May 2002

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EVALUATION SUMMARY

What we did?

- eSYS Development and BDA Group were contracted by the GWRDC to carry out an economic evaluation of 22 research project proposals as part of the selection and approval process for new projects in 2002/03. Following consultation with key GWRDC staff, the following proposals were selected:

    1. SpraySmart - Interactive spray application CD-ROM for viticulture
    2. Winegrape Crop Forecasting Training Module
    3. A total system approach to sustainable pest and weed management in grapevines: research, demonstration, and cost benefit analysis project
    4. Assessment of the environmental impact of fertiliser applications to vineyards
    5. Better disease control by using adjuvants
    6. Control of downy mildew of grapevines by boosting their natural defence system
    7. Groundwater allocation policies to maximise viticultural benefits from groundwater use
    8. Improved management of grapevine powdery mildew
    9. Improving pesticide dose efficiency
    10. Improving vineyard productivity through assessment of bud fruitfulness and bud necrosis
    11. Improving water use efficiency of vineyards in the Great Western region by using effluent water and soil amelioration practices
    12. Investigating the negative impacts of excessive bunch exposure on colour and flavour compounds in grapes and wine
    13. The impact of deteriorating irrigation water quality on the grape industry in the MDB
    14. When to water? Assessment of plant-based measurements to indicate irrigation requirements
    15. A multi-disciplinary analysis of subjective and objective responses to TCA in wine, using sensory, chemical, and electrophysiological techniques
    16. Bunch stem and berry development in merlot and cabernet sauvignon and their effects on berry ripening and composition
    17. Improving the quality of Cabernet Sauvignon grown in warm and hot regions
    18. Removal of mousy taint from wine using molecular imprint polymer technology
    19. Impact of the winery wastewater on ecosystem health
    20. Improving fermentation activity, colour and flavour of wine by using ultrasonics
    21. A social atlas of Australia's wine regions 2001
    22. The economic performance of wine grape growing in Australia

- Benefit cost analysis was used to derive estimates of each project proposal's expected economic pay off – as measured by a project's net present value (the difference between project benefits and costs over a 20 year period) and benefit cost ratio (the ratio of all project benefits to all project costs).

- A value chain summary was also prepared and presented. The summary provides key background assumptions used in the evaluations.

How we did it?

- Project benefits were determined in consultation with potential Principal Investigators and during a workshop with wine-makers and viticulturists. Project costs were obtained from project documents and consultant estimates of possible additional R&D expenditure required for commercial development.

- In estimating project benefits, an assessment was first made on what the R&D would produce and what additional investment would be required to produce an application ready outcome or technology (product, process or information). Industry benefits considered included lower production costs, increased consumer demand (which leads to higher prices), higher quality production, and increased yields.

- A one page summary of each evaluation was prepared and is included in this report. Each summary makes explicit the assumptions regarding industry outcomes, benefits to individual technology users, technology adoption through time and risk or chance of achieving a successful outcome. Research lead time has been built into adoption assumptions or appropriation of benefits where appropriate (details provided in appendix).

What we found?

- 22 proposals were assessed – with GWRDC and other industry partner investment having an annual cost of $3.2 million. The highest annual cost projects included improved management of grapevine powdery mildew ($300K), investigating the negative impacts of excessive bunch exposure on colour and flavour ($285K), plant-based measurement for irrigation scheduling (237K), improving pesticide dose efficiency ($204K) and improving water use efficiency in the Great Western region ($298K).

- Only a limited number of projects had a high expected pay off (more than $10 of benefit for every $1 invested). High pay-off projects included a crop forecasting tool, beneficials as part of integrated pest management, assessment of bud fruitfulness and bud necrosis, impacts of excessive bunch exposure on colour and flavour compounds in grapes and wine, influencing groundwater policies and use of adjuvants in disease control.

- The investment cost, risk and reward, by project proposal are provided in the Table 1. Note: Reward is expressed as the benefit cost ratio at 100% chance of success. Benefit cost ratio was calculated on all project costs (which include GWRDC and partner contributions). Project cost is only reported for 2002/03. Expected pay off is also included and is given by the benefit cost ratio based on the investment's chance of success.

- To date, GWRDC has undertaken an economic evaluation of the majority of investment projects that will receive funding support from 2002/03. This will enable future opportunities for investment to be assessed against the total portfolio, rather than as stand-alone investment opportunities.

- Similar to the previous assessment, it was not possible to derive monetary estimates for potential environmental impacts within this consultancy time frame. Potential environmental threats to the wine industry should, however, be quantified and individual projects assessed on the basis of their contribution to reducing any environmental risks or consequences. In the absence of this data, it is extremely difficult to determine the magnitude of environmental benefits that could be attributed to individual projects.

TABLE 1: INVESTMENT COST, RISK AND POTENTIAL REWARD

Proposal	Page number	Project Title	Annual Cost ($'000)	Risk (%)	Reward (BCR)	Expected Pay off (BCR)
1	**14**	**SpraySmart**	74	40	14	**6**
2	**15**	**Winegrape crop forecasting**	201	40	114	**46**
3	**16**	**A total system approach to sustainable pest and weed management**	132	40	50	**20**
4	**17**	**Assessment of the environmental impact of fertiliser applications**	185	30	5	**1**
5	**18**	**Better disease control by using adjuvants**	151	20	56	**11**
6	**19**	**Control of downy mildew of grapevines**	73	20	29	**6**
7	**20**	**Groundwater allocation policies**	87	15	111	**17**
8	**21**	**Improved management of grapevine powdery mildew**	300	40	8	**3**
9	**22**	**Improving pesticide dose efficiency**	204	40	24	**9**
10	**23**	**Improving vineyard productivity through assessment of bud fruitfulness and bud necrosis**	137	20	130	**26**
11	**24**	**Improving water use efficiency of vineyards in the Great Western region**	298	35	<1	**<1**
12	**25**	**Investigating the negative impacts of excessive bunch exposure on colour and flavour**	285	30	37	**11**

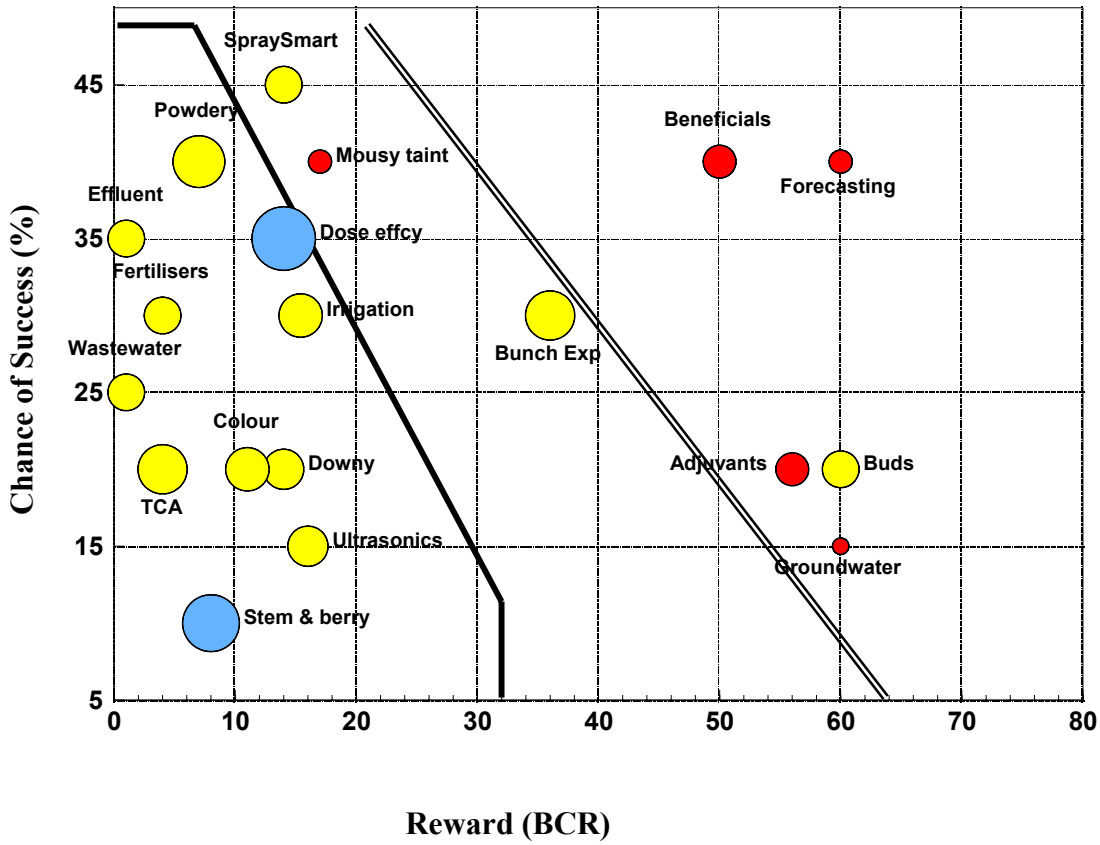
Summary

Proposal	Page number	Project Title	Annual Cost ($'000)	Risk (%)	Reward (BCR)	Expected Pay off (BCR)
13	**26**	**The impact of deteriorating irrigation water quality on the grape industry in the MDB**	28	50	NA	**NA**
14	**27**	**When to water? Assessment of plant-based measurements to indicate irrigation requirements**	237	30	15	**5**
15	**28**	**A multi-disciplinary analysis of subjective and objective responses to TCA**	147	20	4	**2**
16	**29**	**Bunch stem and berry development in merlot and cabernet sauvignon**	100	10	28	**3**
17	**30**	**Improving the colour of Cabernet Sauvignon grown in warm and hot regions**	40	20	11	**2**
18	**31**	**Removal of mousy taint from wine**	83	40	17	**7**
19	**32**	**Impact of the winery wastewater on ecosystem health**	180	25	2	**1**
20	**33**	**Improving fermentation activity, colour and flavour of wine by using ultrasonics**	88	15	16	**3**
21	**34**	**Social atlas of Australia's wine regions 2001**	59	100	NA	**NA**
22	**35**	**The economic performance of wine grape growing in Australia**	99	80	NA	**NA**

Portfolio Matrix: Risk / Reward Tradeoff

Each of the 22 project proposals are plotted on the following matrix (by economic impact (reward) and respective level of risk) to gain an appreciation for portfolio balance and the relative importance of differing research fields in the delivery of industry value. The size of the circle reflects the relative size of the investment in each theme. (Red <$0.5m, brown $0.5m to $1m, green $1m to $2m and blue >$2m.)

FIGURE 1: GWRDC PROPOSED PROJECTS: RISK VERSUS REWARD



Key points

- ➡ Most of the projects have a poor risk / reward trade-off. (In Figure 1 the Reward from three project investments – Forecasting, Bud Necrosis & Groundwater Policies – have been understated to enable a better graphically representation of all investments. The estimated rewards from these investments are substantially higher, as reported in Table 1.)

