Economic impacts of rehabilitating degraded lands in the Burdekin catchment

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Background

Although grazing lands are more profitable at higher land conditions, rehabilitation of D condition land requires mechanical or chemical intervention (B. Shepherd, pers comm). These interventions can incur a significant capital expense. The effectiveness of mechanical soil disturbance treatments in rehabilitating degraded land were quantified in a trial conducted at the Queensland Government's Spyglass Beef Research Facility. The soil disturbance treatments included deep ripping, chisel ploughing and crocodile plough seeding. All treatments were compared to a control treatment which received no soil disturbance and were monitored for a number of outcomes including pasture composition (species % and kg/ha) and pasture yield which was measured in dry matter (kg/ha). Cattle were excluded from the treatments, so the impact of livestock grazing on the efficacy of the treatments is not quantifiable.

The trial site is situated in the Upper Burdekin catchment approximately 130 kilometres north of Charters Towers and 110 kilometres west of Townsville, located at 19˚33'66"S, 145˚81'54"E. The major land type of the trial is loamy alluvial with three (3) soil types, a crusty deep black vertosol (Ug5.15), a deep grey sodosol (Dy3.13) and a sodic brown dermosol (Dy3.13). Tree basal area (TBA) on the trial is zero (0) – although there are smaller shrubs present. These shrubs are not considered to be affecting pasture production. Each treatment was one to two hectares in size. The loamy alluvial land type is one (1) of 33 major land types in the Burdekin Catchment (McIvor, 2012) and is classified as moderate fertility (Queensland Government, 2011).

All treatments, including control, were seeded with the same mix of tropical pasture cultivars. Species included Buffel, Rhodes, Creeping Bluegrass, Sabi, Angleton, Bothriochloa Pertusa, Butterfly Pea, Seca Stylo, Amiga and Caatinga stylos. While no statistical analysis could be performed due to non-replication of treatments, it appears legume yields and pasture yields were consistently higher than the control. Deep ripping grew the highest yields in 2012 (3420 kg/ha), 2013 (2860 kg/ha) and 2014 (2965 kg/ha), followed by chisel ploughing (3352 kg/ha, 2139 kg/ha, 2007 kg/ha) and crocodile seeding, which grew the least amount of pasture of the mechanical treatments with 2304 kg/ha, 1306 kg/ha and 1289 kg/ha of dry matter. All treatments outperformed the control which grew the least amount of pasture which achieved 1848 kg/ha, 420 kg/ha and 622 kg/ha of dry matter. Legume yields for 2012, 2013 and 2014 followed a similar trend, with the deep ripping achieving the highest yields (1432 kg/ha, 1559 kg/ha, 1929 kg/ha), followed by chisel ploughing (1025 kg/ha, 1129 kg/ha, 930 kg/ha) and crocodile seeing (168 kg/ha, 727 kg/ha, 221 kg/ha). Control grew 195 kg/ha in 2012 which was higher than crocodile seeding, however, showed no improvement in 2013 and 2014 with yields of 141 kg/ha and 140 kg/ha, respectively.

Estimates of the trial treatment costs were provided (B. Shepherd, pers comm) and verified by the contractor who performed the work on the trial site. The cost of each treatment was assumed to include necessary contour and diversion bank costs as well as the pasture seeding cost. Total costs for each treatment are shown in Table 1: Total treatment cost These costs include $ 74.85/ha for the pasture and legume cultivar mix seed. Trial results and costs were extrapolated to a 100 hectare scale.

