Hort Innovation

Final Report

Project title:

Horticulture Impact Assessment Program:

Appendix 11: Development of a Vegetable Education Resource – Stage 2 (VG15067 Impact Assessment)

Impact analyst:

Michael Clarke

Delivery partner:

AgEconPlus and Agtrans Research

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MT18011

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Level 7
141 Walker Street
North Sydney NSW 2060

Telephone: (02) 8295 2300

www.horticulture.com.au

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Executive Summary

What the report is about

This report presents the results of an impact assessment of a Horticulture Innovation Australia Limited (Hort Innovation) investment in *VG15076: Development of a Vegetable Education Resource – Stage 2.* The project was funded by Hort Innovation over the period December 2015 and August 2019.

Methodology

The investment was analysed qualitatively within a logical framework that included activities and outputs, outcomes, and impacts. Impacts were categorised into a triple bottom line framework. Principal impacts identified were then considered for valuation. Past and future cash flows were expressed in 2019/20 dollar terms and were discounted to the year 2019/20 using a discount rate of 5% to estimate the investment criteria.

Results/key findings

The investment in VG15067 has contributed to the VERTICAL (Vegetable Education Resource To Increase Children's Acceptance and Liking) program that when rolled out nationally is expected to increase the consumption of vegetables by primary school children and generate additional profitable vegetable sales for Australian growers. Positive environmental and social impacts are also anticipated. Environmental impacts may include reduced vegetable waste in both households and the supply chain. Social impacts may include positive health outcomes for Australian children, researchers with additional education program design capacity and a contribution to community wellbeing with more profitable vegetable growers and healthy school-aged children.

Investment Criteria

Total funding from all sources for the project was $1.13 million (present value terms). The investment produced estimated total expected benefits of $1.54 million (present value terms). This gave a net present value of $0.41 million, an estimated benefit-cost ratio of 1.4 to 1, an internal rate of return of 7% and a modified internal rate of return of 6%.

Conclusions

Four environmental and social impacts were not valued. When inability to value all impacts is combined with conservative assumptions for the principal economic impacts valued, it is reasonable to conclude that the valuation may be an underestimate of the actual performance of the investment.

Keywords

Impact assessment; cost-benefit analysis; VG15076; vegetable, education resource.

Introduction

Horticulture Innovation Australia Limited (Hort Innovation) required a series of impact assessments to be carried out annually on a number of investments in the Hort Innovation research, development, and extension (RD&E) portfolio. The assessments were required to meet the following Hort Innovation evaluation reporting requirements:

- Reporting against the Hort Innovation's current Strategic Plan and the Evaluation Framework associated with Hort Innovation's Statutory Funding Agreement with the Commonwealth Government.
- Annual Reporting to Hort Innovation stakeholders.
- Reporting to the Council of Rural Research and Development Corporations (CRRDC).

Under the impact assessment program (Project MT18011), three series of impact assessments were conducted in calendar 2019, 2020 and 2021. Each included 15 randomly selected Hort Innovation RD&E investments (projects). The third series of impact assessments (current series) was randomly selected from an overall population of 56 Hort Innovation investments worth an estimated $38.9 million (nominal Hort Innovation investment) where a final deliverable had been submitted in the 2019/20 financial year.

The 15 investments were selected through a stratified, random sampling process such that investments chosen represented at least 10% of the total Hort Innovation RD&E investment in the overall population (in nominal terms) and was representative of the Hort Innovation investment across six, pre-defined project size classes.

Project *VG15067: Development of a Vegetable Education Resource – Stage 2* was randomly selected as one of the 15 investments under MT18011 and was analysed in this report.

General Method

The impact assessment follows general evaluation guidelines that are now well entrenched within the Australian primary industry research sector including Research and Development Corporations, Cooperative Research Centres, State Departments of Agriculture, and some universities. The approach includes both qualitative and quantitative descriptions that are in accord with the impact assessment guidelines of the CRRDC (CRRDC, 2018).

