SOUTH AUSTRALIAN
CENTRE FOR ECONOMIC STUDIES
ADELAIDE & FLINDERS UNIVERSITIES

Benefit Cost Analysis of Composted Organic Mulch in Horticultural Industries:

Vines — Cherries — Almonds
Pears — Citrus

and

Potatoes — Capsicums — Carrots — Flowers

Final Report

Prepared for:

Waste Management Committee

Prepared by:

The SA Centre for Economic Studies

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Executive Summary

Since 1997 the CSIRO has undertaken field trials with 'green-organics' compost, derived from municipal green wastes (leaves, lawn clippings and prunings) in nine horticultural crops, namely: vines; cherries; potatoes; capsicums; pears; carrots; almonds; flowers and citrus. The Centre for Economic Studies was commissioned by WMC to analyse the results of these trials to estimate the economic benefits that potentially could be derived from applications of compost.

The purpose of the trials differed for each crop. The objectives ranged from exploring the potential for water saving, to looking for improvements in produce or soil quality, to aiding in the establishment of young trees and vines.

The results must be considered as indicative only, given the lack of statistical significance between the control and compost applications in most of the crop trials.

The field trials involved application of various rates of compost to crops, ranging from 10 mm to 150 mm. Some crops had a mix of coarse and fine compost applied at a cost of $24.50 per cubic metre (includes the total cost of the compost and its delivery, application and spreading), while other crops had a very fine compost applied at a cost of $29.00 per cubic metre (includes application and spreading). Applied as a surface mulch, the higher compost rates are expected to have a life span of 5 years; and the lowest compost rate of 10 mm is expected to have a life expectancy of 2 to 5 years, and 3 years was assumed for the benefit cost analyses (BCAs).

There were significant economic benefits from the application of compost that could not be included or quantified in the BCAs, namely water, herbicide and fertiliser savings.[1] CSIRO's experience suggests that there is the potential for large water savings in horticultural crops using compost, easily up to 30 per cent for some crops. Shown in Table I are the average water needs for most of the horticultural crops in question and the potential for water savings (in kilolitres) from 10 to 30 per cent reduction total water use.

Potential water cost savings from the application of compost are shown in Table II, with the cost of the mulch per hectare shown in Table III.

The BCAs took into consideration increases (or decreases) in yield and changes in quality (and hence effects on revenue received) from the control treatment and the compost treatments. It is important to note that not all benefits could be quantified, hence a summary of qualitative factors is also presented in the results.

[1] These potential savings could not be included in the analyses because production inputs were not varied during the course of the trials, therefore to include them in the analyses with yield increases or decreases is misusing the data.

Table I
Water Use for Various Horticultural Crops

Crop	Indicative irrigation water requirements Kilolitres per hectare per year (per crop if more than one crop is possible in a year)	Average Water Use	Potential Water Savings (Kilolitres)		
			10%	20%	30%
Almonds	5,500-7,500	6,500	650	1,300	1,950
Vines*	5,000-6,000	5,500	550	550	550
Flowers	4,000-8,000	6,000	600	1,200	1,800
Potatoes	4,000-7,000	5,500	550	1,100	1,650
Carrots	4,000-5,000	4,500	450	900	1,350
Capsicums	3,000-5,000	4,000	400	800	1,200

Note: *In the Barossa, supplementary irrigation of vines is based on an irrigation application rate of 1,000 kL/Ha.
Source: Water Reticulation Systems Virginia

Table II
Water Cost Savings for the Nine Horticultural Crops Studied

Horticultural Crop	Cost Per Hectare*	Potential Savings		
		10 %	20 %	30 %
Vines	$334	$33	$67	$100
Cherries	$150	$15	$30	$45
Potatoes	$138	$14	$28	$41
Capsicums	$3,200**	$320	$640	$960
Pears	$10,731**	$1,073	$2,146	$3,219
Carrots	$450	$45	$90	$135
Almonds	$524	$52	$105	$157
Flowers	$3,750*	$375	$750	$1,125
Citrus	$317	$32	$63	$95

Note: * The cost per hectare is derived from estimates of average gross margins produced by PIRSA for various crops. Hence — the water cost represents the average cost incurred for producing a hectare of each horticultural crop. Estimates were derived from PIRSA for all crops.
** Average costs per hectare were not available for these crops, hence figures denote the annual cost of water hectare/year. Hence — the water cost represents the average cost incurred for producing the various horticultural crop on that hectare over a year's time period.
Source: PIRSA 1999, The Grower 1999, SACES 1999.

Table III
Mulch Costs for the Nine Horticultural Crops Studied

Horticultural Crop	Cost Per Hectare
Vines	$24.50
Cherries	$24.50
Potatoes	$29.00
Capsicums	$29.00
Pears	$24.50
Carrots	$29.00
Almonds	$24.50
Flowers	$29.00
Citrus	$37.50

Source: CSIRO

Results

Vines

Composted mulch was applied to vines in McLaren Vale, Willunga and McLaren Flat (both mature and young vines) at depths of 10 mm, 50 mm and 150 mm, and at a cost of $24.50 per cubic metre. Strong economic returns were obtained for all 10 mm and 50 mm applications in the various regions, however the 150 mm mulch application was generally not economic. The BCA's indicated that for every dollar invested by growers in McLaren Vale in the 10 mm mulch they would receive $8.85 in return, Willunga growers $4.27 in return and McLaren Flat growers $6.47 for their mature vines.

Water availability is a key issue for grape growers, and the potential for water savings to be derived from compost mulch is a significant benefit in terms of costs and improvements in the management of their vines. Growers could save up to $100 per hectare in water costs.

Growers are not only seeking ways of saving water, to enable them to continue to operate under proposed water allocation limits, by more efficiently managing their irrigation. With the water available to the grower, it may not be possible to supply the water demand of vines during times of extreme stress. The use of a compost mulch can reduce fluctuations in soil moisture and temperature, reducing the impact of extreme stress on vine performance.

The most significant economic impact of the use of compost mulch on the production of grapes is the potential to improve conditions for the establishment of young vines, giving growers more options for management of early training, pruning, harvest and quality. With more options to manage the growth of young vines, growers have opportunities to reduce establishment costs and lessen the time for the vineyard to achieve economic yields.

Cherries

Composted mulch was applied to cherries in Forreston at depths of 10 mm, 20 mm and 70 mm, at a cost of $24.50 per cubic metre. Very strong economic returns were obtained for the 10 mm mulch scenario, indeed, this was the trial that had the highest benefit cost ratio from all the horticultural crop trials. For every dollar invested by growers in the 10 mm mulch they received $73.78 in return. This benefit was a direct consequence of the grower receiving higher prices for the improvements in cherry size. The 20 mm mulch did not have any economic return while the 70 mm provided a moderate return.

By applying composted mulch, cherry growers could save up to $45 per hectare in water costs.

The application of a compost mulch can reduce fluctuations in soil temperature and moisture, and encourage extension of the root-zone and more efficient use of nutrients. The addition of organic matter to soils has additional benefits, with increased water-holding capacity, increased rainfall infiltration, and reduced run-off further optimising water-use. There has been effective suppression of weeds at this site, which has aided in the non-chemical control of weeds.

The increase in cherry size was of considerable benefit, with the grower noting that the picking costs and time for larger cherries are the same or lower than the costs for smaller cherries.

Almonds

Composted mulch was applied to almonds in Willunga at depths of 10 mm, 50 mm and 150 mm, at a cost of $24.50 per cubic metre. All rates provided negative economic returns.

Given the importance of water availability to almond growers, the water savings of compost mulch provide a considerable benefit. Growers could save up to $157 per hectare in water costs.

The moderated soil moisture and temperature conditions beneath a surface mulch allows extension of the root-zone, and more efficient use of nutrients. Suppression of weeds may reduce the need for herbicides. The addition of organic matter to soils has additional benefits, with increased water holding capacity, increased rainfall infiltration, and reduced run-off further optimising water-use.

The most significant economic impact of the use of compost mulch in the production of almonds is the potential to improve conditions for the establishment of young trees, giving growers more options for management of early training and pruning.

Pears

Composted mulch was applied to pears in Coromandel Valley at depths of 10 mm, 50 mm and 150 mm, and at a cost of $24.50 per cubic metre. Strong economic returns were obtained for the 10 mm and 150 mm mulch scenarios, with the 10 mm mulch providing the highest return with $5.30 for every dollar invested. The 50 mm mulch did not have any economic return.

By applying composted mulch, pear growers could save up to $3,200 hectare/year in water costs.

The trial was established in 1997 in an orchard in which the trees had not established as quickly as expected; after five years they had not reached the top of the trellis. This limited the options for the grower to train and prune the trees to achieve optimal production. Within six weeks of compost mulch application, growers reported obvious responses in growth, and after three months, shoot length in the mulched trees extended well beyond the upper trellis wire.

Application of a compost mulch can reduce soil moisture and temperature fluctuations and allows extension of the root-zone, with more efficient use of nutrients and other soil-applied amendments. Suppression of weeds may reduce the need for herbicides. The addition of organic matter to soils has additional benefits, with increased water-holding capacity, increased rainfall infiltration and reduced run-off, further optimising water-use.

Citrus

Composted mulch was applied to citrus at Waikerie at depths of 10 mm, 50 mm and 150 mm, and at a cost of $37.50 per cubic metre. The additional delivery costs added to the overall cost of the mulch. Negative economic returns were obtained for all mulch scenarios.

By applying composted mulch, citrus growers could save up to $95 per hectare in water costs.

Water is not expensive in the Riverland irrigation areas, and growers are not seeking to save irrigation to reduce costs. However, the availability of water and the times of access to irrigation may be restricted, and long intervals between irrigations can lead to plant stress and potentially, yield loss. Application of a compost mulch can conserve moisture and reduce soil moisture and temperature fluctuations between irrigations, and provide a 'buffer' during hot weather conditions.

Potatoes

Compost was soil incorporated prior to potato planting in the Northern Adelaide Plains at rates of 10 mm, 25 mm and 75 mm, at a cost of $29.00 per cubic metre. There was little economic return achieved from the potato trials, with the 20 mm compost providing a return of $1.30 for every $1 invested. The 75 mm compost did not have any economic return.

By applying composted mulch, potato growers could save up to $41 per hectare in water costs.