- ➡ Potential investments underneath the double line, but outside the bottom left dark line could be re-positioned to address or to achieve greater reward for the risk taken or lower risk for the potential reward. 3 out of the 22 investments were in this category.

- ➡ Investments in the area underneath the dark line on the left have a poor risk / reward trade-off (11 investment projects), and should be re-structured or considered against other areas of potential benefit - including developing industry or scientific capacity, addressing stated social objectives, positioning the industry against future threats or enhancing the environment.

VALUE CHAIN SUMMARY

Physical Structure

FIGURE 2: GRAPE TO WINE (2001)

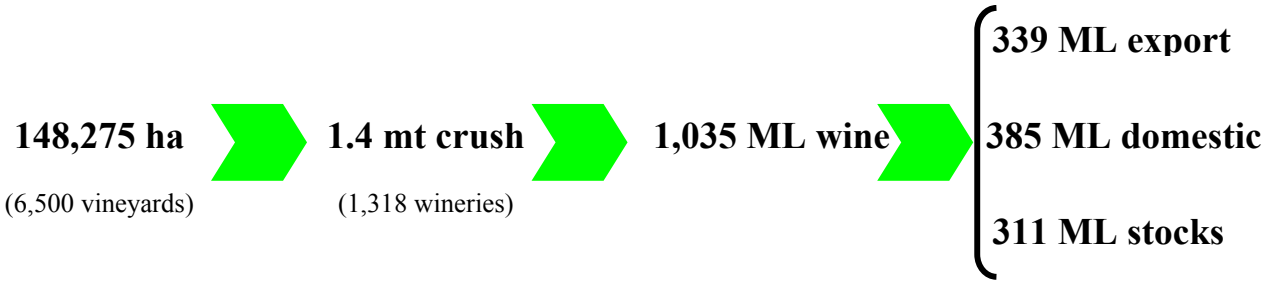


TABLE 2: GRAPE PRODUCTION: BY STATE: 2001

Variable	SA	NSW	VIC	WA	TAS	QLD	AUST
Area ('000ha)	62.2	34.6	36.9	10.9	0.9	2.3	148.3
Crush ('000t)	716	430	217	56	5	1.4	1,424
Yield (t / ha)	13	14	7	6	6	1	11
Red (%)	66%	44%	44%	50%	NA	60%	55%
White (%)	34%	56%	56%	50%	NA	40%	45%
Area Irrigated (%)	80%	72%	87%	46%	0%	43%	76%
Water Use (ML/ha)	5.7	16	10.5	4.2		5.1	9.3

Note: Non-bearing vines 11% of area. Production from cool climate areas expected to reach around 42% of total production by 2003.

TABLE 3: VARIETY PRODUCED: 2001 CRUSH: TONNES

Variety	Australia
Red	**752,662**
Cabernet Sauvigon	243,554
Shiraz	312,868
Merlot	75,943
Other	120,297
White	**605,772**
Chardonnay	241,896
Semillion	85,989
Other	277,887

Note: Other white – 128kt Sultana & Muscat Gordo Blanco

Cool region production accounts for approximately 47% and 30% of the National annual red and white grape crush respectively.

TABLE 4: WINE DISPOSAL: ML (2003)

Variety	Domestic	Export
Premium Red	82	328
PremiumWhite	84	130
Non-Premium	254	41
Total	**420**	**499**

Source (CIES Anderson 2000 – based on Australian production)

Wine production is carried out by 1,318 wineries across Australia. The largest 3 wineries account for just over 50% of production (70% of exports) and the largest 9 for 78%. Some 306 wine making businesses crush more than 50 tonnes of grapes a year.

Financial Flows

FIGURE 3: GRAPE TO WINE (2001)

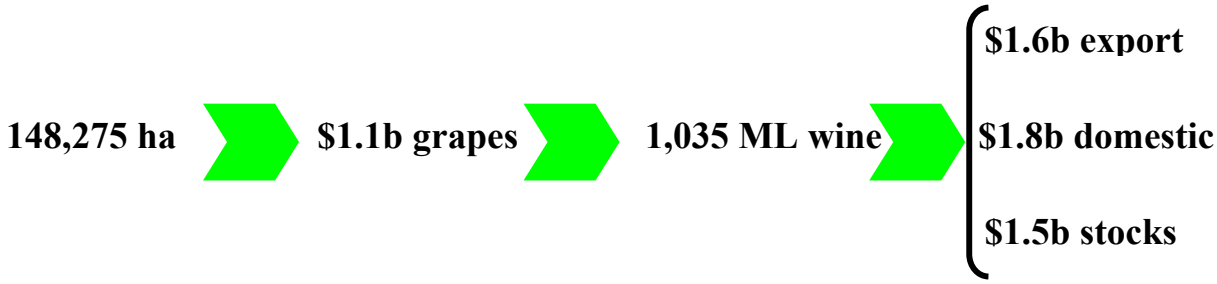


TABLE 5: VARIETY PRODUCED: 2000 CRUSH: $ PER TONNE

Variety	Australia
Red	**$1,000**
Cabernet Sauvigon	$1,165
Shiraz	$1,060
Merlot	$970
Other	$800
White	**$600**
Chardonnay	$885
Semillion	$600
Other	$400

Note: Average price all grapes = $800 per tonne. ABARE Price forecasts for 2005 are around $700 per tonne for red and white.

TABLE 6: WINE PRICES: 2001: FOB

Market	Volume (ML)	Price ($/L)
United Kingdom	183	4.15
United States	78	5.85
New Zealand	23	3.61
Canada	17	6.23
Germany	13	4.23
Total	**375**	**4.70**

Source: Wine Industry Information Service (AWBC 2002). Average consumer price estimated at (CIES 200) $12.22 / l premium red, $10.59 / l premium white and $.62 / l non-premium..

Since 1998 the average export price of Australian wine has increased from $4.20/l to $4.76/l. Over the same period bottle red wine increased $0.57/l to $5.97/l; bottled white increased 16c/l to $4.52/l; bulk red wine increased $0.19/l to $1.95/l and bulk white wine increase $0.05/l to $1.17. (Source: McGrath-Kerr 2001)

Farm Level Costs of Production

TABLE 7: FARM OPERATIONS: BY REGIONS: AVERAGE PER FARM.

Market	Sunraysia	Rest Victoria	Loxton
Grape Yield (tonnes / ha)	26	8	14
Fertiliser ($/ha)	379	166	260
Chemicals ($/ha)	441	457	350
Fuel ($/ha)	145	234	200
Repairs and Maintenance ($/ha)	409	448	630
Contractors ($/ha)	900 [b]	432	360
Water and Drainage ($/ha)	230	103	280
Labour [a] ($/ha)	2,220	5,554	2,860
Total Variable Costs ($/ha)	5,040	8,095	6,590
Gross Margin ($/ha)	**13,205**	**5,019**	**2,900**

Source: Sunraysia (also includes Griffith) and rest of Victoria drawn from Rendell McGuckian Benchmarking study 2000 (costs average 97/98 and 98/99) and Loxton taken from ABARE benchmarking study 2001 (note costs are for 96-97). (a) Includes allowance for operator and operators family labour input. (b) 62% for contract harvesting.

Disease Management

Grape producers use a variety of control methods to offset production losses associated with pests and diseases. Estimated national control costs of disease management across all regions of the Australian wine industry are provided in the following table – following discussions with R. Emmett. Despite the employment of pest and disease management programs, major diseases inflict yield and quality losses. Estimated costs are provided in Table 8.

TABLE 8: ANNUAL CONTROL AND PRODUCTION LOSS COSTS OF MAJOR DISEASES IN 1996

Disease[a]	Powdery Mildew [c]	Downy Mildew	Botrytis [d]
	$ million/year	$ million/year	$ million/year
Control [b]			
Annual cost (spray & application)	14	8	8
Production Loss			
Yield loss	13	-	17
Quality loss	4	-	1
Total Cost	**31**	**na**	**27**

(a): Disease severity and associated production losses for red and white grapes vary each season because of differences in weather conditions, varietal susceptibility and vineyard management.
(b): Assumes cool and warm irrigated vineyards receive 8 and 7 sprays per year respectively, with cool climate areas incurring greater average chemical usage costs because of treatment for Botrytis.
(c): Production loss calculation assume that powdery mildew causes widespread losses (10% crop loss, 20% of crop downgraded due to quality problems) one year-in-ten, moderate losses (4% crop loss, 10% of crop downgraded due to quality problems) six years-in-ten and no losses three years-in-ten. In this estimate, only white grapes are assumed to be affected.
(d): Production loss calculation assume that Botrytis (and other bunch rots) cause widespread losses in warm irrigated areas (10% crop loss, 15% of crop downgraded due to quality problems) one year-in-ten, moderate losses (5% crop loss) three years-in-ten and no losses six years-in-ten. Within cool areas, production loss calculation assume that Botrytis (and other bunch rots) cause widespread losses (25% crop loss, 13% of crop downgraded due to quality problems) one year-in-ten, moderate losses (10% crop loss, 6% of crop downgraded due to quality problems) five years-in-ten and no losses four years-in-ten. In this estimate, only white grapes are assumed to be affected.

It is evident that annual farm-level production loss costs are similar for both powdery mildew and Botrytis. Although not estimated, production loss costs associated with downy mildew are not likely to be greater than those calculated for powdery mildew or Botrytis.

Key Industry Assumptions from GWRDC cost benefit analyses.

Grape Production

- Some 60% of vineyards have a soil compaction problem.
- Vines re-planted every 15 to 20 years at cost of $3.50 per vine. Some 1,800 vines planted per ha with 12.5% vine failure.

- Herbicide cost estimated at $225 ha with 53% of cost in chemical and 37% labour.
- Phyloxera incidence around 1.5% of vines.
- Viruses cause up to 15% loss in yields a year.
- Yellows (AGY) incidence in Chardonnay and Riesling around 10% a year with yield losses up to 13% - annual cost on industry estimated at $2.3m.
- Insect / fungus controlled with around 8 sprays a year at cost of $50 per spray. Uptake of IPM principles has been widespread and number of sprays used falling and effectiveness increasing.
- Irrigation technologies have been well adopted with substantial savings in water applied per ha being realised – up to 4ML per ha. Partial rootzone drying anticipated to reach 50% of industry (70,000 ha) by 2008. Regulated deficit irrigation applicable to 10,000 ha.
- Water entitlements currently trade at $700 ML with an annualised value of $45ML.
- Harvesting costs between $30 and $50 per tonne.
- Vineyard profitability increases around 3% a year
- Grape production instability costs industry around $160 m a year.
- Colour discounts in cabernet sauvignon averages $50 a year across 30kt.

Wine Production

- Quality gains achievable include
  - Tannin management - $1 / l over 20 years (250 ML market)
  - Wine microbiology – 25c / l
  - Oak flavour enhancement – 50c / l (25ML market)
  - Consumer premium on better environmental management 10c / l (50ML)
- Grape sampling cost around $10 per sample – 100,000 samples a year.
- Cost of haze prevention around $45m a year.
- Random oxidation incidence around 4% of aged bottles – industry cost some $32m a year.
- Winery wastewater production is 1KL per tonne of grapes crushed. Treatment cost at $4 per KL.

