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John A. Meadows

Abstract

A commentary discussing topics broached in '*Forest recovery in an Australian amenity landscape: Implications for biodiversity conservation on small-acreage properties*' (Meadows et al., 2018).

Keywords

biodiversity conservation, erosion mitigation, extension and incentives, regenerative agroforestry, run-off, small-scale forestry

Background

Urbanization of rural land continues throughout many parts of the world, with environmental impacts including soil erosion and waterway sedimentation/pollution (Meadows, 2011; Abrams et al., 2012). In urbanizing rural landscapes (or 'peri-urban' or 'amenity' landscapes), land-use and ownership changes have seen increased numbers of 'rural lifestyler' or 'hobby farmer' landowners with diverse land-use interests, capacities, practices and outcomes (Dwyer & Childs, 2004; Barr, 2009). Meadows et al. (2018) found that many small-acreage lifestyle landowners (0.5 – 10 ha) face significant challenges in managing run-off and erosion that causes on-property degradation (i.e. environmental, productive, aesthetic) and concerns about off-site impacts. Sediment from small-scale lifestyle properties is a growing source of rural diffuse pollution that degrades downstream waterways, and places high time and cost burdens on water treatment processes (SEQHWP, 2007). There are clearly environmental, social and economic imperatives for improved soil and water conservation on small-acreage properties.

Small-acreage landowners are commonly interested in support for tree-planting and forest management for multiple conservation and production objectives (Gill et al., 2010; Meadows et al., 2013, 2014). Meadows et al. (2018) found small-acreage landowners were particularly interested in forest management support to mitigate erosion, create/enhance habitat, and develop properties for subsistence and commercial uses (i.e. fruits, vegetables, nuts, timber, fodder, mulch) (Table 1). Adaptations of smallholder tropical home-garden, complex agroforest or analogue forest models (e.g. de Foresta et al., 2000; Senanayake, 2000; Nair, 2004) that integrate conservation and production objectives may therefore be of interest to many small-acreage landowners. Landowner adoption of such regenerative agroforestry systems could facilitate improved soil and water conservation (van Noordwijk & Verbist, 2000), including on small-acreage properties. Increasing small-acreage landowner adoption of soil and water conservation measures in agroforestry systems will require more forest management assistance programs targeted at them.

This commentary builds on the work of Meadows et al. (2018) to provide additional insights for improving soil and water conservation on small-acreage properties. The focus is on property-scale catchment management practices to integrate landowners' conservation and production objectives. The findings can aid natural resource management (NRM) policymakers and support providers in designing forest management assistance programs appropriate to small-scale landowners in rural amenity landscapes throughout Australia and elsewhere.

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Table 1. Small-acreage landowners' forest management information & assistance needs.

Support category	Details
Forest silviculture	Native understorey development; Acacia regrowth treatment; wildlife habitat creation/ enhancement; multi-purpose agroforestry.
Erosion mitigation	Repair and management of existing erosion; preventing new erosion; best-practice management of stormwater/infrastructure run-off.
Forest hydrology	Improving the '*condition*' of waterways/water quality, drainage-lines and dams; stabilising dam-walls/streambanks; '*wildlife-friendly*' aquatic weed control; '*planting and managing the catchment of the dam*'.

Source: Excerpts from Table 2 in Meadows et al. (2018).

Method & Data

The work is a qualitative analysis, drawing on the case-studies dataset of Meadows et al. (2018), relevant literature, and the author's 20-plus years of observations, consultancy and revegetation practice on rural properties in the verdant rolling hills of the Noosa hinterland in sub-tropical south-east Queensland, Australia. Considering landowner attitudes, experiences and desires regarding run-off and erosion management, and their conservation and production objectives, the work uses thematic analysis (following Miles & Huberman, 1994; Patton, 2002) to discuss opportunities for improved soil and water management in multi-purpose revegetation on small-acreage properties. Landowner quotes are in italics.

Results & Discussion

Findings are discussed under three emergent themes – dams and riparian zones, infrastructure and drainage lines, and planted and regrowth forests. The work suggests improved soil and water conservation on small-acreage properties requires greater efforts – by landowners, with increased support from local NRM groups/agencies – to enhance structural complexity in revegetation. The discussion focuses on groundcover and understorey enhancement practices to mitigate erosion by slowing and spreading run-off, trapping sediment, increasing infiltration, and simultaneously building soils, habitat and productivity.

