

**AUSTRALIAN NUFFIELD FARMING
SCHOLARS ASSOCIATION**



2003 SCHOLARSHIP

Farmers Embracing Change via Diversification

Report Completed October 2004

Dr Anthony Hamilton

**“WARILI”
FORBES NSW 2871
Tel: 02 68563173
Email: warili@westserv.net.au**

Sponsored by:



TABLE OF CONTENTS

EXECUTIVE SUMMARY	2
ACKNOWLEDGMENTS	3
INTRODUCTION.....	5
DIVERSIFICATION THEORY	6
THE NUFFIELD TOUR	10
CASE STUDIES	11
<i><u>1. Large scale homogenous agriculture in southern California, USA.....</u></i>	<i>11</i>
<i><u>2. The jojoba industry in Arizona, USA and Israel</u></i>	<i>12</i>
<i><u>3. The azuki bean industry in Michigan, USA and Ontario, Canada.....</u></i>	<i>12</i>
<i><u>4. Transition from arable crops to alternatives in the UK.....</u></i>	<i>12</i>
<i><u>5. Diversification in France and Germany.....</u></i>	<i>13</i>
CAPITAL CONSTRAINTS TO DIVERSIFICATION.....	14
LABOUR ISSUES ASSOCIATED WITH DIVERSIFICATION	16
IRRIGATION TECHNOLOGIES FOR NEW CROPS.....	17
CONCLUSION.....	19
REFERENCES	20

Table of Tables

Table 1 Advantages and disadvantages of diversification.....	8
Table 2 Financing orchard development in California.....	14
Table 3 Comparison of agricultural wages between countries.....	16

Table of Figures

Figure 1. Agricultural terms of trade 1994-2001, (ABARE 2002).....	5
Figure 2. The Boston Consulting Group (BCG) Matrix.....	6
Figure 3 Four diversified enterprises at various stages of the product life cycle.....	7
Figure 4 The Transition Curve (Kubler-Ross 1969).....	7
Figure 5 Adoption of New Technologies.....	9
Figure 6 World Map showing regions visited on the study tour.....	10
Figure 7 Linear Variable Displacement Transducer (LVDT) measurements of almond branches at Paramount Farms, California.....	18

Executive Summary

This report investigates aspects of diversification in agricultural production. It discusses some theory about diversification and change management, namely the Boston Consulting Group (BCG) Matrix, the standard business model for product life cycle (which classifies products into four categories, 'Problem Child', 'Rising Star', 'Cash Cow' and 'Dog'), portfolio theory and the transition curve and their applications to agriculture.

The author visited farms and farming organisations in USA, Canada, UK, France, Germany and Israel on his self-study tour. Case studies are presented in this report outlining some of the advantages and disadvantages of diversification. Balancing the opposing forces of (a) trying to gain economies of scale by having few, large-scale activities or (b) lowering the business risk by having a multiple enterprises often determines the success of diversification.

Although diversity is a feature of Californian agriculture, within each farm business scale seems to dominate over diversification. Diversification for some large-scale growers meant producing a variety of semi-processed products rather than growing a variety of crops. The transition to higher value crops, such as orchards, is made easier in California due to the Farm Credit scheme, which gives farms the opportunity to borrow up to 60% of land values to finance new orchards and re-finance the established orchard at its increased value. This allows more rapid expansion of orchard development than would be possible in Australia under a more conservative gearing level prevalent in rural lending.

Jojobas and azuki beans are grown on the author's farm as part of a diversification strategy. Jojobas were generally grown as a single crop in desert regions in Arizona and Israel where few alternatives for diversification existed. Some jojoba growers were also growing other desert plants such as napolis and date palms. Azuki beans were grown in Michigan and Ontario as part of a high risk-high return strategy to compliment existing crops. They were viewed as being more risky than Roundup Ready® soybeans and generally sold on the spot market hoping to capture market highs.

Diversification in the UK and mainland Europe is primarily directed to non- agricultural uses of farm land and farm buildings. There are government grants to assist this process. Government incentives, in Germany, for energy production may assist diversification into biomass production for energy rather than food. Two contrasting approaches to increasing farm incomes in England are presented in this report. One business grows a limited range of arable crops on a large scale, renting land wherever possible and employing farm managers. Another family owned business has changed from arable crops to celery and lettuce, adopting a Californian style cut and pre-pack in the field operation.

Appropriate irrigation systems are integral to diversification into irrigated crops. Irrigation technologies were generally similar for 'new crops' and 'mainstream crops'. Drip and sprinkler systems were almost universally used, instead of flood irrigation, on high value crops. There is an increasing use of remote soil moisture/weather monitoring with radio link transmitters. There is considerable interest in using Linear Variable Displacement Transducers (LVDTs) to measure the diurnal shrink-swell of plant leaves, petioles, and trunks and relate this to plant moisture stress.

This report has identified several important features of successful diversification:

- Diversification can play an important role in increasing farm profitability. Proper planning and thorough financial feasibility studies are pre-requisites to successful transition to new enterprises.
- There is no ‘magic crop’; diversification is not a panacea for poor performance. Even with new crops, one must outperform one’s competitors.
- Consider using the BCG Matrix to evaluate potential and existing enterprise mix.
- A market-orientated approach to diversification is essential. Market linkages and branding (Trade Marked) crops will be important in the future.
- Access to finance and labour may be barriers to diversifying into high value (capital and labour intensive) horticultural crops in Australia.
- Irrigation efficiencies are paramount to the success of many crops as part of a diversification strategy.

Azuki beans in Michigan USA with Wilhelm Kohl azuki bean trader.



