Response to the 'have your say' relating to the Agriculture and Land Sectoral Plan

POLICY DEVELOPMENT TO DRIVE REGENERATIVE RANGELAND MANAGEMENT

[redacted]

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Abstract

Rigorous research has shown that semi-arid rangeland livestock businesses suffer a burden of market failure that can make regenerative management practices commercially unattractive. In this context, management practices that risk continued land degradation can be the norm, particularly in extended dry seasons or drought. This market failure is a product of slow rates of semi-arid rangeland recovery, the time value of money and the inability of leaseholders to control total grazing pressures. This scenario results in management practices that have often caused incremental, long-term degradation of the natural resource that can be barely perceptible in the short term, highly significant in the medium to long term and unfortunately normalised as a production externality cost that has been borne by the Australian community since the beginning of pastoralism. This paper explains policy rationale and scientific evidence to support the development of potentially cost-neutral government and industry policies to reverse this destructive cycle of rangeland degeneration. Government policies could be designed to provide timely financial incentives to overcome the time value of money barrier, expressed as an economic discount rate approaching zero, that applies to the adoption of regenerative management practices. The objective is to incentivise rangeland managers to adopt practices that improve and maintain ground cover, a precursor to a range of climate change mitigation and drought resilience outcomes including soil and vegetative carbon sequestration, reduced soil erosion as well as increases in perennial cover, biodiversity and livestock productivity. The financial incentives to improve ground cover could be designed to complement the Australian Carbon Credit scheme and the Nature Repair Market Bill 2023, employing suitable administration processes from either or both these legislative frameworks.

Keywords: rangelands, degradation, ground cover, soil carbon, biodiversity.

Introduction

Perpetual and term pastoral leases for livestock grazing cover 39.2% of Australia (ABARE 2021) or approximately 300Mha generally situated in the arid and semi-arid regions and the tropical savannas. The pastoral livestock businesses across this vast area could be incentivised with a Ground Cover Credit (GCC) scheme designed to accelerate adoption of regenerative management practices. The commercial reality of pastoralism in degraded rangelands (Wang and Hacker 1997), operating within the confines of government policies, particularly in relation to control of total grazing pressure (TGP) (Hacker et al 2020), has created long term incremental losses in range condition documented in numerous royal commissions e.g. Fyfe 1940, scientific reports (McKeon et al 2012) and the State of the Environment Report (2021). This land degradation is often seen solely as mismanagement by pastoralists. However, Wang and Hacker (1997) conducted rigorous analyses of pastoral decision-making employing optimal control theory and in-depth knowledge and modelling of rangeland pasture recovery rates, to explain why it has been commercially unattractive to regenerate degraded rangelands. They demonstrated that the lagged response to management that protects the land resource results in management practices that risk land degradation except in special circumstances where the land resource is in its most productive state, or the landholder accepts a zero discount rate for investing in regenerating degraded rangelands. Further to this research, Hacker et al (2004) argue that policies need to be responsive to the commercial market forces that drive management practices that risk land degradation. They argue that to overcome these commercial realities, the provision of financial incentives may be necessary to protect land resources. To test the merit of financial incentives Hacker et al (2010) piloted a program in western New South Wales that made payments to landholders for measured ground cover outcomes. The pilot proved to be practical, leading the authors to recommend that ground cover incentives should be part of a policy mix to support natural resource management and drought assistance.

Despite the success of the Hacker et al (2010) pilot project, governments have not adopted policies to provide ground cover improvement incentives. However, financial support is being provided to pastoralists in the WA southern rangelands to regenerate the productive capacity of their land (DPIRD 2023) and the Queensland government has the Land Restoration Fund that rewards co-benefits of carbon farming projects such as healthier waterways, increased habitat for threatened species, and more resilient landscapes (Queensland Government 2023).

