

# **Horticulture Innovation Australia**

## **Final Report**

### **Economic Modelling of the Impact of Increased Vegetable Intake on Health Expenditure**

Deloitte Access Economics

Project Number: VG15031

## **VG15031**

This project has been funded by Horticulture Innovation Australia Limited using the vegetable industry levy and funds from the Australian Government.

Horticulture Innovation Australia Limited (Hort Innovation) makes no representations and expressly disclaims all warranties (to the extent permitted by law) about the accuracy, completeness, or currency of information in *Economic Modelling of the Impact of Increased Vegetable Intake on Health Expenditure*.

Reliance on any information provided by Hort Innovation is entirely at your own risk. Hort Innovation is not responsible for, and will not be liable for, any loss, damage, claim, expense, cost (including legal costs) or other liability arising in any way (including from Hort Innovation or any other person's negligence or otherwise) from your use or non-use of *Economic Modelling of the Impact of Increased Vegetable Intake on Health Expenditure* or from reliance on information contained in the material or that Hort Innovation provides to you by any other means.

ISBN 0 7341 3845 8

Published and distributed by:  
Horticulture Innovation Australia Limited  
Level 8, 1 Chifley Square  
Sydney NSW 2000  
Tel: (02) 8295 2300  
Fax: (02) 8295 2399

© Copyright 2016

# Contents

Summary.....	3
Keywords .....	6
Introduction.....	7
Methodology.....	8
Australia's vegetable consumption .....	8
Estimating the impact of increased consumption on government health expenditure.....	9
Estimating the impact of increased consumption on producer returns .....	11
Project monitoring and evaluation framework.....	11
Project audience and reach.....	12
Outputs.....	13
Outcomes .....	14
Results from economic modelling .....	14
<i>Results – reduced government health expenditure.....</i>	15
<i>Results – returns to producers.....</i>	17
Evaluation and Discussion .....	19
Effectiveness of the project.....	19
Impact of the project .....	19
Efficiency of the delivery mechanisms .....	19
Appropriateness of project methodology .....	20
Recommendations.....	21
Scientific Refereed Publications.....	22
Intellectual Property/Commercialisation.....	23
References .....	24
Appendix .....	25
Limitation of our work.....	26

## Summary

In 2016, Deloitte Access Economics was commissioned by Horticulture Innovation Australia (“Hort Innovation”) to model the impact of increased vegetable consumption on government health expenditure and producer returns. The objectives of the project are to assist Hort Innovation to:

- identify the potential reduction in health costs due to an increase in vegetable intake;
- develop a business case for external funding support from other sources with an interest in improved health outcomes resulting from increased vegetable intake; and
- identify the increase in grower returns from an increase in vegetable consumption.

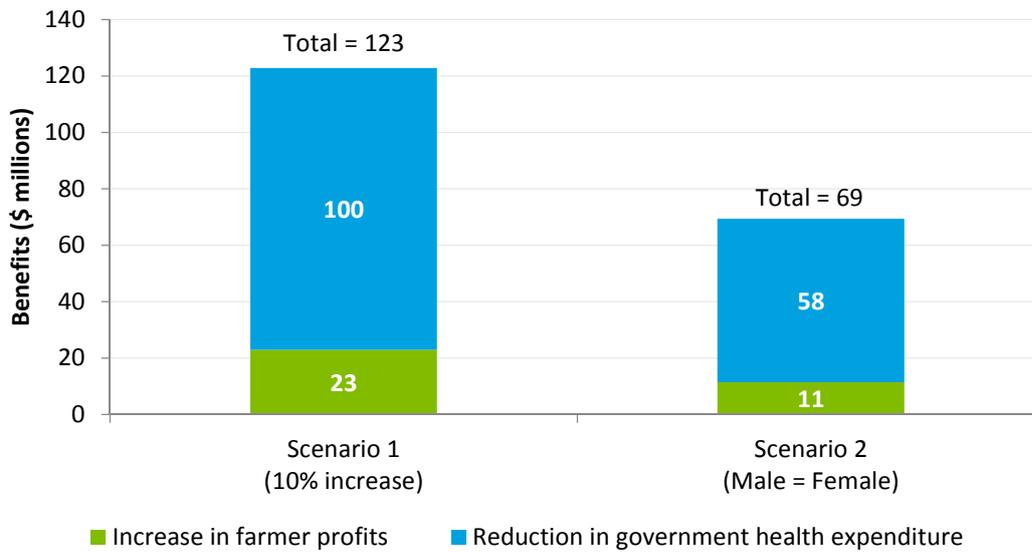
The project is targeted to vegetable value chain stakeholders, and government and non-government audiences.

This document is intended to be a summary of the primary output of this project, which is a business case which outlines a ‘case for change’ for increasing vegetable consumption and identifies options for possible interventions to increase vegetable consumption. The business case is provided as an attachment to this report. In preparing the business case, Deloitte Access Economics has undertaken research and modelling to quantify the potential benefits of increased vegetable intake in terms of reduced government health expenditure and increased financial returns to growers. The modelling considered two scenarios:

- **Scenario 1** – average consumption of vegetables across the population was 10% higher.
- **Scenario 2** – consumption of vegetables by males was equal to that of females (as males currently consume approximately 10% fewer vegetables than females, on average).

Chart 1 shows the estimated impacts under the scenarios.

**Chart 1: Producer returns and health benefits, all vegetables**



Source: Deloitte Access Economics calculations.