Dams and Riparian Zones

Many small-acreage properties contain dams and riparian zones. The dams are typically small-scale and sometimes have shared boundaries, and the riparian zones often include steep gullies. These dams and riparian zones can be biodiversity 'hotspots' and important components of wildlife corridors, making them of high interest to NRM policymakers and support providers (Lindenmayer & Franklin, 2002; Salt et al., 2004). In amenity landscapes, dams and riparian zones are often subject to increased degrading pressures (Sinclair, 2001; Abrams et al., 2012). Degradation of these areas on small-acreage properties commonly includes erosion (e.g. sheet/gully/channel) at dam inflow and outlet points, aquatic and terrestrial weeds (see Figure 1), bank slumping/gouging following intense rain events/ flooding, and historical overgrazing causing bank erosion, soil compaction and low-diversity, structurally-poor vegetation cover. Sedimentation of previously clear streams, believed to be caused by upstream subdivisions, has also been observed ('*...there are creek water quality problems due to clearing of steep country and building activities. ...an episode last year deposited tonnes of builder's sand on our own and neighbouring properties. There is an obvious need for vegetation management up there*'). Many landowners have expressed concerns about the numbers and locations of surrounding dams, and their need for '*better informed management*' including to '*reduce mosquito breeding*' and protect against failures impacting downslope properties and ecosystems.

Sediment traps constructed using materials including soil, woody debris, rocks, coir logs and/or straw-bales mounded on or dug into the ground along the contour (e.g. ditches/trenches, terracing – van Noordwijk & Verbist, 2000; Dorren & Rey, 2004) can mitigate erosion around small-acreage properties' dams and riparian zones and create valuable habitat structures. The riparian zones often contain large woody weeds (e.g. *Cinnamomum camphora*), and their removal can provide useful materials for sediment traps. Staged removals should be considered, and stumps/root-balls retained intact, as these trees provide important temporary habitat and streambank stabilization (Kanowski et al., 2008). Unsuccessful attempts to stabilize gully heads using '*large junk items*' and '*bits and pieces of rubbish, like fridges and car parts*' have been observed, while other landowners have successfully used rocks, logs, native trees (e.g. *Ficus* spp., *Elaeocarpus grandis* – that can quickly produce spreading buttress roots) and clumping grasses (e.g. *Lomandra* spp.) '*so it* (the creek-bank) *doesn't keep getting washed away*' (see Figure 1). Vegetation – ideally native grasses and/or shrubs and scramblers – planted within and around sediment traps will improve their long-term stability (Pease, 2004) and habitat potential. Many landowners' dams require outlet renovations, including installed culverts and grassed spill-zones with regularly-spaced vegetated sediment traps. Dam weeds (e.g. *Salvinia molesta*, *Eichhornia crassipes*) can be material for sediment traps or nutrient-rich

Figure 1. A small-acreage dam infested with *Salvinia molesta*. The former eroding gully at the head of the dam is now revegetated (3-year old planted *Ficus virens* at centre, middle), with sediment traps installed and natural regeneration now occurring. Underplanting of shrubs and groundcovers is ongoing. Native sedges (*Baumea rubiginosa*, *Lepironia articulata*) have been used to stabilize the main dam inflow point and provide frog habitat.

mulch for agroforest plantings, if reintroductions to dams or spread into riparian zones can be avoided. Landowners require improved access to biological controls for aquatic weeds, and support for best-practice dam wall plantings that will strengthen and not threaten their long-term integrity.

Infrastructure and Drainage Lines

Fast-flowing run-off from driveways and access tracks, water tanks and shed roofs commonly causes erosion and waterway sedimentation on small-acreage properties ('*...I get a lot of erosion problems going on. ...along that driveway, when the creek overflows, ...it's a real Niagara Falls there when we get a lot of rain, and I'm not on top of that at all*'). Many landowners do not implement any run-off management. Tracks typically lack functioning whoa-boys (i.e. low profile, trafficable earth banks), and tanks often overflow onto bare soil, creating channelled drainage lines. Some landowners had used agricultural-pipe to divert run-off into their own or neighbouring Acacia-dominated and structurally-sparse regrowth forests so that it was '*out-of-sight and out-of-mind*'. Small-acreage landowners could better manage infrastructure run-off and create habitat by installing rocky overflow bog/wetland gardens (including dry creek-bed constructions) planted with native sedges/rushes and grasses (see Figure 2), with vegetated mixed-material sediment traps placed at regular intervals along drainage lines (see Figure 3).

