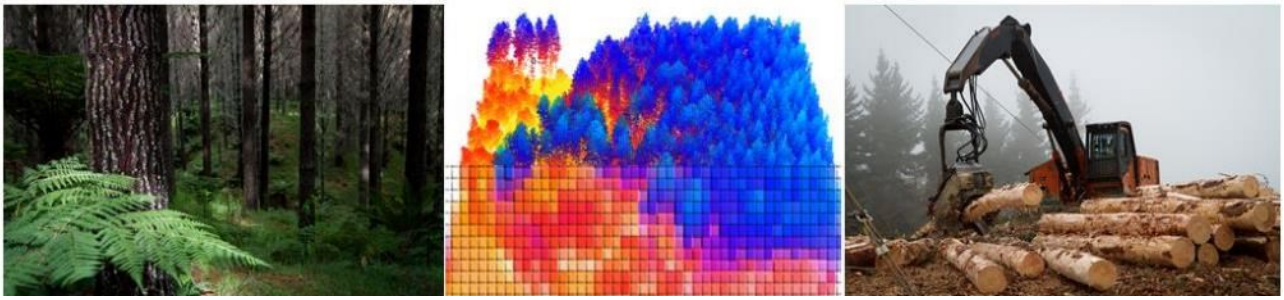
Resilient Forests Research Programme

SCION FORESTS PRODUCTS INNOVATION

Towards quantitative analysis of social risk in forest planning

Steve Wakelin, Andrea Grant, Karen Bayne, Thales West, Sebastian Klinger, Grace Villamor, Andrew Dunningham



Date: 15/06/2021

Report No: RFP-T012

FOREST GROWERS RESEARCH

TABLE OF CONTENTS

supported by forestgrowers commodity levy

EXECUTIVE SUMMARY

Forest investment decisions are made in the face of considerable uncertainty over future costs and benefits. Decision-making tools designed to assist forest managers evaluate trade-offs between alternative management options exist, but often do not explicitly consider such uncertainties. Some analysis approaches do explicitly consider risk and uncertainty, providing a useful framework for decision-making in response to existing and emerging risks. Modern portfolio theory is a decision-making tool that can be applied to forestry, based on computer modelling of the variance of levels of future risk and trade-offs in economic performance. Modern portfolio theory allows managers to balance risks and returns by identifying a portfolio of management options (such as a range of suitable species and regimes) and their trade-offs. Decision-making using this framework is able to identify options that minimise risks for acceptable levels of return, or maximise returns for acceptable levels of risk.

Beyond risks from increasing climate change threats, another emerging risk facing the industry is the social acceptability of forestry, or its loss of a 'social license to operate'. This may be illustrated by public responses to media coverage of post-harvest debris flows in recent years, with these negative public perceptions being comparable to other primary sector issues such as stock access to waterways, live shipments of sheep and cattle or historic harvesting of native forests by the NZ Forest Service. Possible outcomes from a loss of forestry's social license to operate include increased regulation of the forestry industry, prohibition of certain practices such as clear-cutting, reduced market access and therefore reduced net revenues. Few previous applications of modern portfolio theory have attempted to integrate social elements such as those relating to social outcomes risk, such as the loss of a social license to operate.

Work in this programme to date has previously reviewed how to apply modern portfolio theory and related risk modelling approaches to forestry practice, together with an appraisal of social license issues. Modern portfolio theory evaluates trade-offs between acceptable levels of risk and expected economic returns. The previous modelling framework for this analysis method was developed to identify optimal planting regime mixes in response to an array of risks determined by potential changes in future log prices and climate change-induced changes to productivity. Our past work using a survey to examine public attitudes to forestry practices also determined further potential risk areas that could affect returns from forestry through loss of its social license to operate. The aim of this Technical Report is to suggest a quantitative pathway forward for integrating these understandings, both of social risks, together with climate change and economic performance risks, using a modelling framework that enables better decision-making in forestry investment decisions that determine long-term returns on investment.

