 1995 data. Similar queries can be constructed to provide data for 1987 or a subset of cadastral related data only for 1990, 1991 and 1993. The 1995 query does not account for ownership of whole allotments retired from irrigation since the introduction of permanently transferable water entitlements. An additional table relating land parcels to Farm Business must also be utilised for analysis of 1995 land use data.

The final structure of the database is shown below. Using this structure it was possible to design queries to produce flat form data for particular years at a chosen level of aggregation. The figure demonstrates the relationship for a query for 1995.
Data from beyond the Tragowel Plains

In assessing the rate of structural adjustment within the Tragowel Plains one needs to make some comparison with the rate of structural adjustment elsewhere as a reference point. Two foci of comparison were chosen: irrigation properties elsewhere in the Goulburn Murray supply district and agricultural businesses within south east Australia in general.

The Population and Housing Census

The Australian Bureau of Statistics Population and Housing Census contains questions on respondent occupation and migration. Data for these questions was purchased for the years 1986, 1991 and 1996 and for Victoria, NSW, SA and parts of Queensland. The data for each census year was provided in crosstabulation tables disaggregated to the Statistical Local Area classification (SLA) current in 1996. This allowed comparison between census years under a single boundary set.

The Tragowel Plains Irrigation Area falls predominantly in the SLA of Loddon North. The Boort Irrigation District also lies within the same SLA (Figure 12). The SLA data will reflect the combined influences of adjustment in the Pyramid Hill district, the Calivil-Dingee and Mincha district, the Boort Irrigation District and the surrounding dryland districts within the East Loddon Stock and Domestic District.

Figure 12 ABS Statistical Local Area Boundaries surrounding the Tragowel Plains irrigation area
The Farm Census

Australian Bureau of Statistics farm census data is normally only available in aggregated counts for parishes or SLAs. The Australian Bureau of Agricultural and Resource Economics has traditionally had access to the population frame maintained by the ABS for the purpose of drawing samples for the Australian Farm Survey. In 1996 ABARE undertook a longitudinal analysis of this farm establishment population data (Lindsay and Gleeson, 1997). This analysis was complicated by the irregular changes in the cut-off for farm establishments to qualify for inclusion in the census. The cut-off varied between $2,500 and $25,000 minimum Estimated Value of Agricultural Operations (Australian Bureau of Statistics, 1996). Aggregations of this data at SLA level were purchased for 1986 and 1995 showing farm size distribution by Estimated Value of Agricultural Operations in approximate deciles. For 1986 the qualification cut-off was $2,500 and for 1995 it was $5,000. As the aggregate rate of inflation during this 10 year period was approximately 50 per cent, the estimate of farm numbers in the lowest decile will be artificially lowered in the 1995 data. The data for Victoria was based upon the SLA boundaries current in 1985 and 1995. Whilst there has been minimal change in SLA boundaries in NSW, Queensland and South Australia in that time, in Victoria the 1996 SLA boundaries are substantially different from the 1986 and 1995 boundaries. A concordance based upon area of agricultural land was used to adjust the SLA data from 1986 and 1995 to correspond with 1996 boundaries and thus allow comparison with the data derived from the Population and Housing census.

Goulburn Murray Water Customer Information and Billing database

Goulburn Murray Water provided a copy of ownership records for each of its constituent irrigation areas for the period 1993 to 1997. It was beyond the resources of this research to aggregate these records in a manner which reflected true farm business structures as was undertaken with the Tragowel Plains records as described earlier in this chapter. These records were instead aggregated according to the legal structures reflected in these records using cues found in the name, business number and business address fields in the GMW Customer Information and Billing database. The database contained 82,000 records based upon meter readings per year. These were aggregated to 19,000 business entities. This enabled an
examination of adjustment trends for each of the 13 irrigation districts supplied by Goulburn Murray Water including the Pyramid hill district.
Informing salinity appraisal

Research issue 1: Have the soil salinity surveys improved farmers’ appraisal of soil salinity?

- How accurate were farmers’ appraisals of soil salinity prior to the commencement of the Tragowel Plains Salinity Management Plan?

- Have farmers’ appraisals of soil on their farms changed in response to the results of soil salinity surveys?

The soil salinity survey by EM-38 technology was the foundation stone on which the Tragowel Plains Salinity Management Plan was based. The plan assumed that farmers would change their management of saline land and reallocate water in response to accurate soil salinity data. It was assumed that information about soil salinity status would be the catalyst for a restructuring of farms on the Tragowel Plains leading to a more efficient use of water. For this to occur, farmers’ perceptions of soil salinity needed to be significantly improved by gaining access to the results of EM-38 surveys.

Salinity appraisal in 1987

Defining ‘productivity decline’

In the 1987 personal interview study farm decision makers were asked the following question: ‘What percentage of your Tragowel Plains property has lowered productivity because of salting at the moment?’. The relationship between productivity and salinity is dependent upon the crop being grown. In reporting the results of EM-38 soil salinity surveys the survey team classified salinity levels into four categories based upon the impact of salinity on the predominant pasture types of the district- subterranean clover and white clover.

Table 6 Soil salinity - pasture productivity relationships

<table>
<thead>
<tr>
<th>Salinity Class</th>
<th>Soil Salinity at time of survey (ECe)</th>
<th>Estimated average summer soil salinity (ECe)</th>
<th>Estimated average winter soil salinity (ECe)</th>
<th>Productivity of annual pasture as a % of potential</th>
<th>Productivity of Perennial pasture as a % of potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&lt; 3.8</td>
<td>&lt; 4</td>
<td>&lt; 2</td>
<td>90 - 100</td>
<td>70 - 100</td>
</tr>
<tr>
<td>B</td>
<td>3.8 - 6.5</td>
<td>4 - 7</td>
<td>2 - 4</td>
<td>70 - 90</td>
<td>45 - 70</td>
</tr>
<tr>
<td>C</td>
<td>6.5 - 8.6</td>
<td>7 - 9</td>
<td>4 - 7</td>
<td>45 - 70</td>
<td>20 - 45</td>
</tr>
<tr>
<td>D</td>
<td>&gt; 8.6</td>
<td>&gt; 9</td>
<td>&gt; 7</td>
<td>&lt; 45</td>
<td>&lt; 20</td>
</tr>
</tbody>
</table>
From the relationship described in this table, it is clear that for perennial pastures a clear decrease in productivity is to be expected for all soil classes except class A. Even within the A class there is the capacity for a loss of up to 30 per cent of productivity.

In 1987 perennial pasture was uncommon on most farms in the survey area north of the Mitiamo-Durham Ox Road. Perennial pasture occupied less than 20 per cent of pasture area (Rural Water Commission, 1987). It was the predominant culture only on dairy farms, which constituted 13 per cent of district farms and which controlled a smaller proportionate area of the plains (Naunton and Rendell, 1988). Further, perennial pastures are irrigated in a manner which creates a significant leaching fraction which can maintain low salinity within the root zone. For these reasons I decided to make the productivity response of annual pastures the yardstick with which to assess farmer appraisals of salinity.

There is a clear decline in annual pasture productivity on Class C and D soils. The minimum decline indicated in the above table is 30 per cent. For class B soils a productivity decline of between 30 per cent and 10 per cent is indicated. It is doubtful whether the lower margins of this range in productivity decline would be discernible without a formal system of pasture growth measurement (Armstrong, 1995). Formal systems of pasture monitoring are only well adopted by dairy farmers. Wool and meat producers have almost without exception relied upon informal monitoring means, particularly by judging the condition of stock rather than the pasture itself (Marks and O’Keefe, 1996; Wilkinson, 1996; O’Keefe, 1993). Further, given the low standard of pasture management at the time of the 1987 study (Nicholson and Heslop, 1990), it is quite possible that factors other than salinity, including water stress and root disease, may be factors limiting pasture production on B class soils. In this case it could be quite reasonable to conclude that salinity was not reducing productivity on these soils.

It was decided to make a conservative assumption that soils suffering ‘lowered productivity due to salting’ would correspond to C and D class soils. This assumption probably underestimates the extent of real productivity impact due to salting to a limited extent, although I believe it will not underestimate the perceivable losses under current farming systems. Using this criteria we are likely to underestimate the number of farmers who taking an over-optimistic appraisal of productivity decline on their farms caused by salinity. We are likely to overestimate
the number of farmers taking a pessimistic view of the productivity impacts of salinity on their farm.

**Determining 1987 salinity status on farms**

The first step in determining the 1987 salinity status of farms is to recreate the land ownership status of the survey farms. Complete land ownership records were only available in 1995, 1993, 1991 and 1989. A partial reconstruction of 1987 land ownership was undertaken by extensive cross-referencing of data from a number of sources. These included:

- Rural Water Commission 1987 Culture sheets which provided a link between Owner, Register Entry Number, Water Right and land area.
- Property size details given in the 1987 interview survey.
- Register Entry details and property structure for 1989-90.

By taking advantage of the relatively stable land parcel aggregation in the Register Entry Number and the existence of a legal link between land and water right which existed in 1987, it was possible to reconstruct the allotment structure of 75 of the 106 farms visited by interviewers in 1987.

The next step in recreating the salinity status of the 1987 farms was to aggregate the salinity status of individual land parcels making up each farm entity. The data source for this was the spatial database containing the results of salinity surveying conducted between 1989 and 1995. An example of the database is shown below. This was interrogated to determine the area of A, B, C and D class land in each allotment. In using this data we are assuming that the soil salinity status of paddocks had been stable over the five years of implementation of the Salinity Plan, and that measurement accuracy was also stable over time. The results of a salinity monitoring project conducted on the Tragowel Plains during the period of this study indicate there are temporal variations in salinity measurement. The processes behind these variations are as yet unclear. Current interpretations of these variations is that they will, in the majority of cases, be unlikely to shift salinity status between classes except in borderline cases (Terry, 1997; Terry *et al.*, 1997).
At the time of this research approximately 70 per cent of the Tragowel Plains had been surveyed by EM-38 meter. It was therefore inevitable that there would be further extinction of useable data at this stage. A further eleven farms were excluded from the analysis due to incomplete soil salinity data. This left 64 useable cases out of an initial 106 farms (Table 7).

**Table 7 Status of 1987 soil salinity data**

<table>
<thead>
<tr>
<th>No of farms</th>
<th>% of sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987 survey sample size</td>
<td>106</td>
</tr>
<tr>
<td>Cases with incomplete property ownership data</td>
<td>31</td>
</tr>
<tr>
<td>Cases with full property ownership and incomplete salinity data</td>
<td>11</td>
</tr>
<tr>
<td>Cases with complete property ownership and salinity data</td>
<td>64</td>
</tr>
</tbody>
</table>

With such a high data attrition rate, it is advisable to test to determine if the attrition is related to any characteristics of the sample population. A series of t-tests were used to discover if the group with full data differed in any way from the group to be excluded from subsequent analysis (Table 8). No significant differences were detected for farm size, water right, farm income, profit, equity, debt, net assets, number of households, age of operator, off-farm income. Significant differences were detected for three variables. These were concerns about farm

![Soil Salinity Status](image)
productivity, perception of salinity as a problem and dissatisfaction with current farm drainage and relayout. Farmers for whom we could obtain full data were typically more concerned about farm productivity, salinity, layout and drainage on their farms. The mean percentage of land losing production due to salinity was perceived as higher on those farms for whom we could obtain full data. However, this difference was only significant at p = 0.2. It would be expected that these concerns would be more likely to motivate a farm manager to undertake a soil salinity survey.

Table 8 Differences between farms with available soil salinity data and farms without soil salinity data

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean score for farms with full data</th>
<th>Mean score for farms excluded from analysis</th>
<th>T value</th>
<th>Degrees of freedom</th>
<th>Significance of difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘To what extent is farm productivity a problem for you at the moment?’ *</td>
<td>2.81</td>
<td>2.25</td>
<td>2.73</td>
<td>101</td>
<td>.007</td>
</tr>
<tr>
<td>‘To what extent is soil salinity a problem for you at the moment?’ *</td>
<td>3.46</td>
<td>2.94</td>
<td>2.31</td>
<td>101</td>
<td>.023</td>
</tr>
<tr>
<td>‘To what extent is layout and drainage a problem for you on your farm at the moment?’ *</td>
<td>2.56</td>
<td>2.12</td>
<td>1.79</td>
<td>101</td>
<td>.076</td>
</tr>
</tbody>
</table>

* 1 = Not a problem, 5 = Extreme difficulty

Accuracy of salinity appraisal in 1987

A simple test between measured levels of C and D class soils and the responses of farmers to the 1987 productivity loss question shows low levels of correlation (Pearson r = .120, p = 0.346, N=64). If we compare 1987 estimates against measured areas of B, C and D class soils, there is no improvement in the relationship (R=.111, p = 0.382, N=64). No improvement in the correlation rate is made by eliminating dairy farmers from the sample.
Figure 14 shows a wide variation in the accuracy of appraisal of soil salinity. There is a group of farmers whose appraisal corresponds quite closely with the findings of the soil survey (Table 9). There is a group who have significantly underestimated the extent of salting on their farm. They generally have claimed no areas with lowered productivity due to salting despite the EM-38 meter later revealing significant areas of C and D class soils. A third group is shown as estimating greater areas of salinity than C and D class soils found on their property. It can be assumed that these farmers are basing their estimates upon productivity losses in B class soils as well and C and D.

*Figure 14. Relationship between farmer appraisal of soil salinity in 1987 and measurement of soil salinity derived by EM-38 technology.*
These results support a conclusion that in 1987 most farmers were using C and D class soils as their yardstick of productivity loss. Despite the low correlation between appraisal and measurements of salinity, some farmers were quite accurate in their assessments. Taking the C and D class soils as a yardstick of productivity loss, 40 per cent of farmers made an estimate within ten per cent of the area of salinity subsequently measured on their farm.

A group of 34 per cent were clearly underestimating the impact of salinity on their farm productivity. One explanation current in the district is that farmers with less experience of farming on the Tragowel Plains are likely to be inaccurate in their assessment of salinity. An alternate view is that time spent farming on the Tragowel Plains will lead to perceptual adaptation to salinity. This was one interpretation which could have been placed upon the findings of Norman et al. (1988) who found increased underestimation of salinity in the northern more saline areas of the Tragowel Plains. The data supported neither contention, with no relationship revealed between accuracy of appraisal and period farming on the plains.

### Salinity appraisal in 1995

During the 1995 interview survey farmers were asked to identify each crown allotment they owned or managed, to draw each area of C and D class soil on a map and to estimate the area of C and D class soil. For most farmers this estimation task was being undertaken after they had received the results of EM-38 surveying of their property. This identification task has two significant differences from the salinity question asked in the 1987 survey. First, by asking for an identification of each area of salt on the property there may be an enhancement of recall. Secondly, by specifying C and D class soils there is an objective criteria which farmers are being asked to use in answering the question. Each of these differences in question design could be

<table>
<thead>
<tr>
<th>Compared against</th>
<th>Underestimate of salinity by -</th>
<th>Overestimate of salinity by -</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100-50%</td>
<td>50-25%</td>
</tr>
<tr>
<td>C and D class</td>
<td>5%</td>
<td>13%</td>
</tr>
<tr>
<td>B,C and D class</td>
<td>23%</td>
<td>38%</td>
</tr>
</tbody>
</table>

Table 9: Percentage of farmers achieving levels of accuracy of salinity appraisal in 1987 using alternate measures of salinity impact (N = 64)
expected to lead to increased correlation between farmer appraisal and actual salinity levels as measured by the EM-38 meter.

Data enabling a comparison between salinity appraisal and EM-38 survey results was available for 93 subjects (73 subjects in the northern section of the study area). Figure 15 shows the accuracy of farmer perception of salinity in 1995. There is a clear increase in the accuracy of salinity appraisal. There is no longer an outlying group who believe there is no salinity on their farms. By far the majority of points are clustered around the line of perfect appraisal. This is borne out by the Pearson correlation of \( R = .751 \) (N=93) and a probability of less than .001. For the Pyramid Hill district where the 1987 study was undertaken, the correlation was \( .701 \) (p < .001, N = 73). This is significantly different from the correlation between the 1987 estimates and the soil survey results (Z = 5.01, p < .001 using the Pearson test of difference between Pearson correlation coefficients) (Fisher, 1932).

Table 10 shows that by 1995 sixty-three per cent of farmers with soil salinity data available for their farm appraised their farm soil salinity within 10 per cent of the EM-38 measure of C and D class soils. Only seven per cent estimated the extent of C and D class soils on their farm at a level which differed from the EM-38 survey results by twenty-five per cent or greater.

The overall increase in accuracy of appraisal of salinity might have been achieved in one of two manners. The soil salinity test may have increased the appraisal accuracy of all farmers, or it may have worked mainly through informing the large number of new arrivals who have replaced farmers selling out between 1987 and 1995. The evidence is that both processes have occurred (Table 11). For farmers who were interviewed in both 1987 and 1995 the correlation between appraisal and measured salinity increased from .224 to .665 in this period. Hotelling’s test of correlated correlation coefficients was used to test the significance of this change (Hotelling, 1940). There were 35 sample points present in both surveys for which full soil salinity data was available. However, changes in farm size between the two sample surveys required the elimination of 13 of these sample points to achieved a true matched pairs test. This left 22 cases. The respective correlations for 1987 and 1995 for this reduced number of cases was \( r_1 = .126 \) and \( r_2 = .740 \). The Hotelling’s test produced a value of \( T_{dr} = 2.80, df = 19 \). Using a one tail test this was significant at p < .01. The 1987 appraisal measure for farmers who subsequently sold their property was also significantly different from the 1995 measure of those
who purchased their property subsequent to 1987 ($Z = 3.54, p < .001$). From these results one must conclude that whatever accounts for the greater accuracy of the 1995 appraisal measure over the 1987 appraisal measure, it is having an impact on both new and established farmers in the sample.

![Graph showing the relationship between farmer appraisal of soil salinity in 1995 and measurement of soil salinity derived by EM-38 technology.](image)

**Figure 15** Relationship between farmer appraisal of soil salinity in 1995 and measurement of soil salinity derived by EM-38 technology

<table>
<thead>
<tr>
<th>% of farm classified as C or D class soil by EM38 survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>farmer estimate of % of farm C or D class</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>-20</td>
</tr>
</tbody>
</table>

**Table 10** Percentage of farmers achieving levels of accuracy of salinity appraisal in 1987 using alternate measures of salinity impact ($N = 93$)

<table>
<thead>
<tr>
<th>Appraisal accuracy</th>
<th>Underestimate</th>
<th>Overestimate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100-50%</td>
<td>50-25%</td>
</tr>
<tr>
<td>% farmers</td>
<td>0%</td>
<td>5%</td>
</tr>
</tbody>
</table>

| % farmers          | 0%            | 5%           | 19%          | 63%          | 10%          | 2%           | 0%           |
Informing salinity appraisal  

Summary

In 1987 farmers generally considered salinity damage was affecting productivity at class C or worse salinity. Approximately 40 per cent of the farmers interviewed were accurate in their assessment of salinity levels on their farm. A group of 28 per cent did not believe salinity accounted for any productivity loss on their farm. This belief was contradicted by later soil surveys. It can be confidently asserted that this 28 per cent was the target of the soil surveying program embarked on as part of the Salinity Plan.

There are clear statistical differences between the appraisals given in the 1987 and 1995 survey. Some of these differences will be due to information made available in the soil salinity survey. Some differences may also be due to differences in question design between the two surveys. The extent of the difference between the two appraisal measurements is such as to give confidence in the conclusion that the provision of soil salinity survey data to farmers has resulted in an improved appraisal of soil salinity. This is not a generalised awareness of salinity which might be expected of a normal community awareness campaign, but a significantly more accurate appraisal of the distribution of salt upon each farmer owners land. There is no longer a group of farmers who discount the existence of salt on their farms. From this result one one must conclude that the survey has informed farmers’ appraisal of salinity on their farms.

<table>
<thead>
<tr>
<th>Property sold between 1987 and 1995</th>
<th>1987 appraisal-Em38 correlation</th>
<th>1995 appraisal-Em38 correlation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property purchased between 1987 and 1995</td>
<td>-.182</td>
<td>-</td>
<td>22</td>
</tr>
<tr>
<td>Remained on property between 1987 and 1995</td>
<td>-</td>
<td>.818 *</td>
<td>14</td>
</tr>
</tbody>
</table>

* Calivil-Dingee cases excluded from analysis to maintain consistency with other categories in the table.
Retiring saline soils

Research issue 2: Has the provision of soil salinity survey information led to changes in the management of saline soils?

• How extensive was the irrigation of saline soils?
• Has there been a reduction in the irrigation of saline soils since the availability of soil salinity survey results?
• Are saline soils being managed with the Best Environmental Management Practices recommended in the Tragowel Plains Salinity Management Plan?

Adoption of the soil salinity survey

By 1995 the rate of adoption of soil salinity surveying was high, with 86.7% of the sample having had all their property surveyed. A further 4.2% had surveyed part of their property. Nine per cent had not adopted the soil salinity survey. Reasons for not adopting the EM-38 survey are equally divided between those who saw the survey as a waste of time, those who described their farm as already fully developed and those who described themselves as not having got round to it. Those in this latter group all intended to complete a soil survey.

Soil surveys were seen as worthwhile by 82.6 per cent of the sample. A further 10.1 per cent saw them as worthwhile in some circumstances. Seven per cent saw them as a waste of time, mainly because the respondents claimed they knew where the salt was any way. No-one dismissed the surveys as being unreliable. This confidence in the EM38 technology was reflected in the strong correlation between EM38 data and farmers’ 1995 reporting of soil salinity on their farms discussed in the previous chapter.

Farmers obviously expected to gain some benefit from this investment in soil salinity surveying. The main advantage farmers expected from soil surveys could generally be described as risk reduction. Respondents used phrases such as ‘Gives you confidence in your plans’. Other advantages such as access to incentives, monitoring or informing the land market were mentioned relatively infrequently.
Retiring saline soils

Clearly many farmers expected the results of soil salinity surveys to give them the ability to undertake changes in farm management with a greater degree of confidence. We should expect to see this confidence reflected in changes to the management of both saline and unsaline soils. For saline soils we would expect to see adoption of the recommendations of the Tragowel Plains Salinity Management Plan: cessation of irrigation of saline soils, fencing and controlling of grazing pressure on saline soils and sowing of halophytes. The adoption of these practices will be explored in this chapter.

Table 12 Advantages of the EM-38 soil salinity survey

<table>
<thead>
<tr>
<th>Advantage of EM-38 survey</th>
<th>% of 1995 sample (N = 119)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk reduction</td>
<td>62.3</td>
</tr>
<tr>
<td>Incentives</td>
<td>7.5</td>
</tr>
<tr>
<td>Helps newer farmers</td>
<td>5.8</td>
</tr>
<tr>
<td>Monitoring of salt</td>
<td>4.2</td>
</tr>
<tr>
<td>Helping sell land</td>
<td>3.3</td>
</tr>
</tbody>
</table>

In considering the results of the following reports, the reader should bear in mind the practical limitations on full adoption of the recommended Best Management Practices for saline soils. The size of salt areas is obviously important in the decision as to whether to manage that land differently from the rest of the farm. A number of farmers indicated it was difficult to justify separate management for small areas of salt surrounded by A and B class soils. In this study 23 per cent of salted areas were less than 4 hectares in size. Half the reported salted soils were in spots larger than 25 hectares.

**Reductions in the irrigation of saline soils**

**Turnover in land ownership**

The major recommendation of the Tragowel Plains Salinity Management Plan was the cessation of irrigation of C and D class soils. In 1995 the respondents reported 8699 hectares of salting. Respondents were asked whether they irrigated these soils, how they were irrigated and whether the intensity of irrigation had been changed.
To assess changes in irrigation since 1989-90 we must make a number of assumptions. The first assumption is that farmers reporting of soil salinity on their farms were reporting the actual occurrence of salinity rather than an inaccurate perception of that salinity. One hundred and nineteen farmers in the sample provided full information on the extent of salting on their properties. They identified 8,699 hectares of C and D class soils on their farms. This was 18.8 per cent of the total area of these farms. At the time of this study, 81 per cent of the total farm area on the Pyramid Hill area of the Tragowel Plains had been surveyed by EM-38 meter. This surveying had classified 20 per cent of farm area as C and D class soil (Norman et al., 1995). This was not a statistically significantly greater proportion of saline land than reported to us by the sample farmers. These results give us confidence to conclude that farmers’ reports of the management of land they have identified as saline in 1995 will not differ significantly from the management of land that has been identified as saline by EM38 measurement.

The second assumption, that the area of soil salinity has not changed since 1989-90 also appears to be reasonable on the basis of recent research on the stability of soil salinity and soil salinity measurement (Terry, 1997).

The third assumption of stability of land ownership is more problematic. In only asking existing landowners of management changes on saline land we are not collecting data on any changes made by previous owners of land which might have occurred between 1989-90 and the beginning of tenure of current owners. We need to examine the possible extent of data loss. Twenty-six per cent of the saline blocks of land reported by respondents had changed ownership at least once during the period 1989-90 to 1995. Irrigation intensity had been decreased on a third of these blocks since the change of ownership. There remained 17.1 per cent of saline blocks which had not experienced a change of irrigation since falling under new management. Half of these remaining blocks were still irrigated and it can be assumed that this irrigation was a continuation of the practices of the previous owner. This left 8.8 per cent of saline blocks which may have experienced a change in irrigation intensity under a previous owner. This figure may again be reduced by making the reasonable assumption that farmers taking over a property are in a position to tell whether a paddock was watered in the previous season by the previous owner. This means that farmers who took over blocks in 1989-90 and 1990-91 would have been able to report any change in irrigation intensity during the implementation of the Tragowel Plains Management Plan. This reduced the maximum likely under-reporting of changes in irrigation
intensity on saline land to approximately 5 per cent. If we assume that the extent of irrigation on these remaining blocks of land and the extent of change in irrigation intensity reduction was the same as on the remainder of the Tragowel Plains, then the likely under-reporting would fall to somewhere between 2 and 3 per cent of saline land (Table 13). This level of underestimation is sufficiently small to allow it to be ignored in the analysis of the saline land management data reported by 1995 respondents.

Table 13: Stepwise process for estimation of the extent of under reporting of land retirement due to turnover in land ownership between 1990 and 1995

<table>
<thead>
<tr>
<th>Steps in estimation of under reporting of land retirement</th>
<th>Area as a percentage of all reported saline land</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reported saline land</td>
<td>100</td>
</tr>
<tr>
<td>2. Saline land changing ownership between 1989-90 and 1995</td>
<td>26.4</td>
</tr>
<tr>
<td>3. Saline land changing ownership and not being reported as managed with reduced irrigation intensity by new owner</td>
<td>17.1</td>
</tr>
<tr>
<td>4. As above, and not irrigated by new owner</td>
<td>8.8</td>
</tr>
<tr>
<td>5. As above, and experiencing most recent change of ownership after 1990-91</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Land retirement and reduction in irrigation intensity

Of the 8,699 hectares of saline land reported to the researcher, 5112 (59 per cent) was irrigated purposely in the 1989-90 season. In the following five years irrigation intensity was reduced on 2268 hectares. This is 26.6 per cent of the total area of C and D class soils on these

Table 14: Changes in irrigation management of C and D class soils between 1990 and 1995.

<table>
<thead>
<tr>
<th></th>
<th>Area of C and D class soils</th>
<th>% of C and D class soils</th>
<th>Area of previously irrigated C and D class soils</th>
<th>% of previously irrigated C and D class soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased irrigation intensity</td>
<td>2268</td>
<td>26.7</td>
<td>2268</td>
<td>43.6</td>
</tr>
<tr>
<td>No change in irrigation</td>
<td>5902</td>
<td>69.7</td>
<td>2530</td>
<td>48.7</td>
</tr>
<tr>
<td>Increase in irrigation</td>
<td>301</td>
<td>3.6</td>
<td>402</td>
<td>7.7</td>
</tr>
</tbody>
</table>
farms, or 43.6 per cent of those C and D class soils which were being irrigated prior to 1990 (Table 14).

By reporting the areas of land where irrigation intensity has been reduced we are presenting the changes in the Tragowel Plains in their most positive light. Not all reductions in irrigation intensity have led to the cessation of irrigation of C and D class soils. A more rigorous assessment of adoption of this recommendation is produced by measuring where irrigation has ceased on C and D class soils. In the first five years of the plan the area of C and D class soils which were not purposely irrigated rose from 37 per cent to 56 per cent. Eighteen per cent of C and D class soils had been retired from irrigation. Twenty-seven per cent of soils irrigated prior to 1990 had been retired from irrigation (Table 15).

<table>
<thead>
<tr>
<th>Year</th>
<th>Soils not irrigated as a percentage of all C and D class soils</th>
<th>Soils irrigated as a percentage of all C and D class soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>37.6</td>
<td>62.4</td>
</tr>
<tr>
<td>1995</td>
<td>57.2</td>
<td>42.8</td>
</tr>
</tbody>
</table>

**When land retirement and irrigation reduction occurred**

The introduction of the plan appears to be a major factor in encouraging the retirement of C and D class soils from irrigation. Little change in the rate of retirement occurred in the ten years prior to 1990. Significant reductions occurred in 1990, 1991 and 1993 (Table 16). The rate of removal of C and D class land from irrigation slowed after 1993. This suggests that the easy adoption gains have been made in this area and future adoption rates will be slower. To investigate this further we need to examine who is reducing watering of C and D class soils.

From 1990 to 1993 there was a consistent 12 to 15 per cent of farmers reducing irrigation of C and D class soils in any one year. However, after 1993 there was a decrease in the percentage of farmers retiring land each year, matching the slowing of adoption as measured by aggregate area (Table 16).
Retiring saline soils

Why was saline soil irrigated?

In 1995 fifty-one per cent of C and D class soils were irrigated in some manner. Seven per cent of C and D soils were described as irrigated by accident. Mostly these soils were at the bottom of irrigation bays. This leaves 44 per cent of C and D class soils being purposely irrigated.

There seem to be two forms of saline soil irrigation. The first is where saline soils are managed undifferentiated from nearby A and B class soils. Fifteen per cent of C and D class soils were irrigated as part of the farm annual pasture irrigation schedule. Eight per cent were irrigated according to perennial pasture irrigation scheduling. This watering could be motivated by a desire to maintain cover on saline soils, but is more likely to be an outcome of an irrigation layout not planned to take account of soil salinity.