The evaluation process involved identifying and briefly describing project objectives, activities and outputs, outcomes, and impacts. The principal economic, environmental, and social impacts were then summarised in a triple bottom line framework.

Some, but not all, of the impacts identified were then valued in monetary terms. Where impact valuation was exercised, the impact assessment uses cost-benefit analysis as its principal tool. The decision not to value certain impacts was due either to a shortage of necessary evidence/data, a high degree of uncertainty surrounding the potential impact, or the likely low relative significance of the impact compared to those that were valued. The impacts valued are therefore deemed to represent the principal benefits delivered by the project. However, as not all impacts were valued, the investment criteria reported for individual investments potentially represent an underestimate of the performance of that investment.

Background & Rationale

Background

The Australian vegetable industry is one of Australia's largest horticultural industries with a five year estimated annual production value for levied vegetables of $2.9 billion and a production volume of 1.7 million tonnes. Vegetable supply per capita, a proxy for vegetable consumption, stands at 87.7 kg – Table 1.

Table 1: Levied Australian Vegetable Production and Value 2015/16 to 2019/20

Year Ended 30 June	Production (tonnes)	Supply per Capita (kg)	Gross Value of Production ($m)	Farmgate Value of Production ($m)
2016	1,627,149	87.82	2,462.1	2,339.0
2017	1,638,539	86.73	2,762.5	2,624.4
2018	1,709,198	88.79	2,792.2	2,652.6
2019	1,752,690	88.09	3,092.5	2,937.9
2020	1,749,935	86.90	3,330.9	3,164.4
Average	1,695,502	87.67	2,888.0	2,743.6

Source: Horticulture Statistics Handbook 2018/19 and 2019/20 total vegetable production less estimates for potato, tomato, onion, mushroom, asparagus, sweetpotato, garlic, and ginger. Farmgate value estimated by AgEconPlus.

Australian vegetable growers grow more than 130 different vegetable crops. The majority of growers are located in New South Wales, followed by Queensland and Victoria. The top three states by value of production are Queensland, Victoria, and South Australia.

The vegetable industry has a research and development (R&D) levy that is used for vegetable RD&E activities across a range of disciplines targeting both on-farm and supply chain sectors in accordance with industry priorities. The levy is collected on the majority of vegetable commodities, with exceptions of particular note being potato, onion, and tomato, and is matched by Hort Innovation with funding from the Australian Government. Some 1,676 growers pay the vegetable levy each year (Hort Innovation, 2017).

Vegetable R&D levy investment is guided by the Vegetable industry's Strategic Investment Plan (SIP). The current SIP has been driven by levy payers and addresses the Australian vegetable industry's needs from 2017 to 2021. Strategies and priorities in the Plan have been driven by a set of five desired outcomes (Hort Innovation, 2017):

1. Growth in the domestic market
2. Growth in export markets
3. Improved farm productivity
4. Increased levels of post-farmgate integration
5. Improved industry capabilities for adoption and innovation.

Rationale

Fresh vegetable consumption by children lags other groups in society. National Health Surveys show that only 5.4% of children in Australia are meeting the Australian Dietary Guidelines for serves of vegetables. Project Harvest (VG12078) showed that children are eating approximately 1.8 serves per day, well below the recommended guidelines. If children can be encouraged to consume more vegetables, they will set up life-long healthy eating patterns and ensure ongoing sales of Australian fresh vegetables.

A wide variety of projects have been initiated to encourage children to eat vegetables, these include programs such as Stephanie Alexander's Kitchen Garden Foundation and skills-based initiatives such as Oz Harvest's Food Education and Sustainability Training and Jamie Oliver's Learn Your Fruit and Veg.

This project (VG15067) builds on previous RD&E initiatives funded by Hort Innovation including:

- CSIRO's Vegetable Education Kit – Stage 1 (VG13089)
- CSIRO's Investment Plan to Increase Vegetable Consumption by Children (VG13090)
- CSIRO's Implementation Plan for Increasing Children's Vegetable Intake (VG15005)
- CSIRO's Veggycation (VG15034); and
- Edible Adventures Pty Ltd.'s Educational Opportunities around Perceptions of, and Aversions to, Vegetables through Digital Media (VG16018).