The following steps are required to advance this methodology:

1. Gaining a deeper understanding of the drivers of risk affecting forestry's social license to operate, so that the potential impacts of changes in management on this can be estimated;
2. Determining if the level of public trust in forestry is sufficient for theoretical modelling results (e.g. improvements in social license to operate) to be achieved in practice, or if the solution to maintaining social licence rests with adapting the decision-making process itself to enable greater levels of public engagement.
3. Integrating this knowledge with a suitable quantitative modelling framework, such as modern portfolio theory.

INTRODUCTION

Resilient forests RA1 (Management of Risk and Uncertainty)

This Technical Report provides a brief summary of work carried out under RA1 (Management of Risk and Uncertainty) of the Resilient Forests Programme and suggests steps required to allow the consideration of social license to operate within quantitative forest planning framework.

The Resilient Forests programme aims to ensure the long-term economic, environmental and social sustainability of forestry through creating forests that are more resilient to future uncertainty.

The wider programme includes:

- Productivity Enhancement (RA2), which considers the role of the microbiome in enhancing productivity, the impacts of shorter rotations on wood quality and issues related to uniformity and stand dynamics.
- Enhanced Resilience (RA3), which includes research into the epidemiology of needle diseases, genetic and microbiome components of risk and resilience, alternatives to chemical approaches to disease management and disease impacts.

The work described in this Technical Note has been conducted under the RA1 task, which is focussed on management of risk and uncertainty. This includes aspects of risk investigated in the wider programme, such as market risks related to wood quality and chemical use.

The programme takes an integrated approach to reduce the risk of forestry investment decisions. The goal of RA1 is to build a framework that enables forest managers to develop strategies to maximise long-term returns through explicitly considering future risk and uncertainty in decision making.

Forests provide multiple ecosystem services but can also have negative impacts, such as those affecting forestry's social licence to operate. Not only are trade-offs between productivity, profitability and other ecosystem services not always clear, but factors such as weather events and climate change, pests and diseases, market fluctuations and societal shifts make outcomes (both desirable and undesirable) more uncertain.

RA1 outputs to date

Wreford et al (2020) summarised the factors expected to influence the development of forestry in New Zealand over the current century. This includes the projected impacts of climate change on forestry and the major socio-economic drivers and their current characterisation into shared socio-economic pathways.

Climate change risks include productivity changes, damage from abiotic factors (especially wind), wildfires, pests and disease, and weeds. Examples of policies that have social impacts include the One Billion trees (1BT) programme, which has led to concerns that radiata pine is incentivised over native species and the evaluation of climate-related reputational risk (TCFD 2017, Dunningham and Bayne 2019).

West et al (2021) described an application of Modern Portfolio Theory to radiata pine management in New Zealand. The optimum harvest-cycle regime for radiata pine was derived from two data sources used to predict biophysical and economic performance. Firstly, timber growth in response to future climate change was simulated using a forest growth model (3PG), based on future climate

scenarios and projected pathways of future atmospheric CO_2 concentration[1]. Secondly, market volatility was predicted using log price forecasts. This information was used to construct optimal portfolios of forestry planting and management to minimize risks of investment, with a given level of expected returns over a range of climate change scenarios.

The aim was to develop and demonstrate a simple approach to forestry decision-making under global-scale economic and climate risks. The results suggested that future risks can be mitigated through diversifying management regimes, with an optimal mix of regimes varying according to the expected range of uncertainty in future climate and log price scenarios.

Wakelin et al (2020) surveyed the literature on the inclusion of risk in forestry decision-making and, in particular, how to incorporate social risk within Modern Portfolio Theory. To enable this, forests should be managed for a wide range of economic, environmental and social benefits. Increasingly forestry management decision-making is enabled by decision support systems to develop strategies that result in more resilient forests and provide these benefits.

While there is an extensive literature on the optimisation of ecosystem services from forests, social and cultural elements are seldom included. One problem is that modelling requires quantifiable criteria that relate directly to forest metrics such as area. The recreational, aesthetic, health and spiritual values associated with forested landscapes are difficult to quantify, and cannot be represented with a single metric describing “social license to operate”. It is difficult to characterise the expected values of these factors and their variability under a range of alternative management options.

There is scope to identify key social concerns relevant to New Zealand forest management, however, and formally capture these within the planning process. Alternative modelling frameworks such as Robust Optimisation, which accounts for the level of randomness inherent when modelling multiple uncertain variables such as forecasts of future climate and log prices (T. Knoke pers. comm) may be more suitable in decision-making involving multiple objectives, selection criteria and sources of risk.