Other saline soils are irrigated in a manner deemed appropriate for saline soils. Sixteen per cent of saline soils were irrigated once each autumn in what was often described as ‘strategic’ irrigation. This strategic irrigation of saline soils seems to be part of the salinity control culture originally encouraged by Alan Morgan. Some of the strategically watered area

Table 16: Reduction of irrigation of C and D class soils by year 1990-95

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers removing irrigation water from C and D soils as a % of all farmers</td>
<td>14.8</td>
<td>13</td>
<td>12</td>
<td>15.7</td>
<td>5.6</td>
<td>1.9</td>
</tr>
<tr>
<td>C and D class soils where irrigation ceased as a % of all C and D class soils</td>
<td>33.7</td>
<td>3.8</td>
<td>1.8</td>
<td>1.1</td>
<td>2.2</td>
<td>.1</td>
</tr>
<tr>
<td>C and D class soils where irrigation reduced but not eliminated as a % of all C and D class soils</td>
<td>11.1</td>
<td>1.7</td>
<td>4.2</td>
<td>1.6</td>
<td>1.6</td>
<td>.9</td>
</tr>
<tr>
<td>C and D class soils where irrigation reduced or eliminated as a % of all C and D class soils</td>
<td>44.7</td>
<td>5.5</td>
<td>6.0</td>
<td>2.7</td>
<td>3.8</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Farmers removing irrigation water from C and D soils as a % of all farmers: 14.8 1990 or never irrigated: 13 1991: 12 1992: 15.7 1993: 5.6 1994: 1.9

C and D class soils where irrigation ceased as a % of all C and D class soils: 33.7 1990: 3.8 1991: 1.8 1992: 1.1 1993: 2.2 1994: .1 1995: .1

C and D class soils where irrigation reduced but not eliminated as a % of all C and D class soils: 11.1 1990: 1.7 1991: 4.2 1992: 1.6 1993: 1.6 1994: .9 1995: 2.3

C and D class soils where irrigation reduced or eliminated as a % of all C and D class soils: 44.7 1990: 5.5 1991: 6.0 1992: 2.7 1993: 3.8 1994: 1.0 1995: 2.3
Retiring saline soils has been purposely sown to halophytes, and the strategic irrigation is designed to establish these plants. But seventy-five per cent is applied to what might be called volunteer halophytes. In each case the motivation for this use of water is clearly a desire to maintain ground cover.

**How many farmers reduced irrigation?**

Adoption of saline land retirement can be simply described by segmenting that section of the farming population with irrigated saline land in 1990 into three groups (Table 18). Five per cent of Tragowel Plains farmers had retired greater than 40 hectares on their properties. This five per cent were responsible for two thirds of the saline land retirement between 1990 and 1995.

A second group (23.3 per cent of farmers) had retired relatively small areas of saline land, between 1 and 40 hectares. Although this group was three times greater in size than the previous group, they were responsible for only one third of land retirement since the commencement of implementation of the Tragowel Plains Salinity Management Plan.

There remaining 48 per cent of farmers had retired no irrigated C and D class soils since 1990. Lack of adoption amongst this group was not an outcome of lack of opportunity. These farmers managed 50 per cent of the C and D class soils being irrigated in 1990.

The segmentation revealed in Table 18 may be an artefact of the distribution of salt on farms. To test this possibility I re-segmented the population according to the percentage of C and D class soil on the farm which had been retired (Table 19). This revealed a similar pattern to Table 18. Those farmers who had retired greater than 50 per cent of their C and D class soils being irrigated in 1990 had made the major contribution to land retirement.
Table 18: Area of C and D class land retired from irrigation and remaining to be retired by extent of adoption

<table>
<thead>
<tr>
<th>% all farmers</th>
<th>No C and D class soils on property</th>
<th>All C and D class soils retired from irrigation pre 1990</th>
<th>Some C and D class soils irrigated in 1990</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Area of C and D class land on which irrigation reduced between 1990 and 1995 (Ha.)</td>
<td>0</td>
</tr>
<tr>
<td>Area C and D class soils retired from irrigation since 1990 as a % of all irrigated C and D class lands in 1990</td>
<td>0</td>
<td>0</td>
<td>48.3</td>
</tr>
<tr>
<td>Area of C and D class soils still irrigated in 1995 as % of all irrigated C and D class soils in 1990.</td>
<td>0</td>
<td>0</td>
<td>50.6</td>
</tr>
</tbody>
</table>
Table 19: Percent of irrigated C and D class soils where irrigation removed in period 1990-95

<table>
<thead>
<tr>
<th>% of farmers</th>
<th>No C and D class soils on property</th>
<th>All C and D class soils retired from irrigation pre 1990</th>
<th>Some C and D class soils irrigated in 1990</th>
<th>Area of C and D class soils where irrigation reduced as a percentage of all C and D class soils on the farm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10.8</td>
<td>12.5</td>
<td>48.3</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1-24%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7.5</td>
<td>25-49%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7.5</td>
<td>50-74%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5.8</td>
<td>75-100%</td>
</tr>
<tr>
<td>Area C and D class soils retired from irrigation since 1990 as a % of all irrigated C and D class lands in 1990</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.6</td>
</tr>
<tr>
<td>Area of C and D class soils still irrigated in 1995 as % of all irrigated C and D class soils in 1990.</td>
<td>0</td>
<td>0</td>
<td>50.6</td>
<td>11.6</td>
</tr>
</tbody>
</table>
Management of retired C and D class soils

Fencing of C and D class soils

Fencing was seen in the Tragowel Plains Salinity Management Plan as a crucial step to allow grazing control and re-vegetation of saline land. Fencing of saline land was not an idea newly introduced to the Tragowel Plains, with 19 per cent of class C and D land having been fenced off before the commencement of the plan. Some of this fencing would have been incidental where salinity had overtaken a whole paddock. But some would also have been purposeful fencing undertaken to manage saline land..

In the five years of plan implementation 21 per cent of C and D class soils had been fenced. This fencing would have all been purposeful as part of a strategy to manage saline land.

Table 20 Areas of fenced C and D class soils

<table>
<thead>
<tr>
<th>Percent of C and D class soils</th>
<th>Unfenced 1995</th>
<th>Fenced prior to 1990</th>
<th>Fenced since 1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard error</td>
<td>59.9</td>
<td>18.8</td>
<td>21.3</td>
</tr>
<tr>
<td>Standard error</td>
<td>3.7</td>
<td>2.4</td>
<td>3.1</td>
</tr>
</tbody>
</table>

The pattern of adoption of fencing for C and D class land was similar to the adoption pattern for retirement of saline soils. A small minority of 10 per cent of farmers was responsible for the majority of the fencing which has occurred in the 5 years under study. A far larger group of 34 per cent of farmers had fenced relatively small areas of land. There was an even larger group of 42 per cent of farmers who had unfenced C and D class land yet had undertaken no fencing since the commencement of the plan. The majority of the remaining unfenced C and D class soils was on the properties of this latter group of farmers.
### Table 21  Adoption rates for fencing of C and D class soils

<table>
<thead>
<tr>
<th></th>
<th>No C &amp; D class soil</th>
<th>C and D class soils fenced prior to 1990</th>
<th>No C and D class soils fenced</th>
<th>Farms where between 1 and 19 hectares of C and D class soils were fenced between 1990 and 1995</th>
<th>Farms where between 20 and 39 hectares of C and D class soils were fenced between 1990 and 1995</th>
<th>Farms where more than 40 hectares of C and D class soils were fenced between 1990 and 1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of farmers</td>
<td>10.8</td>
<td>1.7</td>
<td>42.5</td>
<td>26.7</td>
<td>7.5</td>
<td>10.8</td>
</tr>
<tr>
<td>C and D class land fenced since 1990 as a % of C and D class land unfenced at 1990</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5.3</td>
<td>3.3</td>
<td>17.8</td>
</tr>
<tr>
<td>C and D class land unfenced by 1995 as a % of C and D class land unfenced at 1990</td>
<td>0</td>
<td>0</td>
<td>38.5</td>
<td>21.95</td>
<td>6.75</td>
<td>6.46</td>
</tr>
</tbody>
</table>
Controlling grazing of C and D class soils

The third step in the recommended management practices for C and D class soils was the controlling of grazing pressure. This can only be effectively achieved with the fencing of saline soils. Thus the adoption patterns for this stage should bear a strong correlation with the adoption pattern for fencing of C and D class soils.

Grazing of C and D class soils was still common practice. Our sampled farm managers grazed 81 per cent of these soils. More than half of these soils were grazed with a modified regime which took account of salinity status in some manner. Mostly this grazing was described as light or strategic (Table 22). However, half of this modified grazing was carried out on unfenced land. It is debatable whether it is reasonable to claim grazing control on saline land which has not been fenced. To limit grazing on unfenced land would mean limiting grazing also on the remaining productive soils in the rest of the paddock and resulting in foregone production. A manager aiming to maximise production is unlikely to undertake this strategy. However, foregoing income by limiting grazing pressure in the interests of soil salinity control is not inconsistent with the income foregone through irrigation of saline soils to achieve the same objective. To avoid the ambiguity within claims of grazing reduction, the remainder of this section will focus only upon claims of grazing elimination in combination with fencing.

Table 22: Area of C and D class soils grazed

<table>
<thead>
<tr>
<th>Grazing practice</th>
<th>Grazed normally</th>
<th>Limited grazing</th>
<th>Not grazed</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of C and D soils</td>
<td>35.5</td>
<td>45.5</td>
<td>19.0</td>
</tr>
<tr>
<td>SE</td>
<td>8.2</td>
<td>4.1</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Forty-five per cent of farmers grazed all the C and D class land on the farms. Forty four per cent had retired some of their C and D class land from grazing. As in the case of retirement from irrigation, most of the retirement from grazing had been carried out by a small minority of 7.5 per cent of farmers who had each retired over 40 hectares (Table 23). When retirement from grazing was expressed in terms of percentage of C and D class soils on the farm rather than in absolute area, the same pattern emerged. Five per cent of farmers had retired from grazing over 75 per cent of their C and D class soils. Another 3.3 per cent had retired between 50 and 75 per cent of their C and D class soils (Table 24).
Retiring saline soils

Sowing halophytes

The final step in the recommended chain of practices for managing saline land was the sowing of halophytes. Sowing of halophytes in saline soils with poor drainage must be described as experimental technology. Success rates have been variable since the implementation of the Salinity Plan (Tragowel Plains Salinity Plan Implementation Group, 1996). Given the experimental nature of this recommendation, the adoption rate was surprisingly high, indicating the strong cultural preference for keeping cover on saline soils. Farmers reported 30 per cent of C and D class soils had been sown to halophytes. Twenty-two per cent of C and D class soils had been sown to halophytes since 1990. Eight per cent were sown previous to the commencement of the Tragowel Plains Salinity Management Plan in 1990.

A quarter of the reported sowing of halophytes was on C and D class land which had not been fenced off from surrounding pastures. Presumably this form of sowing consisted of adding some wheat grass or strawberry clover to a normal pasture mix. The persistence of these

<table>
<thead>
<tr>
<th>Area of C and D class soils on farm where grazing has been eliminated</th>
<th>No C and D class soil</th>
<th>0 hectares</th>
<th>1-20 hectares</th>
<th>20-40 hectares</th>
<th>40+ hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers as a % of all farmers</td>
<td>11</td>
<td>45</td>
<td>28</td>
<td>9</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area of C and D class soils where grazing has been eliminated as a percentage of all C and D class soils on the farm</th>
<th>No C and D class soil</th>
<th>0</th>
<th>1%-24%</th>
<th>25%-50%</th>
<th>50%-74%</th>
<th>75%-100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers as a % of all farmers</td>
<td>11</td>
<td>46</td>
<td>21</td>
<td>14</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 23: Adoption rates for eliminating grazing from C and D class soils by area eliminated from grazing

Table 24: Adoption rates for eliminating grazing from C and D class soils by percentage of saline area eliminated from grazing
halophytes must be questioned. Before 1990, the majority of halophyte sowings were on unfenced C and D class soils. Since 1990 the large majority of sowings have been on fenced off C and D class soils (Table 25).

*Table 25: C and D class soils sown to halophytes by time of sowing and state of fencing*

<table>
<thead>
<tr>
<th>Sown on unfenced C and D class soils</th>
<th>Sown on fenced C and D class soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of C and D class soils sown before 1990 as a % of all C and D class soils</td>
<td>5.1</td>
</tr>
<tr>
<td>Area of C and D class soils sown after 1990 as a % of all C and D class soils</td>
<td>3.0</td>
</tr>
</tbody>
</table>

The pattern of adoption of halophyte sowing can be seen as reflecting a compromise between a desire to maintain cover on saline soils and a caution about experimental technology. Thirty seven per cent of farmers had fenced and sown some C and D class soils on their property. Very few farmers had fenced and sown greater than 40 hectares. Nearly a quarter of farmers had fenced and sown halophytes on areas less than 20 hectares. This suggests that unlike the case with retirement of C and D class land from irrigation, we should expect significant further areas of C and D class soils to be fenced and sown since the study period if the current subsidies continue and the initial sowings prove successful.

**Segmenting management styles for C and D class land**

The Tragowel Plains Salinity Management Plan recommended a graduated series of changes to the management of C and D class land. These changes followed a logical progression as follows:

- Cease irrigation
- Fence the C and D soils
- Reduce or cease grazing
Retiring saline soils

- Sow halophytes

If the adoption of these practices is undertaken in a stepwise manner by Tragowel Plains farmers, we would expect the total area of C and D class soils could be allocated into the following five categories.

- Not Managed: C and D class soils which are managed the same as A and B class soils. These soils are irrigated as usual, grazed as usual, unfenced and not sown to halophytes.

- Not Irrigated: C and D class land on which irrigation is limited or eliminated but on which grazing is not controlled, the land is not fenced off and is not sown to halophytes.

- Fenced: C and D class land on which irrigation has been limited or eliminated and which has been fenced, but is not grazed differently and which has not been sown to halophytes.

- Grazing Controlled: C and D class soils on which irrigation is limited or eliminated and which has been fenced and on which grazing has been reduced, but which is not sown to halophytes.

- Full adoption: C and D class soils where irrigation has been limited or eliminated, has been fenced off, grazing controlled and halophytes sown.

Previous research has shown that farm managers do not always follow recommended stepwise adoption processes, but will often choose their own pathway (Wilkinson, 1989). This is also the case in this adoption process. A strict categorisation of the actual management practices shows 32 per cent of C and D class soils is managed by management strategies which do not fit within the progression outlined in the plan. The most common of these is to reduce water applications and lightly graze unfenced and unsown salty areas (16.7 per cent). The question of grazing control without fencing must be open to debate. The next most common is the sowing of salt tolerant species on unfenced salt land which was discussed in an earlier section. This occurs on almost 4 per cent of C and D class soils. The remaining 12 per cent of C and D class soils is
managed with a number of differing combinations of practices, none of which accounts for a significant area of land.

The classification analysis is based upon the measurement of adoption of recommended management practices for C and D class soil interpreted strictly according to a stepwise adoption model. Any adoption of a practice out of the recommended order is ignored. This form of measurement provides a clear segmentation of farm managers according to management practices.

The most widespread management method was the application of a management regime undifferentiated from that used on A and B class soils. This occurred on 37.1 per cent of C and D class soils. Next most common was the first stage of the recommended practice, reduction of irrigation on C and D class soils. Eighteen per cent of land was managed using the complete package of recommended practices (Table 26). The third stage, in which saline land is retired from irrigation, fenced, but on which grazing is not controlled, can be seen as a temporary transitional stage. Only two per cent of saline land was reported under this management combination.

Using the above five classifications of saline land management the next step in analysis was to undertake a cluster analysis of farmers to determine if farmers could be classified into groups according to a preferred style of management. The results quite clearly show that farmers do indeed have preferred management styles which they apply to their saline land (Table 27).

Group 1 consisted of those farmers who managed their C and D class soils with few concessions to salinity status. This group consisted of 35 per cent of the population. On these

<table>
<thead>
<tr>
<th>Not Managed</th>
<th>Not Irrigated</th>
<th>Fenced</th>
<th>Grazing Controlled</th>
<th>Full adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area as a % of all C and D class soil</td>
<td>37</td>
<td>30</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>S.E.</td>
<td>2.6</td>
<td>2.2</td>
<td>.4</td>
<td>1.4</td>
</tr>
</tbody>
</table>
farms 80 per cent of C and D class soils were not managed differently from surrounding A and B class soils.

Group 2 was those farmers whose most common management strategy was to limit or eliminate the application of irrigation water to C and D class soils. Thirty per cent of managers were classified in this group. Seventy-three per cent of C and D class soils managed by this group had limited or eliminated irrigation strategies. There was some adoption of the full package of practices by members of this group. This group of farmers were following the management strategy which would be expected of farmers committed to a profit maximisation strategy.

Group 3 was a very small group of farmers who had fenced their C and D class soils, but had not yet controlled grazing on this land. This is a transitional management state.

Group 4 consisted of twelve per cent of farm managers who generally retired their C and D class soils from irrigation, fenced them and controlled grazing, but did not sowing halophytes.

Group 5 consisted of 11 per cent of farmers who managed the majority of their C and D class land by applying the full suite of recommended management practices. The farmers in this group could be interpreted as showing commitment to the cultural legacy of Alan Morgan (see page 12) in committing significant resources to the maintenance of cover on essentially unproductive land.
Since the commencement plan implementation, 43 per cent of irrigated saline soils had been retired from irrigation. Much of this retirement occurred on the farms of a minority of farmers.

Farmers can be classified into three similarly sized groups according to their management of saline land. Approximately one third made few concessions to soil salinity status. Much of the remaining irrigated saline land was on the properties of these farmers. Further retirement of this saline land was likely to come about through the sale of these properties to new managers. Another third had ceased irrigating saline land and were investing few resources in its management. This can be seen as a profit maximising strategy. The remaining third were both retiring saline land and investing resources in the management of that land. They were following the heritage of Alan Morgan’s salt reclamation work (see page 12).

Table 27: A classification of farmers according to the extent of their adoption of the practices recommended for management of C and D class soils by the Tragowel Plains Salinity Management Plan

<table>
<thead>
<tr>
<th>Group</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers as a % of sample</td>
<td>35</td>
<td>30</td>
<td>2</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>C and D class soil management practice</td>
<td>Area of management practice on C and D class land as a % of all C and D class land on farm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not managed differently</td>
<td>80</td>
<td>13</td>
<td>17</td>
<td>17</td>
<td>11</td>
</tr>
<tr>
<td>Reduced irrigated</td>
<td>11</td>
<td>74</td>
<td>10</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Fenced</td>
<td>1</td>
<td>0</td>
<td>57</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Grazing controlled</td>
<td>3</td>
<td>4</td>
<td>15</td>
<td>65</td>
<td>7</td>
</tr>
<tr>
<td>Full adoption</td>
<td>5</td>
<td>9</td>
<td>0</td>
<td>4.7</td>
<td>75</td>
</tr>
</tbody>
</table>

Note: The above classifications are generous as the application of limited irrigation water and limited grazing are both counted as full adoption. By using stricter definitions, the portrayed extent of adoption in the higher level groups would be reduced.

Summary

Since the commencement plan implementation, 43 per cent of irrigated saline soils had been retired from irrigation. Much of this retirement occurred on the farms of a minority of farmers.

Farmers can be classified into three similarly sized groups according to their management of saline land. Approximately one third made few concessions to soil salinity status. Much of the remaining irrigated saline land was on the properties of these farmers. Further retirement of this saline land was likely to come about through the sale of these properties to new managers. Another third had ceased irrigating saline land and were investing few resources in its management. This can be seen as a profit maximising strategy. The remaining third were both retiring saline land and investing resources in the management of that land. They were following the heritage of Alan Morgan’s salt reclamation work (see page 12).
Higher value uses for irrigation water

Research Issue 3: Has water released by the retirement of saline soils been reallocated to higher value uses?

• What volume of water has been made available for re-allocation through the reduced irrigation of saline soils?

• To what purposes has this water released from C and D class soils been re-allocated?

The volume of water retired from saline soil irrigation

Although we can be reasonably accurate in the estimates of the area of land retired from irrigation, estimates of the volume of water freed for use elsewhere must be based upon assumptions about water usage. Water usage will vary significantly from season to season depending upon rainfall, water availability and the extent of rationing imposed due to constraints on the capacity of the Waranga Channel. Water consumption records for 1991-95 were aggregated to the supply wheel and at annual consumption. This essentially gives us annual consumption by REN as there is no accurate means of determining where in each REN water is supplied from a particular wheel. More detailed water consumption disaggregated to a monthly basis was available for the 1987 season.

The key to determining actual water consumption on annual pasture lies in records of land culture for each REN. There are three record sources available for this purpose. The first is bailiffs’ records of land culture for the 1987 season. From these it was possible to identify those properties which irrigated solely annual pasture and for these calculate average water usage per hectare of annual pasture. For the 1992-93 season there were the results of the Rural Water Corporation culture survey. Data was only available for about half of the total properties, but sufficient properties with only annual pasture were identified to enable another calculation of water used on annual pasture. By assuming that these properties only produced annual pasture in the preceding and following year, further estimates of water consumption on annual pasture could be calculated. A final source of culture data was available in the data from the 1995 interview survey.
The three sources of culture data allow the determination of the average annual water application rate for annual pasture in five seasons. The resulting estimates varied between 2 and 4 megalitres per year with the average being 2.98. Local opinion amongst extension officers on the Tragowel Plains was that average annual pasture usage was between 3 and 4 megalitres per hectare per annum (Dyson, 1997).

In the 1995 survey sample farms the area of C and D class soils retired from irrigation was 1530 hectares. Again, I did not have accurate data on the amount of water which was applied to these soils. Water use is only recorded in aggregate to the Register Entry Number. RENs are aggregates of many paddocks. Taking a conservative approach I assumed that these soils were watered according to the lower bounds of the measured irrigation intensity for annual pastures at 2 megalitres. This conservative assumption is justified on two grounds. Firstly, saline soils have a lower moisture holding capacity and farmers aware of this would be likely to water less intensely. Secondly, it is reasonable to assume that some of the saline soils retired were being watered at a lower intensity than non-saline soils. The less conservative assumption is that saline soils were being irrigated at 3 megalitres per hectare prior to their retirement from irrigation. The true figure is likely to be somewhere within the two estimates.

Based on these assumptions, between 2 and 3 megalitres per hectare would have been allocated away from each hectare of C and D class soil retired by the survey respondents. The total re-allocation on all the sample farms would have been between 3060 megalitres and 4590 megalitres of irrigation. A mid-range estimate for an average season this would be approximately 3800 megalitres.

Retirement of C and D class soil was not the only management strategy which freed irrigation water. Farmers in the sample reduced the intensity of irrigation water application on a further 738 hectares of C and D class soils without ceasing irrigation altogether on these soils. These soils were generally only irrigated once per year in autumn. This was often described as a light watering to help halophytes to become established. I have assumed that water usage reduced from 2 megalitres to half of a megalitre per year. This conservative assumption implies an additional saving of 1100 megalitres on the sample farms.
This process identified a total saving of 4900 megalitres of irrigation water no longer applied to C and D class soils managed by the sample farmers. This was 6.8 per cent of total water right of the sample. With actual water usage per season being higher than total water right, the actual rate of water saving will be less than 6.8 per cent. However, as most retirement has occurred on mixed farms whose average water use was 110 per cent of water right, the total saving in water application is still likely to be greater than 6 per cent, particularly in the light of my conservative assumptions about previous irrigation of C and D class soils. Further, as the majority of land retirement was undertaken by a small number of farmers, the water savings on these farms will have been very significant.

The re-allocation of water

Farmers were asked where the water no longer applied to C and D class soils had been allocated. The majority of respondents indicated that the water had been reallocated to other uses on the farm. Although an approximately equal number of farmers indicated water had been allocated to a specific project or to the rest of the farm in general, the majority of the volume of reallocated water was described as having been reallocated to the rest of the farm in general (Table 28).

<table>
<thead>
<tr>
<th>Major re-allocation of water removed from C and D class soil</th>
<th>Respondents as a % of all respondents who had retired C and D class soil</th>
<th>Total area of C and D class soils where irrigation reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distributed on rest of farm</td>
<td>41</td>
<td>1000</td>
</tr>
<tr>
<td>Allocated to specific new project</td>
<td>38</td>
<td>370</td>
</tr>
<tr>
<td>Sold</td>
<td>13</td>
<td>228</td>
</tr>
<tr>
<td>Lower use of sales water</td>
<td>8</td>
<td>52</td>
</tr>
</tbody>
</table>

To explore the re-allocation of water freed by the retirement of C and D class soils I sought to model the re-allocation process using the archival data available. Again, modelling is necessary because there are no records of water use by paddock. The model
was a stepwise notional re-allocation of water identified as no longer applied to C and D soils to a series of alternative uses. The progressive re-allocations were made first with relatively permanent re-allocations (permanent sale of water right) through to relatively temporary allocations (reduced sales water, application to annual pasture).

- **Step 1**: Calculate the volume of water saved on each farm through retirement or lowering of irrigation intensity on saline soils.

  \[ W = (2 \times H_r) + (H_d/2) \]

  *where*

  \[ W = \text{Volume of water saved (Ml)} \]
  \[ H_r = \text{Area of C and D class soils retired (Ha.)} \]
  \[ H_d = \text{Area of C and D class soils where irrigation intensity reduced.} \]

- **Step 2**: Identify farmers who had been net vendors of permanent water right. Calculate the average rate of water consumption on each farm per megalitre of water right using the most recent five years of water consumption records. Reduce the notionally unallocated water by this amount, or as much of this as possible.

  \[ W_{rc} = W_r \times C_a \]

  *If* \( W > W_{rc} \) \( Sw_r = W_{rc} \)

  *If* \( W < W_{rc} \) \( Sw_r = W \)

  *where*

  \[ Sw_r = \text{Water reallocated from C and D soils to permanent water right Sale} \]
  \[ W = \text{Water no longer applied to C and D soils} \]
  \[ W_r = \text{Volume of net permanent sale of water right} \]
  \[ C_a = \text{Mean annual consumption per megalitre of water right} \]
  \[ W_{rc} = \text{Water consumption foregone through net permanent sale of water right.} \]

- **Step 3**: Using remote sensing data, identify net increases in the area of perennial pastures. Assume each one hectare increase in perennial pasture requires an additional 8 megalitres of water per year. Reduce the notionally unallocated water by the amount of increased water application to perennial pasture, or as much of this as possible.

  \[ \text{If} \ (W - Sw_r) > W_{pp} \] \( S_{pp} = W_{pp} \)
If \( (W-Swr) < Wpp \) \( Spp = W-Swr \)

\[ \]

where

\[ Spp = \quad \text{Volume water reallocated from C and D class soils to perennial pasture} \]
\[ Wpp = \quad \text{Volume of water applied to net increase in perennial pastures} \]
\[ Swr = \quad \text{Water reallocated from C and D soils to permanent water right sale} \]
\[ W = \quad \text{Water no longer applied to C and D soils} \]

- Step 4: Calculate average net temporary sales of water right or of sales water over the last three years. Using the same procedure as in step 2 convert this to a volume of water consumption foregone. Reduce the notionally unallocated water by this volume or by as much as possible.

\[ Wtc = (Wtw * Ca) + Ws \]
If \( (W-Swr+Spp > Wtc) \) \( St = Wtc \)
If \( (W-Swr+Spp < Wtc) \) \( St = W-Swr+Spp \)

where

\[ Wt = \quad \text{Mean annual water consumption decrease due to temporary water sales} \]
\[ Wtw = \quad \text{Mean annual sales of temporary water right} \]
\[ Ca = \quad \text{Mean annual consumption per megalitre of water right} \]
\[ Ws = \quad \text{Mean annual sales of sales allocation} \]
\[ St = \quad \text{Vol. water reallocated from C and D class soils to temporary water sales} \]
\[ Spp = \quad \text{Vol. water reallocated from C and D class soils to perennial pasture} \]
\[ Swr = \quad \text{Water reallocated from C and D soils to permanent water right sale} \]
\[ W = \quad \text{Water no longer applied to C and D soils} \]

- Step 5: Identify those farmers who indicated that water savings were utilised through lower purchases of sales water. Allocate all the water saved by these farmers to lower sales purchases where possible.

\[ Wtc = (Wtw * Ca) + Ws \]
If \( (W-Swr+Spp-St > Ws) \) \( St = Wtc \)
If \( (W-Swr+Spp-St < Ws) \) \( St = W-Swr+Spp-St \)

where

\[ Ws = \quad \text{Mean annual consumption decrease due to reduced use of sales allocation} \]

Higher value uses for irrigation water

\[ S_s = \text{Volume of water reallocated from C and D class soils to reduction in use of sales allocation} \]
\[ S_t = \text{Volume water reallocated from C and D class soils to temporary water sales} \]
\[ S_{pp} = \text{Volume water reallocated from C and D class soils to perennial pasture} \]
\[ P_{cw} = \text{Volume of water applied to net increase in perennial pastures} \]
\[ S_{wr} = \text{Water reallocated from C and D soils to permanent water right sale} \]
\[ W = \text{Water no longer applied to C and D soils} \]

- Step 6: Assume the remaining notionally unallocated water has been allocated to annual pasture irrigation.

\[ S_a = W - S_{wr} - S_{pp} - S_t - S_s \]

where
\[ S_a = \text{Volume of water reallocated from C and D class soils to annual pasture} \]
\[ S_s = \text{Volume of water reallocated from C and D class soils to reduction in use of sales allocation} \]
\[ S_t = \text{Volume water reallocated from C and D class soils to temporary water sales} \]
\[ S_{pp} = \text{Volume water realallocated from C and D class soils to perennial pasture} \]
\[ P_{cw} = \text{Volume of water applied to net increase in perennial pastures} \]
\[ S_{wr} = \text{Water reallocated from C and D soils to permanent water right sale} \]
\[ W = \text{Water no longer applied to C and D soils} \]

The model results are shown in Table 29. We can conclude from the results of the model that water is being reallocated from C and D class soils to temporary water sales, perennial pasture and annual pasture in approximately equal amounts. The modelling process does not allow any greater certainty.