In 2013, Hort Innovation contracted CSIRO to research and develop a Vegetable Education Resource for primary schools (VG13089) that aimed to improve children's awareness and familiarity with vegetables and would lead to an increased willingness to eat vegetables. The research was completed in 2016, following a pilot study in one Sydney primary school and a validation of the resource in a select number of Sydney primary schools in 2015. The positive results from the research led to the commissioning of the next phase of the program to further develop and validate resources in a broader range of schools and to develop a strategy and the resources for national rollout.

Project Details

Summary

Project Code: VG15076

Title: *Development of a Vegetable Education Resource – Stage 2*

Research Organisation: CSIRO

Principal Investigator: Astrid Poelman

Period of Funding: July 2017 to October 2019

Objectives

The objective of this project was to develop and prepare a Vegetable Education Resource for national roll out to use in Australian primary schools that will effect change in behaviour of children leading to increased willingness to eat vegetables.

Logical Framework

Table 2 provides a description of VG15076 in a logical framework.

Table 2: Logical Framework for Project VG15076

Activities	• Formation of a project steering committee to guide roll out of the project. Establishment of an advisory panel to provide advice on the educational components of the project. The advisory panel included teachers and educational experts. • Review and revise the Stage 1 vegetable education resource for alignment with the national primary school curriculum. Alignment to assist with national uptake and utilise feedback provided by teachers during Stage 1. • Address barriers to resource use including difficulties with vegetable logistics and vegetable preparation. Provision of an opportunity for children to taste fresh produce was seen as critical to behavioural change. • Development of a web-based platform for distribution of the Vegetable Education Resource. A dedicated web portal was built so that schools could access content, a customer database could be created, and additional resources added in the future e.g., linkages to vegetable growers. • Development of a new online (digital) training module for teachers. Testing of the updated module with teachers. Testing included roll out of a training program for individual teachers. Individual teachers would then serve as champions for the Vegetable Education program within their school. • Extend the revised resource and evaluate its success in twenty NSW schools. Schools included a range of socio-demographics and teacher training levels. Children's vegetable awareness and behaviour was measured through online student surveys. • Introduction of the resource into primary schools in South Australia (SA) and evaluation of its effectiveness. Vegetable consumption results from five SA schools were compared to two control schools. SA data was

	particularly valuable as the state was not presently engaged in other school vegetable education initiatives. • Development of a business plan for the program and initiation of stakeholder engagement/partnering for national roll out of the program. Opportunities for industry sponsorship and a public-private partnership were explored and a sustainable financial model proposed.
Outputs	• An updated version of the Vegetable Education Resource (VERTICAL – Vegetable Education Resource To Increase Children's Acceptance and Liking). The program consisted of 5X1 hour unit lessons across the three stages of primary school. • A teacher program/guide for using the Resource. • Data on the effect of the Resource in influencing student behaviour. A large cluster randomised controlled trial (1,639 students from 25 NSW and SA schools) showed that VERTICAL significantly increased their knowledge, ability to verbalise sensations, vegetable acceptance, intentions to increase vegetable consumption, willingness to try vegetables and the number of new vegetables consumed, compared to students who followed the regular curriculum. • Data on teacher appreciation of the program and its materials. Teachers were supportive of the program. • A web-based platform for delivering the Resource. • A digital training model that prepares teachers for the program. • A business model for national roll out. • Communication of project results via trade journals and relevant conferences. • Milestone reports and a final report for Hort Innovation. • NB: National roll out of the Vegetable Education Resource was not part of this project. However, CSIRO have launched the program and continued engagement and dissemination.
Outcomes	• Children with an increased awareness, acceptance, and willingness to consume vegetables. • An increased demand for vegetables amongst parents who are responsible for their purchase. • Increased sales of fresh Australian vegetables. • improved health outcomes for the Australian community including obesity, cardiovascular disease, type 2 diabetes, and certain cancers.
Impacts	• [Economic] Increased vegetable consumption by primary school aged children (8 to 12 year-olds) resulting in additional profitable vegetable sales by Australian growers. • [Environmental] Reduced vegetable waste, in both households and the supply chain, associated with increased consumption. • [Social] Children eating additional healthy vegetables, forming positive life-long habits, and reducing the costs of endemic diseases such as obesity, cardiovascular disease, type 2 diabetes, and certain cancers. • [Social] Researchers with a better understanding of what motivates children and the design of effective education programs. • [Social] Contribution to improved regional community wellbeing with more profitable vegetable growers and healthy school-aged children.

