Exploring the afforestation potential of steep eroding hill country in the Hawke's Bay region

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Abstract

We explore the opportunities for afforestation in the Hawke's Bay region of New Zealand to reduce soil erosion and to provide economic and environmental benefits. The work analyses broad-scale spatial information across a range of tree species and forest systems drawing on existing forestry projects and knowledge. The tools and information produced will help decision-makers understand the implications of different afforestation options to develop a self-sustaining regional afforestation strategy.

Introduction

Around 120,000 ha of land in the Hawke's Bay has been identified as highly susceptible to erosion, losing material at a rate of 1,000 tonnes per square kilometre per year (Figure 1). The majority of this comes from sediment moving from areas not protected by vegetation cover into waterways.

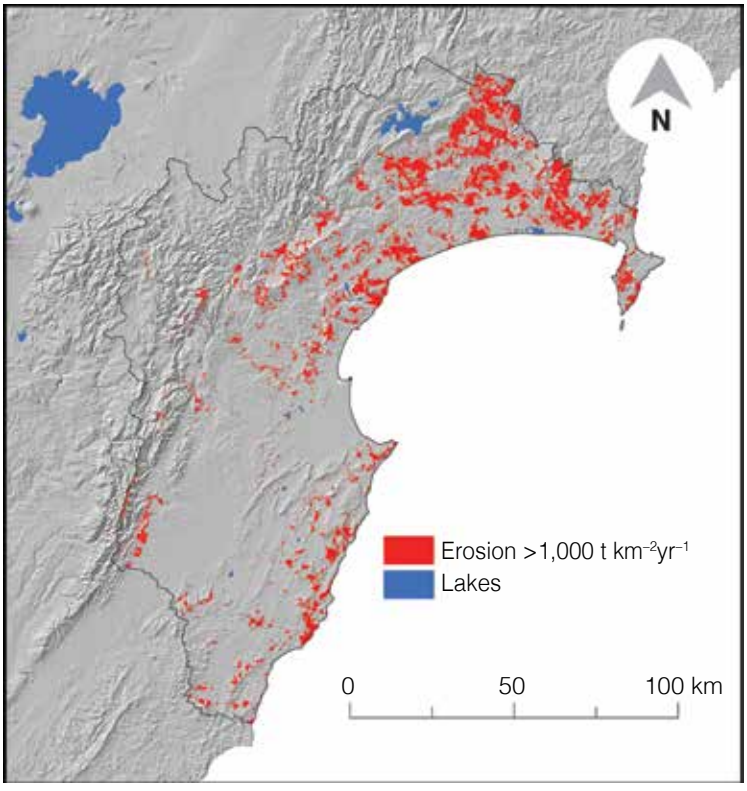

Figure 1: Areas where sediment yields greater than 1,000 tonnes of material per square kilometre per year can be expected across the Hawke's Bay region. Source: SedNetNZ

The Hawke's Bay Regional Investment Company (HBRIC) and the Hawke's Bay Regional Council (HBRC) want to explore and understand investment opportunities for afforestation, reducing soil erosion and providing both economic and environmental solutions to land use. The aim is to develop a self-sustaining regional afforestation strategy.

Erosion can be slowed and controlled by afforesting these vulnerable and unstable landscapes. Trees help protect the land from intense storm events by providing a canopy that intercepts rainfall, and roots that provide a structural integrity by binding the soil matrix together. Trees provide a range of benefits including water filtration, increased carbon sequestration, habitats for native flora and fauna, and opportunities for recreation and other ecosystem services.

The Ministry for Primary Industries (2019) One Billion Trees Programme has sparked discussions about what tree species to plant, where to plant them and for what purpose (right tree, right place, right purpose). The aims of the One Billion Trees Programme are to create employment, optimise land use, mitigate climate change, support Māori values and aspirations, protect the environment, and support New Zealand's transition to a low emissions economy. The Government has budgeted $120 million through the One Billion Trees Fund for grants to landowners, particularly farmers, to include trees on their farms.

This work explores broad-scale spatial information across a range of tree species and forest systems to provide a sound platform for future decision-making (Figure 2). This information will provide tools to ensure the HBRIC and HBRC have the right tree planted in the right place in the landscape, for the right purpose, to achieve positive outcomes for the environment, the economy and communities.

