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Technical Note

Towards quantitative analysis of social risk in forest planning

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Summary: Forest investment decisions are made in the face of considerable uncertainty over future costs and benefits. Decision support systems designed to assist forest managers to evaluate trade-offs between alternative management options often do not explicitly consider this uncertainty. However, there are some analysis approaches that explicitly consider risk and uncertainty, and these approaches could form a useful framework for assessing forest management options in response to existing and emerging risks. Modern Portfolio Theory (MPT) is one example that has been applied to forestry, allowing managers to identify a portfolio of management options (such as species and regimes) that minimise risk for an acceptable level or return, or maximise return for an acceptable level of risk.

One of the emerging risks facing the industry is social acceptability, or the loss of “social license to operate”. This is perhaps illustrated through media coverage of post-harvest debris flows in recent years, and can be compared with increased public concern regarding some dairy farming practices, live shipments of sheep and cattle and (in earlier times) NZ Forest Service harvesting of native forests. Possible outcomes include increased regulation, prohibition of certain practices, reduced market access and therefore reduced net revenues. Few previous applications of MPT have included social elements such as objectives related to social outcomes or risks related to the loss of ‘social license to operate’.

Work in this programme to date has reviewed applications of MPT and related approaches in forestry and the way that social issues have been incorporated. A model framework has been developed that identifies optimal regime mixes in response to risks related to future log prices and climate change-induced productivity levels. A survey of public attitudes to forestry practices has also been carried out to examine potential pressure points. The aim of this Technical Note is to suggest a pathway forward for including the potential risks presented by social expectations and preferences within a quantitative planning framework. Three steps are required:

1. Gaining a deeper understanding of SLO 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 trust is sufficient for theoretical modelling results (e.g. improvements in SLO) 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 (maintenance or enhancement of social licence and reduction of social risk to an acceptable level), together with any additional parameters required such as implementation costs and likely benefits

Introduction

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, 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 there can also be negative impacts. Not only are the trade-offs not always clear, but factors such as weather events and climate change, pests and diseases, market fluctuations and social and political acceptability make likely outcomes (both desirable and undesirable) uncertain.

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

RA1 outputs to date

Wreford et al (2020) summarise 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. The Shared Socio-economic Pathways describe five scenarios with implications for the development of forestry and forest policy in New Zealand. Examples of policies that have social impacts include the One Billion trees (91BT) 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 (submitted) describe an application of Modern Portfolio Theory to radiata pine management in New Zealand. Uncertainty was introduced to the problem of determining the optimum regime from two sources. Firstly, the growth response to future climate change was simulated using the 3-PG process-based forest growth model, based on future climate scenarios and Representative Concentration Pathways. Secondly, market volatility was obtained from log price forecasts. This information was used to construct optimal forestry portfolios that minimize investment risk for a given level of expected returns over a range of climate change scenarios.

The aim was to develop and demonstrate a simple approach to portfolio optimisation under risk. Results suggested that future risks can be mitigated through

the diversification of management regimes, with the optimal mix of regimes in the portfolios varying across the future climate and log price scenarios.

Wakelin et al (2020) survey the literature on the inclusion of risk in forest decision making approaches, and in particular, the incorporation of social risk within Modern Portfolio Theory. Forests are managed for a wide range of economic, environmental and social benefits. Increasingly forestry management decision support systems are being used to develop strategies that result in more resilient forests to better 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 criteria that are quantifiable and scalable. The recreational, aesthetic, health and spiritual values associated with forested landscapes are difficult to capture and quantify, and cannot be represented with a single "social license to operate metric". Differences in expected values and variance of these factors that arise under alternative management options are also difficult to determine.

Nevertheless, there is scope to identify key social concerns relevant to New Zealand forest management and formally capture these within the planning process. Alternative modelling frameworks such as Robust Optimisation (T. Knoke *pers. comm*) may be better suited for considering multiple objectives, 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 on Sustainable License to Operate (SLO) through 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 the three 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.

Five population clusters were identified based on:

- 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 is intended to inform the quantitative extension of social attributes for inclusion within the portfolio framework, providing a better understanding

of how different groups in society perceive current forest management practices and what the implications of those are on forestry 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, and younger respondents having increased trust, and older respondents decreased trust. Trust in forestry is altered mostly through the media, government policy decisions, and personal observation.

There is a moderate level of concern about both harvesting on steep slopes, and use of chemicals and pesticides within forests, and lower level of concern about changing to different 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 decision around how these management practices are being undertaken and the impacts that might result in their communities.

