A review of the land application of biosolids as a tool to help restore and sustain New South Wales grasslands

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Abstract. *While there have been many articles on the value of biosolids in cropping systems, few studies have examined the use of biosolids for restoring degraded landscapes. Biosolids is a valuable and readily available resource that offers significant agronomic value to plants. Studies have shown biosolids is suitable for improving and restoring landscapes due to its high organic matter content and slow release of nutrients. Biosolids contains nutrients such as nitrogen, phosphorous and potassium and other trace elements essential for plant growth, making biosolids an ideal organic soil conditioner for degraded sites. This paper is a short review of studies carried out in Spain and the US in relation to the application of biosolids to semi-arid rangelands. It also examines a study in New South Wales that evaluated the application of biosolids to native grasslands in the southern highlands, and a rehabilitation project undertaken by 'Sydney Water'. The findings from these studies suggest that while biosolids appears to offer considerable benefits to pasture production and regeneration in New South Wales, more research is needed to provide land managers with adequate information about the management options available for using biosolids on grasslands.*

Introduction

There has been only limited research into the application of biosolids products to grasslands or rangelands in Australia, and their potential to assist in the restoration of degraded areas or provide other agronomic benefits. While one study covered a seven year period in the southern highlands of New South Wales (NSW), there has been no further research undertaken. Since this research was completed, the quality of the biosolids has improved and new research now needs to be undertaken in other areas to get a clearer view of the possible benefits biosolids may offer to grassland areas.

Sydney Water currently operates the Biosoil Program, which uses biosolids extensively throughout Central-West NSW for its benefits to the agronomic performance of broad-acre crops, and to a lesser extent for pasture improvement and rehabilitation projects. Biosolids contains organic matter (OM), nitrogen (N), and phosphorus (P) and other trace elements. Biosolids has also been used in mines in NSW for rehabilitation projects, in forestry and composting. The addition of biosolids adds OM, improves water infiltration, soil aeration and soil structure; providing a basis for improved production or regeneration of degraded sites.

Methods

A literature review was undertaken sourcing several research papers and articles from overseas and Australia for their relevance to biosolids applications on grassland areas. The overseas papers were selected because that research had been done on marginal soils that were not too dissimilar to soils in homoclimes in NSW. The Australian papers were selected because of their relevance specifically to degraded pastures and rehabilitation sites in NSW. This literature was used to develop the case for use of biosolids for improving grasslands in NSW.

Results and discussion

Mediterranean environment

In many places, the abandonment of cultivated fields has caused rapid water erosion and the elimination of fertile soil layers, leading to severe degradation of the environment (Holz *et al.* 2000).

The soil at this study site in central Spain was very low in OM, high in pH and moderately rich in carbonates. In this semi-arid environment (379 mm average annual rainfall, AAR), de Andres *et al.* (2007) investigated the survival and growth-rate of four wild leguminous species applied with biosolids over a 24 month period. The type of biosolids used was anaerobically digested and composted, and was a mixture of product from various Madrid treatment plants. After 24 months, the findings were that the successful establishment and growth of the four leguminous shrubs on the biosolids amended soil, plus the increased production of biomass by spontaneous vegetation establishment, indicated that use of biosolids may be a practical technique for the rehabilitation of abandoned agricultural land and reduction of soil erosion.

Rangelands environment

On semi-arid rangelands in Utah (439 mm AAR), where heavy livestock grazing has led to reductions in forage quality and quantity, biosolids has been used to improve moisture infiltration and retention, increase forage yield and improve the topsoil (McFarland *et al.* 2007).

In this study, the sites were saline and sodic. The study (McFarland *et al.* 2007) found that without supplemental irrigation, tilling or seeding, the land application of i) aerobically digested, ii) anaerobically digested, and iii) lime stabilised biosolids (at rates much greater than the agronomic rate) led to significant increases in forage yield when compared to control plots. There were significant improvements in the forage quality and quantity of rangelands and an increase in their economic value. The study concluded that the land application of biosolids was a technically effective and environmentally sound approach to restoring disturbed western US rangelands. Moreover, it was contended that the application of biosolids posed little threat to ground-water supplies because evapo-transpiration usually exceeds precipitation.

Australia has similar areas (to those in this study) where heavy stocking and lack of rain has caused reduction in ground-cover and forage quality. If marginal US soils can be improved with the use of biosolids, then it is likely that Australian soils, not as marginal as those studied in the US, should be able to be improved, or at least sustained over time with the use of biosolids.

Temperate grasslands

A seven-year grazing study near Goulburn (519 mm AAR) in the Southern Tablelands of NSW, investigated the benefits and risks associated with grazing sheep on pastures grown on poor soils applied with biosolids (Michalk *et al.* 1996). The site was unimproved pasture dominated by red grass (*Bothriochloa macra*), with smaller amounts of spear grass (*Austrostipa* spp.), wallaby grass (*Austrodanthonia* spp.) and weeping grass (*Microlaena* spp.). The study examined three hill formations with three major soil types. The highest of three biosolids application rates (30, 60 and 120 t/ha) significantly exceeded normal application rates currently used. Measurements were taken of water quality, soil quality, pastures and livestock.

The findings concluded that after one year of exposure to biosolids, the production and health of ewes and lambs had not been negatively affected by grazing pasture treated with biosolids. Where heavy metals were present in plant and animal tissues, the levels were well within the loadings permitted under current guidelines. The study also found significant sustained agronomic benefits for pasture production (after biosolids application, phalaris and cocksfoot became established), and there was no evidence of environmental contamination by nutrients. The authors suggested that 60 (dry) t Dewatered Biosolids (DWB)/ha was a feasible one-off application rate to maximise benefits on soils and pasture, and to minimise environmental pollution and spoilage of livestock products.

Sydney Water also undertook a rehabilitation project (Anon 2004) near Bumbaldry in the Central Tablelands of NSW, using biosolids on a site suffering from severe tunnel and gully erosion. The project was carried out in conjunction with the then DLWC and the site has now been returned to agricultural production. The site was reshaped, contoured and surface-spread with a mix of lime-amended biosolids and de-watered biosolids, and then sown to pasture. Within three months of the biosolids application, the pasture was well established helping to stabilise the site. The site is now self-sustaining which has reduced the issue of any further erosion. This example demonstrated that beneficially applied biosolids are an environmental and economically viable solution for use in land rehabilitation. No research papers have been written on this project but photos were taken before and after to show the benefits gained from using biosolids.

Conclusions

Biosolids are of environmental significance in terms of improving soil; improvements to soil OM, ground-cover, and to pasture and animal production can be expected. The studies reviewed strongly suggest that biosolids may have a place in the sustainable management of native grasslands and rangelands. In the US, biosolids has also been used on problem soils (saline and sodic soils with promising results). The OM in biosolids added to soil can improve water infiltration and benefit saline soils, but this type of work needs to be verified for NSW soils. Little environmental or health risk should exist where application is correctly managed. It is especially noteworthy to mention that no research has evaluated the use of biosolids on semi-arid or arid rangelands in Australia.

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