The Use of Labour and Machines in Vegetable Production

People and technology work better together

A report for NUFFIELD AUSTRALIA FARMING SCHOLARS

by Steven Newman
2010 Nuffield Scholar

September 2011

Nuffield Australia Project No 1013

Sponsored by Horticulture Australia and the national vegetable levy.

Scholar Contact Details
Steven Newman
Hills Fresh
11 Vista Court
Gumeracha SA 5233
Mobile: 0417 861 942
Fax:+61 8 8389 1236
Email: stevennewman@nuffield.com.au

In submitting this report, the Scholar has agreed to Nuffield Australia publishing this material in its edited form.

Nuffield Australia Contact Details

Nuffield Australia
Telephone: (03) 5480 0755
Facsimile: (03) 5480 0233
Mobile: 0412 696 076
Email: enquiries@nuffield.com.au
PO Box 586 Moama NSW 2731

Foreword

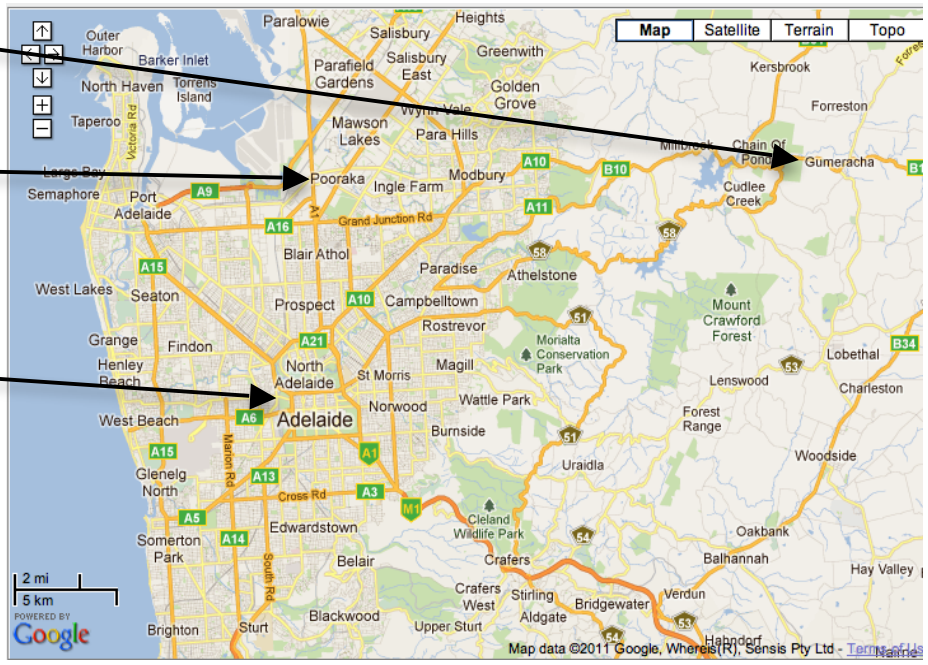
Vegetable growing in Australia is an intensive business, operating 365 days of the year. It is, and always has been, extremely reliant on labour. Some crops are so reliant on labour it is not possible to harvest them in any other way than by hand. The conditions for workers are not always ideal given the job needs to be done come rain, hail or shine. Vegetables are demanding by nature.

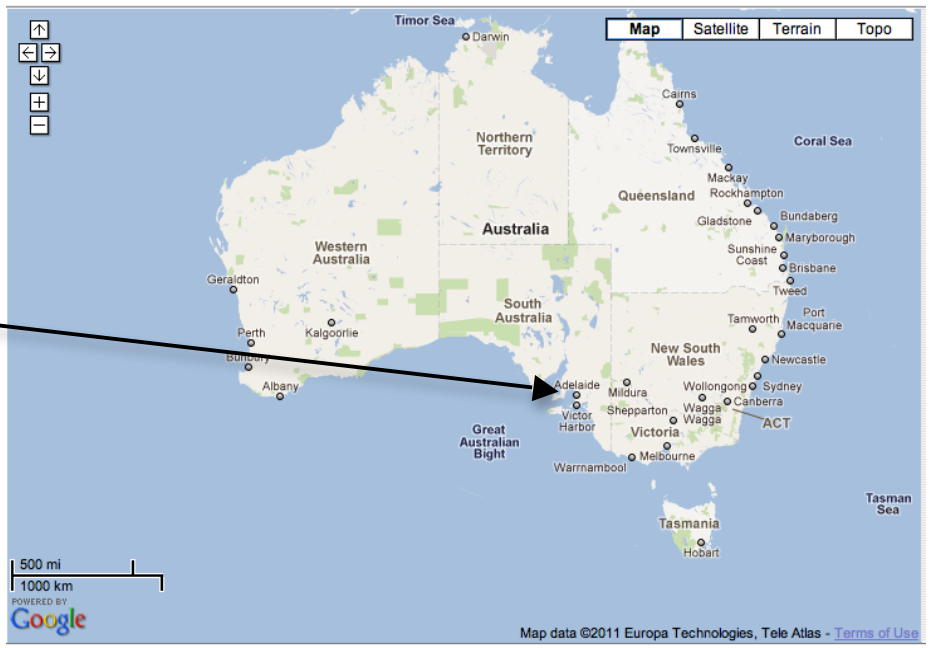
My name is Steven Newman, and I am a sixth generation vegetable grower from Gumeracha in the Adelaide Hills in South Australia. Our farm is located less than 50km from the Adelaide Central Business District (CBD) and the Adelaide Produce Markets at Pooraka.

Gumeracha

Pooraka Markets

Adelaide CBD





Adelaide South Australia

Growing vegetables has always been in my blood, along with the desire to find new ways to do it better.

I can trace my vegetable growing heritage back to my three times great Grandmother, Mary Anne Newman - a smart businesswoman, reported to be the first to sell vegetables on the banks of the River Torrens in Adelaide in the mid 1800s. She and her husband, Charles Frederick Newman, had 20 children. George Newman – one of the 20 – cleared land to plant orchards and vegetables at Chain of Ponds, near Gumeracha in the Adelaide Hills. It is near this original site at Gumeracha where my father John and I now manage the family business, Hills Fresh. We grow cauliflower, broccoli, leek, cabbage and lettuce all year round on 60 hectares of ground.

In 2008 just before the global financial crisis hit, our business had a labour shortage problem. Much of our labour left within a week to take up higher paying jobs with better working conditions. The factory jobs on offer were inside, out of the weather and far more appealing to some. As unemployment was low at that time, we had a lot of problems finding workers. After consulting with other growers in the area, we found we were not alone.