Characteristics of the five population clusters were:

1 Most concerned and have most knowledge, but still think forestry is good for economy. Tend to be urban (Auckland) and well educated.

2 Almost as concerned and knowledgeable, live near forests and have decreased level of trust. Likely to be male, European or Asian.

3. High concern about chemicals, not likely to have visited a forest, tend to be women over 65.

4 Low knowledge and low concern, not engaged, accepting of forestry practices, young non-Maori. Younger millennial males in rural townships.

5. Low level of concern other than steep land harvesting and feel forestry is very good for the economy. Older than 65 and live in rural areas.

A summary of this typology is given in Appendix 1.

Villamor and Dunningham (2020) review literature on how adaptation decisions are modelled in the context of plantation forests. However, findings showed that representation of adaptation decisions and behaviour is poorly represented in most of the models. They propose the application of the Protection Motivation Theory (PMT) as a socio-psychological framework to understand the motivation of forest owners to protect their forest plantations against climate change impacts. PMT examines factors affecting the maladaptation behaviour of forest owners. Based on the 2017 survey of rural decision makers in New Zealand, less than 10% of smallholder forest owners adopted adaptation strategies. Thus, PMT is considered desirable to address the research question of what motivates forest owners to take risk reduction

measures. The paper outlines the key activities for implementation of the framework under the Resilient Forests Programme, outputs from which will later be used in the parameterization of an agent-based model.

Emerging Themes

Several themes have arisen in the course of the work carried out under this programme, in relation to modelling social licence:

- MPT has been applied to forestry and natural resource management in general, however in most cases the sources of risk are physical (e.g. climate change impact on productivity) or economic (e.g. future wood prices). The outcome of interest is generally economic (e.g. NPV).
- It is difficult to obtain the historic data used to determine variance and even more difficult to predict future trends over the long time periods required in forestry analyses.
- While the 1BT programme has led to concerns and negative media attention related to what is described as “the relentless march of pines across the landscape”¹ or “blanket planting of pines”, the strong opinions held by elements of the farming sector and environmental groups may not be shared by the general public.
- The public has a lack of knowledge about forestry practices including the use of agrichemicals. This is probably true also of other land uses.
- There is also a low level of public engagement with forestry, and without engagement there is unlikely to be trust.
- Social licence to operate is difficult to quantify and model because it may be a function of a range of things including some that a forestry company has no control over or that are unrelated to its specific management practices (e.g. foreign ownership, actions of other companies, media campaigns by special interest groups, politics, etc).
- Issues may not be apparent at a stand level, so a regime analysis that identifies a portfolio at that level may not address the issue at a forest or landscape level. e.g. clearfell size limits.
- Relationships may not be linear – there may be binary or step-wise functions (such as acceptable thresholds), which require landscape-level models.
- MPT 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.

¹ e.g.

https://www.nzherald.co.nz/property/news/article.cfm?c_id=8&objectid=12239231

Future quantitative analysis of social risk in forest planning

Social licence

There is clearly a need for a better understanding of potential triggers for a loss of social licence and the likely outcomes. Questions 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 SLO 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 not be enough?

For example, anti-pine sentiment dominates media coverage of afforestation as a climate change response and the 1BT programme, but this may not be a majority public view - 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 the New Zealand forestry sector's SLO. The author listed 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. Some of these are common to other rural land uses (e.g. stock trucks, agri-chemical use).

For a quantitative modelling framework like MPT there is a need to determine:

- individual practices that have a negative impact on SLO;
- whether these factors are additive, scalable or binary, landscape or stand-based.
- alternative management options that could positively influence SLO;
- the likely impact of these options on SLO, net revenue and other parameters;
- probability distributions 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 are not clear.

MPT modelling approach

There is scope to adapt the MPT 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.

While MPT is undoubtedly a useful tool in assessing the impact of uncertainty on decisions and can provide useful insights to all forestry stakeholders, other approaches also have merit and may be more directly applicable to social issues.