- Cork taint incidence around 2% to 5% of bottled production.
- Mousy taint effects 1ML of wine a year with price impact of 50 c / l.
- Colour and flavour enhancement through ultrasonics could generate premium of 10c / l.

Winery Costs of Production

TABLE 9: WINE PRODUCTION COSTS $ PER BOTTLE

Cost Item	$20 Bottle	$11 Bottle
GST	1.81	1.04
Retailer Margin	5.16	2.69
WET	2.90	1.73
Distributor Margin	3.00	1.79
Winery Margin	1.06	0.56
Bottles & Packaging	1.17	0.76
Labour	0.34	0.23
Sale expenses	0.88	0.62
General & Admin	1.49	0.42
Grapes	1.78	0.62
other charges	0.29	0.96

Source: ACIL 2001 – Draft report to WFA.

ECONOMIC EVALUATION OF PROPOSED R&D INVESTMENTS

In this section economic evaluation parameters for future investments supported by GWRDC are discussed. Each evaluation has been reported in a consistent manner with key assumptions made explicit. The format used is described in some detail in the box below.

BOX 1: REPORTING FORMAT FOR INDIVIDUAL EVALUATIONS

R&D Output:

- What will be produced at the completion of the GWRDC supported project?
- Output will typically be a technology – be it a product, process or information.

Industry Outcome *:*

- What further steps will be required before the technology has a commercial application across the industry?
- When will the technology be commercially available?
- What type of gain or benefit will be realised by the industry?

Benefit in Use *:*

- For the typical technology user, what is the estimated benefit in dollar terms?
- Derivation of monetary benefits is shown.

Benefits through time

The distribution of estimated benefits over a 20 year period is shown graphically.

Adoption:

- Size of market
  How large is the target market where the technology could potentially be used?
- Max adoption (as % of market)
  What is the anticipated level of take-up or adoption within the target market?
- Rate of adoption %
  Over what period of time will the technology be taken up within the target market?

Risk: Risk level: (likelihood that industry outcome achieved)

- Is the commercial outcome guaranteed or is there an element of risk?
- What are the major determinants of project risk?

Conclusion :

- Is the project attractive from an economic perspective?
- What is key driver of pay off and at what point would the project break even?

R&D Output:

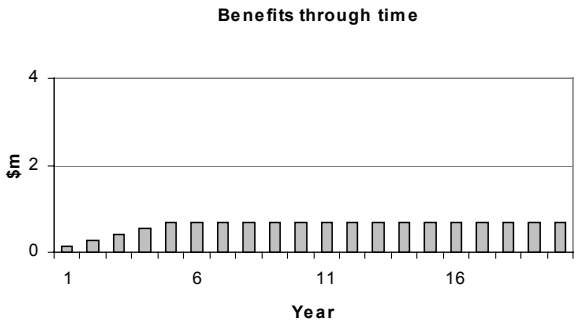
- Determine the appropriate tools and information required on the CD-ROM
- Develop software based interactive content from spray application workshop for pesticide applicators
- CD-ROM will contain video footage, self-assessment modules, software tools; and
- 500 copies of the CD-ROM produced and promoted by October 2003

Industry Outcome*:*

- Reduced chemical wastage, through improved efficacy of pesticide and fungicide use
- Decreased pest and disease pressures through more effective spray coverage – leading to increased grape production and enhanced fruit quality
- Lessened risk of residue problems and off-site impacts with more effective targeting of chemicals
- Provides benchmark set-up and calibration procedures for industry
- Assists in promoting existing industry-wide extension of best pest management practices within *Research to Practice* and other extension activities

Benefit in Use*:*

- Increased fruit quality (reduced powdery mildew and botrytis impact)
  - Assume increase in fruit quality generates premium (@$20/t)
  - Assume adoption of improved calibration or spraying program has no additional labour, capital or consumable costs.
  - Assume 2% of industry would adopt CD-ROM, leading to improved spraying and chemical usage
- Annual total benefit across target segment of industry = $0.7 m



Adoption:

- Max adoption – assume that 2% of industry adopt results
- Assumed that CD-ROM launched in 2003
- Rate of adoption - 5 yrs to maximum adoption
- On-going extension costs associated with promotion (@$0.1 million per annum)

Risk: Medium-low risk because (40% chance of success):

- Integrate with other extension activities
- Grower and consultant familiarity with software tools

Conclusion:

- Investment attractive with NPV = $2.5 m and BCR = 5.7.
- Only a small number of growers would need to benefit for the project to break-even

R&D Output:

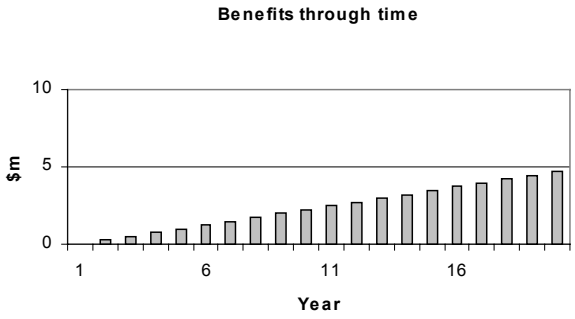
- Development of a Wine Grape Crop Forecasting Training module that can be delivered by training providers and industry extension personnel
- Development of manual, PC Software and interactive web site to support the crop forecasting module
- Series of workshops and training seminars (at least 6 representative groups in SE Australia) to evaluate and test the module and supporting materials
- Materials developed in conjunction with *Crop Control for Consistent Supply of Quality Winegrapes* & *Grapecheque* project teams.

Industry Outcome*:*

- Development of accurate crop forecasting techniques & tools would decrease the costs associated with crop production variability. Most notably, costs associated with overproduction, waiting, transporting, inappropriate processing and unnecessary inventory would be reduced.
- Increased fruit quality could also be expected as a result of the adoption of pruning practices to optimize yields and sugar content.

Benefit in Use*:*

- Reduced costs of production instability
  - Assume annual cost of grape production instability $160 million (transporting, inappropriate processing and unnecessary inventory) and improved forecasting and adoption of crop yield stability practices reduces cost by 25% where adopted
- Enhanced of grape quality
  - Assume manipulation for quality results in net benefit equivalent of 5% grape price increase (@$35/t)



Adoption:

- Enhanced crop control tools launched in 2004
- Rate of adoption @1% of all industry per annum across forecast evaluation period.
- Already projects developing crop forecasting tools (ie. *Crop Control for Consistent Supply of Quality Winegrapes)*. Of total benefits from reduced production instability costs, 25% attributed to this project.

Risk: Medium risk because (40% chance of success):

- Extent of adoption difficult to predict, will be largely driven by wineries demanding increased precision in farm consignment estimates.

Conclusion:

- Investment attractive with NPV = $8.9m and BCR = 45.6.
- A break-even maximum rate of adoption of 0.02% per year of industry would be required to justify project expenditures.

R&D Output:

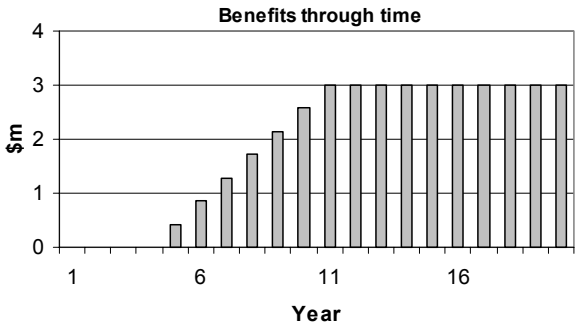
- Benchmark map for growers that will enable them to document all aspects of their pest management applications.
- Information on use and timing of chemicals that will enable grape growers to exploit impacts of beneficial for pest control. As part of this, information on the unintended effects of fungicides and insecticides on beneficial insect and mites will be made available through a grower's guide (also available on the web).
- Extension material for industry via a demonstration project in 3-4 vineyards and grower workshops.

Industry Outcome*:*

- There is a lack of information available to growers on the impact of chemical sprays on beneficial organisms. Current applications often cancel out the effect of beneficials and this in turn leads to unnecessary and ineffective post damage spray applications.
- For table grapes it has been demonstrated that spray applications can be reduced by up to two thirds as beneficial populations are maintained.
- For wine grape production it is anticipated that spray frequency can be reduced.

Benefit in Use*:*

- The main benefit will be a reduction in the number of sprays applied each year. On average, fungus and insects are controlled with 8 sprays per hectare each year at a cost of some $50 per ha per spray.
- With the project it is assumed that the number of sprays can be reduced by 1 a year - with regional and variety differences in type and timing of chemicals used. The number of total sprays used by growers is reducing now as growers are gaining a better understanding of IPM through the Research to Practice® series.



Adoption:

- Project results should be widely applicable as growers face similar pest problems and available chemicals.
- Target market is 150,000 ha across Australia with take up expected from 2006-7. Maximum adoption to 40% over 7 years.

Risk: Medium risk because (40% chance of success):

- Concept has been proven for table grapes and is established in the Australian citrus industry.
- Scientific assessment of chemical impacts straightforward.
- Main risk is whether or not more appropriate timing and chemical type will enable total spray number to be reduced.

Conclusion:

- NPV estimated at $7.2 and BCR at 20.
- Break even cost saving and adoption is estimated at $20 over 7,500 ha.

Assessment of the environmental impact of fertiliser applications to vineyards

R&D Output:

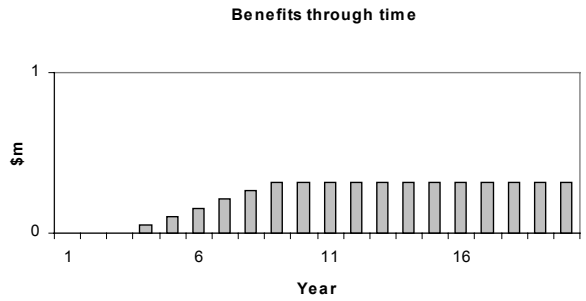
- Establishment of monitoring sites on four properties (Western Australia and Victoria) on sandy and duplex soil sites for collection of surface and sub-surface nutrient losses
- Measurement of nutrient losses from these sites & identification of annual rates of nutrient losses
- Quantification of nutrient losses from differing management practices for two seasons
- Production of guidelines for best fertilizer management practices in vineyards to minimize nutrient losses.

Industry Outcome:

- Enhancement of "clean and green" image of Australian viticultural industries through analysis of nutrient losses and development of best fertilizer management strategies
- Reduced potential for nutrient losses to cause pollution of surface and ground water – possibly resulting in eutrophication and algal bloom problems
- Better matching of plant nutrient demands with fertigation (irrigation and fertiliser application) resulting in cost savings for the farmer through reduced fertiliser overuse.