The fact that the Australian vegetable industry operates in all conditions, seven days a week, 365 days of the year means labour costs are very high, and not always reflected in returns to the grower. Customer demands (in our case, Adelaide Produce Markets and indirectly Coles and Woolworths) are very high. Only fresh, high quality produce at very competitive prices will be accepted.

With labour and all associated input costs constantly rising, Australian vegetable growers need to find better ways to grow and harvest labour intensive vegetable crops to keep the Australian vegetable industry viable.

My Nuffield journey in search of a better and more economical way to grow and harvest vegetables was conducted over a period of 16 weeks in 2010 between February and December. During that time I visited the United States, New Zealand, India, Bahrain, Ukraine, France, Belgium, Holland, Italy and the United Kingdom, thanks to Nuffield Australia and my two sponsors - Horticulture Australia and the national vegetable levy. The experience has been life changing and invaluable to my family business and to me personally. I hope I am able to adequately share my experiences and newfound knowledge with all who read this report and that in some small way it will help keep the Australian vegetable industry alive for future generations.

Acknowledgements

I sincerely thank my sponsors of this scholarship – Horticulture Australia and the national vegetable levy. I also thank Ausveg, the national peak industry body representing the interests of Australian vegetable and potato growers, for its support of the program.

Thank you to my wife and children for their help and endless support in making this study possible. The time spent away would have been impossible without their 100 per cent backing.

Thank you to my parents who guided my path into the vegetable industry. I particularly thank my father who managed the entire business while I was on this study, along with Hills Fresh employees who all "stepped up" to cover my absence.

A special thank you to Jim Geltch, David and Liz Brownhill, Ronald Thompson and the entire Nuffield board for giving me the opportunity to participate in the scholarship. The experience and knowledge gained has and will be invaluable to me now and well into the future.

Thank you to Bejo seeds, Nunhem Seeds, Rabobank and E E Muir & Sons for the many international introductions and contacts provided to me during my study.

Finally, a special mention to fellow Nuffield Scholar, Ellis Luckhurst from the UK, for his time, warm hospitality and expert knowledge imparted to me during my travels.

Abbreviations

AU$ Australian dollars
CAD computer aided drawing
CBD Central business district
CIA Central Intelligence Agency
EVAO Estimated value of agricultural output
EU European Union
GB Great Britain
Ha Hectares
UK United Kingdom
USA United States of America
US$ American dollars

Contents

Executive Summary

I have prepared this report for the Australian vegetable industry and its machinery suppliers.

My report outlines how some of these countries use labour together with machinery to produce vegetables, and the associated costs. I have included labour cost comparisons to Australia where possible.

Objectives

I optimistically and enthusiastically set out aiming to see and learn as much as I could about labour use in tandem with machinery in the vegetable industry around the world. I wanted to see and feel the soils in various countries to see how they compared to Australian soils. I wanted to observe the types of machinery being used and how those machines were being integrated into the vegetable harvesting process to reduce labour costs and create better efficiency. Most importantly for me, I wanted to find that "magic machine" requiring minimal labour to harvest vegetables in all conditions. And I wanted to know what it would cost to bring that machine home and make it work in Australian conditions.

Methods used

I visited many farms and spoke to farmers, seed and machinery industry experts and workers alike, observing how labour was used on large, medium and small vegetable farms on a day-to-day basis in different countries and climates.

I witnessed many different types of machines being used in production, and was fortunate to attend the Bologna farm machinery exhibition in Italy where more machines were on display than I'd ever imagined possible. I was always very conscious from experience on our own farm at home, that many great and costly ideas sometimes ended up in the shed gathering dust, because some machines just don't always deliver perceived results.

Key findings

In essence, my key findings were simple - I found **no silver bullet**. Rather, I have come to the conclusion that by using a series of small steps tailored to each person's particular farm, taking into account available labour, management of that labour and costs, farm size, variety of crops, and financial situation, there are solutions.

Quite simply, I found no "one size fits all" machine that could work in all situations and under a variety of conditions with minimal labour input. However a variety of machines are currently available to make harvest jobs easier, with less labour input than we use in Australia – but all is dependent on funds available to purchase, operate and maintain the machines.

Labour will always be required to plant, harvest, wash and pack vegetables; however, skill levels of operators in the future will need to improve to keep up with technology, which will

mean the need to pay higher salaries to attract and retain these workers. It will be a matter of strategically managing labour for the best and most efficient outcome.

Even crop yields will save labour harvest costs as this reduces the number of field passes required to complete the harvest. As always, this is totally reliant on climate conditions out of human control. But by doing all you can to ensure soils are healthy and maintained will assist to achieve an even crop yield.

To have the best technology readily available to Australian growers, the Australian vegetable industry needs to continue to expand to make it more attractive and viable for large manufactures to build harvest and packing machines for Australia. Increasing vegetable exports to achieve the required critical mass is one option, however, vegetable export is outside the scope of this report. A large enough vegetable industry in Australia would provide competition between various manufacturers both here and overseas to be the first to produce new technology into machines for Australia and keep costs of machinery down.

As we do here, most other countries constantly modify and adapt machines to suit their own conditions. Some of the larger overseas growers I visited in the US have their own machinery shops with their own computer aided drawing (CAD) software and technicians to virtually build and modify machines in house. Business size obviously dictates the ability to do this.

Australian growers also need to consider the skill levels of their staff and the retraining necessary to operate any new high-tech machinery before committing to purchase. Costs of ongoing machinery maintenance and technical support must also be considered. If it is not affordable and sustainable then continue to look for another option.

With the production of vegetables overseas being considerably larger than in Australia (the Californian Salinas Valley is a perfect example) it is more likely than not that somewhere in the world someone is experiencing something similar and has found a solution to a problem which may be beneficial and able to be brought home. It's a matter of going out and making contacts to find those solutions.

I urge Australian vegetable growers to look further afield to find solutions to help improve their own productivity. Network with other growers not only in your area, but all around Australia and overseas. It's a small investment of your time and money, which could yield a large and lasting return.

Introduction

Vegetable growing has always been a very labour intensive business. In 2008/9, hired labour was the biggest item in farm cash costs, nearing 30 per cent (James).

As production manager of our family vegetable growing business since 1995, I have always been concerned at the high cost and amount of labour needed to harvest cauliflower, broccoli, lettuce, cabbage and leek crops.

Our labour costs

On our farm, labour costs are in line with the industry average of 30 per cent of total expenditure. Compared to our annual purchase and maintenance costs of harvest, washing and packing equipment and machinery of around 10 per cent, labour was (and always will be) the obvious area in need of close monitoring and scrutiny. The base hourly labour rates are not overly high compared to other industries in Australia, as the Horticulture Award 2010 table below shows (Fair Work Australia).