It was estimated that higher levels of vegetable consumption would lead to significant economic benefits for governments and for vegetable producers. Scenario 1 results in an estimated \$123 million of benefits annually (in 2015-16 dollars), of which \$100 million is the expected reduction in government health expenditure and \$23 million is the increased profit that will flow to vegetable growers. Scenario 2 results in lower benefits (\$69 million), but would still provide vegetable growers with an additional \$11 million in profit and reduce government health expenditure by \$58 million in 2015-16.

In addition to evaluating financial returns to the vegetable industry as a whole, the modelling also considered the expected returns to growers that pay the National Vegetable Levy (NVL).<sup>1</sup> The modelling showed profits for NVL-paying growers would increase by \$13.0 million and \$6.4 million under Scenario 1 and 2, respectively.

The intended outcomes of this research include:

- an economic rationale for investment in initiatives to increase vegetable intake based on reduction in health expenditure; and
- improved grower returns due to increased vegetable consumption.

This research project provides a clear economic rationale for investment in initiatives to increase vegetable consumption. It does so by identifying the quantum of reduced government health expenditure that could be realised if vegetable intake were higher. While the research project cannot be expected to increase vegetable consumption and therefore deliver improved grower returns in and of itself, it quantifies the increase in grower returns that would occur if vegetable consumption were higher.

---

<sup>1</sup> The NVL is collected from growers at the first point of sale (e.g. wholesale market) and revenue is forwarded to Hort Innovation to coordinate, invest, and manage R&D and promotional programs on behalf of the vegetable industry. The NVL applies to all vegetables produced in Australia with a number of exceptions.

Deloitte Access Economics recommends further analysis be undertaken to investigate the barriers to vegetable consumption in Australia, and possible interventions for increasing intake. This could include research and economic modelling to select the preferred option(s) and identify strategies for effective implementation.

## Keywords

Vegetable consumption; health expenditure; profit; National Vegetable Levy; economic; attributable fraction; relative risk; marginal benefit; burden of disease; Australia.

# Introduction

In 2016, Hort Innovation commissioned Deloitte Access Economics to quantify the impact that an increase in vegetable intake would have on health expenditure. The objectives of the project are to help Hort Innovation to:

- identify the potential reduction in health costs due to an increase in vegetable intake;
- develop a business case for external funding support from other sources with an interest in improved health outcomes resulting from increased vegetable intake; and
- identify the increase in grower returns from an increase in vegetable consumption.

This document is intended to be a summary of the primary output of the project, which is a business case which outlines a 'case for change' for increasing vegetable consumption and identifies options for possible interventions to increase vegetable consumption. The business case is provided as an attachment to this report.

Deloitte Access Economics undertook economic modelling to develop the business case for increasing investment in initiatives that would drive increased consumption. The business case sets out the detailed methodologies that underpin the economic modelling, and the detailed results of the modelling. The business case seeks to make a 'case for change' for increasing consumption by:

- analysing the level of vegetable consumption in Australia;
- establishing the impact of low vegetable consumption on health expenditure;
- calculating the reduction in government health expenditure if vegetable consumption increased; and
- estimating the increase in producer profits that would occur if vegetable consumption increased.

There is a well-established link between increased intake of vegetables and improved health outcomes. An increase in vegetable intake, which is well below the Australian dietary guidelines for all age groups, would have a positive effect for a broad range of stakeholders. These stakeholders include the community (who would benefit from improved health), the government (who would benefit from a reduction in health expenditure), and vegetable producers (who would benefit from an increase in demand for their products).

The outputs from this research project will be used to seek collaboration and investment from stakeholders, as there is evidence that long-term interventions with widespread support from government and the community are most effective. The outcome Hort Innovation is seeking for its members is an increase in producer returns due to growth in domestic vegetable consumption.

# Methodology

Deloitte Access Economics developed a business case to provide an economic rationale for increasing vegetable consumption in Australia, including recommended future research activities. The business case is underpinned by economic modelling which comprises three parts, and is summarised in the sections below:

1. identifying Australia's vegetable consumption;
2. estimating the impact of increased consumption on government health expenditure; and
3. estimating the impact of increased consumption on returns to producers.

The modelling assessed two scenarios, representing moderately higher levels of vegetable consumption:

- **Scenario 1** – average consumption of vegetables across the population was 10% higher.
- **Scenario 2** – consumption of vegetables by males was equal to that of females.

Reductions in government health expenditure were also estimated under a counterfactual scenario whereby all Australians consume the recommended daily intake of vegetables. This is to show the total health expenditure associated with inadequate intake. Producer returns were not estimated under this counterfactual because the required increase in production is too large to be accurately captured in the current model.

As a result of this project, Deloitte Access Economics has developed recommendations for future research (see Recommendations section of this document). A detailed description of the methodology is provided in the business case, which is available from Hort Innovation on request.

This section concludes with a description of the project's monitoring and evaluation framework, the project's reach, and target audience.

## ***Australia's vegetable consumption***

In order to estimate the impact of increased vegetable intake, it was necessary to establish the baseline level of vegetable consumption in Australia. This includes volume of consumption (by grams and number of serves), and how many vegetables are consumed which are subject to the NVL.

Results from the National Health Survey (NHS, previously the Australian Health Survey) were used to estimate the quantity of vegetables consumed, disaggregated by age and gender. The latest NHS was undertaken in 2014-15 (Australian Bureau of Statistics (ABS), 2015a). The National Health and Medical Research Council (NHMRC) define a standard serve of vegetables as approximately 75 grams (NHMRC, 2013). This allows the number of serves to be converted into a weight (gram) equivalent.

For the purposes of estimating returns to producers, the business case considered returns to the vegetable industry as a whole, as well as just vegetables that attract the NVL. As such, it was

necessary to identify the share of vegetable consumption attributable to levied vegetables. The National Nutrition and Physical Activity Survey (NNPAS) 2011-12 asked participants to recall which vegetables they consumed in the last 24 hours, and in what quantities (ABS, 2014). Using results from the NNPAS, Deloitte Access Economics estimated the share of consumption (by weight) attributable to vegetables that pay the NVL.

