STUDY TOUR TO AUSTRALIA AND NEW ZEALAND

MAY-JUNE 2006

REPORT TO THE HORTICULTURAL DEVELOPMENT COUNCIL

Tim Lacey BSc., PhD.

Contents

Executive summary

My study tour to Australia and New Zealand followed on from my PhD research at Cranfield University, looking at improving raingun performance in field scale irrigated horticulture in the UK. There were three main objectives to the trip – firstly to disseminate my work to other researchers and representatives from the irrigated agriculture industry; secondly to learn how other irrigation communities are coping with water resource pressures, and; thirdly to create and foster research links with colleagues abroad. To achieve these aims, the tour included attending the Irrigation Australia 2006 conference, meeting researchers at a number of irrigation and crop research establishments and visiting growers and industry representatives.

There was a great deal of interest in my work from the research and industrial communities in Australia and New Zealand, particularly in the novel combination of an irrigation simulation model with a crop growth model to demonstrate the impacts of non-uniform irrigation on crop yield and quality. Many of the researchers intend to use data from my thesis to validate and improve their own models.

With regard to irrigated agriculture in Australia and New Zealand, the trip gave me a valuable insight into how different irrigation communities are responding to their water resource challenges. Overall, the most striking impression was the amount of effort being applied to irrigation research and dissemination to irrigators compared to the UK (either government funded as in Australia, or predominantly privately, as in New Zealand). In particular, there was a large degree of coherence between the different research and government bodies involved – lessons that the UK must observe to ensure the sustainability of its irrigated agriculture industry.

Background

My recent PhD research at Cranfield University investigated the impacts of non-uniform water application from hose-reel rainguns on field-scale horticultural crops and the practical opportunities available for improving application uniformity. During the course of this study, I worked closely with a number of Australian and New Zealand researchers, particularly at the National Centre for Engineering in Agriculture (NCEA), Queensland, and Crop and Food Research (CFR), New Zealand. As a result of this collaboration, I was determined to visit these colleagues and other stakeholders involved in the irrigation industries of these countries to share information about irrigation research. In May and June 2006, I achieved this aim with financial assistance from the Horticultural Development Council, the Jack Wright Memorial Trust, the UK Irrigation Association, the Chadacre Trust, the Douglas Bomford Trust and the Royal Academy of Engineering.

This report first details the objectives and the itinerary of the study tour before summarising the highlights and the benefits of the trip. Finally, two published articles on my tour are presented in Appendix 1 and Appendix 2.

Objectives

The main objectives of the trip were threefold:

- To disseminate information about my research, particularly to those groups involved in the project (NCEA in Queensland, and CFR in New Zealand), but also to a wider audience at the Irrigation Australia conference and to other stakeholders in the agricultural irrigation industry in both countries.
- To find out how other agricultural irrigation communities, especially those under greater water resource pressure than in the UK, are responding to shortages of water for irrigation and to assess how their responses may be of benefit to the UK.
- To create and foster research links between irrigation research communities in order to consolidate knowledge and provide a more rational, coherent approach to further irrigation research.