Horticulture Australia Award 2010 (MA000028) – 38 hr week

Classification	Minimum weekly wage (*) $	Minimum hourly wage (*) $
Level 1	589.30	15.51
Level 2	606.40	15.96
Level 3	623.70	16.41
Level 4	647.40	17.04
Level 5	686.20	18.06

(*) Could also be transitional over 5 years – 2010 to 2014

By comparison to labour costs in countries of most interest I visited, Australia had the most expensive minimum hourly wage rate when based on an Australian 38 hr week.

Minimum base full time manual labour rate comparison – 38 hr week

Country	Minimum weekly wage 38 hrs Australian AU$	Minimum hourly wage 38 hrs Australian AU$
Australia	589.30	15.51
Belgium	463.51	12.20
Holland (NL)	440.50	11.59
New Zealand	380.00	10.00
UK	357.20	9.40
USA	315.40	8.30

(x-rates.com) conversion rates as at 15.9.11

For vegetable growers, the wage pressure is directly associated with the number of people needed and the hours required to get the job done when necessary – and that is seven days a week, 365 days a year. Overtime and weekend work loadings add extra pressure, not only to the total labour costs, but also to the amount of work done by "family" during these times to minimise the wage bill.

It is important to remember that returns to the grower do not rise in line with the consumer price index (CPI). Input costs (fertilizer, water, electricity, labour, interest) in vegetable growing increase every year, but the sale price to growers is not rising at the same rate. My father's generation was being paid more for cauliflower in 1978 (average $2 per cauli) than our business receives now ($1 – low / $2 – high in 2011). Further industry information on vegetable prices in Australia can be obtained from the Ausveg website – www.ausveg.com.au (Ausveg).

To stay competitive and to indeed "survive" in the competitive Australian vegetable industry, labour costs must be kept at a sustainable level and maximum output and efficiency must be achieved.

To find willing, reliable and appropriately skilled manual labourers, production team leaders and middle managers (in our case, in the Adelaide Hills in South Australia) is another challenge. For us, growing vegetables in "the hills" surrounded by vineyards and better-paid seasonal contract pruning jobs means at times some of our labour deserts us. Consideration is not often given by workers to the short-term nature of the higher paying contract!

To keep a happy, steady and appropriately trained workforce, along with well-maintained machinery and tools to help employees perform at maximum efficiency, we continually need to look for ways to improve.

Our current farm machinery

On our farm in 2010, we already had a number of machines, some of which I had built myself:

- leek harvester
- lettuce harvester and in-field packing trailer
- cauliflower harvester and in-field packing trailer
- leek washing and packing plant
- lettuce and cauliflower planters

All of these machines required a tractor driver and between 4 -12 workers to be efficient.

Our thoughts had always been that we could and would find a better machine in existence somewhere in the world that could do the majority of the manual work and reduce labour

costs. And it would be quicker, better and far more cost effective than manual labour and the machines we currently had. High tech harvest and packing machines would surely be the silver bullet. Let the research continue.

Vegetable farms in Australia

Australia has around 4200 commercial vegetable farms in operation with an estimated value of agricultural output (EVAO) of at least AU$40,000 a farm. These farms accounted for 85 per cent of all vegetable growing farms in 2006-07.

The average area sown to vegetables was 33 hectares a farm during the financial year. However, half of Australian vegetable growers produced vegetables on areas of less than 12 hectares during 2006-07. The majority of Australian vegetables (55 per cent) were produced by farms in Victoria and Queensland. Potatoes and tomatoes were the major vegetable crops grown in Australia during 2005-06, 2006-07 and 2007-08 in terms of area sown, production and contribution to gross value of vegetable production (Crooks).

Size in perspective

Australian markets and farm sizes are small in comparison to the USA and the UK mainly because of demand. There are not as many people to feed in Australia.

At around 7.69 million km2 **Australia** is the planet's sixth largest country by land mass (behind Russia, Canada, USA, China, and Brazil), but it has a very small population density - just 2.7 people per km2 (Australia's population = 22.7 million in 2011).

By comparison, the **United States of America** land mass is only slightly larger – around 9.63 million km2 – but has a population density of 31.6 people per km2 (USA population = 312.2 million in 2011).

Great Britain and **Northern Ireland** land mass is much less at 2.44 million km2 but its population density is much higher at 248.9 people per km2 (GB & Ireland population = 67 million in 2011) (CIA - World Fact Book).

Australia vs USA land mass overlay

Australia vs Great Britain & Northern Ireland land mass overlay

(Geosciences Australia)

Research – virtual vs reality

Looking at what machinery is available in industry journals and researching on line can never replace actually seeing first hand planting, harvesting, washing, and packing machines in operation under conditions similar to what we have in Australia. I can say that with absolute confidence now after completing my travels (CIA - World Fact Book).

Machinery manufacturers from around the world all believe in the capabilities of their machines, labour saving and other benefits. This belief is justified when machines are used in the flat and lighter soils of the Netherlands for example. However, if the same machinery was put to work in some of the heavy soils encountered in Australia – Adelaide Hills in South Australia or Werribee in Victoria during winter for example – the machines may not be quite as efficient.

I know of at least one fellow South Australian grower who spent a small fortune on a harvesting machine, only to find it sunk up to the axles during harvest and had to be abandoned. This is an expensive lesson from which we can all learn.

As mentioner earlier, only by seeing a particular machine operating for yourself in conditions similar to your own, and by speaking to other growers who have actually used the same or similar machines, can one make an informed decision.

Information sharing is vital

Historically the Australian vegetable industry is not great at information sharing – and that includes information about machinery. Competition is so very fierce between Australian growers that even a slight competitive advantage could be the difference between making payments and losing it all. Trade secrets in Australia are almost never shared for fear of losing advantage – real or not.

There are many like-minded people to learn from around the world, and I urge Australian growers to be more open towards information sharing. Consider joining or creating a grower network – both within Australia and overseas. Learn from one another and keep informed. Collaboration can be beneficial.

Countries visited – and what I learned

For ease of reading, I have relayed my experiences country by country covering the following areas, where possible:

- where I went
- average farm size / land area (converted to hectares in all cases)
- soil structure
- crops grown
- average returns to the grower
- markets serviced
- types of machinery used (planting / harvesting / packing / processing)
- labour used (how many / where from / hourly rates)
- markets serviced
- local challenges
- most important "take away" messages from visiting this country

Variations between all countries were significant, and it was blatantly obvious that Australia is not on a level vegetable production playing field with the likes of the USA, United Kingdom and Europe.

United States of America

Whilst in the US, on both my Global Focus tour and my own solo travels, I visited a number of states and cities, including:

- Oklahoma
- Pennsylvania
- Washington DC
- California

My main area of interest in the US was in the Salinas Valley in California on the west coast, commonly known as the "America's Salad Bowl".