There were significant changes in soil properties, with organic carbon levels increased by over 40% under the highest rate of compost. A shift towards neutral pH altered the availability of nutrients in the soil, with the grower noting that he would be able to reduce his use of fertilisers. The addition of organic matter to soils has additional benefits, with increased water-holding capacity, increased rainfall infiltration and reduced run-off, further optimising water-use.

Capsicums

Compost was soil incorporated prior to capsicum planting in the Northern Adelaide Plains at rates of 10 mm, 25 mm and 75 mm, at a cost of $29.00 per cubic metre. Moderate economic returns were obtained for the 10 mm and 20 mm compost trials, with the 20 mm compost having the largest return as every dollar invested by growers meant they received $2.60 in return. The 75 mm compost trial did not have any economic return.

By applying mulch, capsicum growers could save up to $960 hectare/year in water costs.

There were significant changes in soil properties, with a five times increase in soil organic carbon levels under the highest rate of compost, and a shift towards neutral soil pH. Fifty per cent higher soil moisture was recorded during the growing season, under the highest rate of compost. These results demonstrate the potential for altering irrigation and fertiliser inputs, and achieving more efficient use of water and nutrients.

Carrots

Compost was soil incorporated prior to carrot planting in the Northern Adelaide Plains at rates of 10 mm, 25 mm and 75 mm, and at a cost of $29.00 per cubic metre. All provided negative economic returns, however it is important to note that these results are based on only one harvest.

By applying composted mulch, carrot growers could save up to $135 per hectare in water costs.

There were significant changes in soil properties, with a substantial increase in soil organic carbon levels, a shift towards neutral pH, higher soil moisture, and reduced run-off. The change in soil pH altered the availability of nutrients in the soil, with the grower noting that he would be able to reduce his use of fertilisers.

The addition of organic matter to soils has additional benefits, with increased water-holding capacity, increased rainfall infiltration, and reduced run-off, further optimising water-use. For these reasons, the grower is now committed to a program of soil improvement, through addition of organic matter.

Flowers

Compost was incorporated into soil prior to planting *Lisianthus* in Northern Adelaide Plains at depths of 25 mm and 75 mm, at a cost of $29.00 per cubic metre. Very strong economic returns were obtained from the 25 mm compost, with growers receiving $24.16 for every dollar they invested, however the 75 mm compost proved to not be economic.

By applying composted mulch, flower growers could save up to $1,125 hectare/year in water costs.

There were significant changes in soil properties, with a substantial increase in soil organic carbon levels, higher soil moisture, and a shift towards neutral pH which altered the availability of nutrients in the soil.

The addition of organic matter to soils has additional benefits, with increased water holding capacity, increased rainfall infiltration, and reduced run-off further optimising water-use. For these reasons, the grower is committed to a program of soil improvement, through addition of organic matter.

Average Costs of Fruit and Vegetable Growers in South Australia and Summary

The costs for fruit and vegetable agricultural industries in South Australia are shown in Table B.7 in Appendix B. The cost share of irrigation (between 1994-95 to 1996-97) for fruit and vegetable producers is considerably higher (10 and 3 percent respectively) than the overall average for all agricultural industries (which was 2 per cent).

The five highest costs incurred by vegetable producers in 1996/97 were for crop and pasture chemicals (22 per cent); fertiliser and soil conditioners (20 per cent); seed, seedlings and plants (19 per cent); marketing expenses (11 per cent); and fuel and lubricants (7 per cent). In comparison, water rates and drainage charges in 1996-97 represented 4 per cent of total expenses for vegetables.

The application of compost to horticultural crops can be expensive, even though compost only needs to be applied around once every three to five years. The actual share of compost of total variable cost will vary considerably, depending on the type of crop and depth application. The share of compost costs could be extremely large[2], hence it is essential that growers are assured that they are receiving economic returns above what they are investing.

The Centre's economic analyses suggest that on the whole the quantitative benefits from lower rates of compost applications outweigh the costs associated with the compost for most horticultural crops. In addition, growers obtain considerable other benefits that have not been quantified, but such benefits include water savings, increased flexibility with water management and soil improvements.

2 Crops that have small total variable costs per hectare (such as potatoes and carrots) will share a larger burden of the compost cost.

1. Introduction

The Waste Management Committee commissioned the Centre to undertake benefit cost analysis of results from field trials on the application of composted 'green-organics' in nine horticultural crops. These horticultural crops included:

- Vines;
- Cherries;
- Potatoes;
- Capsicums;
- Pears;
- Carrots;
- Almonds;
- Flowers; and
- Citrus.

The field trials were undertaken by CSIRO, beginning in October 1997 and finishing in June 1999.

This study is to assist in the market development process for the use of composts made from green waste, and quantifies the costs and benefits involved with the application of composted green waste. The Waste Management Committee asked the Centre wherever possible to quantify the following costs and benefits:

Costs

- Price of the product;
- Application rates;
- Cost of spreading;
- Reapplication frequency; and
- Costs and benefits.

Costs and Benefits

- Yields and yield quality;
- Water conservation;
- Weed control; and
- Soil quality.

2. Methodology

In conducing the benefit cost analyses, the Centre has used the Federal (Department of Finance 1991) and South Australian (Department of the Treasury 1990) Guidelines.

Benefit cost analysis (BCA), an economic analysis tool for decision making project evaluation was chosen as the most appropriate economic method to use. The following section provides a description of BCA and its objectives.

2.1 Benefit Cost Analysis

Benefit cost analysis is used to determine whether a project/programme is justified on economic grounds.

BCA is a widely used tool for comparing alternative courses of action by reference to the *net benefits* that they produce, and comparing a base case (no change) with the proposed option.

An important feature of the analysis is that costs and benefits are, as far as possible, expressed in money and hence are directly comparable with one another. Because a dollar available for spending (or investing) today is more valuable than a dollar that won't become available until a later period, it is necessary to discount future benefits and costs so they are comparable with current benefits and costs.

A benefit-cost ratio (BCR) provides an indication of the result achieved from a particular activity. For example, a benefit cost ratio above one indicates that a positive economic return was achieved, and a benefit cost ratio below one indicates that a negative economic return resulted.

BCR's for multiple projects can be compared to determine which project has a higher economic return relative to the others with higher BCR's indicating higher return.

2.2 Assumptions made within the Benefit Cost Analyses

The following assumptions were made in the BCAs of results from field trials:

- benefits and costs were assumed to accrue over the life of the compost;
- generally, averages of revenue for the crops were used for the years where no harvest data was available;
- there were generally three compost scenarios considered in the trials, ranging from 10 mm to 150 mm for all crops that had the available data, and they were compared against the base case scenario (or 'No Compost' scenario);
- compost costs were incurred in the first year for each scenario. For the 10 mm compost application, it was assumed that the compost would have a life expectancy of three years, and in the 50 mm and 150 mm compost scenarios the life expectancies were assumed to be 5 years;

- for all crops the BCAs were recalculated using the standard errors to estimate the difference in benefits from the average;
- most of the cost information was based on PIRSA's estimates of typical growers experience for the horticultural crops in question. Information was also obtained from the ABS on estimates of South Australian fruit and vegetable producers costs and from The Grower magazine (1999);
- water cost savings have been estimated at a potential saving of between 10 to 30 per cent; and
- analysis was conducted on the total benefits and costs occurred per hectare of horticultural crop.

The results of the economic analyses for each horticultural crop trial are presented in Sections 3 to 10.

3. Vines

Benefit cost analysis was conducted on field trials undertaken by the CSIRO on a variety of vineyard locations and grape varieties. Analysis was conducted on the following:

- McLaren Vale: Cabernet Sauvignon grapes;
- Willunga: Shiraz grapes;
- McLaren Flat: Cabernet Sauvignon grapes (mature vineyards);
- McLaren Flat: Cabernet Sauvignon grapes (young vineyards); and
- All Region Average: Cabernet Sauvignon and Shiraz grapes (average of all vine data provided).

The compost mulch applied to vines was a mix of coarse and fine compost, at a cost per cubic metre of $24.50, which included application and spreading.

3.1 Vine Results

Benefit cost ratios (BCRs) were estimated for each region and rate of compost mulch. Benefits were calculated using three different values of benefits: (1) the average of the yield for each vineyard; (2) the increase in the yield mean taking into consideration its standard error; and (3) the decrease in the yield mean taking into consideration its standard error.

It is important to note that not all the benefits of compost mulch application are included in the benefit cost analysis. There are two main sources of benefits that have not been included in the analysis below, they are water and herbicide savings. The reason why these benefits were not included in the BCAs is because the field trials did not alter any level of inputs that were utilised in the production of the grapes.[3] Instead, potential water savings for the compost mulch scenarios has been used to estimated a cost savings that could be achieved through a reduction in water use.[4] The trials were established in 1996 to demonstrate to growers the potential for more efficient management of irrigation, in a region where water availability was an increasing concern.

The BCAs did not account for the quality of grapes produced under compost mulched and normal conditions. The differences in quality between the scenarios and the base case were within the limits acceptable to the winemaker, and did not affect the price received per tonne.

The benefit cost ratios obtained are in Table 3.1, and the present values of total benefits and costs are in Table 3.2.

3 If the water levels had been changed to reflect the various moisture conditions under the compost mulch applications, then it is not likely that the same yield per hectare would have been obtained. Assuming water savings within the BCA and using the yield numbers for the compost mulch scenarios would have confounded the results. The same issue is applicable to herbicide (or fertiliser) savings.

4 There has not been enough research to suggest potential herbicide savings.

Table 3.1
Benefit Cost Ratios of Compost Mulch Application for Vines

Location	Mulch Scenario - Benefit Cost Ratio		
	10 mm	50 mm	150 mm
Mean Yield			
McLaren Vale - Cabernet Sauvignon	8.85	2.27	-0.13
Willunga - Shiraz	4.27	1.69	0.72
McLaren Flat - mature - Cabernet Sauvignon	6.47	3.86	1.29
McLaren Flat - young - Cabernet Sauvignon	n.a	2.19	0.24
All Region Average - Cabernet Sauvignon & Shiraz mature only	8.79	2.60	1.04
Yield with Higher Standard Error			
McLaren Vale - Cabernet Sauvignon	8.99	3.60	-0.16
Willunga - Shiraz	4.27	1.69	0.72
McLaren Flat - mature - Cabernet Sauvignon	6.47	3.68	1.24
McLaren Flat - young - Cabernet Sauvignon	n.a	2.19	0.24
All Region Average - Cabernet Sauvignon & Shiraz	8.83	2.55	1.01
Yield with Lower Standard Error			
McLaren Vale - Cabernet Sauvignon	8.72	3.57	-0.10
Willunga - Shiraz	4.27	1.69	0.72
McLaren Flat - mature - Cabernet Sauvignon	6.47	3.71	1.24
McLaren Flat - young - Cabernet Sauvignon	n.a	2.19	0.24
All Region Average - Cabernet Sauvignon & Shiraz	8.67	2.56	1.03

Note: The BCAs of young vines were estimated for a period of 4 years only.
Source: SACES.

