Economic Impact Assessment of Prospective Investment in Phase V of the Managing Climate Variability Program

Final Report

to

Managing Climate Variability Program

16 July 2015

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Acronyms and Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics
BCR	Benefit-Cost Ratio
BoM	Bureau of Meteorology
CRRDC	Council of Rural Research and Development Corporations
CVAP	Climate Variability in Agriculture Program
DAFWA	Department of Agriculture and Food Western Australia
DMI	Dipole Mode Index
DSITI	Department of Science, Information Technology and Innovation
DSS	Decision Support System
ENSO	El Niño Southern Oscillation
GRDC	Grains Research and Development Corporation
IOD	Indian Ocean Dipole
IRR	Internal Rate of Return
MCVP	Managing Climate Variability Program
NCVP	National Climate Variability Program
NPV	Net Present Value
NVP	Net Value of Farm Production
POAMA	Predictive Ocean Atmosphere Model for Australia
PVB	Present Value of Benefits
PVC	Present Value of Costs
R&D	Research and Development
RRDPP	Rural R&D for Profit Program
UKMO	United Kingdom Meteorological Office

Glossary of Economic Terms

Benefit-cost 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, currently set at 5%.

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, Internal Rate of Return, and Modified Internal Rate of Return.

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 costs.

Executive Summary

Background
This report evaluates a prospective investment in a new phase of the Managing Climate Variability Program (MCVP V).

The MCVP (including the initial Climate Variability in Agriculture Program) has been ongoing since 1993. Various economic evaluations of investments that have been undertaken previously of MCVP have produced significantly positive investment criteria. For example, the last publicly available assessment reported the investment in the period from 2008-2009 to 2013-2014 as providing a net present value of $79.5 million against a total investment of $15.4 million, and a benefit-cost ratio of over 6 to 1.

It was considered essential by the MCVP Committee that an assessment be made of the potential economic returns of further R&D investment in the Program. Priorities have been identified relating to improved climate forecasts guided by opportunities for primary producers based on the development of better targeted approaches to using forecasts.. One priority issue identified relates to the increasing recognition of the Indian Ocean on Australian rainfall and implications in a changing climate.

Approach
The investment analysed includes both the investment resources already secured from the Rural R&D for Profit Program (RRDPP) as well as the new future investment likely from MCVP partners. These investments have been combined in this analysis to form the investment in MCVP Phase V.

The evaluation used program logic to identify pathways to impact from the likely R&D investment in two stated priority areas. This involved a description of the activities and outputs, outcomes and impacts that could be occur from new investment in the stated R&D priority areas. Once the qualitative aspects of the logical framework were completed, attention turned to a cost-benefit analysis of the investment.

Outputs
Improved knowledge of producer climate forecast and decision making needs
The principal expected outputs included the identification of the climate forecast information needs of producers from different primary producing industries, as well as improvements to how risky decisions are made by using information from climate forecasts. This included improved understanding of current decision making under climate risk, associated non-climate related risks in decision making, demonstration of use of forecasts in different industries, developing examples of decision types and use of forecast information in those decisions, and demonstration to producers of the likely magnitude of potential gains.

Improvements in climate forecasts
A range of forecasts are expected to be produced that are beyond current weather time scales and that are more relevant to individual primary industries. Improvements are expected to include improved accuracy and reliability, improved spatial resolution, rainfall and heat and frost prediction, and more grower-friendly and usable forecasts for producers.

Pathway to impact
The investment is expected to maintain progress in the further improvement in forecast models and products based on POAMA. These improvements are expected to contribute to increased adoption and use of forecast information by primary producers. The improved understanding of needs of producers relating to forecast information products and how such information is used in decision making is expected to result in more relevant products and more informative presentation of climate forecast information. In turn, the resulting targeted forecast products are expected to increase the use of climate information in decision making

and result in improved profitability resulting from risk management decisions faced by producers.

Assumptions for outcomes/impacts/valuing impacts

Assumptions were made for the increase in use of forecasts by primary producers driven by the improved targeting of climate information needed by producers, a more extensive product range and greater confidence in forecasts due to demonstrated skill and accuracy of new and developing forecasts. Assumptions were made also regarding an increased profit gain by users of forecasts due to an improved understanding by producers of how climate forecasts can be better used in decision making.

Cost-benefit method and results

All new investment costs and associated benefits were expressed in 2014-2015 dollar terms. All costs and benefits were discounted to the 2014-2015 year using a real discount rate of 5%. The base analysis used the best estimates of each variable, notwithstanding a high level of uncertainty for some of the assumptions. Investment criteria were estimated for both the total investment and for that of MCVP V alone.

Given the assumptions made, the table below shows the investment criteria for different benefit periods for the total investment. The 30 year benefit period is the primary period to which later references to the investment criteria are made.

Investment Criteria for Total Investment in MCVP Phase V
(discount rate 5%)

Criterion	**Number of years after first year of investment**						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present value of benefits (million $)	8.13	80.13	105.45	105.45	105.45	105.45	105.45
Present value of costs (million $)	13.49	13.49	13.49	13.49	13.49	13.49	13.49
Net present value (million $)	-5.36	66.64	91.96	91.96	91.96	91.96	91.96
Benefit-cost ratio	0.60	5.94	7.82	7.82	7.82	7.82	7.82
Internal rate of return (%)	negative	44.3	46.0	46.0	46.0	46.0	46.0

1. Introduction

This report evaluates a prospective five year investment in the Managing Climate Variability Program (MCVP) commencing 1 July 2016. The MCVP (including the initial Climate Variability in Agriculture Program (CVAP)) has been ongoing since 1993.