Acknowledgments

I would like to thank Gresham Investment House and Incitec-Pivot and the NSW branch of the Australian Nuffield Scholars for their sponsorship of this Nuffield Farming Scholarship.

I would also like to thank Matthew Swain for his advice about change management theory.

The hospitality shown by all my hosts during my travels was most enjoyable and appreciated.

Finally, I would like to thank my wife, children and parents-in-law for their support and encouragement, and for keeping the farm running so smoothly during my studies.

Three year old jojoba orchard at Kibbutz Hazerim, Israel (Tony Hamilton)



Introduction

This report examines some of the responses by farmers to declining competitiveness. In particular, it focuses on farmers' attempts to diversify their existing production base by adding new enterprises or switching to alternative enterprises. When referring to agricultural production, to diversify means both adding extra enterprises or products to an existing suite and adding a novel agricultural or non-agricultural enterprise to compliment existing agricultural production.

Why change? Some farmers operate a profitable, highly competitive farming operation, yet the reality is that in the long-term agriculture's terms of trade have declined by 4.3% *per annum* for the last 18 years prior to 1997 and the average return on rural investment over that period was 0.3% (ABARE 1996). There has been a slight improvement since then (Figure 1) but the long-term trend for terms of trade is still negative. Poor returns, environmental degradation and an aging farm population have been cited as impetus for a change from current practices (Perkins 1998).

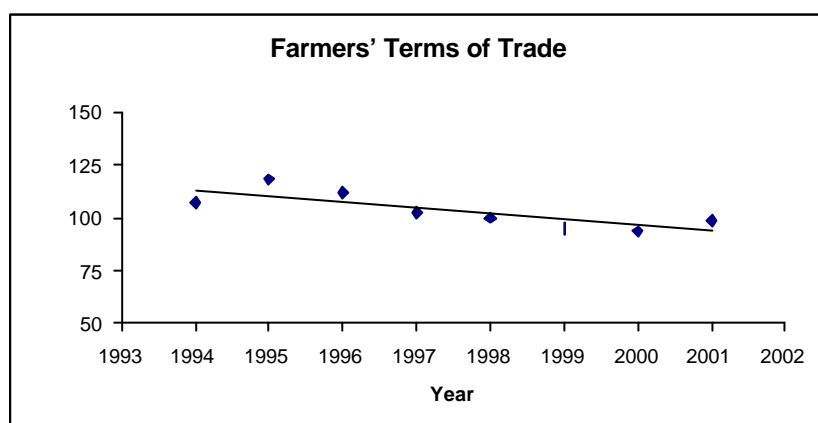


Figure 1. Agricultural terms of trade 1994-2001, (ABARE 2002)

Producers can respond to this challenge in several ways:

- Become more efficient within their existing operation (more product per unit cost)
- Buy or rent more land to achieve 'economies of scale'
- Diversify: (a) into more profitable alternatives or (b) by adding extra enterprises
- Work part-time off-farm
- Or exit farming.

In addition, irrigation farms have the added challenge of increased water charges and decreased allocations due to public pressure to fulfill environmental flow requirements. Thus crops which may have been profitably irrigated might now no longer be viable.

In the farm management textbook 'The Farming Game Now', Makeham and Malcolm (1993) state "Farmers can either willingly embrace and adopt change, or have change forced upon them; avoiding change is not an option". Thus the key to competitiveness is to be pro-active in searching for new opportunities and embracing change rather than waiting until its too late.

"The time to fix the roof is when the sun is shining." John F Kennedy

Diversification Theory

Change Management is a whole field of study and the subject of many books and theses. Whilst not the primary object of this report, some theory is required to set the scene for this study into diversification.

The standard business model for product life cycle is the BCG Matrix (Boston Consulting Group, Matrix developed at Harvard University, USA). It classifies products into four categories, 'Problem Child', 'Rising Star', 'Cash Cow' and 'Dog' (Figure 2). This model is applicable to agricultural products (or enterprises).

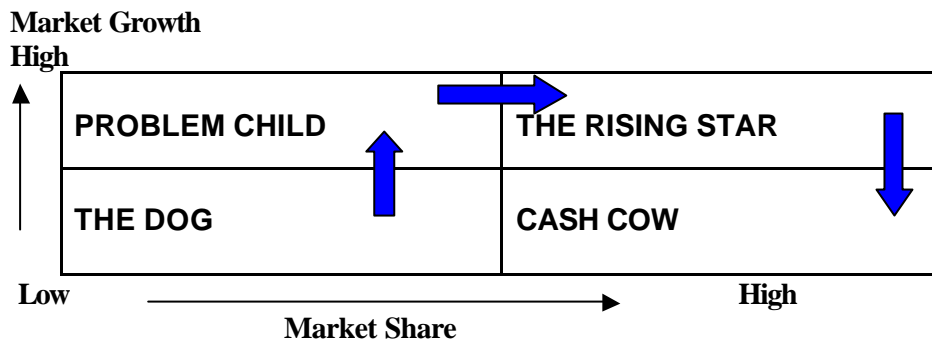


Figure 2. The BCG Matrix

These four stages occur when:

1. A new product will typically go through a difficult start up period where its future is uncertain (The Problem Child)
2. then if successful it starts increasing in profitability (The Rising Star)
3. and once it becomes a mainstream product line for the business, generates consistent cash-flow (The Cash Cow) and should be 'milked for all its worth' which usually means scaling up to achieve economies of scale
4. and finally demand for this product declines to such a point that it should be abandoned (The Dog).

The challenge for any business is to correctly identify these stages and act upon them. For example, one might have a failure trying to grow a new crop eg essential oils or medicinal herbs (The Problem Child). Do you persist or abandon it? Once merino wool was The Cash Cow, for 'Australia rode on the sheep's back'. Is it now 'The Dog' or has it returned to the 'Problem Child' category where new, imaginative uses for wool might turn it back into the 'Rising Star' category?

