Why can't I see the forest for the cows – arboreal solutions for New Zealand's water quality crisis

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Abstract

The ecological health of many waterways in New Zealand has declined dramatically over the past 25 years, predominantly as a result of the intensification of dairy farming. The utilisation of land for production forestry has considerably less, long-term deleterious impacts on water quality and ecological health and may provide part of the solution for cleaner New Zealand waterways. Although forest harvesting, particularly on steep hillslopes, does provide some environmental risk these effects can be managed and/or very short lived. The benefits of forestry for better waterway management needs to be considered more widely in the debate around better water management in New Zealand.

The condition of New Zealand waterways

The state of New Zealand's waterways has become a major issue of public, regional and national concern, particularly with respect to the recent intensification of dairy farming (Parliamentary Commissioner for the Environment, 2013; Joy, 2015; Hughey, Kerr & Cullen, 2016). This year already there have been three separate reports highlighting that the current state of many of New Zealand's water bodies is poor and continuing to decline (Gluckman, 2017; Ministry for the Environment & Statistics NZ, 2017; OECD, 2017). The observed decline results from multiple interacting stressors including:

- Water abstraction (Dewson, James & Death, 2007; Poff & Zimmerman, 2010)
- Invasive species (Collier & Grainger, 2015)
- Channelisation (Death, Fuller & Macklin, 2015)
- Sedimentation (Burdon, McIntosh & Harding, 2013)
- Eutrophication (Carpenter et al., 1998; Allan, 2004)
- Changing climate regimes (Death, Fuller & Macklin, 2015; Death, Bowie & O'Donnell, 2016).

Many of these stressors result from changes in catchment and riparian land use activities, including urbanisation, sheep and beef farming, dairy farming, horticulture and plantation forestry.

Over the last 25 years many measures of water quality have declined at monitored sites throughout the country, particularly in lowland rivers with catchments dominated by agriculture (Davies-Colley & Nagels, 2002; Ballantine & Davies-Colley, 2010; Unwin & Larned, 2013; Foote, Joy & Death, 2015). Most sites in lowland pastoral catchments, and all sites in urban catchments, exceed safe swimming standards for pathogens. Nitrate and dissolved reactive phosphorous are increasing at 55% and 25% of all monitored sites (Larned et al., 2004; Ministry for the Environment & Statistics NZ, 2017). Thirty-two percent of monitored lakes are now classed as polluted with nutrients and 84% of lakes in pastoral catchments are the same (Verburg et al., 2010). Groundwater ecosystems are less well monitored, but at 39% of monitored sites nitrate levels are rising and at 21% pathogen levels exceed human drinking standards (Daughney & Wall, 2007).

Urbanisation, non-dairy livestock farming, horticulture and plantation forestry can have detrimental effects on water quality and the ecological health of waterways (Quinn, 2000; Death & Joy, 2004; Quinn & Phillips, 2016). However, much of the decline in water quality in the last 20 years has been linked with the corresponding increase in the numbers, area and density of dairy cattle (Foote, Joy & Death, 2015; Julian et al., 2017). The two main drivers of declining ecological health in New Zealand streams and rivers from dairy farming are: increased nutrient levels that change the food web base of a stream by boosting periphyton growth; and increased deposited fine sediment which smother faunal habitat (Clapcott et al., 2012).

The effect of production forestry on water quality and ecological health

Land planted in production forestry generally leaches low levels of nutrients (McGroddy, Baisden & Hedin, 2008; Davis, 2014; Quinn & Phillips, 2016), and fertiliser, if applied, is done so judiciously (Davis et al., 2012; Quinn & Phillips, 2016). Some activities of forestry operations such as road construction (Fransen, Phillips & Fahey, 2001; Phillips, Marden & Basher, 2012) and

harvesting (Fahey & Marden, 2006; Quinn & Phillips, 2016) can generate large sediment influx, but well-established forests have streams with lower sediment loads than similar pasture streams (Fahey & Marden, 2006).

The low nutrient and deposited sediment levels in production forest streams, in conjunction with stream shading, are associated with habitat conditions suitable for biological communities with high ecological integrity. In fact, invertebrate communities in production forest are often very similar to those in nearby native forest streams (Death, Baillie & Fransen, 2003; Quinn et al., 2009; Reid, Quinn & Wright-Stow, 2010). Invertebrate communities can be adversely affected by harvesting operations and road construction, which result in large influxes of light, nutrients and sediment, but recovery to a pre-harvest condition usually occurs within six to eight years, with larger streams recovering more quickly (Death, Baillie & Fransen, 2003; Reid, Quinn & Wright-Stow, 2010).

Production forest stream

The wider environmental benefits of production forestry

Water quality and ecological health outcomes for streams and rivers is only one of the factors that landowners take into consideration when planning land use. Broadening public concern, declining ecological health of New Zealand waterways and increasing focus on social responsibility are encouraging many landowners to consider more than simply economic return. Dairy production may currently offer higher returns for landowners, but when the true economic costs and benefits of external inputs are considered forestry can in fact be more profitable than dairy farming (Foote, Joy & Death, 2015; Monge et al., 2015; Monge, Parker & Richardson, 2016). The volatility of milk pay-outs and increasing political pressure to consider greenhouse gas (GHG) emissions make forestry a more financially stable and inviting land use. If we include the benefits of forestry, with careful harvesting regimes, on water quality and ecological health, forestry may offer a more publicly acceptable and profitable land use than it has previously (Vivid Economics, 2017).

I believe we could even go one step further and advocate forestry for assistance in riparian planting of fenced off dairy farm streams. Many dairy farm streams are now fenced, purportedly to reduce sediment and phosphorus inflow, but often with small or absent riparian zones reducing the intended benefit. If there was an economic incentive to increase the size of these riparian zones, by the planting of commercially harvestable forest, this could result in significant water quality improvements for the 30 years it takes to mature. Of course harvesting near waterways would need to be done with extreme care, hence the challenge. However, I believe any significant negative effects on water quality at harvest would be considerably shorter lived than those from continuous intensive dairy farming with the often minimal grass riparian zone (note this has not been tested to the best of my knowledge).

As a freshwater ecologist, I am concerned about the effects of the increasing intensification of dairy farming in New Zealand on water quality. This land use poses great ecological and human health risks. I am surprised that forestry has not been given more positive support for its water quality management potential. Although forestry, particularly harvesting, can have adverse effects on the health of our waterways I believe production forestry would in general be far less devastating than the effects currently experienced from dairy farming. Furthermore, when full accounting for the economic externalities and potential for GHG reductions are considered, the advantages of production forestry over dairy farming are extremely convincing.

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