<table>
<thead>
<tr>
<th>Water re-allocation</th>
<th>Water reallocated as a percentage of all water removed from C and D class soils (%)</th>
<th>Water re-allocated as a percentage of total sample water right (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporary sales of water</td>
<td>32.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Increased perennial pasture</td>
<td>28.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Annual pasture</td>
<td>25.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Permanent water right sales</td>
<td>13.7</td>
<td>0.9</td>
</tr>
<tr>
<td>Reduced sales consumption</td>
<td>0.9</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Table 29 Notional re-allocation of water saved by retirement of C and D class soils
Re-allocation on the farm

For many years the management of annual pastures on the Tragowel Plains has been described as being of a very low standard (Nicholson and Heslop, 1990). Since the commencement of the Salinity Plan the Tragowel Plains Research and Development Farm has been used to promote the message of better annual pasture management. A major message has been to irrigate according to pasture requirements rather than according to a fixed schedule set by either rationing or historic practices. The key to this latter recommendation is the decision to irrigate a smaller area of annual pasture (Hammett, 1994). The major factor contributing to a healthy irrigation annual pasture is the period between the first and second watering. Under normal seasonal conditions this needs to be no more than 10 days. For most farms this objective cannot be attained under rationing unless the area of annual pasture is reduced. To maintain production, it is necessary to water this reduced area of annual pasture earlier in the season, or to grow greater areas of shaftal or white clover pastures which require a longer irrigation season.

Although farmers who have retired C and D class land described their strategy as ‘Concentrating water on the better class soils’, they often did not provide the interviewers with a clear description of what this concentration meant for their annual pasture irrigation strategies beyond ‘More efficient irrigation’ (see Table 30).

Table 30: Changes to annual pasture management in the last 5 years

<table>
<thead>
<tr>
<th>Changes</th>
<th>Percentage of all farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrate resources on better land</td>
<td>10.3</td>
</tr>
<tr>
<td>Water existing pasture more</td>
<td>17.5</td>
</tr>
<tr>
<td>More efficient in general</td>
<td>10.3</td>
</tr>
<tr>
<td>Water less</td>
<td>5.2</td>
</tr>
<tr>
<td>Move away from sub-clover</td>
<td>8.3</td>
</tr>
<tr>
<td>No change</td>
<td>48.4</td>
</tr>
</tbody>
</table>
Farmers who have retired or reduced irrigation on C and D class soils are no more likely to have adopted shorter intervals between first and second sub-clover irrigations (Table 31). It is even clearer that those farmers who have retired larger areas of C and D class soils are generally still making the period between their first and second irrigation longer than 17 days. Adoption of land retirement has not led to a shortening of this period. We can only conclude that water saved by retiring C and D class soils and reallocated to annual pasture is more likely to have been applied to new annual pasture on other soils rather than concentrated upon existing annual pasture to allow more effective irrigation. More formal testing of this conclusion is not possible due to the failure of remote sensing to adequately measure changes in annual pasture area.

### Table 31  Period between first and second watering of sub-clover pastures

<table>
<thead>
<tr>
<th>Period</th>
<th>% of all farmers with sub clover</th>
<th>% of farmers retiring or reducing irrigation of C and D class soils</th>
<th>% of C and D class soils retired</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 77</td>
<td>N = 67</td>
<td></td>
</tr>
<tr>
<td>12 days or less</td>
<td>32.5</td>
<td>32.8</td>
<td>18</td>
</tr>
<tr>
<td>13-17 days</td>
<td>40.2</td>
<td>37.3</td>
<td>12</td>
</tr>
<tr>
<td>Greater than 17 days</td>
<td>27.3</td>
<td>29.8</td>
<td>70</td>
</tr>
</tbody>
</table>

There has been a significant shift from annual to perennial pasture since the development of the Salinity Plan. Remote sensing data indicates that the area of perennial pasture increased from 10560 hectares in 1989-90 to 14533 hectares in 1995-96. This was a 37 per cent increase in perennial pasture area. Increases were distributed across the Tragowel Plains. They were not just concentrated in the southern and north eastern dairying districts (Figure 16). The trend towards increased perennial pasture area in dairy areas is expected due to the relatively buoyant state of the dairy industry through the early 1990s. The trend towards perennial pasture in mixed farming areas can be best explained by the high returns for prime lambs during the period 1993-96.
An overall increase of 1434 hectares of perennial pasture on properties within the sample farms was detected by remote sensing. Dairy farms were significantly more likely to have increased the area of perennial pasture. Because of the relative abundance of mixed farms, 46 per cent of the increased area of perennial pasture occurred on these farms (Table 32).
Higher value uses for irrigation water

How much of this increased area of perennial pasture was associated with decreased irrigation of C and D class soils? There was no correlation between the extent of reduced irrigation of C and D class soils or land retirement and the extent of increase in area of perennial pasture ($r < .01$). There was no relationship between the extent of adoption of the stages of land retirement and increases in perennial pasture.

Clearly the sowing of perennial pasture was not driven by the ability to release water resources by retiring C and D class soils. The best that can be said of the relationship is that the retirement of C and D class soils gave an opportunity to sow perennial pasture if other factors encouraged that management strategy.

### Fate of water reallocated to other farms

It is not logistically possible to specifically track the fate of individual parcels of water withdrawn from saline soil irrigation and sold to other properties. However, the eventual end use of this water can be determined by monitoring changes in the aggregate allocation of water. In the three years between 1992 and the time of the survey over 3.7 per cent of the water right owned by the sample was sold permanently to irrigators outside the Tragowel Plains. Comprehensive water transfer data in Goulburn-Murray Water records detailed 139 permanent transactions from 67 customers. Of the 100 transactions with external water users, 73 per cent were with Rochester district farmers with the bulk of the remaining sales being to Tongala (Kent, 1996). Dairying dominates land use in each of these districts, and it can be safely assumed that by far the majority of the water sold to these areas was allocated to permanent pasture.

<table>
<thead>
<tr>
<th></th>
<th>Mean increase per farm Ha</th>
<th>Total increase in perennial pasture area per farm type Ha</th>
<th>Increase as a percentage of total increase in perennial pasture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed farms</td>
<td>8.57 (±2.5)</td>
<td>660</td>
<td>46 %</td>
</tr>
<tr>
<td>Dairy Farms</td>
<td>18.43 (± 2.6)</td>
<td>774</td>
<td>54 %</td>
</tr>
</tbody>
</table>

Table 32 Increases in perennial pasture area
The GMW water transfer data recorded 39 permanent transfers of water to properties in the Tragowel Plains (Kent, 1996). Of these transfers, 11 were internal transactions, shifting water from one Register Entry Number to another without any change in ownership. These internal transfers would not have been recorded as water right sales in the survey. Of the remaining 28 substantive ownership transfers, 21 were to the dairy industry. The remaining 7 transfers were for tomato production, lucerne and repurchase of water right back to a property after property purchase due to water sale by the previous owners. Seventy-nine per cent of the water rights volume sold to Tragowel Plains farms was destined for use on dairy farms (Table 33). If we make the conservative assumption that all water purchased by mixed farms was utilised on annual sub-clover pasture and all water purchased by dairy farmers was utilised on perennial pastures, we can conclude that 80 per cent of the water right permanently purchased by Tragowel Plains farmers was destined for use on perennial pasture.

No records of temporary sale of water right were available from Goulburn-Murray water. For these transactions I needed to rely upon the information provided from the sample farms. Table 34 shows the total volume of water purchased temporarily by mixed farmers and dairy farmers in the sample over the period of plan implementation. The data has been weighted to reflect the relative under-sampling of the southern part of the study area which is dominated by dairying and could be expected to be a major purchaser of water (see Table 3 and Table 4). By far the majority of temporary water right purchased has gone to dairy farms, with only 4 per cent being purchased by mixed farms. Mixed farms purchased 31 per cent of transferred sales allocations. In total, 82 per cent of water sold temporarily was purchased by dairy farmers. If it is assumed that water purchased by mixed farmers is utilised on annual pasture and water purchased by dairy farmers is utilised on perennial pasture, then we can again conclude that 80 per cent of water temporarily sold to
Tragowel Plains farmers was utilised on perennial pasture of dairy farms. Again, this is a conservative estimate given the trend towards sowing of additional areas of perennial pasture on mixed farms which was outlined in the previous section.

**Table 34  Temporary purchase of water right and sales allocation by industry (1990-95)**

<table>
<thead>
<tr>
<th></th>
<th>Mixed farms</th>
<th>Dairy Farms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 79</td>
<td>N = 45</td>
</tr>
<tr>
<td>(ML)</td>
<td>(ML)</td>
<td>(ML)</td>
</tr>
<tr>
<td>Temporary Water Right</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1.5 (±1.3)</td>
<td>61.2 (±33)</td>
</tr>
<tr>
<td>Sum</td>
<td>126</td>
<td>3199</td>
</tr>
<tr>
<td>Sales Allocation</td>
<td>13.3 (±6)</td>
<td>67.3 (±22)</td>
</tr>
<tr>
<td>Sum</td>
<td>1086</td>
<td>3516</td>
</tr>
</tbody>
</table>

My concluding estimates of the final use of irrigation water removed from C and D class soils is shown in Table 35. The predominant end-use has been perennial pasture. The transfer of water from C and D class soil to perennial pasture has predominantly achieved by water right transfers. Sixty-five per cent of the new perennial pasture created watered with resources once used on C and D class soils is on farms other than the farm on which C and D class soils were retired.

**Table 35  Estimates of end purpose to which irrigation water removed from C and D class soils has been re-allocated**

<table>
<thead>
<tr>
<th>Purpose to which water has been reallocated</th>
<th>Water reallocated as a percentage of all water removed</th>
<th>Water re-allocated as a percentage of water right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent pasture</td>
<td>65.42</td>
<td>4.45</td>
</tr>
<tr>
<td>Annual pasture</td>
<td>34.58</td>
<td>2.35</td>
</tr>
</tbody>
</table>

**Summary**

Using a simple model of water savings, it is estimated that between 1990 and 1995, 4,900 ML of water was removed from irrigation of C and D class soils by the sample farmers. This was 6.8 per cent of total water right. Two thirds of this was re-allocated to perennial pasture, largely through transfer of water ownership from mixed farms to dairy
farms. One third was re-allocated to the irrigation of annual pasture on A and B class soils. This was largely achieved through the re-allocation of water within farm businesses.

Without the introduction of a transferable water entitlement policy the strategy of encouraging retirement of saline soils would have been far less effective. The reasons probably lie in the attributes of the three ‘innovations’ available for use with surplus irrigation water. One, the irrigation of annual pasture under existing management systems is clearly not a very profitable option for many farmers. The second, sowing perennial irrigation pastures was profitable for both dairy farmers and some prime lamb producers, and was a management tool well understood and already on use on many farms. The third option, more intense irrigation of sub-clover pasture was a new innovation. It was not widely adopted and for most farmers remained an untested hypothesis. The gains from investing in perennial pasture or in selling water right would seem relatively risk free.
Investment in water management

Research Issue 4: Has there been an increase in the adoption of land whole farm planning and relayout as part of an integrated farm management package?

- Has the adoption of whole farm planning increased in general, and in particular by the group of farmers previously identified as Intending Developers?
- Has the adoption of laser grading increased in general, and in particular by the group of farmers previously identified as Deterred Developers?

Adoption of whole farm planning

Development of a whole farm plan is generally seen by irrigation advisers as a necessary step before embarking upon any significant investment in relayout and drainage, to ensure that constraints on water supply, drainage outfall and labour are adequately integrated into any farm development. In the case of the Tragowel Plains, whole farm planning takes on an added importance as a whole farm plan must also take account of soil salinity. A major aim of the Tragowel Plains Salinity Management Plan is to ensure that no relayout development takes place on saline soils, either intentionally as a strategy to ‘reclaim’ saline soils, or unintentionally due to lack of awareness of the location of saline soils.

Thirty-five per cent of farmers in the 1987 sample claimed to have a whole farm plan for at least part of their property\(^1\). However, only 13 per cent of farms had invested in a professionally prepared whole farm plan. At the time this was a cause of concern as it was believed by engineers in the water supply authority that most farmers lacked the skills to prepare

\(^1\) The concept of a ‘whole’ farm plan for only part of a property is not the contradiction it sounds. ‘Whole’ refers to planning which takes account of all factors which might impinge on water management and labour constraints. It is possible to plan from this perspective for one block of land which is part of a number of non-contiguous properties owned by one business entity.
an effective whole farm plan. It must be noted that farmers who had prepared a whole farm plan by themselves had a higher level of education than those who sought professional assistance.

The debate over the merits of professional and farmer prepared whole farm plans will never be totally resolved. It is clear that where significant movement of soil is to be undertaken there are real benefits in the professional skills of a whole farm planning engineer. However, where relayout is to be less significant it is still argued by many farmers that the expense of a complete topographic survey is unnecessary. This trade-off is complicated by the dissatisfaction of some clients of professional whole farm planners that the requirements of day to day farm management and the preferences of farmers are sometimes overlooked in the pursuit of water efficiency (Lodge, 1992; Lodge, 1996). In the case of the Tragowel Plains, it is also possible to use the results of a soil survey to guide development without the undertaking of a professional whole farm plan.

By 1995 one third of respondents had a whole farm plan prepared for all of the irrigable areas of their farm. Sixty per cent had had at least part of their irrigation farm planned. Forty percent had no whole farm plan at all. With 207 whole farm plans recorded as being assisted by incentives of the Tragowel Plains Salinity Management Plan, it is clear that almost all the newly reported whole farm plans had been prepared professionally (Tragowel Plains Salinity Plan Implementation Group, 1996) and were taking account of the results of soil salinity surveys.

Further adoption of whole farm planning can be expected in the future. Forty-seven per cent of those who had not fully adopted whole farm planning intended to undertake a whole farm plan in the future. Approximately two thirds of those who had a part of their farm planned

<table>
<thead>
<tr>
<th>Extent of professional whole farm planning</th>
<th>Percent of 1987 sample</th>
<th>Percent of 1995 Pyramid Hill sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>13</td>
<td>33.3</td>
</tr>
<tr>
<td>Some</td>
<td>-</td>
<td>26.0</td>
</tr>
<tr>
<td>None</td>
<td>87</td>
<td>40.7</td>
</tr>
</tbody>
</table>

Valid cases = 123; missing cases = 1.
intended to have a further farm plan prepared, whereas only 36% of those with no whole farm plan intended to have a plan prepared in the future.

Table 37 Intentions of those who have not fully adopted whole farm planning: 1995

<table>
<thead>
<tr>
<th>Value Label</th>
<th>Frequency</th>
<th>Percent of 1995 sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
<td>37</td>
<td>46.8</td>
</tr>
<tr>
<td>no</td>
<td>34</td>
<td>43.0</td>
</tr>
<tr>
<td>maybe</td>
<td>8</td>
<td>10.1</td>
</tr>
</tbody>
</table>

Valid cases = 79; missing cases = 3.

Those respondents who had no intention to undertake further whole farm planning explained their reticence with two differing reasons. The larger group were those who believed there was no reason for them to undertake development work on the farm, either because the farm was laid out to their satisfaction or because they felt no need to invest in farm build up. The second group was those who doubted the value of professional whole farm planning (Table 38). Only 10 respondents who had some of their farm professionally planned stated that they would not have a further plan prepared. The main reason given was that the property was already mostly or all laid out (Table 38).

Table 38 Reasons for not adopting whole farm planning: 1995

<table>
<thead>
<tr>
<th>Category label</th>
<th>Count</th>
<th>Pct of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Multiple responses possible)</td>
</tr>
<tr>
<td>Already mostly or all laid out</td>
<td>18</td>
<td>45</td>
</tr>
<tr>
<td>Know well enough to do myself</td>
<td>14</td>
<td>35</td>
</tr>
<tr>
<td>No need to change farm</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>Benefits do not outweigh costs</td>
<td>16</td>
<td>15</td>
</tr>
</tbody>
</table>

Valid cases = 40; missing cases = 2 (missing cases excluded from table).

In summary, it was clear in 1987 that half of the farmers who had undertaken land relayout had done so without any form of whole farm planning. Seventy-five per cent had done so without professional whole farm planning support. This uncoordinated relayout and drainage could lead to uncoordinated drainage between properties, poor investment decisions and cause
significant problems for the water supply authority. By 1995, two thirds of farmers of those farmers who undertook relayout did so according to the specifications of a professional whole farm plan. Thirty three per cent of the area of relayout undertaken during 1990-95 was not undertaken according to whole farm plan specifications.

**Adoption of land relayout**

Land relayout is the final step in developing effective drainage on a flood irrigation farm. Land relayout may involve the rebuilding of irrigation water supply channels with increased capacity and the creation of larger irrigation bays with a more even and sometimes steeper slope to enable faster watering with a lower labour requirement. Land relayout is a substantial investment. The initial high adoption rates for land relayout and the subsequent financial difficulties which ensued when interest rates rose during the initial stages of financial deregulation in the Australian economy were detailed in chapter 1.

In 1987 land relayout was seen as a valuable investment by 92 per cent of farmers. The main advantages of relayout were seen as controlling watertables, improving production and improved productivity. However, only fifty per cent of farmers in the 1987 sample mentioned relayout as a plan for their farm in the next five years.

Attitudes to land relayout remained positive in 1995, though with a greater degree of caution than was evident in 1987. Sixty-three per cent of respondents believed investment in land relayout was justified by the benefits. A further 35 per cent believed the benefits could justify investment in some situations. The major concerns were the ability to carry the burden of debt over the short term for the longer term returns, and the importance of carrying out relayout works only on the better soils on a farm. The lessons of the late 1980s had been well learnt.

In contrast to the results of the 1987 survey, a higher degree of confidence in the value of land relayout is shown in the widespread expectation of farm operators that they will undertake further land relayout in the next five years. Seventy-five per cent of the total 1995 sample believed there was a strong possibility they would relayout further land. There was no difference in the expectations of farmers in the northern area sampled in the 1987 study and farmers in the southern Calivil-Dingee district.
It is difficult to detect changes in relayout behaviour between 1987 and 1995 due to limitations of the questions used in the 1987 survey. In 1987 seventy per cent of farms had areas of relayed out land. The mean area relayed out was 102 (±14.1) hectares and the median was 40 hectares. This area of reported relayout of land had been undertaken over the previous 10 years following the introduction of laser relayout technology in 1977.

Investment in land relayout continued at significant levels over the period 1990-95 (Table 39). The total area relayed out by the sample was 3969 hectares, 10.9 per cent of the total irrigated area of 36,382 hectares. The mean area relayed out was 51 hectares, a rate not significantly different from that which occurred in the 10 years prior to 1987. Land was relayed out by 82 per cent of farmers in the area where the 1987 survey was sampled. This is a significant increase in the rate of adoption over that observed in 1987 (p < .01). These apparently contradictory results indicate a change in the distribution of adoption between the early years of relayout technology, when a smaller number of farmers invested in large areas of relayout, and the period of Salinity Plan implementation when relayout was undertaken by a larger number of farmers who relayed out smaller areas of land. This change in the pattern of adoption may be explained by the slowing activity of the early adopters of relayout as they neared full relayout of their properties. This interpretation is supported by the lack of correlation between the proportion of land relayed out before 1987 and that relayed out after 1987 amongst those farmers present in both samples.

Table 39 Adoption of land relayout 1990-95

<table>
<thead>
<tr>
<th>% of farm relayed out</th>
<th>Pyramid Hill 1977-87</th>
<th>Pyramid Hill 1990-95</th>
<th>Pyramid-Calivil 1990-95</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30.1</td>
<td>17.2</td>
<td>21</td>
</tr>
<tr>
<td>1 - 10</td>
<td>15.6</td>
<td>31.0</td>
<td>29.8</td>
</tr>
<tr>
<td>11 - 20</td>
<td>9.7</td>
<td>24.1</td>
<td>24.2</td>
</tr>
<tr>
<td>21 - 30</td>
<td>12.7</td>
<td>10.3</td>
<td>12.1</td>
</tr>
<tr>
<td>31 - 40</td>
<td>12.6</td>
<td>9.2</td>
<td>7.3</td>
</tr>
<tr>
<td>41 +</td>
<td>19.3</td>
<td>8.0</td>
<td>5.6</td>
</tr>
</tbody>
</table>
The relayout investment behaviour and intentions of farmers in 1987 were used to create a 5 group segmentation of the 1987 sample (Table 40). This segmentation was created using a simple three way cross tabulation of three variables: adoption of land relayout, intention to undertake further land relayout and attitude towards land relayout.

The Sceptics managers were the oldest farmers. They had few farm debts and managed their farms using low-input strategies, and were sceptical of investment in land relayout. Their survival strategy was to minimise expenditure when times were bad and to increase savings rather than invest in improvements when income was higher. Whilst having the lowest mean farm profit, these farmers also had the lowest stress levels. Sixteen per cent of farmers were members of this group.

Recent investors in land relayout were classified into two groups. The smallest, eight per cent of the population, were called Successful Developers. They had relayed out a large proportion of their farms, but without going into significant debt. They had high farm cash surpluses. Twenty per cent of farmers were members of what was called the Developers at Risk group. This group had high gross farm incomes, yet had the second lowest profit of any of the segments. They had relayed out using debt finance. Only one quarter of the group made a farm cash surplus. Personal stress levels were high.

The last two groups were those who were considering investing in land relayout. Thirty-three per cent of farmers were Discouraged Developers. Most of these farmers had whole farm plans and had considered relayout as a serious investment possibility. However they considered they could not justify the financial risk. The final group was the Intending Developers. These farmers believed their current farm layout and drainage were problematic. They intended to invest in farm relayout in the future. They believed they could manage the financial risk. Interestingly, the members of this group were in a similar financial position to that of the Discouraged Developers. However, unlike the Discouraged Developers, they mostly had no Whole Farm Plan and were comparatively new to the district. Twenty-five per cent of farmers were classified into this segment. It was argued that these farmers were less equipped by experience and planning to undertake an investment in land relayout than those who had rejected this option.
### Characteristics of sample segmentation according to land relayout investment patterns in 1987

<table>
<thead>
<tr>
<th>Segment</th>
<th>Successful developers</th>
<th>Developers at risk</th>
<th>Intending developers</th>
<th>Discouraged developers</th>
<th>Sceptics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=7</td>
<td>N=18</td>
<td>N=22</td>
<td>N=28</td>
<td>N=14</td>
</tr>
<tr>
<td>% of farm relayed out</td>
<td>48</td>
<td>66</td>
<td>12</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>% group intending to relayout further land in next 5 years</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mean annual gross farm income ($000’s)</td>
<td>72</td>
<td>73</td>
<td>57</td>
<td>59</td>
<td>38</td>
</tr>
<tr>
<td>Mean annual farm profit ($000’s)</td>
<td>9.0</td>
<td>-8.2</td>
<td>4.5</td>
<td>3.0</td>
<td>-5.8</td>
</tr>
<tr>
<td>Henderson poverty line score ($/wk)</td>
<td>63</td>
<td>-341</td>
<td>99</td>
<td>-33</td>
<td>-137</td>
</tr>
<tr>
<td>Mean debt ($000’s)</td>
<td>11.7</td>
<td>63.7</td>
<td>52.8</td>
<td>49.8</td>
<td>21.6</td>
</tr>
<tr>
<td>Mean equity</td>
<td>89.8</td>
<td>68.5</td>
<td>79.0</td>
<td>68.6</td>
<td>88.5</td>
</tr>
<tr>
<td>Mean concern over farm layout (1 = low, 5 = high)</td>
<td>1.8</td>
<td>1.6</td>
<td>3.1</td>
<td>2.6</td>
<td>2.3</td>
</tr>
<tr>
<td>% of group having a whole farm plan</td>
<td>28</td>
<td>56</td>
<td>25</td>
<td>50</td>
<td>9</td>
</tr>
<tr>
<td>Mean years farming in district</td>
<td>20</td>
<td>21</td>
<td>15</td>
<td>22</td>
<td>26</td>
</tr>
<tr>
<td>Mean stress score(high score = high reported stress)</td>
<td>18.8</td>
<td>27.3</td>
<td>18.0</td>
<td>21.5</td>
<td>17.4</td>
</tr>
<tr>
<td>% selling out of farm on Tragowel Plains by 1995</td>
<td>16.7</td>
<td>35.3</td>
<td>28.6</td>
<td>35.7</td>
<td>66.7</td>
</tr>
<tr>
<td>% of farm relayed out 1990-95</td>
<td>19.3</td>
<td>24.2</td>
<td>14.6</td>
<td>19.5</td>
<td>8.3</td>
</tr>
<tr>
<td>N=4</td>
<td>N=10</td>
<td>N=15</td>
<td>N=18</td>
<td>N=7</td>
<td></td>
</tr>
</tbody>
</table>

Bolded figures indicate a difference from the remainder of the sample using T-test at p < .05
In 1987 the members of the Tragowel Plains Salinity Management Working Group were concerned that the members of the ‘Intending developers’ group were likely to place themselves in financial difficulty through a combination of inconsistent responses from relayout investment due to unforeseen salt impact, and the financial cost of the prevailing high interest rate regime. In 1995 it was clear there has been no disproportionate exit of members of the ‘Intending developers’ from farms on the Tragowel Plains. This was consistent with the assumptions in the Salinity Plan that provision of soil salinity survey information would minimise the risk of investment in land relayout. However, it is arguable that lower interest rates of the 1990s are probably of greater significance.

Although members of the ‘Discouraged developers’ group had no plans to undertake land relayout in the following five years, their rate of relayout was not significantly different from that of farmers who planned to undertake further relayout (Table 40). The reasons which discouraged this group from investment in 1987, high interest rates and salinity uncertainty, had been substantially alleviated in the following five years. One of the most common advantages of soil salinity surveying mentioned by farmers was that it was a risk reduction strategy. Respondents used phrases such as ‘Gives you confidence in your plans’ or ‘Lets you know what is out there’.

Summary

The adoption of professional whole farm planning has increased significantly since the implementation of the Tragowel Plains Salinity Management Plan. Compliance with whole farm plan recommendations when undertaking land relayout has increased. The rate of land relayout has not increased. However, participation in land relayout investment has increased significantly.

It is speculated that the provision of soil salinity information and the reduction in commercial interest rates has increased the participation in land relayout. However, the reduced relayout by the early adopters of this technology as they near full relayout potential may have slowed the apparent adoption rates. Further, those investing in relayout were doing so with greater caution, with smaller areas being developed than during the 1980s.
Farm consolidation and the “small farm problem”

Research Issue 5: What patterns of structural adjustment have been followed by the farm businesses of the Tragowel Plains?

• To what extent are low exit rates from farming contributing to the continued existence of a small farm sector on the Tragowel Plains?

• To what extent are high entry rates to farming contributing to the continued existence of a small farm sector on the Tragowel Plains?

Changes in the structure of enterprises

It is quite clear in the debate over the appropriate forms of structural adjustment for the Tragowel Plains that for many participants the words structural adjustment were taken to primarily refer to changes to farm size as a result of property amalgamation and entry to and exit from farming. Structural adjustment can be considered to include many other changes to the farming sector. Some of these changes, such as water re-allocation, have been considered in previous chapters. Other changes such as taking off-farm work or diversifying production were measured and are discussed later in this chapter. This chapter primarily considers adjustment in the form of changes in farm size and ownership through the combined impact of farming entries and exits, water sales and land transfers.

The best source of data for this purpose were the Goulburn-Murray Water ownership records for the period 1989-90 to 1995-96. A number of cautions must be noted about this data source. First, the period of study does not mirror the period between the two major interview surveys. This is due to the incomplete nature of water and land ownership records available for the seasons prior to 1989-90. Second, the records reflect legal ownership arrangements rather than management arrangements on farms. Properties which were managed as an integrated unit may well be recorded as being owned by legally separate entities. Thus the legal owner may well be a relative who has ceased involvement in farm management, or ownership may be divided between a number of separate members of a family for taxation or estate purposes despite the properties being managed as a single unit. A significant effort was expended to overcome these
data deficiencies by using local informants’ knowledge of family structures. These efforts significantly improved the quality of this data resource. Reliable water ownership records were created for the seasons 1989-90, 1990-91, 1992-93 and 1995-96.

The population of farm businesses in 1989-90 was aggregated into three groups according to total water right. The division points were at 400 and 800 ML. Changes in membership of these three groups over the period 1989-90 to 1995-96 were analysed to determine rates of entry and exit from farming, and migration between groups due to farm build-up or farm ‘downsizing’. Note that there were no migrations between the smallest and largest farm groups. These changes are depicted in Figure 17 and Figure 18.

![Figure 17](image)

**Figure 17** Transitions in property size in the Pyramid Hill district 1989-90 to 1995-96

![Figure 18](image)

**Figure 18** Transitions in property size in the Calivil-Dingee-Patho-Mincha district 1989-90 to 1995-96
The most striking feature of adjustment in the Pyramid Hill district was the high number of business exits and entries in the lowest farm size. Ownership was quite stable amongst farm businesses with greater than 800 ML water right. Below this size farm ownership was far more unstable with 26 per cent of owners of mid-sized farm operators exiting Goulburn-Murray Water records and 38 per cent of operators of smaller farms exiting the records between 1990 and 1995 (Spearman’s Rho test = -.201, p<.002). There was an even greater difference in the entry rate of larger and smaller farms. Eighty-seven per cent of entries were into farms smaller than 400 ML (Spearman Rho = -.245, p <.0001).

The high entry rate increased the number of small farms. In contrast, the number of mid-sized farms was reduced by the preponderance of exits over entries to this group. The impact of farm build up and build down decisions has been to marginally enhance the changes caused by farm entry and exit. The number of small farms was further increased and mid-range farm numbers were further reduced by a small net migration to smaller farm size and a similar small net migration to larger farm sizes.

The Calivil-Dingee-Mincha-Patho districts showed a quite different pattern of adjustment, with a preponderance of exits ensuring that the number of small farms decreased. The impact of farm build up was quite different from that observed in the Pyramid Hill area, leading to an increase in mean farm size. The north-east Tragowel Plains (Patho and Mincha) were dominated by purchasers from the neighbouring Cohuna district. These purchasers were all dairy farmers who had acquired Tragowel Plains land for use as ‘run-off blocks’ for the grazing of dairy cows who are not being milked. In the southern Calivil and Dingee there was a high proportion of resident dairy farms. In both cases many of the owners in these districts would have been in a stronger financial position than mixed farmers in the Pyramid Hill district.

