Social Discount Rates in Cost Benefit Analysis of Regional Pest Management Plans: Guidance and Recommendations for the Uninitiated

Peter Tait

Research Report No. 382
July 2023

Research to improve decisions and outcomes in business, resource and environmental issues.

The Agribusiness and Economics Research Unit (AERU) operates at Lincoln University, providing research expertise for a wide range of international, national and local organisations. AERU research focuses on business, resource and environmental issues.

The Agribusiness and Economics Research Unit (AERU) has four main areas of focus. These areas are: wellbeing economics; trade and the environment; economic development; and non-market valuations.

Research clients include Government agencies, both within New Zealand and from other countries, other international agencies, New Zealand enterprises in the private sector, and community groups.

AERU MISSION

To exercise leadership in research for sustainable well-being.

AERU VISION

The AERU is a cheerful and vibrant workplace where senior and emerging researchers are working together to produce and deliver new knowledge that promotes sustainable well-being.

AERU STRATEGIC AIMS

- To be recognised by our peers and end-users as research leaders for sustainable well-being;
- To mentor emerging researchers and provide advanced education to postgraduate students;
- To maintain strong networks to guide AERU research efforts and to help disseminate its research findings; and
- To contribute to the University's financial targets as agreed in the AERU business model.

DISCLAIMER

While every effort has been made to ensure that the information herein is accurate, the AERU does not accept any liability for error of fact or opinion which may be present, nor for the consequences of any decision based on this information.

Suggested citation for this report:

Tait, P. (2023). *Social Discount Rates in Cost Benefit Analysis of Regional Pest Management Plans: Guidance and Recommendations for the Uninitiated*. AERU Research Report No. 382, prepared for National Science Challenge: Biological Heritage Strategic Objective 3 – He Tangata, He Taiao, He Ōhanga: a values-based biosecurity risk assessment framework for Aotearoa. Lincoln University: Agribusiness and Economics Research Unit.

Social Discount Rates in Cost Benefit Analysis of Regional Pest Management Plans: Guidance and Recommendations for the Uninitiated

Peter Tait

Research Report No. 382

July 2023

Agribusiness and Economics Research Unit
P O Box 85084
Lincoln University
Lincoln 7647
Canterbury
New Zealand

Ph: (64) (3) 423 0372
www.lincoln.ac.nz/aeru

ISSN 1170-7682 (Print)
ISSN 2230-3197 (Online)
ISBN 978-1-99-103526-4 (Print)
ISBN 978-1-99-103527-1 (Online)

Acknowledgements

This work has been funded by New Zealand's Ministry of Business, Innovation and Employment through the National Science Challenge: Biological Heritage Strategic Objective 3 – He Tangata, He Taiao, He Ōhanga: a values-based biosecurity risk assessment framework for Aotearoa.

I extend my gratitude to the S03 leadership group and stakeholders for the meetings, discussions, and support that contributed to delivering this report. I would like to acknowledge and thank the following individuals for their input and advice that helped in forming this guidance:

Imogen Bassett	Auckland Council
Ben Campbell-Macdonald	Pharmac
John Creedy	Victoria University of Wellington
John Keane	AgResearch Ltd.
Scott Kelley	Parliamentary Commissioner for the Environment
John Reid	Ngai Tahu Research Centre, University of Canterbury
Matthew Rout	Ngai Tahu Research Centre, University of Canterbury
Matthew Roskruge	Massey University
Jay Whitehead	Matatihi

Table of Contents

List of Tables

List Figures

Definitions

ABC	Analysis of Benefits and Costs
BCR	Benefit Cost Ratio
CBA	Cost Benefit Analysis
NPV	Net Present Value
NZ	New Zealand
PV	Present Value
RPMP	Regional Pest Management Plan
SOC	Social Opportunity Cost of Capital
SDR	Social Discount Rate
SRTP	Social Rate of Time Preference

Executive Summary

Decisions concerning pest management frequently carry long-term consequences for the environment and human interests. This situation then leads to a pertinent question: should we value future outcomes equally with immediate ones in our current decision-making processes? This is the question of discounting.

- A central purpose of Regional Pest Management Plans (RPMP) is to provide a framework to manage identified pests efficiently and effectively. Within a limited budget, RPMP decision-makers are tasked with determining which pests to focus response resources on, and the tools of Cost Benefit Analysis (CBA) or other related analytic approaches to analysis of benefits and costs (ABC) can contribute information to inform how to best allocate response budget.
- Discounting in CBA converts future costs and benefits into present value (PV), enabling consistent comparison across different time periods. Discounting is particularly important in determining the PV of environmental projects with significant timing differences between costs and benefits, where benefits are delayed, or where benefits accrue over a long time horizon.
- An important implication of the exponential discounting approach currently used by New Zealand Treasury (TSY), is that this can substantially undervalue long-term benefits, contradicting pest management strategies emphasising preventative actions, and diminishing the role of future societies' wellbeing.
- An important limitation of the TSY approach, is that discount rates are based in estimates of the government's cost of capital using market rate of return data. This approach has limited applicability to environmental decision making and is unlikely to capture the full range of relevant social preferences. For example, the market rate of return is unlikely to reflect the non-market values of environmental goods and services. That is, there are no markets for most of the environmental goods and services society benefits from such as those provided by natural ecosystems, and therefore no relevant market rate of return is directly observable in many instances.
- An alternative approach to setting discount rates is based in maximising the wellbeing of society through time, explicitly considering the importance of future generations' wellbeing. This is known as the social rate of time preference (SRTP). This approach allows for the incorporation of society's preferences for environmental outcomes into the discount rate, is consistent with ethical principles of intergenerational equity and sustainability, and promotes transparency and stakeholder engagement in rates setting.
- The SRTP approach is able to incorporate te ao Māori considerations regarding the choice of discount rate. Discounting from a Māori perspective is relevant because Māori conceptualisations of time may differ from what may be considered as Eurocentric time preferences. The principle of tauutuutu (reciprocity) ethics highlights the obligation Māori have to future generations and the importance of creating and maintaining intergenerational equity. Through whakapapa (genealogy), Māori identify the natural world as a continuum of both ancestors and family through time. This means that the future value of environmental

quality to future Māori generations should be considered equally valuable to present generations. Applying te ao Māori considerations to discounting supports the use of lower rates.