The BCAs show that there were significant quantitative benefits to be derived from applying the compost mulch to vines. Appendix A provides the details of the assumptions, and an example of the BCA.[5]

[5] A detailed BCA spreadsheet has only been provided for the one vine scenario.

Table 3.2
Present Values of Total Benefits and Costs of Compost Mulch Application for Vines

Location	10 mm		50 mm		150 mm	
	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)
Mean Yield						
McLaren Vale - Cabernet Sauvignon	7,156	809	9,171	4,043	-1,616	12,128
Willunga - Shiraz	3,453	809	6,851	4,043	8,720	12,128
McLaren Flat - mature - Cabernet Sauvignon	5,228	809	15,587	4,043	15,685	12,128
McLaren Flat - young - Cabernet Sauvignon	n.a	n.a	13,306	6,076	2,947	12,128
All Region Ave. - Cabernet Sauvignon & Shiraz	7,109	809	10,522	4,043	12,560	12,128
Yield with Higher Standard Error						
McLaren Vale - Cabernet Sauvignon	7,265	809	14,549	4,043	-1,980	12,128
Willunga - Shiraz	3,453	809	6,851	4,043	8,720	12,128
McLaren Flat - mature - Cabernet Sauvignon	5,228	809	14,891	4,043	14,990	12,128
McLaren Flat - young - Cabernet Sauvignon	n.a	n.a	13,306	6,076	2,947	12,128
All Region Ave. - Cabernet Sauvignon & Shiraz	7,141	809	10,324	4,043	12,235	12,128
Yield with Lower Standard Error						
McLaren Vale - Cabernet Sauvignon	7,047	809	14,418	4,043	-1,252	12,128
Willunga - Shiraz	3,453	809	6,851	4,043	8,720	12,128
McLaren Flat - mature - Cabernet Sauvignon	5,228	809	14,997	4,043	15,096	12,128
McLaren Flat - young - Cabernet Sauvignon	n.a	n.a	13,306	6,076	2,947	12,128
All Region Ave. - Cabernet Sauvignon & Shiraz	7,012	809	10,362	4,043	12,527	12,128

Note: The BCAs of young vines were estimated for a period of 4 years only.
Source: SACES

3.1.1 McLaren Vale Cabernet Sauvignon Vines

The BCR for applying a 10 mm compost mulch at McLaren Vale is 8.85.[6] This indicates for every $1 spent on applying 10 mm of compost mulch, the grower receives $8.85 in return. The BCR of applying a 50 mm compost mulch to mature vines over a 5 year

[6] The analysis presented was calculated using the mean of the yields. Taking into consideration the standard error of the yields, the BCR for the 10 mm compost mulch ranged from 8.72 to 8.99 for the lower and higher SE respectively.

period to the same vineyard was estimated to be 2.27[7], and -0.13[8] for the 150 mm compost mulch application.

3.1.2 Willunga Shiraz Mature Vines

The BCR of applying a 10 mm compost mulch in Willunga to a hectare of Shiraz mature vines over a 3 year period was estimated to be 4.27. The BCR of applying a 50 mm compost mulch to mature vines over a 5 year period to the same vineyard was estimated to be 1.69, and 0.72 for the 150 mm compost mulch application.

3.1.3 McLaren Flat Cabernet Sauvignon Vines

The BCR of applying a 10 mm compost mulch in McLaren Flat to a hectare of Cabernet Sauvignon mature vines over a 3 year period was estimated to be 6.47. The BCR of applying a 50 mm compost mulch to mature vines over a 5 year period to the same vineyard was estimated to be 3.86,[9] and 1.29 for the 150 mm compost mulch application.

3.1.4 McLaren Flat Cabernet Sauvignon Young Vines

The BCR of applying a 50 mm compost mulch in McLaren Flat to a hectare of Cabernet Sauvignon young vines over a 4 year period was estimated to be 2.19, and 0.24 for the 150 mm compost mulch application.

3.1.5 Average of Vineyard Results

The average of all the vineyard results was calculated. It must be understood that these figures do not represent the average representation for the region. The BCR of applying a 10 mm compost mulch in to the McLaren Vale Region a hectare of Cabernet Sauvignon/Shiraz mature vines over a 3 year period was estimated to be 8.79[10]. The BCR of applying a 50 mm compost mulch to mature vines over a 5 year period to the same vineyard was estimated to be 2.60[11], and 1.04[12] for the 150 mm compost mulch application.

3.2 Potential Water Savings

As commented previously, water savings were not included in the BCA analyses. However, it is very probable that there are significant water savings to be made with the application of compost mulch. The availability of water and its cost is most likely going to be a major constraint for growers in the near future. Therefore, any production processes that will help growers conserve on water will be valued highly.

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7 Taking into consideration the standard error, the BCR for the 50mm compost mulch ranged from 3.57 to 3.60 for the lower and higher SE respectively.

8 Taking into consideration the standard error, the BCR for the 150 mm compost mulch ranged from -0.10 to - 0.16 for the lower and higher SE respectively.

9 Taking into consideration the standard error, the BCR for the 50 mm compost mulch ranged from 3.68 to 3.71 for the lower and higher SE respectively.

10 Taking into consideration the standard error, the BCR for the 10 mm compost mulch ranged from 8.67 to 8.83 for the lower and higher SE respectively.

11 Taking into consideration the standard error, the BCR for the 50 mm compost mulch ranged from 2.55 to 2.56 for the lower and higher SE respectively.

12 Taking into consideration the standard error, the BCR for the 150 mm compost mulch ranged from 1.01 to 1.03 for the lower and higher SE respectively.

Based on CSIRO experience, it is probable that there are potential water savings of 10 to 30 per cent that can be saved with the application of compost mulch.[13] Average cost of irrigation for growers in McLaren Vale was used to estimate the potential water cost savings that could be made. Irrigation does represents approximately 11.6 per cent of total variable costs for vineyards in McLaren Vale. Table 3.3 illustrates the potential savings to be derived from the compost mulch application.

Table 3.3
Water Savings for Vine Growers in McLaren Vale*

Current Cost Per Hectare ($)	Water Savings		
	10 Per Cent	20 Per Cent	30 Per Cent
	Potential Savings ($)		
334	33.40	66.80	100.20

Note: * Water costs represent water and irrigation costs.
Source: PIRSA.

Potentially, growers could be saving up to $100 per hectare in water savings, on top of the benefits cited previously.

3.3 Economic Qualitative Benefits

Grower interest in the potential for using compost as a mulch undervine to conserve water led to the establishment of trials in the McLaren Vale region in 1996, to demonstrate the potential for more efficient management of irrigation and weed suppression.

Growers are not only seeking ways of saving water, to enable them to continue to operate under proposed water allocation limits, by more efficiently managing their irrigation. With the water available to the grower, it may not be possible to supply the water demand of vines during times of extreme stress. The use of a compost mulch can reduce fluctuations in soil moisture and temperature, reducing the impact of extreme stress on vine performance.

The moderated moisture and temperature conditions beneath a surface mulch may encourage extension of the root-zone, and more efficient use of nutrients. Suppression of weeds may reduce the need for herbicides. The addition of organic matter to soils has additional benefits, with increased water holding capacity, increased infiltration, and reduced run-off further optimising rainfall interception.

The most significant economic impact of the use of compost mulch on the production of grapes is the potential to improve conditions for the establishment of young vines, giving growers more options for management of early training, pruning, harvest and

13 Larger applications of compost mulch will of course save the grower more water. However, as there is no research that defines this the Centre has considered the water savings to be constant across mulch applications.

quality. With more options to manage the growth of young vines, growers have opportunities to reduce establishment costs and lessen the time for the vineyard to achieve economic yields.

3.4 Summary

Overall — taking into consideration the variations in the yields — the compost mulch scenarios provided substantial economic benefits (in both qualitative and quantitative terms) in vines in the McLaren Vale region. However, it is important for the estimates of benefits presented here to be considered as indicative, because not all of the differences in compost mulch yield means were statistically significant from the control/base case.

4. Cherries

Benefit cost analysis was conducted on field trials undertaken by the CSIRO in Forreston in 1998 and 1999.

The compost mulch applied to cherries was a mix of coarse and fine compost, at a cost per cubic metre of $24.50, which included application and spreading.

4.1 Cherry Results

Benefit cost ratios (BCRs) were estimated for yields of each rate of compost mulch, and took into consideration the standard error.

Once again, not all the benefits of compost mulch application are included in the benefit cost analysis. Namely water and herbicide/fertiliser savings have not been estimated. The trials were established to demonstrate the potential for more efficient use of water and nutrients.

An improvement in quality was considered in the benefit cost analysis for cherries. As cherry prices depend considerably on the size of the cherries, the field trial data included a breakdown of the percentage of cherries in each category of size (four categories in all). The grower also provided information on the prices they received for the cherries in those size categories.

The benefit cost ratios obtained are in Table 4.1, and the present value of total benefits and costs are in Table 4.2.

Table 4.1
Benefit Cost Ratios of Compost Mulch Application for Cherries

Location	Compost Mulch Scenario - Benefit Cost Ratios		
	10 mm	20 mm	70 mm
Mean Yield			
Forreston	73.78	0.13	2.10
Yield with Higher Standard Error			
Forreston	74.91	0.56	2.25
Yield with Lower Standard Error			
Forreston	72.65	-0.29	1.95

Source: SACES.

Table 4.2
Present Values of Compost Mulch Application for Cherries

Location	10 mm		20 mm		70 mm	
	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)
Mean Yield						
Forreston	82,080	1,112	688	5,246	33,073	15,738
Yield with Higher Standard Error						
Forreston	83,340	1,112	2,919	5,246	35,427	15,738
Yield with Lower Standard Error						
Forreston	80,821	1,112	-1,543	5,246	30,718	15,738

Source: SACES.

4.1.1 Quantitative Economic Benefits

Like the vine analysis, the BCRs of the trials of compost mulch in cherry orchards indicated that there are diminishing returns to increased depth of mulch application. There are larger net benefits to be derived from the 20 mm compost mulch than the 70 mm mulch.