The rate of exit from Calivil and Mincha regions was 24 per cent compared with 28 per cent for the Pyramid Hill district. However, the rate of new entries to Calivil-Dingee and Patho-Mincha was nearly half that in Pyramid Hill at 14.8 per cent (28.7 per cent in Pyramid Hill). All but one exit in Calivil-Dingee was from properties smaller than 400 ML and all but two entries were into similarly small sized properties. Clearly property build up was occurring in areas where there was a strong dairy farming presence. Even this low rate of entry to dairy areas was likely to be an overestimate of the true rate of entry. By making comparisons with GMW
ownership records for the adjoining Kerang and Cohuna irrigation areas it was established that three of the apparent new entries to the Patho-Mincha district were purchases of run-off blocks by already established dairy-farmers. (A total of seven new entries by landholders from adjoining irrigation areas were identified over the whole of the plains).

These patterns of exit and entry have significant implications for any planning of adjustment assistance within this region. The fragmentation of farm holdings in the north means that expected increases in production efficiency due to property transfer were not occurring during 1989-95. Likewise, expectations that transferable water entitlements would improve the efficiency with which water was utilised may have been outweighed by decreases in labour efficiency. Water being sold out of the district was not matched by an aggregate exit of human resources of a similar relative magnitude.

The aggregate impact of the business exits, entries and changes in scale on the distribution of farm sizes is shown for both the Pyramid Hill and Calivil-Dingee districts in Table 41. In Pyramid Hill, during the period portrayed, there was an increase in the number of farms in the smallest sized segment from 130 to 141. The number of mid-ranged farms decreased 85 to 63 and there was a small increase in the number of larger farms. In the Calivil, Dingee, Patho and Mincha districts adjustment followed a very different pattern with a decline in the number of small farms from 131 to 106. The major factor contributing to these changes was the high rate of new entrants into the Pyramid Hill area and the far smaller number of new entrants in the Calivil Dingee area. Land and water trade contributed to the trends in each area to a far lesser extent. The billing details of these new entrants were examined to determine if there was any evidence of these entrances being purchases of by already established businesses located outside of the Tragowel Plains. There was no evidence of this in the Pyramid Hill region. The only examples discovered were in the northern Mincha region. Purchases made by these businesses were represented as aggregations rather than entrances.
Table 41  Changes in farm numbers by farm size 1989-90 – 1995-96

<table>
<thead>
<tr>
<th>Farm Size</th>
<th>0 - 400 ML</th>
<th>400 - 800 ML</th>
<th>800 + ML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyramid Hill</td>
<td>130</td>
<td>141</td>
<td>87</td>
</tr>
<tr>
<td>Calivil-Mincha</td>
<td>130</td>
<td>106</td>
<td>27</td>
</tr>
</tbody>
</table>

Table 42 depicts the impact these adjustment decisions have had upon the share of the each district’s aggregate water right held by small, medium and large farms. In Pyramid Hill the percentage of water right held by small and large farms increased, while the percentage held by medium size farms fell from 40.7 per cent to 32.4 per cent. The extent of increase in the share of water right held by smaller farms was less than the increase in the number of small farms, indicating that the average size of small farms decreased. In contrast, in the dairy dominated areas the greatest movement in the volume of water was away from small farms to medium and large farms.

Table 42  Water right held by small, medium and large farms as a per cent of total district water right (1989-90 to 1995-96)

<table>
<thead>
<tr>
<th>Farm Size</th>
<th>0 - 400 ML</th>
<th>400 - 800 ML</th>
<th>800 + ML</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Pyramid Hill</td>
<td>23.6</td>
<td>26.2</td>
<td>40.7</td>
</tr>
<tr>
<td>Calivil-Mincha</td>
<td>57.4</td>
<td>51.8</td>
<td>29.0</td>
</tr>
</tbody>
</table>

To more fully explore these patterns of adjustment, in the next sections I will examine in detail each of the processes depicted in Figure 17 and Figure 18. I will attempt to explain the patterns of, and reasons for, farm exit, farm purchase, farm build-up and farm ‘down-sizing’ decisions, and changes in off-farm income and diversification.
Exiting farming

Given the traditional concern of the adjustment policy with the fixity of human resources within farming, it is logical to commence any exploration of structural adjustment on the Tragowel Plains with a consideration of the decision to exit farming.

The rate of exit from farming on the Tragowel Plains 1987-95

The rate of exit from farming in period 1989-90 to 1995-96 as depicted in Figure 17 and Figure 18 was 4.6 per cent per annum. The rate of exit in the Pyramid Hill area was 4.8 per cent. However, this measure underestimates the true rate of exit as it only includes those businesses which were in existence in 1989-90. It does not include those cases where properties changed hands more than once in this period.

To gain some indication of this ‘hidden’ exit rate, it was necessary analyse all ownership records of irrigated land over the period of study. Complete ownership data was available for the years 1989-90, 1990-91, 1992-93 and 1995-96. Incomplete records were available for 1986-87. The contents of each record set are shown in Table 43. Clearly non-commercial irrigated allotments (less than 2.5 hectares in size) were eliminated from the analysis. The gradual decline in allotment numbers from 1990 to 1995 reflects the removal from RWC records of properties which were no longer irrigated as a result of the sale of irrigation water. No tenure data could be obtained for properties which had been removed from the data base. This data shortcoming will cause the estimate of property turnover to be underestimated.

<table>
<thead>
<tr>
<th>Year</th>
<th>No. Irrigated allotments</th>
<th>No. Commercial irrigated allotments</th>
<th>No. Commercial irrigated allotments with EM-38 data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986-87*</td>
<td>1303</td>
<td>1278</td>
<td>743</td>
</tr>
<tr>
<td>1989-90</td>
<td>1707</td>
<td>1673</td>
<td>1038</td>
</tr>
<tr>
<td>1990-91</td>
<td>1700</td>
<td>1643</td>
<td>1030</td>
</tr>
<tr>
<td>1992-93</td>
<td>1660</td>
<td>1532</td>
<td>985</td>
</tr>
<tr>
<td>1995-96</td>
<td>1478</td>
<td>1420</td>
<td>883</td>
</tr>
</tbody>
</table>

* Data incomplete due to incomplete records being available
Using the available time points in the period between 1986-87 and 1995-96 I created a measure of the number of times a land allotment changed legal owners and the number of times an allotment changed owners to a buyer outside the owner’s family. The lack of data for five individual years in this ten year period can be expected to be a further cause of underestimation of the real rate of ownership change. The most striking feature of results of the analysis (Table 45) is the apparently low rate of ownership change of allotments over this period given the high rate of migration out of and migration into farming over this period. This reflects three factors. First, the largest farms had the most stable ownership pattern and thus it is to be expected that the rate of change for allotments will be lower than that of farm ownership. The second factor is the underestimate due to the shortcomings of the available data. The third factor is evidence of cyclical ownership of small properties. Thirty per cent of those properties that did change ownership beyond the immediate family in this period changed ownership more than once.

<table>
<thead>
<tr>
<th>No. of transactions</th>
<th>All transactions</th>
<th>Transactions outside family</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>0</td>
<td>74.6</td>
<td>84.9</td>
</tr>
<tr>
<td>1</td>
<td>19.3</td>
<td>10.6</td>
</tr>
<tr>
<td>2</td>
<td>5.1</td>
<td>3.6</td>
</tr>
<tr>
<td>3</td>
<td>1.0</td>
<td>0.9</td>
</tr>
</tbody>
</table>

This longitudinal record of allotment ownership was aggregated to legal owner and used to estimate the real rate of exit. The improved estimate for the Calivil-Mincha-Dingee-Patho districts was no higher than the simpler measure (4.2 per cent per annum). This clearly indicates that the phenomena of high property ownership turnover is not present in these districts but is confined to the mixed farming region surrounding Pyramid Hill. In contrast, the estimate of exit rates for the Pyramid Hill district rose to 5.6 per cent per annum.

There was evidence that this rate of exit from Pyramid Hill farm business has not changed significantly in the past fifteen years. The rate of exit calculated from Goulburn Murray Water records was equivalent to an average duration of farm ownership of 18 years. Respondents to the surveys in the Pyramid Hill district reported how long they had been managing their farm. The mean of this reported period was 20.3 years. An identical question
was asked of the 1987 survey sample. The mean reported in that survey was 19.6 years. There was no significant difference between these two means. This suggests that the rate of ownership change in the mixed farming areas has not changed significantly since the early 1980s.

A number of conclusions may be drawn from these findings. The rate of exit from farming on the Tragowel Plains was close to five per cent per annum. This rate appears to have been constant over the past 15 years. The exit rate was lower amongst dairy farms and larger mixed farms, between three and four per cent. The exit rate was particularly high amongst smaller mixed farms, approaching seven per cent per annum.

The means of exiting farming

There are three common methods of exiting farming. One is to leave farming but remain within the workforce by selling the farm business and entering into a new occupation or unemployment. The second method, retirement, entails selling the farm and not re-entering the workforce. The third is retirement associated with transferring the management and eventually ownership of the farm to members of the succeeding family generation. To gain an understanding of the impact of farm exits on the structure of the Tragowel Plains community one must consider the occurrence of each of these forms of exit, as each involves different behaviour patterns and has a different impact upon the structure of the region’s agricultural industry. The only data available for this purpose were from the two interview surveys conducted in the Pyramid Hill area.

One hundred and nine households were included in the 1987 interview study. These farms were all in the northern Pyramid Hill study area. No farms were included from the Calivil-Dingee area. When interviewers returned to the same farms in 1995 they were able to trace the fate of 107 of these farms. The fate of operators of these properties is shown in Table 46.
Thirty-seven of the properties in the 1987 sample had been sold. Of the 37, 12 were defined as retirements. Retirement age was calculated by tracing property sales through the records of Goulburn Murray Water to determine the year of final sale of property on the Tragowel Plains. Ten of these 12 operators had sold their farms on or after their 65th birthday. The remaining two had sold at the age of 62 years. The age distribution of property exits suggested that there was a preference by older farmers to remain on their property until the age of 65. Property sale was then more likely to occur. All but one of the 12 operators aged 65 or over in 1987 had sold or transferred their land by 1995.

Twenty-five per cent of farm operators had sold and left, presumably to seek employment elsewhere. These were all aged under 60 years at the time of sale. A further 6 had passed on their farm to the next generation. Sixty per cent of farms were still managed by the same operator. So in a period of eight years 40% per cent of businesses had a change of management and 34 per cent had been sold to an unrelated owner.

### Why farm families decided to exit farming

To help understand likely future exit rates, it is important to understand the characteristics of those farmers who sold properties between 1987 and 1995. The significant differences between businesses which were sold outside of inter-generational transfers and all other businesses are shown in Table 46. Profit is one predictor of farm ownership stability. Analysis of Goulburn-Murray Water records revealed a significant relationship between farm size (in ML) and farm sale ($T=4.14$, df $=403$, $p <.001$). However, this relationship differed significantly between the Pyramid Hill area and the Calivil-Dingee-Patho areas. In Pyramid Hill where mixed farms predominate it appears size was less significant. Any farm smaller than 800
ML in size had at least a one in four chance of being sold in a five year period. In the dairy farm dominated regions farms smaller than 400 ML had a similar chance of being sold, but only 3 per cent of farms larger than this were sold.

A number of important characteristics were not associated with subsequent selling of the farm. These unrelated characteristics included debt and equity, off-farm income, salinity perceptions, industry, age and family stage. The lack of relationship between equity, debt and exiting agriculture was an important change from the situation in 1987 when high debt and high interest rates appeared to be driving exits (Barr, 1988). Likewise, the lack of relationship between salinity status and exit decisions is evidence that changes in salinity status were too slow to have an impact on decisions to exit farming in most cases.

As if to underline the propositions of Stayner (1994; 1992) and Smith (1993) that financial variables are insufficient to explain the complexity of adjustment decisions, personal characteristics of farm household members in 1987 proved to be good predictors of subsequent exit decisions taken between 1987 and 1995. Personal characteristics related to later decisions to sell the farm are shown in Table 47. This table is based upon attitudinal survey results provided by both adult male and adult female household members in 1987. Households where adult males were dissatisfied with productivity potential were more likely to have sold their farm in the 8 years following the survey. More interestingly, males who indicated higher dissatisfaction with living in the local community were also more likely to have sold the farm. Female attitudes to the

### Table 46 Characteristics of farm businesses in 1987 which were associated with the subsequent sale of the farm business.

<table>
<thead>
<tr>
<th></th>
<th>Mean Businesses sold</th>
<th>Mean Businesses not sold</th>
<th>T value*</th>
<th>df</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm Profit ($)</td>
<td>4,164</td>
<td>5,430</td>
<td>3.09</td>
<td>62</td>
<td>.004</td>
</tr>
<tr>
<td>Farm Area (Ha.)</td>
<td>370</td>
<td>601</td>
<td>2.25</td>
<td>82</td>
<td>.027</td>
</tr>
<tr>
<td>Water Right (ML)</td>
<td>515</td>
<td>781</td>
<td>2.19</td>
<td>91</td>
<td>.031</td>
</tr>
<tr>
<td>Mean number of households on farm</td>
<td>1.12</td>
<td>1.36</td>
<td>2.09</td>
<td>96</td>
<td>.039</td>
</tr>
<tr>
<td>Assets ($)</td>
<td>167,000</td>
<td>237,000</td>
<td>2.07</td>
<td>84</td>
<td>.040</td>
</tr>
</tbody>
</table>

* Calculated using separate variance estimates

As if to underline the propositions of Stayner (1994; 1992) and Smith (1993) that financial variables are insufficient to explain the complexity of adjustment decisions, personal characteristics of farm household members in 1987 proved to be good predictors of subsequent exit decisions taken between 1987 and 1995. Personal characteristics related to later decisions to sell the farm are shown in Table 47. This table is based upon attitudinal survey results provided by both adult male and adult female household members in 1987. Households where adult males were dissatisfied with productivity potential were more likely to have sold their farm in the 8 years following the survey. More interestingly, males who indicated higher dissatisfaction with living in the local community were also more likely to have sold the farm. Female attitudes to the
farm and its potential were not related to subsequent decisions to sell. However, female dissatisfaction with family life was significantly related to later decisions to sell the farm. Female dissatisfaction with marriage also tended towards significant co-variance with decisions to sell the farm. Both these suggest a picture where female attitudes to the farm are mediated by how the farm impacts upon family life. This may in part explain the finding that males who described their family life as unpredictable were also more likely to have sold the farm.

A simple logistic regression model of farm exit decisions was created to further explore the characteristics associated with farm exit decisions. The variables showing correlation with farm exit decisions (Table 46 and Table 47) were included in a principal components analysis using varimax rotation. The principal components analysis procedure was used to linear combinations of these variables which can be used to summarise the data whilst losing as little information as possible. The procedure assumes the variables are normally distributed and the relationships between the dependent and independent variables are linear. This principal components analysis produced three orthogonal factors (Table 48). The first factor could be described as ‘Farm scale’ with only asset value, farm size and farm water right loading highly. The second factor is described as ‘Farm performance’. It loaded most heavily on male satisfaction with productivity potential and male satisfaction with living in the community. The third factor was described as ‘Family satisfaction’. Three variables weighted heavily on this factor: female satisfaction with family life, male sense of family unpredictability and plans to sell the farm.

| Table 47 Personal characteristics related to subsequent decisions to sell the farm (1987) |
|-----------------------------------------------|-----------------------------------------------|-----------------|-----------------|-----------------|
|                                              | Mean Businesses sold | Mean Businesses not sold | T value * | df | Significance |
| Satisfaction with potential for productivity improvement (Male) | 4.55 | 5.66 | 2.60 | 76 | .011 |
| Sense of family predictability (Male) | 4.50 | 5.68 | 2.53 | 76 | .017 |
| Satisfaction with family life (Female) | 6.0  | 6.9  | 2.29 | 64 | .025 |
| Satisfaction with living in the community (Male) | 6.29 | 6.96 | 2.04 | 76 | .045 |

* Calculated using separate variance estimates
Subject scores on these three factors were then used as predictors in a logistic regression model of the binary variable representing whether or not farms were sold in the period 1987-95. Again, this procedure assumes that the independent variables are normally distributed and that the relationship with the binary independent variable is linear. The results are shown in Table 49. This model predicted 75 per cent of cases. Despite its predictive limitations, it is important to note the relative predictive power of the three factors. The ‘Family Satisfaction’ factor was the most powerful predictor in the regression equation. The ‘Farm Performance’ factor is the second most powerful predictor. The ‘Farm Size’ factor played only a relatively small role in the predictive power of the model.

Table 48  Rotated component matrix for PCA factor analysis of predictors of the decision to sell the farm (1987 sample, N = 103)

<table>
<thead>
<tr>
<th>Rotated factor</th>
<th>1 (Farm Scale)</th>
<th>2 (Farm performance)</th>
<th>3 (Family satisfaction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plan to sell</td>
<td>.06</td>
<td>.24</td>
<td>.57</td>
</tr>
<tr>
<td>Farm profit</td>
<td>.07</td>
<td>.63</td>
<td>.08</td>
</tr>
<tr>
<td>Asset value</td>
<td>.77</td>
<td>.23</td>
<td>.02</td>
</tr>
<tr>
<td>Farm area</td>
<td>.94</td>
<td>.01</td>
<td>.08</td>
</tr>
<tr>
<td>Water right</td>
<td>.94</td>
<td>.03</td>
<td>.09</td>
</tr>
<tr>
<td>Male sense of family predictability</td>
<td>.10</td>
<td>-.13</td>
<td>.68</td>
</tr>
<tr>
<td>Male satisfaction with living in community</td>
<td>.05</td>
<td>.67</td>
<td>.004</td>
</tr>
<tr>
<td>Male satisfaction with productivity potential</td>
<td>.01</td>
<td>.78</td>
<td>.09</td>
</tr>
<tr>
<td>Female satisfaction with family life</td>
<td>.001</td>
<td>.14</td>
<td>.77</td>
</tr>
<tr>
<td>Per cent of principal component variance (%)</td>
<td>28.7</td>
<td>18.2</td>
<td>13.4</td>
</tr>
</tbody>
</table>
Future decisions to exit farming

The lack of attitudinal questions in the 1995 survey schedule precludes the use of the model to predict the future exit rate. The model does however indicate that data collected in the 1995 survey which will be useful in exploring future exit rates. The most accurate predictor of exits was the family satisfaction factor. One of the major components of this factor was the farmers’ own predictions of their likelihood of selling out. The 1995 survey schedule contained detailed questions on the probability of selling the farm and exiting farming. These were used as a proxy for the family satisfaction factor and the major indicator of future status. The second predictor available is farm profit which is a good proxy for the second predictive factor. Farm size was a very close proxy for the third factor, farm scale, but will not be used directly as an indicator of the likelihood of future exits due to the relatively poor predictive performance of this factor in the mixed farming sector.

The 1995 interview schedule contained questions on the likelihood and desirability of selling the farm in the next five years and retiring in the next five years. There was an additional question on the likelihood of farm transfer at some time in the future. Responses to these questions were used to construct a classification of farm exit strategies in the next five years (Table 50). In the following section I consider each of these strategies in turn. Data for both Pyramid Hill and Calivil-Dingee districts are considered.

Table 49  Logistic regression model of the decision to sell the farm between 1987 and 1995

<table>
<thead>
<tr>
<th></th>
<th>Beta</th>
<th>Standard error</th>
<th>Wald</th>
<th>df</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-.78</td>
<td>.24</td>
<td>10.4</td>
<td>1</td>
<td>.0012</td>
</tr>
<tr>
<td>Family satisfaction</td>
<td>-.78</td>
<td>.25</td>
<td>10.3</td>
<td>1</td>
<td>.0014</td>
</tr>
<tr>
<td>Farm performance</td>
<td>-.68</td>
<td>.26</td>
<td>7.1</td>
<td>1</td>
<td>.0076</td>
</tr>
<tr>
<td>Farm scale</td>
<td>-.56</td>
<td>.40</td>
<td>1.9</td>
<td>1</td>
<td>.166</td>
</tr>
</tbody>
</table>
Future inter-generational transfer

In 1987 a majority of farmer operators (58.3 per cent) believed there was some chance of the next generation of their family taking over the farm operation (Table 51). Seven years later this degree of optimism about inter-generational continuity had not changed significantly, with 65.5 per cent of farm operators believing there was a possibility of the next generation to take over farm management. This was significantly lower than the expectations of inter-generational transfer held by Australian farmers in the early 1970s (Salmon et al., 1973).

The reality of inter-generational transfer is less optimistic than the outlook of the sample of farmers. In the years between 1987 and 1995, less than 6 per cent of farms changed hands within the same family. Of the 39 farm operators who in 1987 expected the next generation to take over the farm, 10 had subsequently sold the business to interests outside the family. A further 9 were either unsure or did not expect the next generation subsequently to take over. In only three cases did the next generation take over and a further 16 still expected this to occur at some time in the future. These figures, combined with the overall lack of change in expectations of inter-generational transfer, suggest a picture of changing expectations as part of the cycle of farm family development. This is confirmed by the differing expectations of farmers who took over management in the last 7 years and farmers who have maintained their management role over the last 7 years. Fifty four per cent of new managers expected the next generation to take

<table>
<thead>
<tr>
<th>Table 50  Business exit expectations over the next 5 years (N = 121)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will remain on farm</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>% of farm operators</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 51  Expectations of inter-generational transfer of farm management: 1987-95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you foresee any of the next generation of your family eventually taking over the property ?</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>1987 (N=103)* (%)</td>
</tr>
<tr>
<td>1995 (N=87)* (%)</td>
</tr>
</tbody>
</table>

* Sample based upon the northern three zones of the Tragowel Plains Irrigation Area.
over the farm compared with 38 per cent of other farmers (difference significant at p < .05 using Mann-Whitney U test). Optimism over the likelihood of inter-generational transfer decreases as the period of farm occupancy lengthens.

Our final estimate of the likelihood of inter-generational transfer in the next five years is constructed by selecting those farmers who expected to retire, did not expect to sell the farm and believed there was a chance of inter-generational transfer in the next five years. The resulting estimate of 8.0 per cent was not significantly different from the observed occurrence in the previous inter-survey period. It is unlikely the rate of inter-generational transfer will be greater than one per cent per annum over next decade.

Future retirement from farming

Retirement would be expected to be a significant concern for many Tragowel Plains farmers. Eighteen per cent of farm managers on Pyramid Hill district farms in the 1995 sample were aged 60 years or over and thus could be expected to have reached the age of 65 within 5 years of the administration of the survey. This age profile was little changed from that observed in 1987 (20 per cent of farm operators aged 60 or over) and was not significantly different from that of the broad acre farming population of Australia, or of Australia as a whole if the total household composition of Tragowel Plains farm families is considered (Garnaut et al., 1996; Australian Bureau of Statistics, 1995).

In 1995 only 9.5 per cent of farm managers saw retirement as a strong possibility. Retirement is a word with differing meanings to different farmers. To traditional full time farmers, retiring means ceasing active management of the farm. However, to new entrants to farming who carry a significant off-farm work commitment, retirement more often means ceasing off-farm work to live and work on the farm. My final estimate of retirement rates is based solely upon the former concept, retiring from farming. It was defined by selecting those farm operators who were aged over 60, who stated they expected there was a possibility of retiring, and who believed there was a possibility of selling the farm. The resulting estimate was 16.3 per cent of farm managers who believed there was a possibility of traditional retirement in the following five years. Only nine per cent believed this was a strong possibility. Again, the indications are that future retirement rates will be similar to that of the past decade.
Exiting farming for another occupation

Farmers considering exiting farming to work elsewhere were identified as those farm operators aged under 60 who indicated a possibility of selling the farm. The future rate of property sale is likely to continue to be very high if farmers’ expectations are borne out. Thirteen per cent of farmers in the Pyramid Hill region expected to sell their farm in the next five years and a further 31 per cent believed there was some possibility of selling up (Table 53). The 13.4 per cent expecting definite property sales is comparable to the 16 per cent expecting to sell out in 1987. The 1987 question did not measure beliefs in possible sales.

The number of farmers expecting to sell up in the five years following 1987 was significantly less than the actual rate of sales (Table 52). Whilst expected exits measured 2.2 per cent per annum, actual exits were over six per cent. For this reason, the inclusion of the option of possibly selling the farm was considered to give a better indication of the likely rate of exits. There were no significant differences between the desire to or expectation of selling of farmers in the Pyramid Hill district and the Calivil-Dingee district.

| Table 52 1987 expectations of selling up compared with farming status change between 1987 and 1995 |
|-----------------------------------------------|-------------------|-------------------|
|                                              | Remained on farm  | Sold up           |
| Expected to remain farming                   | 66                | 28                |
| Expected to sell up                          | 4                 | 8                 |
Table 53: Expectations and aspirations for the future regarding selling the farm (Northern Tragowel Plains)

<table>
<thead>
<tr>
<th>(% of farmers)</th>
<th>No Possibility</th>
<th>Some Possibility</th>
<th>Strong possibility</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desired outcome</td>
<td>0</td>
<td>16.7</td>
<td>11.7</td>
<td>28.4</td>
</tr>
<tr>
<td>Not a desired outcome</td>
<td>55.7</td>
<td>14.2</td>
<td>1.7</td>
<td>71.6</td>
</tr>
<tr>
<td>Total</td>
<td>55.7</td>
<td>30.9</td>
<td>13.4</td>
<td>100</td>
</tr>
</tbody>
</table>

The characteristics of landowners planning to sell up are shown in Table 54. There were three distinct groups — those who do not expect to sell out, those who see a possibility of an unwanted sell up and those who desire to sell up. Those hoping to sell up were characterised as having smaller farms with smaller water rights, lower gross farm incomes and lower farm labour capacity. They were likely to have fewer dependants in their family.

Farms where the operator believed there was a possibility of having to unwillingly sell up were similar in scale to those farms where there was no expectation of selling. The only distinguishing characteristic was low levels of off-farm income. Farms where the operator expected to continue farming were characterised by younger families, higher off-farm work commitment and higher off-farm income. No relationship was found between expectations of selling up and measures of debt, education, qualifications or farm salt.

Most interesting of all is the finding that farms where the operator believed there was a possibility of forced sale differed from the remainder of the sample only in their low level of off-farm income. This suggests that the availability of off-farm income is a key variable in deciding whether a farm business is sold, a finding consistent with the low levels of exit from mixed farms in the Shepparton area where off-farm work opportunities are more available (Mahoney, 1996). Clearly the interaction of farm size and off-farm income are important variables in determining the rate of farm sales.
To summarise the findings discussed in this section, the high rate of farm sales observed between 1987 and 1995 would be expected to continue into the foreseeable future. The factor most likely to reduce this expected high rate of farm sales would be the appearance of significant new sources of off-farm work.

### Entry to farming

The rate of entry to the Tragowel Plains irrigation region, as measured in aggregate between 1989-90 and 1995-96, was 3.2 per cent per annum. Using the full set of available data for years 1989-90, 1990-91, 1992-93 and 1995-96, the overall rate of entry was calculated at 5.2 per cent per annum. The difference in these two measures indicates the instability of ownership amongst recent entrants to farming in the district, with a significant percentage of new entrants leaving again prior to the end of the study period.

The aggregate entry rate for mixed farms smaller than 400 megalitres was 6.9 per cent, and for mixed farms greater than 400 megalitres was only 1.4 per cent (see Table 55). The aggregate rate of entry for dairy farms smaller than 400 ML was 3 per cent and for larger dairy farms was only 0.9 per cent. Given that the majority of multiple exits were measured within

---

**Table 54 Characteristics of farms where operator expects to sell out in the period 1995-2000**

<table>
<thead>
<tr>
<th>Expectations of possibility of selling farm</th>
<th>Not expecting to sell out</th>
<th>Possibility of forced sale</th>
<th>Possibility of desired sale</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 66</td>
<td>1.96</td>
<td>2.10</td>
<td>1.36</td>
</tr>
<tr>
<td>Youngest household member #</td>
<td>13</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>Farm workforce in % F.T.E.</td>
<td>199</td>
<td>211</td>
<td>146</td>
</tr>
<tr>
<td>Off-farm income ($)</td>
<td>30,975</td>
<td>3,740</td>
<td>15,084</td>
</tr>
<tr>
<td>Farm area (Ha.)</td>
<td>467</td>
<td>440</td>
<td>254</td>
</tr>
<tr>
<td>Water right (ML)</td>
<td>667</td>
<td>610</td>
<td>412</td>
</tr>
<tr>
<td>Gross farm income ($000s)</td>
<td>186</td>
<td>232</td>
<td>107</td>
</tr>
<tr>
<td>Farm expenses ($000s)</td>
<td>105</td>
<td>159</td>
<td>87</td>
</tr>
</tbody>
</table>

Bold significant difference from remainder of sample at p < .05 using T-test.

# Estimate of age based upon categorised variable.
smaller farm sizes, it is reasonable to assume that the estimates of business entry to farms larger than 400 megalitres are quite consistent with the findings of Lindsay and Gleeson (1997). Entry to Tragowel Plains agriculture through the purchase of farms larger than 400 ML was within the range of one to two per cent per annum.

There are two common means of entering farming. One is through generational transfer of the farm business, and the other is through purchase unrelated to existing family farm structures. Transfer between generations will normally involve some form of sale, but the sale is often through a means which minimises exposure to banking capital and subsequent equity risks. There were clear differences between the farming businesses of operators whose parents farmed on the Tragowel Plains and those operators whose parents did not farm in the area before them. In 1987 farms of the former group were significantly larger in terms of area and water right and had significantly lower dependence upon off-farm income. The same patterns were unchanged in 1995. Thirty-five per cent of the sample farmers were first generation farmers to the district. Fifty per cent of these new farmers had been managing their properties less than 10 years. Farmers who had succeeded a relative to take over the property had been managing their farms significantly longer. Only 20 per cent had been managing their farm less than 10 years. These differences reinforce the observations of a pattern of smaller businesses changing ownership more rapidly than other farm businesses.