- Alongside an increase in the use of SRTP discount rates, in high income countries, is a move toward implementing declining discount rates over time. This differs from the current TSY approach applying a constant rate in each year. A declining discount rate can promote intergenerational equity by recognising the rights and interests of future generations in decision making. This can help ensure that environmental resources are shared fairly over generations and are more responsive to indigenous world views/te ao Māori. A declining discount rate can reflect the uncertainty associated with long-term decision-making, such as climate change. By reducing the discount rate over time, decision-makers can account for the uncertainty associated with long-term projections.

Key recommendations of this guidance:

- Sensitivity analysis should apply a range of discount rates including:
    - The TSY default discount rate.
    - An SRTP discount rate. This guidance provides an estimate of 3.68 per cent.
    - An SRTP rate with a declining rate schedule over time. This guidance provides a schedule of:
        - 3.68 per cent for the first 30 years
        - 3.15 per cent years 31-75
        - 2.63 per cent years 76-125
        - 2.1 per cent years 126-200
        - 1.58 per cent years 201-300
        - 1.05 per cent years >300
- Context and transparency should be provided on a preferred rate and choice of rates scheme over time. Some factors to consider could include:
    - The types of environmental benefits that the plans actions are likely to achieve.
    - Who the beneficiaries of the plan's actions are.
    - Over what time span are the benefits of the plan's outcomes realised.
    - What are the time preferences of the stakeholders in implementing the plans actions, or of the beneficiaries of the plan's outcomes.
    - What are the consequences of inaction, e.g. irreversible environmental damage.
- While some argue for zero, or negative discount rates, it is highlighted that these rates can have adverse implications for resource allocation between current and future outcomes. Negative discount rates in particular, suggest that future benefits are more valuable than present benefits, potentially leading to neglect of pressing near-term environmental concerns. This can result in an imbalance where long-term outcomes are favoured over critical short-term issues, which may harm societal well-being.

Chapter 1
Introduction

Decisions concerning the preservation and stewardship of natural environment services frequently carry long-term consequences for human interests. This situation then leads to a pertinent question: should we value future outcomes equally with immediate ones in our current decision-making processes? This is the question of discounting. A central purpose of Regional Pest Management Plans (RPMP) is to provide a framework to manage identified pests efficiently and effectively. Regional pest management decision-makers are tasked with determining which pests to focus response resources on. With limited management budget, and seemingly unlimited demands from a range of pest problems, the tools of Cost Benefit Analysis (CBA) or other related analytic approaches to analysis of benefits and costs (ABC) can contribute information to inform how to best allocate response budget[1]. The CBA or ABC framework is used to evaluate and compare the advantages (benefits) and disadvantages (costs) of a project, policy, or decision. For brevity, these techniques are collectively referred to as CBA from here on. CBA help us determine whether a particular action is worth pursuing by comparing the total value of the benefits with the total value of the costs. If the benefits outweigh the costs, the project or policy may be considered a good choice. This method contributes to helping decision-makers make informed choices by considering all relevant factors, making it easier to compare different options and choose those that provide the most benefits to society.

Within CBA, discounting is the process of converting a projects costs and benefits received in future time periods to an equivalent value received today, known as the Present Value (PV). This allows decision-makers to compare the costs and benefits of different choices and management options that occur at different points in time in a consistent way. Discounting can substantially affect the PV calculation of costs and benefits of environmental projects, in particular when there is a significant difference in the timing of costs and benefits, such as with projects that require large initial outlays, or that have long delays before benefits are realised. The choice of the discount rate is one of the most important decisions that CBA practitioners have to contend with as it drives the PV calculation[2]. The benefits of some pest management interventions may only accrue several decades into the future. For example, invasion lag times for woody tree species or other long-lived species such as turtles or parrots may be in the order of 10s-100s of years[3]. In such scenarios, the management cost may be incurred in the short term, but the benefits (avoided impacts) may be several decades away. Exponential discounting may reduce these benefits to negligible levels, even in situations where the actual cost of intervention is low and the intervention may be highly effective. Thus, exponential discounting can be at odds with internationally accepted concepts in pest management which suggest

[1] Under the Biosecurity Act (1993), RPMP are required to undertake an Analysis of Benefits and Costs. An RPMP must not be inconsistent with the National Policy Direction. The stated purpose of the NPD is to ensure that activities under Part 5 of the Biosecurity Act provide the best use of available resources for Aotearoa / New Zealand's best interests.

[2] The typical approach applies exponential discounting, under this approach Present Value is calculated as: PV = Future Value/(1+discount rate)$^{\text{Time period}}$. In practical terms, what this means is that future values are discounted exponentially, that is, at an increasing rate, the further into the future that they occur.