Small-acreage landowners could also better utilise infrastructure run-off to support their production objectives. Overflow garden plantings could include native and exotic wetland/grass species with food, fodder and mulch/compost uses (e.g. *Typha orientalis*, *Colocasia esculenta*, *Canna edulis*, *Cymbopogon* spp., *Vetiveria zizanoides*), but ensuring no spread of exotic species into sensitive riparian zones. Run-off can also be dispersed to gardens and orchards using piping and level spreader constructions. This can convert what was channelled run-off into sheet flow to reduce velocity, increase infiltration and improve soil condition. Good examples of run-off dispersion to develop '*food-forests*' have been seen on permaculture properties using perched ponds and contoured swales[1], although weedy exotic species are often used and there may be little swale maintenance. The spread of planted exotic species into adjacent bushland and riparian zones has been observed. Landowners should be encouraged and supported to undertake regular swale/terrace maintenance and prioritise local

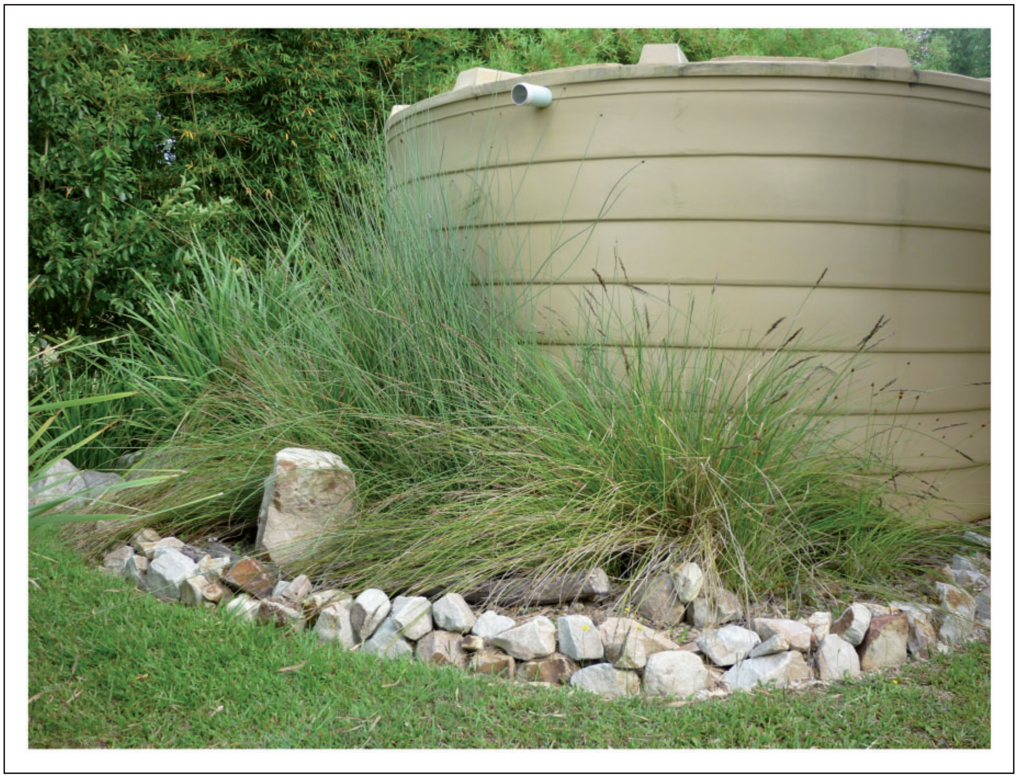

Figure 2. Tank overflow garden – water that once flowed onto bare soil and quickly ran-off is now captured through the use of rocks and logs, stopping erosion and increasing infiltration. The planted native sedges/grasses (*Carex appressa*, *Lepironia articulata*, *Isolepsis nodosa* and *Lomandra hystrix*) thrive in the seasonally wet/dry micro-environment and provide habitat.

native species such as Indigenous bushfoods that have an increasing and high-value niche market demand.