### Table 55 Aggregate entry rate 1989-90 to 1995-96 by farm size and sub-region

<table>
<thead>
<tr>
<th>Sub-region</th>
<th>All farms</th>
<th>Smaller than 400 ML</th>
<th>Greater than 400 ML</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tragowel Plains</td>
<td>3.2</td>
<td>4.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Pyramid Hill</td>
<td>3.6</td>
<td>6.9</td>
<td>1.4</td>
</tr>
<tr>
<td>Patho-Mincha-Calivil-Dingee</td>
<td>2.5</td>
<td>3.0</td>
<td>0.9</td>
</tr>
</tbody>
</table>
These observations of simultaneous high exit rates and high entry rates to farming in the Tragowel Plains raise the question why there was such a demand for entry to farming in an area when commodity prices were poor and the risk of business failure was extremely high. No data were available for the Tragowel Plains businesses which might answer this question, but a good indication can be taken from the work of Stayner (1997). He found that, in general, new entrants were attracted to the intrinsic rather than extrinsic rewards of farming. The decision to enter was not a business decision but a lifestyle decision. Further, although new entrants agreed that farming provided low financial rewards, many believed that such rewards were important in their own decision to enter farming. In other words, they agreed that though most people who enter farming will not make a financial success, they believed that they would somehow be different. Such optimism must seem akin to the optimism of the gambler on the casino doorstep who believes that his or her luck will make the difference against the house. One can only conclude that such optimism pervaded the decisions of the farmers who purchased small

<table>
<thead>
<tr>
<th></th>
<th>Sample size</th>
<th>Mean</th>
<th>Mann-Whitney</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Migrants</td>
<td>Successor</td>
<td>Migrants</td>
<td>Successor</td>
</tr>
<tr>
<td>How long managed a farm on the Tragowel Plains (Yrs)</td>
<td>29</td>
<td>54</td>
<td>11.6</td>
<td>25.5</td>
</tr>
<tr>
<td>Farm area (Ha.)</td>
<td>29</td>
<td>51</td>
<td>266</td>
<td>582</td>
</tr>
<tr>
<td>Farm water right (ML)</td>
<td>29</td>
<td>54</td>
<td>403</td>
<td>823</td>
</tr>
<tr>
<td>Gross farm income ($000s)</td>
<td>24</td>
<td>54</td>
<td>68</td>
<td>215</td>
</tr>
<tr>
<td>Off-farm income ($000s)</td>
<td>24</td>
<td>45</td>
<td>53</td>
<td>13</td>
</tr>
<tr>
<td>Farm labour units (FTE)</td>
<td>29</td>
<td>54</td>
<td>1.4</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Table 56 Differences between farms of in-migrants and farms of farm successors
farms on the Tragowel Plains in the study period. Such optimism is generally short lived. In 1987 farm managers who had farmed on the Tragowel Plains for less than ten years were significantly more concerned about finances and experienced higher levels of stress than farmers who had farmed for longer than ten years in the district.

Whether the high rate of new entry to the area will continue would seem to be dependent upon three factors. The first is the rate of exits. The evidence of the previous section suggests that this would be expected to remain high into the foreseeable future. The second factor is the willingness of outside buyers to purchase Tragowel Plains farms. The optimism of new entrants would seem to be relatively unmitigated by poor financial performance of broadacre industries during the study period, so there is little reason to expect any change in demand. The third factor is the willingness and ability of existing landholders to purchase property for farm build up. The relative occurrence of new entry or farm build up is determined by the competitive bidding strength of the two groups of purchasers: new entrants and existing operators. It is clear that in the Calivil-Dingee-Patho and Mincha districts the existing landholders were in a comparatively strong position, reflecting the strong financial state of the dairy industry. The obverse was true in the Pyramid Hill district, reflecting the poor financial state of irrigation mixed farm businesses. It would seem that a reduction in new entrants would be most likely achieved by improving the financial performance of existing Tragowel Plains mixed farms.

**Farm size reduction**

Table 57 shows the use of farm size reduction (as measured by changes in overall farm water right) by Tragowel Plains farmers. In the predominantly mixed farm areas seventeen per cent of farms present in 1989-90 had reduced their size by 1995-96. In dairy dominated districts the rate was approximately half this.

Reducing the size of a farm business can be accomplished by the sale of land and attached water, or through the sale of water alone. It is not possible to separate the effects of these two mechanisms in the Goulburn Murray Water database. The data gained from the interview survey makes it clear that the predominant means of reducing farm size (as measured by water right) is through the sale of water, not the sale of land and water together. Only 19.6
per cent of the total farm reductions were achieved through the sale of land and water together. Over eighty per cent was achieved through the sale of water entitlements unconnected to land.

Table 57  Farm size reduction by percentage of water right (1989-90 - 1995-96)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N=247</td>
<td>N=161</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>%</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25 %</td>
<td>4.5</td>
</tr>
<tr>
<td>25 % – 50 %</td>
<td>8.5</td>
</tr>
<tr>
<td>&gt; 50 %</td>
<td>4.0</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
</tr>
</tbody>
</table>

The choice of water entitlement sale as the preferred means of farm ‘downsizing’ has implications for the manner in which the use of this strategy changes the structure of the region’s farm industry. Land sale dis-aggregation changes the relative distribution of farm sizes on the Tragowel Plains but maintains the total water right of the Tragowel Plains. Because most land parcels are absorbed by existing property owners, the effect is to polarise farm sizes within the Tragowel Plains.

The impact of transferable water entitlements depends upon where the water entitlement is transferred. Transfers within the region have a similar effect to land sales. Where water is transferred outside the region, the impact is to reduce average farm size without reducing the number of farms. In the three years between 1992 and the time of the 1995 survey 3.7 per cent of the water right owned by the sample was sold permanently to irrigators outside the Tragowel Plains. Most of this water was sold by mixed farming irrigators in the northern part of the Tragowel Plains. Only 1.3 per cent of the 1992 total sample farm water right was sold permanently to other Tragowel Plains farmers in the same period. The district water right was reduced by 3.7 per cent and thus the average farm size has been reduced by this amount. The extent of water export has increased dramatically since 1995.

Temporary water entitlement sale introduced a further option for resources to be transferred between farms. Temporary transfer was more popular than permanent transfer.
Temporary sales of water right averaged approximately 5 per cent of total water right per year over the three year period 1993-95. By far the majority of these sales were to properties outside the Tragowel Plains. This cannot be considered a true ‘downsizing’, but rather a temporary re-allocation of farm resources to where it will provide the most profitable or secure return. Whether this behaviour leads eventually to permanent sale is unclear.

**Why farmers choose to reduce farm size**

There are a number of reasons why farm farmers reduced the size of their farm. The main reasons given for water right sales by farmers were that the vendor had no need for the water and that the vendor needed the money (Table 58). Comments varied from the opportunistic ‘Someone offered me more for the water than I could make from it’, to the strategic view ‘To survive as a mixed irrigation farm one has to act as a water trader’. One third of those who sold water right cited the results of the soil salinity survey as contributing to their decision. Other reasons include workload reduction, farm consolidation, resting land and helping a neighbour.

<table>
<thead>
<tr>
<th>% of farmers selling water right</th>
<th>% of farmers selling sales water</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 28</td>
<td>N = 36</td>
</tr>
<tr>
<td>No need for the water</td>
<td>50</td>
</tr>
<tr>
<td>Needed the money</td>
<td>28</td>
</tr>
<tr>
<td>Help buyer</td>
<td>11</td>
</tr>
<tr>
<td>To rest country</td>
<td>5</td>
</tr>
<tr>
<td>Consolidation</td>
<td>5</td>
</tr>
</tbody>
</table>

There was a clear relationship between off-farm work commitment and reducing farm size (Table 59). The greater the number of hours worked off the farm by both husbands and wives, the greater the likelihood of the decision to permanently sell water.
The findings of the interview survey are consistent with the analysis of water use and sales undertaken by Goulburn Murray Water staff in Pyramid Hill, who estimated that 55% of water entitlement sales were due to sleeper entitlement\(^2\) (Kent, 1996). Correlation with financial records by Goulburn Murray Water revealed 21 per cent of the volume traded was sold by businesses under severe financial difficulty as revealed by unpaid water rates.

In conclusion, the evidence is strong that water sales were motivated by the activation of sleeper entitlements, financial pressure and pressure caused by significant off-farm work commitments. The analysis of chapter 9 also indicates that 23 per cent of water sales were made possible by retirement of saline soils. Farms from which water was sold were not statistically different from other farms in measures of farm size, equity, debt, farm gross income or profit. This latter finding needs to be treated with caution. It appears that farmers who had not sold water or purchased water differed significantly from farmers who had participated in the water market, whether through selling or buying. Non participants had farmed in the area for longer,  

\(^2\) Sleeper entitlement: Right to water which has not been exercised.
had fewer debts, higher equity, fewer dependants and small farms. Water sellers had much in common with water purchasers. Perhaps the major difference is their choice of opposing strategies to meet the challenge of mutually experienced financial pressure.

**Future farm size reduction**

Expectations of land parcel sale in the future mirrored behaviour measured in the previous five years. In the Pyramid Hill district five per cent of respondents believed there was a possibility of selling farm land whilst remaining on the farm. Generally these managers had sold land in the past. I expect land sales will continue to play a small role in the downsizing of farms.

The rate of future water sales will be dependent upon the availability of off-farm income, financial circumstances and seasonal circumstances. There was resistance to permanent sales of water. Permanently selling water right was not a desired or expected future adjustment behaviour amongst the majority of Tragowel Plains farmers. There was a core group of 7.5 per cent who wished to permanently sell some water right in the future. All those who wish to sell were mixed farmers and the majority were net vendors of water in the previous 5 years. The dry seasons and higher water prices subsequent to 1995 would have given these vendors a potential windfall.

The large component of recent downsizing due to activation of sleeper entitlements can be expected to decrease in future. Only 1.5% of entitlements could be identified as ‘sleeping’ (i.e. were not utilised in the years immediately prior to sale according to GMW water use records). It appears most sleeping entitlements have already been sold. Sales motivated by financial pressure can be expected to continue, if only because those who have sold water for this reason would be expected to be in a treadmill where lower farm returns from a smaller farm will place continued financial pressure upon their operations. The main foreseeable reasons why the rate of permanent sales might be expected to increase would be the temporary effect of drought on water prices or changes in off-farm work availability. Changes in off-farm work availability are unlikely.

There is a strong interest in temporarily selling water. Thirty-seven per cent of farmers want to sell temporarily. Fifteen per cent believe such sales are a strong possibility in the future, and a further 27 per cent believe such sales are a possibility. The interest in temporary sales of
water seems to be a reflection of the desire to maintain assets, but to gain a secure and risk free income stream from those assets. Net vendors of water in the previous five years were significantly more likely to expect to sell water temporarily, but interest in selling water was by no means confined to this small group.

**The reticence to permanently sell water**

The lack of enthusiasm for permanent sale expressed in the interviews can be explained by farmers’ perceptions of the relative value of their farms sold as a working whole or sold separately as land or water. In the 1995 interview survey farmers were asked to estimate the value of their land and fixed assets, and then asked to estimate what they would receive if they had to sell in the next 12 months. Farmers were also asked to estimate the value of their stock and of farm machinery. Using these estimates it was possible to estimate farmers’ perceived value of their farm when sold as a disaggregated series of assets, essentially by selling land, water, stock and machinery separately. The estimate is calculated as follows:

\[
S_1 = W + D + S + M
\]

Where

\[
S_1 = \text{Total value of sale achieved by disaggregated sale of farm land, water machinery and stock.}
\]

\[
W = \text{Value of water right.}
\]

\[
D = \text{Class A and Class B dryland @ $300 per Ha (Class C and Class D land worthless). This estimate was derived from the comments of informed local observers.}
\]

\[
S = \text{Stock as valued by farmer}
\]

\[
M = \text{Machinery as valued by farmer}
\]

At the time of the survey the market price of water was $300 per megalitre. At this price very few mixed farm owners would have perceived a separate sale of water from land as having the potential to achieve their own estimate of the full value of their farm. The small number of farmers who did perceive their farm value as no greater than the value of the disaggregated assets of the farm owned approximately ten per cent of the water right on all mixed farms. This difference in perceived farm values and market water prices helps explain the reticence to permanently sell water in 1995. The perceived value of the sunk cost of housing, shedding and irrigation infrastructure explains both the reason for the limited interest in permanent water transfer in 1995, and the processes which lead to the increase in small farm numbers in the Pyramid Hill district during the study period. The objective of any vendor attempting to exit a
farm business is to realise the greatest possible value for farm assets. A sunk cost is not sunk if there is a buyer to pay its value. The buyer likely to pay the highest value is the buyer who will find the greatest value in the largest potential sunk cost on many properties . . . the home. In many cases that will be a buyer who is purchasing both a residential base as well as a business interest. This person will in most cases be a new entrant.

The next obvious question is “to what degree would the price of water need to rise to compensate for the perceived value of fixed assets on properties? To explore this question I calculated for each farm the water price at which the calculated disaggregated value of the farm would equal the farmer’s 1995 perception of the whole farm value. I then graphed water right price and the cumulative volume of water right held on mixed farms for which the perceived value of the farm in 1995 was equal or less than the calculated disaggregated value at that water price (Figure 19).

![Figure 19 Relationship between water price offered to farmers ($/ML) and the volume of water held by Tragowel Plains mixed farmers on which this price would be perceived as compensating for sunk costs in fixed farm infrastructure.](image-url)

This graph is based upon perceptions of farmers during a period when the actual price for water was around $300 per megalitre. Any price above that level was essentially a premium above this existing market value. If the water price were to rise, the premium required to
‘release’ an equivalent volume of water may also rise, but by a lesser amount. The premium can be interpreted as the additional price to be paid to compensate for fixed assets in housing, shedding and water management infrastructure separate from the prevailing value of water.

With these caveats in mind, it is notable that at a value of $700/ML, the sale of water right would provide compensation for the 1995 perceived value of fixed farm assets on mixed farms holding 70 per cent of the total mixed farm water right. During the drought period which followed this study, the market price of water rose to $750/ML. This suggests that the reticence to permanently sell water right would have broken down. More recent data from Goulburn Murray Water shows a dramatic acceleration of permanent water sales since 1995 (Figure 28).

**Farm build-up**

Analysis of the ownership records of Goulburn Murray Water reveals that 21.6 per cent of properties present in 1989-90 increased their water right over the following six years. This measure underestimates the true rate of expansion as it excludes those new entrants who made an initial purchase, then proceeded to expand their operations through further purchases of land and water. Again there were differences in the rate of expansion of properties in the dairying and mixed farming areas (Table 60). However, these differences were not as great as was the case for farm downsizing.

<table>
<thead>
<tr>
<th>Extent of expansion 1989-90 – 1995-96 as a percentage of 1989-90 megalitres</th>
<th>Pyramid Hill farms expanding as a percentage of all Pyramid Hill farmers in 1989-90</th>
<th>Calivil-Dingee-Patho-Minchia farms expanding as a percentage of farms in 1989-90</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=247</td>
<td>N=161</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>&lt; 25 %</td>
<td>2.3</td>
<td>4.9</td>
</tr>
<tr>
<td>25 % – 50 %</td>
<td>5.7</td>
<td>3.9</td>
</tr>
<tr>
<td>&gt; 50 %</td>
<td>10.8</td>
<td>15.5</td>
</tr>
<tr>
<td>Total</td>
<td>18.8</td>
<td>24.3</td>
</tr>
</tbody>
</table>

Farm build up occurred through both land purchase and through purchase of water right alone. These two processes need to be analysed separately using interview survey data as they
cannot be individually examined in the Goulburn Murray Water records. Land purchases accounted for 80.6 per cent of expansion. Purchase of separate water entitlements accounted for 19.4 per cent of expansion. This ratio was in complete contrast to the contributions to farm downsizing which were dominated by sale of transferable water entitlements. The major demand for water was from Rochester Irrigation District. Rochester District is predominantly a dairy farming district. It was more difficult for farms in the Rochester district to expand by land purchase as there were fewer farms seeking to sell out. Expansion through water purchase was a more accessible option. In Tragowel Plains it was relatively easier for expanding dairy businesses to purchase land attached to water right.

On the Tragowel Plains the greater opportunity to purchase land for expansion is an outcome of the high number of farm exits, rather than due to downsizing by other farm businesses. Sale of land parcels split from continuing businesses contribute only a minority of the total land area of land made available on the market. The total area reported being purchased was 21.7 per cent of the total area of land owned by the sample. The total area of land reported as sold by farmers still operating in 1995 was 5.8 per cent of the sample farm area. We can infer from this that 25 per cent of the land area transferring ownership was a result of part sale of land parcels from continuing businesses, and 75 per cent were as a result of full business sales. These proportions were similar in the north and the south of the Tragowel Plains.

Which farms are expanding?

There were few surprises in the characteristics of farm businesses which had expanded. They were dairy businesses. The managers of these farms had been farming for less time on the Tragowel Plains, and the families living on these farms were younger. There was a higher comparative commitment to farm work compared with off-farm pursuits. Debt was higher, equity lower, and farms larger.
Although dairy farms were far more likely to be expanding than mixed farms, there was a minority of mixed farm businesses which were expanding. These businesses were clearly different from downsizing mixed farm businesses. They had significantly greater number of dependants in their family, greater farm area and water right, greater gross farm income and off-farm income, higher debt and lower equity. Differences in scale were particularly marked, with purchasers having a mean farm size of 1022 ML and sellers a mean farm size of 315 ML. This difference suggests that persons selling part of their water right were slowly moving out of agricultural dependence as they increased their commitment to off-farm work. Likewise, the higher number of family members working on the farms of purchasers of water confirms the

<table>
<thead>
<tr>
<th></th>
<th>Expanding farm businesses</th>
<th>Other farm businesses</th>
<th>T value of difference of means</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of years farming on Tragowel Plains</td>
<td>15.9</td>
<td>23.7</td>
<td>-3.04</td>
<td>.003</td>
</tr>
<tr>
<td>No. Dependants in household</td>
<td>2.5</td>
<td>1.4</td>
<td>3.65</td>
<td>.0001</td>
</tr>
<tr>
<td>Hours worked on farm by adult males</td>
<td>59.2</td>
<td>50.2</td>
<td>1.80</td>
<td>.075</td>
</tr>
<tr>
<td>Hours worked off-farm by adult females</td>
<td>6.7</td>
<td>13.0</td>
<td>-1.78</td>
<td>.077</td>
</tr>
<tr>
<td>Hours worked on farm by adult females</td>
<td>26.2</td>
<td>18.7</td>
<td>1.677</td>
<td>.097</td>
</tr>
<tr>
<td>Income from milk sales</td>
<td>$102,915</td>
<td>$29,270</td>
<td>4.04</td>
<td>.0001</td>
</tr>
<tr>
<td>Farm Assets $</td>
<td>1,189,000</td>
<td>784,000</td>
<td>1.73</td>
<td>.087</td>
</tr>
<tr>
<td>Business debt $</td>
<td>180,000</td>
<td>99,000</td>
<td>2.62</td>
<td>.01</td>
</tr>
<tr>
<td>Equity %</td>
<td>80.5</td>
<td>88.7</td>
<td>-2.91</td>
<td>.004</td>
</tr>
</tbody>
</table>

**Bold** = Separate variance estimate used
expectation that purchase is often driven by the desire to expand to realise family succession plans.

**Future build up**

There was far more interest in purchasing water than in selling water. Forty-three per cent of farm managers indicated a desire to purchase water. Fifteen per cent believed there was a strong possibility this would occur. There were marked differences between dairy farmers and mixed farmers. Thirty-two per cent of dairy farmers believed there was a strong possibility of purchase, with another 42 per cent believing there was a possibility. In contrast, 72 per cent of mixed farmers believed there was no possibility of purchasing water, and the remainder generally believed there was only some possibility.

**Table 62: Expectations and aspirations for the future regarding purchasing land - Pyramid Hill businesses**

<table>
<thead>
<tr>
<th>(%) of farmers</th>
<th>No Possibility</th>
<th>Some Possibility</th>
<th>Strong possibility</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 77</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome desired</td>
<td>7.8</td>
<td>28.6</td>
<td>18.2</td>
<td>54.6</td>
</tr>
<tr>
<td>Outcome not desired</td>
<td>42.9</td>
<td>1.3</td>
<td>1.3</td>
<td>45.5</td>
</tr>
<tr>
<td>Total</td>
<td>50.7</td>
<td>29.9</td>
<td>19.5</td>
<td>100.1</td>
</tr>
</tbody>
</table>

In contrast to their pessimism about purchasing water, mixed farmers were optimistic over their chances of expanding by purchasing land. Pyramid Hill farm operators believed there was a stronger possibility of purchasing land than the dairy farm operators in Calivil-Dingee. It is difficult to see why there was greater optimism amongst Pyramid Hill farmers. Certainly they were likely to have a greater variety of land parcels available for purchase. However, past experience suggests that they would generally be unable to out bid the aspiring new entrants to farming.
Changes in the dependence on off-farm income deserve separate analysis given the strong link between off-farm work and the decision to sell water. Off-farm income remained a significant source of income for many Tragowel Plains farming families throughout the study period. In 1995 the sample of families gained a total income from off-farm sources of $3,831,000. This was considerably greater than the total farm profit earned by these same families ($1,825,000). Once again, this off-farm income is not evenly distributed. Forty per cent of households had no off-farm income. Twenty per cent of households earned $38,000 or greater from off-farm sources and account for 85 per cent of the off-farm income earned by the sample.

Off-farm income was significantly less common amongst the dairy farming community of the Calivil Dinge region, with only 30 per cent of the sample families reporting off-farm employment of either husband or wife.

The distribution of off-farm incomes is shown in Figure 20. A small number of extreme values are not shown in the graph to maintain privacy. These values are mostly associated with recent purchasers of properties who maintain significant business interests beyond farming.
By limiting analysis to the northern part of the Tragowel Plains I was able to make comparisons with the situation in 1986-87. There was no significant difference between off-farm earnings for the two periods when 1986-87 earnings were adjusted to account for inflation. The median off-farm income for 1987 was $6,000 (in 1995 $ terms). This rose to $7,500 in 1995. This stability of off-farm earnings held true for both dairy farms and mixed farms. Despite the stable rate of off-farm employment, there was significant unmet demand for off-farm work. Amongst mixed farmers 38.6 per cent wished to take off greater off-farm work. Forty-six per cent thought there was a possibility of this occurring.
Diversification

Diversification of production has traditionally been a strategy used by Australian farmers to manage the risk inherent in market volatility. Financial pressure on Tragowel Plains farmers could be expected to have acted as an incentive for production diversification. Fifty-two per cent of farmers interviewed in 1995 reported making significant changes to the production mix (Table 64). However, the nature of reported diversification was not likely to make a significant impact on the structure of the district agricultural industry.

<table>
<thead>
<tr>
<th>% of farmers (N = 118)</th>
<th>No Possibility</th>
<th>Some Possibility</th>
<th>Strong possibility</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome desired</td>
<td>4.9</td>
<td>21.1</td>
<td>12.6</td>
<td>38.6</td>
</tr>
<tr>
<td>Outcome not desired</td>
<td>49.2</td>
<td>11.0</td>
<td>1.2</td>
<td>61.4</td>
</tr>
<tr>
<td>Total</td>
<td>54.1</td>
<td>32.1</td>
<td>13.8</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 64 Farm diversification strategies 1990-95

<table>
<thead>
<tr>
<th>Diversification strategy</th>
<th>% of farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce sheep numbers</td>
<td>19.8</td>
</tr>
<tr>
<td>Increase cattle numbers</td>
<td>19.8</td>
</tr>
<tr>
<td>Produce hay</td>
<td>9.1</td>
</tr>
<tr>
<td>Greater cropping</td>
<td>9.1</td>
</tr>
<tr>
<td>Produce lucerne</td>
<td>7.5</td>
</tr>
<tr>
<td>Reduce cattle numbers</td>
<td>5.8</td>
</tr>
<tr>
<td>Services to dairy industry</td>
<td>5.0</td>
</tr>
<tr>
<td>Increase merino numbers</td>
<td>3.3</td>
</tr>
<tr>
<td>Increase prime lamb numbers</td>
<td>3.3</td>
</tr>
<tr>
<td>Greater reliance on dairy</td>
<td>2.5</td>
</tr>
<tr>
<td>Start dairy</td>
<td>2.5</td>
</tr>
</tbody>
</table>
The major diversification was a reduction in sheep numbers, consistent with trends across the rest of Australia, and a commensurate increase in cattle numbers. Increasing cattle numbers was probably the simplest alternative available to annual pasture irrigators who had decreased sheep numbers. Unfortunately for those who made this switch, cattle prices fell significantly after 1995 leaving little real difference in the relative returns of wool and beef. The most profitable industry established industry for the area over the period 1990-95 was milk production. Only three mixed farming businesses diversified to dairying in the period 1990-95, reflecting the high capital requirements which act as a barrier to entry for many mixed irrigation farmers.

There remained a strong interest in diversification with almost 60 per cent of farmers in the 1995 sample indicating a desire to diversify their farm production. However, the desire was not matched by a confidence that this desire would be fulfilled. Only 17 per cent of the sample believed diversification was a strong possibility (Table 65).

<table>
<thead>
<tr>
<th>(%) of farmers</th>
<th>No Possibility</th>
<th>Some Possibility</th>
<th>Strong possibility</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N = 119</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome desired</td>
<td>.8</td>
<td>42</td>
<td>16.8</td>
<td>59.6</td>
</tr>
<tr>
<td>Outcome not desired</td>
<td>37.9</td>
<td>2.5</td>
<td>0</td>
<td>40.4</td>
</tr>
<tr>
<td>Total</td>
<td>38.7</td>
<td>44.5</td>
<td>16.8</td>
<td>100</td>
</tr>
</tbody>
</table>

The reason for this lack of confidence lies in the lack of clear alternatives available to mixed irrigation farmers. The most commonly mentioned option was increased emphasis upon cropping, a strategy limited mainly to those who already had made a financial commitment to the cropping industry. Servicing the dairy industry was mentioned by only five per cent of farmers. When asked specifically about servicing the industry, 25 per cent indicated an interest in pursuing this option, although only a very small number believed this was a strong possibility in the next five years.
The possibility of a new industry for the district has been raised with the building of a rice receival station at Mitiamo, on the south eastern border of the study area. This may provide opportunities for those farm businesses with both the capital, cropping skills and farm soil characteristics required. However, it must be expected that only the largest mixed farming businesses in the district may be able to meet these requirements. A further limitation may be controls to minimise the impact on watertables of the intensive irrigation required to grow rice.

**Likely future adjustment**

The farm businesses of the Tragowel Plains can be segmented into four distinct groups based upon the financial, industry and structural characteristics which have been discussed above. This segmentation was created using the judgement of the author. The groups discussed are differentiated by the differing patterns of structural adjustment which can be expected over
the next decade if no significant exogenous factors change from the circumstances current during
the study period. The characteristics of each of these groups are displayed in Table 68.

- **Off-farm focussed**: This group comprised 18 per cent of the population. The group
controlled 14.7 per cent of the regional water right. It was composed of farm owners
who earned the predominant portion of their income from off-farm sources and
managed a mixed farm in the hours away from their off-farm work. The farm was
either a relatively small operation, or was operated at a clear loss for what may have
been taxation purposes. Off-farm income varied from $28,000 to over $100,000.
Members of this group had a wide variation in desires and expectations of the future.
They were significantly more likely to expect to sell water. Ironically, members of this
group were also more likely to express an interest in expanding the farm during the
interview process. This apparent contradiction probably reflects a generally strong
interest in finding alternatives to their current situation. They were also more likely to
express interest in diversification, training or taking further off-farm work. In the past
permanent sales of water right were most common in this group. In the future the size
of this group will depend upon the opportunities for off-farm work which arise. There
is an unsatisfied demand for off-farm work in the Tragowel Plains. A desire for greater
levels of off-farm work was higher amongst those already undertaking off-farm work..
With no increase in off-farm work opportunities this group can be expected to remain
static. With an increase, the rate of sale of water right could be expected to increase.

- **Dairy farms**: Comprised 35 per cent of farms and controlled 32 per cent of the
regional water right. They were characterised by higher than average profit and debt
and lower than average equity. Dairy farmers were significantly more likely to have
purchased water in the past and expected to do so again in the future. The majority of
dairy farms were located in the southern Calivil-Dingee district. It is unlikely there
will be any significant entry into this group. The group can be expected to grow
smaller in number, but to control an increasing share of the regional water right as
surviving dairy farms consolidate by purchasing the assets of exiting dairy farmers and
assets of mixed farmers.
- **Larger mixed farms:** Were defined as those mixed farms with no significant off-farm income and a water right greater than 800 ML. Although comprising less than 11 per cent of the sample, they control 31 per cent of the sample’s water right. The financial performance of these farms was little better than that of the mid-sized farms. In the past mixed farming businesses of this size have achieved only a small degree of farm expansion. The expectations of this group suggest that the future will be much the same. Managers of these farms were in general less interested in making changes in farm management than managers of the other farms in the sample. There were few expectations of land or water purchase or sale.

- **Mid sized mixed farms:** This group was composed of those mixed farms with little off-farm work and a water right in the range of 400 to 800 ML. It comprised 13.5 per cent of farms in the sample, controlling 14 per cent of water right of the sample. Analysis of Goulburn Murray Water records showed this group had an aggregate of exits over entries during the period 1989-95. Based upon the farm performance of this group, and the wishes and expectations of its members, there is no reason to expect that this trend will do other than continue. Despite having larger farms than the members of the small farm group, the farm performance was not greatly different. The median household income was actually lower than that of the small mixed farm group. This was due to a combination of a greater number of households on these farms and a greater debt to support. Members of this group were more interested in buying land than the rest of the sample and less interested in buying water right alone. However, they do not expect this desire will translate into actuality. Members were significantly more likely to express an interest in selling out compared to the sample as a whole.

- **Smaller mixed farms:** These farms all had water rights of less than 400 ML. Farms in this group had high equity and low income, reflecting a common pattern amongst smaller broadacre farms across Australia (Connell et al., 1996). They comprised 22.3 per cent of the sample and controlled only 8.9 per cent of water resources. Members of this group had little interest in expanding the farm by purchasing land or water. Members were more likely to desire and expect to sell parcels of land or water. They generally had no interest in selling out altogether. Their survival appeared to be
contingent upon obtaining off-farm work. Failure to find this work lead to a high exit rate from farming. Despite a high exit rate from this group, the number of farms in the group can not necessarily be expected to decrease over the next decade. The size of this group is dependent upon the competitive position of new entrants in the land market. Under the conditions experienced during the study period, the group size could be expected to increase. A significant increase in the market value of water, or an improvement in the terms of trade of sheep and irrigated crop commodities would be expected to lead to a decrease in the size of this group as their land would be purchased by established farmers rather than new entrants.