[3] For example: Kowarik 1995 Time lags in biological invasions with regard to the success and failure of alien species. In: Plant Invasions – General Aspects and Social Problems. Ed. Pyšek P, Prach K, Rejmánek M and Wade M. SPB Academic Publishing, Amsterdam.

preventative actions low on the Pest Infestation Curve are among the most [cost] effective strategies available in pest management[4].

As you read through this guidance, it is important to remember that this area is a live and evolving field of debate, in general there is no overall scientific agreement or consensus on what the 'correct' discount rate is. A central purpose of this guidance is to empower understanding of why you would choose one discount rate over another. It is ultimately up to the analyst to choose a discount rate that is appropriate and can be backed up with a logical explanation. Presenting a set of alternative discount rates and their accompanying rational will help decision makers weigh up the relative arguments of which rate(s) are relevant to the analysis.

[4] Ahmed DA, Hudgins EJ, Cuthbert RN, Kourantidou M, Diagne C, Haubrock PH, Leung B, Liu C, Leroy B, Petrovskii S, Beida A et a. 2022 Managing biological invasions: the cost of inaction. Biological Invasions 24: 1927-1946.
Grice R 2009 Principles of containment and control of invasive species. In Invasive species management. A handbook of principles and techniques. Ed. Clout MN, Williams PA. Oxford University Press, Oxford.
Groves RH 2006 Are some weeds sleeping? Some concepts and reasons. Euphytica 148:111-120
Stanley MC, Bassett IE 2015 Environmental weeds in New Zealand: impacts and management. In Austral Ark: The state of wildlife in Australia and New Zealand. Ed. Stow A, Maclean N, Holwell GI. Cambridge Books http://dx.doi.org/10.1017/CBO9781139519960.
Williams PA 1997 Ecology and management of invasive weeds. Conservation Sciences Publication No. 7. Department of Conservation, Wellington.

Chapter 2
Why Discount?

To those uninitiated with CBA, the idea of discounting the values of future benefits and costs may seem like a strange thing to do, but there are some good reasons why discounting can be necessary and why is most cases CBA will present analysis using a range of positive discount rates. Some of the main reasons why discounting is applied in environmental CBA include:

- **Time value of money**: Just like in standard cost-benefit analysis, environmental projects should consider that money today is worth more than the same amount in the future due to its potential earning capacity.
- **Time preference for consumption**: Behaviourally, people generally prefer to consume goods and services now rather than in the future. Discounting future environmental benefits and costs reflects this preference by giving more weight to present consumption.
- **Encouraging efficient resource allocation**: By discounting future benefits and costs, decision-makers can prioritise projects with the highest net present value, ensuring that resources are allocated efficiently and effectively for environmental protection and conservation.
- **Wealthier future society**: The growth rate in personal consumption is generally positive. By applying discounting, less weight is placed on providing future increases in consumption simply because those consumers are assumed to be more well-off relative to today's society. Because future consumption is assumed to be higher relative to the current level of consumption, an increase in the consumption of a wealthier person entails lesser increase in welfare than the same increase to a poorer person, therefore discounting helps to avoid a redistribution of income from a present generation that is relatively poor to a relatively rich one in the future.

Sometimes people advocate for **zero discounting**, and even negative rates have been suggested. It is worth pointing out here that zero, and especially negative discount rates, can generate awkward implications when considering how resources are to be allocated between current and future outcomes. A negative discount rate implies that communities will not gain from receiving environmentally beneficial projects at the present time. Instead, they would be in a more favourable position if the same environmental outcome were generated in the distant future. This reasoning can be problematic in practice, as project analysis employing such rates may find that current generations forgo investments in projects that remedy pressing near term environmental concerns, in favour of projects generating future benefits. This creates an incentive where long term outcomes are favoured over often critical near term concerns, some of which may be harming societal wellbeing. In this way, negative and zero discounting can create the opposite effect of high positive discounting, where future generations are ignored, and instead ignore the current generation's needs.

Chapter 3
How Social Discount Rates are Typically Estimated

The first thing we need to mention is that for the types of environmental investments undertaken within RPMP, we are interested in social discount rates (SDR), rather than financial discount rates. Financial rates are applied when assessing an individual investment with the aim to assess whether the investment is financially viable from the **perspective of the investor**. Whereas, social discount rates are used in public projects to assess future societal costs and benefits, with the aim to evaluate a project from a **societal perspective**. Financial discount rates are typically based on market interest rates. Whereas social rates are typically based on factors such as societal time preference (how society values present versus future consumption) and the social opportunity cost of capital (the return that society foregoes by investing resources in the project). Social rates also often incorporate considerations of intergenerational equity, sustainability, and uncertainty about the future. While financial based rates tend to be relatively higher as they include a risk premium to compensate for the risk of the investment, social rates are often relatively lower because it reflects societal preferences, and public projects are considered to have lower risk than private investments. The two main approaches used are the social opportunity cost of capital (SOC) and the social rate of time preference (SRTP).

3.1 Social opportunity cost of capital

This approach is grounded in financial economics and aims to estimate a government's opportunity cost of capital using market rate of return data to infer the SDR. Typically using as a starting point the rate of return on private investment such as that from low risk government bonds, or the government's borrowing rate which is typically lower than private rates. This is the current approach to setting SDRs in NZ[5]. This approach's main advantages include being relatively easy and straightforward to use, however it has several significant problems when considering environmental investments and CBA including:

- **Limited applicability to environmental decision making**: Estimating the SDR primarily based on market rate of return data is unlikely to capture the full range of social preferences that are relevant for environmental decision-making. For example, the market rate of return may not fully reflect the non-market values of environmental goods and services. That is, there are no markets for most of the environmental goods and services society benefits from such as those provided by natural ecosystems, and therefore no relevant market rate of return is directly observable in many instances.

