

# Trees on farms

## Trees for soil conservation

Soil is your most valuable natural resource. Losing it to erosion is a key constraint on production across New Zealand.

The economic and environmental costs of soil erosion are high, both to your farm and your waterways. Loss of topsoil can be chronic through wind and rain while sudden, catastrophic losses can occur during storms in slips or slumps. Both chronic and acute losses cause fine sediments to enter waterways where, through reduced clarity, altered nutrient cycles and infilling of bed habitat, water quality declines. On-farm, erosion affects production and increases risks of flooding, threatening soil structure, pasture and livestock.

With more frequent climate extremes forecast, the risk of soil erosion is set to increase on New Zealand dairy farms.

### *Erosion on farms: The signs*

The main types of erosion on dairy farms are:

- (i) slope erosion - movement of soil down the slope as a soil slip, earthflow or sheet erosion.
- (ii) gully or tunnel gully erosion - removal of soil or soft rock by water for short periods during or immediately after, heavy rainfall.

(On sandy or cultivated soils, wind erosion can be a problem. For further information see the *Trees on Farms: Shelter* guide for how to plant windbreaks.

Signs of erosion are clear - bare subsoil, collapsed tracks or structures, small channels of soil (rills) left behind in paddocks after rain, gully heads, collapsed stream banks, silted up dams or wetlands.

### *First check that your trees are not toxic to animals*

Many trees available and for sale in New Zealand could be harmful to companion animals and livestock. Some of the tree species mentioned on the website below could, in some cases, cause issues in some animals. Before planting, make sure that you have selected the right trees. Check with your vet for advice or visit this site for a general list of toxic plants: [taruavets.co.nz](http://taruavets.co.nz)

### *Tackling erosion: Soil conservation planting*

The planned planting of trees for soil conservation can prevent erosion. While all trees require some maintenance over their lifetime (pruning, thinning), trees are often an economical and sustainable solution for tackling erosion in the long term.

Areas on-farm best suited to soil conservation planting include:

- gullies and areas carrying sudden deluges of water edges, of critical source areas like low lying swales (ephemeral channels)
- marginal hill country or steep lowland slopes ("too steep for the fert truck"). Here, consider reverting to forestry crops, tea tree (manuka, kanuka), or reversion to bush over the marginal production

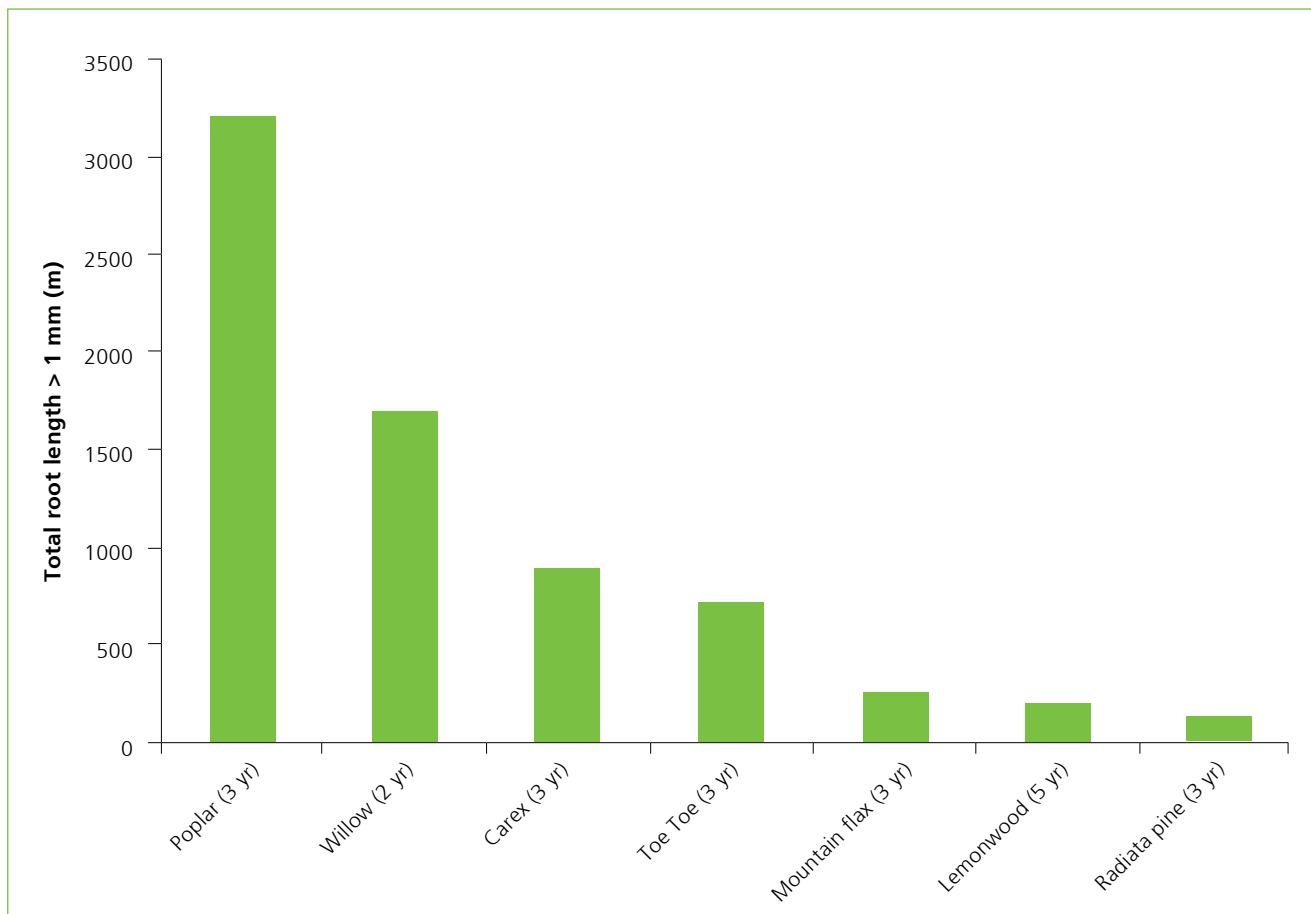
- tunnel gullies where gullying collapses the soil surface, leaving holes connected by a tunnel (tomos)
- loose or poorly consolidated soils (ash, sand). Even in rolling, productive country (<15°) sheet erosion and mass earthflows can occur (slips, slumps). If productive, planting spaced trees and restricting grazing is good management, while retiring land from grazing to production forestry offers an alternative.