## ***Estimating the impact of increased consumption on government health expenditure***

To determine the impact of increased vegetable consumption on government health expenditure, there were four primary steps taken in the modelling. These steps were:

- **Step 1:** identifying the conditions that may be reduced by increasing vegetable consumption. These were cardiovascular conditions, and some cancers (Australian Institute of Health and Welfare (AIHW), 2016).
- **Step 2:** the ratio of the burden of disease that is attributable to low consumption of vegetables relative to the total burden for the condition (the “attributable fraction”) was applied to the total health expenditure for the broad level groups - cardiovascular conditions and cancer – to determine the total health system expenditure attributable to low consumption. The burden of disease data were obtained from AIHW (2016). Health expenditure was obtained at the broad level of cardiovascular disease (CVD) in Australia and cancers in Australia for the year 2008-09 (AIHW; 2013, 2014). This expenditure was inflated using population growth and health inflation to bring these estimates forward to 2015-16 (ABS, 2015b; AIHW, 2015). Government health expenditure was derived using data from the AIHW (2016).
- **Step 3:** literature was then used to determine the relative risk curve for a marginal increase in vegetable consumption. The relative risk curve represents the expected risk of incidence of a condition, or mortality due to a condition, given a certain level of vegetable consumption in terms of grams. The risk curve for CVD is steeper than for cancer, reflecting that low vegetable consumption has a larger impact on CVD.
- **Step 4:** the marginal reduction in risk of CVD or cancer relative to the difference between the baseline consumption risk and the minimum risk<sup>2</sup> was considered to represent the proportion of attributable health expenditure that may be avoided by the increase in consumption. The maximum expenditure that could be avoided is 100% of the expenditure attributable to low vegetable consumption.

Steps 3 and 4 are reflected in the following charts for a 10% increase in vegetable consumption and the change in risk for cancer and CVD, respectively. Step 3 was used to derive the solid blue line, while step 4 represents the relative difference in risk of a condition between the green (10% increase in consumption) and blue points (baseline consumption). The same methodology was

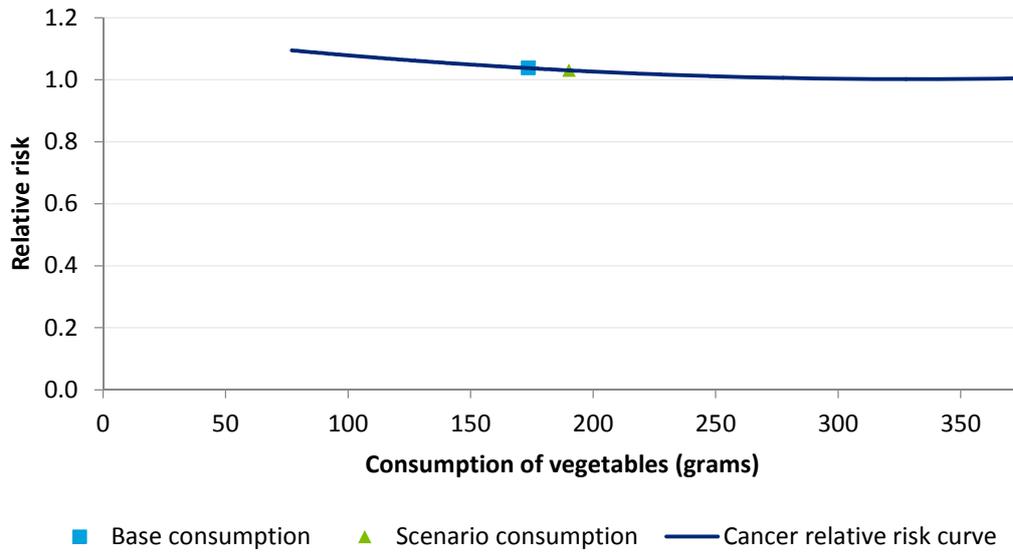
---

<sup>2</sup> As the work by the AIHW (2016) considers the attributable fractions relative to a minimum risk profile the literature was rebased to be relative to the approximate vegetable minimum risk profile. The minimum risk profile in this study is defined as 5 serves to align with current recommendations (NHMRC, 2013). The minimum risk profile does not imply that there is no risk that people will develop cancer or CVD; rather, it implies that none of these incident cases will be as a result of low vegetable consumption. Thus, at the minimum risk profile the risk of developing cancer or CVD due to low consumption of vegetables is given a value of 1. Risk above this level has a value greater than 1.

followed for scenario 2.