Various economic evaluations of MCVP investments that have been undertaken in the past have produced significantly positive investment criteria. For example, the last assessment reported for the investment in the period from 2008-2009 to 2013-2014 estimated a net present value of $79.5 million against a total investment of $15.4 million, and a benefit-cost ratio of over 6 to 1. A further analysis currently being undertake for the period 2008-2009 to 2015-2016 is likely to provide a similar result.

It was considered essential by the MCVP Management Committee that an assessment be made of the potential economic returns of further R&D investment in the Program, referred to here as MCVP Phase V or MCVP V.

Past Investment Performance

MCVP Phases II, III and IV have built on the initial investment in CVAP and the MCVP Phase I. Economic evaluations over different periods of these investments have been undertaken in the past by Agtrans Research. Results have been consistently positive as reported in Table 1.

Table 1: Investment Criteria for Past Investment in Climate Variability Programs

Program and year of evaluation	Investment period evaluated	Present value of costs ($m)	Present value of benefits ($m)	Net present value ($m)	Benefit-cost ratio	Reference
NCVP and CVAP, 2006	1992-1993 to 2001-2002	70.6	363.8	293.2	5.2	Agtrans Research, 2006
MCVP I, 2007	2002-2003 to 2006-2007	16.6	28.6	12.0	1.7 (a)	Agtrans Research, 2007
MCVP II, and III, 2013	2008-2009 to 2013-2014	15.5	95.0	79.5	6.15	Agtrans Research, 2013
MCVP II, III and IV 2015	2008-2009 to 2015-2016 (b)	24.1	160.3	135.2	6.64	Agtrans Research, 2015

(a) The reduced rate of increase in adoption and concerns on the eventual loss of skill from statistical forecasts as result of climate change were contributors to the lower return in the 2007 analysis.
(b) Draft only

2. The Investment in MCVP Phase V

The prospective investment in MCVP V following the completion of MCVP IV in 2015-2016 is expected to run for five years from 1 July 2016 to 30th June 2021. As no prospective budget is currently available, it has been assumed that the annual investment from MCVP partners and others (mainly the research organisations) will be similar in nominal terms to that invested in the past eight years. See Table 1.

In the eight years to 2015-2016, the annual total investment in MCVP was $2.5 m per annum. The split averaged $1.4 m per annum for MCVP partners and $1.1 m per annum for the other investment.

Table 2: Assumed Eight Year Investment in MCVP Phase V ($m)

Financial year ended June	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
MCVP Partners	1.4	1.4	1.4	1.4	1.4	7.0
Others	1.1	1.1	1.1	1.1	1.1	5.5
Total	2.5	2.5	2.5	2.5	2.5	12.5

However, a complexity in the investment framework arises as MCVP has been successful in securing a grant from the Australian Government's Rural R&D Profit Program (RRDPP) under the application titled 'Improved Use of Seasonal Forecasting to increase Farmer Profitability'. The RRDPP grant includes unexpended resource from MCVP IV. The annual amounts to be invested via the RRDPP grant are shown in Table 3.

Table 3: Annual Investment from RRDPP ($m)

Financial year ended June	**2015**	**2016**	**2017**	**2018**	**Total**
Commonwealth grant (a)	1.32	0.29	0.15	0.07	1,83
MCVP Partners	0.11	0.79	0	0	0.90
Others (in kind)	0.03	0.16	0.20	0.19	0.58
Total	1.46	1.24	0.35	0.26	3.31

(a) GST exclusive

The total investment envisaged from 2014-2015 to 2020-2021 for all resources expected to be managed under MCVP V is shown in Table 4.

Table 4: Total Investment in MCVP Phase V ($m)

Financial year ended June	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Commonwealth	1.32	0.29	0.15	0.07	0	0	0	1.83
MCVP Partners	0.11	0.79	1.40	1.40	1.40	1.40	1.40	7.90
Others	0.03	0.16	1.30	1.29	1.10	1.10	1.10	6.08
Total	1.46	1.24	2.85	2.76	2.50	2.50	2.50	15.81

As the resources for the Rural R&D for Profit Program (RRDPP) are now secure, and the new MCVP prospective investment addresses the same set of objectives as the RRDPP, it is logical to consider both investments jointly as MCVP Phase V. This investment framework could be viewed as the RRDPP being one specific slab of MCVP V investment, albeit with its own reporting requirements as well as leveraging industry funds. This approach avoids the issue of a complex counterfactual scenario and is amenable to attributing impacts valued to the total investment to that of the MCVP partners and to that of the Commonwealth contribution (and its leveraging of industry funds) as, and if, required.

Other reasons for considering the two investments as joint is that both will be managed by MCVP and the source of the MCVP component for the RRDPP budget came from savings in the last two years of MCVP IV in order to secure the Commonwealth contribution. Also, this approach would ensure that, despite MCVP Phase V commencing at an earlier date than the completion of MCVP IV, there would be no double counting of any benefits or costs between MCVP IV and MCVP V.

3. Approach

Stated priorities by MCVP Management Committee

The principal issues and activities that Phase V will address include:

1. Farmers' needs and use of forecast information

1a. Defining farmers' climate information needs. On an industry-by-industry basis, work with farmers to drill into and clearly define what their information needs are and how best to package the information that services these needs.

1b. Improved use of seasonal forecasts by farmers – work with farmers to better understand seasonal forecasts and how to use them in business decision making.