Salinas Valley, California, USA – "America's Salad Bowl"

About Salinas Valley

The Salinas Valley runs approximately 145km southeast from Salinas towards King City. The City of Salinas was founded after Mexico seceded from Spain in 1822 and began granting ranch lands.

Agriculture dominates the economy of the valley, where a large majority of the salad greens consumed in the US are grown. The valley produces lettuce, broccoli, cauliflower, peppers,

celery, spinach, strawberries and tomatoes. The climate is also ideal for the floral industry and grape vineyards.

Due to the intensity of local agriculture the area has earned itself the nickname, "America's Salad Bowl."

The climate is precise to grow these crops, and Salinas Valley has an extended period of time in which crops can be grown compared to more northern regions where the winter causes quite an obstacle to farmers.

Supplying Salinas Valley farms is an underground water supply fed, in part, by the large watershed in surrounding mountains. Two reservoirs – Nacimiento and San Antonio -- store and release the water for groundwater recharge, flood control and farming.

Farm size

Farm sizes in California were generally very large. Family-owned farms ranged from “small” around 400 hectares, to “large” partnerships and corporate farms with holdings of 8000 plus hectares. The smallest farm I visited was San Ysidro Farms in Guadalupe California covering 485 hectares. The largest by far was Boswell Farms, and although it was “privately owned” it covered 60,702 hectares and said to be the largest privately owned farm in the world (Wikipedia).

Labour

The majority of the manual farm labour in California could be sourced from Mexico, which borders California to the south. According to figures published by the University of California (University of California Cooperative Extension) wage rates for machine operators in California were US$10 per hour and US$8.50 per hour for general labour. (AU$9.76 and AU$8.30 respectively) (x-rates.com).

Large corporate farms used a lot of labour to harvest. I learned much about this from time spent with John Pattullo, general manager of Buotonnet Farms (Pattullo), which is a major part of the Ocean Mist group. Ocean Mist employs around 1500 people, growing broccoli, fava beans, english peas, cabbage, cardone (similar to artichoke), asparagus, cauliflower, celery, corn, fennel, green onions, leeks, iceberg lettuce, mixed lettuce, romaine hearts (cos lettuce), rapini (Italian brassica, similar to broccoli) and spinach (Ocean Mist).

The labour on the farms I visited was generally divided up into work gangs of harvesting and planting and was paid by output (piecework) and quality of each gang’s harvest. The work gangs soon identified and weeded out the less efficient and rough workers, as they slowed the collective gang’s ability to earn money. At the time of visiting (and historically), there were a

lot of people from Mexico seeking work. This put pressure on those already in work to perform. The plentiful nature of the labour also kept wage costs down.

Photo by Steven Newman: Cauliflower harvesting using intense labour with mechanical aides on Boutonnet Farms – Castroville, Salinas Valley, California, 2010. Buotonnet Farms is part of the Ocean Mist Group.

Harvest methods

Harvesting in Salinas was mostly performed by hand for iceberg lettuce and the brassicas (cauliflower and broccoli) using basic harvest aids (knives) to cut; mechanical aids (belts) to collect; and trailers set up to pack produce in field. If the harvest needed to be quicker, managers would seek to make the machines larger and add more people or add another machine and gang. Most of the packing was done in field on rigs, saving double handling of produce and minimising damage. The surprise I found at Buotonnet Farms was they had flow-wrapping machines on some of the harvesting rigs to wrap the produce in field.

When the produce came off the rig it was simply cooled and shipped to the customer. Double handling was kept to an absolute minimum, creating better efficiency.

Planting methods

Planting technology I saw in Salinas was still very basic, with most still using semi automatic transplanters for cauliflower (similar to what is used on our farm in the Adelaide Hills). To plant the large volumes required by the US market, wide machine planters (planting up to six rows at a time) were used in tandem with a lot of people. The alternatives were to use up to three smaller planters and tractors (two rows at a time) to cover the same amount of ground.

Bejo Seeds (Brian Crummey) hosted me on a visit to Rio Farms in the Salinas Valley. Rio Farms used contract labour gangs courtesy of the nursery they bought their seedlings from to plant 4 or more hectares a day. The cost of the gang labour was included in the initial seedling cost.

In Salinas, seed at very high rates was used to plant lettuce and broccoli. (Planting by seed is not very common in Australia – transplanting seedlings is more the norm, possibly due to the high cost of seed in Australia.) On germination, the plants were thinned by hand at a cost of US$195 per hectare. This appeared to me to be an expensive way of doing things, but "it was the best way to do the job" according to farm managers I spoke to at both Rio Farms and Boutonnet Farms. A machine that could do the thinning job was not deemed accurate enough and it was thought the plant density remaining was not "correct". The result was the company made more money using the manual labour method to thin rather than the less-effective mechanical option.

In-house machinery manufacturing

Outside of the Salinas Valley, in the Californian area of Corcoran, I visited Gary Lindley, district manager of J G Boswell Company - the largest privately owned farm in the world covering a massive 60,702 hectares (as mentioned earlier). On Boswell Farms, more than 10,000 hectares of processing tomatoes were grown rotationally with more than 30,000 hectares of cotton. In Boswell's machinery workshop alone, there were 125 workers, 40 of which were specifically devoted to machine design and manufacturing their own machinery! (Lindley).

At Boutonnet Farms in Castroville in Salinas Valley, I spent time with John Pattullo, general manager learning about their business. Buotonnet Farms employed its own manufacturing engineer who used CAD software facilities to virtually design machinery before actually building it to pre-test its effectiveness and suitability for the task (Pattullo).

Markets

The larger California farms I visited generally supplied to the local US domestic markets. One farm I visited, Rio Farms that owned and operated 5867 hectares in Monterey, Ventura and Imperial counties, grew baby leaf produce for the east coast (New York). This delivery required a seven day road journey to reach its market. According to one of the Rio Farm's managers, there were occasions when the produce simply didn't make it in time due to transport delays, and the entire shipment could easily be lost.

San Ysidro Farms in Guadalupe (a "small" family farm), exported broccoli and cauliflower to Japan and Taiwan by sea freight. Roy Killgore, president of San Ysidro Farms, said the sea

freight costs were far cheaper than air freight between the US and Japan / Taiwan, and that this market was working well for them (Killgore).

Most important learnings from US

- Farm size is relevant to population – it was so beneficial to see this scale to put things in perspective back home.
- Labour costs were lower compared to Australia.
- US labour was more plentiful and worked hard and fast – they really need the work!
- Harvesting machines and methods used were similar to what I have seen in Australia, but farm and business size made it easier to explore options in house with dedicated CAD personnel and engineers to build the designs.
- Salinas Valley soils were pushed to the limits in an effort to achieve maximum output in minimum turn-around times. This may be an issue for future generations.
- In general, the practise of farming was more highly regarded in the US than I feel it is in Australia.