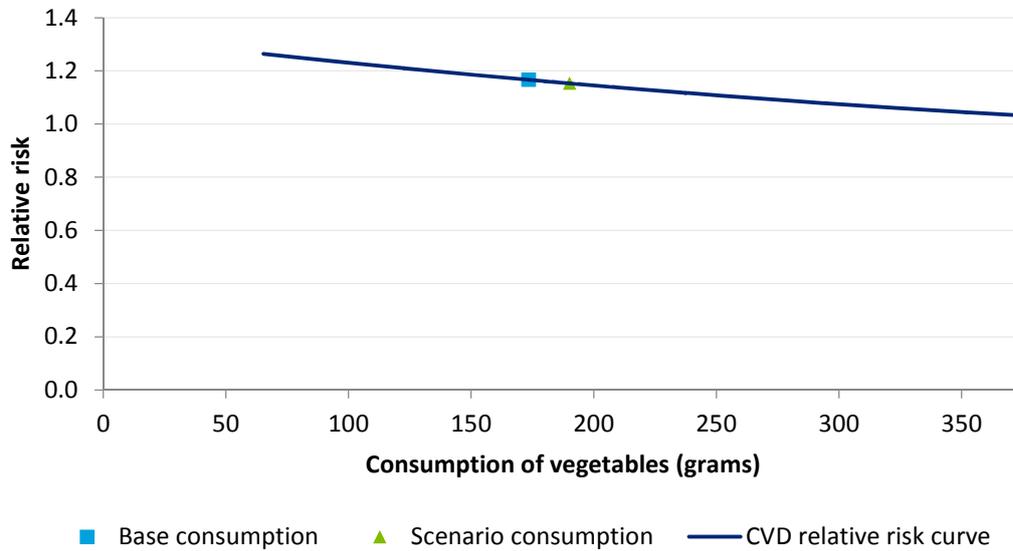
Base consumption of 174 grams increased 10% to 190 grams would result in a reduction in cancer risk from 1.037 to 1.030 (Chart 2), and a reduction in CVD risk from 1.166 to 1.153 (Chart 3).

**Chart 2: Change in cancer risk associated with a 10% increase in vegetable consumption, persons**



Source: Deloitte Access Economics calculations.

**Chart 3: Change in CVD risk associated with a 10% increase in vegetable consumption, persons**



Source: Deloitte Access Economics calculations.

## ***Estimating the impact of increased consumption on producer returns***

The economic modelling assessed the impact of increased consumption on producer returns, in terms of increased profits and value of production. This was done for the vegetable growing industry as a whole, as well as just vegetables that pay the NVL. The modelling involved the following steps:

- **Step 1:** The baseline gross value of vegetable production for human consumption was estimated using data from the ABS' *Value of Agricultural Commodities Produced* publication (ABS, 2016). This publication allowed value of production to be disaggregated by the major vegetable types that are subject to the NVL.
- **Step 2:** In identifying producer returns, the analysis excluded vegetables that are exported. This is because we assumed that exports would be unaffected by increased consumption in Australia. Using data from the Australian Bureau of Agriculture and Resources (ABARES), and subtracting vegetable exports (ABARES, 2016) from total value of production (for both levied and non-levied vegetables), we estimated the value of domestic production for domestic consumption.
- **Step 3:** Having established the baseline value of production, grower profit margins were estimated using data from the ABARES survey of vegetable growing farm businesses (ABARES, 2015). The survey captured financial statistics including average vegetable cash receipts and business profits, for all farms as well as NVL paying farms. This allowed producer profit margins to be estimated. The profit margins were applied to the estimated value of production to estimate total industry profit.
- **Step 4:** The final step involved modelling the impacts of the two scenarios. The modelling treated a proportional increase in consumption as resulting in equal proportional increases in production, value of production, and profits. For example, we assumed that a 10% increase in consumption would require a 10% increase in production. This implicitly assumed that the ratios in which particular vegetables are consumed, wastage rates, and the relative shares of imports/exports, remain constant. We further assumed that Australian growers can absorb moderate increases in vegetable demand without changing vegetable prices or cost drivers. Thus, the results represent long-run producer returns.

## ***Project monitoring and evaluation framework***

The methodology for this project involved robust governance and monitoring arrangements to ensure the project met its intended objectives.

A project plan was developed at the commencement of the project, and Deloitte Access Economics actively monitored progress against the plan during the course of the project. Drawing on our extensive project management experience, we ensured that any emerging risks or methodological challenges were identified early and addressed in a timely and effective manner. A project initiation meeting was held with Hort Innovation to confirm the project objectives and methodology. An interim progress milestone report was also provided to Hort Innovation which gave an overview of progress and identified potential risks.

The project outputs were subject to Deloitte Access Economics' stringent quality assurance process. This involved an independent review of the business case by a partner to ensure it was of a high

standard and met the intended project scope.

### ***Project audience and reach***

The outcomes from this project are relevant to a wide range of stakeholders. Higher levels of vegetable consumption have the potential to benefit the community (who would benefit from improved health), the government (who would benefit fiscally from a reduction in health expenditure), and vegetable producers (who would benefit from an increase in demand for their products). The methodology for this project has been targeted at a broad audience including vegetable levy payers, vegetable value chain stakeholders, and government and non-government audiences.

This project has assessed the impacts of increased vegetable consumption by all people in Australia, and reductions in government health expenditure have been modeled for both Federal and state/territory governments. Similarly, producer returns are estimated for all vegetable growers in Australia. As such, the project has a national reach and relevance to the wider Australian community, and potentially further afield.

# Outputs

The following deliverables comprise the outputs of this research project:

- **Business case** – the business case outlines a ‘case for change’ for increasing vegetable consumption, and identifies possible interventions to increase vegetable consumption. The business case is supported by detailed economic modelling to quantify the potential benefits of increased vegetable intake in terms of reduced government health expenditure and increased financial returns to growers. The results of the modelling provide an economic rationale for investment in initiatives to increase vegetable intake. This includes a rationale for government stakeholders (in terms of reduced health expenditure) as well as industry (in terms of increased financial returns). The business case is an attachment to this document.
- **Summary Report** (this document) – the summary report includes an overview of the research project, methodology, outputs, outcomes and recommendations. The summary report is designed to succinctly summarise the research project to Hort Innovation members, and other stakeholders.

The outputs from this research will be used to seek collaboration and investment from key stakeholders, including vegetable levy payers, vegetable value chain stakeholders, and government/non-government stakeholders.

