Improving management of post-harvest risks in steepland plantations

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Abstract

This overview paper introduces the topic of inter-rotational management of steepland forests and is the first of a series of short papers on post-harvest steepland forest management. These papers focus on: what we know; what research we are currently undertaking in the national Growing Confidence in Forestry's Future (GCFF) programme funded by the Ministry of Business Innovation and Employment (MBIE) and the Forest Growers Levy Trust (FGLT); what we still need to know; and the implications for steepland management. Topics covered are freshwater management, nutrient supply over multiple rotations, the role of tree roots in slope stabilisation, and risk management approaches in erodible terrains.

Introduction

An opinion piece in this Journal a few years ago discussed the topic of landscape response to forest harvesting (Phillips et al., 2012). That contribution aimed to address the issue of the apparent increasing incidence of localised storm-induced landsliding mobilising woody residue during or after planted forest harvesting and causing debris flows that were affecting houses, roads and bridges downstream of forests in several parts of New Zealand. The topic and how it might be dealt with has been the subject of further more recent papers (Bloomberg & Davies, 2012; Marden et al., 2015; Bloomberg, 2015). In several cases, these storm-induced incidents have featured on national television and in newspaper headlines, with members of the public complaining about the consequences of forestry operations on steep erodible hill country.

Forestry companies have proactively responded by developing more detailed environmental impact assessment, erosion and sediment control planning and operational approaches, and by assisting with post-storm clean-up operations. Similarly, regional councils have looked more closely at the environmental impacts of forest harvesting and some have modified erosion and sediment control guidelines, previously largely applied to urban earthworks, for forestry application (e.g. Bryant et al., 2007). In addition, at the national level, the New Zealand Forest Owners Association (NZFOA) and the Ministry for Primary Industries (MPI) have been instrumental in developing a National Environmental Standard (NES) for Plantation Forestry aimed at standardising planning rules and approaches across the country. The basis for this is an Erosion Susceptibility Classification (ESC) originally developed by Bloomberg et al. (2011) and recently revised by Basher et al. (2015a). This paper and four associated short papers in this issue of the *New Zealand Journal of Forestry* build on Phillips et al. (2012).

The four papers briefly outline our knowledge (what we know) about some, but not all, of the strands that contribute to the topic of improving management of post-harvest risks in steepland plantations (other papers will follow in a later issue of this Journal). They each describe what we are currently doing in the GCFF (http://gcff.nz/) programme and related work, and then outline what still needs to be done to address this issue.

What we know

We know harvesting on steep terrain is challenging and can result in an increased level of risk of erosion and debris flows in the years following harvesting. However it was acknowledged in the 2012 paper in this Journal that it will not ever be possible to completely avoid slope failures and debris flows following harvesting (Phillips et al., 2012). It was also pointed out that the forest industry needs tools to improve 'whole of forest planning' and risk assessment as a basis for improved management of the incidence and consequences of these events. The concept of inter-rotational forestry, where a single long-term plan for a forest area covers planning and execution of the harvesting and re-establishment phases through to canopy closure, could be one way in which post-harvest risk is managed. For example, this approach should include:

- The roading and harvesting infrastructure design and construction
- The harvest plan and type of harvesting systems to be used
- The likely impacts of harvesting on-site and its ability to continue to grow trees into the future
- The risk of erosion including storm-induced landslides and debris flows and any on-site and off-site impacts
- Any environmental impacts on streams and other water bodies, and native biota
- What tree species to plant
- The design of planting layout to mitigate risks of landslides and debris flows, e.g. different species in gullies or on fans
- Areas that might need special attention or withdrawal and retirement from production

- The overall economics of any proposed plan
- Aspects of communication and understanding by the public of the role that forests play in a broad range of ecosystem service benefits.