A successful business will usually have a mix of products (A,B,C,D) at various stages of this life cycle (Figure 3). Diversification can mean one is developing some 'rising stars', while the bulk of the farm's income is still coming from the 'cash cows'. The aim is to identify and get rid of the 'dogs' and decide whether the 'problem child' is worth pursuing even though in this start-up phase it may be initially unprofitable. In this example, at time 'X' product 'A' has become the 'dog', 'B' the 'cash cow', 'C' is the 'rising star' and 'D' is the problem child.

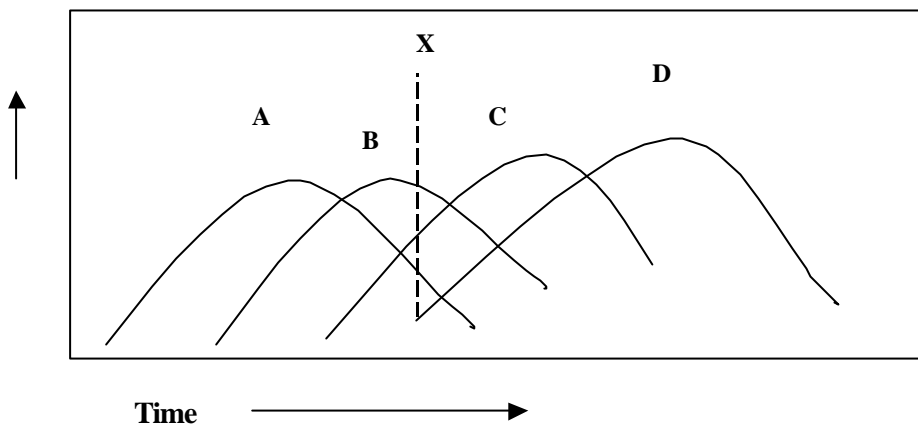


Figure 3 Four diversified enterprises at various stages of the product life cycle.

Another important aspect of diversification is in one's willingness to accept the need for change. The Transition Curve was originally postulated by Kubler-Ross (1969) in her book 'On death and dying' to explain the bereavement process. It has applications to all forms of change and has been presented graphically to illustrate the various phases (Figure 4). Aspects of change management theory have been applied to UK farming (Swain 2004).

Self-Esteem/Perceived Competence

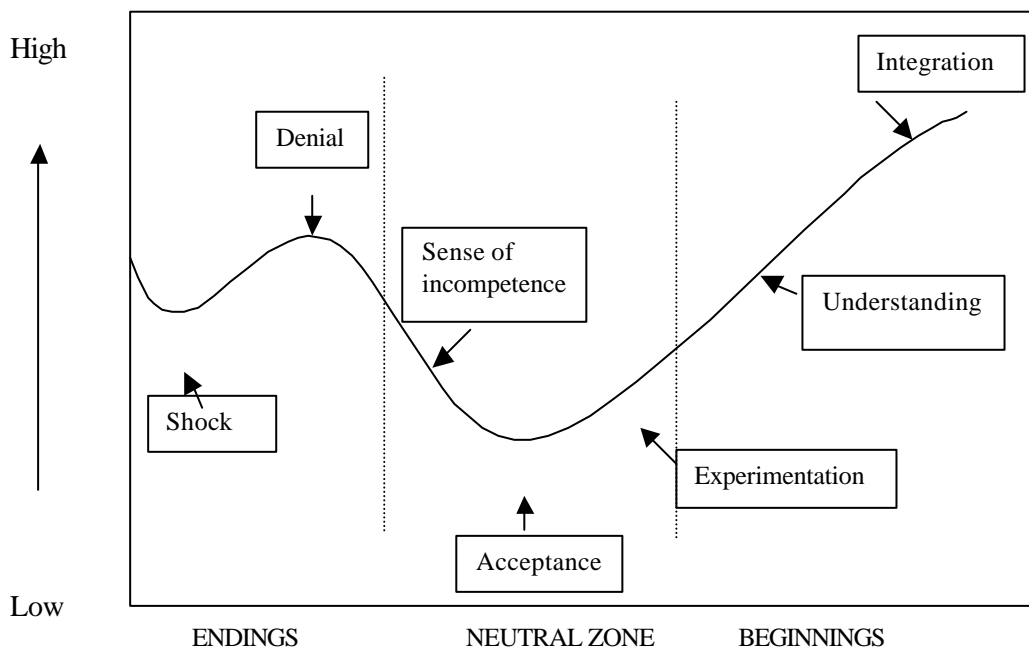


Figure 4 The Transition Curve (Kubler-Ross 1969)

Often a barrier to diversification is one's unwillingness to change from familiar tasks and attempt to commence a new enterprise. It may be due to a perceived lack of expertise or the financial risks associated with undertaking a new enterprise.

Diversification in the strict sense of the word, ie adding additional enterprises to one's business can also help reduce risk. Indeed, portfolio theory is one of the cornerstones of stock market investment. The riskiness of a stock (or share) is characterised by its beta value (β). In the foreword to the latest edition of *The New Crop Industries Handbook*, Senator Judith Troth states that "As well, diversification of cropping opportunities, within the limits of good business sense, provides an essential part of risk management in modern farming." (RIRDC 2004).