Benefit in Use: Improved fertiliser and irrigation management practices

- Reduced costs of irrigation and fertiliser application
  - Reduced cost of irrigation = @$50/ha
  - Reduced cost of fertiliser = @$20/ha
- Annual total benefit = $0.3 million



Adoption:

- Improved fertiliser management practices launched in 2006
- Rate of adoption @0.5% of all industry per annum
- Maximum adoption 3%. Fertilizer over-use is not common throughout the industry.

Risk: Medium risk because (30% chance of success):

- Adoption could be constrained if lower fertiliser application rates resulted in reduced vine growth
- No major technical issues are likely to constrain the establishment of monitoring sites and measurement of nutrient movement (using tried techniques).

Conclusion:

- Investment returns modest with NPV = $0.2 m and BCR = 1.4.
- A break-even maximum adoption of 2% of industry would be required to justify project expenditures.

R&D Output:

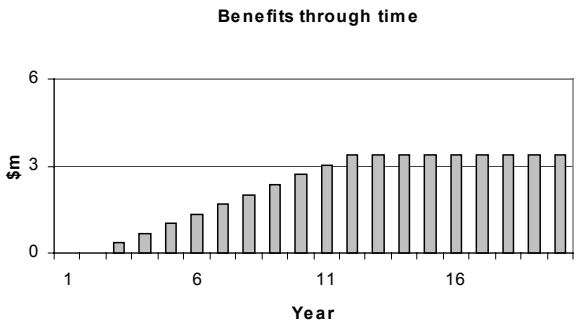
- Determine the physical and chemical interactions when conventional and adjuvants are used with a range of active ingredient formulations currently used in Australian viticulture
- Assess foliar deposits and penetrations of liquid films into grape bunches at flowering and various stages of bunch closure of a range of fungicide and adjuvant combinations
- Undertake field and laboratory trials to quantify changes in bio-efficacy when fungicides are deployed with various adjuvants
- Conduct trials to assess fungicide efficacy when application volumes are reduced (up to 50%)
- Synthesis of recommendations for bunch spray applications that are suited to Australian growing conditions

Industry Outcome*:*

- Lower spray volumes result in reduced fungicide costs, less water usage, decreased fuel expenses and reduced labour input
- Decreased Powdery/Downy Mildew and Botrytis through more effective spraying – increased grape production and enhanced fruit quality
- Lessened risk of residue problems and off-site impacts with more effective targeting of chemicals

Benefit in Use*:*

- Increased fruit quality (reduced disease incidence as a result of improved coverage and chemical efficacy)
  - Assume increase in fruit quality attracts premium of(@$20/t)
  - Assume 10% of industry would adopt adjuvants and spraying recommendations
- Annual total benefit across target segment of industry = $3.4 m



Adoption:

- Max adoption – assume that 10% of industry adopt results
- Assumed that new recommendations are launched by 2005
- Rate of adoption - 10 yrs to maximum adoption

Risk: Medium-high risk because (20% chance of success):

- Trials need to establish whether there are any adverse effects relating to efficacy, yield, quality or residues resulting from adjuvant usage
- Industry has adopted IPM practices in the pest, therefore adoption of adjuvants should occur if efficacious

Conclusion:

- Investment attractive with NPV = $4.1 m and BCR = 11.2.
- Only a 2 %chance of success would be required for project to break-even

Control of downy mildew of grapevines by boosting their natural defence system

R&D Output:

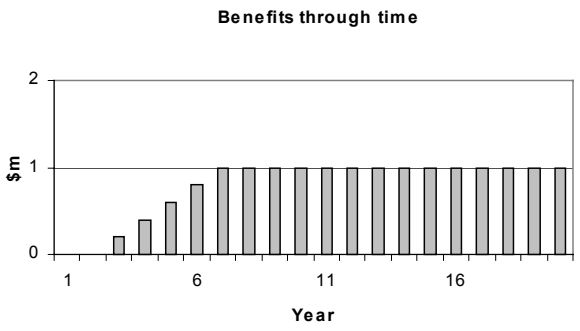
- Identification of soft chemicals which elicit natural downy mildew resistance
- Optimize the efficacy (dose and timing of application) of identified chemicals to maximize suppression of downy mildew
- Evaluate the efficacy of identified soft chemicals when used in conjunction with commonly used fungicides
- Determine if identified chemicals cause phyotoxicity in grapevines
- Record whether chemicals have activity against other grapevine pests, other pathogens, or on beneficial insects (i.e. predatory mites)

Industry Outcome:

- Reduce fungicide use on grape vines through identification and adoption of soft chemicals which elicit natural downy mildew resistance
- Decrease potential for residue impacts of export demand for Australia grape and wine products
- Decrease the potential of impacts of copper fungicide products.
- Reduce the production loss costs of downy mildew on the Australian grape industry.

Benefit in Use:

- Decreased the impact of downy mildew
  - Assume decrease in farm-level downy mildew production loss cost by $1 million per annum at maximum adoption of optimal control practices
  - Changes in annual control costs not calculated, as optimal timing and product usage yet to be determined
- Additional on-going research and development costs would be required to extension of project recommendations (@$0.1m per annum, for 5 years)



Adoption:

- Max adoption – assume that adoption results in a $1 million reduction in production loss cost of downy mildew.
- Assumed that new recommendations are launched by 2005
- Rate of adoption - 5 yrs to maximum adoption

Risk: Medium-high risk because (20% chance of success):

- Industry needs to be convinced of increased efficacy or other benefits of alternative fungicide products
- Previously developed pest management practice programs adopted by industry

Conclusion:

- Investment attractive with NPV = $1.4 m and BCR = 5.5.
- Extension project likely to facilitate registration and extension of best use products

Groundwater allocation policies to maximise viticultural benefits from groundwater use.

R&D Output:

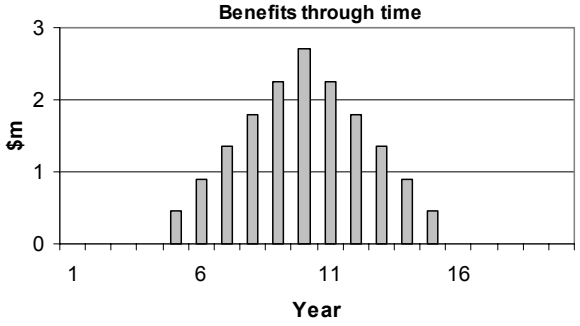
- ABARE has developed a groundwater model of an aquifer system that incorporates economic and hydrogeological aspects. This project will further develop and apply this model.
- The model will be used to assess the economic costs of different groundwater extraction rules. This will enable appropriate policy frameworks to be determined.
- Policy assessment will be documented and released as a public report.

Industry Outcome*:*

- This work will not have a direct impact on grape growers. Rather, findings will feed into groundwater policy development processes currently underway in South Australia and in other states.
- If policy is changed as a result of this work it is expected that growers with a groundwater extraction license will have greater flexibility in using groundwater from year to year. The net impact on vineyards will be increased availability of groundwater over time. In turn, this would increase average annual yields and / or quality.

Benefit in Use*:*

- Around 20,000 ha in South Australia rely predominately on groundwater and rain fed dams. Typical yields are around 9 t per ha and average water use some 2ML per ha.
- Assuming a 1 year in 5 drought, yields might drop 50% because of inadequate groundwater supplies. At $700 tonne this represents a loss of $3,150 every 5 years or $630 annually per ha.
- Policy reform likely to have occurred anyway without GWRDC input as groundwater likely to have increased emphasis in the future. GWRDC investment assumed to accelerate reform processes by 5 years.



Adoption:

- Adoption will mainly be limited to growers with groundwater extraction rights and flexibility to carry over extraction rights from year to year.
- Assume 25% benefit from policy change.
- Policy implemented in 2006-7.

Risk: High risk because (15% chance of success):

- Limited availability of information on groundwater hydrology and precautionary approach may be adopted.
- Policy reform will need to consider all industries not just grapes, although the same principles will apply for other industries.
- Policy reform at State level typically a slow process.

Conclusion:

- NPV estimated at $1.3m and BCR at 16.7.
- Breakeven at 2,000 ha avoiding 1.4 tonne yield loss once in 5 years.
- Pathway to achieving policy reform not direct and project better assessed as how cost-effective it is compared against other options that also are expected to lead to policy reform.

R&D Output:

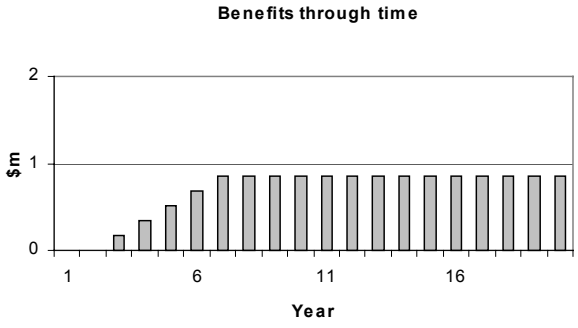
- Determine the period of susceptibility of grape vine buds to infection by the powdery mildew fungus
- Examination of the effects of environmental factors on bud infection and expression of disease
- Develop treatment programs – largely related to spray timings - to reduce bud infection, the expression of disease and/or infection in vineyards
- Communicate results of the R&D to industry stakeholders via seminars, workshops, reports and publications in industry and scientific journals

Industry Outcome:

- Improve the efficacy of fungicide use on grape vines through optimal application of currently available fungicides
- Increase level of grape production and fruit quality
- Decrease the estimated $17.2 million production loss cost impact of powdery mildew on the Australia grape industry.