Project Investment

Nominal Investment

Table 3 shows the annual investment (cash and in-kind) in project VG15076 by Hort Innovation and other investors. Funds were also contributed to the project by CSIRO.

Table 3: Annual Investment in the Project VG15076 (nominal $)

Year ended 30 June	Hort Innovation ($)	Other ($)	Total ($)
2017	328,000	55,625	383,625
2018	153,000	55,625	208,625
2019	53,000	55,625	108,625
2020	133,500	55,625	189,125
Totals	**667,500**	**222,500**	**890,000**

Program Management Costs

For the Hort Innovation investment the cost of managing the Hort Innovation funding was added to the Hort Innovation contribution for the project via a management cost multiplier (1.162). This multiplier was estimated based on the share of 'payments to suppliers and employees' in total Hort Innovation expenditure (3-year average) reported in the Hort Innovation's Statement of Cash Flows (Hort Innovation Annual Report, various years). This multiplier was then applied to the nominal investment by Hort Innovation shown in Table 3.

Real Investment and Extension Costs

For the purposes of the investment analysis, investment costs of all parties were expressed in 2019/20 dollar terms using the GDP deflator index. Project extension included roll out of the Vegetable Education Resource in twenty NSW schools and five SA schools. Additional extension costs will be incurred for the roll out of the national program and, if researcher recommendations are adopted, a further implementation measurement project.

Impacts

Table 4 provides a summary of the principal types of impacts delivered by the project. Impacts have been categorised into economic, environmental, and social impacts.

Table 4: Triple Bottom Line Categories of Principal Impacts from Project VG15076

Economic	• Increased vegetable consumption by primary school aged children (8 to 12 year-olds) resulting in additional profitable vegetable sales by Australian growers.
Environmental	• Reduced vegetable waste, in both households and the supply chain, associated with increased consumption.
Social	• Children eating additional healthy vegetables, forming positive life-long habits, and reducing the costs of endemic diseases such as obesity, cardiovascular disease, type 2 diabetes, and certain cancers. • Researchers with a better understanding of what motivates children and the design of effective education programs. • Contribution to improved regional community wellbeing with more profitable vegetable growers and healthy school-aged children.

Public versus Private Impacts

Impacts identified in this evaluation are both private and public in nature. Private benefits will be realised with an increase in vegetable consumption by primary school aged children generating additional profitable vegetable sales for Australian growers. Public benefits will include reduced vegetable waste, improved health outcomes, increased researcher capacity and a contribution to regional community wellbeing with more profitable and sustainable vegetable growers.

Distribution of Private Impacts

The impacts on the vegetable industry from investment in this project will be shared along the vegetable supply chain with growers, transporters, wholesalers, and retailers all capturing a share of the impact. The share of total impact retained by each link in the supply chain will be dependent on a combination of both short- and long-term supply and demand elasticities.

Impacts on Other Australian Industries

Widespread roll out and adoption of the VERTICAL program with a resultant increase in vegetable consumption by children aged 8 to 12 years may come at the expense of other food suppliers e.g., those who supply protein for children's meals. Strategies developed to engage children and increase vegetable consumption could also be applied to the fruit, nut, and unlevied vegetable industries.

Impacts Overseas

Online teaching resources developed through the project will be applicable to vegetable industries in other countries especially those countries with similar curriculums and attitudes e.g., New Zealand.