2. Seasonal forecasting model enhancement.

These activities will address specific model issues in relation to how the Indian Ocean circulation is built into forecast models.

Background and rationale

As a prospective evaluation, the analysis needs to build on experience with similar programs and projects. There has been a substantial body of research over more than two decades into improved climate risk management for Australian farmers. The emphasis has been on investments in climate science to improve skill and on a wide range of approaches to encourage increased awareness and adoption of seasonal climate forecasts. Themes and issues have evolved although some issues have remained prominent. Three of the earliest research issues were:

- the lack of predictability in the Indian Ocean,
- problems with readily accessing continuous and local historic climate records and forecasts suitable for testing strategies, and
- the probability basis of seasonal forecasts

The Indian Ocean has been a neglected research focus internationally unlike the Pacific. The global impact of ENSO has ensured a major international research effort in the Pacific. MCVP projects on the Indian Ocean dating back to the early 1990s have been successful in at least partly clarifying or resolving aspects and contributing to development of improved models.

The access to data issue has been largely resolved or is being resolved in the case of being able to download POAMA ensemble forecasts. The CliMate app is an example of the state of the art product made feasible by the availability of up to date continuous data through SILO. SILO was initially funded by a MCVP forerunner. SILO is an enhanced climate database hosted by the Science Delivery Division of the Queensland Government Department of Science, Information Technology and Innovation (DSITI). SILO contains Australian climate data from 1889 (current to yesterday), in a number of ready-to-use formats, suitable for research and climate applications. (https://www.longpaddock.qld.gov.au/silo/)

In relation to probability issues in communicating forecasts, there is often poor comprehension of seasonal forecasts based on probabilities as confirmed by Watkins and Jones (2012). That finding is consistent with studies in other fields, particularly psychology. The probabilistic nature of seasonal forecasts remains as one of the on-going barriers to clear communication. It is likely that many farmers simply react to a headline warning of an El Niño as having a certain impact at their location. This perception ignores the probability

basis as determined by the complexity of past seasonal and spatial patterns. A recency bias is also likely where the risk is determined from experience in only the last few years.
In terms of evaluation, three persistent themes have emerged that are highly relevant for considering the benefits of a further investment in climate risk management. They are:

- The generally poor performance of DSS in contributing directly to improved climate risk management , notwithstanding benefits in increased understanding by researchers of the system involved (Hochman and Carberry,2011),
- Limited priority for evaluation at project level initially constraining learning and feedback at project and program level, and increasing uncertainty of benefits for current and potential stakeholders, and
- A prospective evaluation needs to take into account the processes involved in program and project development to provide increased confidence that investments target issues most likely to contribute to outcomes.

There are a number of structured approaches which can be used to inform evaluation. These include:

- Processes for initial consultation and priorities setting (for example Thomas 2010),
- Guidelines for successful development of DSS (for example Freebairn, 2011), and
- The ADOPT framework developed by CSIRO (Kuehne et al, 2013) as proposed for MCVP V for estimating likely adoption

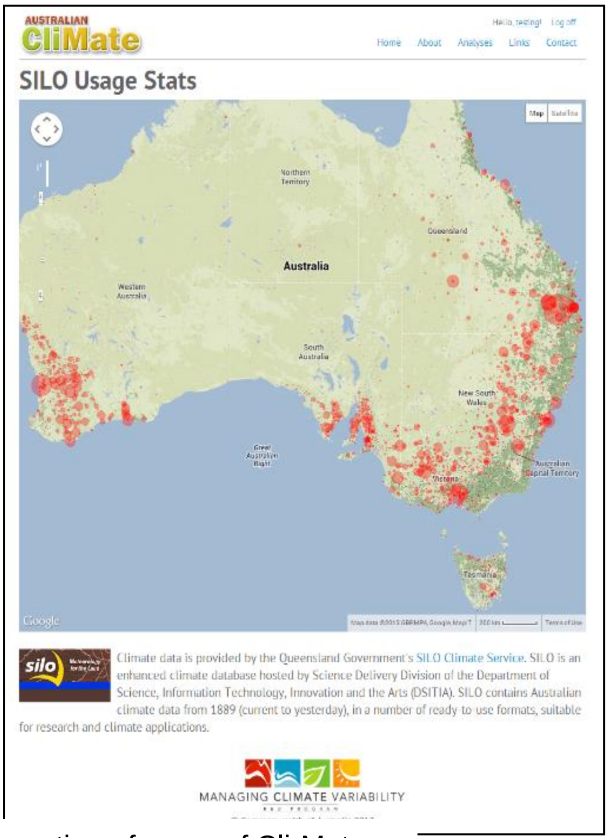
Freebairn (2011) has distilled experiences of a group of researchers developing and marketing a range of models designed primarily for management of soil and water resources in grain cropping areas of Queensland. Ingredients of successful models useful in a DSS context included:

- An emphasis on exploring and learning puts emphasis on simplicity and transparency
- Modellers are more challenged by complexity and uncertainty than farmers are
- “Scientists are generally slow adopters of new technology that has not been developed by them!”

MCVP V as structured will have an emphasis on developing tools for a range of industries and regions. This approach has been adopted in previous phases with one exception in terms of project selection. Given that previous programs were pioneering a new research focus, a call for projects targeting broad program priorities has been used to stimulate a wider choice and to develop capacity in institutions.