Benefit in Use:

- Decreased the production loss impact of powdery mildew
  - Assume decrease production loss costs associated with powdery mildew reduced by 5% at maximum adoption
  - Assume adoption of improved treatment program has no additional labour, capital or consumable costs.
- Annual total benefit across target segment of industry = $0.9m
- Additional on-going research and development costs would be required for extension of project recommendations (@$0.05m per annum, for 3 years)



Adoption:

- Max adoption – assume that adoption results in a 5% reduction in cost of powdery mildew.
- Assumed that new recommendations are launched by 2005
- Rate of adoption - 5 yrs to maximum adoption

Risk: Medium risk because (40% chance of success):

- Development of reliable method for artificial infection of buds is important for success
- Success of field trials is dependant on suitable weather conditions for disease expression

Conclusion:

- Investment returns modest with NPV = $2.0 m and BCR = 3.2.
- Only 12% chance of success would be required for project to break-even

R&D Output:

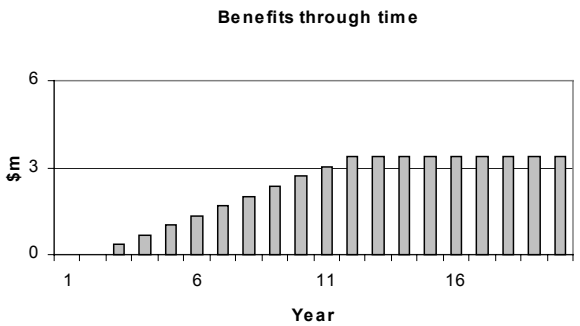
- Calibrate and evaluate a simple droplet rating chart to improve coverage and dose on foliage with pesticide application
- Validate the unit Canopy Row Model as a basis for achieving dose consistency in grapevine canopies of different size with pesticide applications (field trials conducted by June 1995)
- Protocols to establish appropriate spray volumes from droplet distribution data from dilute and concentrate spraying
- Chart and publications on appropriate spray volumes and row length calibration
- Dissemination of project findings into AVCARE information and *Research to Practice* workshops

Industry Outcome*:*

- Reduced chemical wastage, through improved efficacy of pesticide and fungicide use
- Decreased pest and disease pressures (through more effective coverage) and corresponding increased grape production and enhanced fruit quality
- Lessened risk of residue problems and off-site impacts as a result of more effective chemical targeting

Benefit in Use*:*

- Increased fruit quality (reduced mildew and botrytis impact), through optimized spraying
  - Assume increase in fruit quality generates premium (@$20/t)
  - Assume adoption of improved treatment program has no additional labour, capital or consumable costs.
  - Assume 10% of industry would adopt improved calibration and spraying recommendations
  - On-going costs of $100,000 per annum to continue extension
- Annual total benefit across target segment of industry = $3.4 million



Adoption:

- Max adoption – assume that 10% of industry adopt results
- Assumed that new recommendations are launched by 2005
- Rate of adoption - 10 yrs to maximum adoption

Risk: Medium risk because (40% chance of success):

- Some grower "mind shift" is required from area based to distance based calibration of spraying equipment
- Results would be adopted by target segment of industry. Mind shift issues would slow adoption

Conclusion:

- Investment attractive with NPV = $8.1 m and BCR = 9.4.
- Only a 3% chance of success would be required for project to break-even

R&D Output:

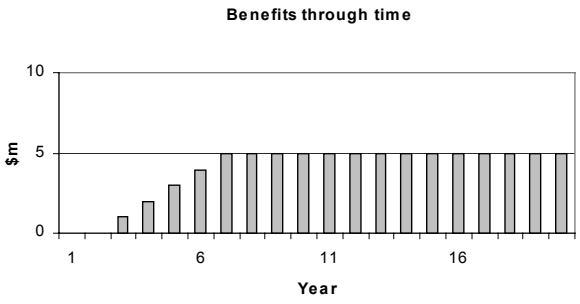
- Assessment of the distribution and impact of bud necrosis throughout the major grape-growing regions in South Australia, Victoria and New South Wales.
- Determination of the cause of bud failure and development of bud necrosis for major grape varieties in a selection of climates (measure shoot and bud development in field trials)
- Develop standard protocols for collecting and assessing dormant grapevine buds for fruitfulness
- Assessment of vineyards with necrotic buds for possible pathogenic causes using culturing and DNA-based procedures
- Synthesis of appropriate management options (pruning levels, shoot thinning, number shoots/node) for bud necrosis
- Extension of best practices via Research to Practice workshops, industry and scientific journals and provision of an information packages to consultancy and diagnostic services

Industry Outcome*:*

- Increase in the stock of knowledge about the scientific nature of bud necrosis
- Development of best management practices (pruning levels, shoot thinning, number shoots/node) for bud necrosis, which could possibly increase vineyard yields

Benefit in Use*:*

- Increased vineyard yields
  - Adoption of best management practices assumed to increase vineyard yields by 1 t/ha of bearing area (@$660/t net benefit of yield gain)
  - Optimal pruning levels and shoot thinning practices could be adopted at no additional costs, as these operations are currently conducted
  - Assume that 5% of the wine-grape industry could adopt best practices and capture production increases



Adoption:

- Assumed that bud necrosis practices are launched by 2005
- Rate of adoption – 5 yrs to maximum adoption
- Additional extension costs would be required for on-going recommendation dissemination (@$0.1 m per annum, for 3 years)

Risk: High risk (20% chance of success) because:

- Will require commercial support – crop consultant and associated services

Conclusion:

- Investment attractive with NPV = $8.1m and BCR = 25.9.
- Project would break-even with 0.1% adoption of best practices

Improving water use efficiency of vineyards in the Great Western region by using effluent water and soil amelioration practices.

R&D Output:

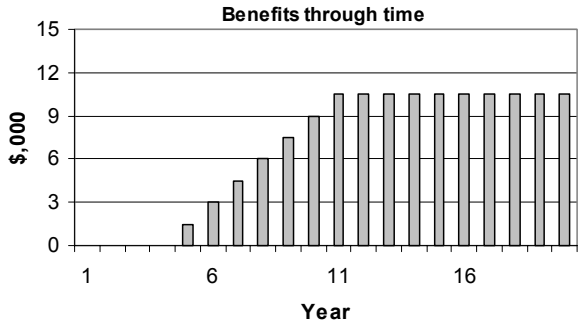
- Knowledge of impact of effluent water on sub-soil environment in region.
- Soil management strategies to increase water use efficiency through improving sub-soil environment where poor quality water is used.
- Protocols and procedures to assess risk of sub-soil impacts from using wastewater.
- Better models to improve predictions about impact of sub-soil amelioration benefits where wastewater is used.
- Trained researcher to PhD level.

Industry Outcome*:*

- Effluent water from Ararat is available, but long term consequences on sub-soils unknown. Available 600 ML a year used for golf courses and 520ML for wine grape. Cost is $83ML and will increase to $145 in 2 year's time.
- Main reason effluent water used is to enable expansion of vine area. No river irrigation available and groundwater limited. Applied at 1.5 ML / ha. Expansion has occurred already.
- If sodium build up a problem (currently maximum concentration managed by local water authority) will need on-farm strategies to manage, otherwise longer term yields may decline or additional costs incurred.

Benefit in Use*:*

- Potential sub-soil amelioration strategies could possibly cost around $30 per ha each year if sodium becomes a problem. Because of differences across vineyards, operators will need to tailor strategies to their own circumstances. It is assumed that these strategies would enable amelioration costs to be avoided through prevention of sodium build-up.



Adoption:

- Grape production in Western Victoria that could be sustained from effluent is estimated at 350 ha (1.5ML per ha). Maximum regional benefit is $10,500.
- Adoption within this assumed to be 100% over 7 years.
- Outcomes to be realised commercially from year 2007

Risk: Moderate to high risk because (35% chance of success):

- Some vineyards already using waste water.
- Measurement methods known, but considerable strategic research component to work (modeling).
- Main risk is in development of strategies that ensure sodium content of wastewater can be managed effectively across all areas.

Conclusion:

- NPV estimated at -$0.6m and BCR at 0.04.
- Breakeven cost saving at $750 per ha – unlikely to be achieved.
- Main benefit from work will be contribution to broader understanding of sub-soil processes that can be applied in region and more widely.

Investigating the Negative Impacts of Excessive Bunch Exposure on Colour and Flavour Compounds in Grapes and Wine.

R&D Output:

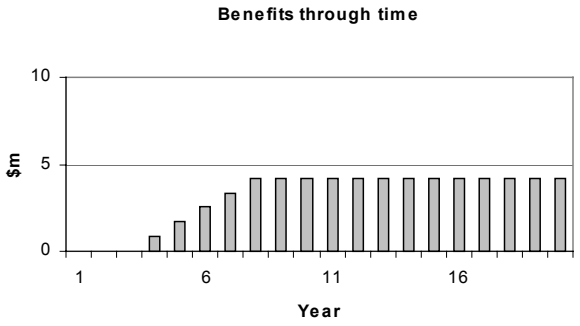
- Increase the body of knowledge relating to over-exposed fruit and off-type flavours in wine
- Investigate the canopy light and temperature conditions which result in optimal bunch exposure
- Undertake sensory analysis of changes in wine during maturation and aging
- Evaluate viticultural treatments (ie. pruning, irrigation schedule, shading) in relation to bunch exposure
- Facilitate adoption of research findings through wine industry via *Grapecheque*, *Viticare* and industry bodies

Industry Outcome*:*

- Establishing link between bunch exposure and wine quality. Relationship used to devise fruit premiums and discounting
- Enhanced fruit quality through the identification of factors influencing bunch exposure and extension of best management practices
- Reduced wastage of grape production – (ie.) 'cooked', 'porty' or 'varnishy' fruit.
- Overall improvement in wine quality as a result of enhanced grape quality – particularly in Riesling, Shiraz, Cabernet Sauvignon, Chardonnay and Merlot varieties

Benefit in Use*:*

- Increased fruit quality through extension of optimal exposure practices
  - Assume average net benefit from enhanced fruit quality (@$50/t)
  - Warm irrigated areas likely to capture most benefits
  - 5% of industry would adoption improved practice
- Annual total benefit across target segment of industry = $4.2 million
- Additional on-going research and development costs would be required to extension of project recommendations (@$0.1m per annum, for 3 years)



Adoption:

- Max adoption – assume that 5% of industry- primarily areas like Sunraysia, Riverland, Barossa adopt optimal exposure recommendations
- Assumed that new recommendations are launched by 2006
- Rate of adoption – 5 years to maximum adoption

Risk: Medium risk because (30% chance of success):

- Demonstrated success of *Research to Practice* programs within viticulture industry
- Industry has identified over-exposure as a major problem (Riverlink 2000 and 2001 industry forums)

Conclusion:

- Investment attractive with NPV = $8.9m and BCR = 11.0.
- Follow-on extension project needed to promote adoption of best practices

The Impact of Deteriorating Water Quality on the Grape Industry in the Murray-Darling Basin (MDB).

R&D Output:

- Highlight areas where research and development into managing irrigation with saline water may be a higher priority in the future
- Collect data on irrigated areas where salinity may become a problem. Data includes areas of plantings, sources of irrigation water, plantings on salt tolerant rootstock and irrigation technologies used.
- Identify those regions where catchment or farm level infrastructure maybe needed to manage, or avoid, yield losses associated with saline irrigation water. Modeling will use ABARE's peer reviewed Salinity and Landuse simulation analysis model (SALSA)
- Focus appropriate consideration on protecting viticultural assets when developing catchment based salinity management plans in the MDB
- Final project report produced that contains data, approach and results. Results also disseminated to industry stakeholders and government agencies.

Industry Outcome*:*

- Increase the body of knowledge relating to impact of salinity on viticultural industries in the Murray-Darling basin.
- Viticultural interests in the region may be better represented, particularly if the potential economic losses to the industry from saline water problems, are quantified and more widely appreciated.
- Possible on-farm management options for dealing with salinity identified

Benefit in Use*:*

- Economic benefits from project not quantified
- Project largely aimed at increasing industry capacity for planning for, and dealing with, salinity problems

Adoption:

- Max adoption – viticultural interests in the Murray-Darling Basin would capture economic and environmental benefits
- Results disseminated in 2004
- Rate of adoption – results likely to be of most value to industry bodies and government agencies

Risk: Low risk because (50% chance of success):

- ABARE long history of research in agricultural and natural resource industries
- Validity of assumption will need to be assessed by CSIRO collaborators who helped develop the physical modules of the SALSA model.