Itinerary

Date	Location	Activity
7th-11th May	Brisbane (QLD)	Attend Irrigation Australia conference and present poster of research
12th-13th May	Darling Downs (QLD)	Conference tour to the Darling Downs irrigated area of Queensland
15th-19th May	Toowoomba (QLD)	Visit NCEA to present my research, visit vegetable growers, discuss collaboration and their irrigation research
18th May	Toowoomba (QLD)	Visit Growcom to discuss the Water for Profit programme and tour the Lockyer Valley
22nd-26th May	Maroochydore (QLD)	Discuss raingun model used in my research, its validation and future with the key author
29th May	Pukekohe (NZ north)	Visit AS Wilcox & Sons Ltd (a large vegetable/potato grower) to discuss my research and its implications
30th M – 5th J	Hawkes Bay (NZ north)	Visit CFR to present my research, discuss crop modelling and learn about horticultural research in NZ
2nd June	Hawkes Bay (NZ north)	Visit PageBloomer Associates to learn about their irrigation auditing work and to tour local vegetable growers
6th June	Ohakune (NZ north)	Tour AS Wilcox & Sons Ltd. farm and irrigation facilities
8th June	Canterbury Plains (NZ south)	Visit Turley Farms Ltd. (a large vegetable/potato grower) to discuss my research and its implications
9th June	Canterbury Plains (NZ south)	Tour AS Wilcox & Sons Ltd. packhouse and discuss my research. Visit carrot grower with irrigation problems
14th June	Canterbury Plains (NZ south)	Discuss irrigation in the Canterbury Plains area with Environment Canterbury (the regulatory authority)
15th June	Canterbury Plains (NZ south)	Visit CFR Lincoln to discuss my research and tour their irrigation research facilities
15th June	Canterbury Plains (NZ south)	Visit Lincoln University to find out about academic research into crop water requirements

Summary of study tour

Irrigation Australia 2006 Conference, Brisbane

The conference provided a diverse range of presentations and workshops, focussing on the theme of "*It's time to deliver*". This message reflects the intent of the Australian irrigation industry to deliver advances in technology, planning and training to the end-users, both in agricultural and urban environments.

This generally well-thought out event covered a wide variety of topics including:

- over-views of the current state of the Australian irrigation industry, the drivers for improving efficiency and the opportunities for improvement;
- measures to investigate the environmental performance of irrigation systems;
- research to improve irrigation scheduling on a range of crops;
- methods to monitor and improve irrigation application and overall water use efficiency;
- the launch of the National Irrigation Skills Initiative, to provide training to irrigators in order to get the best out of their irrigation systems.

The conference provided an opportunity for me to present my poster from my PhD work (Fig. 1), in a small and unfortunately poorly located area. Nevertheless, there was a considerable amount of interest in my work.

Fig. 1 *Poster presentation at Irrigation Australia conference*

Fig. 2 *Examining bore-hole pumping systems in Darling Downs*

The conference tour to the Darling Downs irrigated area provided a highly interesting opportunity to observe many of the topics of the conference at first hand (Fig. 2), and also offered the chance to develop useful relationships with others in the irrigation industry.

National Centre for Engineering in Agriculture (NCEA) and Growcom, Toowoomba

The NCEA is one of the most widely recognised irrigation research establishments, focussing on a wide range of topics including: reducing storage losses in reservoirs; deficit irrigation; and improving the efficiency of irrigation systems on a diverse range of crops (Fig. 3). During my time at NCEA, I was introduced to many of their current research projects and visited some of their field sites and the growers involved in the projects.

Also in Toowoomba, I was introduced to the activities of Growcom (the levy body representing the horticulture industry in Queensland), in particular their Water for Profit programme. This provided an excellent example of how cutting-edge irrigation research is disseminated through direct interaction with growers in a range of free workshops, grower open days and farm visits.

Fig. 3 *Irrigating lettuce in the Lockyer Valley*

At NCEA, I presented my work to considerable interest from researchers, growers and other interested parties at their weekly WaterTap meeting. I also spent some time with modelling researchers (both at NCEA and in Maroochydore) involved with the development of the raingun model used in my thesis. Data collected during my research was used to improve the program, with the potential for future academic papers.

Environment Canterbury and grower visits, New Zealand

Fig. 4 *Visiting carrot growers*

Through contacts in the UK and from the irrigation conference, I visited a number of farming operations in New Zealand – namely AS Wilcox & Sons Ltd. (operating in both North and South islands) and Turley Farms Ltd. (South island). I also met with representatives from Environment Canterbury, the water resource regulator for the Canterbury Plains region of the South island. This presented a useful opportunity to observe the attitudes of NZ agribusinesses to irrigation and the responses of the regulatory bodies.