Match with National Priorities

The Australian Government's Science and Research Priorities and Rural RD&E priorities are reproduced in Table 5. The project findings and related impacts will contribute to Science and Research Priority 1 and 8.

Table 5: Australian Government Research Priorities

Australian Government	
Rural RD&E Priorities (est. 2015)	**Science and Research Priorities (est. 2015)**
1. Advanced technology 2. Biosecurity 3. Soil, water and managing natural resources 4. Adoption of R&D	1. Food 2. Soil and Water 3. Transport 4. Cybersecurity 5. Energy and Resources 6. Manufacturing 7. Environmental Change 8. Health

Sources: (DAWR, 2015) and (OCS, 2015)

Alignment with the Vegetable Strategic Investment Plan 2017-2021

The strategic outcomes and strategies of the Vegetable industry are outlined in the Vegetable Industry's SIP 2017-2021 (Hort Innovation 2017). Project VG15076 addressed Outcome 1 ('Growth in the domestic market').

Valuation of Impacts

Impacts Valued

Analyses were undertaken for total benefits that included future expected benefits. A degree of conservatism was used when finalising assumptions, particularly when some uncertainty was involved. Sensitivity analyses were undertaken for those variables where there was greatest uncertainty or for those that were identified as key drivers of the investment criteria.

A single impact was valued – increased vegetable consumption by primary school aged children (8 to 12 year-olds) resulting in additional profitable vegetable sales by Australian growers.

Impacts Not Valued

Not all of the impacts identified in Table 4 could be valued in the assessment. Environmental and social impacts were hard to value due to lack of evidence/data, difficulty in quantifying the causal relationship and pathway between VG15076 and the impact and the complexity of assigning monetary values to the impact.

The environmental and social impacts identified but not valued were:

- Reduced vegetable waste, in both households and the supply chain, associated with increased consumption.
- Children eating additional healthy vegetables, forming positive life-long habits, and reducing the costs of endemic diseases such as obesity, cardiovascular disease, type 2 diabetes, and certain cancers.
- Researchers with a better understanding of what motivates children and the design of effective education programs.
- Contribution to improved regional community wellbeing with more profitable vegetable growers and healthy school-aged children.

Valuation of Impact: Increase in profitable sales for vegetable growers

VG15076 has contributed to a program, that if rolled out nationally, has strong potential to increase vegetable consumption amongst primary school aged children. Research has shown that children in the 8 to 12 years age bracket consume an average of 1.8 serves of vegetables per day. The recommended daily intake for children of this age is between 2.2 and 2.5 serves per day (VG12078: Project Harvest). Additional research (VG16008: Gap Analysis of Vegetable Consumption Data) has shown, that on average, people exposed to positive health messages increase their vegetable consumption by 0.5 serves per day. These data have been used to assess the potential for a shift in children's attitudes to vegetables and a resultant increase in profitable vegetable sales by Australian growers.

Attribution

A 25% attribution factor has been assumed for VG15076's contribution to increased vegetable consumption by school children aged 8 to 12 years. A low attribution factor is in recognition of the previous research and other investments highlighted in the Rationale section of this report and the further investment required for national roll out of the VERTICAL program.

Counterfactual

It is assumed that in the absence of Hort Innovation investment in VG15076, it is only 20% likely that the VERTICAL program would have been further developed.

Summary of Assumptions

A summary of the key assumptions made for valuation of the impacts is shown in Table 6.