Considerably high benefits were derived from the 20 mm compost mulch application in the Forreston orchards. The BCR was a huge 73.8[14], indicating that for every dollar invested the grower received $73.80 in return. This was driven in part by the increase in yield, but also the increase in the larger size of cherries (hence more money was received per kilogram).

No significant increase in yield with the 50 mm compost mulch harvest meant that there were very low returns. The BCR was 0.13[15] in the 50 mm scenario and 2.10[16] in the 70 mm scenario.

4.1.2 Potential Water Savings

The Centre has used the average cost of irrigation for cherry growers in South Australia to estimate the potential water cost savings that could be made. For cherry growers, water is not a large cost. It represents approximately 0.5 per cent of their total variable costs. The savings for cherry growers is shown in Table 4.3.

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14 Taking into consideration the standard error, the BCR for the 20 mm compost mulch ranged from 72.7 to 74.9 for the lower and higher SE respectively.

15 Taking into consideration the standard error, the BCR for the 50 mm compost mulch ranged from -0.3 to 0.6 for the lower and higher SE respectively.

16 Taking into consideration the standard error, the BCR for the 70 mm compost mulch ranged from 2.0 to 2.3 for the lower and higher SE respectively.

Table 4.3
Potential Water Cost Savings for Cherry Growers

Current Cost Per Hectare $	Water Savings		
	10 Per Cent	20 Per Cent	30 Per Cent
	Potential Savings ($)		
150	15.00	30.00	45.00

Source: PIRSA.

Potentially, growers could be saving up to $45 per hectare in water savings, on top of the other benefits cited previously.

4.1.3 Qualitative Economic Benefits

The field trial under cherries was established in 1997 to demonstrate alternatives for optimising production in a commercial orchard. The grower was seeking to minimise his use of chemical fertilisers and pesticides, and provide optimal soil conditions for the production of cherries.

The application of a compost mulch can reduce fluctuations in soil temperature and moisture, and encourage extension of the root-zone and more efficient use of nutrients. The addition of organic matter to soils has additional benefits, with increased water-holding capacity, increased rainfall infiltration, and reduced run-off further optimising water-use. There has been effective suppression of weeds at this site, which has aided in the non-chemical control of weeds.

Herbicide costs represent approximately 2.5 per cent of cherry growers total variable costs.

The increase in cherry size was of considerable benefit, with the grower noting that the picking costs and time for larger cherries are the same or lower than the costs for smaller cherries.

Overall — taking into consideration the variations in the yields — the compost mulch scenarios provided substantial economic benefits in cherries. However, it is important for the estimates of benefits presented here to be considered as indicative, because not all of the differences in compost mulch yield means were significant from the control/base case.

5. Almonds

Benefit cost analysis was conducted on field trials undertaken by the CSIRO on mature almond trees in Willunga, with harvests in 1997, 1998 and 1999.

The grade of compost mulch applied to almonds was a mixture of coarse and fine material, at a cost per cubic metre of $24.50, which includes the cost for delivery, application and spreading.

5.1 Almond Results

Compost mulch applications in Willunga on young almond trees had spectacular effects on growth. Indeed, the trial had to be discontinued as the grower insisted on mulching all his younger almond trees. It was therefore not possible to conduct a benefit cost analysis on younger almond trees given the lack of comparative data, however there is substantial anecdotal evidence that it is economic to apply compost mulch to young almond trees.

Once again, not all the benefits of compost mulch application are included in the quantitative benefit cost analysis. Namely water and fertiliser savings have been excluded due to lack of information. The initial trials in Willunga were established to look at the potential for saving water, and the grower did substantially reduce the water input.

The benefit cost ratios obtained are in Table 5.1, and the present values of total benefits and costs are in Table 5.2.

Table 5.1
Benefit Cost Ratios of Compost Mulch Application for Almonds

Location	Compost Mulch Scenario - Benefit Cost Ratio		
	10 mm	50 mm	150 mm
Mean Yield			
NAP	-5.81	-1.46	-0.59

Source: SACES

Table 5.2
Present Values of Compost Mulch Application for Almonds

Location	10 mm		50 mm		150 mm	
	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)
Mean Yield						
NAP	-996	172	-1,144	784	-1,353	2,303

Source: SACES.

5.1.1 Quantitative Economic Benefits

There was no quantitative economic benefits that could be identified from the application of compost mulch. All mulch scenarios had negative economic returns.

Results showed indications of a positive yield trend in the deeper compost mulch applications on a yield per basal area of trunk basis. However, these results were not statistically significant.

5.1.2 Potential Water and Fertiliser Savings

Water costs represent a, significant proportion of total costs for almond growers, at approximately 12 per cent of their total variable costs. Table 5.3 illustrates the potential savings that could be derived from mulch application.

Table 5.3
Water Savings for Almond Growers

Cost per Hectare	Water Savings		
$	10 Per Cent	20 Per Cent	30 Per Cent
	Potential Savings Per Year ($)		
524	52	105	157

Source: PIRSA

Potentially, growers could be saving up to $150 per hectare in water costs.

There may be some potential savings in herbicide costs from the application of 150 mm compost mulch[17]. This deep mulch appeared to be effective in controlling weeds, but the scale of this potential saving would be very low as herbicide costs only make up 1 per cent of total variable costs for almond growers.

5.1.3 Qualitative Economic Benefits

Grower interest in the potential for using compost as a mulch to conserve water and more efficiently manage irrigation led to the establishment of trials at Willunga in 1996, to demonstrate the potential for more efficient management of irrigation, nutrition, soil, orchard establishment, and weed suppression.

Almond growers were seeking ways of not only saving water, to enable them to continue producing under proposed water allocation limits, but also to more efficiently manage their irrigation. Growers were keen to test the effectiveness of compost mulch in saving water.

[17] Almond growers herbicide the entire orchard well before harvest to ensure a 'clean' surface to harvest from. Use of compost mulch may not impact on this practice.

The moderated soil moisture and temperature conditions beneath a surface mulch allows extension of the root-zone, and more efficient use of nutrients. Suppression of weeds may reduce the need for herbicides. The addition of organic matter to soils has additional benefits, with increased water holding capacity, increased rainfall infiltration, and reduced run-off further optimising water-use.

The most significant economic impact of the use of compost mulch in the production of almonds is the potential to improve conditions for the establishment of young trees, giving growers more options for management of early training and pruning.

Overall the compost mulch scenarios provided no quantitative economic benefits for almond growers. Again, caution is urged given the previous comments about tree sizes, and the fact that the mean yield of mulched trees was not significantly different from the control/base case.

6. Pears

Benefit cost analysis was conducted on a trial undertaken by the CSIRO in Coromandel Valley in 1998 and 1999. Two harvests of lemon bergamot pears were obtained.

The compost mulch applied to pears was a mix of coarse and fine compost at a cost per cubic metre of $24.50, which included delivery and application/spreading.

6.1 Pear Results

Once again, not all the benefits of compost mulch application are included in the quantitative benefit cost analysis. Namely water and herbicide savings have been excluded. The trials were established to demonstrate the potential for more efficient use of water and nutrients, and to increase the options available to the grower to manage the growth and training of the trees.

Table 6.1 illustrates the benefit cost ratios obtained, and Table 6.2 the present value of total benefits and costs.

Table 6.1
Benefit Cost Ratios of Compost Mulch Application for Pears

Location	Compost Mulch Scenario - Benefit Cost Ratio		
	10 mm	50 mm	150 mm
Mean Yield			
Coromandel Valley	5.32	-0.34	2.29

Source: SACES.

Table 6.2
Present Values of Compost Mulch Application for Pears

Location	10 mm		50 mm		150 mm	
	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)
Mean Yield						
Coromandel Valley	3,257	613	-1,034	3,063	21,054	9,188

Source: SACES.

6.1.1 Quantitative Economic Benefits

The quantitative economic net benefits from the application of compost mulch to pears were the second largest after cherries and vines.

An application of 10 mm compost mulch in Coromandel Valley provided a BCR of 5.32[18], indicating that there was a very small, positive return for every dollar the grower invested.

The 50 mm mulch application had negative economic returns, with a BCR of -0.3, but the 150 mm scenario showed strong economic returns again with a BCR of 2.3.

6.1.2 Potential Water and Fertiliser Savings

Water costs represent a reasonably significant proportion of total costs for fruit growers, pear growers spend approximately $10,731 hectare annually on water and irrigation. Table 6.3 illustrates the savings that could be made under a mulch application.

Table 6.3
Water Savings for Pear Growers

Total Cost Hectare/Year $	Water Savings		
	10 Per Cent	20 Per Cent	30 Per Cent
	Potential Savings Per Year $		
10,731	1,073	2,146	3,219

Source: PIRSA.

Potentially, growers could be saving up to $3,000 hectare/year in water savings, on top of the other benefits cited previously.

There is expected to be potential savings in fertiliser and herbicide costs, although at this stage it is impossible to quantify the exact amount. Nevertheless, these potential savings would not be minimal as chemicals represent 11 per cent of fruit producers total variable costs and fertilisers represent around 9 per cent.

6.1.3 Qualitative Economic Benefits

The trial under pears was established in response to grower interest in the potential for compost mulch to aid in more efficient management of plant growth, irrigation, nutrition and weed suppression.

The trial was established in 1997 in an orchard in which the trees had not established as quickly as expected; after five years they had not reached the top of the trellis. This limited the options for the grower to train and prune the trees to achieve optimal production. Within six weeks of compost mulch application, growers reported obvious responses in growth, and after three months, shoot length in the mulched trees extended well beyond the upper trellis wire.

Application of a compost mulch can reduce soil moisture and temperature fluctuations and allows extension of the root-zone, with more efficient use of nutrients and other soil-applied amendments. Suppression of weeds may reduce the need for herbicides. The

18 The BCRs did not change with the application of higher and lower standard errors.

addition of organic matter to soils has additional benefits, with increased water-holding capacity, increased rainfall infiltration and reduced run-off, further optimising water-use.

Overall, the compost mulch scenarios provided substantial economic benefits for pear growers.

7. Citrus

Benefit cost analysis was conducted on trials undertaken by the CSIRO in Waikerie in 1998 and 1999. Two harvests of Pasin Navel oranges were obtained.

The compost mulch applied to pears was a mix of coarse and fine compost at a cost per cubic metre of $37.50, which included delivery and application/spreading. The additional delivery cost for the mulch increased its overall cost.