- **Assumes perfect capital markets**: Using market rates as a measure of the opportunity cost of alternative investments may not make much sense when substitutes for ecosystem services are not available.

- **Potential for distortion**: Using market rates of return data assumes that these rates reflect societal preferences, but in reality, market rates may be influenced by a range of factors including taxes, regulations, and other distortions. This can lead to biased estimated of SDRs.

[5] New Zealand Treasury. 2008. Public sector discount rates for cost benefit analysis.

- **Uncertainty and variability:** Market rates can be highly uncertain and variable, making it difficult to estimate SDRs with confidence. This is of particular concern when projects have very long time horizons as market rates of return estimated from relatively short time spans may be poor indicators of societal preferences and consumption in the distant future.

3.2 Social rate of time preference

The SRTP approach to setting SDR in environmental CBA involves estimating the rate at which society values environmental benefits and costs today compared to those in the future. This approach recognizes that environmental benefits and costs have long-term impacts that may extend beyond the immediate time frame of a policy or project, and that these impacts should be properly evaluated and compared over time. The main advantages of the SRTP approach in environmental CBA include:

- **Incorporation of social values and preferences**: Allows for the incorporation of society's preferences for environmental outcomes into the discount rate used in evaluation.
- **Consistency with ethical principles:** The approach is consistent with ethical principles of intergenerational equity and sustainability, which require that the interests of future generations be given due consideration in decision-making.
- **Better transparency and stakeholder engagement:** The approach can promote better transparency and stakeholder engagement by incorporating the values and preferences of different stakeholders into the discount rate used in evaluation, leading to more informed and equitable decision-making.

Limitations to this approach include that estimating the SRTP for environmental benefits and costs may require assumptions about future environmental conditions, which can be difficult to predict. Additionally, there may be disagreement among stakeholders and analysts about the appropriate level of the SRTP, which can lead to disagreements about the appropriate discount rate to use in environmental CBA. The Ramsey equation[6] is an important method used by many countries to estimate SDRs grounded in SRTP, and it is based on the idea that the discount rate should reflect the rate of economic growth and the societal rate of time preference. To apply the Ramsey equation the following steps are taken:

- **Estimate the rate of time preference**. This is made up of two factors, a rate of pure time preference, and a rate for catastrophic risk. Overall, this reflects how much society prefers present consumption to future consumption. The pure time preference rate can be based on surveys or studies of individual preferences for consumption and savings, or to reflect the ethics of the stakeholders and decision makers. The rate of catastrophic risk is often measured as the ratio of total deaths to total population.
- **Estimate the elasticity of marginal utility of consumption.** This represents how much society's welfare changes as consumption changes. If positive growth in consumption is expected to continue, then future societies will be materially better off than those today, this

[6] The Ramsey equation is a key formula used in economics, especially in the context of optimal savings and optimal growth literature. In the context of determining the social discount rate, the Ramsey equation is often expressed as follows: $r = \rho + \eta g$. Where: r is the social discount rate, ρ is the rate of pure time preference, η is the elasticity of marginal utility with respect to consumption, g is the per capita growth rate of consumption.

has been the historical experience[7]. This means that allocating resources into the future may have less benefit than using it to enhance the wellbeing of current (relatively poorer) individuals. Selecting a lower value of this elasticity implies that society would choose to save a larger proportion of current output in order to increase the welfare of future generations. One approach to empirically estimate this elasticity is revealed by society's current decisions to redistribute income, such as through progressive income taxes as used in New Zealand.

- **Estimate the expected growth rate of consumption per capita in the economy**. This can be based on historical data or projections of future growth. Growth rates have on average been positive for developed economies, meaning that generations have become relatively better off as economic development has progressed and improved many aspects of our day-to-day lives.
- To determine the SDR we add the pure rate of time preference to the elasticity multiplied by the growth rate.

The Ramsey equation suggests that the optimal SDR should be equal to the sum of the pure rate of time preference, the expected growth rate of consumption per capita over time, and the elasticity of marginal utility of consumption. The pure rate of time preference represents society's inherent preference for consuming goods and services today rather than in the future. While the expected growth rate of consumption and the elasticity of marginal utility of consumption capture the impacts of economic growth and changes in welfare over time. Many countries have adopted the recommendations of the Ramsey equation, or similar theoretical models, for setting discount rates in environmental cost-benefit analysis. For example: the United Kingdom, France, Canada, United States, Denmark, Germany, Italy, Portugal, Spain.

3.2.1 Estimating a STRP discount rate for New Zealand

When considering constructing a SRTP discount rate for New Zealand we need to choose the values for each of the Ramsey components. Some examples from other countries are given in Table 3-1.

Table 3-1: Selected examples of SRTP parameters[8]

	Time preference	Utility of consumption	Consumption growth	SRTP
UK base public sector	1.5	1	2	3.5
France base public sector	1	2	1.5	4
Stern climate change review	0.1	1	1.3	1.4
Harmonised European transport costing	1.5	1	1.5	3

[7] Predicting long-term growth rates involves many uncertainties. In general, over long periods, the trend in many economies has been positive due to factors like technological advancements, productivity increases, and capital accumulation. However, positive long-term growth is not guaranteed. Numerous factors can influence economic growth rates negatively, such as political instability, natural disasters, pandemics, and economic crises. Sustainability concerns and climate change could also impact long-term growth, as resources are finite, and the economic implications of environmental degradation can be substantial. Also, certain economic theories, like the Solow growth model, suggest that economies may eventually reach a steady-state where per capita growth ceases in the absence of technological progress.