United Kingdom

My main interest in the UK was to visit Cornwall in the southwest and Lincolnshire in the midlands, both major vegetable production regions for brassicas (cauliflower and broccoli). In Cornwall I was fortunate to meet with UK Nuffield Scholar, Ellis Luckhurst, (Luckhurst) and visit several cauliflower growing sites owned and operated by P E Simmons & Sons (based in Redruth) including Riviera Produce - based in Hayle. P E Simmons grows, packs and distributes vegetables nationally from both their own farms and 35 others in the region (Simmons). I also spent time at Fentongollan farms (Hosking) - a family-owned flower growing and vegetable seedling nursery farm in Truro. Fentongollan also operated an interesting farm gate sales outlet including a mail order venture to sell flower bulbs. The interesting area for me at Fentongollan was seeing how their seedling nursery operated – something I have not had huge exposure to in Australia.

In the town of Boston in Lincolnshire County, I visited T H Clements & Son's Farm Manager, Neil Sharpe, (Sharpe) who managed production of cauliflower, broccoli, cabbage and potato. Clements also grew broad hectare crops. The total area farmed by Clements was 2428 hectares, although the company owned not all land.

European Union

It is important to mention the European Union (EU) at this point.

The European Union spends more than AU$80 billion on subsidies available to UK and European farmers to buy various plant and equipment and also to encourage land to be left

fallow (EU). As at September 2011, more than AU$272.55 billion had been paid to 20,838,172 recipients. The EU is a big topic of discussion amongst UK farmers, as subsidies must be applied for and granted based on each submission, not an across the board standard amount. More information on EU subsidies can be found at http://farmsubsidy.org.

Farm size

Land holdings by family farmers in the UK were small, and land sharing was common, as were landlord agreements. The total open field area under vegetables (and flowers) in the UK was 69,000 hectares in 2008 (defra.gov.uk). Approximately 300,000 farms were active with an average size of around 57 hectares (UK Agriculture). To put size in perspective here, Boswell Farms in the US owned and operated more than 60,000 hectares. At the time of visiting the UK (November 2010) one of the companies I met with felt there was a need for farm sizes to increase as margins to the grower were trending down. In a bid to gain economy of scale, some larger farms like T H Clements & Son Ltd in Boston, Lincolnshire, were growing 900 hectares of cauliflower along with other crops to "make it pay" as many of their smaller suppliers were "dropping out" (Sharpe).

Labour

Agriculture labour rates in the UK and Wales were lower to what we now pay in Australia. I have converted rates to Australian dollars for ease of comparison.

UK hourly agriculture labour rates ranged from full time worker above compulsory school leaving age (Grade 1) AU$9.40 to (Grade 6) AU$14.09. Higher rates were paid to full time and part time flexible workers depending on number of days worked in one week. Overtime and other benefits were also paid accordingly (defra.gov.uk).

The sources of labour in the areas I visited in the UK were a mix of imports from Europe and local UK workers.

UK labour had similar types of regulations to Australian workers. (Fair Work Australia). Imported labour had to abide by a number of government regulations, including only being able to stay and work in the UK for three months before having to return to their country of origin. This labour could, however, return again to the UK later with the proper work visa in place (Luckhurst). In the areas visited (predominantly Cornwall and Lincolnshire) labour mainly came in from Poland and other eastern European countries. I observed more local UK labour in use in the Lincolnshire area than in Cornwall, where more imported labour was used. The harsh outdoor nature of the industry at times deterred a lot of UK local workers. This is similar to what we experience in Australia.

Harvest methods

Harvesting methods in the UK were again similar to Australia, with a few individual improvement ideas.

In Cornwall, harvesting of cauliflower and broccoli was done by hand using small gangs of six to eight people. The harvest aids used were packing trailers/rigs towed with tractors, with a conveyer to return harvested produce to the packing trailer. In Cornwall, the rigs I saw used a plastic chain with a bucket type arrangement attached for the workers to place cut produce in. The individual plastic harvest buckets were a great idea in my opinion and one I could easily adopt and adapt to use on our farm.

Cauliflower harvest in Cornwall, UK 2010
Photography by Steven Newman

Plastic harvest buckets used

The packing rigs were mounted on the tractor and the produce was packed by workers in the rigs and put on pallets in a trailer also attached to the tractor. Plastic flow wrapping was done back at a pack house – not in the field.

In Boston (Lincolnshire), harvest methods and work gang sizes were similar. I did see a cabbage harvest in the Lincolnshire area where wooden bins were simply placed in the field for workers to place produce directly in, with no mechanical aids except for the tractor collecting the full bins to return to the pack house.

Planting methods

In the UK, transplanting is where they are starting to go more high tech. In Boston I met with Andy Wilson, Sales Manager of Vegetable Harvesting Systems (VHS) (Wilson). VHS supplied much of the new equipment to farms in Lincolnshire and Cornwall. The competitive nature of the industry means in depth future product intellectual property sharing does not occur. However, I am lead to believe VHS has some great new technology on the way.

On one of the T H Clements farms in Boston, I saw an automatic transplanter needing only one person to drive the tractor and one person to feed seedlings for five rows instead of the traditional one person per row method – essentially saving four people. New technology is out there – but it's up to the individual grower to make an informed decision as to how it may or may not work on his or her own property.

Regard for farming

Overall, farmers appeared to be more highly regarded and the practise more accepted by the general public in the UK than what I have experienced in Australia. There was an

understanding by motorists of machinery (tractors with trailers) travelling on major roads and major highways. Signs indicating tractor use on UK roads were a common sight.

Water and salinity

Water was not a big issue in the UK (and Europe), unlike in Australia. One patch of cauliflowers I visited in Cornwall were being grown right up to the seafront, with no irrigation equipment in sight! And salinity caused little concern thanks to the high rainfall.

Choose the right variety

From time spent with Ellis Luckhurst in Cornwall (Luckhurst) I learned a lot about the importance of choosing the right variety of plant for your soil in the right season to increase crop yield.

Working with P E Simmons, Ellis undertook a Knowledge Transfer Partnership (KTP) through the University of Plymouth to develop and implement a crop prediction program. The results improved labour planning and reduced company waste, increasing P E Simmons company turnover by 28 per cent and a rise in profits by 14 per cent (KTP). The results speak for themselves.