Bayne et al (2020) sought a better understanding of how different groups in society perceive current forest practices and the implications of this on social license to operate using a values-based survey with 1501 respondents. Results showed there was a low level of knowledge of forestry activities and a moderate to high level of concern about three forestry practices targeted in the survey:

- Harvesting on steep slopes.
- Changing to different species in smaller sized forest areas.
- Chemical sprays and pesticide use in forests.

Within the survey, five common response clusters were identified based on the respondents’:

- Proximity to the nearest pine forest
- Frequency of visiting a pine forest
- Perception of benefit of forestry for the regional economy
- Trust in the forest sector
- Level of concern, knowledge, acceptance, perceived impact and engagement across three forest management practices (after Wyatt et al., 1995)
- Personal values, politics and worldviews
- Environmental values
- Level of social media use and volunteerism

This work informs a quantitative understanding of social attributes for a modern portfolio theory analysis of trade-offs involving social attitudes, by determining how different groups in society

[1] RCPs (Representative Concentration Pathways)

perceive current forest management practices and what the implications are of those on forestry's social licence to operate.

Overall, 80% of respondents stated they held the same level of trust as 5 years ago. Māori have a greater proportion who have decreased trust in forestry, while younger respondents have increased trust, and older respondents decreased trust. Trust in forestry is determined mostly through exposure to negative media about forestry, government policy decisions, and personal observations.

There is a moderate level of concern about both forest harvesting on steep slopes, and the use of chemicals and pesticides within forests, with lower levels of concern about the utilisation of new tree species or different forestry regimes. However, there was a very low level of knowledge about what each of these forestry practices entails, and a low perception of forest industry engagement with the public about how decisions regarding these management practices are being undertaken and the impacts that might arise near their communities.

Characteristics of the five common response clusters were:

1. "Most concerned and have most knowledge". This group think forestry remains good for the economy. They tend to be urban (Auckland-based) and well educated.
2. "Almost as concerned and knowledgeable". This group lives near forests and has a decreased level of trust. They are likely to be male, European or Asian.
3. "High concern about chemicals". This group are not likely to have visited a forest recently. They tend to be women over 65.
4. "Low knowledge and low concern". This group is not engaged with forestry issues and is accepting of forestry practices. They tend to be young non-Maori and younger millennial males in rural townships.
5. "Low level of concern other than steep land harvesting". This group feels forestry is very good for the economy. They tend to be older than 65 and live in rural areas.

A summary of this typology is given in Appendix 1.

Villamor and Dunningham (2020) reviewed literature on how modelling is used to assist adaptation decisions in the context of plantation forests. Their findings showed that most models used in this area of analysis poorly represent adaptation decisions and behaviour. This work proposed applying a socio-psychological framework called protection motivation theory to understand the motivation of forest owners to protect their forest plantations against climate change impacts. Protection motivation theory examines maladaptive behaviour and uses this to understand the causes of decision-making in response to perceived threats. The 2017 survey of rural decision makers in New Zealand determined that less than 10% of smallholder forest owners adopted adaptation strategies, which suggests maladaptive decision-making is wide-spread. Perception motivation theory addresses what factors motivate forest owners to take risk reduction measures. The paper outlined key activities for implementation of this framework under the Resilient Forests Programme, outputs from which will later be used in the parameterization of a modelling analysis used to predict spatial impacts of this decision-making at a landscape scale.

Emerging Themes

Several themes have arisen over the course of this work:

- A modern portfolio theory decision support framework has been applied to forestry using computer modelling. In most cases the sources of risk considered are physical (e.g. climate change impacts on productivity) or economic (e.g. future wood prices). The outcome of interest in these studies is generally economic (e.g. maximising net present value).
- Studies note that it is difficult to obtain the historic data required to determine the variance in risk factors, and this was also the case in our application for both climate change impacts on tree growth and log prices. It is difficult to predict future trends over the long time periods required for forestry performance analyses.