## Roots and cover: How trees conserve soil

Trees improve land stability by binding soils with their roots, covering the ground with litter and preventing repeated drying/wetting or cracking, intercepting rainfall and slowing runoff. Riparian planting often involves deep-rooted trees for this reason; they can bind and reinforce banks, preventing them from slumping into waterways.

The risk of soil erosion is greatly reduced by planting trees or allowing vegetation to regenerate. Planting will often offer a quicker response than letting land revert to bush. Different species establish roots at different rates – this can be an important factor when rapid soil erosion control is needed.

Effectiveness in controlling erosion will depend on the tree species, growth rate, age and spacing. The closer trees are planted, the sooner a site will be stabilised as roots grow and interconnect. And the bigger a tree is, the larger its root system, and the more soil it protects. Remember too, that where trees and livestock coexist, closely spaced trees will require more regular pruning and maintenance to ensure pasture growth.



Root length of poplar and willow trees compared to some native plants and radiata pine.

Source: Landcare Research

The best soil erosion plantings establish quickly and have extensive root systems. On eroded, exposed, drought-prone sites, species choice is limited, simply because not many species will survive in these conditions. Similarly, only limited species will tolerate very moist land, for example swampy earthflows prone to water-logging and riparian areas which flood regularly.

## Planting options

Leaving native vegetation cover on fragile soils and a buffer or riparian margin along waterways is the most effective way to prevent soil erosion before it occurs, but if erosion is occurring, here are some options to consider. (Waterway erosion is dealt with under the water quality objectives of Riparian Planning) Visit [dairynz.co.nz/riparianplanner](http://dairynz.co.nz/riparianplanner) for more information.

### Productive soil, localised erosion

#### STEEP SLOPE: fence off, retire from grazing

| Site characteristics  | Options to consider   | Potential co-benefits  |
|---|---|--|
| Steep slope or sidling - accessible, relatively sheltered and fertile | Alternative timber species e.g. cypress, redwood, eucalypts, natives (e.g. totara, rimu, matai, beech). | Timber<br>Biodiversity (including bees if eucalypts are planted)<br>Shelter<br>Redwoods and some eucalypts will coppice (i.e. regrow from a cut stump) so roots will stay alive and control erosion from rotation to rotation. |
| Steep slope or gully - accessible, dry, hard site                     | Selected durable eucalypts for posts and poles  | Timber<br>Biodiversity (including bees)<br>Shelter<br>Landscape diversity  |

#### DEEP GULLY: fence off, retire from grazing (especially if gully is steep and dangerous)

| Site characteristics   | Options to consider   | Potential co-benefits  |
|--|---|--|
| Active gully erosion; gully sides relatively fertile and sheltered | Plant willows along gully bottom to control rapid erosion.<br>Allow gully sides to regenerate naturally or enrich with smaller native species e.g. flax, pittosporums, cabbage trees etc. | Biodiversity (including bees)<br>Landscape diversity<br>Timber |