## Outcomes

The intended outcomes of this project include:

- an economic rationale for investment in initiatives to increase vegetable intake based on reduction in health expenditure; and
- improved grower returns due to increased vegetable consumption

The business case, including the underpinning modelling, provides an economic rationale for investment in initiatives to increase vegetable intake. It does so by quantifying the potential reductions in government health expenditure and increases in grower returns associated with higher vegetable intake. The results are summarised below, with detailed results and methodology provided in the business case (attached).

While the research project cannot be expected to increase vegetable consumption and therefore deliver improved grower returns in and of itself, it quantifies the increase in grower returns that would be associated with higher levels of vegetable consumption. Further research and analysis is required to identify practical, cost-effective options for increasing vegetable intake in Australia (see Recommendations section).

### ***Results from economic modelling***

This section provides an overview of results from the economic modelling. For a detailed discussion of the results and methodology, see the business case attached to this document.

The modelling assessed two scenarios, representing moderately higher levels of vegetable consumption:

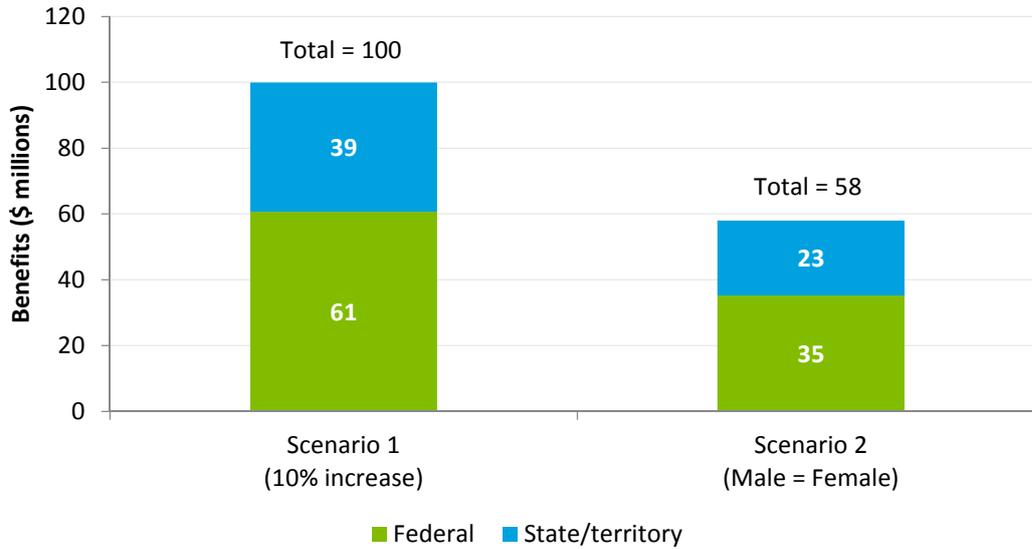
- **Scenario 1** – average consumption of vegetables across the population was 10% higher.
- **Scenario 2** – consumption of vegetables by males was equal to that of females.

It was found that 10% higher vegetable consumption across the population would result in \$123 million of benefits annually (in 2015-16 dollars).<sup>3</sup> Of this, reductions in government health expenditure represent approximately \$100 million while \$23 million will flow to growers as increased profits. Similarly, Scenario 2 would provide vegetable growers with an additional \$11 million in profit in 2015-16, and reduce health expenditure by \$58 million. Government returns by Federal and state/territory tiers are shown in Chart 4.

---

<sup>3</sup> Note, we have assumed that there is no net cost to consumers from higher levels of vegetable consumption. This is because we assume that higher vegetable intake would displace consumption of food groups with limited or negative health value (e.g. sugary carbonated drinks), and expenditure on these products would be redirected to vegetables. In addition, consumers would benefit from improved health outcomes associated with vegetable intake.

**Chart 4: Government health expenditure savings, by tier of government**



Source: Deloitte Access Economics calculations.

The total reduction in expenditure was estimated to be \$100 million, of which \$61 million (61%) accrues to the Federal government and \$39 million (39%) accrues to state/territory governments, under Scenario 1. Scenario 2 would reduce health expenditure by \$58 million, with \$35 million (61%) of savings flowing to the Federal government and \$23 million (39%) accruing to state/territory governments.

Deloitte Access Economics also assessed reductions in health expenditure under a counterfactual where all Australians consume the recommended daily intake. This would lead to a reduction in government health expenditure of \$978 million (in 2015-16 dollars). Producer returns cannot be accurately modeled for such a large increase in consumption without a detailed general equilibrium analysis, which is outside the scope of this project.

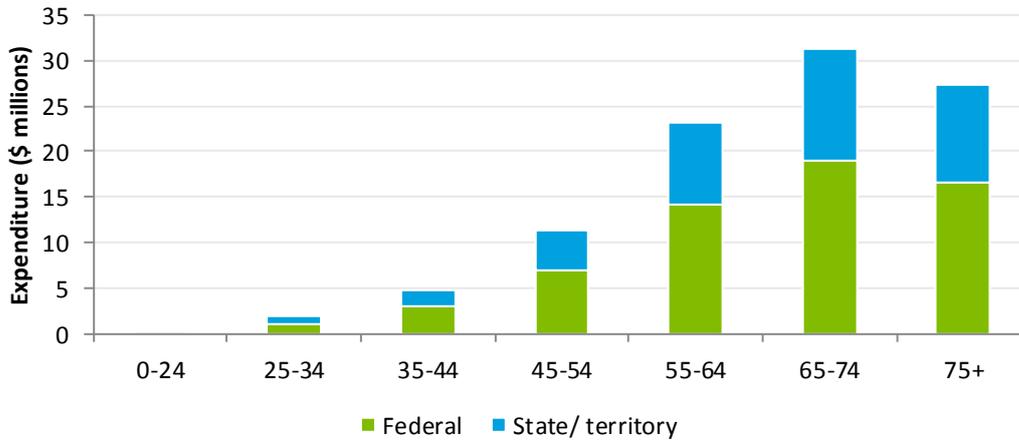
These results represent the potential 'size of the prize', and provide a strong rationale to implement interventions for increasing vegetable consumption.