- Social risks may apply at different levels of spatial resolution, from stand to landscape. Concerns about maximum clearfell size (a landscape-scale concern) would not be addressed by a stand-level portfolio analysis.
- A landscape-level model is generally more appropriate because relationships between variables (e.g. changing climate and log prices) may not be linear. Because of binary threshold relationships, this method is best applied at coarse spatial scales.
- While the 1BT programme has led to apparent public concern through negative media attention relating to the fear of a large-scale expansion of exotic pines, these strong opinions may not be reflected in wider public consensus. However, in elements of the farming sector and environmental groups these concerns are strongly held.
- Some sectors of the public have limited knowledge about forestry practices including the use of agrichemicals. We expect that this situation would also apply other land uses, e.g. agriculture and horticulture.
- Our results evidenced a low overall level of public engagement with forestry, which leads to a situation of reduced trust.
- Social licence to operate is difficult to quantify because it is the product of a range of social and behavioural factors including some that arise from events unrelated to specific management practices, e.g. increased levels of foreign ownership, actions of other individuals or land management companies, and media campaigns by special interest groups and politics.
- Given the above complexity, modern portfolio theory may not be the most appropriate option for modelling social issues related to forest management. Other approaches are possible, such as robust optimisation which could be used to deliver a portfolio of management practices that consider risks and attempt to avoid the worst outcomes.

Future quantitative analysis of social risk in forest planning

Building a better understanding of forestry's social licence to operate

There is need for a better understanding of potential triggers for a loss of forestry's social licence to operate and the outcomes of this. Questions for further research include:

- Do campaigns by well-placed lobby groups have more influence on the regulatory environment than the opinions of the general public?
- Is factual information relevant in an increasingly polarised "post-truth" world? How are opinions formed and where is information obtained? How can entrenched positions be countered?
- Does social license to operate loss involve accumulated relatively minor concerns across a broad range of topics and a tipping point, such that addressing only one or two issues may have no effect?
- Has trust declined to the point that correcting previous management failings (e.g. harvest debris flows) will be insufficient in the near future?

For example, anti-pine sentiment appears to dominate media coverage of afforestation as part of both national-scale climate change mitigation plans and the 1BT programme, but this may not be a majority public view. The choice of tree species was not rated highly as an issue across the clusters in the segmentation study (Bayne et al 2020).

Radiata pine itself was not mentioned by Hall (2019) with respect to impacts on the New Zealand forestry sector's social license to operate. The author listed negative consequences of the forestry sector as reduced regional jobs and loss of aesthetic and cultural value, harvest debris management failures, sedimentation in Marlborough Sounds and Coromandel, logging trucks on public roads and toxic chemicals in forest management and timber treatment. We recognise, however, that some of these issues are common to other rural land uses (e.g. stock trucks, agri-chemical use).

For a quantitative modelling framework like modern portfolio theory there is a need to determine:

- individual practices that have a negative impact on social license to operate;

- the landscape scale at which these factors operate and whether interactions are linear, or defined by thresholds of change;
- alternative management options that could positively influence social license to operate;
- the likely impact of such options on social license to operate, net revenue and other parameters;
- the statistical variance around these outcomes.

Costs of risk reduction measures for extreme weather events and environmental hazards can be relatively easily estimated, but currently the key social risks inherent within them are not clear.

Adapting the modern portfolio theory modelling approach to forestry risks

There is scope to adapt the modern portfolio theory framework to account for numerous sources of future forestry-related risks based on uncertainty theory. This would make use of research developed within the programme related to diseases, pests, climate change impacts on productivity and wood quality.

Currently there is a lack of clarity regarding the key social risks, the magnitude of impacts, mitigation options and their likelihood of success.

Furthermore, analysis at the stand level may not be appropriate. For example, if "*maximum clearfell block size*" was an issue, this needs to be addressed at a landscape rather than stand level. A perception of "too much pine" may need to focus on the highly visible part of the estate, requiring a spatial analysis.

Modern portfolio theory is a powerful tool in assessing how uncertainty affects decisions involving trade-offs between acceptable risks and economic performance, which could be developed further to provide useful insights to all forestry stakeholders. Other decision-making assistance modelling tools also have merit and these may be more applicable to model the impacts of social issues.