Table 68 A financial segmentation of Tragowel Plains farm businesses in 1995

<table>
<thead>
<tr>
<th></th>
<th>Off-farm focussed</th>
<th>Dairy farms</th>
<th>Smaller mixed farms</th>
<th>Mid-range mixed farms</th>
<th>Larger mixed farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of full 1995 sample (N=117)</td>
<td>18.3</td>
<td>35.4</td>
<td>22.3</td>
<td>13.5</td>
<td>10.5</td>
</tr>
<tr>
<td>Percentage of farms in 1987 sample area (N=80)</td>
<td>23.3</td>
<td>18.3</td>
<td>23.7</td>
<td>18.9</td>
<td>15.8</td>
</tr>
<tr>
<td>Water right as a % of total sample water right</td>
<td>14.7</td>
<td>30.9</td>
<td>8.9</td>
<td>14.0</td>
<td>31.5</td>
</tr>
<tr>
<td>Gross farm income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>$69,920</td>
<td>$234,57</td>
<td>$60,240</td>
<td>$95,780</td>
<td>$408,920</td>
</tr>
<tr>
<td>(Standard error)</td>
<td>(18,35)</td>
<td>0</td>
<td>(11,720)</td>
<td>(12,360)</td>
<td>(150,440)</td>
</tr>
<tr>
<td>Median</td>
<td>$51,60</td>
<td>(34,630)</td>
<td>$49,550</td>
<td>$83,450</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$172,19</td>
<td></td>
<td></td>
<td></td>
<td>$124,030</td>
</tr>
<tr>
<td>Farm profit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>$5,130</td>
<td>$35,070</td>
<td>$11,080</td>
<td>$14,970</td>
<td>$12,520</td>
</tr>
<tr>
<td>(Standard error)</td>
<td>(21,220)</td>
<td>(8,450)</td>
<td>(3,910)</td>
<td>(8,250)</td>
<td>(5,760)</td>
</tr>
<tr>
<td>Median</td>
<td>$3,270</td>
<td>$32,360</td>
<td>$8,600</td>
<td>$15,350</td>
<td>$8,660</td>
</tr>
<tr>
<td>Off-farm Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>$151,378</td>
<td>$10,121</td>
<td>$4,140</td>
<td>$9,676</td>
<td>$3,247</td>
</tr>
<tr>
<td>(Standard error)</td>
<td>(63,832)</td>
<td>(2,931)</td>
<td>(1,659)</td>
<td>(4,309)</td>
<td>(1,260)</td>
</tr>
<tr>
<td>Median</td>
<td>$65,733</td>
<td>$806</td>
<td>$0</td>
<td>$307</td>
<td>$1,624</td>
</tr>
<tr>
<td>Family Disposable Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>$112,610</td>
<td>$37,633</td>
<td>$3,638</td>
<td>$20,603</td>
<td>$14,579</td>
</tr>
<tr>
<td>(Standard error)</td>
<td>(34,288)</td>
<td>(5,476)</td>
<td>(21,447)</td>
<td>(7,281)</td>
<td>(6,065)</td>
</tr>
<tr>
<td>Median</td>
<td>$34,148</td>
<td>$39,755</td>
<td>$39,755</td>
<td>$25,931</td>
<td>$12,667</td>
</tr>
<tr>
<td>Equity (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>86</td>
<td>81</td>
<td>92</td>
<td>88</td>
<td>93</td>
</tr>
<tr>
<td>(Standard error)</td>
<td>(3.9)</td>
<td>(1.8)</td>
<td>(3)</td>
<td>(3)</td>
<td>3</td>
</tr>
<tr>
<td>Median</td>
<td>91</td>
<td>81</td>
<td>99</td>
<td>91</td>
<td>94</td>
</tr>
</tbody>
</table>
Summary

The classic adjustment pattern of a net exit from farming and associated amalgamation of properties seems to be most likely to occur when there is a prosperous local agricultural industry which is producing sufficient returns to enable its operators to outbid potential outside land purchasers. This bidding must be at a price sufficient to absorb the sunk costs of the housing assets of exiting farm families. Successful consolidation of enterprises was underway within dairy farm areas of the Tragowel Plains during the period of this study. The process was driven by the relative prosperity of dairy industry which enabled the operators of those businesses to fund farm expansion. The preferred means of expansion was through combined land and water purchase.

Little consolidation was measured in mixed farming areas in the north of the study area. The number of small farm businesses increased during the period of study. The major processes causing this structural adjustment on the Tragowel Plains can be summarised as follows:

- Low returns to existing mixed farming industries encouraged many to exit, and made the possibility of funding farm build-up remote.

- A high exit rate due to financial pressure was being accelerated by non-financial issues such as the family and lifestyle satisfaction of women on farms.

- A high concentration of mixed farms in the north created a geographic shortage of strong businesses able to fund expansion in that district.

- A high demand for small farms in the north from new entrants appeared to be based upon unrealistic expectations of the limitations of small farms and local off-farm work opportunities.

- When the existing agricultural industries of a region are all in a weak financial position, there will be greater difficulty in existing businesses investing in expansion, particularly where they must bid for sunk costs such as housing. They will be at a competitive disadvantage when bidding against new entrants for whom the housing is not a sunk cost. Significant investment in capital infrastructure, particularly housing
and land relayout, ensures that new entrants were able to outbid existing mixed farming businesses.

This process of fragmentation through sales to new entrants was exacerbated by TWE sales forced by financial hardship. The introduction of TWE offered a new method of selling assets, but remaining on farm. There was a limited export of water to other areas, but this was not matched by commensurate decrease in the number of farm businesses.

This analysis leads to support for the implicit model of farm consolidation which underlies the proposals for farm adjustment measures made by the community group developing the Loddon-Murray 2000+ plan. The data does not support the exit-driven model of farm consolidation underlying the proposals of the Commonwealth representatives.
Comparisons with agricultural structural change elsewhere in south east Australia

Research issue 6: Are the processes of adjustment observed on the Tragowel Plains consistent with adjustment elsewhere in Australian agriculture?

- Are the observed rates of exit and entry to agriculture on the Tragowel Plains consistent with those observed elsewhere in south east Australia?
- Are the patterns of consolidation, fragmentation and polarisation observed on the Tragowel Plains consistent with those observed elsewhere in south east Australia?

Given the resources available, it was not possible to make an analysis of the adjustment process which occurred in south east Australia between 1989-95 in a manner which allowed direct comparison with the analysis described in the preceding sections of the previous chapter. To enable the changes within the Tragowel Plains to be placed within the context of changes in agriculture elsewhere in Australia, three data sets were analysed. There were:

- Australian Population and Housing Census data
- Australian Farm Census data
- Goulburn Murray Water Customer Information Base.

Each of these data sets is described in chapter 6. The first two allowed a comparison between adjustment within the Loddon North SLA, which included most of the Tragowel Plains, and rural SLAs across south east Australia. The third data set allowed a comparison between the Tragowel Plains and other irrigation districts supplied with water by Goulburn Murray Water.

Farm exit rates

There are no contemporary sources which allow a direct comparison of the exit rates measured on the Tragowel Plains with similar situations across Australia, although a similar exit rate has been observed in the 1970s amongst dairy farm businesses experiencing significant financial stress (Barr et al., 1980). The best available tool for comparison is the ABS Population...
Comparisons with agricultural structural change elsewhere in south east Australia

Respondents to the census are asked to declare their main occupation and this is then coded by the Australian Bureau of Statistics. The ABS codes include a category called Farm Manager. This category must be used with caution as it is unclear how those with multiple occupations decide which is their major occupation . . . whether by money earned, time devoted or emotional attachment. Comparison of ABS farm establishment population data and Population and Housing Census counts of farm families indicates that many farm managers will describe themselves by their off-farm occupation if that contributes significantly to total income, but farm managers who have retired to a small farm property will often prefer to describe themselves as a farm manager rather than a retiree, despite earning significant off-farm income from investments (Barr and Ridges, 1998a).

Respondents to the census are also asked whether their home address has changed since the last census (Australian Bureau of Statistics, 1998). Most of those who report living at a new residence and who described themselves as farmers can be taken as an indicator of entry to an occupation as farm manager. [Some of these new entrants will be moving from other farms in the district where they have operated in a subsidiary role as sharefarmer or family assistant (Garnaut and Lim-Applegate, 1997)]. Cross tabulations of these two questions were purchased. There is no means of identifying persons who described themselves as farmers in the previous census and who now are coded into another occupational category. A proxy measure of exit rates was calculated based upon the change in number of persons calling themselves farmers between successive censuses and the number of new entrants to farming identified as described in the previous section. The measure was calculated as follows:

\[
Ne = F96 - F91 - N96
\]

where

Ne = number of farmers exiting farming 1991 to 1996
F96 = number of persons describing themselves as farmers in the 1996 census
F91 = number of persons describing themselves as farmers in the 1991 census
N96 = Number of persons describing themselves as farmers who changed addresses between 1991 and 1996.

This measure has a number of potential shortcomings. As with the measure of farm entries, it only includes farmers resident in the SLA. It will include in its count those who have taken an off-farm job in the inter-censal period and changed their occupation response in the census to reflect this change, even though they still continue to operate their farm. It will also be influenced by any change between censuses in the propensity for female partners to describe...
themselves as farmers rather than housewives. This latter effect is quite small and may be discounted (Barr and Ridges, 1998a). Because of these shortcomings, estimates of exit rates from this measure must be treated with caution and used for relative comparisons rather than as actual measures.

The estimated annual rate of exit from Loddon North SLA between 1991 and 1996 was 3.85%. This is significantly less than the rate estimated by analysis of GMW records, underscoring the need for caution in using this measure. The difference may be partly due to the absence of part time farmers from the ABS Population and Housing Census category. The overall rate of exit from farming for the state was estimated from the ABS Population and Housing census at 4.7% per annum. There was a tendency for exit rates to be higher in proximity to major population centres and lower in the sheep-wheat regions in the west of the state (Figure 22). The exit rate calculated for Loddon North was similar to that found in the GMID irrigation region using the same methodology, and higher than the rate found in the sheep-wheat areas on the inland slopes of the Great Dividing Range (see Figure 22).

![Figure 22](image-url)
Farm entry rates

The ABS Population and Housing Census was used to estimate entry rates to agriculture across south east Australia. The estimate of farm entry was calculated using the census questions on major form of employment and change of domestic address. Those who described themselves as farmers and who had changed their address since the last census were taken to be new entrants to farming. This construction of entry to farming does not include new entrants who were not resident within the SLA where the farm is located. In other words, absentee entrants to farming are excluded. Likewise, new entrants who were still substantially dependent upon non-farm income sources will not be counted in this measure.

The annual rate of entry to farming in the Loddon North SLA, as calculated by the cross-tabulation described above, was 3.0 per cent for the years between 1991 and 1996. This was little different from the entry rate for the Tragowel Plains as a whole calculated using GMW records for the period 1989-95 (3.2 per cent). Despite the cautions given above over the use of the ABS data to calculate farmer entry rates, the similarity with the GMW based calculation gives confidence in the use of ABS data for comparisons with entry rates to farming elsewhere in Australia.

There was significant regional variation in entry rates (Figure 23). In much of the sheep and sheep-wheat districts of western Victoria entry rates were similar to that measured for the Calivil Dingee district. The higher entry rates measured in the northern Tragowel Plains in this study were not atypical of that observed in many Murray Darling Basin irrigation districts and in SLAs close to major provincial towns.
Structural polarisation

One of the notable characteristics of adjustment with the Tragowel Plains district during 1989-95 was the fragmentation of holdings in the north of the irrigation area. The number of medium sized holdings declined, while the number of smaller sized holdings increased. Is this pattern found elsewhere in Australian rural communities? One means of searching for the occurrence of this phenomena is to examine the relative rate of change in the numbers of small sized and medium sized farms in other Statistical Local Areas using an estimate of farm size based upon Estimated Value of Agricultural Operations (EVAO). The EVAO is an estimate of gross farm income based upon commodity sales data provided to the Australian Bureau of Statistics through their Farm Census (Australian Bureau of Statistics, 1997). This estimate of farm size changes in response to changing commodity prices as well as changes in the production system on the farms. Changes in EVAO are not strictly a measure of physical farm size, but of changes in the value of farm produce. However, EVAO is the only available measure of farm size which allows an examination of farm size distribution disaggregated to the SLA level.
In planning for its annual survey, ABARE has had access to the ABS frame of farm establishments. It has used the EVAO measure to build its stratified samples. ABARE has maintained a record of farm establishment size distribution and tracked changes in farm establishment and creation in SLAs over the period 1986-95 (Lindsay and Gleeson, 1997). Lindsay and Gleeson analysed this data at the national level and concluded that in, in aggregate, average farm size has been increasing as a result of the progressive exodus of small farms from agriculture. This trend was most obvious in the dairy industry and least obvious in broadacre grazing industries. There was no evidence of an aggregate fragmentation of holdings or of involution (the disappearing middle phenomena (Salamon and Davis-Brown, 1986)) at a national level.

In order to investigate the occurrence of fragmentation at the regional level, I was given access to summary data for the years 1986 and 1995 aggregated to SLA boundaries. This data allocated farms into national decile categories of Estimated Value of Agricultural Operations for each of these two years. No attempt was made to adjust the EVAO estimates for changes in agricultural commodity prices between the two period. The data was examined in aggregate for Victoria, NSW and southern Queensland. During the period 1986 to 1995 there was a consistent average 15 per cent decline in the number of farms in each of the four EVAO categories between $25,000 and $80,000. For each of the farm categories with EVAOs of $160,000 or greater there was a consistent increase in farm numbers of over 30 per cent. For the three remaining categories of EVAO between $80,000 and $160,000 there was no common trend. These three groups of categories were used to explore the occurrence of any fragmentation and involution in the distribution of farm establishments EVAO. In the following discussion these three categories will be referred to as small, medium and large farms.

Figure 24 is a scattergram representation of the annual rate of change in the number of small and medium sized farms in SLAs in Victoria, New South Wales and southern Queensland between 1986 and 1995. SLAs with fewer than 30 farm establishments in 1986 were excluded from the analysis. In only two SLAs did the pattern of fragmentation emerge . . . a decline in the number of medium sized farm establishments and increase in the number small sized establishments. Both of these SLAs were in NSW. Involution was not detected in the Loddon North SLA. By this test, the form of involution observed in the northern Tragowel Plains is
Comparisons with agricultural structural change elsewhere in south east Australia

uncommon when measured at the SLA level of aggregation. A second, less stringent indicator of fragmentation was also explored. This was a comparison of the rate of decline of small farms and the rate of decline of medium sized farms.

[For a definition of the relationship between Loddon North SLA and the study area, see Figure 12]

![Graph showing the relationship between the rate of change in number of small farm establishments and the number of medium sized farm establishments in Victorian Statistical Local Areas for the period 1986-95 (source: ABS and ABARE).]

Where the numbers of medium sized farms are declining faster than the numbers of small farms, one may hypothesise that the growth of larger agricultural enterprises is more likely to be through the absorption of medium sized farms than small farms.
In all but four Victorian SLAs the rate of decline in the number of small farms was greater than the rate of decline in the number of medium sized farms. In New South Wales, however, there were 25 SLAs where the rate of decline of medium sized farms exceeded that of small farms. These SLAs were predominantly in the central NSW grain belt and in the coastal fringe (Figure 25). Such fragmentation was also measured in a number of southern Queensland SLAs. The most probable explanation for this milder form of fragmentation in the coastal regions can be attributed to the attraction of such regions for hobby farmers, retirees and others who are likely to have a degree of economic security independent of agricultural commodity prices. In the cropping belt this apparent involution may be partly explained by an apparent decline in farm size caused by the impact of de-stocking in response to drought (Martin, 1995c).

Figure 25  SLAs where the rate of disappearance of medium sized properties was greater than the rate of disappearance of small properties (EVAO measured in 1986 and 1995)
These results suggest that the involution phenomena observed in the Pyramid Hill district in 1989-95 was uncommon in the period of study, but that it may have occurred to some extent in the cropping zone of NSW and Queensland during the period 1986-96. This conclusion must be caveated with the recognition of the limitations of the use of EVAO as a measure of change in property structure, the different time frame for the EVAO analysis and the lack of discrimination in data disaggregated only to SLA size.

**Fragmentation and consolidation**

EVAO as a measure of property size is weakened by the interaction of commodity prices and changes in farm size. A further weakness of this measure lies in its consideration of only property structure. It does not represent the flow of persons into and out of agriculture which may have little impact upon property structure. An alternative perspective on adjustment processes may be gained by considering the rate of exit and entry of persons into agriculture.

A simple conceptual model of the relationship between entry and exit rates is shown in Figure 26. Low exit and entry rates characterise areas which have traditionally been described as tightly held, and have been the focus of past Federal rural adjustment policies.. High entry and exit rates describe an area such as the Nyah irrigation district, where property turnover could be described as a form of ‘churning’ (Barr and McDougall., 1990). High exit rates and low entry rates are characteristic of a district where business amalgamation is consolidating the structure of the district. Low exit rates and high entry rates are characteristic of business fragmentation.

<table>
<thead>
<tr>
<th>Entry Rate</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Fragmentation</td>
<td>Churning</td>
</tr>
<tr>
<td>Low</td>
<td>Tightly held</td>
<td>Consolidation</td>
</tr>
</tbody>
</table>

*Figure 26 A simple conceptual model of the relationship between farm exit and entry rates*
An analysis based upon this model was undertaken using both the ABS Population and Housing Census data and Goulburn-Murray Water records. Ownership records from GMW for the period 1993-97 were aggregated to business entities using cues available in ownership names, property numbers and in business addresses. This analysis provided business structures for the Tragowel Plains region and for 13 other irrigation districts. This simplified matching procedure was not as accurate as that used for Tragowel Plains businesses for the period 1989-95. Such a full matching was beyond the resources available.

The results of this analysis of GMW records are shown in Figure 27, where the axes depict the annual exit and entry rates. Data derived for other irrigation districts using GMW records for the period 1993-97 is depicted using blue markers. Entry and exit rates for the two areas of the Tragowel Plains calculated using the same method are shown with green markers. Entry and exit rates calculated earlier in this thesis for the Tragowel Plains between 1989 and 1995 are depicted by red markers.

Two observations must be made. First, the more recent data shows a much reduced entry rate for both the Pyramid Hill district and the Calivil-Dingee-Mincha district compared to that measured in the period 1989-95. Exit rates decreased in the Calivil-Dingee-Mincha districts, but have remained relatively unchanged in the Pyramid Hill district. Thus, while the pattern of adjustment (as measured by entry and exit rates) in the dairying districts has shifted towards the tightly held classification, the Pyramid Hill district has shifted strongly towards a consolidation pattern. This suggests that the fragmentation observed during the study period was a temporary phenomena.

Two caveats must be applied to this interpretation. First, it is possible that part of the apparent shift may be due to measurement difference caused by the less stringent process of determining business structure. Second, the rate of entry and exit is only one of the processes contributing to the overall pattern of adjustment. The sale of land and water between properties unconnected with entry or exit also influences the overall pattern of adjustment.
Most recent figures on the sale of water show a significant increase in the rate of permanent internal transfer of water within the Tragowle Plains region (Goulburn Murray Water, 1998). Figure 28 shows an acceleration of internal transfers in both irrigation districts dominated by mixed farming (Pyramid Hill-Boort and Swan Hill). The majority of purchasers of internally transferred water in the Pyramid Hill and Boort districts would have been dairy farmers in the Calivil-Dingee district. Much of this ‘internal’ transfer would have been exported from the Pyramid Hill locality and may be a factor in shifting the pattern of adjustment towards the ‘fragmentation’ category in the northern Tragowle Plains.
Figure 28  Cumulative internal transfer of water within irrigation districts through permanent TWE, expressed as a percentage of total district water right (Source: GMW)

The ABS Population and Housing Census provides another means of studying the relationship between farm entry and farm exit. In earlier sections of this chapter I explained a methodology for calculating exit and entry rates using the ABS Population and Housing Census data. Figure 29 shows the relationship between exit and entry rates calculated from ABS Population and Housing Census data for south east Australian Statistical Local Areas. Only SLAs with greater than 30 farm establishments in 1991 were included in the analysis. The adjustment patterns measured in the Calivil-Dingee-Mincha districts in the period 1989-95 might be described as typical for Victorian SLAs. The adjustment pattern for Pyramid Hill is characterised by an above average entry rate, and a typical exit rate.

The four class model of adjustment depicted in Figure 26 was mapped by classifying SLAs into one of the five classes according to the following classification rules depicted in Table 69. The results of this classification applied to SLAs in south east Australia for the period 1991-96 are mapped in Figure 30. The Loddon North SLA was classified as ‘Average’. This reflects the combination of the different patterns of adjustment observed across the Tragowel Plains and Boort using the full land and water ownership database.
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Figure 29  Relationship between annual exit rates from farming and annual entry rates into farming for Victorian, NSW and southern Queensland Statistical Local Areas (using data derived from the 1991 and 1996 ABS Population and Housing Censuses)

Entry Rate

<table>
<thead>
<tr>
<th>Exit Rate</th>
<th>Lowest quartile</th>
<th>Second quartile</th>
<th>Third quartile</th>
<th>Highest quartile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest quartile</td>
<td>Fragmenting</td>
<td>Fragmenting</td>
<td>Churning</td>
<td>Churning</td>
</tr>
<tr>
<td>Second quartile</td>
<td>Fragmenting</td>
<td>Average</td>
<td>Average</td>
<td>Churning</td>
</tr>
<tr>
<td>Third quartile</td>
<td>Tight</td>
<td>Average</td>
<td>Average</td>
<td>Consolidating</td>
</tr>
<tr>
<td>Highest quartile</td>
<td>Tight</td>
<td>Tight</td>
<td>Consolidating</td>
<td>Consolidating</td>
</tr>
</tbody>
</table>

Table 69  Classification model of adjustment in Victorian SLAs using ABS Population and Housing Census data
The pattern of fragmenting adjustment is found in SLAs near major population centres of Melbourne and Sydney and the regional population centres of Bendigo, Ballarat, Traralgon, Geelong and Bairnsdale. The only rural SLA in Victoria with this pattern of adjustment is the Glenelg Shire in south west Victoria. The pattern of tightly held ownership and relatively slow rates of adjustment predominates in the wool producing Western district of Victoria and the south west slopes of NSW, the cropping districts of north western Victoria and north of Adelaide and the beef districts of north east Victoria and east Gippsland. It is this pattern of adjustment which has been the target of a sequence of rural adjustment programs implemented since the early 1970s. High ownership turnover, or ‘churning’ was less common, being found most often on NSW. Consolidation was likewise found most often in NSW.

![Loddon North SLA Relative adjustment pattern 1991-96](Map.png)

*Figure 30  Mapping of adjustment patterns in Victorian SLAs 1991-96 (Using ABS Population and Housing Census data)*
Summary

The rate of exit from agriculture and the rate of entry to agriculture observed in the Tragowel Plains area are not atypical of much of the rural regions of south east Australia. The pattern of consolidation observed in the dairy dominated districts of the Tragowle Plains is found in many districts across south east Australia. The fragmentation pattern of adjustment observed in the northern Tragowel Plains during 1989-95 is not as widespread in Australian agriculture. As has been observed in the United States, it appears to be a temporal aberration (Albrecht, 1997). It is most likely to occur in areas where general low commodity prices are being received by most farm businesses, there is an absence of a profitable local rural industry and there exists a pool of aspiring entrants to farming. High interest rates may accelerate fragmentation. A perception of declining opportunities for off-farm employment may be reducing the demand for small farm entry (Albrecht and Murdock, 1984).

While patterns of clear fragmentation are uncommon in Australian agriculture, the dampening of farm consolidation rates by significant numbers of new entrants to agriculture appears to be a commonplace situation across much of rural south-east Australia. The effect is magnified by the tendency of new entrants to enter by purchasing relatively small properties. This result indicates that the implicit model of “exit driven” consolidation which seems to underlie policy debate is in need of revision.
Structural adjustment and the Salinity Plan

Research Issue 7: What has been the relationship between the Tragowel Plains Salinity Management Plan and structural adjustment on the Tragowel Plains?

- Has the Tragowel Plains Salinity Management Plan influenced the rate of structural change and farm consolidation amongst Tragowel Plains farms?

- Has structural change influenced the rate of adoption of Best Environmental Management Practices advocated in the Tragowel Plains Salinity Management Plan?

In this chapter I explore the interaction between the Salinity Plan and structural adjustment. The creators of the Salinity Plan sought to influence the direction of structural adjustment in a direction which would increase the adoption of the practices recommended in the Salinity Plan. The extent of influence attempted was only modest in comparison to the influence exerted upon the direction of structural adjustment by everyday financial pressures. It is quite possible that the process of structural adjustment may have had a significant influence of the extent of adoption of the practices recommended in the Salinity Plan.

The influence of the Salinity Plan on structural adjustment

It is not surprising that farmers reported that salinity had only a limited influence on major adjustment decisions. During the 1995 interview farm managers were asked if the provision of soil salinity data for their farm had influenced their land or water transaction decisions. Only 17.5 per cent of those who had undertaken land or water transactions in the previous five years reported that the results of soil salinity surveys had influenced their decisions.

The degree of influence of soil salinity survey data on land and water transactions is lower if expressed in terms of the volume of such transactions (Table 70). Farmers who reported soil salinity surveys influencing their decision sold 12 per cent of the total volume of water trade in both water entitlement and land sales. Similarly, ten per cent of the volume of purchases was reported by farmers who also reported that soil salinity survey results influenced their land and water purchase decisions.
This modest level of influence must be interpreted in the light of a number of shortcomings of this analysis. First, the self report data excludes the decisions made by those farmers who exited the sample between 1987 and 1995. Whether this omission underestimates or overstates the extent of influence of soil salinity surveys cannot be determined using the interview survey data. A second shortcoming lies in the fixed reporting period of the survey, the five years between 1990 and 1995 in which farmers were asked to report transactions. Adoption of soil salinity surveying occurred throughout this 5 year period (Department of Natural Resources and Environment Victoria, 1995). The work of soil salinity surveying occurred at a fixed rate over this period determined by the limits of the government resources committed to soil surveying. It can be assumed that half the reported land transactions will have occurred prior to the availability of soil survey results for a property. The true level of influence of soil salinity surveys on property transactions may eventually grow to twice that reported in Table 70.

The modest influence of salinity surveys on land transactions is confirmed by an analysis of the relationship between land transaction and salinity status. Using the land transaction database portrayed in Table 43 it was possible to correlate land transactions with soil salinity status for a large number of allotments. A full comparison of transactions with salinity status was not possible due to some limitations in the land tenure data transaction data discussed earlier and the incomplete state of soil salinity surveys. Of these shortcomings, the greatest problem with this data is the removal of land records from Goulburn Murray Water records as water is withdrawn from this land. It might be expected that this land would be more saline than land

<table>
<thead>
<tr>
<th>Purchases</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of land transactions as a % of all similar land transactions</td>
<td>18.4</td>
</tr>
<tr>
<td>ML of water transactions as a % of all similar water transactions</td>
<td>3.9</td>
</tr>
<tr>
<td>Land and water transactions expressed in ML as a % of all similar transactions</td>
<td>9.8</td>
</tr>
</tbody>
</table>
remaining in the database. However, statistical testing of the limited available data revealed no significant difference in salinity between the land leaving and land remaining in the Goulburn Murray Water database.

There was a significant relationship between soil salinity status and land transfer (Table 71). In most years saline land was more likely to be sold than non-saline land. However, the extent of this relationship was quite small, supporting the observations of farmers that soil salinity surveys played only a small part in their decisions to sell land.

Table 71  Relationship between land ownership transfer and salinity status

<table>
<thead>
<tr>
<th>Year</th>
<th>All legal transactions</th>
<th>Transactions outside the family</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% allotments transacted</td>
<td>Correlation with % C and D class soils</td>
</tr>
<tr>
<td>1989-91</td>
<td>6.3</td>
<td>-.015</td>
</tr>
<tr>
<td>1991-93</td>
<td>11.1</td>
<td>.154</td>
</tr>
<tr>
<td>1993-96</td>
<td>8.9</td>
<td>.081</td>
</tr>
<tr>
<td>1987-96</td>
<td>22.1</td>
<td>.103</td>
</tr>
</tbody>
</table>

The provision of the Stamp Duty Rebate as assistance within the Tragowel Plains Salinity Management Plan was intended as a means of assisting farm aggregation. The rebate was targeted at the phenomena of a growing number of small farms (Tragowel Plains Salinity Working Group, 1988). Over 5 years there were 51 successful applicants for this subsidy.

Within the 1995 sample, 46.6 per cent of land purchasers reported using the scheme. The scheme was not seen as effective by most users. Seventy-nine per cent of those who utilised the scheme reported it made no difference to their decision to purchase land and expand. So although the fragmentation of holdings the scheme appears to be targeted towards may well be
worthy of solving, one would have to conclude the rebate itself is inefficient due to the small level of funds available to influence decisions.

The influence of structural adjustment on Salinity Plan implementation

As suggested in previous section, with there being little influence of Tragowel Plains Salinity Management Plan on decisions by farmers to remain in, or leave, farming then it is possible that causality may lie in the opposite direction. It may be that differential exits and entry influenced the adoption of Best Environmental Management Practices recommended in the plan. This would occur if farmers with a higher propensity to adopt Best Management practices had a significantly different rate of exit or entry to farming in the Tragowel Plains, or if new entrants had a significantly different propensity to adopt BEMPs.

Did the high rate of ownership turnover increase or decrease the propensity to implement ‘Best Management Practices’? This hypothesis is tested in the reminder of this section. One simple means of testing for any impact of differential exits and entry on adoption rates would be to compare the rate of adoption of exiters in the years before they exited with that of new entrants in the years following their entry. In a world of stable commodity prices and seasons, this test could be accepted. However, the unstable financial environment outlined in chapter 3 gives strong cause for doubting that a comparison of the behaviour of one group of farmers in the period 1980-87 with the behaviour of another group in the period 1987-95 would be reliable.