However, the current global warming emergency has created markets for soil carbon and biodiversity that may provide the Australian Government with an opportunity to develop policies that provide financial incentives designed to mitigate the impacts of climate change while concurrently reversing the apparently benign but long-term destructive cycle of rangeland degradation across the nation. A policy that supported financial incentives for ground cover outcomes would align with both the existing carbon farming and biodiversity legislation. For example, in the same semi-arid region of western NSW, where Hacker et al (2010) conducted the ground cover pilot trial, Gray et al (2022) employed digital mapping and modelling to estimate that a SOC sequestration potential of 3.3 Mg ha^{-1} could be sequestered from a hypothetical 10% relative increase in long-term vegetation cover over a 20-year period. This equates to 0.6 ACCU $year^{-1}$. However, before carbon farming projects will be viable for many pastoral leases, significant reductions in costs of measuring SOC are necessary and also significant developments in the FullCAM model are required for estimating vegetative carbon across the expansion of eligible areas under the pending IFLM method. Furthermore, after registering a carbon farming project, it will be at least 5 and more likely 10 years before revenue from the sale of ACCUs is received. The question must be asked: is it in Australia's interests to accept this long delay or is it better to provide economic incentives to catalyse the immediate commencement of regenerative management practices that can deliver the broad array of co-benefits. These co-benefits include a more drought resilient and profitable pastoral industry (D'Abbadie 2021, Walsh and Holmes 2022).

A Ground Cover Credit scheme to drive regenerative management

The basic thesis of this paper is that financial incentives for improvements and maintenance of ground cover could be integrated with the developing markets for above and below ground carbon stocks, with their value enhanced by government verified biodiversity certificates. Such a strategy complements Australian Government policies for carbon farming and biodiversity, the Future Drought Fund for drought resilience, Meat and Livestock Australia's (MLA) CN30 strategy, as well as all state and territory initiatives supporting sustainable land and livestock management to reduce carbon emissions and increase carbon sequestration in soils and vegetation. The objective is to provide a timely financial incentive to act as a catalyst to accelerate adoption of the regenerative pastoral management practices required by all these government and industry policies, if they are to have an impact on the 39% of Australia under pastoral lease titles (ABARE 2023).

Regenerative management has been defined by Gosnells et al (2019) as practices to produce food and fibre that aims to restore resilient systems with functioning ecosystem processes and healthy soils that deliver a full suite of ecosystem services including soil carbon sequestration and improved soil water retention. The introduction of rest from grazing is often seen as important for regenerative management (McDonald et al 2019) that often connotes rotation grazing and the high cost of fencing. However, significant regeneration has been achieved with continuous grazing at low stocking rates in low rainfall (~ 220mm) regions of the WA southern rangelands. In this scenario, a low stocking rate at 66% of government recommendations enables the accumulation of a forage buffer, sufficient to maintain herd productivity and business profitability through two successive decile 2 drought years (D'Abbadie 2021). This strategy should be seen as an important paradigm shift in semi-arid livestock production. At these low stocking rates during the occasional seasons with high rainfall, growth of forage far exceeds animal demand so that most land areas enjoy a period of rest from grazing, enabling regeneration processes to proceed (Rangelands NRM WA 2017). Nonetheless, a period of 5-10 years, depending on rainfall patterns, is likely to be required to enable pastures to regenerate sufficiently to deliver the improved herd or flock productivity. This production system will also require significant investments in station infrastructure to fully water the land, provide good animal control and adjust herd structure. These costs add to the already significant disincentive of the time lag in rangeland pasture recovery.