There have been attempts to apply portfolio theory to agriculture, in mathematical optimisation programmes. For example, Quadratic Programming is a mathematical technique designed to choose a suitable mix of enterprises for a farm (given the usual constraints of land, labour and resources) and maximise the potential return given the farmer's attitude to risk (Hamilton 1981). Variance co-variance matrices can be used to choose farming enterprises that compliment each other in terms of minimising the overall risk of one's farm business. Thus a risk-taker may choose only one enterprise which may be, on average, the most profitable but with wildly fluctuating incomes. Whereas a risk-averse farmer may decide to choose a mix of enterprises, to even out his returns over a number of years even though the potential return may be lower than choosing only the most profitable activity.

Hardaker *et al.* (1997) emphasize the need for thorough planning and an appreciation of the disadvantages of diversification. Haines and Davies (1987) suggest using a table to rank personal and financial objectives and also recommend using a four step process when contemplating diversification:

1. Identify opportunities for diversification and the objectives
2. Resource analysis – list strengths and weakness of available resources (land, labour and capital)
3. Market analysis –market research, competitive advantages etc, formulate a market plan
4. Project appraisal – business structure, taxation issues, financial feasibility.

Naturally diversification has disadvantages as well as advantages (Table 1).

Table 1 Advantages and disadvantages of Diversification

Advantages	Disadvantages
Risk minimisation (Portfolio theory)	Risk of not becoming highly proficient at one activity.
Dumping the 'dogs' and adopting the 'rising stars'	Lack economies of scale by doing a little bit of a lot of different things
Interest in learning about a new industry	Need to have diverse range of skills (or access to them).
Innovator- satisfaction in trying something new	

Some other risks of diversification to consider:

- ◆ If you are on a good thing, is it possible to expand the existing business rather than divert resources to a new venture,
- ◆ if the core business is not successful, it maybe due to management and the diversification may go the same way,

Unfortunately, being an ‘innovator’ does not usually guarantee financial success. Adoption of new technologies (or enterprises) is characterised by the ‘Adoption Curve’ (Figure 5). This has parallels with the BCG Matrix (Figure 2) and shows how various groups of people fit with the enterprise life cycle. Usually the ‘innovators’ go through all the teething problems of starting a new industry, and get it established without reaping the financial rewards. Then the ‘early adopters’ are the ones who can successfully adopt a new enterprise once the initial problems have been resolved. ‘Mainstream adopters’ also usually benefit but don’t secure the premiums available to early adopters. Finally, by the time the ‘laggards’ adopt the technology it is superceded and others in the industry have moved on to newer technologies or enterprises.

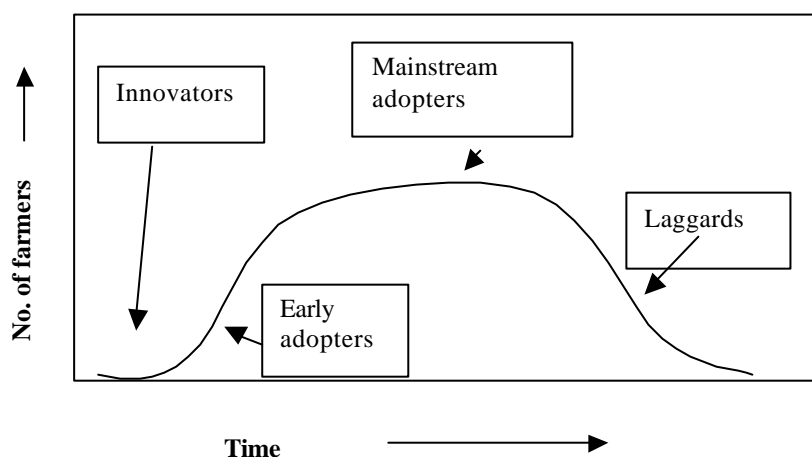


Figure 5 Adoption of New Technologies

‘Soft issues’ also dominate agriculture. Despite being told by consultants that ‘farming is a business, not a lifestyle’ many farming decisions are not based solely on financial terms. For example, it could be argued that innovators are motivated primarily by an interest in perfecting a new crop or technique and derive satisfaction from this challenge.

Many farmers in Australia have successfully embraced diversification, either by adopting new agricultural enterprises or by adding non-agricultural enterprises such as farm tourism. Some examples are presented in the publication: ‘New Rural Industries. A handbook for farmers and investors.’ (RIRDC 1997). Another study of diversification by 10 farmers concluded that ‘The case study farms with the shortest time to break even, generally have a much lower level of initial investment in diversification’ (Campbell White and Black 2004).

The Nuffield Tour

The author visited farmers and agricultural organisations in USA, Canada, United Kingdom, France, Germany, and Israel (Figure 6). Diversification *per se* is not a panacea for poor financial performance. It seems everyone is looking for ‘the magic crop’.

The underlying desire to diversify seems to be declining profitability of existing activities. In some cases this is due to structural change, such as tobacco farmers in Ontario, Canada, facing declining demand for their crop, or increased water charges in California making broad-acre annual row crops less profitable or competition from cheaper imports.