Input costs and grower returns

Because of the lessened need for irrigation, and the European Union subsidies available to farmers, input costs for farming in the UK were generally lower than in Australia (Luckhurst). This appeared to be balanced out however, with lessened returns to UK growers (Simmons) (Sharpe). Produce prices to the consumer were fairly similar to Australian retail prices, although in the areas I visited, in my opinion the quality available on supermarket shelves appeared less fresh and was not on a par with Australian produce.

Technology

One machinery manufacturer I met with in Boston (Wilson) from VHS said the technology is available to automate cauliflower harvest, however more research (and investment) is needed to bring this machine to the market. Manual labour is currently by far the most cost effective method of to harvest cauliflower.

Markets

The majority of produce grown in the UK was sold to the big four supermarkets – Tesco, Sainsbury's, Asda and Morrisons. The "big four" had a combined share of 75.6 per cent of the UK grocery market in November 2009 (Wikipedia). Produce grown by T H Clements in Lincolnshire and P E Simmons in Cornwall was mainly headed to the "big four" with a smaller portion earmarked for sale to Aldi – a discount supermarket chain based in Germany.

Most important learnings from the UK

- EU subsidies keep farming viable.
- Labour costs were lower compared to Australia.
- Growing conditions were similar to South Australia's winter months.

- Water was not an issue for farmers in the UK and Europe – minimal need for irrigation equipment.
- Salinity was not an issue due to high rainfall.
- UK farmers used people and technology together - similar to current Australian methods.
- The practise of farming was more highly regarded in the UK than I feel it is in Australia. People were glad and proud to work on the farms I visited.

Holland (a region of the Netherlands)

Language was a barrier in obtaining specific information from the farmers I visited in Holland. However, my main host from Bejo Seeds, Mark van Gerven (Gerven), helped with translations enabling me to gain a fair understanding of farming practise in this region.

Farm size

Farm sizes in Holland were smaller than in the UK. A "big" family operation was around 150 hectares.

Labour

Labour in the areas I visited in Holland was mainly sourced from eastern European countries such as Poland. Although I was unable to get firm hourly rates from growers, the Federation of European Employers website (Federation of European Employers) states a minimum monthly wage for a full time adult employee (23 years +) to be 1424.40 Euros (AU$1908.83 or AU$11.59 per hour for 38 hrs) (x-rates.com).

Work gang sizes in Holland varied according to farm sizes. Large farms had up to 7 workers in a gang, small farms had up to 4 workers.

Climate & soils

Holland appeared to have similar growing conditions to South Australia, except summer temperatures were not as extreme and winter temperatures could reach below zero more often. The soils in southern Holland appeared more sand structured but were heavier in the north.

Produce grown

Holland grows a wide variety of vegetables, however, my main focus was on cauliflower production in the north, and leek production in the south. Varieties grown were similar to what we have in Australia.

Harvest methods

In Holland, I expected to see a high amount of automation. What I actually found was that all cauliflowers in the heavier northern soils were still harvested by hand, placed on belts and returned to produce trailers to be packed straight into boxes or crates and loaded onto pallets.

The trailers were then taken back to the cooling sheds, via major roads (not Auto-Bahn though) with tractors not trucks. This is very similar to UK methods.

Leeks in the south were harvested with automated machines with one driver, made possible because of the sandy structure southern Holland soil. After harvest, leeks were taken back to the packing shed for cleaning, washing and packing. The cold conditions in the fields made this the best option (Gerven).

Planting methods

Transplanting in Holland was done with semi automatic transplanters. The farmers I visited (Gerven) believed it was still the most cost efficient way to plant, as they could use family members or students at minimal or no cost to operate the tractors and feed the seedlings into the transplanter.

New technology

By chance, my Bejo host (Gerven) came across a cauliflower leaf sowing machine, working in Holland. Reported to cost over 100,000 Euro (AU$134,000), the four-row machine sewed cauliflower leaves together to protect the curd from sunlight and frost, preventing yellowing. This would be a fantastic machine for Australian cauliflower growers if the investment could be justified. Presently we employ manual labour to perform this task on our farm at home.

Cauliflower leaf sewing machine – Holland 2010

Photography by Steven Newman

host all reported their returns on produce were low – which seemed to be a "standard" response, no matter what country I was in. However EU (European Union) rebates were available for eligible growers (EU) to help this reported short fall.

Markets

Produce grown in Holland was mainly sold to domestic and European markets.

Most important learnings from Holland

- Climate was similar to Australia in autumn, although we don't get the subzero temperatures endured there. Summer temperatures were not as extreme.
- Soils were sandier in the south, making automated leek harvest easier, but heavier in the north where more cauliflower were grown and harvested by hand.
- An automated cauliflower leaf sewing machine is available, but expensive at around AU$134,000.
- Business premises had high automation with electronic doors and sensor lights etc, yet in the fields cauliflowers were still harvested by hand.

Belgium

The farmers I visited in Belgium were more fluent in English, making information sharing a lot easier. My host, Veronique Savelkoul, a Nunhems leek sales specialist (Savelkoul), introduced me to several leek and cauliflower farmers. I also made some valuable new contacts with machinery manufacturers, Baekelandt (Baekelandt - Belgium) and Verhoest (Verhoest - Belgium) whilst there.

Farm size

The farm size in Belgium was small by comparison to other countries visited. In Belgium, a farm size of 50 hectares was deemed "large". There were a lot of farms of around 10 hectares in size. Future predictions were that farm sizes would increase in a bid to achieve economies of scale and there appeared to be hope that the industry was sustainable for future generations (Savelkoul).

Labour

Belgium sourced its labour in a very similar fashion to Holland; however, minimum wage rates in Belgium were slightly higher (AU$12.20 per hour). Regulations and EU issues were almost identical in both countries (refer to "Labour" in Holland section above). Smaller farms in Belgium used family labour and school aged students to help keep their wage costs down. This created a culture that the farmer wants a machine to do the work so that the farmer could drive them. For this reason, farmers wanted machines to be more automated (Clerq). One farm I visited grew leek on only 20 hectares yet had two automated leek harvest machines and a leek flow wrap machine so the farmer could harvest and pack with minimal external labour costs (Clerq).

Work gang sizes in Belgium varied according to farm sizes. Large farms had up to 7 workers in a gang, small farms had between 2 and 4 workers.

Planting methods

Planting methods varied in Belgium from semi-automatic transplanters to the older methods of manual planting, all totally dependent on labour availability and farm size (Clerq) (Savelkoul).

Harvest methods

Although Cauliflower was not being harvested at the time I visited, I understand that it was generally done the same way as in the Netherlands (by hand – not highly automated) (Savelkoul).

Leeks in Belgium were harvested in the field by machine with higher technology. Because of the wet and heavier ground conditions there, caterpillar track machines were adapted to harvest leeks that were then taken back to a pack house for washing and cleaning. Washing

and packing machines used in some of the pack houses had very advanced computer weighing technology for pre packs (Savelkoul).