The next alternative is to search for differences in the adoption rate of Best Environmental Management Practices in the period 1980-87 between farmers who have exited farming and those who have remained on the farm subsequent to 1987. Any difference would then need to be reconciled with a test for differences in the adoption rate of new entrants and established farmers in the period 1987-95. A high adoption rate for exiting farmers not balanced by a high adoption rate for new entrants would indicate that differential exits were decreasing the rate of adoption of ‘Best Management Environmental Practices’. An obverse finding would indicate that differential exit rates were enhancing the rate of adoption.

The design of the 1987 survey instrument introduces limitations into this line of investigation. The instrument included questions about the adoption of land relayout and tree
planting. It did not include questions about land retirement and management of saline land, nor about irrigation practice. Whilst not providing comprehensive measures of adoption, these two measures can be taken to represent two quite different environmental innovations. Investment in land relayout is a high cost activity with significant business risk and the potential for significant business returns. Tree planting is a low cost activity which entails little risk, and economic returns which are difficult to perceive. A second limitation of the 1987 design is the limiting of the sample to the Pyramid Hill area, and the exclusion of farms in the Calivil-Dingee districts.

**Land relayout**

A measure of land relayout behaviour needs to be carefully constructed. In the 1987 survey farmers were asked whether they had relayed out any of their farm and the area of that relayout. The area relayed out could be seen as a function of three influences. One could be described as the propensity of the farmer to invest in land relayout as a management tool. It is this factor which is of most interest in the question of the impact of exit rates on investment in relayout. The second factor is the size of the farm, which sets a maximum limit on the area which can be developed with relayout investment. The third factor is the number of years which a farmer has managed the farm. The longer the period of management, the greater opportunity to fund and implement relayout. There is a limit to the number of years during which laser grading could have been implemented. The technology was introduced to the region in 1978 and adoption effectively commenced in 1980 (Ewers, 1988). There is a degree of interaction between property size and years of management, with property size often increasing as years of management lengthen. However, as there is no data available on property build-up prior to 1987, this interaction must be discounted from the analysis.

The most appropriate measure of the propensity to invest in land relayout is therefore the one which eliminates the effects of period of management and size of farm.

\[
L_p = \frac{L}{(Y_{80} \times H)}
\]

Where

- \(L_p\) = Proportion of land relayed out per year of availability of land relayout technology
- \(L\) = Area of land relayed out by farmer
- \(Y_{80}\) = Years farmer has managed farm since 1979
- \(H\) = Area of farm
The resulting variable, a measure of propensity to relayout farm land, was bi-modally distributed, with one maxima on the point of zero adoption. The Kolmogorov-Smirnov test indicated a deviation from normality significant at $p = .001$. The use of a parametric test of the difference between the selling and surviving groups was therefore inappropriate. Farm managers in the 1987 sample who remained on the farm between 1987 and 1995 had a mean rate of relayout of 4.3 per cent of the farm per year during the period 1979-87. Those farmers who left their farm between 1987 and 1995 had a mean relayout rate of 2.8 per cent per year. Using the Mann-Whitney test for independent samples demonstrated only a tendency towards a significant difference between the two groups.

A similar measurement of the rate of land relayout per hectare per year was constructed for the period 1990-95 based upon information given by farmers in the 1995 survey. The mean rate for new entrants was 7.1 per cent per year. The rate for existing farmers was 2.4 per cent. Once again testing of this difference was limited to the non-parametric Mann-Whitney test which detected a tendency towards significance ($p=.1$).

A further two part analysis was undertaken. The 1995 sample was first split into two groups, adopters and non-adopters of land relayout, and a chi square test taken to detect any difference in the distribution of new entrants and established farmers between these two groups. The rate of relayout on adopters’ properties was then transformed with a log transform to create a normally distributed adoption variable to allow a parametric test for differences between the entrants and established farmers. Although there was no difference between the groups in the binary measurement of adoption, there was a difference in the behaviour of adopters in the two groups. Use of the T-test showed a high level of significance in the difference between the relayout rate of new arrivals and that of farmers already in the area in 1990. Established farmers were no more likely to invest in land relayout than new entrants, but those established farmers who did invest in land relayout invested at a far lesser rate than did the new entrants who invested in land relayout.

These mixed findings may be partially explained by the non-homogeneous composition of the new entrants to the district. They are split between a majority who are members of the Smaller mixed farm segment and smaller number of members of the Off-farm focussed group.
Some of these latter farmers have embarked upon a rapid rate of relayout. They have been able to invest at this rate because of significant off-farm income.

The results of this analysis suggest that structural adjustment on the Tragowel Plains is having a minor impact on the adoption of land relayout. Adjustment is bringing a sub group of farmers with significant capital who are investing in land relayout at a higher rate than either established farmers or those farmers who they replaced. However, this is at best a cautious interpretation, and a more definitive finding would require a larger sample and an extended period of analysis.

**Tree planting**

In 1987 farmers were asked how many trees they had planted on their farm. Following the logic outlined in the analysis of land relayout data, a measure of trees planted per hectare per year was created. The rates of tree planting of those who left farms after 1987 and those who remained were virtually identical. This lack of apparent relationship was confirmed by use of the Mann-Whitney U test for independent samples.

A similar measure was constructed for the rate of tree planting for the period between 1990 and 1995. The mean rate of tree planting per hectare per year for new arrivals was .78. The rate for established farmers was .58. There was no indication of any significant difference in these means. Structural adjustment is having no impact upon the rate of tree planting.

**Land retirement**

As no measurement were made of land retirement in the 1987 survey, it was not possible to conduct a similar analysis to that undertaken for land relayout and tree planting to find difference in adoption between those who exited and those who continued farming in the study period. It is still possible to compare the land retirement behaviour of new arrivals and established farmers.

The construction of an appropriate measure of the propensity to retire land is complicated by the uneven distribution of salt on farms. A measure of the proportion of previously irrigated C and D soils retired is likely to have little real meaning if it includes cases
with only a small area of salinity. The analysis was limited to farms with greater than 10 hectares of irrigated saline land in 1990.

Between 1990 and 1995 new entrants to the area reduced the irrigation of saline land by a mean of 9 per cent per annum. Established farmers reduced the irrigation of their saline land by a mean of 3.3 per cent per annum. Again, using the Mann-Whitney U test, this difference in the extent of removal of water from saline land irrigation was found to only tend to significance at $p = 0.1$.

Again, these results must be interpreted with some caution. However, they are consistent with the observations of the relationship between adjustment and investment in relayout. The new entrants to farming on the Tragowel Plains can be divided into two distinct groups. One group consists of farmers who start small mixed farming business. The second group is new entrants who bring significant capital or capacity to earn off-farm income. The first group, the new entrants on small mixed farms are no more likely to invest in water management than existing farmers. The second group are able to undertake significant investment in land relayout, and in doing so under the direction of a whole farm plan and soil survey, are likely to be retiring significant areas of land.

**Summary**

Despite the limitations of the above analyses, the results in aggregate allow a conclusion that the pattern of adjustment on the Tragowel Plains (high rate of exits and new entrants to farming) is not greatly influencing the rate of adoption of best management practices as advocated in the Tragowel Plains Salinity Management Plan.

Soil salinity surveys had a definite, but modest impact in bringing forward a decision to place land or water on the market. However, in the context of the contemporary financial pressures experienced by farm businesses, salinity status was a relatively stable and minor influence on decision making.

The Salinity Plan had little direct impact upon decisions to purchase land. The stamp duty rebate was well targeted to assist this process, but was too small to have any significant impact. The relatively low levels of salinity in the dairy dominated regions of the plan area meant that the soil salinity survey had little impact upon the decision to purchase land in this
area. The Salinity Plan had some effect upon the purchase of water rights by dairy farmers, as some mixed farm managers made a decision to sell water based upon the results of soil salinity surveys. The salinity Plan is not a policy tool to use to influence rates of farm consolidation.
Discussion

Judging the outcomes of the Tragowel Plains Salinity Management Plan against structural adjustment objectives

In chapter three I reviewed the expectations of appropriate adjustment on the Tragowel Plains. Adjustment was expected to occur in three different, though related forms: improved water use efficiency, farm consolidation and a reduction in human resources allocated to agriculture. Differing emphasis was placed upon each of these forms of adjustment, depending upon the perspective held by the observer. I classified these perspectives as economic, social and environmental. In this chapter I first review the adjustment outcomes of the Tragowel Plains Salinity Management Plan from each of these three perspectives.

After reviewing the outcomes of the plan, I assess alternative policy tools which might have been used to better achieve the objectives of the various actors in the development of the Loddon-Murray 2000+ plan. In assessing these alternative policy tools, I test the implicit models of structural change and farm consolidation used by these actors.

Finally, after reviewing alternative policy tools for enhancing structural change and farm consolidation in the Loddon-Torrumbarry irrigation districts, I consider the implications of my research for structural adjustment policy in Australia.

Enhancing water resource efficiency

The developers of the Tragowel Plains Salinity Management Plan envisaged a stepwise process leading to adjustment beneficial to their district. The initial steps in the process have been well adopted. There has been significant improvement in the accuracy of salinity appraisal, despite a high tenure turnover amongst land managers. The percentage of saline land retired by farmers increased from 37.6 per cent to 56.2 per cent in the five year period of this study. It is unclear whether this rate of retirement will continue. Thirty-five per cent of farmers had no plans to retire their saline land. Much of the remaining irrigated saline land remained on the properties
of these farmers. This evidence must be balanced against the increased turnover in water right ownership which has occurred in the two years following the completion of this study.

The water transferred from C and D class soils was predominantly being applied to perennial pasture rather than annual pasture. Over 5 years, 6.7 per cent of the district water right has been shifted from saline land to higher value uses. There has been an even greater transfer of water from annual pasture on A and B class soils to perennial pasture. This is the first measured increase in perennial pasture in the region in two decades. Half of the increase was due to dairy farm expansion through water purchase from mixed farms, and half due to a change of pasture mix on mixed farms. This increase in the area of perennial pasture may in part be claimed as a success of the Salinity Plan which attempted to minimise the risks of investing in land relayout, a requirement for the successful establishment and management of perennial pasture. In a separate economic study, Baird and Gyles (Baird and Gyles, 1997) have estimated that the net present value of the retirement of saline soils and transfer of water to perennial pasture to be over $3,000,000 at the 30th June 1996.

These results are best described as evolutionary change, in the direction of greater water use efficiency. They lack the decisive impact of a major transfer of water to NSW rice producers and Goulburn Valley dairy farmers, but also lack the possible dramatic consequences for infra-structure maintenance which may arise from these more dramatic forms of adjustment. This outcome must be interpreted as consistent with the objectives of the Tragowel Plains community who developed their Salinity Plan with the aim of strengthening the financial security of farm businesses on the plains. To the extent that water has transferred to dairy farms on the Tragowel Plains, this is also consistent with economic objectives of State and Federal policy makers.

**Farm consolidation**

In the research reported in this thesis no evidence was found of what Gow described as ‘the immobility of human resources in farming’ (Gow, 1997). There has been a rapid rate of exits from farming in the area. In the dairying dominated south and north-east this has led to a consolidation of farm businesses as the land previously held by exiting mixed farmers is purchased by dairy based businesses. However, in the predominantly mixed farm areas around Pyramid Hill, the high rate of exit has lead merely to a turnover in ownership and a minor
increase in the number of small farms at the expense of the numbers of mid-sized farms in the period up to 1996.

Given the low incomes generated by the increasing number of small farms and the demand for additional off-farm work, it is not hard to conclude that there was a significant degree of economic under-employment on these farms. Whether this under-employment is a sign of economic inefficiency would depend upon the extent to which these labour resources would be employed elsewhere in the economy if they were not committed to farming. Given that most of the new entrants to these farms had managed to accumulate sufficient capital to enter farming, even at this relatively small scale, it can be assumed that they have skills which were previously used effectively elsewhere in the economy. So from the perspective of economic efficiency, the growth in number of these small farms may well be seen as undesirable.

A recent analysis of the productivity performance of small and large farms has demonstrated that the majority of productivity improvement in agriculture has been generated on larger businesses. Small broadacre farms have achieved a rate of productivity improvement of only one per cent per annum over the last twenty years (Knopke et al., 1995). Given these observations, the growth in the numbers of small farms is not consistent with the objectives increased economic efficiency which form the basis of federal rural adjustment policy. Further, a similar growth of this farm segment, if repeated in other government irrigation areas, may have significant implications for salinity control and infrastructure rationalisation. Significant savings in infrastructure maintenance have been identified as arising from farm amalgamation and consolidation (Langford et al., 1998). Dis-aggregation of holdings clearly reduces the opportunity for the capture of these benefits. A more subtle infrastructure difficulty may also arise. In many irrigation settlements salinity control is dependent upon infrastructure investment which cannot result from the individual choice of a single farmer, but requires commitment from all who are likely to depend upon that infra-structure. This situation places a far sharper message into the concept of catchment management, which has in general in Australia been dominated by an emphasis on persuasion rather than regulation (Syme et al., 1993). Depending upon the institutional setting, investment in whole catchment management in irrigation areas may involve a degree of compulsion or a requirement for a widespread support and a dependence on successful persuasion (Wilkinson and Barr, 1991). The Victorian Drainage Act requires almost universal support from landholders as a pre-requisite for community drain construction. Failure
of the persuasion model to mobilise such support has stymied a number of significant community drainage projects, leading to calls from catchment planners for a greater emphasis upon regulation (Dainton, 1990). Compulsory payment to fund salinity control was identified as a major social issue in the Shepparton irrigation district. Smaller farms under financial pressure were more likely to perceive this possibility as a threat to farm survival (Sawtell and Bottomley, 1990). Greater numbers of these smaller farms may lead to increased complexity in achieving formal agreement for drainage works (Young and Gyles, 1991).

The Tragowel Plains Salinity Management Plan was designed to avoid complications of community infra-structure investment by focussing upon actions which could be embarked upon on a voluntary basis. The only exception to this was the support for continuation of community drainage investment. The choice of this strategy was in part a reflection of the limited management options available for the district due to the intractable nature of its salinity problem. But it was also an admission of the inability of a farming community, with a weak economic base, to support many of the salinity control strategies being considered in more prosperous irrigation districts.

High entrance rates to farming cannot be completely dismissed as a policy problem. In a recent report Stayner (1997) has argued that:

*The future health and adaptiveness of the farm sector depends upon the continuing entry to the industry of people with appropriate skills, knowledge, attitudes and motivations, as well as adequate financial capital. (p.1)*

There is no doubt that a number of the new entrants to farming on the Tragowel Plains have made significant contributions to farming in the district through the injection of capital, new ideas and high levels of skill. However, it cannot be argued that a majority of the new entrants to farming on the Tragowel Plains meet with all the criteria Stayner has outlined, particularly the capital criterion. The phenomenon of short term ownership of small farms is strong evidence of this shortcoming, as successive owners sell out soon after entering farming, often as a result of financial pressure resulting from lack of scale and insufficient capitalisation.

Overall, the high rate of ownership transfer and lack of consolidation of properties can be interpreted as inconsistent with the objectives of the economic, environmental and social
perspectives of adjustment. Current adjustment policy tools, whether in the Tragowel Plains Salinity Management Plan or within the Rural Adjustment Scheme have not been effective in achieving consolidation goals. Any future attempt to design a regional adjustment strategy for the area should target the phenomena of low consolidation rates.

**Human resources**

The Tragowel Plains Salinity Management Plan has had little impact upon the extent of structural adjustment pressure which is pushing farmers to exit farming. This is consistent with the findings of other studies of farm manager response to insidious environmental decline. Short term financial pressures and acute climatic events will generally be the dominating environmental influence on behaviour (Hooper, 1993; Barr, 1984). The plan’s lack of influence in reducing farm exits might be seen as indicative of the problems facing Lawrence’s prescription for adjustment policy within a ‘resource limits’ paradigm (Lawrence, 1997). While the search for sustainable agricultural practices may have a significant long term impact upon the long term survival of a particular agricultural industry, it may have little impact on the immediate survival of existing businesses in that industry. The search for biologically sustainable agricultural practices will follow a timetable with far greater time lags between action and outcome than the cycles of commodity price pressures which inevitably dictate the short term experience of the pressure for structural adjustment.

More importantly, the key issue which lay behind Lawrence’s critique of the Rural Adjustment Scheme was the assumption by policy makers that some form of market failure justified intervention to encourage increased exit rates from agriculture. Did government have a right to dissuade a farmer from his desire to remain in agriculture? The assumption that immobility of human resources is leading to less than efficient industry structure on the Tragowel Plains is not consistent with the evidence. From an economic efficiency point of view the key issue may well be the high rate of new entries. And the invalidity of these assumptions of human resource immobility as a problem may be applicable to some areas other than the Tragowel Plains. The argument over whether it is morally acceptable to assist or encourage farmers to exit when they do not want to is thus irrelevant to the problem of the Tragowel Plains . . . where there are many exits and the issue is whether people should think further before stepping into farming on the Tragowel Plains.
The question for those who hold the same views as Lawrence is whether they see any ethical problem with a State desire to discourage entry to farming by those with limited capital or skills. From a social perspective I would contend that there should be a number of reasons for concern with the situation.

The clues to Lawrence’s probable position lie elsewhere in his observations of the trends in the adjustment of Australian agriculture. What I have described as occurring on the Tragowiel Plains could be further evidence of the disappearing middle, described by Salamon in US, or being found elsewhere in Australia (Catt, 1992; Share et al., 1991). The disappearing middle is the increasingly stratified farm structure of large, viable producers, small semi-viable producers and an economically vulnerable third group who are unable to diversify despite economic signals. Growth in this phenomena is not seen as desirable by many who work within the sociological paradigm (Gray, 1994; Vanclay and Lawrence, 1993; Lawrence and Vanclay, 1992; Lawrence, 1987). The disappearing middle is produced by the process of agricultural involution (Geertz, 1963), the adoption of survival strategies which reduce and ultimately eliminate the possibility of change in response to further economic pressure. In the United States in the 1980s it was seen as being driven by low commodity prices and high interest rates. In the Tragowiel Plains the disappearing middle was driven by forces including the high interest rates of the 1980s, low commodity prices, and the introduction of transferable water entitlements which provides another mechanism for owners of small farms to take the path of involution. One further factor may well be unrealistic bidding for entry to farming. Stayner (1997) and Reeve and Kaine (1996) have documented the importance of intrinsic values in the decision of many farmers to enter that profession. These values clearly add to the price new entrants are prepared to pay to gain their farm.

The likelihood of unrealistic bidding for entry raises questions of social welfare. One could infer from the high turnover and often short occupancy of many of the smaller mixed farms that many of these new arrivals have based their decision upon an unrealistic assessment of the possibility of making a living from limited resources, or of gaining off-farm income. The desire to enter based upon this lack of information will result for many in unintended hardship. Those who are then forced to exit may be in a far worse financial position than before they entered farming. There is evidence from the survey that there may well be other undesirable outcomes in the form of weakened marriage relationships. Such outcomes must surely be seen as undesirable.
by those who take a social perspective to the problem. Overseas research indicates that a consolidating structural adjustment pattern is associated with an improved social welfare outcome for those who remain in the district, although this may be in part through a shifting of social hardship to other locations (Albrecht, 1998). It would follow that those who adopt a social welfare based interest in the adjustment of farming communities would need to support policy intervention to reduce the rate of under-capitalised and under-skilled entries to farming.

**Environmental perspectives**

In chapter three I described two differing alternative views of the environmentally desirable nature of structural adjustment. One view could be described as focussed upon the protection of the soil and water resources of the Tragowel Plains. From this perspective, the important feature of structural adjustment is whether it increases or decreases the probability of the adoption of agricultural Best Management Practices. The second perspective places greatest emphasis upon the provision of environmental flows for the protection of biodiversity within riverine environments. From this perspective, any structural adjustment outcome will be assessed on its ability to free up water for purchase for environmental purposes.

The environmental achievements of the Tragowel Plains Salinity Management Plan are impressive when viewed from within the framework adopted by the community. There has been a significant reduction of irrigation on saline soils, and adoption of measures to protect saline soils. Further, the current patterns of adjustment with high exit rates and high entry rates to farming in the area do not appear to be acting against the adoption of the environmental practices recommended in the plan.

But the key to this positive environmental view is the community based framework in which this judgement is embedded. This framework takes as a given the objective that the Tragowel Plains farming community should survive in something resembling its current form. A more dispassionate environmental critique would describe this as a “business as usual” perspective and would not see the adoption achievements of these irrigation farmers as of high environmental significance. The plan has achieved little in the mobilisation of water for environmental flows, and given the poor financial performance of irrigation farming in this region, it is from farms such as these that anyone advocating increased environmental flows must expect water to be transferred. If viewed from this context, it would be a disappointment to see
that the current structure of the water market is such that bidding for environmental water at
market prices current during this research would do little to catalyse significant adjustment and
release of water from this region. Water prices current during the study period were not
sufficient to compensate for redundant capital and allow for a dignified exit from farming.

There is an expectation that in the future the transferable water entitlements policy will
provide farmers with greater options to plan their exit from farming. Besides enabling farmers to
use their water as an annuity, some hope that high demand for water will provide a more
attractive sale option through property dis-aggregation than through the sale of the farm business
as a whole (Keyworth, 1995). Such an outcome would provide a painless mechanism for
reducing the number of mixed farms in irrigation areas such as the Tragowel Plains while
shifting large volumes of water to higher value uses.

The research reported in this thesis has shown, however, that hopes of a major
movement of water through this mechanism were possibly illusory because of the major sunk
costs in fixed infrastructure on existing mixed farms. This is ironic as many who anticipate such
a solution are overlooking the resulting privately held stranded assets in housing and water
management infrastructure, while being quite aware of the possibility of water authority stranded
assets being created by the export of water from the Tragowel Plains.

Enhancing the Tragowel Plains Salinity Plan model

The research undertaken for this thesis was designed to provide information on a
decision as to whether the model of the Tragowel Plains Salinity Management Plan should be
extended to other irrigation settlements in the Loddon Valley to achieve the objectives of the
local community and both State and Federal governments.

The Tragowel Plains Salinity Management plan has achieved significant intra-farm
adjustment. These achievements are likely to be evaluated positively from economic and social
perspectives, and from some environmental perspectives. Achievements in inter-farm adjustment
have been mixed. Significant consolidation and strengthening of farm businesses has occurred in
areas where there is a strong dairy farming presence. However, there was little consolidation of
holdings in mixed farming areas during the study period. It is clear that from economic,
sociological and environmental perspectives that this outcome can be construed as undesirable.
and a failure of existing structural adjustment policy tools. It also suggests that the policy tools used in the Tragowel Plains Salinity Management Plan would have a positive outcome if applied to other irrigation districts, but would not of themselves achieve the all the adjustment expectations of the Department of Primary Industry and Energy.

An important finding has been that rates of farm consolidation have varied significantly across the Plains, despite a lack of variation in the rate of farm exit. The major factor which has influenced the rate of consolidation has been the competition for land and water resources between new entrants and existing landholders. The major processes causing this structural adjustment on the Tragowel Plains can be summarised as follows:

- Low returns to existing mixed farming industries were encouraging many to exit, and made the possibility of mixed farm build-up remote (see page 178).

- A high exit rate due to financial pressure was being accelerated by non-financial issues such as family and lifestyle satisfaction of women on farms (see page 178).

- A high concentration of mixed farms in the north created a geographic shortage of strong businesses able to fund expansion in that district (see page 170).

- A high demand for small farms in the north from new entrants is consistent with work by Stayner (1997a) which has shown that small farm entry is often based upon unrealistic expectations of the potential of small farms and local off-farm work opportunities.

- Existing farmers were experiencing a competitive disadvantage when bidding against new entrants for whom the housing was not a sunk cost. Significant investment in capital infrastructure, particularly housing and land relayout, ensured that new entrants are able to outbid existing mixed farming businesses (see page 195).

This finding casts serious doubt on the “exit-driven” model of structural adjustment implicitly held by representatives of the Department of Primary Industry and Energy. Any alternate policy prescription to enhance farm consolidation must place greater emphasis upon the contribution of farm entry rates to farm consolidation rates.

In the following sections I discuss a number of policy alternatives which might be included in any adjustment plan for the Loddon irrigation regions and evaluate the likely impact
of this proposal on environmental, social and economic adjustment objectives for the region. Most of these proposals are drawn from the previous Rural Adjustment Scheme, the new “Agriculture-Advancing Australia” initiative of the Federal Government, or have been recommended for inclusion in the Loddon-Murray 2000+ Regional Development Plan. A number of these proposals are targeted at farm entry rather than farm exit.

**Skills training**

In its new incarnation the Rural Adjustment Scheme will place a far greater and more formal emphasis upon the role of training, or re-skilling, of farmers. The particular emphasis of this training will be upon building skills in marketing, financial management and business management, all areas where the deregulation of agricultural markets and winding back of government support has created a more complex management environment for farmers. There is initial evidence that increasing skills through formal training is linked to improved business performance, although the direction of causality is still a matter of debate (Kilpatrick, 1995). There can be no doubting any improvement in business management skills will be of benefit to many farm managers in the area, but it would be unrealistic to assume that a program to increase the business management skills of established farmers would have any impact on the process of adjustment which is increasing the number of small farms.

The greatest emphasis in skills training will probably be placed on business management, in areas such as financial management, decision evaluation and risk management. One of the key business decisions is whether or not to expand by purchasing land. Above all others, this is the decision which risks placing the financial health of the farm business in jeopardy (Reeve and Kaine, 1996). Although the success of any land purchase decision is in part an outcome of luck (Watson et al., 1992), there are tools available which can be used to quantify risks and assist in developing strategies to manage these risks (Madden, 1996). Training in risk management and financial control, if successful, would be likely to curb the tendency for sometimes over-optimistic bidding to gain ownership of adjoining properties during times of relatively buoyant commodity prices. New entrants would be expected to therefore face a less competitive market for entry to a district. This would not be expected to assist in reducing the trend to property fragmentation, and may have actually increased the rate in the short term.
Business planning for established farm families

In its new incarnation the Agriculture-Advancing Australia program has a strong component of funding for professional advice for farmers (Anderson, 1997). Business planning has also been agreed for inclusion in the new Loddon-Murray 2000+ regional development plan. The provision of business planning support is seen, in part, as a tool to encourage a greater exit rate from farms. The current trend towards decision making counselling takes two forms. One is the development of strategic farm business plans (Blackburn, 1994; McGuckian and Stephens, 1992; McGuckian, 1995; Scott, 1993; Letts, 1992). The emphasis in this model is on a combination of family group goal setting and effective financial planning. The other form is the more conventional financial counselling which has been established since the 1980s. Financial counselling is a service targeted to the mediation of relationships with creditors once farm businesses have encountered financial difficulties.

There is an irony in the recent interest of governments in supporting decision counselling services. It is clear that the expectation of policy makers is that better decision making will reduce what is often seen as the inflexible commitment of farmers to remaining within agriculture.

Critics such as Lawrence could be expected to take exception to the motivations of the Federal government in increasing funds to decision counselling services. But there can be no doubt they would applaud the provision of the services. They would see a clear social welfare justification for providing assistance to farmers in their negotiation with banks. Likewise, they would be expected to support any change in decision making towards the processes espoused in Property Management Planning with its aims of greater gender inclusiveness and attention to a wide range of social goals beyond the simple maximisation of profit. One could portray this as a return to the counselling form of extension, once prominent in the late 1960s and early 1970s (Salmon, 1981; Anderson, 1979), though with somewhat more utilitarian motives.

One could question the effectiveness of these training proposals, whose design is more likely to be based upon analysis of market failure, rather than an understanding of the complexity of the advisory relationship (Phillips, 1985; Anderson, 1981). The implications of the personal contract implied in an effective extension relationship have never fitted comfortably with those arguing an economic justification for farm training and extension programs and who have
generally seen one to one extension as unfairly favouring a minority of farmers with publicly provided goods (Watson et al., 1992).

Leaving aside any doubts about the capacity of the new decision-making skills training program emerging from the Rural Adjustment Scheme to have any significant influence upon farm family decision making, the capacity of these programs to have any significant and positive impact on the adjustment processes in the Tragowel Plains is still open to question. In fact, the provision of greater funds to decision counselling services could have an opposite effect to that envisaged by the policy makers of the Department of Primary Industries and Energy. The objective of this component of Rural Adjustment Scheme is in part to assist farmers to come to the decision to leave agriculture. During the study period there was no shortage of farmers exiting farming on the Tragowel Plains. In fact, it could be argued that there was an excess, as some farms being sold were viable and their sale resulted in a break up of these viable units. It is conceivable that the effective use of this program could lead mixed farmers on larger farms to conclude that they would be best advised to forego plans for expansion by land purchase, and even to suggest that they sell up. The program may also bring to the surface the differences in goals of husbands and wives, further increasing the exit rate. However, with no change in the expectations of new entrants, the result may well have been a further increase in the number of small farms and a lessening of the already low rate of property aggregation.

**Business planning for intending entrants**

If one believes the fragmentation of farm holdings in the Pyramid Hill region to be a problem needing a solution, then one must also conclude that the high level of new entrants to the farming in the district during the period of study is also a problem. The high rate of entries contributes to lower water use efficiency, social welfare problems and a lower rate of productivity improvement in the district.

There are currently no policy mechanisms existing to counsel new entrants to farming. In Victoria such policies disappeared with the demise of the closer settlement programs of the 1960s (Barr and Cary, 1992). The closest examples today are training for new entrants to dairy, or registration requirements for irrigators in Sunraysia which require training in irrigation for access to salinity program grants. Indeed, government attentions seems to periodically focus upon the need to encourage younger farmers to enter agriculture.
Existing farm business planning programs target existing or newly arrived farm managers who have already made the purchase decision. The key for influencing the rate of new arrivals is to achieve some impact on decision making before the decision to purchase a farm is made.

It would seem that the increased emphasis of the new Rural Adjustment Scheme on assisting existing farmers to develop planning skills and to develop business plans could well be extended to those who are contemplating an excursion into agriculture. If such a policy were able to be successfully implemented, it could have a far greater impact on the nature of structural adjustment on the Tragowel Plains and Torrumbarry irrigation district than planning assistance for existing businesses.