[8] From: Creedy J. and Passi H.2018. Public sector discount rates: a comparison of alternative approaches. The Australian Economic Review, 51(1):139-57.

A SDR estimate for NZ using the SRTP approach and the Ramsey equation could take as a starting point for each component the following guidance:

- The catastrophic risk component of the **rate of time preference** can be estimated from available demographic information as 0.68 per cent[9] We don't yet have a NZ specific empirical estimate available for the pure rate of time preference, however, it may be plausible in the interim to adopt the combined UK rate of 1.5 per cent.
- The **elasticity of utility of consumption** has been estimated for NZ at 1.5 per cent[10,11].
- The NZ average inflation adjusted per capita **growth rate in private consumption** expenditure over the period 1978 to 2021 is estimated as 1.45 per cent[12]
- Applying these values into the Ramsey equation yields an estimate of a **SRTP SDR for NZ equal to 3.68 per cent**[13]. This rate could be considered as the base SDR for public sector analysis (Table 3-2).

Table 3-2: SRTP estimates for NZ

	Time Preference	Consumption Elasticity	Consumption Growth	SRTP
NZ base public sector	1.5	1.5	1.45	3.68%
NZ intergenerational rate	0.68	1.5	1.45	2.85%

There are plausible reasons for using a lower rate of pure time preference. Many economists have argued from an ethical position that the weight placed on a person's wellbeing should not be reduced simply because they live in the future. A lower rate says that we judge the wellbeing of future generations to contribute as much to social welfare as the wellbeing of the current generation. In applications where intergenerational equity is of prominent importance then lowering the pure time preference component could be justified (for example, preferences are culturally constructed, and in te ao Māori intergenerational equity may be more prominently considered than across New Zealand society more broadly – see next section for further consideration of this issue). This is in line with the argument applied in the UK by the Stern review who specify what is considered by some to be a very low rate of 0.1. If in our NZ calculation, we set a zero rate of pure time preference, but retain a rate for catastrophic risk, then the reduced discount rate for NZ is now 2.85 per cent (Table 3-2).

---

[9] 0.00677 = 33,225 deaths annually / 4,902,000 total population (Statistics New Zealand, births and deaths registrations; and 2018 Census).

[10] Evans DJ. 2005. The elasticity of marginal utility of consumption: estimates for 20 OECD countries. Fiscal Studies, 26(2):197-224. This estimate is based on differences in income tax rates. Tax rates increase with higher income, this implies that those on higher incomes gain less benefit from each additional dollar earned compared to relatively lower income earners. Declining marginal utility of additional consumption is often observed in economic studies.

[11] While convenient, using personal tax rates to estimate this elasticity has important limitations. Namely, it assumes that decision makers will trade-off future public investment decisions in the same way that individuals make trade-offs for private consumption. For a critique, see for example, Creedy J. (2007). Policy evaluation, welfare weights and value judgements : A reminder. Australian Journal of Labour Economics, 1091):1-15.

[12] https://datatopics.worldbank.org/world-development-indicators/

[13] 3.68% = 1.5 + 1.5(1.45).

3.2.2 Incorporating a Te ao Māori perspective into SRTP discounting

Another important consideration in setting discount rates concerns the relevance of a te ao Māori perspective. Many RPMP environmental projects involve Māori communities. From a te ao Māori perspective, the SRTP approach may be able to incorporate some important considerations regarding the choice of discount rate. Many (most if not all-current) analyses of benefits and costs of programmes that affect Māori communities apply what are considered to be standard rates, that is, the rates recommended by the NZ Treasury. For example, a recent report examining the value of the census for Māori applies standard rates and does not attempt to consider the appropriateness of this choice[14]. Discounting from a Māori perspective is relevant because Māori conceptualisations of time may differ from what may be considered as Eurocentric time preferences. Discounting often reflects very Eurocentric time preferences, and there is increasing acknowledgement (noticeable in the business space particularly) that Māori have much longer, often intergenerational, time preferences and that when combined with Māori cultural ethics might mean that a lower discount rate is appropriate. There are at least two main considerations when thinking about discounting from a te ao Māori perspective that support lower rates. One is **tauutuutu** (reciprocity) ethics, this supports a low discount rate for environmental initiatives as it means that Māori have an obligation to future generations, and to create and maintain intergenerational equity. Another is through **whakapapa**. Māori identify the natural world as a continuum of both ancestors and family, with links that go forward and backwards through time. This means that that for Māori communities, the future value of environmental quality to future generations has to be of equal value to present generations. These considerations support setting a pure rate of time preference rate at zero.

[14] Bakker, C (2019). Value of the census for Māori. Retrieved from www.stats.govt.nz.

Chapter 4
Dual Discounting

Dual discounting in environmental CBA refers to the practice of using two separate discount rates to account for the different types of impacts that environmental policies and projects may have. Specifically, the approach involves using a **lower discount rate to evaluate long-term environmental benefits**, and a **higher discount rate to evaluate short-term costs**.

The dual discounting approach recognises that environmental policies and projects often have long-term benefits that extend beyond the immediate time frame of the policy or project, while the economic costs are typically incurred in the short term. By using a lower discount rate to evaluate the long-term environmental benefits, the approach helps ensure that the full value of these benefits is properly captured in the analysis. At the same time, by using a higher discount rate to evaluate the short-term economic costs, the approach reflects the fact that society tends to place greater value on present benefits and costs compared to those in the future.