7.1 Citrus Results

Once again, not all the benefits of compost mulch application are included in the quantitative benefit cost analysis. Namely water and herbicide savings have been excluded. The trials were established to demonstrate the potential for more efficient use of water and nutrients in the establishment of a young orchard.

Table 7.1 illustrates the benefit cost ratios obtained, and Table 7.2 the present value of total benefits and costs.

Table 7.1
Benefit Cost Ratios of Compost Mulch Application for Citrus

Location	Compost Mulch Scenario - Benefit Cost Ratio		
	10 mm	50 mm	150 mm
Mean Yield			
Waikerie	-3.04	-5.96	-4.42

Source: SACES.

Table 7.2
Present Values of Compost Mulch Application for Citrus

Location	10 mm		50 mm		150 mm	
	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)
Mean Yield						
Waikerie	-455	150	-4,249	713	-9,440	2,138

Source: SACES.

7.1.1 Quantitative Economic Benefits

There was no quantitative economic net benefits from the application of compost mulch to citrus.

An application of 10 mm compost mulch in Waikerie provided a BCR of -3.04[19], indicating that for every dollar the grower invested, they had a negative return of about $3 dollars.

Deeper mulch applications had even more negative returns.

7.1.2 Potential Water and Fertiliser Savings

Water costs represent a reasonably significant proportion of total costs for fruit growers, citrus growers spend approximately $317 per hectare on water and irrigation. Table 7.3 illustrates the savings that could be made under a mulch application.

Table 7.3
Water Savings for Citrus Growers

Per Hectare Cost	Water Savings		
$	10 Per Cent	20 Per Cent	30 Per Cent
	Potential Savings Per Hectare ($)		
317	31.70	63.40	95.10

Source: PIRSA

Potentially, growers could be saving up to $95 per hectare in water savings, on top of the other benefits cited previously.

There is expected to be potential savings in fertiliser and herbicide costs, although at this stage these savings have not been quantified. These potential savings would not be minimal as chemicals represent 11 per cent of fruit producers total variable costs and fertilisers represent around 9 per cent.

Nevertheless, these potential savings would not be minimal as chemicals represent 11 per cent of fruit producers total variable costs and fertilisers represent around 9 per cent.

7.1.3 Qualitative Economic Benefits

Water is not expensive in the Riverland irrigation areas, and growers are not seeking to save irrigation to reduce costs. However, the availability of water and the times of access to irrigation may be restricted, and long intervals between irrigations can lead to plant stress and potentially, yield loss. Application of a compost mulch can conserve moisture and reduce soil moisture and temperature fluctuations between irrigations, and provide a ‘buffer’ during hot weather conditions.

The moderated soil conditions under a compost mulch can allow extension of the root-zone, with more efficient use of nutrients and other soil-applied amendments. Suppression of weeds may reduce the need for herbicides. The addition of organic matter to soils has additional benefits, with increased water-holding capacity, increased rainfall infiltration and reduced run-off, further optimising water-use.

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19 The BCRs did not change with the application of higher and lower standard errors.

Overall — taking into consideration the variations in the yields — the compost scenarios provided negative economic benefits in citrus. However, it is important for the estimates of benefits presented here to be considered as indicative, because not all of the differences in compost yield means were statistically significant from the control/base case.

8. Potatoes

Benefit cost analysis was conducted on a field trial undertaken by the CSIRO in Northern Adelaide Plains in 1998. Only one harvest was obtained.

The compost applied to the soil was a very fine compost, at a cost per cubic metre of $29.00, which includes the cost to the grower to apply and spread the compost.

8.1 Potato Results

Once again, not all the potential benefits of compost application are included in the benefit cost analysis. Namely water and fertiliser savings have been excluded because that information was not available.

An improvement in quality was considered in the benefit cost analysis. As potato prices depend on grade, the field trial data included a breakdown of the amount of premium and seconds potatoes. The grower also provided information on the prices expected for the potatoes in those grades.

The other main benefit not considered from compost application was the improvement in soil conditions. The trial was established in conjunction with the Northern Adelaide Plains Landcare Group to demonstrate ways for growers to achieve their aims of increasing soil organic matter, improving soil structure, and more efficient use of nutrients.

The benefit cost ratios obtained are in Table 8.1, and the present values of total benefits and costs are in Table 8.2.

Table 8.1
Benefit Cost Ratios of Compost Application for Potatoes

Location	Compost Scenario - Benefit Cost Ratios		
	10 mm	25 mm	75 mm
Mean Yield			
NAP	0.97	1.29	-0.25
Yield with Higher Standard Error			
NAP	0.98	1.33	-0.29
Yield with Lower Standard Error			
NAP	0.95	1.25	-0.22

Source: SACES

Table 8.2
Present Values of Compost Application for Potatoes

Location	10 mm		25 mm		750 mm	
	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)
Mean Yield						
NAP	2,801	2,900	9,336	7,250	-5,543	21,750
Yield with Higher Standard Error						
NAP	2838	2,900	9,640	7,250	-6,276	21,750
Yield with Lower Standard Error						
NAP	2,764	2,900	9,032	7,250	-4,810	21,750

Source: SACES.

8.1.1 Quantitative Economic Benefits

The quantitative economic benefits from the application of compost were considerably smaller for potatoes than in vines or cherries. However, the limited availability of data (one harvest only) must be taken into consideration in viewing these results.

An application of 10 mm of compost in Virginia provided a BCR of 0.97[20], indicating that there was a very small, negative return for every dollar the grower invested.

The 25 mm compost application had stronger economic returns, the BCR was 1.29[21] and -0.25[22] in the 75 mm scenario.

8.1.2 Potential Water and Fertiliser Savings

The average cost of irrigation for potato growers in South Australia was used to estimate the potential water cost savings that could be made. For potato growers, water is not a large cost. It represents approximately 3.3 per cent of their total variable costs. The savings in potato growers is shown in Table 8.3.

Table 8.3
Water Savings for Potato Growers

Current Cost Per Hectare $	Water Savings		
	10 Per Cent	20 Per Cent	30 Per Cent
	Potential Savings ($)		
1,138	14.00	28.00	41.00

Source: PIRSA.

20 Taking into consideration the standard error, the BCR for the 10 mm compost ranged from 0.95 to 0.98 for the lower and higher SE respectively.

21 Taking into consideration the standard error, the BCR for the 25 mm compost ranged from 1.25 to 1.33 for the lower and higher SE respectively.

22 Taking into consideration the standard error, the BCR for the 75 mm compost ranged from -0.22 to -0.29 for the lower and higher SE respectively.

Potentially, growers could be saving up to $41 per hectare in water savings, on top of the often benefits cited previously.

The improvement in soil conditions may imply a reduction in the rate of fertiliser to be applied (currently or in the future). It is not possible to suggest a range of potential savings (further research would be required), suffice to say that fertilisers represent a considerable amount of total variable costs for vegetable producers, almost 20 per cent, hence any savings made in fertiliser costs would not be trivial.

8.1.3 Qualitative Economic Benefits

The trial was established in conjunction with the Northern Adelaide Plains Landcare group, to address the group’s aims of increasing soil organic carbon levels, improving soil structure, and achieving more efficient use of nutrients and water.

There were significant changes in soil properties, with organic carbon levels increased by over 40 per cent under the highest rate of compost. A shift towards neutral pH altered the availability of nutrients in the soil, with the grower noting that he would be able to reduce his use of fertilisers. The addition of organic matter to soils has additional benefits, with increased water-holding capacity, increased rainfall infiltration and reduced run-off, further optimising water-use.

Overall — taking into consideration the variations in the yields — the compost scenarios provided modest economic benefits in potatoes. However, it is important for the estimates of benefits presented here to be considered as indicative, because not all of the differences in compost yield means were statistically significant from the control/base case.

9. Capsicums

Benefit cost analysis was conducted on a field trial undertaken by the CSIRO in the Northern Adelaide Plains in 1998. Only one harvest of capsicums was obtained.

The compost applied to capsicums was a very fine compost, at a cost per cubic metre of $29, including the cost of the grower applying and spreading the compost.

9.1 Capsicum Results

Once again, not all the benefits of compost application are included in the quantitative benefit cost analysis. Namely water and fertiliser savings have been excluded because this information was not available.

The main benefit not considered from compost application was the improvement in soil conditions. The trial was established in conjunction with the Northern Adelaide Plains Landcare Group to demonstrate ways for growers to achieve their aims of increasing soil organic matter, improving soil structure, and more efficient use of nutrients.

Table 9.1 illustrates the benefit cost ratios obtained, and Table 9.2 the present value of total benefits and costs.

Table 9.1
Benefit Cost Ratios of Compost Application for Capsicums

Location	Compost Scenario - Benefit Cost Ratio		
	10 mm	25 mm	75 mm
Mean Yield			
NAP	2.08	2.59	0.43

Note: Benefit cost ratios do not vary allowing for higher and lower standard errors.
Source: SACES

Table 9.2
Present Values of Compost Application for Capsicums

Location	10 mm		25 mm		75 mm	
	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)	PV Benefits ($)	PV Costs ($)
Mean Yield						
NAP	6,020	2,900	18,812	7,250	9,406	21,750

Note: Benefits and costs do not vary allowing for higher and lower standard errors.
Source: SACES

9.1.1 Quantitative Economic Benefits

The quantitative economic benefits from the application of compost were smaller for the capsicum than for vines or cherries, but larger than in potatoes. The availability of data (one harvest only) must also be taken into consideration in viewing these results.

An application of 10 mm compost in the Northern Adelaide Plains provided a BCR of 2.1[23], indicating that for every dollar the grower invested in the compost she/he received a return of $2.10.

The 25 mm compost application had stronger economic returns, the BCR was 2.6 but there was no economic return in the 75 mm scenario with a BCR of 0.43.

9.1.2 Potential Water and Fertiliser Savings

The average cost of irrigation for capsicum growers in South Australia was used to estimate the potential water cost savings that could be made. For vegetable growers, water is not a large cost. It represents approximately 3.3 per cent of their total variable costs.[24] Table 9.3 illustrates the savings.

Table 9.3
Water Savings for Capsicum Growers

Total Annual Cost Hectare ($)	Water Savings		
	10 Per Cent	20 Per Cent	30 Per Cent
	Potential Savings $		
3,200	320	640	960

Source: PIRSA.

Potentially, growers could be saving up to $960 hectare year in water savings, on top of the other benefits cited previously.