Right tree, right place, right purpose – regional screening

Identifying sites for potential afforestation across erodible landscapes in Hawke's Bay

Land Use Classes (LUC) and other factors (such as the degree of erosion, slope angle and whether slopes face the direction intensive storm events normally hit from) have been used by Scion spatial scientists to develop a series of 'Afforestation Groupings'. While LUC tends to be coarse in scale, incorporating the extra

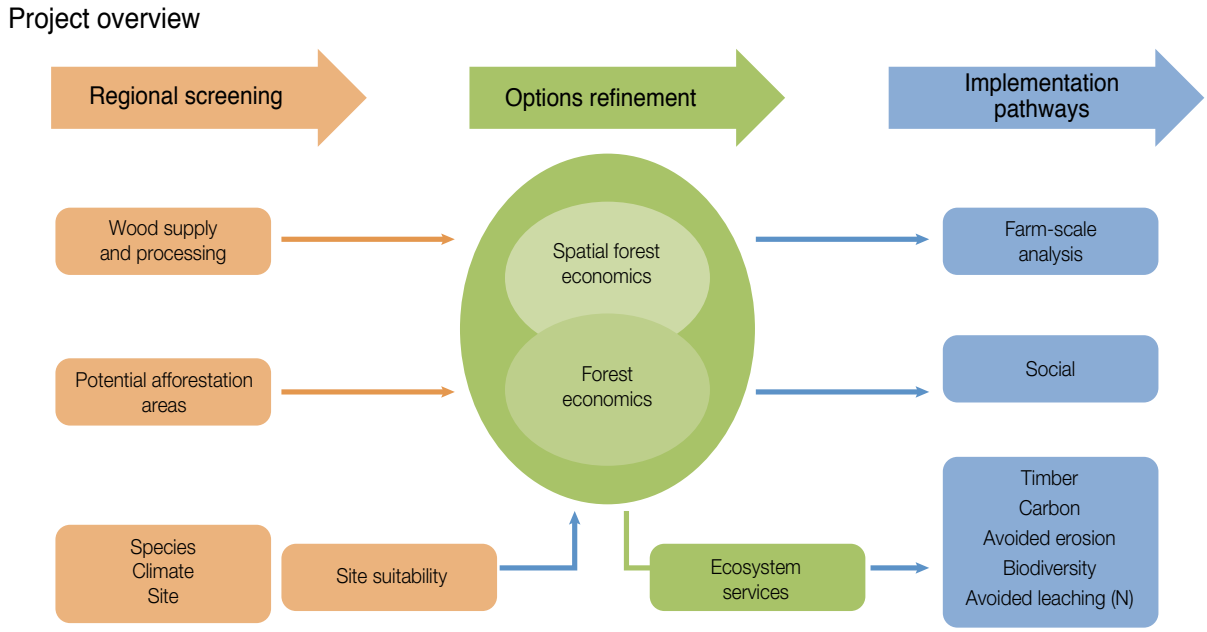

Figure 2: An overview of the 'Planting Eroding Hill Country in the Hawke's Bay Region: Right Tree, Right Place, Right Purpose' project

factors using fuzzy logic allows for the identification of highly erodible sites at a 625 sqm resolution. This level of detail will assist landowners with decision-making around which parts of their property would be most suitable for commercial forestry, or if permanent forests might be a better choice.

Spatial mapping of tree species site suitability for Hawke's Bay

Productive trees are those that survive and thrive under the conditions on a particular site. Maps of tree species site suitability in the Hawke's Bay have been developed by considering the environmental and climatic conditions where different species are currently growing, and the trees' productivity. The factors that come into play include temperature, rainfall, altitude, soil fertility and moisture availability, orientation to the sun, exposure to damaging winds or salt-laden sea spray.

Scion spatial scientists have developed tree species site suitability maps that show which species (or group of species) may be best suited to local conditions. However, it is not possible to claim that one forest system is better than another. The most important consideration is to optimally match each site and landowner to a forest system (or systems) considering site suitability, how well a species controls erosion, financial and market risk, and landowner aspirations.

Tree biomass resources and timber processing opportunities in Hawke's Bay

Increased afforestation on the scale proposed above has the potential to triple the Hawke's Bay timber supply over the next 30 years. The region has an existing plantation forest resource and an associated timber processing industry. The current wood supply is already adequate for timber processing to expand to provide around 500 jobs, $500,000 in GDP, and reduce the region's carbon footprint by utilising the surplus logs currently exported. With a growing supply, timber processing could expand, as could other industries that use large quantities of biomass such as biofuel production. Processing facilities that specialise in non-radiata species (e.g. coast redwood) will be needed if significant planting of other plantation species is to take place.

Forest economics – options refinement

Forestry options for planting eroding hill country in Hawke's Bay

A financial model has been developed to generate cashflows and financial outputs of potential species and regimes for afforestation in Hawke's Bay to assist individual landowners, the HBRC and HBRIC and local communities understand the implications of large-scale afforestation. The model can be used to compare the potential returns of different forest systems and species on different sites, and to understand how targeted incentives or regulations may be needed to achieve a desirable species mix (i.e. ensure native or other species are as equally attractive as radiata pine to a landowner). The model also provides data in a form useful for agricultural comparisons. (Note: The paper below will be published in the next issue of *New Zealand Journal of Forestry*.)

Spatial economic assessment of ecosystem services for potential afforestation areas in Hawke's Bay

Trees and forests provide benefits beyond timber, fuel and fibre. These include carbon sequestration, erosion control, flood mitigation, improved water quality, biodiversity and recreation resources. Together, the benefits people gain from the environment are known as ecosystem services. While many of these

services do not have a market value, a non-market 'value' can often be calculated to better understand or appreciate these benefits compared with timber value.