In general, it appeared that, until recently, irrigation ranked as a relatively low priority both for farmers and regulators, particularly in the North Island where irrigation serves a more supplemental purpose than in the South Island. However, the rapid increase in irrigated agriculture in NZ is now placing an unsustainable burden on water resources, particularly in the Canterbury Plains. Consequently, regulatory bodies such as Environment Canterbury are being forced to make abstraction licence conditions much stricter (similarly to the UK).

Largely as a result of these restrictions, many forward-thinking growers are embracing more efficient irrigation systems – in particular, the growth of centre pivot and lateral move irrigators is booming (Fig. 5). Plans are also in place for developing an irrigation infrastructure including storage dam in the Canterbury Plains region.

Fig. 5 *One of many new centre pivot installations in NZ*

Crop and Food Research, PageBloomer Associates and Lincoln University, New Zealand

Fig. 6 *Rain shelter experiments at CFR Lincoln*

Crop and Food Research (CFR) are leading researchers in broadacre and horticultural crops, specialising in practical studies of crop physiology and methods to improve agronomy and crop production. Here, I was introduced to a number of the diverse research projects currently underway, in particular those relating to vegetable crop modelling at Hawke's Bay and irrigation research at Lincoln (Fig. 6). Also in Lincoln, I visited a crop physiology expert at Lincoln University to discuss the role of irrigation uniformity in crop growth and development.

At CFR, I also spent time with the author of the carrot growth model used in my PhD discussing my use of the model and the opportunities for further work. I also presented my work to researchers and representatives from the irrigation and agricultural industries.

In Hawke's Bay, I visited the founder of PageBloomer Associates, a private commercial enterprise dedicated to providing solutions to soil and water issues within the agricultural sector. One of the main functions of the company is to bridge the gulf that commonly appears between academic research and the growers for whom the research is intended. This is achieved through grower visits, open days and publications. The company has also recently been involved in publishing national codes of practice for designing and evaluating irrigation systems.

Benefits

This study tour has been of great benefit to me, both personally and professionally. On a personal level, the study tour allowed me to broaden my horizons, and introduced me to many interesting and exciting people who encouraged me to follow my chosen career path as a vegetable agronomist. Professionally, it has given me the opportunity to increase my general knowledge of irrigation systems and the water resource issues facing irrigated agriculture. More importantly, it has given me an insight into how the irrigation communities in areas of high pressure on water resources are developing to cope with the resource issues they face. Furthermore, the tour has allowed me to develop research links and professional contacts of great potential use in my chosen career.

Publications

Two reports on my study tour were published: in UK Irrigation (the journal of the UK Irrigation Association); and in the HDC News. These reports are attached in Appendices 1 and 2.

Acknowledgements

Grateful thanks are extended to the Horticultural Development Council for providing financial support to my study tour. Thanks also to the other organisations who provided financial support: the Jack Wright Memorial Association and the UKIA; the Chadacre Trust; the Douglas Bomford Trust, and the Royal Academy of Engineering. Finally, this trip could not have been such a success without the willing assistance and enthusiasm of all those I visited or met along the way – in particular Erik Schmidt and Stephen Raine at NCEA, Brent Wilcox at AS Wilcox and Sons Ltd. and Jeff Reid at CFR – many thanks to you all for a memorable experience.

Appendix 1 – UK Irrigation, Issue 34 (Summer 2006)

Irrigation lessons from Australia and New Zealand

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How is the irrigation industry in Australia and New Zealand responding to the challenges of water scarcity and can we in the UK learn something from them? Here Tim Lacey, who has just completed his PhD at Cranfield University on improving raingun irrigation for field vegetables, reports on his recent study tour 'down-under' which was partly funded by the UK Irrigation Association.