Planted and Regrowth Forests

Sheet and gully erosion has been observed within small-acreage landowners' rainforest revegetation plantings on moderate-steep slopes. These sites had transitioned from a grassy groundcover to bare soils following repeated herbicide applications and canopy closure. The plantings were supported by a local farm forestry incentive program. The landowners' grass and weed control was based on valid plantation establishment recommendations, and was well-implemented, but to the point of creating the bare-earth forest floor. Without any longer-term support (i.e. technical, financial, materials, labour) for the landowners to develop the forest groundcover and understorey, the bare-earth floor and run-off had led to soil erosion. Permanent groundcover is essential for effective soil conservation (Pease, 2004), including for moisture retention and nutrient cycling to improve forest productivity. Revegetation incentive programs should therefore include native groundcover and understorey plantings, and other measures to support their development. For example, mulch (i.e. whole-tree chip and/or straw) is an often-overlooked ingredient for successful revegetation that should always be included in site establishment support. Additionally, mixed-material sediment traps planted with native understorey species should be positioned at critical drainage points, providing long-term erosion mitigation, habitat, and soil improvements to support ongoing understorey development (see Figure 3). Programs should also promote and support ongoing active forest management, specifically strategic thinning and pruning, to create gaps for underplanting, maintain the health, vigour and form of retained trees, and provide woody debris/litter for the forest floor. Sediment traps can be focal points for accumulating such thinned materials and other weed-free biomass (e.g. grass clippings, other garden/household green-waste), facilitating long-term soil carbon, microbiological and moisture retention improvements.

Sheet erosion and gully formation was also common under the canopies of large old Acacia trees and dense Acacia-dominated regrowth. These areas are typically found on moderate-steep slopes with little groundcover and understorey ('...(near) *nothing grows there'*). Many small-acreage landowners are interested in diversifying the structure and native composition of these degraded regrowth forests, but Local Government regulations intended to protect habitat and soil stability may prevent thinning. As noted above for planted forests, such

Figure 3. Use of vegetated sediment traps (at right) along a gully drainage line/ephemeral stream. The revegetation is a staged planting, with the oldest plantings 3.5-years old (with remnant *Flindersia bennettiana* at centre, right). Ample mulch and woody debris used throughout the site to ensure groundcover (litter layer/nutrient cycling development) of a formerly Acacia-topped, bare-earth, eroding slope.

thinning could have benefits that help to achieve these regulatory and landowner objectives. The Queensland State Government has also recently introduced new laws preventing thinning in some regrowth forests. These laws were primarily targeted at preventing habitat/biodiversity loss and soil erosion resulting from vegetation clearing on large-scale grazing properties in Great Barrier Reef (GBR) catchments damaging the fragile reef environment. But many small-acreage landowners could also be prevented from implementing thinning and associated structural enhancement practices that have potential to improve soil and water conservation in degraded regrowth forests. Trials are needed in degraded regrowth forests to determine the best-practice methods for enhancing their groundcover and understorey complexity to most effectively slow run-off, trap its sediment loads and reduce erosion and waterway pollution.

Concluding Comments

This commentary discusses run-off and erosion challenges experienced by small-acreage landowners and opportunities for improved management via revegetation that integrates landowners' conservation and production objectives. The findings are drawn from experiences in the Noosa hinterland in south-east Queensland, but the themes and discussions have relevance to other coastal and inland rural amenity landscapes elsewhere in Australia and internationally. For example, numbers of small-acreage landowners have increased in hinterland parts of the North Queensland tropics, and sediment-laden run-off from these catchments impacting the World Heritage-listed GBR is of increasing community, political and NRM group/agency concern and action (see Brodie, 2015; Kroon & Schaffelke, 2016). Attention in GBR catchments has focused on large-scale farmers, but small-acreage landowners are also important NRM stakeholders in these settings and part of the solution to the reef sedimentation problem.

In conclusion, two key findings are highlighted:

- First, revegetation incentive programs often target erosion mitigation, but to more effectively achieve this goal, programs need to support landowners with more than the standard provisions of plants, labour and herbicides for planting and weed control. Technical, financial and labour support for the use of other materials including mulches, rocks, logs/woody debris, erosion matting and spray-on soil binders containing native seed mixes, and management

interventions including thinning and constructions of mixed-material sediment traps, should also be provided by revegetation incentive programs.
- Second, vegetation protection laws preventing management disturbance do not necessarily achieve their goal of erosion mitigation. This is evident in degraded regrowth forests like the structurally- and compositionally-sparse Acacia-dominated patches seen in the Noosa hinterland. This highlights the need for evidence-based and locally-adapted policies of active forest management rather than 'blanket' legislation that can restrict beneficial management interventions.

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Note

1. https://permaculturenews.org/category/earthworks-earth-resources/swales-earthworks-earth-resources/

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