The MLA funded Wambiana grazing research project commenced in 1997 and is located in the Burdekin Catchment Qld. O'Reagain et al (2018) reported that after 20 years, the trial had shown that 'the best sustainability and economic outcomes were achieved with either fixed or flexible stocking strategies that aligned stocking rates with the amount of feed available each year'. Multiple research and demonstration projects across Australia produce similar results e.g. Freudenberger et al (1998), Materne et al (2017). O'Reagain et al (2018) describe workshops with industry to discuss extension strategies to overcome barriers to adoption of the practices across the grazing industry. It was said that 'people need to be inspired to change'. However, 20 years earlier, Wang and Hacker (1997) explained with abundant clarity that this lack of adoption in the complex adaptive system (Gross et al 2006), may not be due to an absence of inspiration but rational economic decision making in the context of degraded rangelands. In semi-arid environments with highly variable rainfall patterns, the economic benefits from adopting the recommended management practices will rarely be realised before the passage of several years, or even many years with the onset of unfavourable seasons. In that instance, the time value of money barrier is highly significant. In addition, the benefits of rigorously reducing stock numbers to align with low forage supply can result in financial penalties when followed by unseasonal high rainfall where higher stock numbers capture the increased profit potential. Brennan (2020), attempting to understand the lack of adoption of the grazing management recommendations such as those described in O'Reagain et al (2018), listed 21 disincentives that can discourage a pastoralist from adopting these practices. Wang and Hacker (1997), used optimal control theory, combined with modelling and detailed knowledge of rates of regeneration of semi-arid shrubs, to explain how pastoralists are making rational commercial decisions when they fail to adopt regenerative management practices. I suggest that the economic incentive of a Ground Cover Credit (GCC) scheme could cut through the multiple disincentives to trigger widespread adoption of regenerative management practices. The GCC scheme could be designed to complement the Australian Carbon Credit Scheme and the Nature Repair Market Bill 2023.

Bastin et al (2012, 2023) developed remote sensing technologies to separate management related outcomes from seasonally related ground cover outcomes in the Burdekin Catchment Qld and Alice Springs, Northern Territory respectively. Additional developments in remote sensing suggest that in combination with on-site monitoring, management-related ground cover outcomes could be reliably detected 12 months after management changes (Beutel et al 2021, Beutel et al 2023, Donohue et al 2022). MLA and Cibo Labs currently provide all agricultural land parcels across Australia with remote sensing products through the Australian Feedbase Monitor (AFM). The AFM provides monthly pasture biomass and ground cover estimates at 1ha resolution at a land parcel level dating back to 2017. The service is available to every livestock producer for $90/yr and free to MLA members. Cibo Labs also provides paddock level estimates of forage supply and ground cover on a weekly basis through commercial subscriptions (Cibo Labs 2024). The Cibo Labs' subscription service also provides a mobile app and training for landholders to carry out calibration processes by collecting pasture data and photographs along 50m transects. The data is recorded on-location with a mobile phone application that is uploaded to the Cloud for processing by technicians and provision of data back to pastoralists. This existing service could be enhanced to meet the specific needs of landholders participating in a GCC scheme (P. Tickle pers comm 3 Jan 2024).

The Blueprint (CMI 2021) relating to the IFLM carbon farming method development, and recent DCCEEW updates indicate that this new method, that supersedes the Human Induced Regeneration (HIR) method, will enable carbon credits to be claimed for increases in SOC and vegetative carbon in carbon estimation areas, without the 2m height and the 20% canopy cover restrictions of the HIR method. These changes, to be finalised for 2024 legislation and release, will enable significant expansion in areas eligible for carbon farming projects in the rangelands. However, economic viability depends on the success of current R&D to develop low-cost measurement and modelling of both above and below ground carbon pools. In November 2022, the Australian Government announced a $50M investment in the National Soil Carbon Innovation Challenge to accelerate the development of reliable, low-cost technologies for measuring soil organic carbon. Together with global developments in proximal sensing (Wijewardane et al 2020), remote sensing (Angelopoulou et al 2019, Turner et al 2021) and flux tower technologies (TERN 2021), the costs of accurate SOC measurements can be expected to decline significantly. However, it could be several years before current R&D enables economically viable soil and vegetative carbon farming projects to operate across the increased areas of the Australian rangelands. While this important R&D proceeds, there are a potential 300Mha of grazed Australian rangelands where managers could begin adopting regenerative management practices if economic incentives were provided to mitigate the time value of money disincentive described by Wang and Hacker (1997).

For the northern Australian rangelands Bartley et al (2022) found that in the Burdekin Catchment, Qld, sites that maintained remotely sensed percentage ground cover at or above a benchmark for >10 years, had significantly higher SOC when they also had higher biomass, basal areas of perennial grasses and litter. To accommodate this scenario, the GCC could be designed to include with remote sensing, a simplified on-site method to monitor biomass, basal areas and litter. This exercise could be designed as a simplified first step or Stage 1 of a Biodiversity Certificate under the Nature Repair Market Bill 2023. Such a monitoring system could be easily incorporated into the $4.7M Australian Feedbase Monitor (AFM), a partnership between MLA and Cibo Labs that already provides monthly Ground Cover estimates for every farm in Australia. Thus, the GCC could be administered under proposed Commonwealth administrative structures for biodiversity certification under the Nature Repair Bill 2023.