The subsections below provide further analysis of the results for health expenditure and producer returns. Detailed results and methodology, including estimates of vegetable consumption, are provided in the business case attached to this document.

### ***Results – reduced government health expenditure***

The estimated reduction in Federal and state/territory expenditure is shown in Chart 5 and Chart 6, by age group. The modelling showed that 10% higher levels of vegetable consumption can reduce the risk of cancer by approximately 0.9 percentage points and reduce the risk of CVD by approximately 1.6 percentage points across the population. The change in the risk of cancer and CVD represents a reduction of approximately 23.4% and 9.8% of total expenditure attributable to low consumption of vegetables for cancer and CVD, respectively.

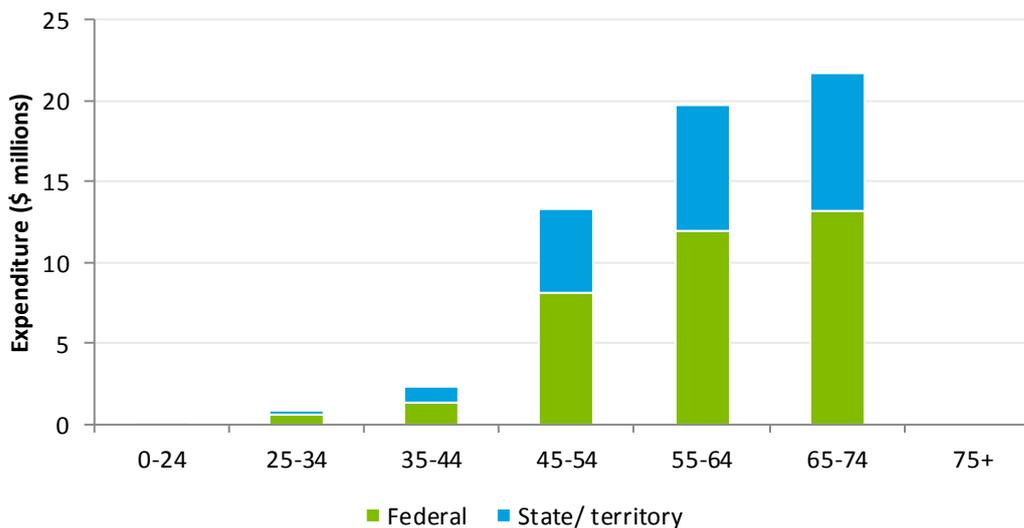
**Chart 5: Change in government expenditure – scenario 1**



Source: Deloitte Access Economics calculations.

Scenario 2 considered higher levels of vegetable consumption by males, so that male consumption was the same as for females in each age group. The only exception to this is males aged 75 years or older, who consume more vegetables than females – as such there was no change applied to consumption for this group. Scenario 2 can reduce the risk of cancer by approximately 0.9 percentage points and reduce the risk of CVD by approximately 1.7 percentage points across males in Australia.<sup>4</sup> This represents a reduction in health expenditure on males attributable to low consumption of vegetables of approximately 22.5% and 9.9% for cancer and CVD respectively.

**Chart 6: Change in government expenditure – scenario 2**



Source: Deloitte Access Economics calculations.

The final scenario considers the change in expenditure if all people in Australia consumed the recommended amount of vegetables for their age. This scenario is hypothetical and does not take

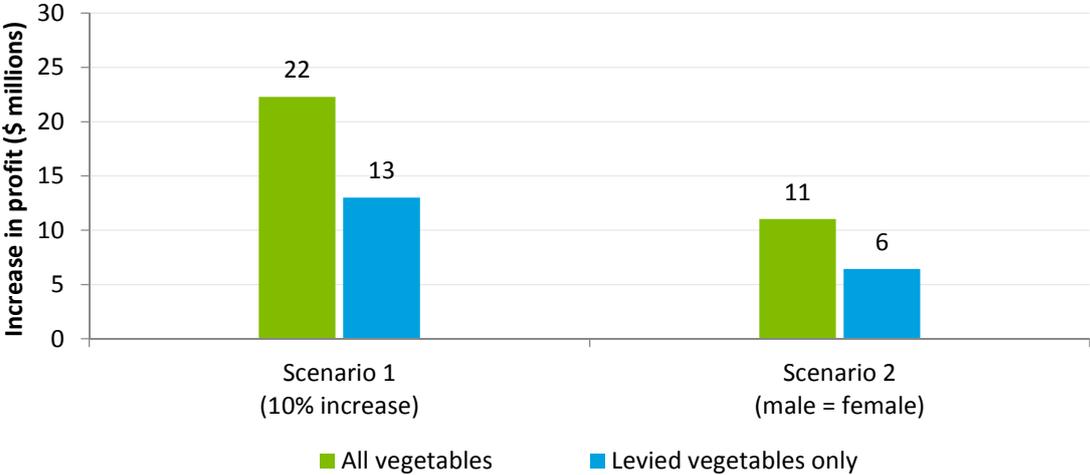
<sup>4</sup> Note, since the reduced risk is only for males, even though these numbers are the same or higher than the risk reductions under scenario 1, the health savings are substantially lower for scenario 2 since females have no risk reduction or associated health savings.

into account that increasing consumption to this level may result in substantial changes to other aspects of diet and other health risk factors. If all Australians met the recommended intake, the risk of cancer and CVD would be reduced by approximately 3.7 and 16.6 percentage points, respectively. Federal government health expenditure would be reduced by \$595 million while state/territory governments would see a reduction of \$384 million. The overall reduction in government health expenditure was estimated to be \$978 million.