The spatial economic tool Forest Investment Framework (FIF) developed by Scion has been used to quantify the broader value of potential forests in the Hawke's Bay for avoided erosion, reduced nutrient leaching and carbon storage.

The annual value of non-timber ecosystem services in highly erodible areas is typically one-and-a-half to two times greater than the value of timber. Or, for each dollar earned from timber, the region gains one-and-a-half times that value in ecosystem services. Other ecosystem benefits that have not been assigned values in this work include habitats for species such as kiwi and karearea, increased opportunities for recreation, and improved water quality.

Afforestation of headwater riparian areas – a review

Many of the areas identified for afforestation in the Hawke's Bay are in steep, erodible headwater catchments. These areas have the highest density of stream and riparian areas and comprise a large percentage of total stream length in many catchments. Unlike riparian areas downstream, those in steep headwater streams tend to be narrow and closely linked to their terrestrial and aquatic environments. Disturbances such as landslides, debris flows, droughts and floods (along with forest management activities) will have a strong influence on their function and condition. The state of headwater streams also influences the health of downstream waterways and their biological communities.

The ecosystem services provided by forested riparian areas in headwater streams may be able to be assigned non-market values using the economic modelling tool Forest Investment Finder.

Encouraging afforestation – implementation pathways

Knowing where and what to plant is only one factor. Landowners will have to be convinced that afforestation makes financial, environmental and social sense. Understanding financial implications, desired environmental outcomes and the effects on communities, the HBRC and HBRIC can consider how best to support landowners considering afforestation initiatives with

Erosion at the East Cape, near Gisborne

targeted funding (e.g. with knowledge and know how). The papers described below will be published in the next issue of *New Zealand Journal of Forestry*.

An overview of the economic advantages of planting production forestry on pastoral land

AgFirst Hawke's Bay demonstrates that there is a tipping point where trees make more sense than keeping land in pasture. Using a complementary approach, where less productive land is afforested and higher quality land is managed more intensively, can lead to higher overall farm returns. Land use assessment needs to be done at a whole-farm level, rather than on a gross margin/ha basis. Landowners need to analyse their returns down to a LUC level and be aware of the relativities that exist between these classes. Not doing this can lead to the value of the better land being underestimated while the value of poorer land is overestimated.

Higher resolution land inventory mapping would facilitate the process of comparing and selecting appropriate areas to consider for forestry. Wider education addressed to farmers and other rural professionals on forestry, the benefits of better land use selection and its potential would be also help with efforts to afforest highly erodible land.

Landowner attitudes to afforestation in the Hawke's Bay region of New Zealand

Business consultants, Fresh Perspective Insight, have delved into landowner attitudes to afforestation. Each landowner's situation is unique and therefore has its own blend of factors, drivers and barriers when it comes to looking at tree planting or any other strategic-level decisions about land use. However, there are a set of core drivers and barriers that can be understood and addressed to increase the likelihood of landowners planting trees. This includes an approach that looks at each property individually and recognises that the range of potential benefits can be achieved through purposeful tree planting.

There is also a clear gap (and opportunity) for a central support and guidance system to work alongside landowners to understand their objectives and constraints, and to develop long-term plans that fit with the needs and expectations of landowners.

Summary

Planting highly erodible land in the Hawke's Bay in plantation forests could increase financial returns from land and, for each dollar earned, provide one-and-a-half times the value in avoided erosion, avoided nitrogen leaching and carbon sequestration. Also, new forests could provide habitat for species like kiwi and karearea, and the benefits from regenerating headwater streams and riparian areas would flow to downstream waterways.

Landowners have valid concerns around the financial, environmental and social implications of afforestation for them, their land and the wider community. Detailed information on the areas that are most susceptible to erosion and which alternative tree species and forest systems are most suitable on these sites, and the financial implications of investing in afforestation, will assist landowners with decision-making.

The HBRC/HBRIC can use the same information as a basis to develop environmentally sustainable and economically self-sustaining afforestation in the region. This is likely to include working alongside landowners to understand their objectives and constraints and develop a long-term plan that fits with the needs and expectations of the landowner, providing support from consultants and industry experts and using targeted funding to ensure desired species are planted. Non-market benefits beyond erosion also need to be promoted, as does job provision to increase community acceptance of wider tree planting.

A community dynamic that encourages responsible planting activity is also highly desirable. This can be helped by promoting non-market benefits beyond erosion to include increased resilience to climate change and carbon sequestration to support a move toward regional carbon neutrality. It is also important that new forests are seen to be providing jobs, whether opportunities for local people to participate at all stages of the forestry value chain through to new timber processing plants and high-value secondary processing.

The project is potentially transformational and integrates existing forestry projects and knowledge. It provides tools and information that will help decision-makers (including iwi, landowners, the wider community, and regional and national government) understand the implications of different afforestation options to develop a strategy that sees the right tree planted in the right place for the desired outcomes.

Acknowledgements

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