The improvement in soil conditions may imply a reduction in the rate of fertiliser to be applied (currently or in the future). It is not possible to suggest a range of potential savings (further research would be required), suffice to say that fertilisers represent a considerable amount of total variable costs for vegetable producers, almost 20 per cent, hence any savings made in fertiliser costs would not be trivial.

9.1.3 Qualitative Economic Benefits

The trial under capsicums was established in conjunction with the Northern Adelaide Plains Landcare group, to address the group's aims of increasing soil organic carbon levels, improving soil structure, and achieving more efficient use of nutrients and water.

23 Taking into consideration the standard errors, the BCRs for all scenarios did not change.
24 The Centre did have figures on the use of water by glasshouse capsicum producers, who spend approximately $3,200 hectare/year on water and power.

There were significant changes in soil properties, with a five times increase in soil organic carbon levels under the highest rate of compost, and a shift towards neutral soil pH. Fifty per cent higher soil moisture was recorded during the growing season, under the highest rate of compost. These results demonstrate the potential for altering irrigation and fertiliser inputs, and achieving more efficient use of water and nutrients.

Overall — taking into consideration the variations in the yields — there is good indication the compost scenarios of 10 mm and 25 mm provided economic benefits in capsicums.

10. Carrots

Benefit cost analysis was conducted on a field trial undertaken by the CSIRO in the Northern Adelaide Plains in 1997. Only one harvest of carrots was obtained, hence the BCAs have limited application.

The compost applied to carrots was a very fine compost, at a cost per cubic metre of $29.00, which includes the cost for the grower to apply and spread the compost.

10.1 Carrot Results

Benefit cost ratios (BCRs) were estimated for each compost application, taking into consideration the yields standard error.

Once again, not all the benefits of compost application are included in the quantitative benefit cost analysis. Namely water and fertiliser savings have been excluded due to lack of information.

The main benefit not considered from compost application was the improvement in soil conditions. The trial was established in conjunction with the Northern Adelaide Plains Landcare Group to demonstrate ways for growers to achieve their aims of increasing soil organic matter, improving soil structure, and making more efficient use of nutrients.

The benefit cost ratios obtained are in Table 10.1, and the present values of total benefits and costs are in Table 10.2.

Table 10.1
Benefit Cost Ratios of Compost Application for Carrots

Location	Compost Scenario - Benefit Cost Ratio		
	10 mm	25 mm	75 mm
	Mean Yield		
NAP	0.16	0.00	-0.97

Source: SACES

Table 10.2
Present Values of Compost Application for Carrots

Location	10 mm		25 mm		75 mm	
	PV Benefits $	PV Costs $	PV Benefits $	PV Costs $	PV Benefits $	PV Costs $
	Mean Yield					
NAP	467	2,900	0	7,250	-21,152	21,750

Source: SACES

10.1.1 Quantitative Economic Benefits

Taking into consideration that there was only one field trial for carrots, there was no indication of quantitative economic benefits to be derived from the application of compost.

An application of 10 mm compost in Virginia provided a BCR of 0.16[25], indicating that there were no economic returns.

The 25 mm compost application had zero economic returns with a BCR of 0 and -0.97 in the 75 mm scenario.

10.1.2 Potential Water and Fertiliser Savings

As commented previously, water savings were not included in the BCA analyses.

The cost of irrigation and water for carrot growers in South Australia was used to estimate the potential water cost savings that could be realised. Water costs represent a small proportion of total costs for carrot growers, at approximately 5 per cent of their total variable costs. The savings are shown in Table 10.3.

Table 10.3
Potential Water Savings for Carrot Growers

Cost Per Hectare ($)	Water Savings		
	10 Per Cent	20 Per Cent	30 Per Cent
	Potential Savings Per Hectare ($)		
450	45	90	135

Source: PIRSA.

Potentially, growers could be saving around $130 per hectare in water costs.

There is expected to be some potential savings in fertiliser costs (but not herbicide costs). Fertilisers represent around 5 per cent of carrot growers total variable costs.

10.1.3 Qualitative Economic Benefits/Costs

The quality of carrots depends on the amount which are forked and bent. It was found that higher rates of compost resulted in a significantly higher percentage of carrots which were forked. There was a general increasing trend with the percentage of carrots forked and bent with higher rates of compost, but most were not statistically significant. These results suggest the possibility that the grower may receive less money per crop with higher rates of compost given the higher percentage of forked and bent carrots.

The trial was established in conjunction with the Northern Adelaide Plains Landcare group, to address the group's aims of increasing soil organic carbon levels, improving soil structure, and achieving more efficient use of nutrients and water.

25 The BCRs did not change taking into consideration the standard error.

The moderated soil moisture and temperature conditions beneath a surface mulch allows extension of the root-zone, and more efficient use of nutrients. Suppression of weeds may reduce the need for herbicides. The addition of organic matter to soils has additional benefits, with increased water holding capacity, increased rainfall infiltration, and reduced run-off further optimising water-use.

The most significant economic impact of the use of compost mulch in the production of almonds is the potential to improve conditions for the establishment of young trees, giving growers more options for management of early training and pruning.

The compost scenarios evaluated did not show any indication of quantitative economic benefits in carrots.

11. Flowers — *Lisianthus*

Benefit cost analysis was conducted on a field trial undertaken by the CSIRO in the Northern Adelaide Plains on *Lisianthus* in early 1998. There were seven harvests of flowers obtained over a period of around three weeks. Because data is from only one trial, the BCAs have limited application.

The compost applied to flowers was a very fine compost, at a cost per cubic metre of $29.00, which includes the cost for the grower to apply and spread the compost.

11.1 *Lisianthus* Results

Once again, not all the benefits of compost application are included in the quantitative benefit cost analysis. Namely water and fertiliser savings have been excluded because that information was not available.

The main benefit not considered from compost application was the improvement in soil conditions. The trial was established in conjunction with the Northern Adelaide Plains Landcare Group to demonstrate ways for growers to achieve their aims of increasing soil organic matter, improving soil structure, and more efficient use of nutrients.

The benefit cost ratios obtained are in Table 11.1, and the present values of total benefits and costs are in Table 11.2.

Table 11.1
Benefit Cost Ratios of Compost Application for Flowers

Location	Compost Scenario - Benefit Cost Ratio	
	25 mm	75 mm
Mean Yield		
NAP	24.16	-13.63

Source: SACES

Table 11.2
Present Values of Compost Application for Flowers

Location	25 mm		75 mm	
	PV Benefits $	PV Costs $	PV Benefits $	PV Costs $
Mean Yield				
NAP	176,334	7,300	- 298,412	21,900

Source: SACES

11.1.1 Quantitative Economic Benefits

The quantitative economic benefits from the application of compost were considerably variable in the flower crops.

An application of 25 mm compost in Evanston Gardens provided a BCR of 24.16[26], indicating that there was a very large, positive return for every dollar the grower invested.

Interestingly, because of the lower yields in the 75 mm compost application, it had negative economic returns with a BCR of -13.6.

11.1.2 Potential Water and Fertiliser Savings

The average cost of irrigation for flower growers in South Australia was used to estimate potential water cost savings. Water costs represent a small proportion of total costs for flower growers, at approximately 2 per cent of their total variable costs. Table 11.3 illustrates the potential savings to be made from the mulch.

Table 11.3
Water Savings for Flower Growers

Total Annual Cost ($)	Water Savings		
	10 Per Cent	20 Per Cent	30 Per Cent
	Potential Savings Per Year ($)		
3,750	375	750	1,125

Source: PIRSA.

Potentially, growers could be saving up to $1,000 per annum in water savings.

Savings may also be derived from a reduction in fertiliser costs. Fertiliser costs represent approximately 3 per cent of flower growers total variable costs.

11.1.3 Economic Qualitative Benefits

The trial was established in conjunction with the Northern Adelaide Plains Landcare group, to address the group's aims of increasing soil organic carbon levels, improving soil structure, and achieving more efficient use of nutrients and water.

There were significant changes in soil properties, with a substantial increase in soil organic carbon levels, higher soil moisture, and a shift towards neutral pH which altered the availability of nutrients in the soil.

The addition of organic matter to soils has additional benefits, with increased water holding capacity, increased rainfall infiltration, and reduced run-off further optimising water-use. For these reasons, the grower is committed to a program of soil improvement, through addition of organic matter.

Overall the compost scenarios provided substantial benefits in flowers. Benefits must be considered as indicative only.

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26 The BCRs did not vary taking into consideration the higher and lower standard errors.

Further Reading

Trials of 'green-organics' compost derived from collections of garden prunings, clippings and leaves have been undertaken in horticultural crops across Australia. Results from these trials are reported in the proceedings of the International Composting Conference, Melbourne 1998 and the Compost in Horticulture Seminar, Perth 1999. Results from CSIRO trials have been widely reported in grower journals and at industry conferences.

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Appendix A
Assumptions/Calculations Used Within The BCAs

No Mulch Application	**Vines - Average** **1st Harvest**	**Vines - Average** **2nd Harvest**	**Vines - Average** **3rd Harvest**
Benefits			
Yield (kg/vine)	7.90	11.23	8.97
Standard error	0.83	1.13	0.97
Yield (kg/vine) (+SE)	8.73	12.37	9.93
Yield (kg/vine) (-SE)	7.07	10.10	8.00
Yield/ha	13.04	18.54	14.80
Yield/ha (+SE)	14.41	20.41	16.39
Yield/ha (-SE)	11.66	16.67	13.20
Price received $	1504.00	1504.00	1504.00
Revenue $	19604.64	27876.64	22251.68
			15.455
Av. Revenue over the Harvests $			23244.32
Revenue $ (+SE)	21,702	30,713	24,633
Av. Revenue over the Harvests $			25,773
Revenue $ (-SE)	17,559	25,087	19,836
Av. Revenue over the Harvests $			20900.9
Water cost savings $	0.00	0.00	0.00
Total Benefits	19,605	27,877	22,252
Av. Total Benefits over the Harvests $			23244.32
Total Benefits (+SE)	21,702	30,713	24,633
Av. Total Benefits over the Harvests $			25,773
Total Benefits (-SE)	17,559	25,087	19,836
Av. Total Benefits over the Harvests $			20,901
Costs			
Cubic metres of compost/ha	0	0	0
Cost per cubic metre $	24.5		
Cost of compost annually/ha $	0.00	0.00	0.00
Labour: casual & permanent $	220	220	220
Irrigation	334	334	334
Herbicide costs for weeds $	110	110	110
Herbicide costs for pests $	328	328	328
Fertilisers $	306	306	306
Pruning $	250	250	250
Harvesting costs $	682	682	682
Plants and soil preparation $	0	0	0
Machinery operating costs $	390	390	390
Other Costs (seeds & seedlings, Freight costs, and Other costs) $	257	257	257
Total Costs	2,877	2,877	2,877