Dual discounting has become an increasingly popular approach in environmental cost-benefit analysis, particularly in the context of climate change, where policies and projects may have significant long-term impacts on greenhouse gas emissions and the environment. The approach can help ensure that the full value of these impacts is properly captured in the analysis, while also reflecting the fact that society may place greater weight on immediate economic costs. However, there is still debate over the appropriate discount rates to use in dual discounting, and different approaches may be more appropriate depending on the specific context and policy being evaluated. Several countries use dual discounting in environmental cost-benefit analysis, particularly in the context of climate change, including:

- **United States**: In 2020, the U.S. Interagency Working Group on the Social Cost of Carbon adopted a dual discounting approach, which uses a 2.0 per cent discount rate for long-term climate damages and a 3.0 per cent discount rate for near-term economic costs.
- **Canada**: In 2018, the Canadian federal government introduced a dual discounting approach for evaluating the economic impacts of climate change policies, which uses a 1.5 per cent discount rate for long-term climate damages and a 3.5 per cent discount rate for near-term economic costs.

Chapter 5
Treating Discount Rates Over time

In typical CBA, a constant discount rate over time is used to convert future costs and benefits into present value. However, while this exponential discounting is the norm in economic textbooks, there is in fact no particular reason to suppose that discounting should proceed in this way. Instead, many practitioners apply a declining discount rate, which means that the discount rate decreases over time. The use of rates that diminish over time has been accepted as important when assessing projects with relatively long-term benefits and is typically used in environmental and sustainability analysis. One significant reason for using declining discount rates is the recognition that future generations should be given more weight in decision making. This is because for many investments in environmental projects, future generations will be affected by the decisions made today, and their interests should be taken into account.

The main benefits of using a declining discount rate include:

- **Considers the interests of future generations**: A declining discount rate gives more weight to the interests of future generations, which can help ensure that decisions made today do not negatively impact the well-being of future generations.
- **Reflecting changing social values**: As societies become more aware of the importance of environmental protection, there may be greater emphasis on the long-term benefits of a project, and a declining discount rate can reflect these changing societal values.
- **Increases the value of long-term investments:** A declining discount rate can increase the Present Value of long-term investments such as conservation efforts, which can help ensure that these investments are economically feasible.
- **Encourages intergenerational equity:** A declining discount rate can promote intergenerational equity by recognising the rights and interests of future generations in decision making. This can help ensure that environmental resources are shared fairly over generations and are more responsive to indigenous world views/te ao Māori.
- **Reflects uncertainty:** A declining discount rate can reflect the uncertainty associated with long-term decision-making, such as climate change. By reducing the discount rate over time, decision-makers can account for the uncertainty associated with long-term projections.

While currently the New Zealand Treasury provides no commentary on the use of declining discount rates[15], examples of some of the countries using declining discount rates and their SDR schedules are provided in Table 5-1.

.

[15] NZ Treasury. 2015. Guide to social cost benefit analysis.

Table 5-1: Selected examples of declining discount rate schedules[16]

United Kingdom:	3.5% for the first 30 years
	3% years 31-75
	2.5% years 76-125
	2% years 126-200
	1.5% years 201-300
	1% years >300
Norway	4% for the first 40 years
	3% for years 41-75
	2% for years > 75
Denmark	4% for the first 35 years
	3% for years 36-70
	2% for years > 70
France	4% for the first 30 years
	2% for years > 30
USA	Lower rate for intergenerational projects of 2.5%

If we use our estimates of SRTP SDR for NZ calculated above and apply the same proportionate decreases in rates over time in line with the UK, we create the declining rates schedules shown in Table 5-2.

Table 5-2: Time declining SDR schedule for New Zealand

Base rate	3.68% for the first 30 years
	3.15% years 31-75
	2.63% years 76-125
	2.1% years 126-200
	1.58% years 201-300
	1.05% years >300
Intergenerational rate	2.85% for the first 30 years
	2.45% years 31-75
	1.45% years 76-125
	1.20% years 126-200
	0.90% years 201-300
	0.60% years >300

[16] HM Treasury. 2022. The Green Book. Central government guidance on appraisal and evaluation.
Hepburn C. 2007. Use of Discount Rates in the Estimation of the Costs of Inaction with Respect to Selected Environmental Concerns. Organisation for Economic Cooperation and Development.
Creedy J. and Passi H.2017. Public sector discount rates: a comparison of alternative approaches. New Zealand Treasury Working Paper 17/02.

Chapter 6
Practical Implications of using Constant SOC vs. Declining SRTP: An Illustrative Example

Now let's examine an example of how the choice of SDR effects the results of CBA analysis. If we take as our example an environmental investment that might be considered to characterise projects where relatively larger startup costs occur immediately, and relatively lower costs are required to maintain a project overtime. While the benefits of the project may take some time before they start to be realised, but are expected to continue for an extended period into the future (Table 6-1).