Other approaches

- Hall (2019) suggested public consultation and participatory forest planning to be an effective mechanism for maintaining forestry's social licence to operate. In this view, the forestry sector can make a strong argument for supporting the delivery of public goods. Therefore, it is in the public interest for resources being granted to deliver these goods – e.g. subsidies for silvicultural systems that would otherwise not be economic. Such an approach could also include more formalised public participation in the planning process, which would also support FSC certification. An outcome could be that forestry's social licence to operate is maintained by involving stakeholders from the first stage of the decision-making process.

- A deeper understanding of public concerns could allow these to be abated at the outset, rather than accommodated at a later stage. For example, commercial radiata pine forestry as a land use is being judged in the media against two alternatives:

  1) Pastoral farming (e.g. the 50 Shades of Green lobby group). Some of the rhetoric amounts to an argument for preserving the status quo regardless of cost and regardless of environmental and economic sustainability.

  2) Indigenous forest restoration. In this case the ecosystem services provided by plantation forests are compared against mature native forests rather than the pasture systems they are replacing.

  In both cases the claims made, both in favour of the alternative land use and against forestry, are testable. For example, unsubstantiated claims have been made that reforestation of erodible hill country with native tree species will return significant tourism and recreation benefits.

Research evidence is needed to counter such arguments, but unless the public is also directly involved in designing and undertaking this research, it may be difficult to change perceptions.

- The World Business Council for Sustainable Development[2] has developed guidance for addressing Environmental, Social and Governance risks. A framework for corporate social responsibility based on this could be developed using, firstly, a survey targeting public perceptions of social responsibility in the forestry industry.

CONCLUSION

Modern portfolio theory modelling has indicated a useful approach for evaluating the uncertainty related to markets, abiotic and biotic risks, productivity and wood properties. A better understanding of key social licence issues in relation to forest management is needed before it is possible to determine whether this method can provide useful insights also incorporating social risks.

The steps required are illustrated in Figure 1.

1. Gaining a deeper understanding of social license to operate in relation to forestry, so that the potential impacts of changes in management on social licence can be estimated;

2. Determining if the level of public trust is sufficient for theoretical modelling results (e.g. improvements in social license to operate) to be achieved in practice, or if the solution to maintaining social licence rests with the decision-making process itself.

3. If necessary, developing alternative approaches to achieve the same goals (via the reduction of social risk to an acceptable level), together with any additional parameters required such as the implementation costs of this and likely benefits.

An iterative research process is needed to achieve this, as illustrated with blue arrows in Figure 1. The initial focus of this process is on social licence itself, in order to identify suitable management options and impacts. These can be tested to gain insights into improvements in social acceptability. The green arrows represent adaptive management in the forest sector – which involves implementing idealised management changes, monitoring their impacts and developing alternative options, followed by testing and further adaptation. An example of this would be decision-making needed to form a climate change adaptation strategy.

[2] https://www.wbcsd.org/Programs/Redefining-Value/Business-Decision-Making/Enterprise-Risk-Management/Resources/Applying-Enterprise-Risk-Management-to-Environmental-Social-and-Governance-related-Risks