Applying Compost Mulch **10 mm Application Scenario**	**Vines - Average** **1st harvest**	**Vines - Average** **2nd Harvest**	**Vines - Average** **3rd Harvest**
Benefits			
Yield (kg/vine)	8.51	11.52	11.26
Standard error	0.83	1.13	1.00
Yield (kg/vine) (+SE)	9.3	12.7	12.3
Yield (kg/vine) (-SE)	7.7	10.4	10.3
Yield/ha	14.05	19.01	18.58
Yield/ha (+SE)	15.42	20.88	20.23
Yield/ha (-SE)	12.67	17.14	16.93
Price received $	1,504.00	1504.00	1,504.00
Revenue $	21,127	28,588	27,887
Av. Revenue over the Harvests $			25,869
Revenue $ (+SE)	23,195.	31,401	30,364
Av. Revenue over the Harvests $			28,321
Revenue $ (-SE)	19,059	25,776	25,410
Av. Revenue over the Harvests $			23,416
Water cost savings $	0.00	0.00	0.00
Total Benefits	21,127	28,588	27,887
Av. Total Benefits over the Harvests $			25,869
Total Benefits (+SE)	23,195	31,401	30,364
Av. Total Benefits over the Harvests $			28,321
Total Benefits (-SE)	19,059	25,776	25,410
Av. Total Benefits over the Harvests $			23,416
Costs			
Cubic metres of compost/ha	33		
Cost per cubic metre $	24.50		
Cost of compost annually/ha $	808.50		
Labour: casual & permanent $	220	220	220
Irrigation	334	334	334
Herbicide costs for weeds $	110	110	110
Herbicide costs for pests $	328	328	328
Fertilisers $	306	306	306
Pruning $	250	250	250
Harvesting costs $	682	682	682
Machinery operating costs $	390	390	390
Other Costs (seeds & seedlings, Freight costs, and Other costs) $	257	257	257
Total Costs	3,686	2,877	2,877

Applying Compost Mulch **50 mm Mulch Application**	**Vines - Average** **1st harvest**	**Vines - Average** **2nd Harvest**	**Vines - Average** **3rd Harvest**
Benefits			
Yield (kg/vine)	8.20	12.80	10.03
Standard error	0.83	1.13	0.97
Yield (kg/vine) (+SE)	9.0	13.9	11.0
Yield (kg/vine) (-SE)	7.4	11.7	9.1
Yield/ha	13.53	21.12	16.555
Yield/ha (+SE)	14.91	22.99	18.15
Yield/ha (-SE)	12.16	19.25	14.96
Price received $	1504.00	1504.00	1504.00
Revenue $	20,349	31,765	24,899
Av. Revenue over the Harvests $			25,671
Revenue $ (+SE)	22,417	34,577	27,298
Av. Revenue over the Harvests $			28,097
Revenue $ (-SE)	18,281	28,952	22,500
Av. Revenue over the Harvests $			23,244
Water cost savings $	0.00	0.00	0.00
Total Benefits	20,349	31,764	24,899
Av. Total Benefits over the Harvests $			25,671
Total Benefits (+SE)	22,417	34,577	27,298
Av. Total Benefits over the Harvests $			28,097
Total Benefits (-SE)	18,281	28,952	22,500
Av. Total Benefits over the Harvests $			23,244
Costs			
Cubic metres of compost/ha	165	0	0
Cost per cubic metre $	24.5		
Cost of compost annually/ha $	4042.50		
Labour: casual & permanent $	220	220	220
Irrigation	334	334	334
Herbicide costs for weeds $	110	110	110
Herbicide costs for pests $	328	328	328
Fertilisers $	306	306	306
Pruning $	250	250	250
Harvesting costs $	682	682	682
Machinery operating costs $	390	390	390
Other Costs (seeds & seedlings, Freight costs, and Other costs) $	257	257	257
Total Costs	**6,920**	**2,877**	**2,877**

Applying Compost Mulch 150 mm Mulch Application	Vines - Average 1st harvest	Vines - Average 2nd Harvest	Vines - Average 3rd Harvest
Benefits			
Yield (kg/vine)	8.00	11.90	11.80
Standard error	0.83	1.10	0.97
Yield (kg/vine) (+SE)	8.8	13.0	12.8
Yield (kg/vine) (-SE)	7.2	10.8	10.8
Yield/ha	13.20	19.64	19.47
Yield/ha (+SE)	14.58	21.45	21.07
Yield/ha (-SE)	11.83	17.82	17.88
Price received $	1504.00	1504.00	1501.00
Revenue $	19,853	29,531	29,225
Av. Revenue over the Harvests $			26,205
Revenue $ (+SE)	21,921	32,261	31,619
Av. Revenue over the Harvests $			28,602
Revenue $ (-SE)	17,785	26,801	26,830
Av. Revenue over the Harvests $			23,808
Water cost savings $	0.00	0.00	0.00
Total Benefits	19,853	29,531	29,224
Av. Total Benefits over the Harvests $			26,205
Total Benefits (+SE)	21,921	32,261	31,619
Av. Total Benefits over the Harvests $			28,602
Total Benefits (-SE)	17,785	26,801	26,830
Av. Total Benefits over the Harvests $			23,808
Costs			
Cubic metres of compost/ha	495		
Cost per cubic metre $	24.5		
Cost of compost annually $	12127.50		
Labour: casual & permanent $	220	220	220
Irrigation $	334	334	334
Water costs $	334	334	334
Herbicide costs for weeds $	110	110	110
Herbicide costs for pests $	328	328	328
Fertilisers $	306	306	306
Pruning $	250	250	250
Harvesting costs $	682	682	682
Machinery operating costs $	390	390	390
Other Costs (seeds & seedlings, Freight costs, and Other costs) $	257	257	257
Total Costs	**15,005**	**2,877**	**2,877**

Benefit Cost Analysis for Vines for All Regions and Grape Varieties

Benefit cost analysis of Organic Mulch in Wine Industry	**All Regions**						
Discount rate	7%						
Mean of yields	**Cabernet Sauvignon and Shiraz Grapes**						
Year	***1999***	***2000***	***2001***	***2002***	***2003***	**Sum**	
Discount factor	1.000	0.935	0.873	0.816	0.763		
Base Case Benefits	19,605	27,877	22,252	23,244	23,244	**116,222**	
Organic Mulch Benefits 10 mm	21,127	28,588	27,887			**77,602**	
Organic Mulch Benefits 50 mm	20,349	31,764	24,899	25,671	25,671	**128,354**	
Organic Mulch Benefits 150 mm	19,853	29,531	29,224	26,205	26,205	**131,018**	
Difference - 10 mm	1,522	711	5,635				
Difference - 50 mm	744	3,888	2,647	2,426	2,426		
Difference - 150 mm	248	1,654	6,973	2,960	2,960		
Non-use benefits ?							
Total benefits - 10 mm	1,522	711	5,635			**7,869**	
Total benefits - 50 mm	744	3,888	2,647	2,426	2,426	**12,132**	
Total benefits - 150 mm	248	1,654	6,973	2,960	2,960	**14,796**	
PV total benefits - 10 mm	1,522	665	4,922			**7,109**	
PV total benefits - 50 mm	744	3,633	2,312	1,981	1,851	**10,522**	
PV total benefits - 150 mm	248	1,546	6,090	2,417	2,259	**12,560**	
Base Case Costs	2,877	2,877	2,877	2,877	2,877	**14,385**	
Organic Mulch Costs - 10 mm (reapplication every 3 years)	3,686	2,877	2,877			**9,440**	
Organic Mulch Costs - 50 mm	6,920	2,877	2,877	2,877	2,877	**18,428**	
Organic Mulch Costs - 150 mm	15,005	2,877	2,877	2,877	2,877	**26,513**	
Total costs - 10 mm	809	-	-			**809**	
Total costs - 50 mm	4,043	-	-	-	-	**4,043**	
Total costs - 150 mm	12,128	-	-	-	-	**12,128**	
PV Total costs - 10 mm	**809**	**-**	**-**	**-**	**-**	**809**	
PV Total costs - 50 mm	4,043	-	-	-	-	**4,043**	
PV Total costs - 150 mm	12,128	-	-	-	-	**12,128**	
						8.79	**10 mm BCR**
						2.60	**50 mm BCR**
						1.04	**150 mm BCR**

Appendix B
Water In South Australia

B.1 An Overview of Water Issues in Australia

Agriculture is the largest sectoral water user in Australia. Agriculture consumes more than 70 per cent of the country's stored water (including groundwater). As a proportion of land area, irrigation appears insignificant. Australia's 2.5 million hectares of irrigated crops and pastures are less than one half of 1 per cent of the total agricultural land and about 12 per cent of the total area of crops and pastures. In terms of value of production, however, irrigation is hugely important. The value of irrigated production fluctuates between 25 and 30 per cent of Australia's gross value of agricultural output (Cape, 1997; 1998).

Almost all fruits and vegetables are produced with some form of irrigation. Irrigation supports all rice production, and most dairy and cotton as well as significant amounts of soybeans and sugar. Its contribution to meat, cereal, pulse and oilseed production is relatively minor (DPIE, 1996).

Irrigated crops vary greatly in areas irrigated, water used, and production values. In the Southern Murray–Darling Basin, citrus, grapes and other horticulture account for 16 per cent of total water use and more than 50 per cent of total gross margin. Rice accounts for 25 per cent of total water use, but only 8 per cent of total gross margin (Hall et al. 1994).

Water costs make up a very small proportion of production costs. For vegetables, water accounts for only one per cent of average cash costs; for fruits, it represents about four per cent (IC, 1993). A long standing controversial aspect of irrigation in Australia is the low value crops that are grown. Irrigation land use is dominated by pastures and other low value crops. For example, rice and pasture return only $0.09 per kilolitre of water used while fruits, vegetables and wine grapes return from $1.00 to $5.00 per kilolitre of water used.

Many crops grown are of low value in relation to their water requirements — although major export earners (Meyer 1992). A common conclusion of agricultural water use studies over the years has been that the price of water has not been a critical factor in the choice of crop (Smith, 1998) nor the choice of irrigation technology.