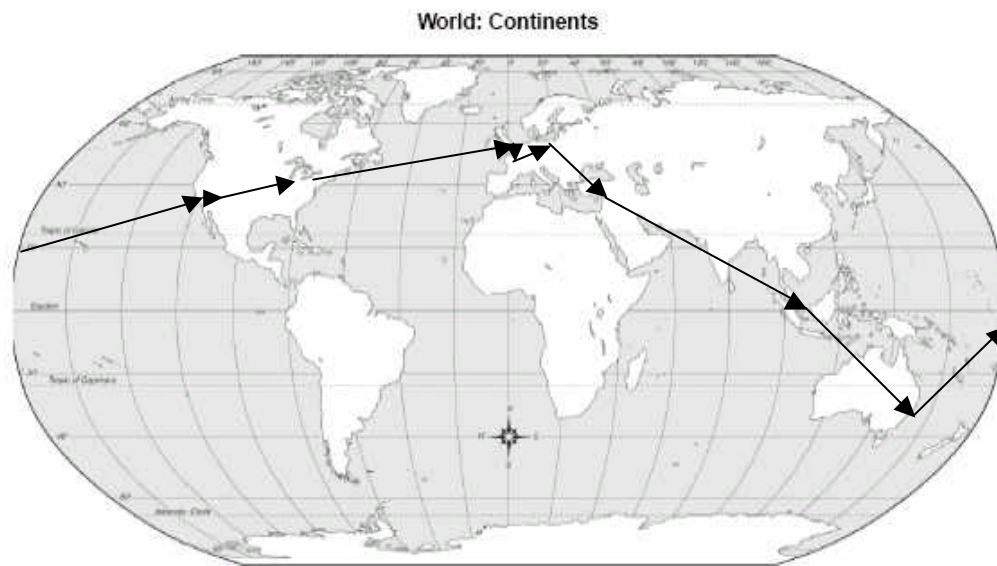


Figure 6 World Map showing regions visited on the study tour.

Several case studies are used in this report to demonstrate successes and failures of farmers embracing change via diversification. These are:

1. Large scale homogenous agriculture in southern California, USA
2. The jojoba industry, USA and Israel
3. The azuki bean industry, USA and Canada
4. Transition from arable crops to alternatives in the UK
5. Diversification in France and Germany

Case Studies

1. Large scale homogenous agriculture in southern California, USA

In southern California around Bakersfield, farmers have been moving to 'higher value crops' in response to increased irrigation water costs. Over the past twenty years the transition has been:

Irrigated Pastures → Row crops (eg Beans & Cotton) → Orchards (eg Almonds) & Vegetables

The next stage seems to be a more market orientated approach to diversification rather than simply finding a new crop. Linkages with processing companies allow diversified uses of the same product and the uses of 'trade marked' foods secure market advantages for new entrants.

One of the largest producers of carrots in the USA grows 16,000ha of carrots (about half on their own land and half on a share-farming basis). They are a family owned company that specialises in carrots. So is there any requirement to diversify?

A representative from the company indicated that there was "little margin in just growing carrots". So they have been diversifying with one to two thousand hectares of organic carrots. They also have one of the most modern processing plants in the country, producing a diversified range of products. Machines turn regular carrots into pre-packed 'baby carrots' (technically cut and peeled carrots), or 'coin', julienne, diced and shredded lines as well as carrot juice. They specialise in processed carrots, because cut and peeled carrots, 'baby carrots' are the most lucrative and other processed carrot products have higher margins than fresh carrots.

Another huge, family owned business, based at Bakersfield, growing approximately 10,000ha of almonds and 10,000ha of pistachios. It is a highly profitable, well-run company producing at least 150% of the state average yield. They have also diversified into growing pomegranates. From an initial trial of 120ha several years ago they now have over 2,400ha of pomegranates. When asked why such a large company is not more diversified as it already has economies of scale, the company president explained that at this stage they have not found any more profitable crops to grow. However, he noted that processing the almonds into products readily available for users such as confectionery manufacture is where the real margins are, not in just producing raw almonds.

Pomegranate juice has been shown to reduce the risk of cardio-vascular problems and in trials with laboratory rats it even helped repair damage due to strokes. Thus the company considers this new 'rising star' has the potential to be a profitable adjunct to almonds and pistachios. Nevertheless, they are still planting more of these 'cash cow' crops as well.

Conclusion: Don't think of diversification as just growing another crop. It could mean finding new uses for an existing product.

Conclusion: "If you're on a winner, stick to it." Don't change products or diversify just for the sake of it.

2. The jojoba industry in Arizona, USA and Israel

Jojoba has a checkered history. There was large scale planting around the world in the 1970s but most failed due to a variety of reasons. Since then a more cautious revival has occurred in various countries including USA, Israel, Australia and Argentina.

Unlike those in Australia, the jojoba growers visited as part of this study tour were effectively specialist growers and did not plant jojoba as part of a diversification strategy. There were several large growers in Arizona, USA. One grower sold just cleaned seed, whereas the other pressed his own oil and diversified somewhat by manufacturing a different range of products from the jojoba. The largest jojoba grower in Israel also pressed and manufactured its own products. All plantations visited were grown in harsh desert environments, where there were few alternative crop options.

Thus these jojoba plantations were established as stand-alone enterprises, to be grown in a desert environment. One grower in Arizona had financial troubles and was trying to diversify into other desert crops including Date Palms, ornamental palm trees and edible cactus (Napolis).

Conclusion: If you are going to diversify into new crops don't take on too many, get the marketing right and manage it well.

3. The azuki bean industry in Michigan, USA and Ontario, Canada

Azuki crops were generally viewed as high risk/high return crops and most growers visited in Michigan, USA and Ontario, Canada said they planted a portion of their summer crop area to azuki beans but were reluctant to commit the whole area. In contrast, Roundup Ready ® soybeans which had government price support was considered a low risk crop. Although a little more demanding to grow than soybeans, it seems that market fluctuations was the major risk as well as the chance of early frosts curtailing azuki maturity. Well-managed crops have a yield potential of 2.5-3 tonnes per hectare. One azuki buyer said that although he could offer firm contracts, the growers preferred to sell on the spot market hoping to achieve higher prices. Thus diversification in this case is akin to having a few speculative shares in your portfolio, rather than trying to diversify in order to lower the overall risk. However, in Australia, part of the risk of producing inferior quality product has been minimised by judicious choice of planting dates (Hamilton 2001).

Conclusion: Diversification doesn't just mean extending your portfolio to reduce risk, it can mean seeking higher returns with a more risky crop than your existing crops.