Table 6-1: Illustrative costs and benefits schedule

Year	Costs	Benefits
Project Start	$1 million	None
1	$10,000	None
2	$10,000	None
3	$10,000	None
4	$10,000	None
5	$10,000	$100,000
6	$10,000	$100,000
7	$10,000	$100,000
8	$10,000	$100,000
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
100	$10,000	$100,000

In our example, we will examine the effect of different discount rate choices on two common metrics used in CBA for assessing project viability; the Net Present (NPV), which is the difference between costs and benefits, with projects generating a positive NPV being generally favoured (Figure 6-1), and the Benefit-Cost Ratio (BCR), which is the ratio of benefits to costs, with projects generating a value greater than one being generally favoured (Figure 6-2). We will apply two discounting approaches, the first will use the NZ Treasury recommended general rate of 5 per cent in each year[17]. The second approach will use the base SRTP discount rate estimated above for NZ (3.68 per cent), with the relevant declining discount rate schedule (Table 5-2). The graphs reveal two significantly important results. The first is that using the SRTP declining rates approach brings the breakeven point for the project forward by about six years or 21 per cent sooner (from 27years to 21years). And that, under the current government advice for 5 per cent exponential discounting, additional benefits beyond fifty years contribute little to the decision to undertake the project. Indeed, the marginal value gained in

[17] NZ Treasury. 2015. Guide to social cost benefit analysis

benefits flattens off substantially from about year forty. An implication worth noting, concerns the difficultly in how the government recommended discounting regime can be considered consistent with long-term environmental policy expenditure, in particular for climate mitigation. While for the STRP rate, the value of addition benefits has a material contribution to the CBA decision metrics. To support practical application, discount factors are reported in Table A-1. These are essentially weights that can be applied to future values. Multiply a cost and/or benefit occurring in a particular year, with the discount factor for that year to retrieve its discounted PV. For example, $50 in 30 years time has a PV = $17 ($50*0.3382).

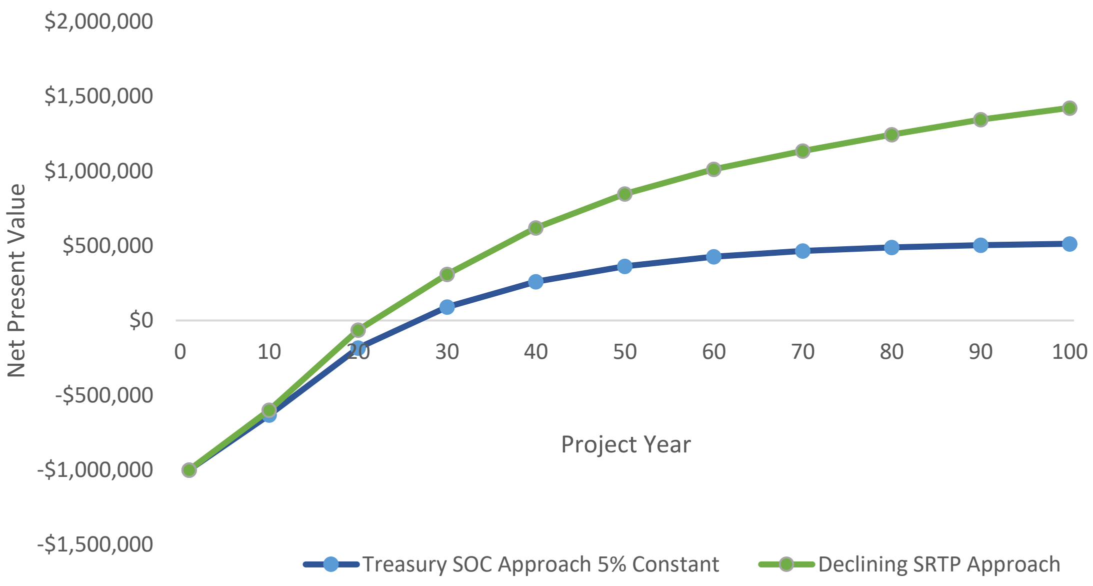

Figure 6-1: Illustration of effect of discount rate choice on Net Present Value estimates

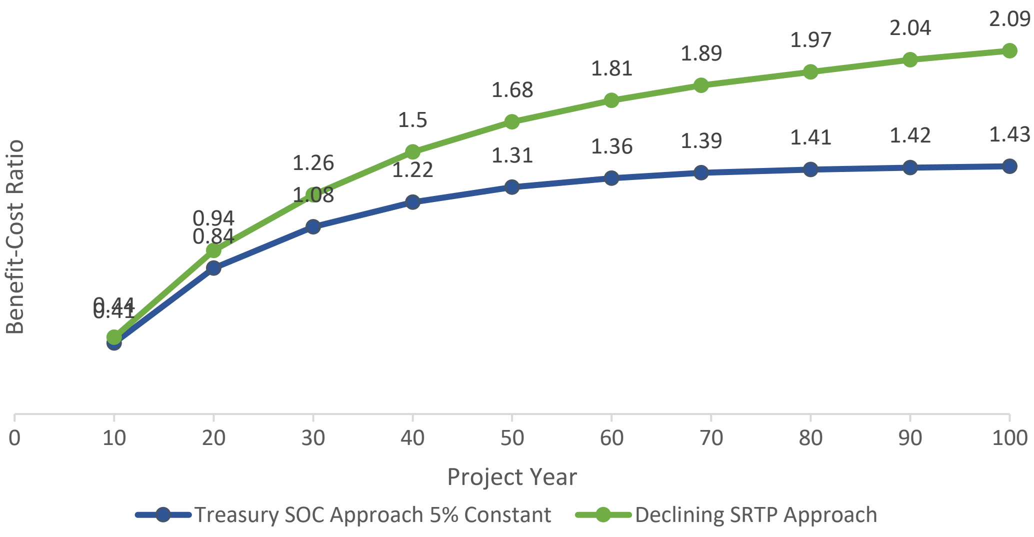

Figure 6-2: Illustration of effect of discount rate choice on Benefit Cost Ratio estimates

Chapter 7
Summary and Recommendations

The concept and application of discounting can be a difficult area of CBA to navigate. What typically happens, is that different rates are used as part of sensitivity analysis, but without any clarification as to which rate is preferred or more appropriate to the context being appraised. A primary objective of the guidance provided here is to impower those appraising environmental investment within RPMP development to be able to select a preferred discounting approach that is suitable to the projects being assessed. Ultimately, selecting an appropriate discount rate for environmental CBA requires a careful balance of factors reflecting the unique characteristics of each project and the broader societal values.