Despite successes in stimulating awareness and adoption of newly developed seasonal climate forecasts, there were substantial investments in DSS which were not widely adopted but which may have been viewed as important contributors to understanding and to capacity development. However the environment for DSS has evolved and there are highly successful examples which show how rapid adoption can be achieved. The most notable example in the current MCVP phase is the CliMate project. The app is free and has had 20,000 downloads in a short period without a major marketing program. There have been articles in the GRDC “Groundcover” which is distributed to graingrowers. As there are about 20,000 grainfarmers (defined as more than 100 ha grain) the market penetration is exceptional.

The following information including on evaluation was provided by David Freebairn (pers. comm., 2015).



SILO Usage Stats

Climate data is provided by the Queensland Government's SILO Climate Service. SILO is an enhanced climate database hosted by Science Delivery Division of the Department of Science, Information Technology, Innovation and the Arts (DSITIA). SILO contains Australian climate data from 1889 (current to yesterday), in a number of ready to use formats, suitable for research and climate applications.

Figure 1: Location of users of Cli-Mate showing the concentration in grain areas. The locations are of users accessing the SILO database for downloads to update local weather data.

"CliMate has been well received, with greater than 20,000 downloads in the first 11 months of release. Update statistics indicate at least 75% active use. Direct feedback has been positive both from farmers and advisors. The Silo climate database has been accessed 80,000 times, with ~200 downloads/day indicating a steady level of increase in use.
Tools such as CliMate require:

- maintenance,
- evaluation and
- development of new analyses,

as a result of feedback from users.
A proposed new project aims to maintain data and server access and develop new analyses.

Evaluation of CliMate will guide future product development for a wide range of DSS investments.
In summary, evaluation can provide insights into user's characteristics, attitudes, and behaviours towards the App.

Furthermore, evaluation can provide valuable information with which to develop future Apps that will provide the drivers for adoption and minimise the barriers to use and adoption."

POAMA enhancements for Improved Seasonal Climate Forecasting

The recent MCVP evaluation (2015) showed that the current forecasts based on POAMA-2 had made useful gains in forecast skill in some agriculturally important regions and seasons. The gains are over the previous SCO based on a statistical forecast taking into account SST in the Indian and Pacific Oceans. However Alves (2015) states that even though the POAMA model has a high level of skill in predicting ENSO, a key driver of regional Australian rainfall, its ability to predict the IOD is significantly lower. The IOD is a significant contributor to rainfall experienced in winter and spring in particular across southern Australia.

The 2015 evaluation included a BoM project continuing to 2017 on "Improved skill for regional climate in the ACCESS-based POAMA-3 model"(MCV00036).The evaluation highlighted the potential for substantial gains in skill to be realised from incorporating components of a UKMO seasonal forecast model (Harry Hendon, pers. comm., 2015). This was seen as an alternative to the planned development path centred on POAMA- ACCESS. The gains were attributed to improved resolution and updated physics in particular. Higher resolution in a POAMA version will be feasible in 2016 when there is a major increase in BoM supercomputing capacity. These plans bring forward the implementation of a high resolution (60km) model with the latest overseas physics at the Bureau by 2-3 years and therefore within the lifetime of the current project.

A further issue relating to predictability in the 2015 evaluation concerned the changes in predictability of ENSO with phases of the IPO. Such changes could have a major impact on skill and value of POAMA forecasts. There were long periods during the last century when seasonal forecasts such as the SOI had substantially reduced skill. Similar periods could seriously undermine forecast skill and perceptions of value when there is skill.

Concerns relating to the current and predicted impacts of climate change were one of the factors driving the MCVP priority to invest in POAMA with a priority on more skilful forecasts and with the capacity to take account of climate change to some extent. But there are current trends relating to declining rainfall trends and potential loss of predictability which are of increasing concern.

These can be summarised based on extensive research in recent years including by Cai et al (2011) as:

- The frequency of positive IOD events has increased in recent years,
- The positive trend in the DMI (Dipole Mode Index) is mainly confined to late winter and spring,
- The recent DMI winter-spring trend accounts for a significant portion of the observed winter-spring rainfall decline across southern Australia,
- Many climate change models suggest a trend toward more positive IOD events including a trebling of frequency, and
- The autumn decline is larger (only 4 above average years since 1990 in SE Australia) and is unlikely to be related to the IOD.

As summarised by BoM (2015a): ”A shift in atmospheric circulation characterised by a contraction of mid-latitude storm tracks towards higher southern latitudes, and movement of the subtropical and polar jetstreams, has very likely contributed to the cool season rainfall declines in southern Australia. A contraction of these weather systems toward the pole is at least partly explainable by anthropogenic warming and potentially also contributed to by anthropogenic reductions in stratospheric ozone”. However it is also noted that natural variability still dominates the trend.

As Cai et al note: “This eastern part of the tropical Indian Ocean is notoriously difficult to predict due to both problems in simulating the mean state and generally lower intrinsic predictability of surface climate in the Indian Ocean than in the Pacific.” Improved understanding of SST and convection in relation to the IOD and ENSO are necessary for improved predictability.

McIntosh et al (2013) in a MCVP study of impacts on Australian rainfall concluded that climate models with improved blocking, more cutoff lows and a more accurate representation of one of the key rainfall processes in the southern Australian region would likely result from improvements relating to:

- A more accurate representation of tropical Indian Ocean and atmosphere processes such as convection
- The atmosphere-ocean feedback necessary to sustain an independent Indian Ocean Dipole
- The land-surface temperature interaction with the atmosphere

Rainfall impacts and IOD frequency

There has been a preponderance of IOD (positive) events in recent years but to a lesser extent than for the period 1958 to 2007 (Meyers et al 2007) as shown in Table 5. The most serious in terms of reduced rainfall have been when an IOD positive event occurs in conjunction with an El Niño as has occurred about one year in eight since 1958. Other El Niño events would have also occurred at about the same frequency.