Conclusion:

- Investment not quantified
- Very small project $28 K. Minor economic benefits would justify cost

When to water? Assessment of plant-based measurements to indicate irrigation requirements.

R&D Output:

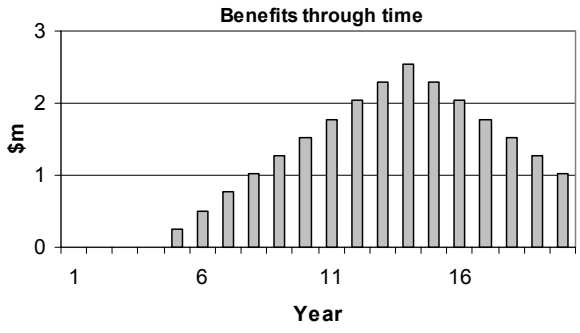
- Training of researcher to PhD level.
- Guidelines for use of plant-based measures to assist in scheduling of irrigation under PRD (Partial Rootzone Drying) and RDI (Regulated Deficit Irrigation) strategies.
- Identification of cost-effective technologies that can be used in a vineyard for measurement purposes. A range of technologies is commercially available.

***Industry Outcome**:*

- R&D outputs will be extended to industry via scientific papers, articles in trade and industry journals and workshops and seminars. Additional extension cost of $100,000 for one year is included.
- Main impact will be further efficiency gains for growers using PRD / RDI technologies. These technologies have the potential to generate water savings of up to 3 to 4 ML per ha. An additional gain of around 25% or 1 ML per ha is expected through this project.
- Additional tools would be provided for all irrigators, regardless of the irrigation strategy employed – may be a conventional or deficit strategy.

***Benefit in Use**:*

- The value of water is estimated at $45 per ML (based on $700 ML as permanent transfer). Additional benefit per ha is $45.
- No additional monitoring costs are assumed as it is anticipated that measurement costs are likely to be similar to current costs associated with soil moisture monitoring.
- Considerable work in this area being carried out overseas and therefore assumed that technologies would be available in the future. This project would accelerate realisation of benefits by 10 years.



Adoption:

- Some 113,000 ha of vineyards are irrigated (average application of 9 ML per ha) and by 2008 it is expected that most growers would be using PRD or RDI.
- Industry focus shifting to quality gains rather than incremental reductions in water use. Moderate to high adoption 50% - high demand for objective measurement.
- Take-up rate at least what PRD expected to achieve– over 10 year period.

Risk: Medium to high risk because (30% chance of success):

- Scientific approach well established and PRD and RDI delivering gains now.
- Plant measures may be too variable through time to be meaningfully interpreted.

Conclusion:

- NPV estimated at $2.8m and BCR at 4.6.
- Breakeven water saving is 0.2 ML per ha – or $10 per ha.
- If fruit quality can be improved further (in addition to existing technologies like RDI) than benefits would be substantially higher. Water cost as part of overall vineyard cost more marginal.

R&D Output:

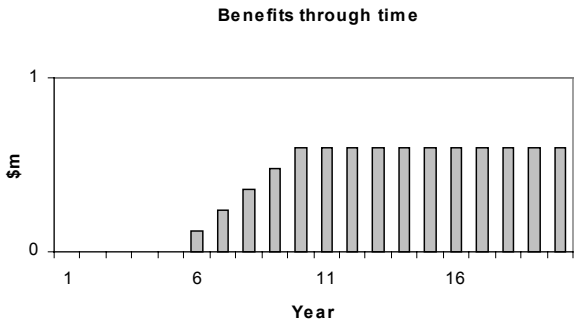
- Measure TCA (cork taint) taste and odour thresholds and perceptual responses by untrained wine consumers and non-wine drinkers.
- Determination of the variations in perceptions of TCA taint in differing wines at various thresholds
- Quantify electro-physiological (EEG recordings) differences in responses to the flavours of wines containing different concentrations of TCA to determine the degree of sub-conscious and conscious responses in wine flavours
- Results of the analysis will be reported to industry via conferences, industry seminars and journal publications

Industry Outcome*:*

- Quantification of TCA concentrations in wine which elicit TCA taint sensory reaction
- Optimal bottle closure practices and quality assurance measures synthesized from follow-on research.
- Industry cost savings reaped by avoiding unnecessary taint prevention practices
- Premiums for the production of taint-free wines and protection of brands

Benefit in Use*:*

- 'Cork taint' have been estimated to effect 5-15 million bottles of Australian wine per annum (possibly 2%-5% of production)
  - Improved bottle closure and taint management practices assumed to increase the long run average price of export wine
  - Assume 6 million bottles of export wine capture price premium @$0.1 per bottle.



Adoption:

- Assumed that TCA management practices are launched by 2008
- Rate of adoption – 5 yrs to maximum adoption
- Additional on-going research and development costs would be required for TCA threshold recommendations to be synthesized into management practices (@$0.2m per annum, for 3 years)

Risk: High risk because (20% chance of success):

- Technical difficulties working with TCA need to be overcome
- Link between industry outcome and this, largely strategic research project, difficult to predict

Conclusion:

- Investment returns modest with NPV = $0.3 m and BCR = 1.5.
- Project would break-even with 12% chance of success.

Bunchstem and Berry Development in Merlot and Cabernet Sauvignon and their Effects on Berry Ripening and Composition.

R&D Output:

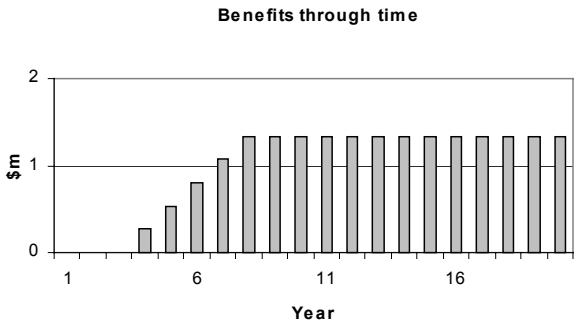
- Information on bunchstem structure and development on two major red varieties
- Knowledge of nutrient and sugar accumulation into the berry
- Study of phloem and xylem composition and delivery
- Information on carbohydrate production on fruitfulness, berry set and bunchstem development
- Strategies to improve berry composition presented in seminars and research publications.

Industry Outcome*:*

- Enhancement of grape quality and production through development of strategies to improve berry composition
- Increase in the body of knowledge relating to berry composition and bunchstem vascular system
- Decrease in the incidence of fruit variability (size and ripeness) as a result of the adoption of improved management systems

Benefit in Use*:*

- Enhancement of red grape quality and production through improved management
  - Assume red grape price increase by 5% (@$35/t)
  - Assume 5% of red grape production captures benefits of improved management
- Additional on-going research and development costs would be required to extension of project recommendations (@$0.2m per annum, for 5 years)



Adoption:

- Max adoption – assume that 5% of red wine production for quality and reduced shrinkage practices
- Rate of adoption - 5 yrs to maximum adoption.
- Initial adoption = 2006 (extension of best practices and systems begins)

Risk: High risk (10% chance of success) because:

- Research largely strategic in nature – there is limited knowledge about the role of bunchstem vascular system and influence on berry composition and maturation.
- Impact of project difficult to predict. In the event management strategies are devised, there is demonstrated success of *Research to Practice* programs within viticulture industry

Conclusion:

- Investment returns modest with NPV = $0.7m and BCR = 2.8.
- Only a small percentage of red grape production would need to capture benefits for project to break-even

R&D Output:

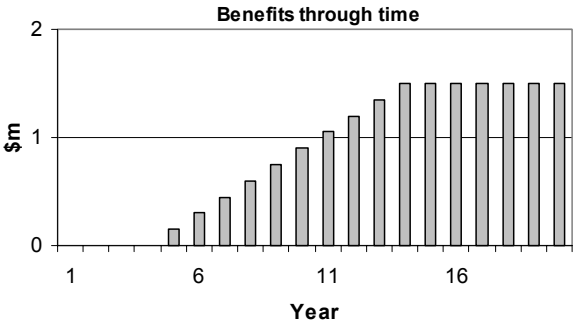
- This is a scoping or feasibility project that will examine quality differences of cabernet sauvignon grapes grown in warm regions (100 kt a year).
- The study will utilise existing data held by wineries to ascertain whether or not specific farm practices contribute to observed quality differences. The main quality attribute that will be examined is berry colour.
- Recommendations will be made to GWRDC on an appropriate R&D program that could be implemented to improve berry colour.

Industry Outcome*:*

- The long term goal is to develop farm level strategies that will enable growers that consistently produce lower quality cabernet sauvignon to increase the price they receive for their grapes.
- Following this project – and assuming that quality differences are found to be a result of farm practices rather than seasonal conditions or location – a R&D project of 3 years at possibly $250,000 would be required to ensure an industry outcome. Benefits possibly commence in 2007.

Benefit in Use*:*

- Price premiums / discounts are greatest in season of high supply. Poor colour grapes can be discounted by $200 per tonne or more. Impact will be at lower end of quality spectrum where colour is more important than other attributes.
- Assuming that 30% of grapes (30 kt) are regularly discounted because of poor colour at an average annual value of $50 per tonne, the cost on the industry would be around $1.5m each year.
- Minimal implementation cost to achieve better fruit colour is assumed.



Adoption:

- Target market will be defined by those growers that consistently receive a colour discount – assumed 30%.
- Rate of take up will depend on cost and complexity of required farm level changes – at this stage assume take-up across target market over 10 year period.

Risk: High risk because (20% chance of success):

- Project is at scoping level and relationship between farm practices and improved fruit colour still needs to be determined.
- Higher costs of different farm practices will limit rate of take-up.

Conclusion:

- NPV estimated at $0.9m and BCR at 2.3.
- Breakeven discount is $25 per tonne each year across target market.
- Investment in scoping project should be assessed as part of portfolio administration costs. BCA helpful in testing potential extent of cost of colour discount in industry that is needed to make possible future investment attractive. Investment can be assessed once scale of potential pay off better known.

R&D Output:

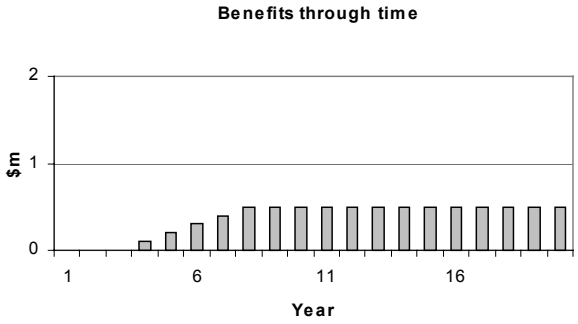
- Synthesis of molecular imprint polymers capable of specifically removing target "mousy taint" related molecules from wine
- Investigation of the efficacy of a range of polymers to remove 2-acetlyltetrahydropyridine (ATHP) from artificial and genuine wine matrices
- To develop a number of candidate polymers as commercial reagents following the synthesis and investigation of a suite of polymers.