Arguments in favour of training assistance for those contemplating an entry to farming have been made in a recent report by Stayner (1997). Stayner justified his support on the basis of the importance of new entries to agriculture as an injection of ideas, enthusiasm and innovation. Clearly a number of new entrants are making such a contribution in the Pyramid Hill region. The more cautious position taken on new entries in this report is not incompatible with Stayner’s research which also included the finding that the most important reasons for deciding to enter farming are intrinsic rather than instrumental, and that entry is commonly associated with high levels of commercial debt making the new business vulnerable to farming’s risky environment. This results in the Australia-wide phenomena of new entrants being over-represented in agricultural exits (Lindsay and Gleeson, 1997).

The major question as to the usefulness of this proposed policy tool would be whether intending new entrants could be enticed to use such a service, given the predominant role of intrinsic values in the entry decision. Balanced against the at times unjustified optimism of the new entrant is the decreased likelihood of poor decision making being undertaken in times of stress (Shrapnel et al., 1997). The promotion of business plan development and training as a means of aiding in negotiations with potential lenders could well be an important strategy in promoting involvement by farm entrance aspirants. There is a risk that any successful implementation of a policy which reduces the demand for land would be seen as reducing land values, and so would need to be implemented in tandem with other policies which compensated vendors for the potential lowering of sale price.
Re-establishment grants

Re-establishment grants are a tool aimed at increasing the exit rate from farming by ensuring farmers know that if they sell out they will have sufficient assets to enable themselves to re-establish elsewhere. The grant has been capped at $45,000 for some time. The grant is made to top up any existing capital which farmers may realise from the sale of their assets. Thus the grant is only applicable to farmers who sell up when they have exhausted or come close to exhausting their capital. The current re-establishment grant was made available for another two years before being terminated. Re-establishment grants have been included within the Loddon-Murray 2000+ plan.

Given that the current exit rate provisions have rarely been used in the Tragowel Plains area, the likelihood of the proposed continuation of the grant (until the sunset provision) having any impact on the forms of structural adjustment in the Tragowel Plains and in the Torrumbarry region is negligible.

A recent proposal by the National Farmers’ Federation to enhance the re-establishment component is also not likely to be an effective policy tool to intervene in the current structural adjustment processes of the Tragowel Plains and Torrumbarry. Exit rates are already high on the Tragowel Plains. With a roundabout of entrants and exiters, exit grants may merely help government to share in the exhaustion of private capital by funding a sequential series of exiters within the constraints imposed by the existing eligibility criteria which limit the provision of the grant to those who have farmed on their current property for at least five years.

Whilst a cynical analyst may conclude that this cycle of funding could provide a significant on-going injection of cash into the local economy as potential exiters hang back from an inevitable decision to sell while they exhaust their own capital, from any other perspective the possibility of such an outcome would be entirely unwelcome.

Compensation for vendors’ sunk costs

The origins of the Rural Adjustment Scheme lie in the proposals of the Marginal Dairy Farms Reconstruction Scheme to compensate exiting farmers for the loss of value of redundant assets when selling to neighbouring dairy farmers (Anthony, 1970). This objective was quickly lost in the political transformation of the scheme into a tool to placate rural constituencies by
providing support to remain in farming. The original intentions of the scheme to assist farm build-up by removing the market impact of redundant assets were dismissed in the latest review of the Rural Adjustment Scheme with a single short paragraph that observed that as the redundant assets have a value to new entrants, they cannot be legitimately seen as redundant and are thus not a form of market failure (McColl et al., 1997; Kingma and Samuel, 1977). The value new entrants are placing upon these redundant assets reflects both the need for housing which is not shared by a bidder on an existing property, and intrinsic values which are presumably already satisfied amongst existing landholders.

Whether or not one defines these processes as a market failure is not to be debated here. What is clear is that if one wishes to increase the rate of consolidation of holdings in areas such as Pyramid Hill, then ignoring the problem of redundant assets ensures that existing farm owners will be at a competitive disadvantage in the market when seeking to build up their farm. Introducing some form of compensation for this redundant asset component of any purchase would reduce this disadvantage and lessen the rate of fragmentation.

A problem with this form of intervention is the need for quite tight geographical targeting. Whilst this form of intervention would be expected to have a significant impact in Pyramid Hill, it would be totally unnecessary in Calivil and Dingee where there is no sign of a fragmentation phenomena. A better alternative to a blanket policy of compensation for sunk costs may lie in active intervention in the form of land or water bank to amalgamate and absorb sunk capital costs on a one off basis. This form of intervention would enable discretionary application to targeted areas. Such a power has been available in previous versions of the Rural Adjustment Scheme and has been occasionally used in Victoria to assist relocation of dwellings from flood plains. These strategies have been used recently in two separate locations in Victoria. The first example of this is the targeting of 102 properties in the Echuca west flood plain (Office of Water Sector Reform, 1993). A land bank scheme has also been initiated as a government response to a period of prolonged drought, low wool prices and a severe flooding incident in the Tambo valley of East Gippsland. At the time of writing nine properties have been purchased by the State and a further two are under offer.

The limited use of this policy tool may reflect high administration costs or reflect the culture of the administering body. Associated with this form of intervention would be some form
of planning control on dwelling rights to prevent subsequent dis-aggregation. Similar measures have been proposed as a tool to reduce fragmentation in horticultural irrigation areas (Barr and McDougall, 1990).

One form of this proposal could be developed specifically for irrigation areas as part of a policy to redirect water to the environment through transferable water entitlements purchase. The administering authority would purchase properties and amalgamate them to form viable dryland properties for sale whilst retaining the water for environmental uses. This is the irrigation industry equivalent of the proposal raised by Clive Thomas of the Murray-Darling Basin Community Advisory Council who argued there may be a need for Natural Heritage Trust funds to aggregate land to create reserves for environmental purposes such as recharge control (Thomas, 1997; Wilson, 1995). A simpler form of proposal might well take the form of a targeted exit grant which only applied to the sunk costs associated with selling water separate from the land and where the sale of water was to provide for environmental flows.

Targeted interest rate subsidies for farm build-up

Interest rate subsidies are clearly out of favour with Federal policy makers. The subsidies in the last incarnation of the Rural Adjustment Scheme were dismissed by McColl, who, in his review of the RAS scheme, claimed there was no evidence that they contributed to the improvement in competitiveness of Australian agriculture (McColl et al., 1997). In response to his report, the government announced in 1997 that it would eliminate interest subsidies for farm build up claiming they were ‘not appropriate to the adjustment needs of Australia’s agriculture in today’s business environment or that expected early next century’ (Anderson, 1997) and cited the results of the McColl inquiry, published less than a week earlier, as justification for this decision (McColl et al., 1997).

For many years economists have argued that the provision of interest rate subsidies inflated the value of land, becoming a benefit to the seller rather than purchaser. The rejection of interest rate subsidies by McColl in his review seems to be founded upon an assumption of a simple general conceptual model of adjustment applying throughout Australian agriculture. This model portrays adjustment and build-up as being a competition between existing landowners for resources to add to existing farms. Whilst this model may have general applicability to many areas in Australia (Lindsay and Gleeson, 1997), in the Tragowel Plains there is clear competition
between existing landholders and new entrants. In the northern area the new entrants were clearly winning during the study period. New entrants often were able to bid higher than existing farm operators as the home component of sunk capital was not sunk to them.

In this situation it would appear that the interest rate subsidy does discriminate between new and existing operators if correctly administered and as such could still be a tool to enhance the likelihood of farm-build-up. However, it may well be questioned on grounds of providing an advantage to Tragowel Plains land purchasers over external purchasers of water. Any provision of an interest rate subsidy to the Tragowel Plains to assist farm build up would be an extension of the existing Stamp Duty Rebate Scheme.

Facilitate development of the rice industry.

The major contention of the Loddon-Murray 2000+ rural regional adjustment plan was that the solution to the adjustment problems besetting the region was to adopt a solutions focussed approach.

*There are currently too many non-viable farmers with low value enterprises in the region. There is currently a system in place for water to leave low value agriculture which generally caters well for sellers . . . The Loddon-Murray region needs more high value agriculture and the strategy needs to identify and facilitate high value agricultural opportunities. The development of these opportunities will increase the transfer of water and cause substantial structural adjustment (Rendell-McGuckian and Associates, 1996).*

While the results of my research suggest less faith should be placed in the mechanism of transferable water entitlements and more in the mechanism of land sales with associated water, the results uphold the general principle outlined in the Loddon-Murray 2000+ plan. Property fragmentation was not a problem in areas where the dairy industry was well established. It occurred in areas where there was no strong industry capable of funding property amalgamation.

Any alternative primary industry with the capacity to catalyse structural adjustment in the Pyramid Hill region would need to be accessible to a reasonable number of existing producers within the high or medium size farm groups in the Pyramid Hill district. Cool climate rice varieties, ample water supplies, clay soils and the recent investment in a conveniently located
rice handling infrastructure in the southern Tragowel Plains offer a significant opportunity to develop an industry to act as a catalyst in much the same way as the dairy industry. For existing mixed farmers entry to the rice industry requires significantly less capital investment than entry to the dairy industry. If the industry were able to be successfully developed it would improve the financial performance of a number of existing farm businesses able to enter the industry. It would also remove a major impediment in the current patterns of adjustment . . . the shortage of businesses with sufficient financial security to be able to undertake expansion and compete successfully against new entrants on the land market. The existence of a greater number of strong businesses would have a catalytic effect on the processes of structural adjustment.

However, the potential environmental implications of the introduction of the rice industry for salinity would need to be investigated. The high application rate of water may mean the development of significant local watertable cell effects and the growth of further discharge areas which would require careful management and attention to off-site impacts. The highly intensive water use of rice would be set against the far smaller area of land irrigated. Planners would need to use an approach as used in Shepparton to clearly target geographically where rice growing would be beneficial to the community whilst minimising damage to the resource base (Kularatne, 1996).

Such a change in cultural patterns would be sure to be controversial. It would be portrayed as consistent with the objections of Lawrence that what foreign markets demand will occur despite the consequences for resource degradation (Lawrence and Vanclay, 1992). But the introduction of a rice industry would be consistent with the holistic principles adopted by the local community in developing their salinity management plan. Sustainability was always seen by the community planning group as encompassing not just resource issues, but also community survival. In taking this view, they were acting consistently with an opinion held by many other regional catchment planning bodies and participants in landcare who believed that rural community decline is often a more pressing problem than resource degradation (Alexander, 1995; Campbell, 1992; McKenzie, 1991).

**Providing relationship resources for farm families**

The study has identified a significant number of exits which can be attributed to non-financial motivations. In a district where it could be argued there has been too great a rate of
exits, particularly from larger farm businesses which are subsequently broken up on sale, it is worth exploring whether there are any measures which might reduce the number in this particular exit category.

Non-financial exits are likely to be undertaken for reasons such as lack of satisfaction with the community, with family or with marriage. The finding of the link between male sense of family unpredictability and female satisfaction with family are not isolated results. In the late 1960s Bell and Nalson (1974) found the wife’s dissatisfaction with family farm life was the precipitating factor which lead to the decision to exit dairy farms in Northern NSW. Gray et al (1996) found strong evidence of role conflict between being ideal parents/spouses and ideal farmers, with men appearing not to be able to fulfil their family’s expectations of themselves and their own expectations of themselves. Gray et al predicted that the ultimate result of these role conflicts would be loss of marriage, home and farm.

There would appear to be no easy answer to these challenges. One solution may be the provision of more accessible relationship counselling services. Certainly the fear of instability in the marriage relationship of the next generation is often a disincentive for a family to embark on the path of inter-generational transfer (Gamble et al., 1995). Such services are generally poorly available in rural regions (Sturmey, 1995). In response to these needs the Federal Government has sponsored the development of distance models of relationship education (Rada Consultants et al, 1997). A pilot program was due to commenced operation in northern Victoria, and in the initial weeks of service was subject to extraordinary levels of demand for services. Services are based upon the provision of video recordings. Whether the availability of these limited services will have an impact on the stability of farm marriages or the perceptions of participants in the inter-generational transfer process is questionable unless backed up by the availability of additional counselling services.

**Maintenance of rural community services**

The trend to reduction in service availability and decreasing opportunities for development of a sense of community in regional areas such as the Tragowel Plains and Torrumbarry may well be having an impact upon the region (Cooney, 1998). Gray et al (1996) raised the possibility of policies which provide ‘coping’ resources to farm families. Family goal setting and relationship communications skills programs at the farm level may provide some
degree of solution. Community leadership development as proposed in the Loddon-Murray 2000+ plan may be a little wider of the mark, but if successful may increase the ability of the region to lever a greater share of services and support from both Government and business. But there remains a suspicion that the decline in service availability in rural districts over the past decade may have reduced family support mechanisms and, while existing families on the plains are well aware of the situation, families considering entering farming may not be nearly as aware of the new realities of rural community life. Their expectations of family and community life may be unrealistic, reflecting neither the declining availability of community services or the sense of social involvement (Stayner, 1997b). This may be another factor contributing to the high rate of ownership turnover of small farms.

‘Mainstreaming’ of welfare assistance

The final strategy I will discuss is the mainstreaming of welfare assistance to farmers. This is not a tool available for regional targeting to the Torrumbarry region. It is, however, a major plank of recent generic agricultural policy and it is intended to influence the rate of structural change in Australian agriculture.

The objectives of ‘mainstreaming’ of social welfare are to separate equity decisions concerning the social welfare of farm families from policy decisions based upon industry circumstances (Anderson, 1997). This policy has been a long recommended prescription proffered by economic analysts with the objective of avoiding the risk of government intervention distorting agricultural markets (Lloyd, 1986; Industries Assistance Commission, 1977; Mauldon and Schapper, 1974). A more immediate pressure for ‘mainstreaming’ of welfare may well lie in its link to the removal of interest rate subsidies from the Rural Adjustment Scheme and the subsequent reduction in government expenditure. The interest rate subsidies available under Exceptional Circumstances provisions of the Rural Adjustment Scheme have allowed a group of farmers to remain in farming despite adverse temporary financial circumstances. Will the farmers who gain assistance from mainstreaming of social services provisions differ from those who have taken advantage of interest rate subsidies, and if they do, will this change the form of structural adjustment processes on the Tragowel Plain? The answer to these questions must be speculative, based upon the limited available evidence.
In the case of the Tragowel Plains, the Rural Adjustment Scheme has played a negligible role in adjustment over the years 1992-93 to 1995-96, with less than $50,000 spent in the previous Gordon Shire on Exceptional Circumstances assistance in this period. No farmers received re-establishment assistance (RAS Management Information System, 1997). The Pyramid Hill district was mostly located within Gordon Shire, as was the Boort irrigation district and a significant area of dryland farming.

‘Mainstreaming’ will make farm support during times of commodity price decline available for a period of time up to two years as income support, without the necessity for a declaration of Exceptional Circumstances. This greater access to income support under hardship conditions will be achieved through a relaxation of the activity test and the liquid assets test (Special Rural Task Force, 1997). The most important change will be that farmers who apply for unemployment support under hardship provisions will no longer be required to put their farm on the market to meet work test criteria.

The farmers who will utilise these provisions will be those without off-farm work, without significant liquid assets whose farms, and who are experiencing a temporary downturn in commodity prices. It is probable that the majority of farmers who are assisted to remain in agriculture by these changes will fall within the mid-sized group identified in chapter 10 as the disappearing middle. Farmers operating small farms are unlikely to survive in the long term without significant off-farm income, which would disqualify them from welfare assistance. Without off-farm income, it is unlikely that long term viability is possible, and thus, income assistance would merely delay the period before departure while the limited period of assistance expires. Farmers on properties with water rights greater than 800 megalitres are unlikely to meet the liquid cash reserves criterion, and are probably unlikely to need to apply for assistance given the low rate of observed exits in this group.

I conclude that the impact of this measure will be upon adjustment during periods of exceptional and temporary financial pressure when it may provide a means of reducing the immediate pressure to sell by full-time farmers in the mid-range of farm sizes. This may tend to reduce the fragmentation of farms and somewhat reduce the number of exits.
Implications for national adjustment policy

In the previous section I reviewed a number of possible components of a regional rural adjustment plan for the irrigation districts of the lower Loddon catchment. Two tools, promotion of the rice industry and compensation for sunk costs are clearly proposals specific to the Loddon irrigation districts and a potentially small number of related situations. A number of other tools are already in widespread use. However, two tools are potentially innovative suggestions, and are not used in any current structural adjustment programs. These new tools are:

- Business planning for intending entrants
- Providing relationship resources for farm families

To what extent might these tools be considered for application elsewhere in rural Australia? Should they be considered for targeted ‘adjustment hot-spots’ as identified by Barson (1990), or as generic policy tools? Both tools are designed to address the impact of non-economic exits from farming and under-capitalised entry to farming upon the rate of establishment consolidation.

The rate of exit from farming on the Tragowel Plains was also below that of much of south-eastern Australia. Despite low exit rates, there was evidence of a significant number of exits from farming which were not motivated by economic pressures, but by relationship and life-style concerns. Many of these exits from farming business which were clearly of above average size resulted in property break-up followed by the entry of a greater number of farm operators on smaller farm businesses. In other words, these exits lead to establishment fragmentation rather than consolidation. Besides the clear non-economic benefits of improved relationship functionality, the economic benefits would include decreased fragmentation of farm holdings and improved planning of inter-generational transfer.

The rate of entry to farming on the Tragowel Plains was clearly lower than the average for much of south-eastern Australia. Yet even in this situation of lower than average entry rates, there was clear evidence that the rate of consolidation was being lessened by farm entry backed by insufficient capital, and that five yearly census figures masked a significant churning of ownership of a substantial number of smaller properties. It is therefore arguable that the need to
better inform new entrants of the business potential of farm entry exists in many places beyond the irrigation areas of the Loddon.

In some cases these high entry rates can be construed as limiting the possibility of farm consolidation which would otherwise be offered by high exit rates, as well as being a cause of ongoing welfare problems in districts where farm incomes are generally low. Lindsay and Gleeson (1997) found an annual exit rate of five per cent per annum in the first three years after entry to broadacre and dairy farming. This estimate excluded entry rates for broadacre farms with an estimated value of production lower than $75,000. Stayner (1997) observed a high level of vulnerability amongst businesses of new entrants to farming. Together these observations can be taken as evidence that there is potential to improve the outcomes of adjustment policy by targeting in some areas the potential new entrants to farming, an idea which has been suggested in previous decades (Lloyd, 1972).

In much of the sheep wheat belt of south eastern Australia the main form of adjustment is a decision by younger persons not to pursue a career in farming on the family farm. The result is a rapid ageing of the farm population and a deferral of major adjustment decisions until the point of inter-generational transfer (Barr and Ridges, 1998a). This trend is common across much of the developed world (Potter and Lobley, 1992; Potter and Lobley, 1996). Simple demographic modelling will probably suggest that while these areas may currently be tightly held, within a decade the pattern must change as increasing numbers of farms are placed on the market (Barr, 1998). At this stage there may be significant opportunities for the implementation of policies for the re-afforestation of marginal farmland (Selby and Petajisto, 1995). These opportunities could be undermined by a re-emergence of high entry rates driven by unrealistic expectations of farm profitability and rural lifestyles.

The obvious conclusion is that resources if government expects to enhance the rate of property amalgamation by supporting farm business planning by existing farm managers, this investment will need to be matched by similar services for intending entrants to farming in districts where migration into farming is having a significant impact upon adjustment patterns.
Conclusions

The creation of an irrigation settlement upon the Tragowel Plains might be seen, with the benefit of hindsight, as a failure of resource planning. From the early part of the 20th century salinity has played a part in shaping both agricultural practices used on the Tragowel Plains. Through the three decades following the Second World War, the limited government response to the challenge of salinity was predicated upon the objective of salinity reclamation. This strategy proved to carry the seeds of its own failure, whether through the failure of leaching strategies to achieve any more than transfer salinity from one paddock to another, or through the deleterious impacts of downstream salinity discharges. In the late 1980s the strategy of salinity reclamation was abandoned in favour of solutions based upon adjustment and living with salt.

The Tragowel Plains Salinity Management Plan began its life with the goal of assisting local farm families to learn to live with salinity. Whilst the plan was designed to achieve significant internal adjustment through the movement of water within and between properties within the Tragowel Plains, its aims in encouraging structural adjustment through land transfers and amalgamations were only modest during the first six years of implementation. Exogenous developments, including the deregulation of the water industry, the response of governments to rising environmental concerns of an increasingly urban population and the unexpected and rapid deterioration of the Torrumbarry Weir interacted to create new expectations of the Tragowel Plains Salinity Management Plan.

In the debate over the mechanism for financing the replacement of the Torrumbarry Weir an agreement was made between the State and Federal governments to support a regional development plan which would accelerate the rate of structural adjustment in the lower Loddon to achieve a higher return from the water investments of both governments. The involvement of the local community in the development of this plan exposed the underlying philosophical differences held by participants as to what was a desirable form of
intervention to facilitate structural adjustment. The community plan proposed a combination of the existing Salinity Plan components, as found in the Tragowel Plains Salinity Management Plan, together with measures to foster the development of industries which would produce a higher return from the water resource. Their proposal specifically recommended that few resources be targeted to encouraging the owners of small farms to adjust out of agriculture.

The community proposed regional development plan met with the scepticism of Federal departmental representatives, who saw the proposal as avoiding the hard issues of adjustment and placing emphasis upon recommendations which were least challenging to the local community. While part of the difference of opinion of the policy actors was due to differing social objectives, part was also due to the use of differing implicit models of structural change in irrigation areas. The object of this thesis has been to define and test the implicit models of the policy actors involved in the development of the Loddon-Murray 2000+ plan. This objective has been made feasible by the existence of a rich and unique data set. In determining the nature of structural adjustment in this district over the previous decade, and the role of the Salinity Plan in shaping this adjustment, it has been possible to make an informed assessment as to the effectiveness of the Tragowel Plains Salinity Management Plan and the appropriateness of the proposals within the Loddon-Murray 2000+ regional development plan as a strategy to achieve the structural adjustment goals of both the government and the community.

The key action of the Tragowel Plains Salinity Management Plan was the provision of soil salinity data on a paddock by paddock basis to farmers. The assumption that many farmers were unaware of the salinity status of their land was based upon initial investigations conducted during the development of the salinity management plan. The evidence for this assumption was limited and the first question to be answered in this thesis was whether the soil salinity surveying program had improved the accuracy of salinity appraisals made by farmers of the Tragowel Plains. The results of this investigation show clearly that soil salinity appraisal has become significantly more accurate with the implementation of the Tragowel Plains Salinity Management Plan.
The Tragowel Plains Salinity Management Plan encouraged farmers who irrigated saline soils to reduce or preferably cease irrigation of those soils once the location of soil salinity had been identified in a soil salinity survey. Irrigation of annual pasture on saline soils had been identified in the plan as the lowest value use of irrigation water in the region. This thesis has shown that prior to the introduction of the plan irrigation of saline soils was extensive, with 60 per cent of such soils being purposively irrigated in the 1989-90 season. In the following five years 27 per cent of saline soils irrigated in 1989-90 have been retired. A further 17 per cent have been subject to significant reductions in irrigation intensity, mostly only now irrigated lightly once to establish halophytes. Most Tragowel Plains farmers appear to have a single preferred method of managing saline land. While one third continue to irrigate saline land, another third have generally ceased irrigation and invested no more capital in that land. The remaining third have tended to eliminate irrigation and then invest in the management of saline land through fencing and the establishment of halophytes.

Water equivalent to almost 7 per cent of the district water right has been saved by ceasing irrigation of saline soils. This is twice the volume of water sold permanently out of the Tragowel Plains in the same period. Two thirds of this released water was allocated to the production of perennial pasture and one third to annual pasture. The most common method of transferring water to perennial pasture was through temporary and permanent sale of water right to dairy farmers within the Tragowel Plains. There has also been a significant shift in the pattern of pasture management by mixed farmers with a significant increase in the area of perennial pasture on mixed farms, and some of the water released from saline soil irrigation has been allocated to this purpose.

The evidence available in this thesis is consistent with the hypothesis that the provision of soil salinity data to farmers has reduced the uncertainties associated with land development through laser grading. Those farmers, who in 1987 considered land relayout too great a risk to undertake, had by 1995 achieved a rate of land relayout no different from those who even in 1987 considered land relayout a justifiable risk. The comparative contribution of confidence gained from soil surveys and significant reductions in interest rates cannot be determined. But soil surveys are an accepted component of whole farm plans
and two thirds of laser grading investment has been undertaken according to whole farm plan specifications.

These findings lend strong support to the implicit models of farmer behaviour held by the community representatives on the Loddon-Murray 2000+ group. It is reasonable to conclude that the application of the Tragowel Plains Salinity Plan as a model for the Torrumbarry irrigation district and beyond will achieve significant water use efficiency improvements.

Whilst the Tragowel Plains Salinity Management Plan has had significant achievements in encouraging the movement of irrigation water away from the irrigation of saline soils and re-allocation of that water to perennial pasture, the achievements of the plan in influencing land sales to achieve greater farm viability were less than impressive during the first 6 years of implementation. In the mixed farming areas of this irrigation district the rate of entry to farming was greater than the rate of exit. This created a fragmentation of farm numbers, and a growth in the number of small enterprises at the expense of mid-sized enterprises. The introduction of transferable water entitlements initially exacerbated this trend. There is evidence of a substantial minority of farm businesses undergoing frequent changes in ownership.

In those parts of the Tragowel Plains where dairying predominated, fragmentation did not occur. Most land purchases were by existing dairy farm businesses. The number of small farms declined. This difference is attributed to the ability of financially stronger dairy farm businesses to bid successfully against new entrants despite the disadvantage of having to purchase redundant assets in the form of milking sheds, housing and in some cases irrigation layout.

These findings call into question the implicit “exit-driven” model of farm consolidation which seems to have been the basis of Federal representatives’ concerns about the structural adjustment components of the Tragowel Plains and Loddon-Murray 2000+ plans. Policy makers who are dissatisfied with the form of structural adjustment on the Tragowel Plains and the relatively low export of water to higher value enterprises need to consider the use of policy tools which not only seek to enhance the rate of exit from
agriculture, but also the rate of entry to agriculture. Alternatives include education of potential entrants to lower their expectations of intrinsic and extrinsic rewards from farming, greater support for the enrichment of communication within marriage relationships, support to establish a rice industry in the area and targeted re-establishment grants or interest rate subsidies which are designed to achieve an objective of increased environmental flows.

The potentially most controversial of these alternative strategies is the development of a rice industry on the Tragowel Plains. It was hypothesised that this would improve the financial position of a number of larger mixed farming businesses sufficiently to enable them to bid successfully against new entrants in much the same way as dairy farmers in the south and east of the Tragowel Plains. This recommendation is consistent with the strategies outlined in the Loddon-Murray 2000+ regional development plan which argued that it was more effective to focus resources upon developing profitable industries to catalyse adjustment rather than funding measures to encourage owners of small farms to exit.

The introduction or promotion of business training opportunities for intending entrants to farming was recommended as worthy of consideration, particularly in the light of intention of recent Federal Government policy to invest further funds into the business training of existing farm managers. A reconsideration of the role of sunk capital in hindering farm consolidation was recommended and several potential policy tools including grants and interest rate subsidies were considered. A promising strategy may well be the development of a purchasing scheme to provide water for environmental flows.

The provision of business planning support to new entrants to agriculture, and the provision of support for relationship counselling and development are both policy tools worthy of serious consideration for application in many other regions of rural Australia. This study has identified the significant impact of high entry rates on farm consolidation patterns across much of south-east Australia. This matter is not addressed in any significant manner in current Federal or State structural adjustment policy. The finding of this study that relationship and family satisfaction are greater contributors to farm exit rates than farm size and viability considerations also poses significant challenges for current structural adjustment policy. If this finding were to be reproduced at a national level, then the provision of support for farm family relationship building could be far more effective than
current policies to enhance the rate of farm exit. These latter policies have proven a dismal failure in the State of Victoria.
Afterword

In drawing this thesis to a close, I hope I have documented the successes and the shortcomings of the Tragowel Plains Salinity Management Plan with a dispassionate eye. I hope my analysis of the processes of adjustment which have occurred over the seven year study period are valuable to those who make decisions on adjustment policy.

The future of their irrigation district is still unclear. The innovative strategies they adopted in their Salinity Plan were a radical revision of the vision of Thomas Mitchell who passed by in the 1840s, and also an abandonment of the vision of salt reclamation extolled by Morgan a century later. But the current vision may be no more enduring than that of their predecessors and may give no guarantee of future prosperity. Any reasonable prognosis must face the inevitability of continued withdrawal of people and resources from the northern Tragowel Plains. Representatives of the local community believe the future will again be bright. At a recent Landcare conference Russell Smith, a veteran of the community fight against salinity looked to the horizon, much as Mitchell had done one hundred and fifty years earlier and saw a positive future for the region because of the achievements of the Tragowel Plains Salinity Management Plan. Unlike Mitchell, his view was closer to ground level.

Well has it succeeded? The district where I farm always had a creekline of scattered clumps of timber in depressions. These trees made a live horizon. In the late seventies these had mostly changed to a dead tree horizon. Today, due to allowing the creek to flow, and the planting again of many trees we have a live tree horizon. I was talking to a neighbour two days ago and he said that he has planted wheat on the edge of a depression that had grown nothing for thirty years, and the wheat is coming up. The plan has given us confidence to have a go. There are many new enterprises being trialled; olive trees on several farms. Maize is grown in increasing quantities. Dairies are getting bigger with increasing numbers of cows. A salt harvesting project is well advanced using ground water and is fish farming. Lucerne
and tomatoes from the most reliable area in Australia. It is starting to look as if after 100 years of mismanagement and ignorance we are learning to do it right. We hope it continues. (Smith, 1996, p. 40)

At the same conference another keynote speaker was Bill Twigg, a farmer who has developed a lucerne based system dryland farming system on the southern edge of the Tragowel Plains (Twigg, 1996). His system could be called a conservationist vision of a future for the Tragowel Plains. The system appears to be quite profitable. Bill has sold most of the water originally attached to his farm, and has also purchased other dryland properties created by the sale of irrigation water by previous owners. If Mr. Twigg’s style of farming were to become widespread across the plains, farms would need to be much larger, and there would be far fewer farm families. Whether the future of the Tragowel Plains is one of prosperous irrigation based upon the dairy and rice industries, one of dryland agriculture based upon lucerne and cropping, or a mixture of both, is a subject which future researchers may choose to study. The pressure for adjustment has no end. This thesis does.
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Appendices

1987 Interview Schedules

30 pages
1995 Interview Schedule

33 pages
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