Introduction

Although there are considerable climatic differences between irrigated areas in both the UK and New Zealand and those in Australia, the issues facing growers in these regions are similar; namely an increasing demand for water resources which are decreasing in reliability and availability. The Australian irrigation industry has faced these challenges for a few decades, whereas in New Zealand and the UK, water scarcity is a relatively recent, but increasingly important development. There are many useful lessons that we in the UK can learn from Antipodean responses to irrigation water scarcity.

The Lockyer Valley

The Lockyer Valley (known as "Australia's Salad Bowl") lies within the Great Dividing Range about 90 km west of Brisbane (Figure 1). Its highly fertile soils are used to grow around 13,000ha of irrigated crops – primarily high value vegetables such as lettuce, capsicum, cauliflower, broccoli, beetroot and sweetcorn.

The area has a semi-tropical climate with mean daily temperatures of 20-25° in summer (October-March) and around 15°C in winter. Annual rainfall is around 790mm, falling mainly in the summer months. However, evapotranspiration in the Lockyer Valley is very high (about 2000mm/yr – an average of 5.5mm/day). Typically, 2-3 crops/yr are grown, resulting in very high annual irrigation demands. Until recently, much of the area was irrigated using rainguns (mainly cable-tow machines) with only a relatively small proportion of cable-tow booms and sprinklers.

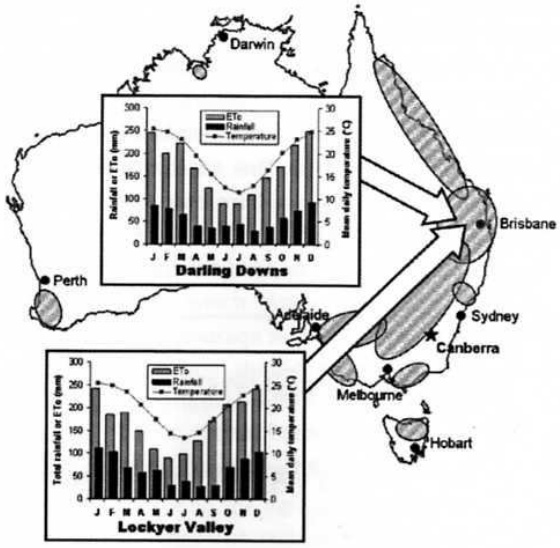

FIGURE 1 Main irrigated areas in Australia (shaded), showing the location and climate of the Lockyer Valley and Darling Downs

Many growers have storage dams to collect surface water (both from overland and river/stream flows). However, in recent years, rainfall has significantly reduced and is much less reliable. Therefore, most growers now use groundwater from alluvial aquifers (20-30m deep), either pumped directly to the field, or to storage dams for use when abstraction rates are too low to supply peak irrigation demands.

As a result of the increased groundwater abstraction and reduced recharge, water salinity levels in the area are rising and bore levels are dropping or even

disappearing in drier periods. Water resources (both quality and quantity) are therefore an increasingly significant limitation to growers.

The Darling Downs

The Darling Downs lie on the western flanks of the Great Dividing Range (Figure 1). Irrigated agriculture covers approximately 70,000ha on fertile "cracking" clay soils, focusing primarily on broad-acre crops such as cotton, maize, sunflowers, cereals, soy beans and sorghum – although vegetables feature in the eastern extent of the area.

The climate of the Darling Downs area is more arid than the Lockyer Valley with slightly lower annual rainfall of 680mm and higher evapotranspiration of 2000-2500mm/yr.

Traditionally, furrow irrigation was used with most water sourced from surface supplies (primarily from overland flow). Almost all irrigators use large on-farm dams which are often located on the areas of poorest soil. However, some growers can access groundwater, particularly those near watercourses.

As in the Lockyer Valley the quantity and reliability of rainfall in the Downs has considerably fallen in recent years. This has had significant impacts on growers relying on rainfall events to fill storage dams. Furthermore, those farmers with access to groundwater are finding lower bore levels and increasing salinity. Many Darling Downs growers are therefore seriously concerned about the future viability of their operations.