**Results – returns to producers**

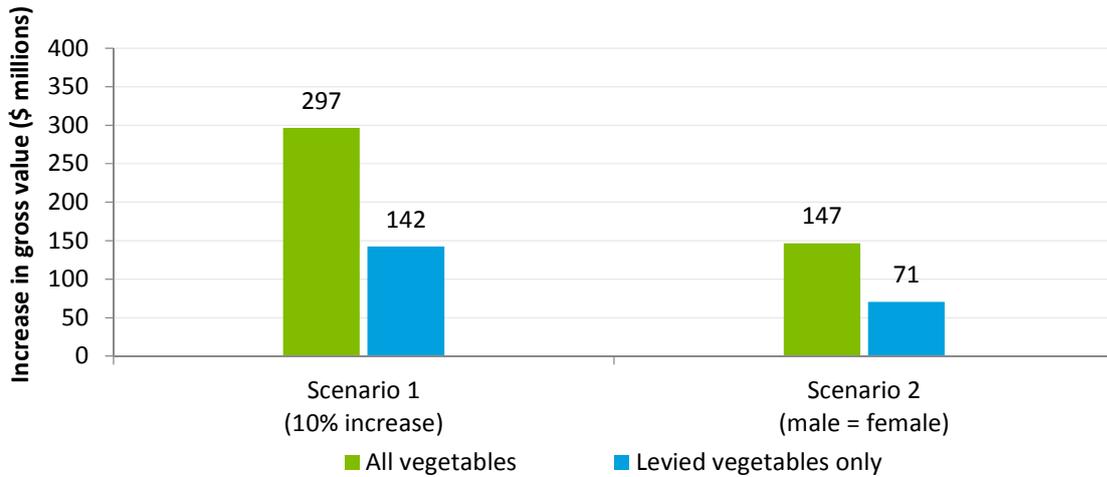
Overall, it was estimated that total benefits to the vegetable industry (measured by increased profits) would be over \$22 million under Scenario 1 and over \$11 million for Scenario 2 (in 2015-16 dollars). The size of the vegetable industry as a whole (measured by gross value of production) is estimated to be larger by \$297 million and \$147 million under Scenarios 1 and 2 respectively. The results are shown in Chart 7 and Chart 8, for all vegetables and levied vegetables only.

**Chart 7: Increase in vegetable industry profits**



Source: Deloitte Access Economics calculations.

**Chart 8: Increase in gross value of vegetables produced**



Source: Deloitte Access Economics calculations.

Considering levied vegetables alone, Scenario 1 and 2 result in increased industry revenue of \$142 million and \$71 million respectively. The results for levied vegetables are approximately equal to half the results for all vegetables. This is because the estimated value of production of levied vegetables is around 48% of total value of production for human consumption (see the attached business case). Note, however, that estimated profit margins for NVL paying growers (9.1%) are higher than the average for all producers (7.5%) (ABARES, 2015). As a result, the estimated increase in profits for NVL paying producers is slightly more than 50% of the increase for the vegetable industry as a whole (\$13 million in Scenario 1 and \$6 million in Scenario 2, as shown in Chart 7).

These results represent long-run benefits. They implicitly assume that the Australian vegetable industry is able to absorb the increased demand without altering grower cost drivers and wholesale vegetable prices. In the short-run, some growers are likely to be constrained in their ability to scale-up production, including the availability of resources such as land, labour and financial capital.

## **Evaluation and Discussion**

This section provides discussion of the overall effectiveness of the research project, the impact of the research project, the efficiency of the delivery mechanisms and appropriateness of the methodology.

### ***Effectiveness of the project***

This research project was intended to establish an economic 'case for change' to increase vegetable intake in Australia. This project has achieved this aim, by estimating the quantity of vegetables consumed in Australia, and identifying the negative health implications of low vegetable consumption. Building from this, the project quantified the reductions in government health expenditure as a result of increased vegetable consumption. The project also estimated the returns to producers from increased consumption.

These results provide industry and government with useful metrics for assessing the merits of potential interventions to increase vegetable consumption. For example, it is expected that any intervention which successfully lifts consumption by 10% across the population, and has a total cost of less than \$123 million (in 2015-16 dollars), would provide net benefits to Australia. This provides a strong rationale for investment by government and industry. As such, the results from this research can be used to build support for increased collaboration and funding from stakeholders to develop new interventions.

### ***Impact of the project***

This project has contributed to the industry's body of knowledge, and clearly articulated the benefits that would flow from increased vegetable consumption. This project will be an important element of future policies which seek to increase consumption of vegetables in Australia. Dissemination and circulation of the findings from the project to stakeholders will assist with increasing the impact of the project.

The project cannot deliver an increase in vegetable consumption in and of itself, and successful benefits realisation will depend on the particular interventions that are chosen, and how they are implemented. The business case identifies some potential interventions, however further analysis is required to select the preferred option(s).

### ***Efficiency of the delivery mechanisms***

The delivery mechanisms used in this project have proven to be efficient, as the project has been delivered within project timeframes, and has achieved its outcomes. At the commencement of the project, Deloitte Access Economics held a project initiation meeting with Hort Innovation to confirm project timelines, liaison arrangements and methodology. Deloitte Access Economics also provided Hort Innovation with an interim progress milestone report which gave an overview of project progress, identified potential risks, and provided an opportunity to receive feedback.