Currently the New Zealand forest estate is dominated by one species – *Pinus radiata*. We expect, however, that in the future, and particularly on steep erosion-prone hill country, that issues surrounding landslides and debris flows in the years following harvesting will require alternative ways to manage many of these forests. Interest within the forestry sector seems to be mounting for strategies and approaches to deal with some difficult parts of the forest estate. Some of these alternatives include giving attention to improving our understanding of how to reduce the risk from landslides and associated debris flows (Basher et al., 2015b), consideration of strategic withdrawals from areas deemed either high risk or unprofitable, including managed reversion and abandonment, and even changing forest species with the aim of taking a longer-term view of a forest and its ability to provide multi-functional benefits. Key steeplands research areas are illustrated in Figure 1.

What we are doing

One of the aims of the current GCFF research programme, supported by MBIE and the FGLT, is to address the issue of steepland hazards by providing improved risk assessment and mitigation options to maintain long-term productivity on sites where erosion risk is high, and to reduce the likelihood of off-site damage from debris flows.

The purpose of this overview paper is to introduce and discuss the concept of inter-rotational forestry as it relates to the issue of post-harvest risk such as landsliding, debris flows and site productivity. In doing so, it aims to address a series of questions raised at the New Zealand Institute of Forestry's 2014 annual conference in Napier by Chris Phillips, to which some in the industry wanted an update, namely:

- Are there better approaches to manage the risk of steepland harvesting?
- Is it time to recognise that there are parts of our steepland landscapes unsuitable for production forestry?

A planted forest stream in Mahurangi Forest, Northland. Photo courtesy of Brenda Baillie, Scion