Leek harvesters in Belgium where the soil was heavier needed to be different to those in Holland, yet still highly automated to suit farmer requirements of minimal labour relative to farm size (Clerq).

Climate & soils

As in Holland, Belgium appeared to have similar growing conditions to South Australia, although winter temperatures were far more extreme. Belgium had heavier ground, similar to my farm in the Adelaide Hills in South Australia.

Produce grown in Belgium

Belgium grows a wide variety of vegetables, however, my main focus was on cauliflower and leek production. Varieties grown again were similar to what we use in Australia.

Grower returns

Belgium growers I visited also gave the standard response that their returns on produce were low. However, EU rebates were available here for eligible growers (EU) to balance this.

Technology

I was able to meet with two machinery manufacturers, although there were three within a one hour driving distance radius.

Marc Verhoest (www.verhoestmarc.be) and Baekelandt (www.baekelandt.com) built a wide variety of machines for cauliflower, lettuce and leek harvest to planters, to infield dicing machines.

As mentioned, I highly recommend doing the research, and speaking to as many peers and industry experts as possible to make the most informed decision about what is best suited to personal circumstances. If the means are there to travel, then do it.

Markets

Produce grown in Belgium was sold to domestic and European markets using the 'Dutch auction' big wheel system, which is also used at the Sydney fish markets in Australia.

Most important learnings from Belgium

- There is a wide choice of machinery manufacturers within Belgium, creating more competition and quicker advancement of technology.
- Climate was similar to Australia in autumn, although we don't get the subzero temperatures endured there. Summer temperatures were not as extreme.
- Holland and Belgium are very similar in many cases, yet soils vary between sandy and heavy in Holland and heavy in Belgium.

Italy – Bologna International Trade Show

One highlight of my journey was travelling to Italy to attend the massive biennial Bologna international agriculture machinery trade show from 7 – 11 November 2010.

My machinery manufacturing background helped me to truly appreciate and be excited about the massive number of displays of machinery components, along with the tractors, sprayers, rotary hoes, transplanters, and broad hectare machinery just to name a few.

I found several soil preparation machines, but nothing really new in harvest aid sector. My silver bullet was nowhere to be seen!

Farewell Europe!

New Zealand

Vegetable growing occupies more than 50,000 hectares of land and employs 25,000 people in New Zealand (Wikipedia).

During my short stay in New Zealand in April 2010, I spent one day at Das & Sons (Bhakta), commercial vegetable growers producing export onions, cauliflower and lettuce on 50 hectares in Pukekohe; one day at Perfect Produce (Fong) (tomatoes, cucumbers, iceberg lettuce, baby cos lettuce, fancy leaf lettuce, broccoli grown on 300 hectares of land in Pukekohe for the New Zealand wholesale, retail and restaurant trade). My final two days were spent at an impressive operation run by LeaderBrand (Carter) – a large New Zealand owned vertically integrated vegetable operation. Founded in 1975 by Murray McPhail, LeaderBrand is recognised as one of New Zealand's largest and most diversified horticultural and fresh food businesses. With farms located in Gisborne (north island) and Canterbury (south island), LeaderBrand grew 3,000 hectares of fresh produce per year for process, domestic and international customers (LeaderBrand - NZ).

Farm size

Given that the average outdoor vegetable farm size in New Zealand was 85 hectares (Ave), LeaderBrand (at 3000 hectares) was a large-scale business by comparison.

Labour

In April 2010 New Zealand labour was cheaper than in Australia at AU$10.00 (minimum hourly adult rate) (NZ minimum wage). This compares to Australia at AU$15.51 (Fair Work Australia).

Planting methods

At Leader Brand, seedlings were all planted with semi automatic transplanters. Although there was an automatic seedling planter in a shed at the Gisborne site it was not being used. A LeaderBrand employee commented to me it was "too hard to get it working properly".

Harvest methods

The two smaller farms I visited in Pukekohe area still harvested most of their produce by hand, throwing produce up on to a trailer or in to produce bins placed in the field on the ground.

Perfect Produce in Pukekohe, NZ, 2010
Harvesting broccoli by hand using produce bins in field

Photography by Steven Newman

LeaderBrand still used the hand harvesting method but packed produce straight into crates in the field using a harvest rig with conveyor belts loading crates straight into trailers. LeaderBrand appear to be professionally managed and were doing tasks very efficiently and on a large scale.

Climate & soils

New Zealand climate has a cooler climate similar to Tasmania in Australia – with mid to high rainfall. Water is not as big an issue in New Zealand as in Australia. Soils are volcanic by nature meaning nutrient rich. The soils were still heavy (not sandy) but workable.

Grower returns

New Zealand growers reported returns were "low" – another global standard response. However, no EU-type subsidies were on offer.

Technology

I generally found technology used in the vegetable industry in New Zealand to be behind Australia at the time of visiting (April 2010) with no real advancement in automation. The farms I visited generally manufactured their own machinery to suit their purposes to save on labour (LeaderBrand - NZ).

Markets

New Zealand growers supply both domestic and export markets. 2007 figures showed more than 50 different vegetables were grown in New Zealand by 1450 growers, 750 of which grew

specifically for the frozen vegetable processing export market (potatoes, sweet corn and peas mostly). Fresh produce exports were mainly onions and squash (Wikipedia).

Major learnings

- New Zealand excelled in growing hard produce (eg. potatoes) for export and was doing it well.
- New Zealand soft produce (salad greens and brassicas) serviced its domestic market.
- Use of technology was not as advanced as in Australia, given then lower cost of labour there (AU$10 per hour).

Summary – major learnings

1. The vegetable growing industry in Australia is very small compared to other developed countries.
2. Australia had the most expensive minimum base hourly labour rate (AU$15.51) out of the main countries of interest I visited.
3. In countries with cheaper labour costs, at times it is cheaper to perform tasks by hand.
4. There can never be a "one size fits all" harvest machine. Machines will always need to be adapted to suit different areas and conditions. Australia is not alone in this respect, with all main countries visited report the need to continually adapt machines to local conditions.
5. Geographically, Australia is a long way from Europe where the major vegetable harvesting machine manufacturers are based. This means costs are high to import machines, which in nearly all cases would need to be at least slightly modified for Australian conditions. Aftersales service being a long way from Australia is another challenge once a machine has been purchased and imported to Australia.
6. As the number of Australian vegetable producers is small, so are choices of machines – unlike in Europe where there are a huge variety of manufactures, creating more competition to keep the price down and the features and innovation up.
7. Machinery manufacturers both in Australia and overseas are working hard to bring new technology to the market.
8. After six years of development, Dobmac Machinery, based in Tasmania, has manufactured a broccoli harvester – a world first! Dobmac sells its agricultural services and machinery in Australia, New Zealand, and overseas (Dobmac Tasmania).
9. In Holland, I found an automated cauliflower leaf sewing machine that sows cauliflower leaves together so the white curds don't go yellow. The machine is expensive at around AU$134,000.
10. One machinery manufacturing company in the UK (Wilson) believes the technology is there to harvest with robots but it needs more funds to continue its development. If labour costs increase, this project will become more important and funds may become available.
11. Technology is only as good as the employees working with it.
12. Visit the basic practices to advance the technology – you can't have one without the other.