The Canterbury Plains

MAF (2004) estimates that around 60% (287,000ha) of the irrigated land in New Zealand lies in the Canterbury Plains on the South Island (Figure 2). The freely drained, fertile alluvial soil was historically used for dryland cropping, but it has been rapidly developed for irrigation since the mid 20th Century. Indeed, the irrigated area on the Plains is estimated to have doubled every 12 years since the late 1970s (INZ, 2006). Much of this development has been for dairy and grazing, but grain and seed crops, vegetables, fruit and grapes also constitute a significant proportion.

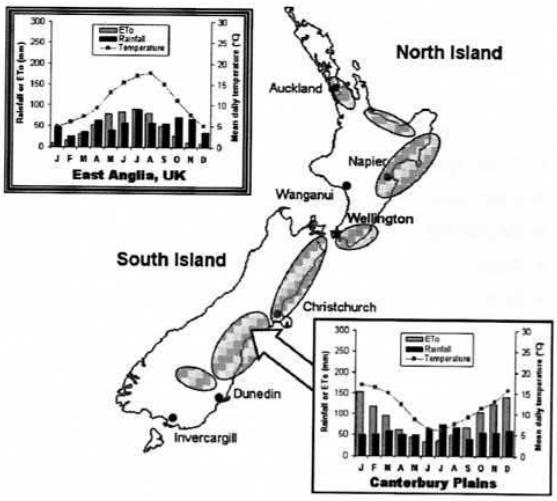

FIGURE 2 Main irrigated areas in New Zealand (shaded), showing the location and climate of the Canterbury Plains. The typical climate for East Anglia, UK, is also shown for reference

The climate in the Canterbury Plains is similar to irrigated areas in the east of the UK. Annual rainfall is about 680mm, spread fairly evenly through the year, with mean daily summer temperatures of 10-15°C and winter temperatures of about 5°C. However, evapotranspiration is considerably higher at just over 1000mm/yr with summer maximum rates of up to 8mm/day.

Until recently, much of the area was irrigated using border dyke surface irrigation (particularly for grazing) in addition to a relatively large proportion of hose-reel rainguns and cable-tow rotating booms. Few growers store water in dams. About half the irrigators source their water from surface supplies (mainly river water), with the remainder using groundwater (CPWL, 2004).

Although summer river flows are relatively high due to snow melt from the Southern Alps, peak irrigation demands often exceed available supplies, leading to restrictions on surface water abstractions. Furthermore, groundwater abstraction rates often exceed recharge, particularly during the summer, resulting in low or dry bores. Shortages of water caused by the rapid development of irrigation, combined limited regulation, are therefore beginning to cause significant concern for Cantabrian growers.

Solutions and implications for the UK

The irrigation industries in these areas have employed a range of strategies to cope with increasing irrigation water scarcity:

- Finding alternative water sources
- Improving irrigation systems
- Changing agronomic practices
- Reducing storage losses
- Improving education and extension

FINDING ALTERNATIVE WATER SOURCES

Growers in the Lockyer Valley and Darling Downs are considering alternative water sources; recycled water being an attractive, but controversial option. A scheme has been proposed to pump between 15 and 126Mm^3/yr of recycled (treated) effluent water from major urban centres near the coast tens of kilometres and several hundred metres uphill to the irrigation areas.

Irrigation groups, such as the Lockyer Water Users Forum, suggest that even with the extra on-farm costs (estimated at around 40 times that of conventional supplies), the value of water to growers is sufficient for the scheme to be economically viable. However, the proposal has faced considerable environmental and political opposition. For example, many contest that the cost of the water would be prohibitive for agricultural usage and that the environmental costs of treating and pumping the water would be too high.

In the Canterbury Plains, irrigation groups are proposing a large storage and distribution scheme to exploit currently unused flows in two of the regions largest river systems. This Central Plains Water scheme aims to secure irrigation water for around 60,000ha for the next 100 years, even in drought conditions (CPW, 2004).