Table 5: IOD Occurrence in relation to ENSO events since 1958

ENSO status	IOD positive	IOD negative

El Niño	7	1
La Niña	1	4
Neutral	3	6
Total	11	10

The increased impact of IOD positive events when there is also an El Niño are shown in Figure 2.

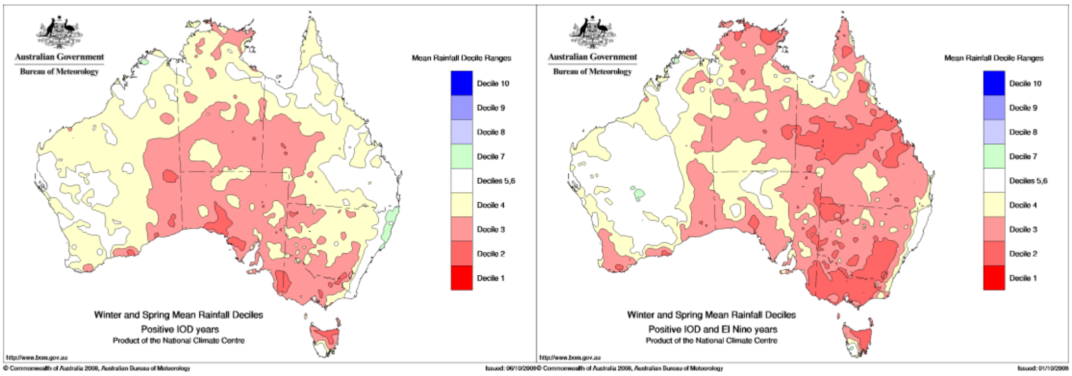


Figure 2: On left, winter spring mean rainfall deciles for 11 Positive IOD years since 1958, and on right for 7 of the 11 years which also included an El Niño. (Product of the National Climate Centre, BoM, BoM (2015b)

The impact of the IOD on Australian rainfall and agricultural production has become of increasing concern during this century. There has been extreme variability in Australian wheat production including in Western Australia. As stated for the major wheat producing state, Western Australia where there had been rapid yield increases during the 1990s "*It is notable that the low variability of yield during the period of rapid increase has been followed by a period since about 2000 of quite extreme variability of yield. It might be inferred that an unstable yield plateau has been reached, characterised by variable yield and associated with extreme variability of seasonal rainfall*" (DAFWA 2012).

For production in the Rest of Australia there has been a fourfold range from highest to lowest production years. In Western Australia where rainfall and production variability have been recognised as lower there has been a twofold range in production (Figure 3).

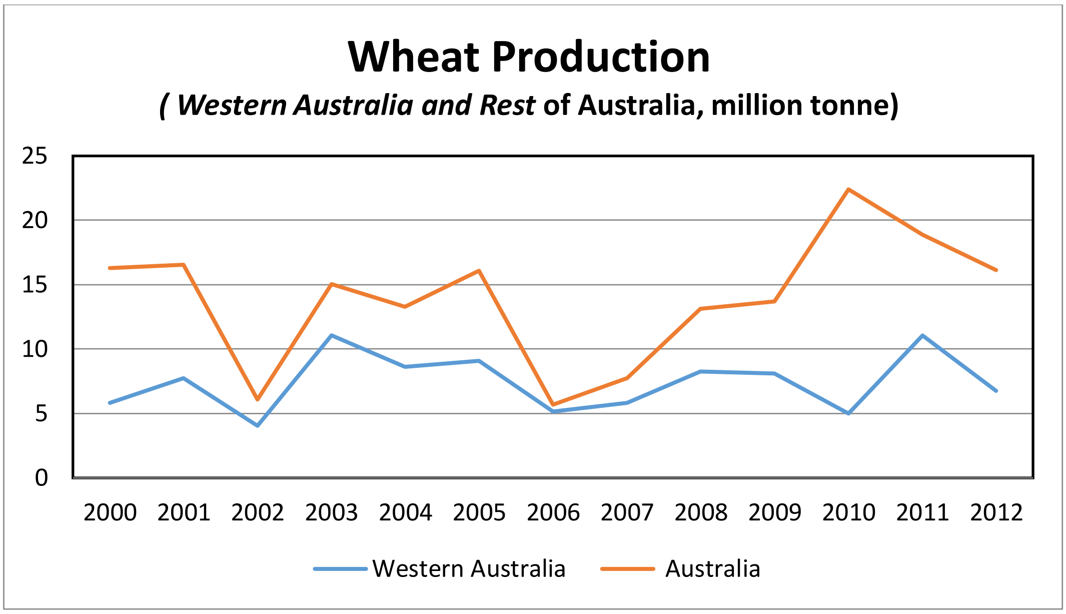


Figure 3: Wheat production for Western Australia and for the Rest of Australia from 2000 (Source ABARES (2012)).

The extreme two years of drought in 2006 and 2007 were both IOD positive events as was 2002 by some classifications (trends in the IOD index complicate classification). The extreme volatility of production this century coupled with concerns relating to the increased incidence of IOD positive events reinforce the priority for a greater research effort in understanding and forecasting the IOD.

Qualitative description of Potential Phase V investment

Commencing with assumptions regarding activities and outputs, the likely outcomes (usage of the outputs) through to impacts can be tracked. This is achieved below through a combined logical framework table (Table 6) and a pathway to impact diagram for MCVP Phase V (Figure 4).