Recommendations

Embrace change

With the threat of cheaper food imports ever present, to stay competitive and profitable the Australian vegetable industry must embrace change and be willing to adopt new technology with modern, innovative and efficient growing techniques to survive.

Manage labour more efficiently

People and technology work better together! The efficient management of labour in conjunction with new technology will be the challenge in the future for everyone involved in the production and marketing of Australian vegetables. Train labour to suit your needs and continue to up skill. Reward good practices and lead by example.

Do your sums

Keep on top of operating costs and continue to look for ways to become more efficient. Challenge suppliers for the best deal and continue to seek better ways of doing EVERYTHING.

Network - information sharing is vital

Australian growers must be more willing to share information. Learn from one another and keep informed. A good start is to contact Ausveg - the national peak industry body representing the interests of Australian vegetable and potato growers. Visit their website (www.ausveg.com.au) for latest industry news or give them a call. Ask how you can get involved in the industry and help to secure its future.

Lobby - for a level playing field

Growers need to unite and state their case to Australian politicians often. Growers (through Ausveg) can encourage policy makers to take a close look at how industrial relations affect the price of fresh food and the ability of Australian producers to compete in the global market.

Go out and see for yourself

If you have the means to travel – intrastate, interstate and/or overseas - do it! If not, speak to those who have. Collaboration can be beneficial.

Bibliography

New Zealand Average Farm Size by Farm Type - December 2010. <www.linz.govt.nz>.
<www.expertssouthwest.com>.
Ausveg. <www.ausveg.com.au>.
Baekelandt - Belgium. <www.baekelandt.com>.
Bhakta, Sam - New Zealand. Managing Director - Das & Sons Steven Newman. 2010 April.
Carter, Matthew. LeaderBrand Lettuce Crop Production Manager Steven Newman. 2010 April.
CIA - World Fact Book. 2011 September <www.cia.gov/library/publications/the-world-factbook>.
Clerq, De. Manager - bvba De Clercq A Groenten Steven Newman. 2010 November.
Crooks, S 2009, Australian vegetable growing farms: an economic survey, 2006-07, ABARE Report to Horticulture Australia Ltd, Canberra, January. 2009. Australian Government. 2011 <http://adl.brs.gov.au/data/warehouse/pe_abarebrs99001613/rr09.3_veg_growing.pdf>.
defra.gov.uk.
<www.defre.gov.uk/evidence/statistics/foodfarm/landuselivestock/vegflowers/documents/veg_flowers.pdf>.
Dobmac Tasmania. 2011 <www.dobmac.com.au>.
EU. <www.farmsubsidy.org>.
Fair Work Australia. <www.fwa.gov.au>.
Federation of European Employers. <www.fedee.com/minwage.html>.
Fong, Allan. Perfect Produce Steven Newman. 2010 April.
Geosciences Australia. 2011. <www.ga.gov.au>.
Gerven, Mark van. Bejo Seeds - Holland 2010 November.
Hosking, Jeremy. Partner - Fentongollan Steven Newman. 2010 October.
James, Ian. "Australian Vegetable Industry 2008/9." 0439 440 023, 2011.
Killgore, Roy E. President - San Ysidro Farms March 2010.
LeaderBrand - NZ. <www.leaderbrand.co.nz>.
Lindley, Gary. District Manager - J G Boswell Company March 2010.
Luckhurst, Ellis. KTP Associate - PE Simmons & Son Steven Newman. 2010 October.
Maps. <www.maps.google.com.au>.
NZ minimum wage. <www.dolgovt.nz/er/pay/minimumwage>.
Ocean Mist. 2011. <www.oceanmist.com>.
Pattullo, John. General Manager - Buotonnet Farms March 2010.
Savelkoul, Veronique. Nunhems Leek Sales Specialist - Netherlands 2010 November.
Sharpe, Neil. Farm Manager - T H Clements & Son Ltd Steven Newman. 2010 October.
Simmons, David. Managing Director - Riviera Produce, Cornwall Steven Newman. 2010 October.
UK Agriculture. <www.ukagriculture.com/uk_farming.cfm>.
University of California Cooperative Extension. "2009 Lettuce (Iceberg) Costs and Returns Study." University of California, 2009.
Verhoest - Belgium. <www.verhoestmarc.be>.
VHS - Vegetable Harvesting Systems. VHS Lincolnshire - Andy WIlson.
<www.vhsharvesting.co.uk>.
Wikipedia.
Wilson, Andy. Sales Manager - Vegetable Harvesting Systems (VHS) Steven Newman. 2010 November.
x-rates.com. Exchange Rates. 2011 15-September <www.x-rates.com>.

Plain English Compendium Summary

Project Title:	
Nuffield Australia Project No.:	1013
Scholar:	Steven Newman
Organisation:	Hills Fresh
Phone:	0417 861 942
Fax:	(08) 8389 1236
Email:	stnewman@bigpond.net.au
Objectives	Research how labour costs can be reduced in vegetable production with the use of machines and new technology.
Background	Vegetables are becoming more expensive to produce than ever before. This is making the industry less profitable. One of the biggest costs is labour – 30 per cent of input costs. Can the use of new technology be the way that this cost can be reduced?
Research	Travelling to the USA, Europe, New Zealand and UK growing regions looking at farming practices, meeting growers and the people using machinery and machinery manufactures to compile this report.
Outcomes	This report has no silver bullet. It includes information on how other countries are using labour and its basic costs. It outlines some new machinery I found overseas and one harvesting machine developed by a local Tasmanian company. All farms and conditions are different and machinery needs to be adapted to suit. Individuals need to make machinery decisions based on their economic need and must consider the benefits of networking. The Australian vegetable industry is a small fish in a big pond – explore the pond! Anything is possible with money and imagination.
Implications	Industry will need to adopt and adapt new technology in some way to be profitable in the future. Policy makers will need to have a close look at how industrial relations affect the price of fresh food and the ability of Australian producers to be competitive in the global market place given the high costs of Australian wages. The vegetable industry in Australia needs to expand in order to attract more machinery manufactures to build for our industry (and create competition to reduce costs of machines).
Publications	Nil