#### SHALLOW SLOPE, GULLY OR TUNNEL GULLY EROSION: continue grazing

| Site characteristics                      | Options to consider                    | Potential co-benefits  |
|---|--|--|
| Less active erosion – valued grazing area | Spaced planting of poplars and willows | Shelter<br>Shade<br>Biodiversity (including bees)<br>Landscape diversity<br>Timber<br>Fodder |

## Marginal hill country, extensive erosion

**STEEP OR SHALLOW SLOPE, GULLY OR TUNNEL GULLY EROSION:** fence off, retire from grazing

| Site characteristics  | Options to consider   | Potential co-benefits                                       |
|---|---|---|
| Accessible site, steep/exposed/eroded, economic distance to market (<60-100 km)   | Radiata pine, Douglas-fir (or an alternative species e.g. cypresses, redwoods, eucalypts if site allows). | Timber<br>Biodiversity<br>Shelter in adjacent paddocks      |
| Extensive erosion prone area, inaccessible/far from markets (100 ha minimum area) | Manuka  | Biodiversity (including bees)<br>Income from carbon credits |
| Inaccessible site, small or large area  | Allow to regenerate naturally.<br>Plant gaps if required.   | Biodiversity (including bees)<br>Income from carbon         |



Durable eucalypts newly established on erosion-prone hill country.



An eroding gully planted with durable eucalypts and willow in the gully bottom to hold the water-course in place.

## Have a plan

All planting on-farm is better when it's planned.

All planting requires livestock exclusion, even if just a guard or poplar sleeve (a protective plastic sleeve that protects the pole from stock damage).

Think about integrating your trees on-farm with your riparian management plans. Visit [dairynz.co.nz/waterways](http://dairynz.co.nz/waterways) for more information. Thinking bigger helps ensure erosion around waterways is included in water quality objectives, or windbreaks and shade trees are included under shelter objectives.

## Establishing trees

Where the decision has been taken to plant, it is good practice to:

- Open plant on productive gentler slopes which will require guards or sleeves. Even with sleeves, cattle are best excluded from areas planted with poles for at least the first year following planting, preferably longer.

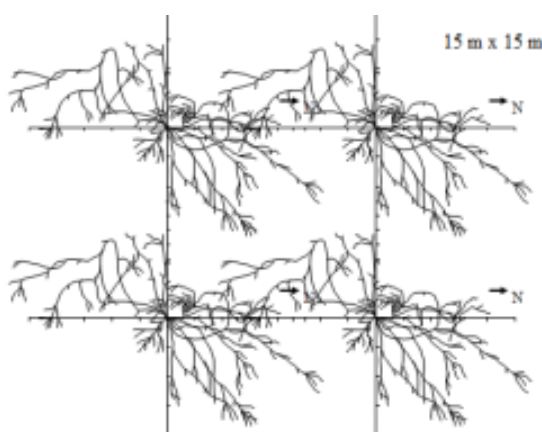
- Exclude livestock – livestock will browse any unguarded or readily available plantings (exotic or native) and even guarded poles or other exotics can be damaged by pressure from stock on trunks and roots. Permanent fencing is best for retired areas. If possible, graze the area to be planted hard before excluding livestock.
- Estimate the planting area, and order trees from a reputable nursery well in advance (look for a Farm Forestry Association or regional council logo).
- Control problem weeds like gorse and blackberry.
- Spot-spray planting sites to remove competing vegetation before planting - this can be done post-planting where guards are used on trees or a shield is used on the spray wand to avoid herbicide striking plantings;
- Control pests – rabbits, hares, deer, goats and possums can all spell disaster to young trees. Try to minimise numbers before planting and keep numbers low thereafter with suitable control see *Trees on Farms: Biodiversity* for further information on pest control.
- If planting slips, plant from bottom-up (most remediation is needed in the bottom-third of slips).
- Avoid planting in cracks (these will dry and open up in summer, drying out any trees).
- If planting poles, target damper areas (depressions) and plant poles deeply (>0.75 m deep).

## Spaced willows and poplars

The most commonly used trees for erosion control are willows and poplars. The best species and variety ('cultivar') depends on the site and also any secondary objectives, such as shade, shelter, timber or fodder production.

Sites are most commonly established using 2-3 metre long poles, planted in winter by ramming them into the ground (0.75m depth or more) and then using plastic or netting sleeves for protection. Recommended initial spacing is between 5 and 8 metres apart (50-150 trees/ha) depending on site stability (they can be thinned to 10-12m spacing only after 10-20 years).