Table 6: The Logical Framework for MCVP V

Activity	Output	Outcome	Impact
Issue 1a: Defining producer needs of seasonal forecasts			
Define climate information needs for beef/sheep, dairy grains, cotton, sugar, and horticulture; undertaken across a range of Australian climatic zones for industries that are not spatially homogenous	Information on a range of needs by industry via descriptors such as type of forecast (time of year, frequency, lead time, and climate characteristic such as rainfall, heat days, frost etc.) Feedback Information on how forecasts need to be expressed	Improved understanding of producer needs so that future forecasts can be better tailored to needs	Improved servicing of forecast information needs of producers resulting in increased use of forecast information and improved producer decisions where climate factors are involved Improved resource allocation of future investment in climate modelling and in new climate product development
Issue 1b: Defining producer use of seasonal forecasts			

Define producers' current use and understanding of seasonal climate information in decision making	Information on current decision making processes such as heuristics (e.g. rule of thumb based on experience), systematic objective personal modelling or use of off-the shelf optimising or decision support system models Reasons why models such as Yield Prophet are only infrequently used by most grain producers and others such as CliMate are proving popular	Improved understanding of whether and how producers incorporate climate information into various decision making processes Guidelines available on how climate information can best be translated into producer decision making and future exploitation of the potential for improving decision support systems	Increased use of forecast information by producers improved outcomes of decisions by producers where climate factors are involved
Issue 2: POAMA enhancement with special reference to Indian Ocean Circulation			
Investigations including how the Indian Ocean Dipole (IOD) (difference in sea surface temperature in the west and east of the equatorial Indian Ocean) influence can be better represented in forecasting seasonal climate in Australia	Improved representation of IOD influence as part of POAMA	Improved skill, reliability and spatial resolution of seasonal forecasts in Australia	Increased adoption of forecast information by primary producers Improved outcomes of decisions by producer users of seasonal forecasts due to greater confidence in forecasts

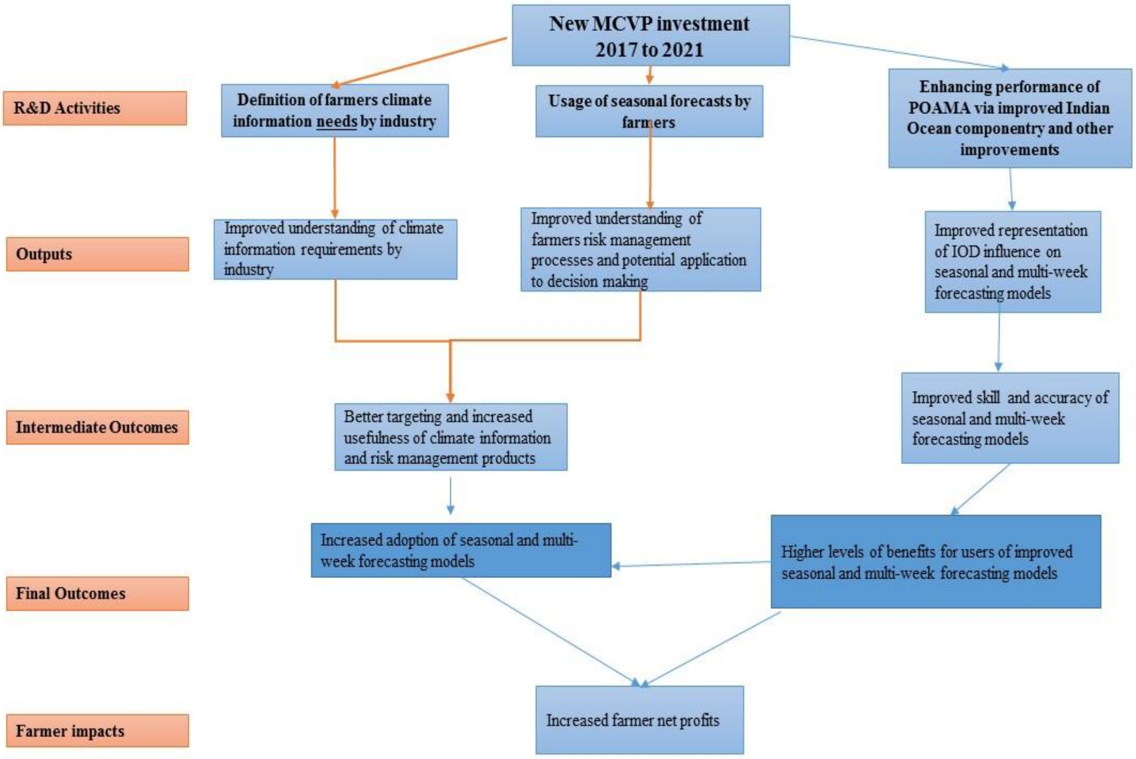


Figure 4: Pathway to Impact for Investment in MCVP Phase V

4. Valuation of impacts

Introduction

The identification of needs of different producer enterprises across different regional areas is the key driver of the new investment in the prospective MCVP Phase V. These identified needs will drive:

- the priorities for new investment by MCVP in improved forecast modelling as well as any further climate forecast development outside of the direct MCVP investment.
- a greater understanding of current use of climate forecast information by producers in a range of decisions across different enterprises, production systems, and across regional areas.
- reductions in the current deficiencies in various attributes of forecast information.
- improvements in how current forecast information is presented that is line with user needs.