Other approaches

- Hall (2019) suggested public consultation and participatory forest planning as a mechanism for maintaining social licence. He felt that the forestry sector can make a strong case for providing public goods, and therefore a case for being granted resources to deliver the good – e.g. subsidies for silvicultural systems that are not otherwise economic. This could include more formalised participation in the planning process, which would also support FSC certification. An outcome could be that social licence is maintained and enhanced not by making major changes to management decisions but by involving stakeholders in the decision-making process.
- A deeper understanding of public concerns could allow these concerns to be abated rather than accommodated. 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). Much of the rhetoric amounts to an argument for preserving the status quo at almost any cost and regardless of environmental and economic sustainability.
 - 2) Indigenous forest restoration. In this case the ecosystem services provided by commercial forestry are compared against native forests rather than the pasture systems they are replacing.

In both cases claims made both in favour of the alternative land use and against forestry are testable. For example, unsupported claims are often made that reforestation of erodible hill country with native tree species will have higher tourism and recreation benefits. The difficulty is

that it may not be enough to counter these arguments with research unless the public is directly involved in designing and undertaking the research and determining how it is used.

- The World Business Council for Sustainable Development² has developed guidance for addressing Environmental, Social and Governance risks. A framework for corporate social responsibility based on this could be developed, with a first task being to survey public perceptions of forestry social responsibility.

Summary

MPT is a useful approach for considering 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 MPT can provide useful insights in this area.

The steps required are illustrated in Figure 1.

1. Gaining a deeper understanding of SLO 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 trust is sufficient for theoretical modelling results (e.g. improvements in SLO) 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 (maintenance or enhancement of social licence and reduction of social risk to an acceptable level), together with any additional parameters required such as implementation costs and likely benefits.

The iterative research process is illustrated with blue arrows. The initial focus is on social licence itself, in order to better identify suitable approaches. These can be prototyped and tested to gain insights into social acceptability. The green arrows represent adaptive management in the forest sector – implementing promising management changes, monitoring the impacts, developing alternative options, testing and adapting.

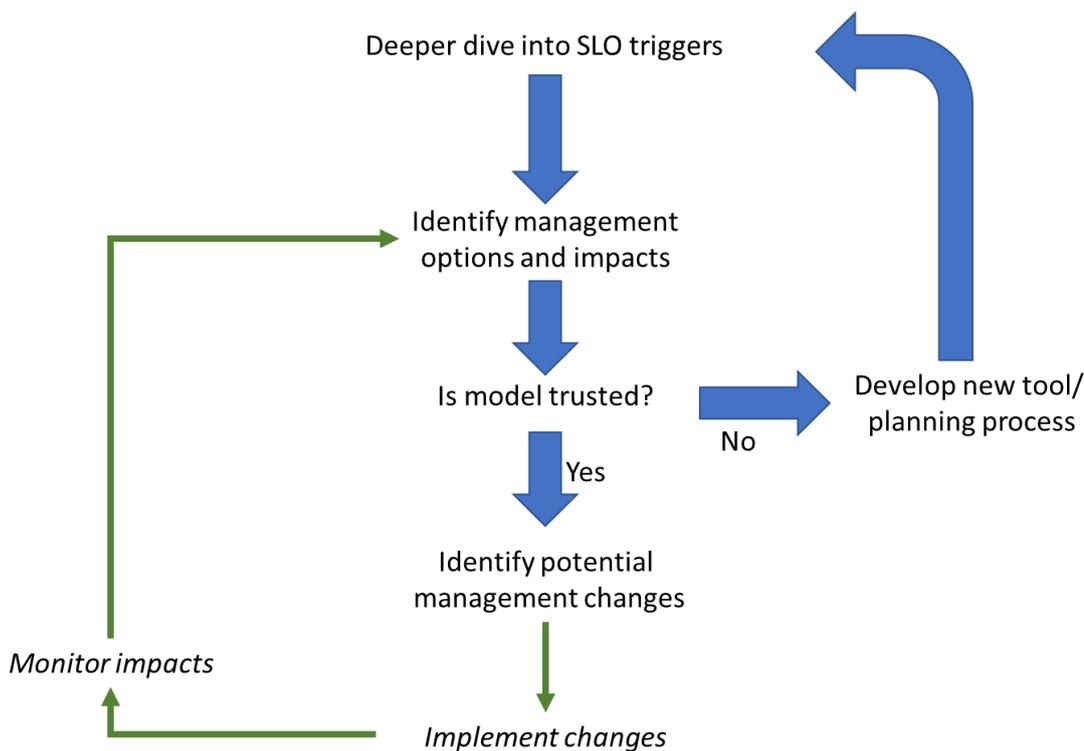


Figure 1. Adaptive research and adaptive forest management

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](#)

Appendix 1. Overview of cluster characteristics

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

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