A GCC scheme could also encourage or require participants to upgrade to a carbon farming project under the pending IFLM method, when costs of measuring SOC are acceptable for rangelands. It could also require converting to full biodiversity certification under the Nature Repair Bill when the monitoring and verification processes are finalised.

To address the challenge of managing the ‘newness’ or ‘additionality’ requirement of the IFLM method, a GCC scheme should be designed to include registration of the new management practices employed to achieve ground cover outcomes, so that these new management practices are deemed eligible for passing the ‘additionality’ or ‘newness’ test for later transition seamlessly into the IFLM method. This additionality issue is of critical importance for optimising the accelerated adoption of regenerative management practices across the 300Mha of grazed rangelands. The scenario must be avoided where leaseholders who adopt a range of new management practices to achieve ground cover outcomes for a GCC scheme, are then unable to use these same practices to qualify for an IFLM carbon project. Given the relatively slow and possibly undetectable rate of increases in SOC in years 0-10 (Deng et al 2016), particularly in semi-arid rangelands, the gap between GCC and IFLM registration and baselining, should not significantly impact the future ACCU claims by a landholder.

Large emitters of green-house gases covered by the Australian Safeguard Mechanism will need carbon credits to offset emissions above their regulated baselines. They could see merit in investing in GCCs to secure future supplies of high quality ACCUs to meet increasing obligations to the Safeguard Mechanism, making the scheme cost-neutral for government. The Commonwealth may also see merit in legislating to require financial contributions to the GCC scheme by the large emitters.

The biological basis for a Ground Cover Credit scheme

Productivity benefits of improving ground cover

D'Abbadie (2021) modelled different cattle production systems for semi-arid rangelands showing the economic and drought resilience superiority of producing 330-365kg steers with low stocking rates, that build forage buffers sufficient to maintain herd productivity through two successive decile-2 drought years. These forage buffers will provide abundant ground cover that reduce soil erosion, drive perennial plant regeneration, accumulation of SOC and improved biodiversity (Lal et al 2018). Management that maintains forage buffers for provisioning pasture in drought years requires forage of adequate nutritional value if livestock productivity is to be maintained. A similar production system has operated for over a decade at Old Man Plains research station, NT, demonstrating that the quality of dry forage buffers in a regenerated mulga ecosystem, can deliver average weight gains of 0.5kg per day from weaning at six months, through to sale as trade steers (~550kg liveweight) at 28-30 months of age. These steers required only one period of green forage over the 24 months period post weaning, to lay down sufficient fat to meet Meat Standards Australia grading requirements at slaughter (Materne et al 2017). For more than two decades, a similar production system operated profitably while regenerating a pastoral lease in WA's southern rangelands (R NRM 2017). Maintaining this forage buffer inevitably regenerated a wide range of palatable perennial grasses and shrubs that are likely to have improved stocks of soil carbon (Gray et al 2021, Orgill et al 2017), plant diversity (McDonald et al 2019) and biodiversity outcomes (Dorrough et al 2008).

Management practices that focus on maintaining a forage buffer to endure two successive decile 2 drought years, can be seen as providing the 'constant care', that leading soil scientists state is required to optimise accumulation and persistence of SOC (Lehmann et al 2020). New paradigms of soil science suggest that SOC accumulation and persistence is more a function of soil ecosystems than of soil texture (Begill et al 2023, Lehmann et al 2020, Schmidt et al 2011), auguring well for the extensive low-clay soils of Australia's southern rangelands.