The improvements in understanding of needs and how climate forecast related decisions are made will assist extension and communication of best practice decision making related to climate forecast information. This is expected to result in increased use of climate related forecast information as well as improved outcomes of risk management decisions, resulting in higher average profitability at an individual producer accepted risk level. In addition, any improved performance and/or targeting of climate forecast information from improved POAMA models will contribute to new producers using climate forecasts in their decisions, as well as improvements in the decision outcomes of existing users. These impacts are discussed further later in this section.

Impacts not valued

Industries other than agriculture will also stand to benefit from improved POAMA modelling, albeit the improvements being based on the needs of primary producers. These spillover impacts may apply to a wide range of enterprises other than primary producers. These would include those in the input and product supply chains, emergency services, and natural resource managers such as water managers (hydroelectricity, irrigation and town/urban supply). These impacts are not valued in this analysis. Neither are the gains to regional communities from gains in the expected average profitability of producers.

It is also possible that the initial focus on needs of producers and the linked weaknesses and derived priorities for future POAMA development will ensure greater efficiency in resource use (less resources used for the same outcomes or outcomes brought forward for the same or lower investment).

Valuation assumptions

The key assumption is that the investment will increase benefits that can be estimated over what would have otherwise eventuated. For simplicity, no distinction is made between the different pathways to adoption. As improved forecasts evolve as a result of the investment, benefits will accrue from direct use in decisions and from indirect use through various interpretive products developed by the program.

Counterfactual

A counterfactual scenario needs to be defined as a base to compare with benefits accruing as a consequence of the MCVP V investment. As described earlier, the investment is defined as the investment already secured under the Rural R&D for Profit Program (RRDPP) together with the prospective new MCVP investment. The ensuing analysis is structured therefore to include both investments jointly, with the relative share of benefits apportioned according to the relative investment between the two initiatives, if this required.

In the scenario of this combined investment, the counterfactual would be both delayed and deliver a reduced level of benefits. A lag of three years before benefits begin has been assumed. For simplicity the analysis has not distinguished between lags for different outputs of the investment. For the climate science projects, it is reasonable to assume that priorities for increased research relating to the Indian Ocean would continue but with a lag. Further, adoption of improved forecasts would likely occur with a longer lag. There would be less effective links with potential users and more limited development of decision aids to interpret forecasts so that they are of value in decisions.

A summary of the specific assumptions used to value the impacts described above is given in Table 7.

Table 7: Summary of Assumptions

Item	Value	Source
Net value of farm production (NVP)	$10.76 billion	ABARES (2014); average for 2011-12 and 2012-13
WITH MCVP V INVESTMENT		
Adoption of Climate Products and Improved Use of Forecasts		
First year of adoption	2019	Authors' assumptions
Maximum increase in adoption of new products and improved decision processes	10%	Authors' assumption
Year maximum adoption reached	2023	5 year adoption period (Authors' assumption)
Profits Gained by Adoptees		
First year of profits	2020	Authors' assumption
Maximum increased profit attributable to MCVP V (% of Net Value of Farm Production)	2.5%	Authors' assumption
Year maximum profit reached	2023	Same as max. adoption, Authors' assumption
WITHOUT MCVP INVESTMENT		
Adoption of Climate Products and Improved Use of Forecasts		
First year of adoption	2022	3 years after the WITH MCVP V scenario (Authors' assumption)
Maximum increase in adoption (% of Farm Establishments)	10%	Authors' assumption
Year the maximum adoption reached	2031	10 year period compared to the 5 year period WITH MCVP V (Authors' assumption)
Profits Gained by Adoptees		
First year of profits	2023	3 year lag compared to WITH MCVP V (Authors assumption)
Maximum increased profit (% of Net Value of Farm Production)	2.5%	Authors' assumption (assumes same as for WITH MCVP V)
Year maximum profit reached	2031	10 year period compared to the 5 year period WITH MCVP V (Authors' assumption)

5. Results of analyses

All costs and benefits were expressed in 2016-2017 dollar terms. All costs and benefits were discounted to 2016-2017 using a discount rate of 5%. Investment criteria estimated included the net present value, the benefit-cost ratio, and the internal rate of return (IRR).

The basic analysis used assumptions for the best estimates of each variable, notwithstanding a high level of uncertainty for many of the estimates. All analyses ran for the length of the investment period plus 30 years from the first year of investment (2016-17).

Investment criteria were estimated for both the total investment and for the MCVP investment alone. Each set of investment criteria were estimated for different periods measured from the first year of investment. The investment criteria were all positive from a period of 5 years after the last year of investment as reported in Tables 8 and 9.

Table 8: Investment Criteria for Total Investment and Total Benefits for Each Benefit Period (Discount rate 5%)

Criterion	Years from first year of investment (2016-2017)						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present value of benefits (m$)	8.13	80.13	105.45	105.45	105.45	105.45	105.45
Present value of costs (m$)	13.49	13.49	13.49	13.49	13.49	13.49	13.49
Net present value (m$)	-5.36	66.64	91.96	91.96	91.96	91.96	91.96
Benefit-cost ratio	0.60	5.94	7.82	7.82	7.82	7.82	7.82
Internal rate of return (%)	negative	44.3	46.0	46.0	46.0	46.0	46.0

Table 9: Investment Criteria for MCVP Investment and Benefits for Each Benefit Period (Discount Rate 5%)

Criterion	Years from last year of investment (2016-2017)						
	0	**5**	**10**	**15**	**20**	**25**	**30**
Present value of benefits (m$)	4.06	40.04	52.69	52.69	52.69	52.69	52.69
Present value of costs (m$)	6.64	6.64	6.64	6.64	6.64	6.64	6.64
Net present value (m$)	-2.57	33.41	46.05	46.05	46.05	46.05	46.05
Benefit-cost ratio	0.61	6.03	7.94	7.94	7.94	7.94	7.94
Internal rate of return (%)	negative	48.8	50.4	50.4	50.4	50.4	50.4

The annual benefit cash flows for both total investment and MCVP investment only, for the 30 year period from the year of first investment, are shown in Figure 5.