Since opportunities for large irrigation schemes such as that planned for Canterbury are limited in the UK, other options such as using recycled water should be considered. In areas where demand for irrigation water is high and in close proximity to large urban developments, such schemes could potentially provide sufficient, reliable water supplies to growers at an acceptable price.

IMPROVING IRRIGATIONS SYSTEMS

In order to make the most of their limited water resources, some growers in Queensland and New Zealand are improving existing irrigation systems – e.g. surface irrigators in the Darling Downs using SIRMOD software from Utah State University with support from the Australian National Centre for Engineering in Agriculture (NCEA). However many have moved away from these traditional methods turned instead to technological solutions which are perceived to have greater application efficiency.

In the Lockyer Valley, high pressure cable-tow rainguns have traditionally dominated vegetable irrigation. However, these systems tend have low application efficiencies. This is particularly true in the typical situation where pumping and conveyance systems were inadequately designed for the peak pressure and flow demands now placed on them. Consequently, most vegetable growers have switched to portable sprinkler systems (Figure 3), cable-tow booms or drip systems, all of which offer higher application uniformity and place lower pressure and/or peak flow demands on pumps and conveyance systems. For example, cable-tow booms of up to 100m span are quoted to achieve a Christiansen's coefficient of uniformity of >80% using a water pressure of only 2-3 bar.

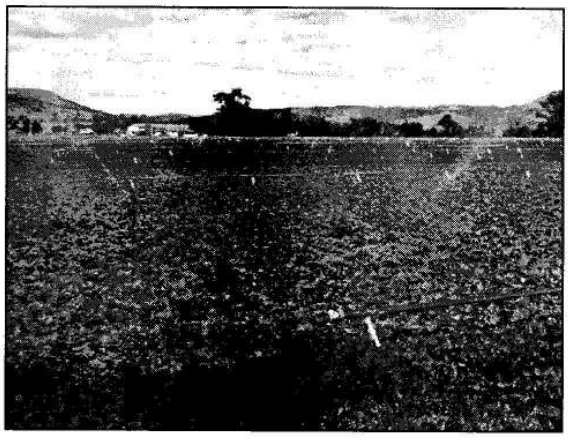

FIGURE 3 Portable sprinkler system on lettuce in the Lockyer Valley

In the Darling Downs, many growers are substituting surface irrigation with large linear-move systems (often spanning 500-1200m and travelling similar distances). These machines are considered to provide much greater control over irrigation application than surface irrigation, in particular allowing greater exploitation of summer rainfall. One grower calculated that changing to a linear-move system almost halved his water use despite doubling the area of cotton grown.

train irrigation stakeholders in some of the techniques outlined in this article to achieve more "crop per drop".

Acknowledgements

The support of the UK Irrigation Association, the Jack Wright Memorial Trust, the Horticultural Development Council, the Chadacre Agricultural Trust, the Douglas Bomford Trust and the Royal Academy of Engineering in funding this study tour are gratefully acknowledged. Thanks are also extended to the many growers, irrigation specialists and researchers visited during the trip.

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Appendix 2 – HDC News Issue 134 (June 2007)

Fluid thinking from the dry south

Above: Portable sprinklers used for lettuce production in the Lockyer Valley, Australia
Right: A centre pivot system used to irrigate potatoes and carrots in New Zealand

Tim Lacey looks at how field vegetable growers in Queensland, Australia, and New Zealand are responding to water scarcity and how the UK could learn from their strategies

Worries about both water availability and quality have forced vegetable growers in both Queensland and New Zealand to take a hard look at their irrigation strategies (see panel). In New Zealand the problems are similar to those here in the UK, while Queensland has been facing greater shortages for much longer.

Their solutions include finding alternative water sources, improving irrigation systems, changing the way crops are grown and making improvements to the information available from their education and advisory services.