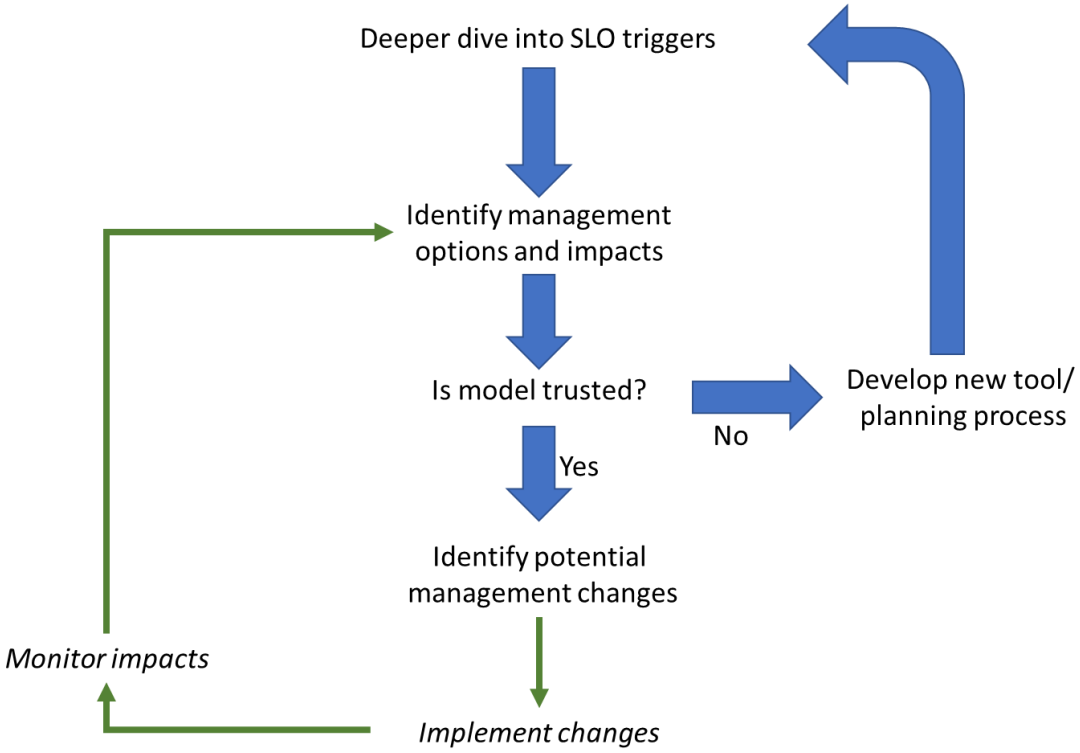


Figure 1. A framework for adaptive research and adaptive forest management, showing how decision-making can be adapted to accommodate risks from both social license to operate (SLO) and a range of external pressures

ACKNOWLEDGEMENTS

Funding for this research came from Scion and the Forest Growers Levy Trust, with the support of the NZ Forest Owners Association (FOA) and the NZ Farm Forestry Association (FFA).

REFERENCES

Bayne K, Grant A, McCarthy M, Makore S (2020). Mapping perceptions of forest management impacts and the effect on social acceptability. Report for Forest Growers Research. Scion.

Dunningham, A & Bayne K (2019). Developing strategies for risk assessment and adaptation in the primary sector by businesses, focusing on forestry using the TCFD process. SLMACC contract report, Scion.

Hall D (2019). A state of licence – the social licence to operate as an opportunity for the forestry sector. NZ Journal of Forestry 64(2) 25-31.

TCFD (2017). Final Report: Recommendations of the Task Force on Climate-related Financial Disclosure. https://www.fsb-tcfd.org/publications/

Villamor GB, Dunningham A, (2020) Improving the representation of adaptation behaviour to climate change in New Zealand's forestry sector. Manuscript for Forest Growers Research. Scion

Wakelin S, Grant A, Klinger S (2020) Social Extension of Quantitative Portfolio Framework – Literature Review. Report for Forest Growers Research. Scion.

West, T. A. P., Salekin, S., Melia, N., Wakelin, S. J., Yao, R. T. & Meason, D. (*2021*) Diversification of forestry portfolios for climate change and market risk mitigation. Journal of Environmental Management. 289, 112482.

Wreford A, Dunningham A, Jones A, Melia N, Villamor G, West T (2020). Review of literature on the development of climatic and socio-economic scenarios for New Zealand forestry. Report for Forest Growers Research. Scion.

Wyatt, S., Rousseau, M. H., Nadeau, S., Thiffault, N., & Guay, L. (2011). Social concerns, risk and the acceptability of forest vegetation management alternatives: Insights for managers. *The Forestry Chronicle*, *87*(2), 274-289.

APPENDICES

Appendix 1. Overview of cluster characteristics from the survey responses

Key concern	Cluster 1 *n=222*	Cluster 2 *n=222*	Cluster 3 *n=222*	Cluster 4 *n=274*	Cluster 5 *n=252*
Harvest concern	Very high	High	High	Very low	Moderate
Species change concern	High	Moderate	Low	Very low	Very low
Chemicals concern	Very high	High	High	Low	Low
Trust in Forestry	Increased	Slight decrease	Slight decrease	Slight decrease	Slight decrease
Good for regional economy?	Very good	Good	Neither	Good	Very good
Knowledge of forestry activities	Low	Moderate	Very low	Very low	Low