4. Transition from arable crops to alternatives in the UK

It appears that agriculture is in a state of change in the UK. There is uncertainty regarding the transition to single farm payments and a general mood of pessimism. One English Nuffield

Farming Scholar said, “The silliest thing you can do with agricultural land in the UK is to try and grow food on it.”

Indeed, there were many government grants to help farmers diversify out of farming in to activities such as running bed and breakfast accommodation, wedding venues, golf courses and fishing ponds. In fact, the UK government is actively encouraging off-farm diversification through its Farm Diversification Grants Scheme (Gasson 1988).

However, not everyone was pessimistic about the future of farming in the UK. For example, two farmers visited on this study tour had optimism about agriculture but were tackling the problems of declining terms of trade in opposite ways. One large scale arable farming operation concentrated on growing a few mainstream crops such as wheat, and canola, growing them well and achieving economies of scale. The other farmer, in Sussex England, used to grow wheat and canola, then diversified into lettuce and celery and now only grows these two crops. This is a case of initially diversifying by adding enterprises to his portfolio, then narrowing the crop range in order to concentrate on his new ‘cash cow’ and discarding, what was in his case, ‘the dog’.

Thus two different approaches have both been satisfactory. Who’s right and who’s wrong? Perhaps both are right. In the case of the large farming company, it is an unlisted public company and the owners do not own much land and concentrate on leasing more land and appointing managers on each unit of farms. In the case of the Sussex farmer, he and his wife own their own land and were seeking to achieve a higher return from this existing land by switching from arable crops to horticulture.

5. Diversification in France and Germany

Farmers visited in France and Germany also faced similar problems of declining returns and uncertainty regarding the transition to the single farm payment, to those in the UK. Like many farmers in the UK, tourism was a popular means of diversification. The percentage of farms offering some kind of tourist accommodation stands at 10% in West Germany, 12% in France and 8% in Italy. Sweden and Denmark have the highest proportion, exceeding 25% (Parry, N. 2002).

In southern France around Toulouse, it seems most farmers were continuing with wheat, maize and sunflowers in addition to farm tourism. There is also a growing interest in ‘regional produce’ which may allow opportunities for diversification into niche markets.

In Germany, government incentives to produce bio-energy were just commencing. Methane digesters on dairies and growing maize for ethanol may well be options in the future. There are tax incentives to grow rapeseed for fuel oil and bio-diesel. Thus diversification for many farmers may well involve producing bio-energy in its various forms. There is even the ridiculous situation that, at current wheat prices, there is speculation that the energy obtained from burning wheat may be worth more than the wheat for human consumption. This is due to government subsidies for renewable energy. For example, it costs domestic users €0.15/kWh to buy electricity but they are paid €0.49/kWh to produce ‘green electricity’ for the grid. This has encouraged rapid uptake of photovoltaic cells for household electricity generation with pay back periods as low as eight years.

Capital Constraints to Diversification

In many instances diversification requires extra capital. Indeed, access to capital can be a major impediment to diversification. Various strategies to access finance were employed, including conventional loans, equity partners and particularly in Europe, government grants to aid diversification.

A grower in the UK who diversified into vegetables explained that he set up three business entities; one to own the land, a second proprietary limited company to conduct the vegetable growing in an attempt to isolate potential business failure from the land ownership. He did not go into details about how he financed the venture. He also had a third joint venture with other growers in a marketing company to market the product. His aim was to diversify into a new, potentially risky business without jeopardising the family farm.

In the USA, there is a well-established Farm Credit Association that provides loans to farmers. Major banks, such as Wells Fargo, generally do not lend under \$1M thus the farm credit banks tend to be the major source of loans to small and medium sized farms. Discussions with representatives from Farm Credit West, at Wasco CA, indicated that providing cash flow projections could be substantiated, it was possible to borrow 60% of the value of the land security (ie have 40% equity). In the case of permanent plantings, such as vineyards and orchards, it is also possible to re-finance the loan once the orchard is established based on the new value of this orchard. For example a typical development (in USD/acre) may be financed thus:

Table 2 Typical financing arrangement for orchards in California (in USD/acre)

Land value (bare)	\$3000/acre
Loan (if land initially unencumbered)	\$1800/acre
Equity	\$1200/acre (40%)
Orchard cost (almonds- trees and irrigation)	\$1500/acre
Developed Orchard	\$4500/acre
New loan	\$2700/acre
Equity	\$1800/acre (40%)
Cost of development	\$1500/acre
Working capital required until 1 st crop	\$400/acre
Spare cash (for further development?)	\$800/acre

Thus the orchard can be fully financed until the first crop. It's possibly a high-risk strategy, but providing good management underpins it, this seems to be a common way of financing new orchards in California. In Australia our lending institutions are much more cautious, wanting much higher equity levels.

Other farmers retained ownership of the land and conducted the new enterprise as a joint venture with an equity partner. This has the benefit of both parties sharing in the risk of a new enterprise. As one farmer commented “its better to have 50% of a good business than 100% of an unprofitable one”.

In Europe there are numerous government schemes to aid diversification such as ‘The Farm Diversification Grants Scheme’ established in the UK in 1988. Many are aimed towards catering for the growing tourism demand. For example, one farmer from Sussex, England, interviewed on this study trip, secured a grant to build self-catering apartments on his farm. Another had constructed a golf course.