Growers in Queensland's Lockyer Valley are considering the controversial option of using recycled urban water with a proposed scheme to pump up to 126 million cu m per year of treated effluent water from major cities near the coast. It has faced considerable opposition – many say the cost of the water (about 40 times that of conventional supplies) would be prohibitive for agricultural use and that the environmental costs of treating and pumping the water would be too high.

In the Canterbury Plains, irrigation groups are proposing a large storage and distribution scheme to exploit currently unused flows in two of the region's largest river systems. This Central Plains Water Scheme aims to secure irrigation water for around 60,000ha for the next 100 years, even in drought conditions.

Opportunities for large irrigation schemes such as that planned for Canterbury are limited in the UK. However, in areas where demand for irrigation water is high and in close proximity to large towns, recycled water schemes could provide sufficient reliable water volumes to growers at an acceptable price.

To make the most of their limited water resources, growers in Queensland and New Zealand have made significant advances in adopting more efficient irrigation systems. In the Lockyer Valley, high pressure cable-tow rainguns traditionally dominated vegetable irrigation. But they tend to be relatively inefficient with poor application uniformity, so most growers have switched to portable sprinkler systems, cable-tow booms or drip systems, all of which offer better uniformity and ask less of pumping equipment.

In New Zealand, centre pivots and linear moves are rapidly replacing traditional systems. Most centre pivot installations are portable with spans of 400-700m. Growers say they provide much greater control over application than traditional methods, in particular allowing them to make better use of summer rainfall.

But new technology can be costly and is not always more efficient. For example, centre pivot systems in New Zealand typically cost over £150,000 plus the running costs of the high capacity pumping systems required. Equipment performance is easily compromised through poor design, maintenance or operation. Some centre pivot systems in New Zealand are working on steeply undulating land, resulting in malfunction, poor uniformity and waterlogging in low-lying areas.

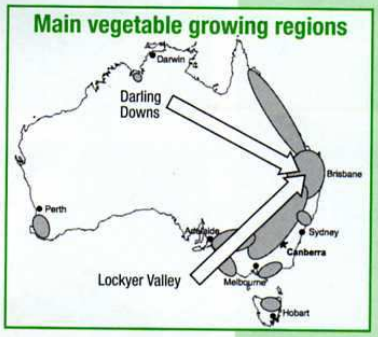
Although factors such as crop

Project profile

FV 288 Sponsorship for irrigation study tour
From: May to June 2006
Project undertaken by: Tim Lacey
Location: farms and research stations in Lockyer Valley, Queensland, Australia; Canterbury Plains, South Island, New Zealand

rotations, field shape and size may limit the alternatives for improving irrigation systems in the UK, it is time for growers to start considering equipment options. However, moving to a new irrigation system should be very carefully considered and planned, with realistic expectations of its potential benefits. For some, the best option may be to improve their management and operation of existing systems.

Growers in both the Lockyer Valley and Canterbury Plains are adapting traditional crop management practices to improve water use efficiency. Many are moving towards conservation tillage techniques that not only reduce energy use but also improve soil structure and organic matter content with the aim of increasing water-holding capacity to make better use of rain.



Large-scale vegetable growers are adopting irrigation scheduling tools such as the EnviroSCAN or water balance modelling, to determine crop water needs more accurately. Those using them are often realising their previous regimes were wasteful.

In the UK we could do much more to adopt water-saving crop management practices. In particular, irrigation scheduling to reflect crop needs accurately should be a much higher priority.

The UK also needs to follow the Australian example to develop integrated structures to educate and train those involved in all aspects of the irrigation industry. Much more needs to be done to deliver the results of irrigation research to those who need it most – the growers.

For example, Australia now has certification schemes for irrigation managers, operators, contractors and installers. These provide competency-based practical training to a nationally agreed standard to improve irrigation practices. For growers, the 'Water for Profit' programme operated by Growcom (the horticulture industry body for Queensland) provides direct support and training through on-farm consultations and training courses. Many useful factsheets for improving irrigation efficiency can be found on their website, www.growcom.com.au.