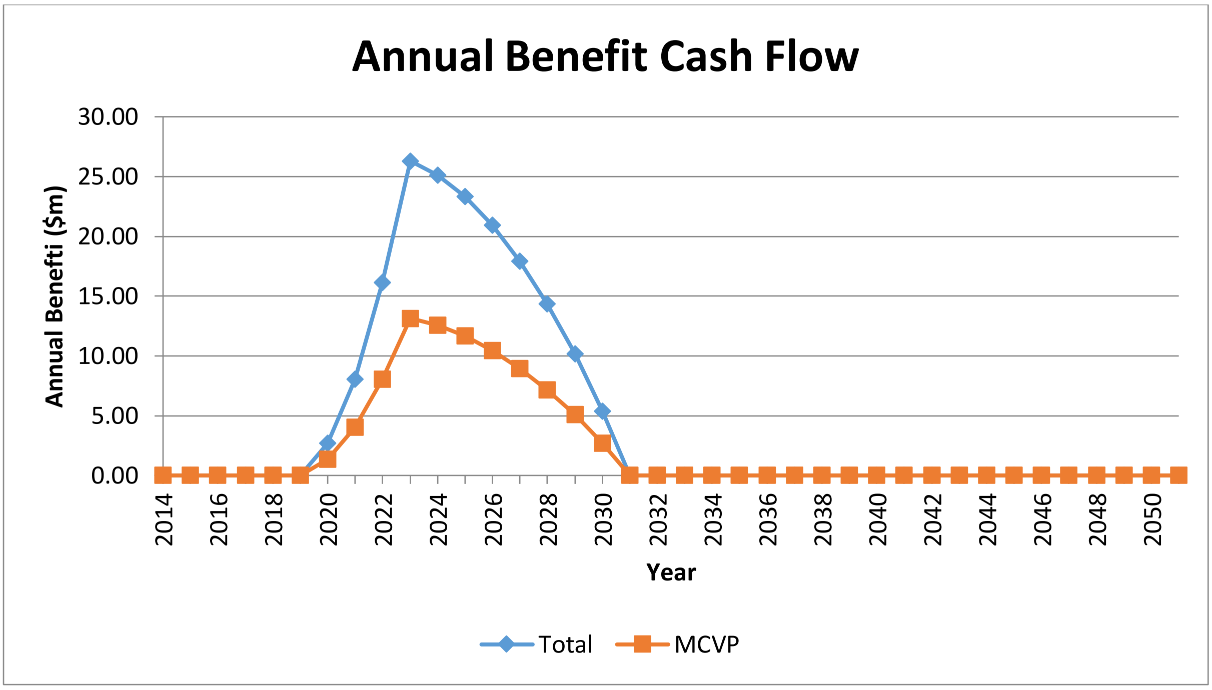


Figure 5: Annual Benefit Cash Flow

Sensitivity Analyses

Sensitivity analyses were carried out on the discount rate assumed and results are reported in Table 10. The sensitivity analysis was performed on the total investment results using a 5% discount rate with benefits taken over the life of the investment plus 30 years from the year of first investment. All other parameters were held at their base values.

Table 10: Sensitivity of Investment Criteria to Discount Rate
(Total investment, 30 years)

Criterion	0%	5% (Base)	10%
Present value of benefits (m$)	170.37	105.45	67.58
Present value of costs (m$)	15.81	13.49	11.69
Net present value (m$)	154.56	91.96	55.89
Benefit-cost ratio	10.8	7.82	5.78

6. Conclusions

This ex-ante economic analysis of a new prospective investment in Phase V of MCVP has been undertaken to provide some indication of the magnitude of values of the expected impacts compared to the investment being made.

The investment to be made includes both the investment resources already secured from the RRDPP as well as the new future investment likely from MCVP partners. These investments have been combined in this analysis to form the investment in MCVP Phase V.

The prospective impacts will be largely confined to those on primary producers where information from future multi-week and seasonal climate forecasts can be extremely useful across a wide range of strategic and tactical decisions. The assumptions made to value the likely impacts of the investment are associated with:

- increased use of climate forecasts from improved delivery and targeting of climate forecasts from existing models
- increased effectiveness of use of climate forecasts in decision making resulting in improved net profits
- improvements in climate models (POAMA) and their subsequent use providing improved net farm profits

The investment in MCVP Phase V is expected to deliver a number of impacts some of which have been valued in this evaluation. Despite the conservative assumptions made regarding future use of improved climate forecasts, the investment criteria estimated are favourable. The total investment of $13.5 million (present value terms) has been estimated to produce total benefits of $105.5 million (present value terms) providing a net present value of $92.0 million. Measures of the rate of return also were high including a benefit-cost ratio of 7.8 to 1 (over 30 years, using a 5% discount rate) and an internal rate of return of 46%.

Acknowledgments

Sarah Cole, Econnect Communications
David Freebairn, University of Southern Queensland
Harry Hendon, Bureau of Meteorology
Jenni Metcalfe, Econnect Communications
Simon Winter, MCVP Coordinator

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