Labour issues associated with diversification

Diversification frequently involves intensification and, as such, there is often a requirement for additional manual labour. In countries visited as part of this study trip it appeared the cost and availability of labour were not barriers to this diversification process. For example:

- The USA has access to plentiful, relatively cheap Mexican labour under its various inter-governmental agreements. Some orchards were paying employees about five US dollars per hour, which is slightly above the award rate.
- Canada has an islander labour scheme where workers from the Caribbean Islands are flown in for the summer season and returned home during winter.
- Availability of eastern European labour has aided the change to horticultural crops in the UK. For example, many young Polish workers will spend several years in the UK, save enough money to buy a small business in Poland, and return home.
- Israel had kibbutz labour and Palestinian Arab labour, but these sources are less available due to the collapsing kibbutz system and the increased security barriers preventing Palestinians from making the daily journey to Israeli farms.

In Australia, the geographical isolation and the hard physical work, coupled with a generous social security system, has meant it is increasingly difficult to source casual labour for jobs such as fruit picking. Several employment agencies now specialise in sourcing overseas back-packers for these jobs. Thus labour availability in Australia may be a barrier to diversification into intensive horticultural operations in areas where a large pool of manual labour is not available.

Perhaps increased wage rates and a fly-in fly-out scheme such as that adopted by the mining industry in remote parts of Australia may be the answer. However, this increased cost burden will put Australian farmers at a competitive disadvantage to other countries with cheaper labour sources. A comparison of typical wage rates for farm labourers, based on interviews with farmers in countries visited on the trip, places Australia among the dearest source of labour (Table 3).

Table 3 Comparison of wage rates between countries (in AUD/h Sept 2004)

Country	Typical hourly rate (in AUD/hour)
Australia	\$15
UK	\$15
France	\$15
Germany	\$15
Canada	\$10
USA	\$8
Israel	\$7

Irrigation Technologies for New Crops

The author also investigated irrigation technologies and systems and their implications for 'new crops'. The basic principles of irrigation remain the same for 'mainstream' crops and new ones (ie replace water that the plant uses). In general, most high value crops were grown on sprinkler or drip irrigation systems. One exception was a jojoba crop in Arizona where the owner still used furrow irrigation, because of capital constraints.

Drip irrigation systems in California and Israel were generally regulated by remote controllers with scheduling based on deficit irrigation in response to soil moisture measurements. There was a trend to using soil capacitance monitors but vapour deficit monitors (tensiometers) were also used. Netafim also market TDT (Time Domain Transmissometry) meters, which measure the speed of an electromagnetic wave in soil. It provides rapid responses to changing soil moisture and can measure large soil volumes (5cm radius from the sensor).

The irrigation specialist at Paramount Farming Company used pressure bombs to try and relate plant stress to soil moisture measurements. From a practical point of view he tended to schedule almonds and pistachios for irrigating every 2nd or 3rd day rather than more frequent irrigation that is often recommended when using drip irrigation. He commented that problems getting the pipes full and pressurised and the chance of getting sand sucked back into the system as it is switched off, as well as the logistics of irrigating 26,000ha of orchard, negated any potential water saving or additional production with more frequent irrigation.

When translating existing experience to a 'new crop' such as pomegranates, he used similar assumptions about replacing plant water use that he had used in almonds. He irrigated the trees and monitored their water use and made adjustments accordingly.

One potential problem irrigating a new crop, could be deciding whether it is better to apply small amounts of water regularly or a large amount less frequently. For example, jojoba is susceptible to *Fusarium oxysporum* and large plants can suffer 'dieback'. The farm manager at Kibbutz Hazerim feels it is better to irrigate weekly and let the soil dry out between irrigations to minimise potential problems with *Fusarium*. However, the irrigation representative from Netafim also based at Hatzerim, differed suggesting it was better to irrigate more frequently, at least every second day. To resolve this dilemma a long-term trial should be carried out. Because *Fusarium* symptoms are slow to develop differences in irrigation regimes may not appear for years. In the meantime, the manager has to evaluate the options and make decision.

Researchers at one organisation in Israel are claiming improved fruit quality and large increases in yields of capsicum and tomatoes by cooling the root zone. Plastic tubing is buried next to the roots and also at about one metre depth when seasonal changes in soil temperature are minimal. Water is circulated through this buried pipe which acts as a heat exchanger dissipating heat into the cooler, deep soil during summer. This process can then be reversed (like a reverse-cycle air conditioner) to warm the soil near the root zone during winter.

Another technique in vogue at the moment is LVDT (Linear Variable Displacement Technology) where a sensitive strain gauge measures minute (micron) diurnal changes in stem, leaf or petiole thickness. Plant tissue shrinks during the heat of day and swells at night in response to stomatal opening and closing. It is hoped that the magnitude of this change can be related to plant moisture stress (Figure 7). Thus, in theory, the plant can tell the manager when it's thirsty rather than extrapolating this information from soil measurements.

This technology was tried at one farm in California, with almonds (Figure 7), but not continued because the researcher concluded that problems, such as securing the instruments and interpreting the readings, outweighed any potential benefits. However, another consultant at Phoenix Arizona uses the technology for nursery plants with the aim of eventually using feedback from the VDT sensors to automatically regulate irrigation. Netafim's research station at Kibbutz Magal, Israel is still trying to relate readings to pressure bomb measurements before moving the technology from the 'research' to the 'applied' stage. At Kibbutz Dahlia, the orchard manager has commenced using a commercial unit ('Phytec System') to monitor avocados, but admits he is in a learning phase.