The Australian irrigation industry is also developing standards for equipment and best practice codes for growers.

The New Zealand government has produced similar guidelines to help growers improve irrigation practices and evaluate irrigation systems while codes of practice for irrigation design are currently being drafted. On-farm education and extension work is being carried out by private enterprises.

It is heartening to see that such measures are now beginning to take shape in the UK irrigation industry. For example, the UK Irrigation Association (www.ukia.org) is now widely recognised both as a useful source of information to growers and as a powerful lobbying force on their behalf. A recent series of grower workshops on irrigation skills has been a sell-out success. Meanwhile, Cranfield University is heading a new project (funded by the East of England Development Agency) that will identify and address the issues facing irrigated agriculture in East Anglia.

The strategies employed in Queensland and New Zealand offer the UK a number of useful lessons. In particular, growers here need a more structured, integrated system to help them learn how to achieve more crop per drop.

Queensland, Australia

Lockyer Valley, a major vegetable producing area, is known as 'Australia's Salad Bowl' with highly fertile soils and around 13,000ha of irrigated crops – mainly high value field vegetables such as lettuce, capsicum, cauliflower, broccoli, beetroot and sweetcorn.

The arid semi-tropical climate sees average daily temperatures of 20-25°C in summer and around 15°C in winter. Annual rainfall is around 790mm, falling mainly in the summer. Evapotranspiration averages 5.5mm per day (2m per year). Typically, two or three crops are grown per year so irrigation demand is very high.

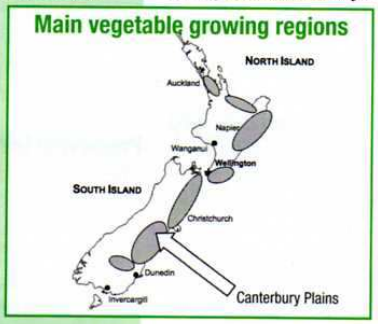
Many growers have storage dams (reservoirs) to collect surface water but rainfall has been significantly lower and much less reliable in recent years so the emphasis has switched to groundwater, either pumped directly to the field, or to the dams for use when abstraction rates are too low to supply peak irrigation demand.

The increased groundwater abstraction and reduced recharge rates mean salinity is rising and bore levels are dropping or even disappearing.

New Zealand

Irrigated vegetable production is concentrated on the coastal fringes of North Island and the east of South Island, where the Canterbury Plains account for around 60% (287,000ha) of total irrigated land.

Irrigation has been rapidly developed on the freely drained, fertile soil of this area – the irrigated area has quadrupled since the late 1970s with vegetables, fruit and grapes taking a significant proportion.



The Canterbury Plains climate is similar to irrigated areas in the east of the UK. Annual rainfall is about 680mm, spread evenly through the year, with average daily summer temperatures of 10-15°C and about 5°C in winter. However, evapotranspiration is much higher, at just over 1m per year, with summer maximum rates of up to 8mm per day.

About half of irrigators source their water from surface supplies (mainly rivers), with the rest using groundwater. Few have dams.

Peak irrigation demands often exceed available supply, leading to restrictions on surface water abstractions. Groundwater abstraction rates often exceed recharge, particularly during the summer, resulting in low or dry bores.

Tim Lacey recently completed an HDC-funded PhD studentship at Cranfield University looking at improving raingun irrigation for field vegetable growers (see HDC News, October 2006). This article is based on a study tour to Queensland, Australia and New Zealand related to the project and part-funded by the HDC.

Acknowledgements: the support of the HDC, the Jack Wright Memorial Trust, the UK Irrigation Association, the Chadacre Agricultural Trust, the Douglas Bomford Trust and the Royal Academy of Engineering in funding this study tour are gratefully acknowledged. Thanks are also extended to the many growers, irrigation specialists and researchers visited.