Throughout the project, Deloitte Access Economics drew on its extensive experience in quantitative and qualitative research, economic modelling, report writing and project management capabilities to deliver project outputs that were in line with the desired scope of the project.

The project was supported by strong governance arrangements to ensure the effectiveness of project activities and quality of all deliverables. Throughout the project, Deloitte Access Economics actively monitored progress against objectives and identified any emerging risks.

### ***Appropriateness of project methodology***

The methodology for this project was designed in order that a rigorous, detailed and defensible estimate of the impact of vegetable consumption on government health expenditure could be calculated, which can be used to influence future policy decisions in this space. The methodology has achieved this aim, as demonstrated by the content in the attached business case.

The methodology involved wide-ranging research, including literature reviews, data gathering, and quantitative analysis. This informed the creation of an economic model to establish baseline levels of vegetable consumption, and quantify the potential reductions in government health expenditure from increased vegetable intake. The modelling also considered financial returns flowing to vegetable producers, including growers that pay the NVL. Deloitte Access Economics also undertook research of possible interventions for increasing vegetable consumption, including analysis of case studies in Australia and overseas.

The scenarios that were modelled were chosen because they represent moderately higher levels of vegetable consumption, and are illustrative of the benefits that could be generated as part of successful intervention programs.

Importantly, the methodology allows benefits to be disaggregated for specific stakeholder groups. This includes benefits to Federal and state/territory governments (in terms of reductions in health expenditure), as well as industry (in terms of increased producer returns). Producer returns were also assessed for NVL-paying vegetables specifically. This provides the basis for building support among a broad range of stakeholders for funding to further develop options for intervention.

A small number of methodological challenges and caveats were identified through the course of this project. These items have been addressed in the methodology and have not affected the outputs and outcomes of this project. Key examples are summarised below.

- The analysis only applied to a small range of conditions. Available literature does not provide sufficient evidence to include conditions outside of some cancers and CVD. Some further areas for consideration may include conditions such as type 2 diabetes, chronic obstructive pulmonary disease and cataracts.
- The analysis was undertaken *ceteris paribus* – i.e. it was assumed that external factors such as fruit consumption and other diet related risks are held constant. This may mean that our results are conservative as an increase in vegetable consumption may lower other diet related risks (since increased vegetable consumption likely displaces consumption of some higher risk food groups).
- In estimating returns to producers, we assumed Australian vegetable growers are able to absorb increased demand for vegetables without altering their cost and revenue fundamentals. We believe this assumption is reasonable for moderately higher levels of vegetable demand (such as 5-10%). In practice, some growers are likely to face short-term capacity constraints (e.g. limited availability of land and labour) which may affect production costs and vegetable prices. Hence the estimated producer returns should be interpreted as 'long-run' returns.

## Recommendations

This project has been an important step in articulating the economic benefits that could be achieved from increased vegetable consumption in Australia. However, Deloitte Access Economics recommends that further work be undertaken to design and implement specific interventions for increasing consumption and realising the identified economic benefits. Future activities could include analysis of options for intervention, selecting the preferred option(s) (e.g. through cost-benefit analysis), identifying financing and partnership opportunities, and developing strategies for implementation.

## Scientific Refereed Publications

None to report.

# Intellectual Property/Commercialisation

No commercial IP generated, except for that contained in the Deloitte Access Economics methodology and model.

## References

Key references are listed below:

Australian Bureau of Agricultural and Resource Economics and Sciences 2016, *Agricultural commodities March Quarter 2016*, Australian Government, Canberra.

- 2015, *Australian vegetable growing farm businesses: an economic survey, 2013-14 and 2014-15*, Australian Government, Canberra.

- 2014, *Australian Health Survey: Nutrition First Results – Food and Nutrients 2011-12, Australia*, Australian Government, Canberra.

Australian Bureau of Statistics 2016, *Value of Agricultural Commodities Produced 2014-15, Australia*, Australian Government, Canberra.

- 2015a, *National Health Survey: First Results 2014-15, Australia*, Australian Government, Canberra.

- 2015b, *Australian Demographic Statistics June 2015, Australia*, Australian Government, Canberra.

Australian Institute of Health and Welfare 2016, *Australian Burden of Disease Study: Impact and causes of illness and death in Australia 2011*, Australian Burden of Disease Study series no. 3, BOD 4, Australian Government, Canberra.

- 2015, *Health expenditure Australia 2013-14*, Health and welfare expenditure series no. 54, cat. no. HWE 63, Australian Government, Canberra.

- 2014, *Health-care expenditure on CVDs 2008-09*, cat. no. CVD 65, Australian Government, Canberra.

- 2013, *Health system expenditure on cancer and other neoplasms in Australia, 2008-09*, Cancer series no. 81, cat. no. 78, Australian Government, Canberra.

National Health and Medical Research Council 2013, *Australian Dietary Guidelines 2013*, Australian Government, Canberra.

A full list of all references used in this project are provided in the attached business case.

## Appendix

**Business case** – the business case contains detailed results from economic modelling and a comprehensive description of the methodology for this project.

## **Limitation of our work**

### **General use restriction**

This report is prepared by Deloitte Access Economics solely for the use of Horticulture Innovation Australia Limited. This report is not intended to and should not be used or relied upon by anyone else and we accept no duty of care to any other person or entity. The report has been prepared for the purpose of modelling the impact of increased consumption of vegetables on government health expenditure and producer returns. You should not refer to or use our name or the advice for any other purpose.

© 2016 Deloitte Access Economics Pty Ltd.

Limited liability by a scheme approved under Professional Standards Legislation.