Scientific evidence suggests that the financial incentives of a GCC scheme could also apply equally to both the southern and northern Australian rangelands, driving rapid adoption of regenerative management practices across all the 300Mha of grazed Australian rangelands. When the GCC financial incentives can be delivered within 18-24 months of project commencement, it will remove the time value of money barrier identified by Wang and Hacker (1997) as the primary disincentive against regenerative management practices in degraded rangelands. The necessary increases in biomass production and plant root dynamics to drive SOC accumulation and persistence (Lal et al 2018, Lehmann et al 2020) will require advanced grazing and land management practices, particularly rigorous control of TGP in low rainfall periods (Hacker and MacDonald 2021). Significant investments in station infrastructure for improved animal control, stock water and grazing management will often be required, as well as investments in earthworks to address gully erosion and water loss due to malfunctioning drainage systems (Pringle and Tinley 2003). These investments, including the costs involved in significant changes in herd structures, are unlikely to be commercially attractive (Wang and Hacker 1997), without the timely financial incentives that a GCC scheme could provide.

Regenerating rangelands' soil health and soil carbon stocks

The process of regenerating degraded rangelands in Mediterranean environments has been described by Le Houerou (2006) as a series of 16 cascading actions and reactions that are triggered initially by the production of organic matter, that is later incorporated into the soil. Le Houerou describes how the production and maintenance of organic matter as litter and living plants results in an increase in populations of perennial plants, improvements in water use efficiency, ecosystem functioning and its productivity. These developments will also increase carbon stocks (Lal et al 2018). It is likely that both southern and northern Australian rangelands will follow the same regeneration processes described by Le Houerou (2006).

Modelling by Gray et al (2022) described earlier, and a study of SOC changes in 20 to 40 year-old exclosures in grazed areas of the semi-arid rangelands of western NSW and south western Qld, (Carter et al 2006, Daryanto et al 2013, Witt et al 2011), together with increases in SOC associated with increases in perennial cover reported by Orgill et al (2017) and Waters et al (2015), suggest that with regenerative management, average SOC sequestration rates of 0.1 ACCU per ha per annum, could be reliably achieved across Australia's southern rangelands. Not included in this estimate is the potential for ACCUs earned from vegetative carbon sequestered under the new Integrated Farm and Land Management (IFLM) method; nor is any account made for the avoided emissions from 'business as usual' management of rangelands as estimated by Schuman et al (2002) in USA rangelands.

Research shows that light or moderate grazing pressure sequesters more SOC than no grazing (Piñeiro et al 2010, Wang et al 2017), suggesting that exclosure data may understate the quantum of SOC sequestered. Badgery et al (2020) reported total organic carbon changes 0-30cm, 16 years after the establishment of improved perennial pastures in central NSW where the average annual rainfall was 424mm. This research also included a range of different cropping practices where all practices significantly increased SOC stocks (0-30cm) over the first 12 years of the research. However, in the last 4 years of the research, SOC in all cropping treatments reverted to the baseline measured at commencement of the project. However, the perennial pasture treatment gained 1.6% in total organic carbon (0.1 ACCU yr^{-1}) from the baseline, despite mean rainfall during the last 4-year period falling to 14% below the mean of the previous 12 years and 20% below the long-term mean (Badgery et al 2020, Table S.3). It was stated that over the 16-year period, the perennial pasture of sown lucerne, clover and annual medic became dominated by native perennial grass (e.g. *Digitaria* sp.) and exotic annuals. This decline in pasture condition could indicate that the management of the lucerne pasture was suboptimal in a research context compared to what can be achieved on a well-managed farm that can better meet the detailed management requirements for the persistence of lucerne (Lodge 1991).

In northern Australia, Bray et al (2016) analysed SOC data from 329 sites, reporting that the land condition indicators most closely correlated with SOC stocks included ground cover, pasture biomass and density of perennial grasses. Globally, Piñeiro et al (2010) reviewed grazing effects on soil organic matter for 67 paired comparisons of grazed vs. un-grazed sites. Their main conclusion was that increasing N retention should be the primary means of increasing rangeland productivity and SOC sequestration. This conclusion is supported by Soussana and Lemaire's (2014) recommendation for temperate pastures, that avoiding harvesting more than 20% of biomass maintains the coupling of soil C and soil N cycles, balancing production with environmental outcomes. These findings support the potential for increasing SOC stocks, particularly on degraded rangelands, by controlling TGP to build ground cover and regenerate perennial grasses, especially across the ~97Mha of the pastoral mulga ecosystems (Hacker and McDonald 2021), that often have relatively high levels of soil N (Pate et al 1998, Barnes et al 1992). Across these mulga ecosystems, heavy grazing pressures in dry seasons since pastoralism began, has removed large proportions of native perennial grasses (Brennan 2006, Freudenberger et al 1998, Gardner 1986, Hacker et al 2005).