Table 6: Summary of Assumptions

Variable	Assumption	Source/Comment
Impact 1: Increase in profitable vegetable sales		
Number of Australian children aged 8 to 12 years (demographic targeted by VG15076).	1,500,000 children.	Adapted from ABS Census 2016 Quick Stats.
Share of population reached by VERTICAL when the program has been rolled out nationally.	80%.	VG15076 proposes a comprehensive national roll out.
Share of school aged children who increase their vegetable consumption when exposed to the VERTICAL program.	75%.	Analyst assumption – not all school children targeted will be motivated or have opportunity to increase their vegetable consumption.
Increase in consumption following exposure to the VERTICAL program.	0.5 serves/day. (1.0 serve = 75 grams). 37.5 grams/day. 13.7 kg/year.	MT16008 and the RCT showed that on average people exposed to positive health messages increase their vegetable consumption by 0.5 serves per day.
Grower profit on increased vegetable sales.	$80.30/tonne.	Farmgate value of vegetable production of $4,182 million divide production of 3,645,684 tonnes to give a gross value of $1,147/tonne (see Table 1). Typically, profit averages somewhere between 2% and 10% in established horticultural industries and 7% has been used in this analysis to reflect higher value crops covered by the vegetable levy.
Year of first impact.	2021/22.	The project was completed in 2019/20 and it is assumed that two years is required to contract partners and complete VERTICAL program logistics.
Attribution of impacts to VG15076.	25%	See above text.
Counterfactual.	20%	See above text.
Probability of valuable outputs.	100%	Valuable outputs have been created.
Probability of valuable outcome (i.e., outcomes described in Table 2 realised).	80%	Analyst assumption.
Probability of valuable impact (i.e., impacts described in Table 2 realised).	80%	Analyst assumption.

Results

All costs and benefits were discounted to 2019/20 using a discount rate of 5%. A reinvestment rate of 5% was used for estimating the Modified Internal Rate of Return (MIRR). The base analysis used the best available estimates for each variable, notwithstanding a level of uncertainty for many of the estimates. All analyses ran for the length of the project investment period plus 30 years from the last year of investment (2019/20) as per the CRRDC Impact Assessment Guidelines (CRRDC, 2018).

Investment Criteria

Tables 7 and 8 show the investment criteria estimated for different periods of benefit for the total investment and Hort Innovation investment, respectively. The present value of benefits (PVB) attributable to Hort Innovation investment only, shown in Table 8, has been estimated by multiplying the total PVB by the Hort Innovation proportion of real investment (77%).

Table 7: Investment Criteria for Total Investment in Project VG15076

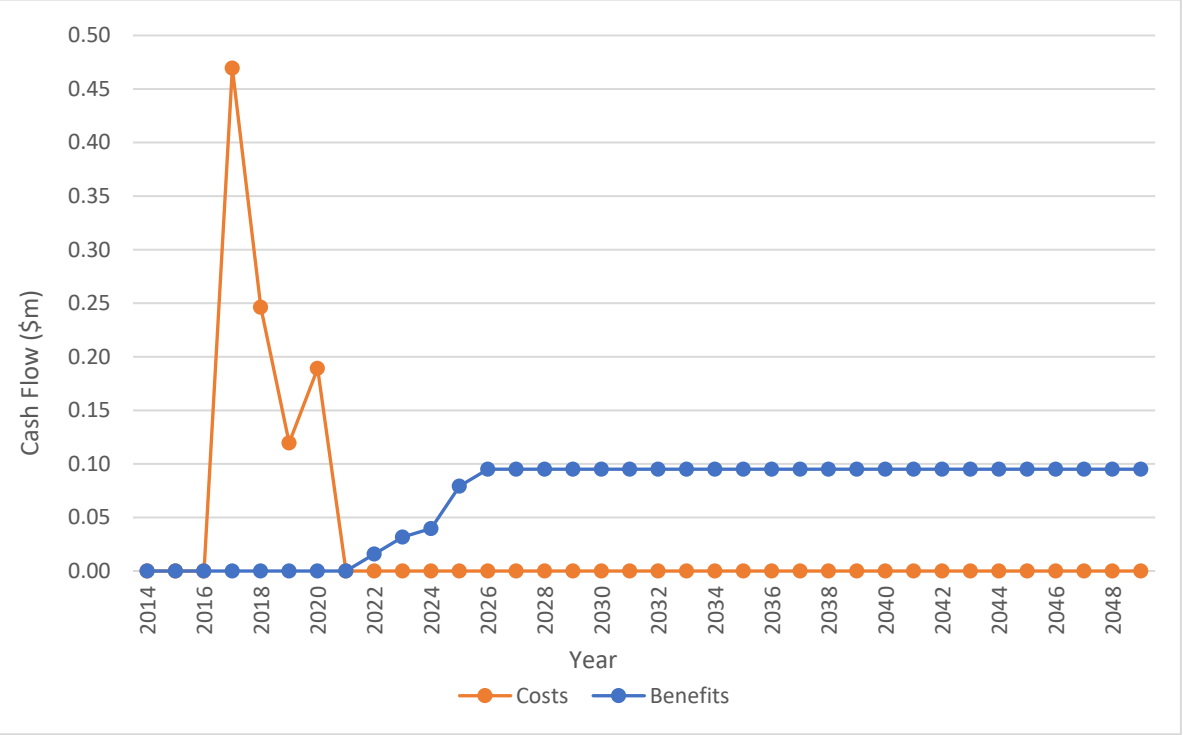
Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits ($m)	0.00	0.14	0.57	0.90	1.17	1.37	1.54
Present Value of Costs ($m)	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Net Present Value ($m)	-1.13	-0.99	-0.56	-0.23	0.04	0.24	0.41
Benefit-Cost Ratio	0.00	0.12	0.50	0.80	1.03	1.22	1.36
Internal Rate of Return (%)	negative	negative	negative	2.9	5.3	6.4	7.0
MIRR (%)	negative	negative	negative	3.8	5.1	5.7	6.0