Industry Outcome*:*

- Offer a treatment for mousy taint in wine – which currently cannot be removed, or readily masked using blending
- Red wine production most susceptible to mousy taint problems, as $S0_2$ cannot be used as readily as in whites due to bleaching problems.
- Reduced wastage of tainted wine production

Benefit in Use*:*

- Increased wine quality following development of commercially acceptable "mouse taint" removal reagent
  - Assume average net benefit from enhanced wine quality (@$0.5/L)
  - Lower value red wine production likely to use reagent most often
  - Assume volume of wine treated at maximum adoption - 1 ML per year
- Annual total benefit across target segment of industry = $0.5m



Adoption:

- Maximum adoption – assume that minor percentage of overall industry production - primarily red wine production adopts reagent
- Assumed that reagent is launched by 2006
- Rate of adoption – 5 yrs to maximum adoption. Rapid adoption, as wine production capacity relatively concentrated

Risk: Medium risk because (40% chance of success):

- May not be able to synthesize and produce a polymer that removes mousy taint molecules
- Polymers are already used throughout the wine industry, so should be adopted
- The move the to lower use of preservatives in wine making has resulted in mousy taint becoming more of a problem. Demand for a reagent should increase with this trend

Conclusion:

- Investment attractive with NPV = $1.3 m and BCR = 6.9.
- Possible spin-off benefits for the management of other taints using imprint polymers not quantified, but possibly of major benefit.

R&D Output:

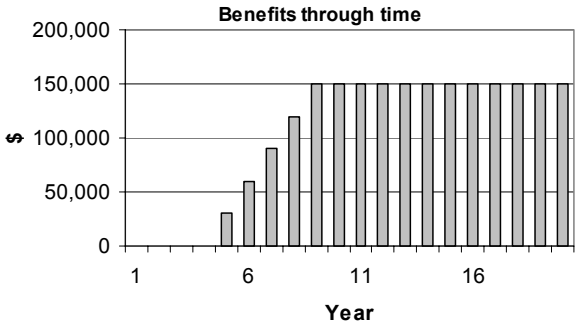
- Chemical characterisation of winery wastewater.
- Information on the impact of winery wastewater on ecosystem health.
- Information of the soil health of vineyards and woodlots after the application of wastewater.
- Assessment of off-site environmental impacts as a result of accidental spills and subsurface leaching.

Industry Outcome*:*

- Guidelines for effluent management strategies for wineries and distilleries have been produced for the National Water Quality Management Strategy involving contributions from ANZECC, ARMCANZ, CSIRO and industry.
- As a result of water use efficiencies wastewater volumes have been reduced to around 1 KL per tonne of grapes crushed. Treatment costs are approximately $4 per KL. Reused water may have an impact on long term soil health. If impact not assessed, treatment costs might be higher than they should, as discharge options facing wineries become more limited.
- The main outcome from this work will be the provision of recommendations for the ecotoxicological effects of wastewater. If significant, environmental regulations may be changed to limit how wastewater is disposed. Wider environmental benefits may be generated as a result. These benefits are not considered.

Benefit in Use*:*

- Wastewater volumes from wineries are estimated at 1,500 ML a year. Additional cost assumed to be $0.5 per KL.



Adoption:

- Adoption likely to be in those areas where water is re-used for vine irrigation or winery located in sensitive area. Impact of project assumed on 20% of winery production.
- Take-up rapid – over 5 years from 2007.

Risk: High risk because (25% chance of success):

- Long term impacts of winery wastewater on soil will be hard to isolate from other influencing factors.
- Chemical characterisation may demonstrate that potential ecotoxicological impacts negligible or contribution to regulatory reform limited.
- Research methods well established.

Conclusion:

- NPV estimated at negative $0.3m and BCR at 0.5.
- Breakeven at $1 KL saving.
- In environmentally sensitive areas restrictions on winery expansion because of environmental regulations may impose higher (opportunity) costs. If winery production constrained will need to process grapes outside local areas. In Adelaide Hills issue is risk of environmental contamination, and this will be resolved outside of this project.
- Attractiveness should be considered against wider environmental benefits.

R&D Output:

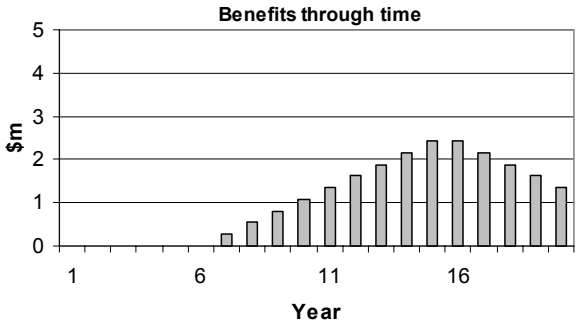
- This is a two step project. The first step will run for a year and test the concept that ultrasonics can be used to increase the fermentation rate and enhance the fermentation activity and colour.
- Step one will generate new knowledge and skills in ultrasonic application, and if concept valid will lead in to step 2.
- Step 2 will focus on development of ultrasonic technology for commercial wine making - variability of operating conditions and samples for quality assessment and sensory evaluation.
- Longer term work would involve storage trials and commercial scale-up of ultrasonic technology.

Industry Outcome*:*

- The ultimate goal of this work will be the development of a low intensity ultrasound technology that can be used with existing fermentation systems.
- The technology may enhance yeast cell growth – and therefore increase throughput times - and the activity of some yeast enzymes that in turn could lead to improved wine colour and flavour.
- The ultrasonics may enhance anthocyanins extraction and red wine quality (although can be achieved by other means).
- If successful it is anticipated that an additional three years would be required for full scale commercial testing. Potential costs of $100,000 a year are assumed.

Benefit in Use*:*

- The approximate cost of a 4 kW ultrasonic unit for fermentation process is $40,000 – 1 c per litre - and is compatible with existing fermenters (additional cost may be required for revolving roto fermenters). No throughput advantage. Operational cost (power) 0.025c per litre.
- The main area of benefit is in colour and flavour enhancement. Most benefits will occur in red wine production and a premium of 10cents per litre is assumed – 9 cents after costs.



Adoption:

- Target market will be red wine production at premium end - 150 ML
- Take-up influenced by premium achieved and may require refinement at individual wineries – perhaps slower over 10 years 20% of target market.
- Benefits first realised from 2008. Assume lead time of 10 years.

Risk: High risk because (15% chance of success):

- Novel application of ultrasonics. To date there has been limited application in food processing.
- Ultrasound generation technology widely available. Development will only require adaptation to wine making if concept can be proven.

Conclusion:

- NPV estimated at $0.9m and BCR at 2.5.
- Breakeven estimated at 4c / l or application to 15ML a year.

R&D Output:

- A social atlas has been prepared using 1991 and 1996 data on industry and social characteristics by wine regions of Australia. This was released in 2001.
- This atlas will be updated using ABS 2001 census data.
- Trend analysis will also be undertaken to identify changes in industry and social characteristics across the major wine growing regions of Australia.
- Comparisons will also be made between wine and other regional areas to determine the relative performance of areas associated with the wine industry compared to areas where other rural industries dominate.

Industry Outcome*:*

- This work will have no direct impact on the wine industry.
- Indirect impacts will be through policy assessment and change at the federal and state government level that are supported by quantitative estimates of social change.
- A benefit to the GWRDC will be the contribution of the information to investment planning and project selection. Given the need to target some R&D at improving the social position of people involved in the wine industry, the atlas will provide a framework for monitoring change.

Benefit in Use*:*

- The social atlas will not enable the impact of GWRDC supported R&D on the industry's social well being to be determined. This is a separate issue, however it does provide the basis for a social impact assessment (SIA), which would be a baseline requirement for the assessment of any potential investment in this area.
- The value of the atlas will be determined by what cost saving the GWRDC can achieve by contracting BRS rather than obtain the information by other means.
- If the information is deemed desirable for GWRDC investment planning then this project will be economically attractive if it is the most cost effective means of generating the information.

Adoption:

- Not applicable – information made available to GWRDC

Risk: Low risk because (100% chance of success):

- Social atlas already prepared for earlier years – this project just providing an update and trend analysis.
- Information on other regions being funded by third parties.

Conclusion:

- GWRDC investment in this area will be part of broader administration costs of their R&D portfolio. Value of updated social atlas should be weighed up against other information requirements of the GWRDC.
- Scope to leverage off investment by government in this area is substantial given the relative investment made by government in regional development compared to achieving development goals through R&D.

R&D Output:

- Monitoring economic well being of wine grape growers
- Surveying wine grape growers to gain data on the financial, physical, social and environmental aspects of grape growing
- Annual data will be tabulated for each region studied, with data being made available to growers, industry organisations and government.
- Summary reports will be provided by June 2003, 2004, and 2005. Data will be disseminated on the web, similarly to other ABARE surveys

Industry Outcome*:*

- Improved industry planning and performance through the provision of up to date data on industry physical, financial and environmental performance
- Provide grape farmers with benchmark physical and financial performance from which they can assess their performance,
- Provide industry leaders with objective measures of grape grower profitability and sustainability which can be used to lobby government
- Help meet any reporting requirements for industry and provide data on which to assess future productivity changes

Benefit in Use*:*

- The project would increase capacity of industry leaders and research organizations to improve industry planning, and also promote the industry itself
- Provision of such data - demonstrating the substantial contribution of wine production to Australia (particularly rural and regional Australia
- These potential benefits are not quantified as it is difficult to attribute the survey output in relation to positive growth of industry.

Adoption:

- Maximum adoption – only a small number of grape producers are likely to utilise the data. It is most probable that the data would be used by industry leaders, research organisations and government bodies in conjunction with industry planning and promotion
- Rate of adoption – rapid adoption of results by potential users could be expected. ABARE publications are readily accessible via web and hard copy.

Risk: Low risk because (80% chance of success):

- ABARE have a long history of economic research in Australian agricultural industries
- No technical barriers to impede the collection and synthesis of data.

Conclusion:

- Investment not quantified in economic terms

DETAILS OF EVALUATION METHOD - BENEFIT COSTS ANALYSIS

In this section the fundamentals of BCA are discussed to a level of detail that will enable readers to work through the individual evaluations of projects submitted to the GWRDC for funding consideration.

There are two critical aspects in the benefit-cost assessment of a proposed research and development project. The first involves an assessment of what technology (be it a product, process or information) will ultimately be made available for commercial use in the industry. The second involves an assessment of how the technology will increase industry profits. The first part requires consideration of the technical aspects of a proposed project while the latter involves a costing of industry benefits once the likely industry outcome has been identified.

For any valid comparisons to be made between projects in which GWRDC could invest, it is essential that there be consistency in the data used, assumptions made, approach taken to cost industry benefits and how the likely pay offs are evaluated. Without this consistency evaluations provide little value to decision makers.