The poles establish roots close to the surface in the first year and then grow rapidly and establish extensive root networks in a few years.



*Veronese poplar roots at age nine: root systems of adjacent trees add reinforcement strength as they mesh together.*

Areas planted with poles can be grazed by sheep immediately following planting, but ideally cattle need to be excluded for two years. The addition of tree guards will help reduce cattle damage on unfenced trees.



*Three-year old poplars established to control major slope erosion. These trees will also provide shade, shelter and biodiversity benefits.*

Some poplar cultivars (e.g. kawa, toa, Veronese) produce good timber if managed accordingly. Trees need to be form-pruned to create a single main stem, and then clear-pruned, to create a branchless butt log.

To retain pasture growth under spaced plantings, over time the trees need to be either thinned out or pollarded. Pollarding involves cutting all the branches off the tree above browsing height (around two metres for cattle). If done every three to four years, pollarding produces a significant quantity of nutritious fodder for livestock. Once pollarded, the tree grows multiple new branches. The tree roots continue to bind the soil throughout many cycles of pollarding, similar to coppicing.

Seek advice from your local regional council, as many provide good support for landowners wishing to control soil erosion. This support may include free advice, financial incentives, and discounted supply of planting stock and other materials.



*Wide-spaced Veronese poplars holding an erosion-prone slope with good grazing, shelter and shade underneath, and clear-pruned for timber.*



*Pollarded willows continue to bind the soil through many rotations of cutting for fodder and regrowth.*

## Indicative costs:

### 1. Spaced willows and poplars

| Cost item  | How much  | Other considerations  |
|--|---|---|
| <b>Planting stock – usually poles, 2-3 metres long 50-150 poles/ha</b> | \$5-7 for 2m poles<br>\$8-10 for 3m poles                     | If cattle graze the area or deer are present, use 3m poles. Much smaller cuttings/stakes can be planted where livestock are absent. |
| <b>Shelters/sleeves</b>  | \$5-\$7 for 2m poles<br>\$8-\$10 for 3m poles                 | If deer are present, use the tallest shelters available.  |
| <b>Planting</b>  | \$4-5 per pole (contractor rates)                             | Helicopters are sometimes used to distribute poles, which adds to costs.  |
| <b>Chemical weed control</b>   | 25-30c per application (contractor rates including herbicide) | Not essential, but helps get poles off to a good start.   |
| <b>Pruning</b>   | Around \$2 per pole per lift                                  | Only timber varieties. Budget for 2-3 lifts in the first 10 years.  |

### 2. Other species

| Cost item                   | How much  | Other considerations  |
|-----------------------------|---|---|
| Fencing                     | Electric fencing \$5-\$8/m<br>Post and batten fencing \$13-\$17/m                         | Young trees and livestock do not mix. Ensure fences are secure and check newly established plantations regularly.           |
| Plants (1100-2500 trees/ha) | Exotic species - \$0.50-\$4/plant<br>Native species - \$2-\$7/plant                       | Price per tree depends on species, size/quality of stock and numbers ordered. Quality of stock is more important than size. |
| Planting                    | 40-70c/tree (contractor rates for bare-rooted trees).                                     | Planting costs increase with bigger plants (but bigger plants tend to need less maintenance).                               |
| Weed control                | 25-30 cents/tree (contractor rates including herbicide).                                  | May need several repeat applications. 1.4m <sup>2</sup> spot recommended.   |
| Shelters                    | \$1-\$3 each<br>Some designs include a mat (to prevent weeds growing within the shelter). | Protect from rabbits, hares, and spray damage.  |

## Allowing vegetation to regenerate naturally

If you are allowing areas to regenerate naturally, some light grazing may help create gaps in dense vegetation, but eventually, livestock will need to be fenced out. Pest control is a key aspect. Grazing and browsing pests such as rabbits, deer, goats and possums can severely reduce the growth of natural regeneration and need to be continually controlled.

Naturally regenerating areas can be slow to become established to the point where they are protecting soils. They can be enriched, and soil conservation sped up, by planting. Planted trees will need protection from grazing and good spot weed control in their first few years to get established.

### *More information*

The Poplar and Willow Research Trust have many resources on using poplars and willows for soil conservation [www.poplarandwillow.org.nz](http://www.poplarandwillow.org.nz)

*Forests and erosion protection – getting to the root of the matter.* Phillips et al (2015) NZ Journal of Forestry 60 (2) pp11-15.

NZ Farm Forestry Association [www.nzffa.org.nz](http://www.nzffa.org.nz)

Many regional councils have good resources.