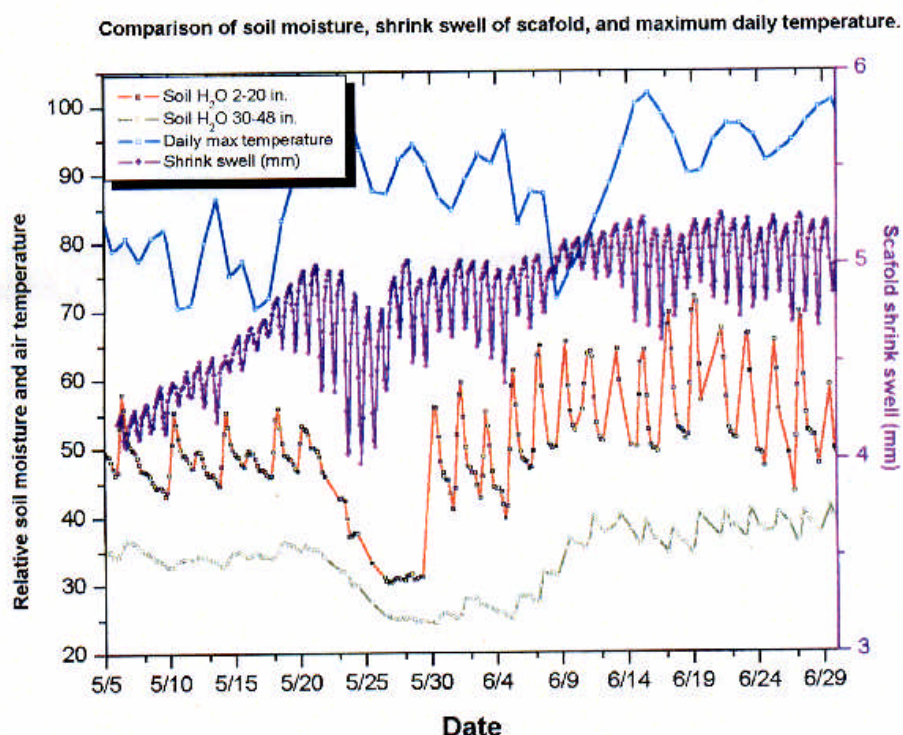


Figure 7 LVDT measurements of almond branches in California, USA.

Netafim are also researching low-pressure drip irrigation systems. These are operated with only one to two metres head from a low-pressure, high-volume pump or an overhead storage tank. They will apply water at 0.5 l/h per emitter instead of a more usual 1.5 l/h. Thus the system has to be run three times as long as standard systems. The chief researcher said initial trials showed better plant growth, more even wetting and less through drainage.

Finally, security of water supply is crucial when growing high value permanent crops such as almonds. To this end, several large 'water banking' projects have been constructed in California to recharge the aquifer system during wet years and access this 'banked' water with a network of wells during dry times. The North Kern Water Bank can store about 1.2 million megalitres (1.2 GJ) by spreading water over an 8,000 hectare series of ponds. Semi-Tropic Water District, north of Bakersfield CA can store a similar amount. It is also storing water on behalf of Los Angeles and using revenue from this 'water banking' to reduce irrigation charges to its members.

Conclusion

Diversification in the UK and mainland Europe is primarily directed to non- agricultural uses of farm land and farm buildings. California farmers grow a huge range of crops. Diversity is a feature but within each farm business scale seems to dominate over diversification. Israel has a variety of crops and products.

Azuki beans were grown as part of a high risk-high return strategy to compliment existing crops. Jojobas were generally grown as a single crop in desert regions.

This report has identified several important features of successful diversification:

- There is no ‘magic crop’ - diversification is not a panacea for poor performance. Even with new crops, one has to outperform one’s competitors.
- Consider using the BCG Matrix to evaluate potential and existing enterprise mix.
- A market-orientated approach to diversification is essential.
- Market linkages and branding new crops will be important in the future.
- Access to finance and labour may be barriers to diversifying into high value (capital and labour intensive) horticultural crops in Australia.
- Efficient use of water resources through irrigation technologies is vital.
- Diversification can play an important role in increasing farm profitability. Proper planning and thorough financial feasibility studies are pre-requisites for successful transition to new enterprises.

References

ABARE (1996) Commodity Statistical Bulletin.

ABARE (2002) Commodity Statistical Bulletin.

Campbell White and Associates and Black, A. (2002) 'Costs and Benefits of Diversification-Whole Farm Case Studies' RIRDC Publication No 02/029, Canberra.

Gasson, R. (1988) Farm Diversification and rural development. *Journal of Agricultural Economics* **39**: 175-182.

Haines, M. and Davies, R. (1987) 'Diversifying the Farm Business – A practical guide to the opportunities and constraints'. BSP Professional Books.

Hamilton, A.J. (1981) Farm Management and Land Use. B.Sc. Agr (Hons) Thesis, University of Sydney

Hamilton, A.J. (2001) Seed quality of azuki and kintoki beans. RIRDC Project US-97A, Publication 01/022 Canberra 16pp.

Hardaker, J.B., Huirne, R.B.M. and Anderson, J.R. (1997) 'Coping with Risk in Agriculture'. CAB International.

Kubler-Ross, E. (1969) 'On death and dying' Macmillan Publishing Co. NY, USA.

Makeham, J. and Malcolm, L. (1993) 'The Farming Game Now' , ISBN 0521 040452-5, Cambridge University press, Melbourne.

Parry, N. (2002) 'Opportunities for diversification in agriculture' Nuffield Farming Scholarship Trust, England.

Perkins, I. (1998) 'Multi-level land use: creative resource use for rural Australia' *The Australian New Crops Newsletter* **10**, article 14.

Rural Industries Research and Development Corporation (1997) 'New Rural Industries: A handbook for farmers and investors' (Edited by Keith Hyde)

Rural Industries Research and Development Corporation (2004) 'The New Crop Industries Handbook' (edited by Salvin, S., Bourke, M, and Byrne, T.) Publication 04/0125.

Swain, M. (2004) 'Change Management in UK Farming' Nuffield Farming Scholarship Trust, England.