Wiedemann and Dunn (2021) produced a carbon accounting technical manual for Meat and Livestock Australia, providing guidance for building carbon accounts, using the GHG Accounting Framework calculators developed by the University of Melbourne[1] . These authors suggest an approximate benchmark for annual livestock emissions rates at 0.23 -0.25 ACCU DSE^{-1} (DSE is a 50kg wether), including enteric methane and manure emissions and purchased inputs. If this benchmark estimate is doubled to 0.5 ACCU DSE^{-1} for relatively low productivity of rangeland systems at average stocking rates of 1.0 DSE $10ha^{-1}$, an average sequestration rate of 0.05 ACCU ha^{-1} is needed from SOC and vegetation assimilation of carbon to cover scope 1 and scope 2 emissions. If a conservative figure of 0.1 ACCU ha^{-1} yr^{-1} is assumed to be the total tonnage of SOC sequestered on a station above the baseline (excluding ACCUs from vegetative carbon), half can cover enterprise emissions and the remainder can either be retained to cover associated risks or sold on the voluntary market. At an ACCU price of $30, the gross margin of SOC farming in this instance represents about 25% of the gross margin of a highly productive pastoral beef enterprise (SAGIT 2021).

Evidence that ground cover is a precursor for improved biodiversity

Seinfeld et al (2006) argue that the livestock sector may play a major role in the reduction of biodiversity because of land degradation. Informed livestock management, however, can be a vehicle to maintain and improve rangelands (O'Reagain et al 2018, Teague and Kruter 2020) or regenerate degraded rangelands with rigorous control of TGP that rebuilds and maintains ground cover while regenerating perennial grasses and forbs (Le Houerou 2006, Ludwig et al 2005, Walsh et al 2014).

The accumulation of organic matter on degraded rangelands increases populations of soil microbes and invertebrates that live in and feed on soil organic matter and surface litter (Berryman et al 2020, Le Houerou 2006, Teague and Kreuter 2020). Multiple species of vertebrates will also repopulate in response to increased vegetative biomass. When maintained over time, improved ground cover will support regeneration of depleted perennial grasses and forbs. These diverse populations of

[1] University of Melbourne Greenhouse Accounting Framework: http://www.piccc.org.au/resources/Tools

plants, and their seeds, will provide habitats and food sources for birdlife, threatened species (Smith et al 2020) and other vertebrates in the food web of a healthy ecosystem. The close linkages expected between increases in ground cover and improved biodiversity support the creation of a GCC that incorporate simple but sound biodiversity measures. A GCC Scheme could be designed to complement the Nature Repair Bill by obligations to convert to full Biodiversity Certification when measuring, monitoring and verifying systems are finalised for rangelands.

Conclusion

Historically there has been an unnecessarily high risk of rangeland degradation when commercial forces are not compatible with the slow regeneration of rangeland ecosystems. This phenomenon may largely explain the slow but long-term, incremental degradation across a significant portion of Australia's rangelands.

The burgeoning market for carbon and biodiversity products may provide a cost-neutral opportunity for government and industry to collaborate in the development of policies that create markets for Australian pastoral leaseholders that mitigate climate change while delivering drought reliance, improved livestock productivity and provide the Australian community with a climate resilient and biodiverse rangeland. Without policies to overcome the commercial reality of near zero discount rates for rangeland regeneration projects, there are 300Mha of grazed rangelands that may be at risk of continued degradation with the passage of every period of below average rainfall. This paper has described government policies that could reverse this destructive cycle to create a new era of regenerative rangeland management that addresses both the threats and the opportunities created by the climate emergency.

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