Table B.1 illustrates the percentage of production attributable to irrigation in four states and in Australia as a whole. Within South Australia, the main crops requiring irrigation include vegetables, fruit, grapes, pastures and milk respectively.

Table B.1
Percentage Of Production Attributable To Irrigation - 1990

Crop	Queensland	NSW	Victoria	SA	Australia
Rice	100	100	0	0	100
Apples	97	97	97	97	97
Citrus	95	95	95	95	95
Pears	95	95	95	95	95
Apricots	100	90	100	95	92.9
Vegetables	96	81	83	96	91
Grapes	99.2	85.9	94.5	81.3	88.5
Peaches	87	87	87	87	87
Cotton	80	80	0	0	80
Maize	6	89	0	0	70.1
Oilseeds	50	65.5	95	7	65.8
Milk	33	47	47	51	44
Pastures	0.8	50.3	5.6	54.5	19.8
Sheep	1	20	5	1	6.6
Wool	1	7	2	0.5	3.2
Cereals	5.2	6.9	0.2	0	2.1
Wheat	0	5	0	0	1.2
Barley	1.5	6.2	0	0	1.2
Cattle	0.5	0.5	0.3	0.3	0.4

Source: Australian Irrigation Council, Melbourne

B.2 Water Sources and Use in South Australia

South Australia has 3,300 million KL of available water. Table B.2 illustrates that just less than half of the State's water supplies is subterranean. South Australia is dependent upon groundwater for much of its irrigated agriculture, and a high proportion of irrigation occurs outside of the Riverland (Thomson, 1997). These groundwater resources are most often aquifers.

With limited possibilities for expanding supplies, the continued expansion of irrigated agriculture in South Australia is dependent on sustainable demand management practices. Table B.3 presents an overview of the State's water use, indicating that irrigation accounts for 71 per cent of total water use.

Table B.2
Water Source In South Australia

Source	Gigalitres
Groundwater	1,400
Re-claimed	50
Murray	1,050
Streams & Dams	800
Total	**3,300**

Source: Thomson (1997)

Table B.3
Water Use In South Australia

Use	Gigalitres
Irrigation	1,000
Domestic	250
Industry	100
Rural	50
Total	**1,400**

Source: Thomson (1997)

Irrigated agriculture plays an important economic role in South Australia's economy. With a total farmgate value in the mid 1990s of $530 million, irrigated agriculture represents 25 per cent of total agricultural production in the State.

Much of this irrigation is for low value production. In South Australia, some 20 per cent of the irrigators, use around 70 per cent of the water on 50 per cent of the land to produce less than 10 per cent of value of irrigated agriculture (Thomson, 1997).

The main regions of irrigated agriculture in South Australia and their values are shown in Table B.4.

Table B.4
Irrigated Agriculture In South Australia

Region	$Million	Hectares
Barossa	**17.9**	**4,430**
Riverland	225.6	25,028
Lower Murray	32.9	11,219
North Adelaide Plains	**41.0**	**2,951**
Central Mt Lofty Ranges	61.1	5,345
Southern Vales	23.3	3,234
Upper South East	41.4	24,614
South East Coast	11.8	9,984
Lower South East	42.9	10,885
Total SA	**497.9**	**97,690**

Source: Thomson (1997)

Table B.5 indicates irrigation water requirements of various crops. Pastures are the crops requiring the largest amount of water, followed by almonds and flowers. Herbs require the least amount of water.

Table B.6 details the value of irrigated produce for South Australia and Australia as a whole our ten main crops. Grapes have the highest irrigation value, followed by vegetables, milk and other fruit.

Table B.5
Irrigation Water Required For Various Crops

Crop	Indicative irrigation water requirements Kilolitres per hectare per year (per crop if more than one crop is possible in a year)
Lucerne	8,000-10,000
Almonds	5,500-7,500
Olives	5,000-6,500
Onions	5,000-6,000
Vines*	5,000-6,000
Flowers	4,000-8,000
Potatoes	4,000-7,000
Cereal Crops	4,500-6,000
Lettuce	4,000-6,000
Carrots, parsnips and turnips	4,000-5,000
Cauliflower, cabbage or broccoli	4,000-5,000
Celery	3,000-5,000
Capsicums	3,000-5,000
Herbs (including parsley)	1,000-2,000
Tomatoes	200-280 per 150m2 glasshouse
Cucumbers	120-170 per 150m2 glasshouse

Note: * In the Barossa, supplementary irrigation of vines is based on an irrigation application rate of 1,000 kL/Ha.
Source: Water Reticulation Systems Virginia

Table B.6
Value Of Irrigated Produce In SA 1995-96

Commodity	South Australia $ millions	Australia $ millions
Cereals	n.a.	60.5
Cane	n.a.	1,319.6
Cotton	n.a.	964.5
Rice	n.a.	213.2
Pastures & Grasses	27.5	119
Apples	28.8	281.2
Other Fruit	134.9	892.6
Milk	170.2	2,965.3
Vegetables	219.2	1,461.7
Grapes	331.8	675.1
Total	**912.4**	**8,952 .7**

Source: ABS Rural Survey

B.3 Water Resources and Use in the Northern Adelaide Plains

The Northern Adelaide Plains (NAP) region has been included in this report because of the importance of the sector in vegetable producing. Water resources in the area have always been limited and controversial, hence any potential saving in water and its costs would be considerably welcome.

Most water in the NAP is obtained using groundwater from two aquifers within the region. All users are required to have a license. Before the implementation of the *Water Resources Act 1997*, water users were not charged.[27]

In 1998, the local licensed water allocation was 26,500 ML per annum, with an average use of only 17,000 ML because of the limited supply available (NABCWMB 1998). Estimates in 1995 placed the sustainable yield of water in the NAP at about 6,000 ML per annum (SACES 1995). It is currently estimated that the current annual allocation is more than 3 times the amount which is annually recharged into the aquifers.

Within the NAP, use of groundwater over the years has resulted in an increase in salinity of about 5 mg/L per annum (SACES 1995). A 1996 study identified a number of other issues related to water availability and management issues in the Barossa and NAP (Patrick 1996). These include:

- water availability is a barrier to economic development;
- the groundwater system is operating under severe stress, the sustainable rate of use has been exceeded for many years;
- water quality has deteriorated;
- water pressure in the confined aquifer has dropped;
- treated effluent is a relatively undeveloped and untried resource;
- allocations are three times the sustainable limit; and
- some areas remain prone to flooding.

The data in Table B.4 (from the mid 1990s) suggest that the NAP and Barossa regions together account for 12 per cent of the value of South Australia's irrigated production (SA's total production was approximately $498 million) and 7.5 per cent of the irrigated area (where SA's total irrigated area was 97,690 hectares, and NAP's and Barossa's total irrigated area was 7,381 hectares).

B.4 Expenses Incurred by South Australian Fruit and Vegetable Producers

Table B.7 illustrates the cost and share of expenses for fruit and vegetable agricultural industries in South Australia. The average cost share of irrigation (between 1994-95 to 1996-97) for fruit and vegetable producers is considerably higher (10 and 3 percent respectively) than the overall average for all agricultural industries (which was 2 percent).

The five highest costs incurred by vegetable producers in 1996/97 was for crop and pasture chemicals (22 per cent); fertiliser and soil conditioners (20 per cent); seed, seedlings and plants (19 per cent); marketing expenses (11 per cent); and fuel and lubricants (7 per cent). In comparison, water rates and drainage charges in 1996-97

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27 Pumping coats have been estimated at 6-7 cents per kilolitre and water used beyond the quota is charged at mains-water rates. Average annual fees to renew water licenses and monitor water meters was approximately $192 (Government Gazette 1997). It is hoped that all will be replaced by December 1999, so the meter rent will not apply beyond 1999.

represented 4 per cent of total expenses for vegetables.

Table B.7
South Australian Costs For Fruit And Vegetable Agricultural Industries

Item / *Industry*	**1994-95** ***($'000)***	**1995-96** ***($'000)***	**1996-97** ***($'000)***	**1994-95** %	**1995-96** %	**1996-97** %
Payments for Crop and Pasture chemicals						
Fruit	10,358	9,718	13,453	12.0	10.4	11.2
Vegetable	9,973	8,375	12,582	12.2	13.6	22.4
Payments for fertiliser and soil conditioners						
Fruit	5,349	8,034	12,964	6.2	8.6	10.8
Vegetable	11,975	12,316	10,939	14.7	20.0	19.5
Payments for seed, seedlings and plants						
Fruit	4,813	4,546	9,994	5.6	4.9	8.3
Vegetable	11,782	8,492	10,588	14.4	13.8	18.9
Other crop and pasture expenses						
Fruit	4,180	1,341	2,537	4.8	1.4	2.1
Vegetable	607	776	2,004	0.7	1.3	3.6
Contract payments for work on crops and pastures						
Fruit	11,730	20,542	22,350	13.6	21.9	18.6
Vegetable	6,534	1,365	2,773	8.0	2.2	4.9
Rates paid to Vermin and weed authorities						
Fruit	27	59	140	0.0	0.1	0.1
Vegetable	0	2	1	0.0	0.0	0.0
Water rates and drainage charges						
Fruit	6,540	10,894	14,760	7.6	11.6	12.3
Vegetable	1,827	1,069	2,317	2.2	1.7	4.1
Land tax & land rates						
Fruit	2,831	4,944	5,185	3.3	5.3	4.3
Vegetable	1,699	1,193	1,449	2.1	1.9	2.6
Other rates taxes & licences						
Fruit	824	1,440	1,748	1.0	1.5	1.5
Vegetable	265	383	346	0.3	0.6	0.6
Electricity & gas charges						
Fruit	5,611	6,232	8,380	6.5	6.7	7.0
Vegetable	3,425	3,664	3,059	4.2	6.0	5.5
Payment fuels & lubricants						
Fruit	9,117	6,700	9,267	10.5	7.2	7.7
Vegetable	7,999	7,755	3,638	9.8	12.6	6.5
Marketing expenses						
Fruit	25,102	19,224	19,274	29.0	20.5	16.1
Vegetable	25,465	16,058	6,372	31.2	26.1	11.4
Total Expenses						
Fruit	86,482	93,674	120,052	100.0	100.0	100.0
Vegetable	81,551	61,448	56,068	100.0	100.0	100.0

Source: ABS, Selected Financial Statistics, South Australia