Table 8: Investment Criteria for Hort Innovation Investment in Project VG15076

Investment Criteria	Years after Last Year of Investment						
	0	5	10	15	20	25	30
Present Value of Benefits ($m)	0.00	0.11	0.44	0.70	0.90	1.06	1.19
Present Value of Costs ($m)	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Net Present Value ($m)	-0.88	-0.77	-0.44	-0.18	0.02	0.18	0.31
Benefit-Cost Ratio	0.00	0.12	0.50	0.79	1.03	1.21	1.35
Internal Rate of Return (%)	negative	negative	negative	2.9	5.2	6.3	7.0
MIRR (%)	negative	negative	negative	3.7	5.1	5.7	5.9

The annual undiscounted benefit and cost cash flows for the total investment for the duration of VG15076 investment plus 30 years from the last year of investment are shown in Figure 1.

Figure 1: Annual Cash Flow of Undiscounted Total Benefits and Total Investment Costs



Sensitivity Analyses

A sensitivity analysis was carried out on the discount rate. The analysis was performed for the total investment and with benefits taken over the life of the investment plus 30 years from the last year of investment. All other parameters were held at their base values. Table 9 present the results. The results are moderately sensitive to the discount rate and the project fails to breakeven at a discount rate of 10%.

Table 9: Sensitivity to Discount Rate
(Total investment, 30 years)

Investment Criteria	Discount rate		
	0%	5%	10%
Present Value of Benefits ($m)	3.33	1.54	0.83
Present Value of Costs ($m)	1.02	1.13	1.24
Net Present Value ($m)	2.31	0.41	-0.42
Benefit-cost ratio	3.26	1.36	0.67

A sensitivity analysis was then undertaken for the assumed share of 8- to 12-year old children reached by the program. Results are provided in Table 10. The project continues to breakeven when the share of 8- to 12-year old children is sensitivity tested at 70%. Breakeven occurs when population reached is 60% (not shown in Table 10).

Table 10: Sensitivity to Share of Population Reached by VERTICAL
(Total investment, 30 years)

Investment Criteria	Share of 8- to 12-year old Children Reached by VERTICAL		
	70%	80% (base)	90%
Present Value of Benefits ($m)	1.36	1.54	1.71
Present Value of Costs ($m)	1.13	1.13	1.13
Net Present Value ($m)	0.23	0.41	0.58
Benefit-cost ratio	1.20	1.36	1.51

A final sensitivity analysis tested the sensitivity of the investment criteria to the increase in vegetable consumption realised. The results (Table 11) show that if increase in consumption is halved to 0.25 serves per day, the project will not breakeven.