Key recommendations from this guidance are:

- All RPMP CBA should assess the sensitivity of results to the choice of discount rate. In particular, where the environmental outcomes of a pest management plan being examined are long term and/or involve substantial or irreversible wealth transfers between generations. This includes irreversible changes to the natural environment that the plan's actions will contribute to avoiding.
- Sensitivity analysis should apply a range of discount rates including:
    - The NZ Treasury recommended discount rate.
    - A SRTP discount rate. This could be as calculated above or from stakeholder input.
    - The SRTP rate with a declining rate schedule over time. This could follow the schedule described above.
- Context and transparency should be provided on a preferred rate. Use the guidance provided here to build reasoning for the choice of preferred discounting scheme and consider:
    - The types of environmental benefits that the plans actions are likely to achieve.
    - Who the beneficiaries of the plan's actions are.
    - Over what time span are the benefits of the plan's outcomes realised.
    - What are the time preferences of the stakeholders in implementing the plans actions, or of the beneficiaries of the plan's outcomes.
    - What are the consequences of inaction, e.g. irreversible environmental damage.

This guidance finishes with some cautionary comments on how discount rates are intended to be used. Discounting is used to judge how much we take into account benefits accruing in the future in the expenditure decisions made today. It is not intended to increase the value of future outcomes. There is a compelling argument that the genuine worth of environmental assets, like biodiversity and ecosystem services, may grow over time. This could result from the perception of environmental services as luxury items in a world where incomes consistently rise, or from the expectation that environmental resources, or their quality, will become increasingly scarce as time goes on. Taking into account the evolving valuation of environmental goods and services at different points in time is crucial for accurate social CBA. If the anticipated growth rate in the value of these assets is constant, it is mathematically comparable to using a lower discount rate, although conceptually different. It is more appropriate to directly increase the benefits of environmental protection to account for expected changes in value before applying a general SDR. This is because the SDR mirrors society's general time preference and assumptions about future growth rates. Consequently, incorporating the rising valuations of environmental assets directly into the cost-benefit analysis and applying the same framework to discount all costs and benefits yields a more precise analysis.

Appendix
Discount Factors

Table A-1: Standard STRP declining discount rates and discount factors

Year	Discount Rate	Discount Factor	Year	Discount Rate	Discount Factor	Year	Discount Rate	Discount Factor
0		1	34	3.15%	0.3484	68	3.15%	0.1214
1	3.68%	0.9645	35	3.15%	0.3377	69	3.15%	0.1177
2	3.68%	0.9303	36	3.15%	0.3274	70	3.15%	0.1141
3	3.68%	0.8973	37	3.15%	0.3174	71	3.15%	0.1106
4	3.68%	0.8654	38	3.15%	0.3077	72	3.15%	0.1072
5	3.68%	0.8347	39	3.15%	0.2983	73	3.15%	0.1039
6	3.68%	0.8051	40	3.15%	0.2892	74	3.15%	0.1008
7	3.68%	0.7765	41	3.15%	0.2804	75	3.15%	0.0977
8	3.68%	0.7489	42	3.15%	0.2718	76	2.63%	0.1390
9	3.68%	0.7223	43	3.15%	0.2635	77	2.63%	0.1355
10	3.68%	0.6967	44	3.15%	0.2555	78	2.63%	0.1320
11	3.68%	0.6720	45	3.15%	0.2477	79	2.63%	0.1286
12	3.68%	0.6481	46	3.15%	0.2401	80	2.63%	0.1253
13	3.68%	0.6251	47	3.15%	0.2328	81	2.63%	0.1221
14	3.68%	0.6029	48	3.15%	0.2257	82	2.63%	0.1190
15	3.68%	0.5815	49	3.15%	0.2188	83	2.63%	0.1159
16	3.68%	0.5609	50	3.15%	0.2121	84	2.63%	0.1130
17	3.68%	0.5410	51	3.15%	0.2056	85	2.63%	0.1101
18	3.68%	0.5218	52	3.15%	0.1993	86	2.63%	0.1073
19	3.68%	0.5033	53	3.15%	0.1933	87	2.63%	0.1045
20	3.68%	0.4854	54	3.15%	0.1874	88	2.63%	0.1018
21	3.68%	0.4682	55	3.15%	0.1816	89	2.63%	0.0992
22	3.68%	0.4516	56	3.15%	0.1761	90	2.63%	0.0967
23	3.68%	0.4355	57	3.15%	0.1707	91	2.63%	0.0942
24	3.68%	0.4201	58	3.15%	0.1655	92	2.63%	0.0918
25	3.68%	0.4052	59	3.15%	0.1604	93	2.63%	0.0894
26	3.68%	0.3908	60	3.15%	0.1555	94	2.63%	0.0871
27	3.68%	0.3769	61	3.15%	0.1508	95	2.63%	0.0849
28	3.68%	0.3635	62	3.15%	0.1462	96	2.63%	0.0827
29	3.68%	0.3506	63	3.15%	0.1417	97	2.63%	0.0806
30	3.68%	0.3382	64	3.15%	0.1374	98	2.63%	0.0785
31	3.15%	0.3823	65	3.15%	0.1332	99	2.63%	0.0765
32	3.15%	0.3707	66	3.15%	0.1291	100	2.63%	0.0746
33	3.15%	0.3593	67	3.15%	0.1252			