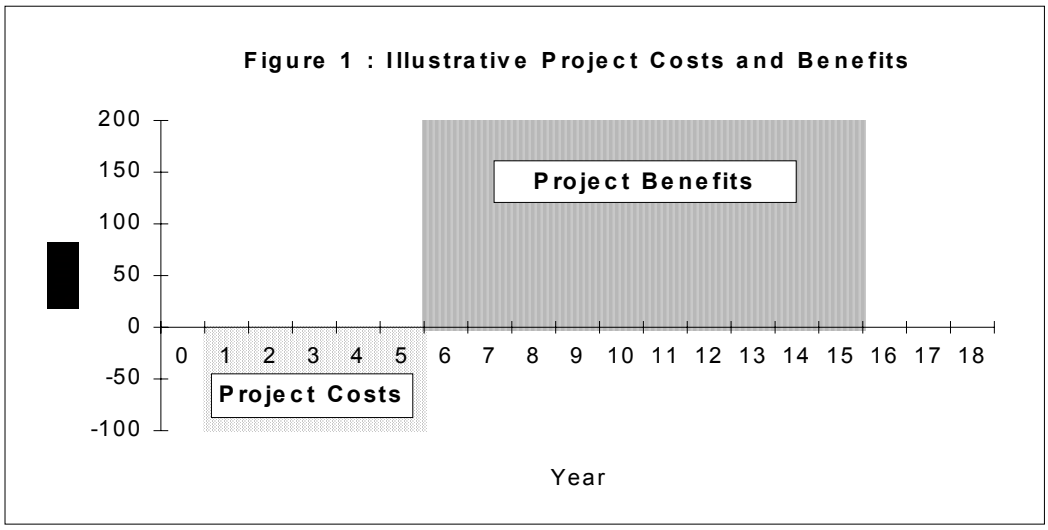
Two of the main strengths of using benefit cost analysis are that assumptions can be made explicit and evaluation results can be readily reproduced. Benefit cost analysis is a "tool" for research decision makers and the extent to which it is used and the detail given should be matched closely to the needs of individual decision makers. Although the degree of detail required may vary from project to project there will always remain a number of key factors that should be considered. These include: the likely specifics of the technology that would be produced through R&D and the associated cost; the strategy which would be followed to ensure that the technology is used commercially; how industry participants would use the technology; and what impact the technology will have on their profitability.

What is BCA?

Benefit-cost analysis is simply a comparison of project benefits against project costs that are realised or incurred through time. Project costs are the costs incurred in carrying out a given research project plus the costs involved in developing research outcomes for direct commercial application in the wine and wine grape industry. Project benefits are the gains realised by these industries and the Australian community at large from the commercial application of research and development outcomes.

In Figure 1 a representative stream of project costs and benefits through time is illustrated. In this example, annual project costs of $100,000 are planned for 5 years after which annual benefits of $200,000 are generated for a period of 10 years. In total, $500,000 is invested in the project for a return of $2 million. But, is the investment worthwhile?

Two measures of project pay off are used to answer this question. The first is the net value of the project, measured by the total value of benefits minus the total value of costs. In our example, the net value of the project is $1.5m, and as this sum is greater than zero the project would represent a profitable investment. However, because we are concerned with the relative attractiveness of projects, projects should be ranked on the basis of the benefit realised for every dollar invested.



The second measure reflects this and is called the benefit/cost ratio. It is calculated by dividing total project costs into total project benefits. In our example the benefit cost ratio is equal to 4. Hence, for every dollar invested in the project a return of $4 is realised.

An important consideration in BCA is the treatment of project costs and benefits that are incurred or generated at different points in time. Generally speaking, in a decision to have a dollar today or at some later date, individuals would show a preference for having the dollar today. In a commercial environment, the extent to which an individual would be prepared to postpone having the dollar is at least equal to the rate of interest that could possibly be earned from having the dollar today and investing it. In other words, if you could get an interest rate of 6% over a year so that after one year your dollar was worth $1.06, then, to compensate you for waiting one year to have your dollar, it would be necessary to offer you $1.06 after the year.

In BCA the extent to which individuals prefer a dollar today as opposed to a dollar in a later period is called the discount rate. The discount rate utilised for these benefit cost analyses is 6% each year, and reflects market interest rates (net of inflation) on borrowed capital.

Handling project benefits

The estimation of project benefits is usually the most difficult part of any BCA. Project benefits are the total net gains realised directly by users of R&D outcomes and indirectly by other participants in the industry or the community at large. To determine project benefits, a clear understanding of the anticipated direct industry impact is essential. In BCA there are three aspects which need to be considered when estimating project benefits. These are the size of the gain to individual users, the number of users realising the gain (target market and adoption), and the likelihood that R&D will be successful in delivering the anticipated commercial outcomes.

Estimating individual gains

The net gain to an individual user can be measured by the difference in profits that could be earned with and without the use of the developed technology (commercial R&D outcomes in the form of a product, process or information).

Technological improvement can increase profitability of a given business in several ways. It can:

(i) increase yields or the volume of output given existing resources.

(ii) enable higher prices to be realised on output sold.

(iii) decrease the unit cost of inputs used.

(iv) decrease the volume of inputs used.

In most cases, these impacts can be adequately expressed in terms of a given unit of production, for example, per tonne of grapes sold. Offsetting these impacts are the costs to the individual of purchasing and using the technology.

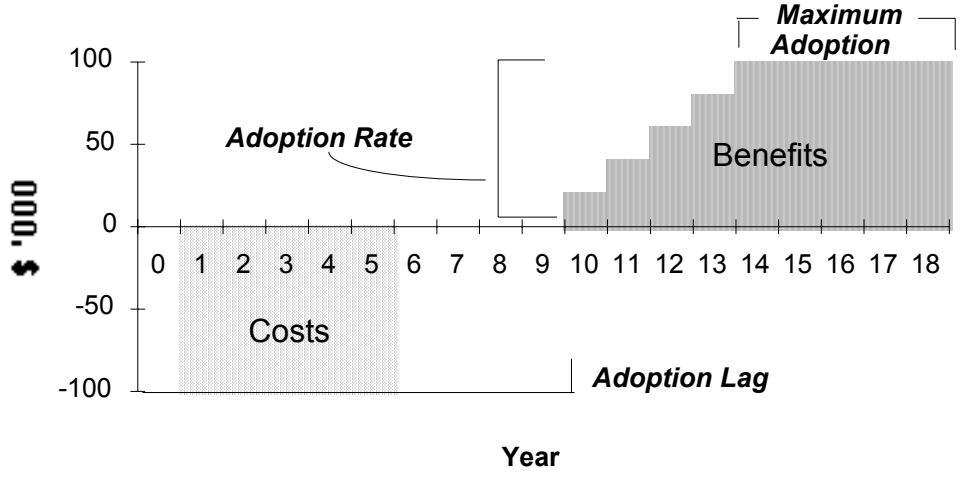
Adoption

To derive total net gains from the use of a developed technology it is necessary to estimate the net gain to all individuals that could potentially benefit from adoption and use of the technology, and then sum these gains. Obviously, this would not be practical, and instead, a representative business for the target group of potential beneficiaries should be selected and net gains estimated for this business alone. This group would therefore represent the potential users of the technology, and adoption would reflect the extent to which the technology would be taken up within this group.

The rate and level of adoption of a new technology in the derivation of total net gains is usually very understated in benefit cost analysis. The total net gain in any given year is simply the sum of individual net gains that are generated in that year. The effect of halving net individual gains or total net gains is the same as halving the anticipated rate of adoption of the new technology.

Technology adoption has three components critical to benefit cost evaluation. These components are illustrated in Figure 2.

Figure 2 : Impact of Adoption on Net Gains



1. Adoption Lag - the time lag between successful R&D and the first commercial use of a technology (adoption lag).

   Once the R&D project has been brought to a successful close the technology would then be ready for commercialisation and release into the market. During this phase the technology would be produced in commercial quantities, marketed and distributed. While the costs incurred during this phase are reflected in the price at which the technology is sold, the time taken from project commencement to the first commercial use of the technology is important because, as the realisation of benefits is delayed in time the attractiveness of the project declines.

2. Adoption Rate – the rate at which a technology is taken up within the target market.

   The rate of technology adoption is important because, like adoption lag, it influences the extent to which gains are realised in any one year. In practise, technology adoption tends to occur gradually at first, then quite rapid for a while before tapering off. In prospective evaluations a constant rate of adoption through time (linear) is a reasonable assumption to make in the absence of detailed market survey information. The main factors that will influence the rate of adoption through time are the size of the benefit realised by the user, the complexity of use of the technology, the ease with which the technology can be integrated into existing business practices, the degree of financial risk and the communicability of benefits between users.

3. Maximum Adoption – the ultimate level of technology take up within the total market.

   The final component is the maximum level of adoption within the target group. The factors described above that influence the rate of adoption also affect the adoption ceiling.

Probability of Project success

The final aspect in the estimation of total net gains is the likelihood that a R&D project will be successful in ultimately delivering the anticipated benefits to industry. For project success, the research, development and commercialisation phases must meet all their desired objectives. The probability of project success is therefore conditional on the success of each phase. As an example, if the probability of success for each phase were 50%, then the probability of project success would be 12.5%. Because of project risks, project benefits need to be weighted accordingly and expressed in terms of an expected benefit to the funds invested. This is done simply by multiplying annual project benefits by the probability of project success.

Dealing with project costs

Project costs are the planned expenditures in the research and development phase of a project – by all parties involved. In order to carry out a BCA, project costs need to be estimated on an annual basis over the anticipated life of the project. The end of the project will be when the research output has been fully developed and is ready for commercialisation.

Price Effects

Simplifying assumptions have been made on price effects as a result of increased industry profitability. Price impacts are important and should be considered. Such impacts determine the distribution of R&D benefits between different industry participants - including grape growers, wine makers and consumers. Price effects also indicate the extent to which production increases following technology adoption that results in higher industry profitability or stimulates consumer demand. For the purpose of the evaluations carried out for GWRDC it has been assumed that Australia is largely a price taker on world markets and that export parity drives domestic prices. Therefore, no leakage of R&D benefits to overseas consumers is assumed.

Research Lead Time

Research lead time (RLT) is a measure of the competitive advantage of GWRDC's R&D investment. RLT has been incorporated into individual evaluations in one of two ways.

First, because GWRDC is only one of many players in the R&D market it is most likely that benefits would be realised without GWRDC's financial involvement. The involvement of GWRDC in given areas of R&D will enable industry benefits to be realised sooner than would otherwise be the case or to a greater extent through time. In some cases GWRDC's and partner's investment will accelerate the rate of take up of a technology compared to what would otherwise occur. Underlying this is an assumption that economic units or businesses – will ultimately take up a technology if it is profitable. GWRDC and their partners are not the sole source of technology improvements captured by the industry. Many of the extension investments are of this nature.

Second, in some cases GWRDC investment delivers incremental benefits to users that would not be realised without GWRDC involvement. This is typically the case when private incentives are minimal and the majority of investment in R&D is supported by the GWRDC.