Table 11: Sensitivity to Increase in Vegetable Consumption Attribution to VERTICAL (Total investment, 30 years)

Investment Criteria	Increase in Vegetable Consumption by 8- to 12-year olds		
	0.25 serve	0.5 serve (base)	1.0 serve
Present Value of Benefits ($m)	0.77	1.54	3.07
Present Value of Costs ($m)	1.13	1.13	1.13
Net Present Value ($m)	-0.36	0.41	1.94
Benefit-cost ratio	0.68	1.36	2.72

Confidence Rating

The results produced are highly dependent on the assumptions made, some of which are uncertain. There are two factors that warrant recognition. The first factor is the coverage of benefits. Where there are multiple types of benefits it is often not possible to quantify all the benefits that may be linked to the investment. The second factor involves uncertainty regarding the assumptions made, including the linkage between the research and the assumed outcomes.

A confidence rating based on these two factors has been given to the results of the investment analysis (Table 12). The rating categories used are High, Medium, and Low, where:

- High: denotes a good coverage of benefits or reasonable confidence in the assumptions made
- Medium: denotes only a reasonable coverage of benefits or some uncertainties in assumptions made
- Low: denotes a poor coverage of benefits or many uncertainties in assumptions made

Table 12: Confidence in Analysis of Project

Coverage of Benefits	Confidence in Assumptions
Medium-high	Medium-Low

Coverage of benefits was assessed as medium-high. The main benefit of the research project, increased consumption of vegetables by children, quantified.

Confidence in assumptions was rated as Medium-Low. While data were mostly drawn from reliable sources such as Hort Innovation and ABS, a number of percentage based estimates were required, and these data were estimates.

Conclusion

The investment in VG15067 has contributed to the VERTICAL program that when rolled out nationally is expected to increase the consumption of vegetables by primary school children and generate additional profitable vegetable sales for Australian growers. Positive environmental and social impacts are also anticipated. Environmental impacts may include reduced vegetable waste in both households and the supply chain. Social impacts may include positive health outcomes for Australian children, researchers with additional education program design capacity and a contribution to community wellbeing with more profitable vegetable growers and healthy school-aged children.

Four environmental and social impacts were not valued. When inability to value all impacts is combined with conservative assumptions for the principal economic impacts valued, it is reasonable to conclude that the valuation may be an underestimate of the actual performance of the investment.

Glossary of Economic Terms

Cost-benefit analysis:	A conceptual framework for the economic evaluation of projects and programs in the public sector. It differs from a financial appraisal or evaluation in that it considers all gains (benefits) and losses (costs), regardless of to whom they accrue.
Benefit-cost ratio:	The ratio of the present value of investment benefits to the present value of investment costs.
Discounting:	The process of relating the costs and benefits of an investment to a base year using a stated discount rate.
Internal rate of return:	The discount rate at which an investment has a net present value of zero, i.e. where present value of benefits = present value of costs.
Investment criteria:	Measures of the economic worth of an investment such as Net Present Value, Benefit-Cost Ratio, and Internal Rate of Return.
Modified internal rate of return:	The internal rate of return of an investment that is modified so that the cash inflows from an investment are re-invested at the rate of the cost of capital (the re-investment rate).
Net present value:	The discounted value of the benefits of an investment less the discounted value of the costs, i.e. present value of benefits - present value of costs.
Present value of benefits:	The discounted value of benefits.
Present value of costs:	The discounted value of investment costs.

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Astrid Poelman, Principal Investigator, CSIRO

Abbreviations

CRRDC	Council of Research and Development Corporations
DAWR	Department of Agriculture and Water Resources (Australian Government)
GDP	Gross Domestic Product
GVP	Gross Value of Production
IRR	Internal Rate of Return
MIRR	Modified Internal Rate of Return
OCS	Office of Chief Scientist Queensland
PVB	Present Value of Benefits
R&D	Research and Development
RD&E	Research, Development and Extension
SIAP	Strategic Investment Advisory Panel
SIP	Strategic Investment Plan
VERTICAL	Vegetable Education Resource To Increase Children's Acceptance and Liking