Table 1: Total treatment cost

Treatment	Total ($)	$ / ha
Deep ripping	26,085	260.85
Chisel ploughing	21,085	210.85
Crocodile seeding	15,085	150.85
Control	0	0

Benefits

Benefits accruing to businesses from land rehabilitation activities include an increase in carrying capacity and potential increase in productivity, especially where legumes are established as part of the rehabilitation. To determine stocking rate, a long term carrying capacity formula was used (Chilcott, et al., 2005). The formula for this calculation is: (Pasture Growth * Pasture Utilisation) / (Forage Demand (kg/AE). Pasture utilisation was set at 30%, which is the recommended utilisation rate for the alluvial land type (Karfs, et al., 2009). Residual yield requirements were ignored. Measured pastured yields were used for years one (1) to three (3). For years four (4) through 20, average yield from the first three (3) years was used. Recorded rainfall for the trial period was at the 80th percentile, 50th percentile and 20th percentile of historical rainfall distribution, suggesting that averaging these years was reasonable. Within the model, cattle were excluded for one year to allow establishment of legumes and grasses. Cattle exclusion for pasture and legume establishment is widely recommended at a practical level and is assumed in other economic analysis of land rehabilitation (Peck, et al., 2011), (Gowen, et al., 2012). Stocking rates used in the analysis are shown in Table 2: Calculated carrying capacities in Adult Equivalents per 100 hectaresbelow.

Table 2: Calculated carrying capacities in Adult Equivalents per 100 hectares

Treatment / Year	1	2	3	4	Subsequent Years	20
Deep ripping	0	23.5	24.4	25.3	25.3	25.3
Chisel ploughing	0	17.6	16.5	20.5	20.5	20.5
Crocodile seeding	0	10.7	10.6	13.4	13.4	13.4
Control	15.2	3.5	5.1	7.9	7.9	7.9

Individual animal performance was also assumed to be higher for rehabilitation treatments. Control was assumed to have a liveweight gain of 115kg / annum, based on Wambiana trial data (O'Reagain & Bushell, 2011). Liveweight gain per annum was increased for rehabilitation treatments by 40 kilograms, resulting from better diet quality provided by legumes (Coates, et al., 1997). Mortalities were calculated using the following formula: Mortality (dry stock) % = $2 + 88e^{-0.034(LWG + 50)}$ (Gillard & Moneypenny, 1988). As a result, mortalities were 2.32% for the control scenario and 2.08% for the rehabilitation scenarios. Other variables to determine gross margins are shown in Table 3.

Table 3: Gross margins

	Control	Treatments
Landed weight (kg)	485	455
Landed price ($/kg)	1.70	1.70
Gross purchase price ($/Steer)	824.50	756.50
LWG (kg/annum)	115	155
Exit weight (kg)	600	600
Sale price ($/kg)	1.60	1.60
Gross sale price ($)	960.00	960.00
Levy cost ($/Steer)	5.00	5.00
Transport cost ($/Steer)	16.00	16.00
Opportunity cost $/Steer	44.61	42.91
Gross margin before interest ($/Steer)	111.84	178.70
Gross margin after interest ($/Steer)	67.23	135.79

To determine the economic viability of the land rehabilitation treatments, a partial discounted cashflow analysis was used to calculate a Net Present Value (NPV). In this form of analysis, the NPV is the sum of the difference between the discounted net cash flows of each type of investment in land rehabilitation and the control. Internal rates of return were also calculated. At the chosen discount rate of 10% none of the mechanical treatments achieved a positive NPV (Table 4) when compared to the control treatment.

Table 4: Results of the partial discounted cashflow analysis.

Treatment	NPV ($) (at 10%)	IRR
Deep ripping	-10,806	4.36%
Chisel ploughing	-8,247	4.55%
Crocodile seeding	-5,485	4.37%

The analysis demonstrates that there are differences in treatments for pasture production and composition when compared to control but small economic differences. Further, the IRR results show that initial outlays and subsequent improvement in carrying capacity can offset each other. For example, while deep ripping grew the highest pasture yield and established more legumes, it also had the largest initial outlay. This resulted in the treatment returning a slightly lower IRR than chisel ploughing which did not produce as much pasture nor cost as much initially to establish. Producers should perform analysis relevant to their business and landtypes to determine the best economic outcome for their situation.

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