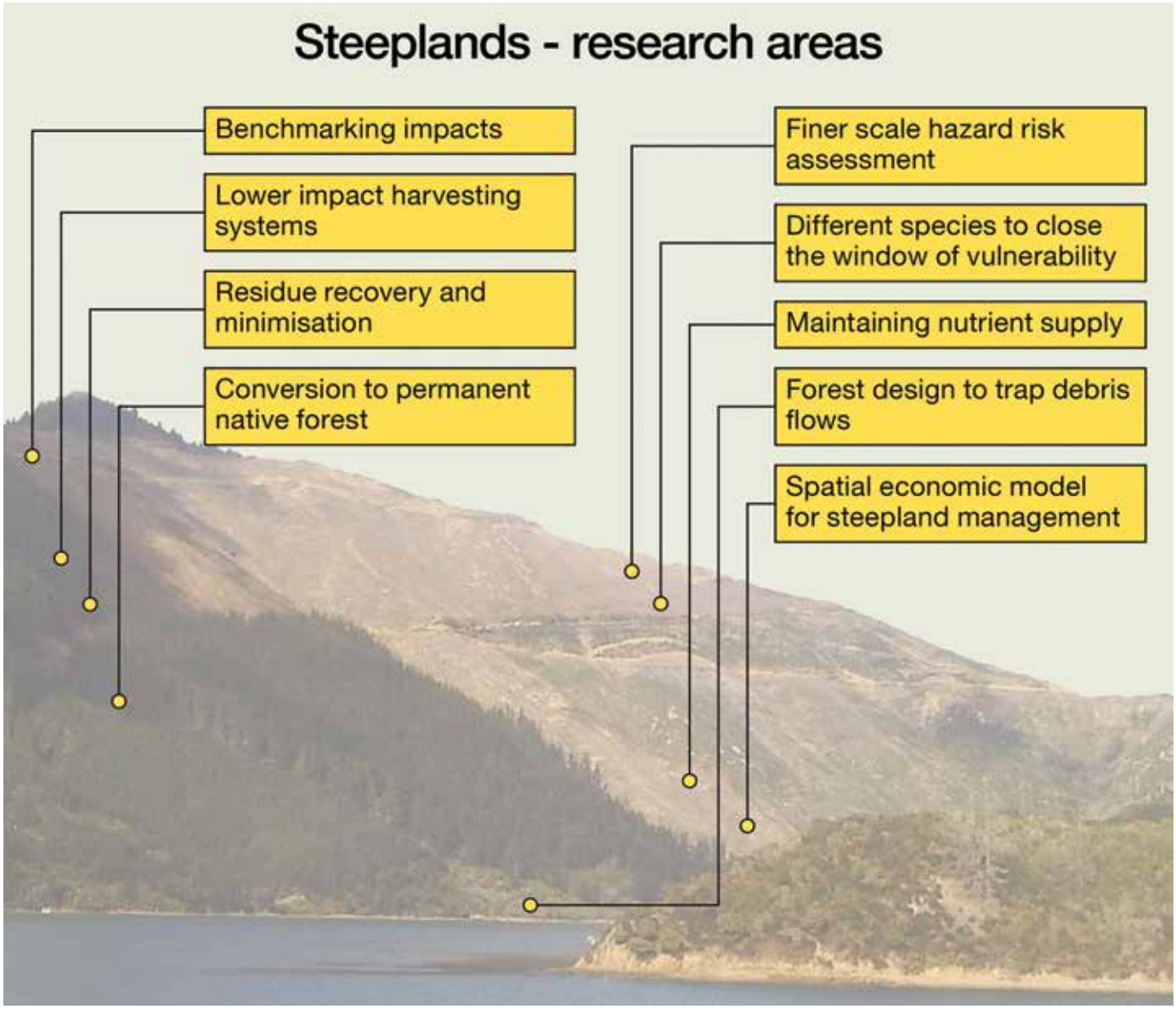

Figure 1: Key steeplands research areas that are needed to address risk during inter-rotation forest management in steepland planted forests in NZ

- Are there better ways to clearfell harvest or are there viable alternatives to clearfelling?
- Are some future steepland forests going to be something other than radiata, i.e. other exotic or indigenous species?

The following four short papers each address an aspect of the issue of future forests and their management, particularly in our erosion-prone steeplands.

What still needs to be known?

Much work on erosion susceptibility and processes has been undertaken and the major gaps in our knowledge that are currently of the highest priority relate to the 'window of vulnerability' period when the site is at most risk with a new crop planted but not yet fully occupying the site (see Figure 1, Phillips et al., this issue). One very basic question that occurs regularly, but that no-one has an answer to, is 'what is the size of the problem?' For example, how many debris flows escape forest boundaries each year and what damage or impact do they cause? The GCFF research is currently benchmarking the scale of the problem and the findings will be presented at the NZFOA annual research conference in October 2015. Public perception of the scale of the issue is likely at variance with the actual impact – and this is a major threat to forestry's 'social licence to operate'.

Implications for inter-rotational management of steeplands

The research outlined in the GCFF programme will cover most but not all of the key research areas outlined in Figure 1 and will provide solid evidence to support future mitigations or new approaches to management. This we propose will lead to a 'good practice guide' for

steepland management which could form part of an updated NZFOA Environmental Code of Practice (see www.nzfoa.org.nz/resources/file-libraries-resources/codes-of-practice/44-environmental-code-of-practice/file). Four areas where big science questions remain and that are not currently being investigated include:

- Whether harvesting disturbance actually causes decreased productivity and heterogeneity in the subsequent crop
- How very high-risk areas might be retired economically – currently considerations such as realising the value of ecosystem services provided from retirement to adjacent landowners or communities are not feasible options
- How to design forest layout to utilise bioengineering approaches to trap debris flows
- How the overall economics of very different silvicultural regimes may play out for forest managers – as this is new thinking there is little to no data or information available to support changes in regimes.

The outcome of this research will be to provide new risk management and mitigation options for steepland forestry that in the longer term minimises environmental impacts and improves the economic returns on these sites. It will lead to fewer cases of debris flows leaving the forest and adverse responses from the community to events such as illustrated in the second photo. It will also lead to the forest industry and the wider New Zealand public recognising what foresters can and can't manage.

To achieve this will require us to work closely with local communities and neighbours to communicate the new knowledge and thus contribute to maintaining forestry's social licence to operate on these sites and realise the multi-functional benefits from steepland forests.

This paper is followed by four short papers that cover aspects of 'what we know, what we are doing and what we still need to know' on: (1) Improving management of erosion risk (Basher et al.), (2) The role of roots in stabilising soil (Phillips et al.), (3) Nutrient supply from one rotation to the next (Garrett et al.), and (4) Inter-rotational management of freshwater in steeplands (Baillie & Rolando). Additional topics will be covered in future issues of this Journal.

Example of a debris flow

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